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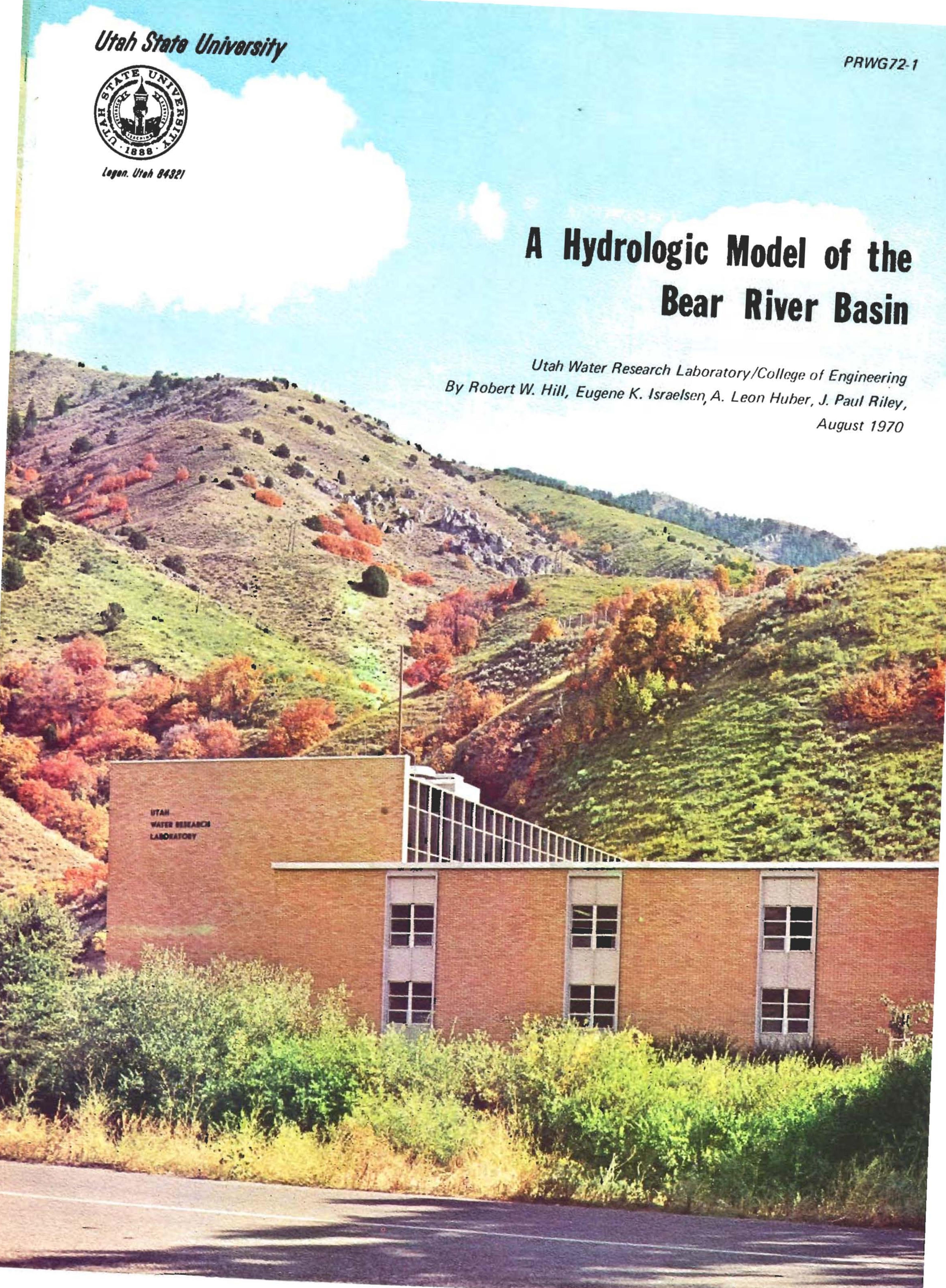
Utah Water Research Laboratory/College of Engineering
By Robert W. Hill, Eugene K. Israelsen, A. Leon Huber, J. Paul Riley,
August 1970



A HYDROLOGIC MODEL OF THE BEAR RIVER BASIN

by

Robert W. Hill
Eugene K. Israelsen
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College of Engineering
Utah State University
Logan, Utah

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ABSTRACT

A HYDROLOGIC MODEL OF THE BEAR RIVER BASIN

As demands upon available water supplies increase, there is an accompanying increase in the need to assess the downstream consequences resulting from changes at specific locations within a hydrologic system. The problem is approached in this study by hybrid computer simulation of the hydrologic system. Modeling concepts are based upon the development of basic relationships which describe the various hydrologic processes. Within a system these relationships are linked by the continuity-of-mass principle which requires a hydrologic balance at all points. Spatial resolution is achieved by considering the modeled area as a series of subbasins. The time increment adopted for the model is one month, so that time varying quantities are expressed in terms of mean monthly values. The model is general in nature and is applied to a particular hydrologic system through a programmed verification procedure whereby model coefficients are evaluated for the particular system.

In this study the model was synthesized on a hybrid computer and applied to the Bear River basin of western Wyoming, southern Idaho, and northern Utah. Comparisons between observed and computed outflow hydrographs for each subbasin are shown. The utility of the model for predicting the effects of various possible water resource management alternatives is demonstrated for the number 1, or Evanston subbasin. The hybrid computer is very efficient for model development, and the verified model can be readily programmed on the all-digital computer.

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KEYWORDS--*hydrologic models/*hydrologic simulation/*computer simulation/*simulation/groundwater/*watershed studies/snowmelt/evapotranspiration/deep percolation/water yields/*hydrologic relationship/*hydrologic research/*hydrology/hydrologic data/water yield improvement/soil moisture/*water resource planning and management/*hybrid computer

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Robert W. Hill
Eugene K. Israelsen
A. Leon Huber
J. Paul Riley

TABLE OF CONTENTS

Chapter I

Chapter II

Chapter III

Chapter IV

Chapter V

Chapter VI

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

INTRODUCTION

General

Of the total precipitation falling on watersheds throughout the world, an average of approximately 85 percent returns directly to the atmosphere through evaporation and use by mountain vegetation. The remaining 15 percent moves from the watersheds as runoff and becomes available in the valleys to be used by man for irrigation, industry, recreation, and many other requirements. The very rapid growth of these requirements in recent years has led to an increasing need for additional usable water resources.

Several grandiose and costly schemes have been suggested to supplement existing water resources in the western United States. The enormity of the engineering, social, and legal aspects of implementing one of these schemes certainly shifts the realization of the proposed resource supplement well into the future. However, the need for additional water resources protrudes from immediate future requirements and refuses to disappear even though ignored. Alternative methods must then be identified in order to satisfy or appease the immediate future requirements.

Alternate methods of supplementing water resources must be almost immediately applicable, relatively inexpensive, and effective. Some of the methods proposed to fill the immediate need include groundwater mining, conjunctive use of ground and surface water, and more efficient use of existing supplies. The research work described in this report has focused on the efficient use of existing supplies.

Efficient use of water in a dynamic system implies that the system be described with sufficient accuracy to quantitatively predict depletions resulting from water use in the system. The next step is to realistically alter the system parameters and points of use to determine system configurations which produce increased benefits and/or decreased water use. The ultimate result of this method is to determine the system configuration which maximizes the benefits per unit of water resource depletion. Water use includes the consumptive use of water and the addition of undesirable elements to the water. This report, however, deals with the hydrology and consumptive use of water in the Bear River basin.

System simulation is a tool currently employed by many researchers to increase the definition of dynamic systems. Since hydrologic systems, like the Bear River basin, are certainly dynamic, the tool of simulation modeling was employed to gain increased system definition. The various processes within the model are linked by the continuity of mass principle, which requires a hydrologic balance at all points. The computer is essential for the solution of the time-dependent differential equations of the model and for the selection of coefficients required during calibration and testing.

Scope of Study

The scope of this study is limited to describing the hydrology of the Bear River basin and demonstrating the possibility of increased efficiency of water use through selection of proper management alternatives.

Objectives. The objectives of this research project were as follows:

1. To simulate the complex hydrologic flow system of the Bear River basin.
2. To demonstrate the applicability of the simulation model to efficient water resources planning in the Bear River basin by evaluating various alternative management possibilities subject to selected constraints.

Procedure

To meet the objectives of this study the following procedure was followed:

1. Basic hydrologic data for the Bear River basin were assembled and analyzed.
2. The Bear River basin was divided into ten subbasins based upon the available hydrologic data and the physical characteristics of the basin.
3. A simulation model was verified for each subbasin. These subbasin models were then linked together to form the model of the entire basin.
4. Three management alternatives were applied to a single subbasin (Evanston) to demonstrate the use of the model in selecting management alternatives.

Discussion

Several problems were encountered during the modeling of the ten subbasins. These problems stemmed from the lack of adequate data required to verify proposed model configurations. Determination of ungaged surface and subsurface flows always presents a problem, but this problem can usually be solved if other data requirements are satisfied. Correlation techniques provide satisfactory estimates of temporal and spatial distribution of ungaged flows. Records of water diversion for irrigation use were lacking in all of the subbasins. Irrigation diversions are important because they alter the hydrologic system, and thus affect stream depletions, groundwater inputs, evapotranspiration losses, and irrigation delivery efficiencies. Records for other required inputs were adequate for formulating satisfactory models.

The Bear Lake and Malad subbasins presented the largest problem in the verification process. The Bear Lake subbasin seems to have a large amount of ungaged inflow and evaporation losses from the lake surface are high. Flow records, diversion records, and data for correlation are lacking for the Malad subbasin. Because of this problem the Malad model could not be satisfactorily verified. Fortunately, however, the subbasin does not include any of the main stem of the Bear River, and inflows of the Malad River to the Bear River are gaged. All other subbasins could be satisfactorily verified. Until sufficient data are available, the Malad subbasin will be deleted from management studies.

Management applications were demonstrated in the four upper subbasins by changing land use patterns. Perhaps the most significant change in land use would be the complete removal of phreatophytes and this alternative was demonstrated in one of the management runs. Other possible management schemes, not yet tested by the model, might involve the construction of additional reservoirs, enlargement of existing reservoirs, alteration of reservoir operating rules, and various combinations of reservoir operation and land use patterns. Export of water from the basin could be studied though, at present, there are no facilities to perform sizable exports. The management schemes shown are to demonstrate the capability of the model to predict system responses to proposed or desired changes within the system.

CHAPTER II
THE BEAR RIVER BASIN

Description of the Study Area

The boundaries and subbasins of the Bear River basin are shown in Figure 2.1, which also indicates the location of the existing streamflow measuring stations.

The Bear River (USBR, 1970) originates in Utah but flows through parts of Wyoming, Idaho, and Utah before entering the Great Salt Lake. This interstate river is the largest stream in the Western Hemisphere which terminates before reaching the ocean. The river winds and twists about 500 miles in a U-shaped course to cover the 90 airline miles from its origin to its mouth. Included in the Bear River basin are 7,465 square miles of mountain and valley lands.

From its Utah origin the river flows for 20 miles down the north slopes of the Uinta Mountains, Utah's east-west mountain range. Near the Wyoming border the river enters the Bear River Valley, the first of five major valleys. The valleys are separated by narrow canyons or gorges which form ideal locations for hydroelectric power generation.

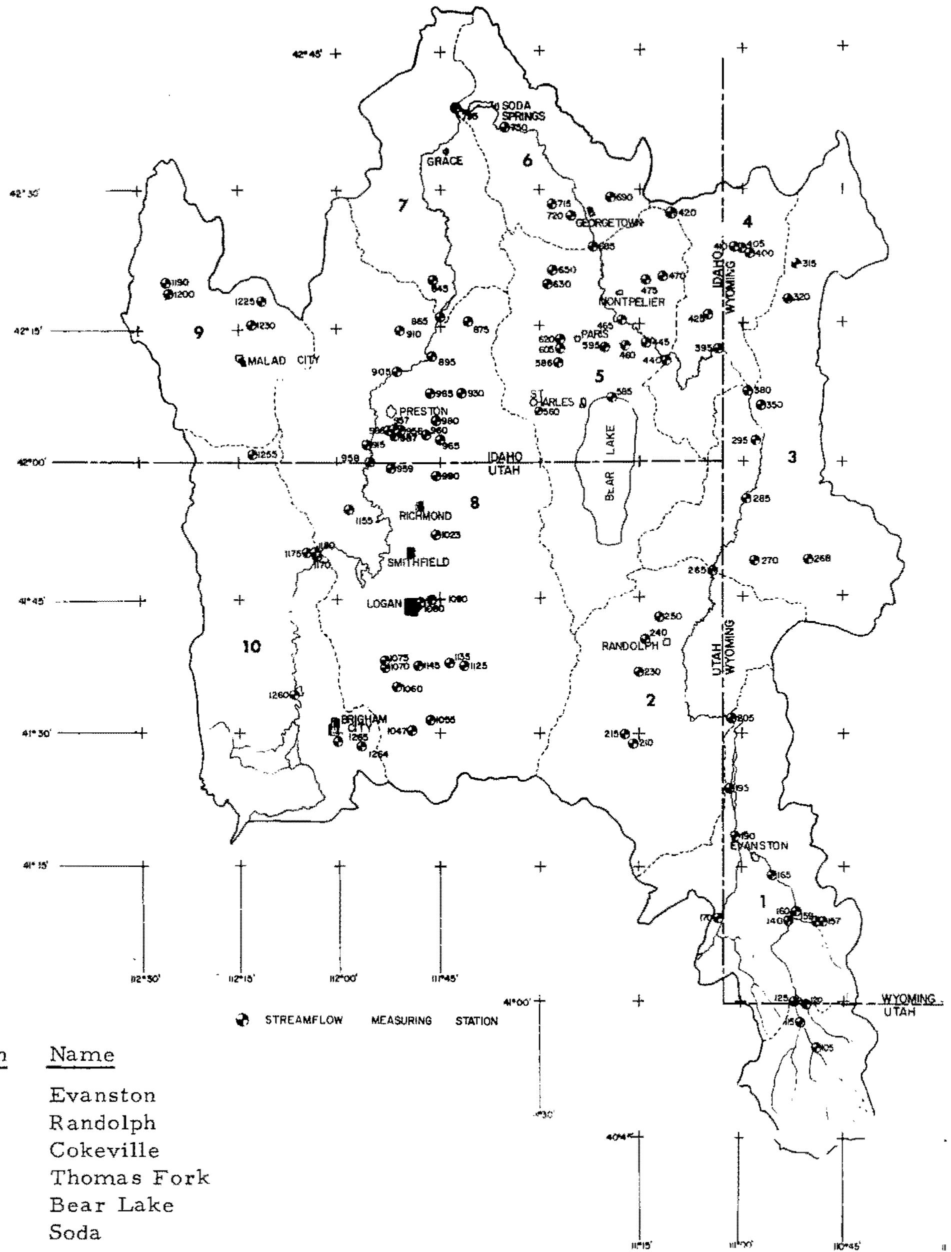
The Bear River Valley is the highest and longest valley in the Bear River basin. The valley is narrow, five miles or less in width, and extends for nearly 100 miles along the western border of Wyoming. However, a significant portion of the valley lies in Utah and Idaho.

Near the Idaho border the river flows westward to enter the Bear Lake Valley which is about 50 miles long and 12 miles wide. The south end of Bear Lake valley is occupied mostly by Bear Lake and Mud Lake. Bear Lake is about 20 miles long and averages seven miles in width, while Mud Lake, at the north end of Bear Lake, is about three miles in diameter. Bear River did not naturally flow into Bear Lake, but inlet and outlet canals have been constructed north of the lakes to facilitate hydroelectric power generation. A combined active storage of these two lakes of about 1,450,000 acre-feet provides a complete control of the flow in Bear River at that location.

The river flows northwest from the Bear Lake Valley through several miles of hilly and broken grazing lands and through a narrow channel near Soda Springs, Idaho, into Gem Valley. In the narrow lava channel are located the Soda Reservoir and hydroelectric power plant. Gem Valley is a broad agricultural area which was formed in the northern and central portions by a lava flow plain. Originally, the Bear River flowed north through Gem Valley to the Snake River. However, lava flows eventually turned the course of Bear River south toward the Great Salt Lake. Gem Valley south of the lava flow is about 500 feel lower than the central portion. This drop is used for power generation. The southern portion of Gem Valley is also called Gentile and Mound Valley. At the south end of Gem Valley the river enters the Oneida Narrows, a canyon about 11 miles long, which forms another power generation location.

From Oneida Narrows the Bear River enters Cache Valley, one of the more highly developed valleys in the Bear River basin. The river enters Cache Valley from the northeast, meanders southward, and leaves the valley through a gorge into the Lower Bear River Valley. Cache Valley is about 45 miles long and 10 miles wide. Several tributaries enter Cache Valley and combine with Bear River prior to leaving the valley. The gorge followed by the river in leaving Cache Valley forms a good location for power generation.

The Bear River continues through the Lower Bear River Valley and into the Great Salt Lake. The Lower Bear River Valley is part of the generally flat



Subbasin	Name
1	Evanston
2	Randolph
3	Cokeville
4	Thomas Fork
5	Bear Lake
6	Soda
7	Oneida
8	Cache Valley
9	Malad
10	Tremonton

Figure 2.1. The Bear River basin and subbasins.

Salt Lake Valley that drains toward the Bear River. The Malad River enters the Bear River in the Lower Bear River Valley from an origin some 50 miles to the north.

Valley elevations range from 7,800 feet near Evanston, Wyoming, in the Bear River Valley to 4,200 feet at the Bear River Bay in the Lower Bear River Valley.

Climate

Wide seasonal and diurnal temperature variations characterize the typical mountain continental climate of the Bear River basin. The high valleys have long hard winters and short cool summers. The climate of the lower valleys is generally more moderate. The average frost-free season varies from about 30-days in the higher valleys to over 150 days in the Lower Bear River Valley. Precipitation is heaviest in the mountain sections with the majority of precipitation coming as snow. About one-third of the annual precipitation occurs during the growing season which results in the irrigation water demand on the Bear River and its tributaries.

Soil Materials

Soils in the Bear River basin have been deposited by winds, lakes, and streams. The parent materials are quartzites and sandstones in the upper valleys; limestone, dolomites, and sandstone in the central valleys; and tuffaceous sediments, limestone, shale, and basalts in the lower valley.

Surface Flows

The maximum annual flows normally occur during the snowmelt period in May or June, but can also appear in April or July. The maximum discharge at the Utah-Wyoming border of 2,860 cfs occurred on June 12, 1965. The maximum discharge recorded at the Harer station near the lower end of the Upper Bear River Valley was 4,440 cfs on May 7, 1952. The maximum flow in the Lower Bear River Valley near Corinne was 7,200 cfs on May 3, 1952. The maximum flows result from melting snow and spring rainstorms. After the snow has melted, the river flow drops to a low level and remains fairly constant through the remainder of the year. Minimum flows have occurred in April, September, October, and November. Local, high intensity, summer thundershowers cause high flows in tributaries but seldom cause record setting flows in the main stem.

Diversion of water from the main stem of the Bear River and its tributaries has increased since about 1860. The consumptive use associated with the increased diversions has affected river flows throughout the entire basin. The average flow near the upper part of the river near the Utah-Wyoming state line is about 135,000 acre-feet per year. The average annual flow at the Harer station east of Dingle, Idaho, is about 367,000 acre-feet. Near Corinne, Utah, the average annual flow of the Bear River is nearly 1,174,000 acre-feet. The length of records used to obtain these estimates is not equal, and the flows are partly controlled; but the comparison does portray the relative magnitudes of flow at successive downstream points along the course of the Bear River.

The quantity of water used consumptively by irrigated crops is usually much less than the total quantity applied. Water used consumptively by evaporation and plant transpiration is lost to the basin. Part of the water applied, but not used consumptively, either percolates to the water table or returns directly to the stream as overland flow. These waters become available for reuse.

Land Use

The land use in the Bear River system ranges from pasture and meadow hay in the upper reaches through pasture, alfalfa, and grains in the middle reaches to potatoes, sugar beets, and small truck garden items in the lower reaches. Pasture, alfalfa, and grains are also grown in certain areas of the lower subbasins. In addition, lakes, rivers, and marshes occupy significant areas within the Bear River basin. The water-loving vegetation which borders these water bodies is classified into the general category of phreatophytes. Because phreatophytes deplete the water supplies they were considered in the model. Municipalities and dwellings cover many acres in the basin. Land use statistics are summarized in Table 2.1.

Subbasins

In developing a hydrologic model, spatial resolution is achieved by dividing the total area into specific spatial increments or subbasins. Increasing the number of subbasins within a particular area increases the spatial resolution of the model, and therefore, its general utility. However, this trend also increases model complexity, so that data and computer requirements are also usually substantially increased. The selection of the appropriate spatial increment is, therefore, an important phase of hydrologic modeling, and is based upon many considerations, the most important of which is data availability, land and water use patterns, and the resolution required in answering questions relating to basin planning and management problems. In this study the Bear River basin was divided into 10 subbasins, and each of these is outlined in Figure 2.1. Only the valley floor was included in the hydrologic model of each subbasin with surface and subsurface flows to this area being included as inputs to the model.

Table 2.1. Summary of' water related land use in the Bear River basin (all units in acres).

Crops	Subbasins	Evanston 01	Randolph 02	Cokeville 03	Thomas Fork 04	Bear Lake 05	Soda 06	Oneida 07	Cache Valley 08	Malad 09	Tremonton 10
Alfalfa	1	2599	1916	577	425	8959	2677	11873	52429	8006	17803
Pasture	2	8823	5518	9076	7435	12347	3703	5381	27563	7254	13750
Other hay	3	19835	40025	18982	13064	20121	6098	2367	6058	753	1158
Small grains	4	314	1213	510	319	10098	3022	7927	50020	5064	16645
Corn	5					42		36	9469	182	6513
Sugar beets	6							1471	4827	137	8612
Potatoes	7							1363	289	91	72
Orchard	8								392		2093
Peas	9								0		0
Tomatoes	10								3		507
Small truck	11					46		466	683		217
Idle	12								0		0
Beans	13								275		217
Total		31571	48672	29145	21243	51613	15500	30884	152008	21487	67587
Open water	B	632	884	0	291	21283	848	597	7515	1172	934
Marshes, tules, cattails	C1	609	2145	68	720	7307	0	0	15863	1758	3092
Grasses, willows, cottonwoods	C2	3523	765	1344	199	3100	2886	1233	15771	2930	4525
Grasses & med. density trees	C3	261	608	15	0	2636	0	0	5776	0	2698
Low water table, light density	C4	2434	2073	803	924	8030	1890	1005	7775	163	9506
Total		7459	6475	2230	2134	42356	5624	2835	52700	6023	20755

CHAPTER III

THE HYDROLOGIC MODEL

Simulation is a technique for investigating the behavior or response of a dynamic system subject to particular constraints and input functions. This technique has been applied by means of both physical and electronic models. Physical models and analog models consisting of electrical resistor-capacitor networks have been used to investigate hydraulic and hydrologic phenomena for many years. However, simulation by means of high-speed electronic computers is a relatively new technique.

The advantages of simulation include the following:

1. The system can be non-destructively tested, which is of practical interest in the hydrologic design of structures such as large dams and flood control works in a river basin.
2. Proposed modifications of existing systems can be tested for improved performance. This is especially desirable if the original system is in operation, since operation time will not be lost during testing.
3. Hypothetical system designs may be verified at minimum expense, thus paying large dividends if the proposed system turns out to be inefficient.
4. Simulation provides insight into the system being studied and is thus a powerful teaching device.

Formulation of a Hydrologic Model

Model Requirements

The fundamental requirements of a computer model of a hydrologic system are:

1. It simulates on a continuous basis all important processes and relationships within the system it represents.
2. It is non-unique with respect to space. This implies that it can be easily applied to different geographic areas with existing hydrologic data.
3. It is capable of answering questions concerning perturbations in the system or of accurately predicting outputs resulting from varying input and process parameters.

The general research philosophy involved in the development of a simulation model of a dynamic system, such as a hydrologic unit, is shown by the flow diagram of Figure 3.1. In addition to predicting system responses to particular input functions and parameter changes, the process of model development provides for improvement of system relationships.

The Conceptual Model

The hydrologic model utilized in this study is a modified version of that developed in earlier studies involving the computer simulation of a complete watershed unit (Riley et al., 1966 and 1967). Simplification was achieved by including only the valley bottom lands of each subbasin.

The basis of the hydrologic model is a fundamental and logical mathematical representation of the various hydrologic processes and routing functions. These physical processes are not specific to any particular geography, but rather are applicable to any hydrologic unit, including all of the subbasins located within the Bear River basin. Experimental and analytical results were used whenever possible to assist in testing and establishing some of the mathematical relationships included within the model. Under a model verification procedure, equation constants are established which calibrate or fit the model for a particular drainage area. Average values of hydrologic quantities needed for model verification were estimated in one of three ways:

(1) From available data, (2) by statistical correlation techniques, and (3) through verification of the model.

A flow diagram of the hydrologic system is shown by Figure 3.2. As this flow chart indicates, the total input to a subbasin is the combination of surface and subsurface inflows of water obtained by summing river and tributary inflows, precipitation, and imports from other basins. Depletions from the subbasins occur through evapotranspiration, municipal and industrial consumption, and exports. The residual quantity is a combination of surface and subsurface outflow of water from the area. Subsurface flows may undergo various time delays as they move through the system. Each parameter and process depicted by Figure 3.2 is discussed in some detail in the following sections.

The Hydrologic Balance

A dynamic system consists of three basic components, namely the medium or media acted upon, a set of constraints, and an energy supply or driving force. In a hydrologic system, water in any one of its three physical states is the medium of interest. The constraints are applied by the physical nature of the hydrologic basin, and the driving forces are supplied by direct solar energy, gravity, and capillary potential fields. The various functions and operations of the different parts of the system are interrelated by the concepts of continuity of mass and momentum. Unless relatively high velocities are encountered, such as in channel flow, the effects of momentum are negligible, and the continuity of mass becomes the only link between the various processes within the system.

Continuity of mass is expressed by the general equation:

$$\text{Input} = \text{Output} \pm \text{Change in storage}$$

A hydrologic balance is the application of this equation to achieve an accounting of physical, hydrologic measurements within a particular unit. Through this means and the application of appropriate translation or routing functions, it is possible to predict the movement of water within a system in terms of its occurrence in space and time.

The concept of the hydrologic balance is pictured by the block diagram in Figure 3.2. The inputs to the system are precipitation and surface and groundwater inflow, while the output quantity is divided among surface outflow, groundwater outflow, and evapotranspiration. As water passes through this system, storage changes occur on the land surface, in the soil moisture zone, in the groundwater zone, and in the stream channels. These changes occur rapidly in surface locations and more slowly in the subsurface zones.

In the course of model development, each of the system processes must be described mathematically as completely as possible. The flow chart of Figure 3.2 is a schematic representation of the system processes and storage locations and their relationship to each other. In the model each box and connecting line is represented by a mathematical expression.

Time and Space Increments

Practical data limitations and problem constraints require that increments of time and space be considered during model design. Data, such as temperature and precipitation readings, are usually available as point measurements in terms of time

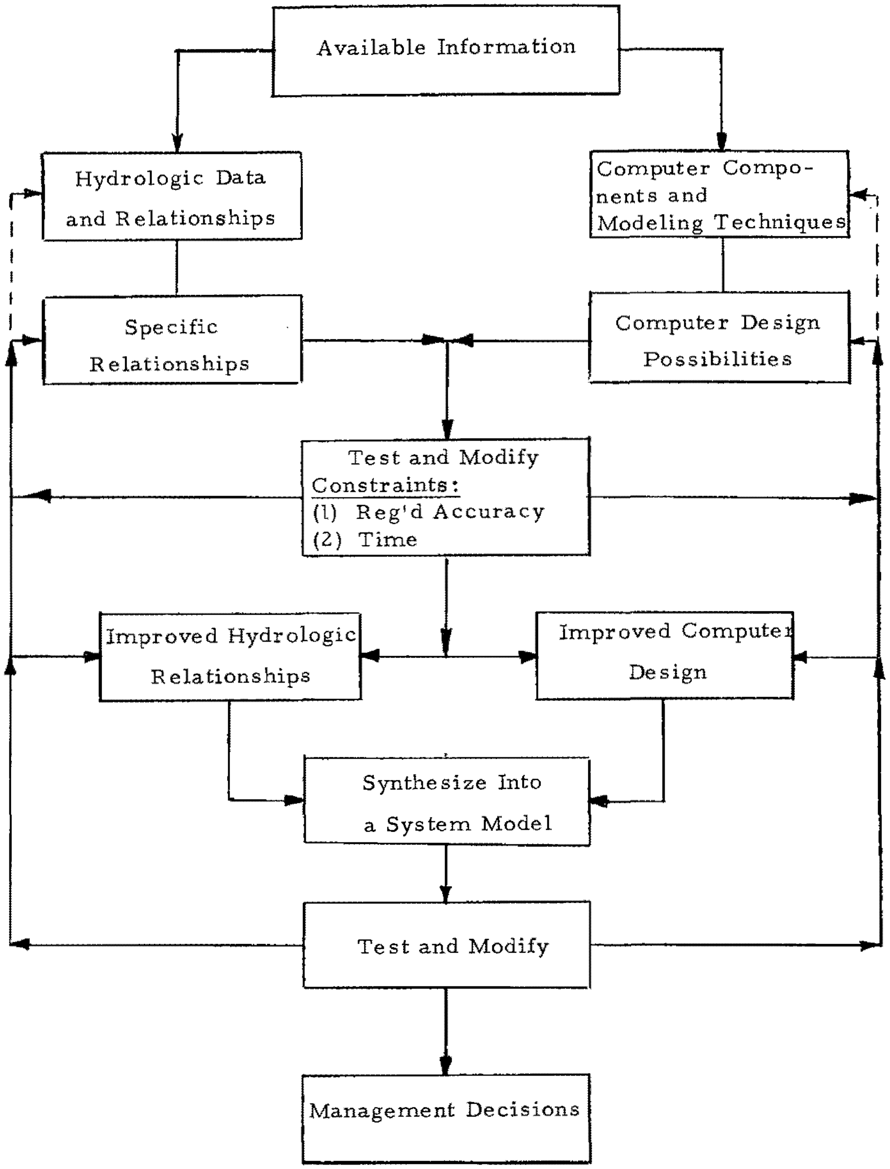


Figure 3.1. Development process of a hydrologic model.

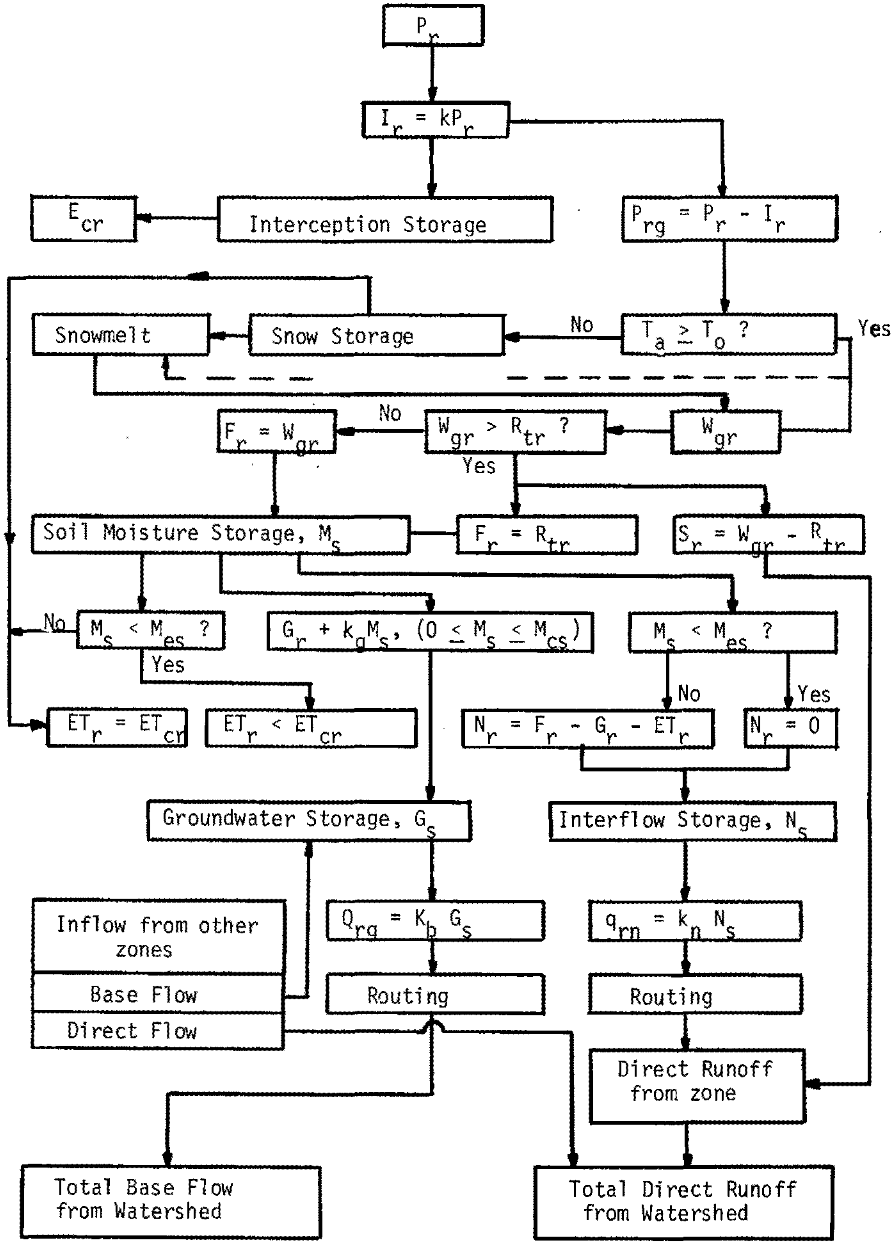


Figure 3.2 Flow diagram for a typical hydrologic model using large time increments.

and space; and integration in both dimensions is usually accomplished by the method of finite increments.

The complexity of a model designed to represent a hydrologic system largely depends upon the magnitude of the time and spatial increments utilized in the model. In particular, when large increments are applied, the scale magnitude is such that the effect of phenomena which change over relatively small increments of space and time is insignificant. For instance, on a monthly time increment, interception rates and changing snowpack temperatures are neglected. In addition, the time increment chosen might coincide with the period of cyclic changes in certain hydrologic phenomena. In this event net changes in these phenomena during the time interval are usually negligible. For example, on an annual basis, storage changes within a hydrologic system are often insignificant, whereas on a monthly basis, the magnitude of these changes are frequently appreciable and need to be considered. As time and spatial increments decrease, improved definition of the hydrologic processes is required. No longer can short-term transient effects or appreciable variations in space be neglected, and the mathematical model, therefore, becomes increasingly more complex with an accompanying increase in the requirements of computer capacity and capability.

For the study of the Upper Bear River basin discussed by this report, a monthly time increment and large space units (subbasins) were adopted. Selection of the subbasins was based on hydrologic boundaries and points of data collection. It was felt that the selection of the subbasins and the monthly time increment would satisfy the requirements of a general planning-management model for the basin.

System Processes

Surface Inflows

The basic inflow or input of water into any hydrologic system originates as a form of precipitation. However, for simulation models of valley floor areas, direct precipitation input to the system is greatly overshadowed by river and tributary inflows.

Streamflow is defined as that portion of the precipitation which appears in streams and rivers as the net or residual flow collected from all or a portion of a watershed. When unaffected by the activities of man, such runoff is referred to as "natural or virgin" flow. Except in headwater reaches, no streams in the Bear River basin now carry natural flows. Artificial diversions and regulatory action in lakes and reservoirs affect the regimes of every stream within the basin.

The surface water inflow component consists of flow traveling over the ground surface and through channels to enter a stream. At the stream, surface runoff usually combines with other flow components to form the total surface runoff hydrograph. Within the runoff cycle (Chow, 1964), surface runoff begins to occur when the capacities of vegetative interception, infiltration, and surface retention are reached. Continued precipitation beyond this point serves as a source for surface runoff. Small basins have different runoff characteristics than do large watersheds, and the characteristics peculiar to each basin must be evaluated on an individual basis.

For each subbasin in the Bear River basin, a limiting rate of surface runoff exists for any particular time period. Surface runoff is assumed to occur when the threshold or limiting rate of surface water supply, consisting of snowmelt, rainfall, canal diversions, or any combination of these, is exceeded.

This concept of surface runoff is particularly important when precipitation is considered as the initial water input to the watershed. Riley and Chadwick (1966) indicate that for particular conditions there exists a limiting or threshold rate of surface supply, R_{tr}, at which surface runoff, S_r, begins to occur. This relationship can be written:

$$S_{wr} = W_{gr} - R_{tr} \ , \ (S_{wr} \geq 0) \ . \ . \quad (3.1)$$

in which

S_{wr} = rate of surface runoff during a particular time

W_{gr} = rate at which water is available at the soil surface

R_{tr} = limiting or threshold rate of surface water supply at which surface runoff begins to occur

When considered for a model time increment of one month, an average value of the threshold surface runoff rate, R_{tr}, is probabilistic in nature, depending essentially upon soil surface conditions, soil moisture, storm characteristics, and rate of available water, W_{gr}.

In this study only the valley bottom lands are considered in the model, and it is assumed that no surface runoff from precipitation occurs from these relatively flat areas. Under this assumption, the rate at which precipitation is available at the soil surface at no time exceeds the threshold rate for surface runoff to occur. Thus,

$$S_{wr} = 0 \ , \ (W_{gr} \leq R_{tr}) \quad . \ . \ . \ . \quad (3.2)$$

The model does provide for surface runoff from agricultural lands due to irrigation application rates which exceed soil infiltration rates. This runoff quantity constitutes a portion of the irrigation return flow.

Surface runoff from the surrounding watershed areas is concentrated in stream channels, and therefore enters the model (valley bottom) as tributary flow. That part of the inflow rate which is measured or gaged is designated as $Q_{is}(m)$.

Unmeasured surface inflows to the model are estimated by a correlation technique which considers three hydrologic parameters, namely a gaged tributary inflow rate, precipitation rate, and snowmelt rate. Thus, in functional form:

$$Q_{is}(u) = f[q_{is}(m) \ , \ P_r, \ W_{sr}] \quad . \ . \ . \quad (3.3)$$

in which

$Q_{is}(u)$ = estimated rate of unmeasured surface inflow

$q_{is}(m)$ = measured rate of surface inflow from a particular tributary area

P_r = gaged precipitation rate in the form of rain on the valley floor

W_{sr} = estimated snowmelt rate in terms of water equivalent

If empirical correlation factors are included in the preceding equation, the expression becomes:

$$Q_{is}(u) = k_u q_{is}(m) + k_a P_r + k_b W_{sr} \quad . \quad (3.4)$$

in which k_u, k_a, and k_b are correlation factors relating ungaged surface inflow rate to, respectively, a gaged surface inflow rate, precipitation rate, and snowmelt rate. Each of these factors is established through the model verification process for a particular subbasin.

With reference to the measured tributary inflow rate, $q_{is}(m)$, used in Equation 3.4, this quantity might refer to either the total measured tributary inflow or a specific stream within the area. The main criterion for selecting the gaged area is that the watershed exhibit the same general runoff characteristics as that of the ungaged area.

The second independent term in Equation 3.4 refers to the rates of precipitation occurring on the valley floor in the form of rain. Because it is assumed that the influence of snow upon the surface runoff is restricted to the melt period, only rainfall is considered by the equation. Generally, a direct plot of rainfall against runoff for individual storms yields a low correlation because of the variable nature of the factors affecting runoff (Chow, 1964). However, when mean monthly values of precipitation and runoff are considered, many of the transient processes are smoothed and reasonably good correlation of runoff with precipitation is achieved.

The third independent term of Equation 3.4 considers the influence of snowmelt upon surface runoff. Snowmelt rates on the valley floor are predicted in the model by Equation 3.9. This process is discussed in further detail later in this chapter.

The total surface inflow rate to the model (valley floor) is estimated by summing the measured rate and estimated ungaged rate from Equation 3.4. Thus,

$$Q_{is} = Q_{is}(m) + Q_{is}(u) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3.5)$$

in which Q_{is} refers to the total surface inflow rate, and the two independent quantities are as previously defined.

Interflow

Interflow is defined as the lateral movement of moisture through the plant root zone. The process is discussed in further detail at a later point in this chapter. Interflow rate, N_r, is not treated as a separate identity in the hydrologic model of the valley bottoms, but is considered as being a part of the surface runoff from irrigation. In most cases, small interflow rates are encountered in flat lands. Furthermore, for a model time increment of one month, interflow usually produces an insufficient delay time to enable this quantity to be distinguished from surface runoff.

Groundwater Inflow

Groundwater or subsurface inflow refers to those waters which enter the model area or valley floor beneath the ground surface. Much of this water is subsequently discharged as effluent flow into the main channel of the valley, and thus provides a "base flow" for the stream. Discharge from the groundwater basin of the valley floor also occurs by way of spring flows, pumped waters, and consumptive use by phreatophytes.

Essentially, all groundwater is constantly in motion though velocities may range from several feet per day to only a few inches per year. This groundwater movement is basically confined to permeable geologic formations called aquifers which serve as transmission conduits. Movement and volume of groundwater runoff may be calculated through application of Darcy's Law, providing adequate data are available. However, subsurface flow data are sparse within the Bear River basin. Time and spatial distribution of groundwater flows in this study were estimated by an empirical approach through the model verification procedure. For the steep watersheds near the headwaters of major drainage divisions, groundwater inflows to the valley floors were usually sufficiently small to be neglected. As the study proceeded downstream to lower subbasins, it generally became apparent through the time distribution of the water inputs to the model in relation to the recorded outflow that groundwater inflow rates were appreciable. Correlation procedures and transport delays were then used to estimate and simulate groundwater movement into the subbasin. This water was then distributed with time through use of long transport delay networks on the computer. The required delay setting of these networks was established during the model verification process. Hence, the rate of groundwater inflow was described as follows:

$$Q_{ig}(u) = k_c q_{is} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3.6)$$

in which

$Q_{ig}(u)$ = rate of total unmeasured inflow to the groundwater system

k_c = coefficient relating the rate of unmeasured groundwater inflow to a measured surface runoff rate

q_{is} = rate of surface runoff (either total measured tributary inflow or measured tributary inflow or measured inflow from a representative tributary)

For some subbasins a subsurface outflow, as groundwater movement under the outflow gage in the streambed alluvium, was determined by the model verification process. The time and spatial distribution of this outflow formed a component of the groundwater inflow or input to the adjacent downstream subbasin.

Total Inflow

Total inflow rate to the valley bottoms consists of the summation of the surface and groundwater flow rates. The surface inflows for the most part have already been summed and are concentrated in stream channels as they enter the valley floor or agricultural areas. Gaged surface inflow rates are available from surface water records published by the U. S. Geological Survey. These records were utilized wherever possible.

The remaining two components of total inflow, namely ungaged surface inflow and groundwater inflow, are estimated from Equation 3. 4 and 3. 6, respectively. Therefore, the total inflow, Q_i, to a given subbasin within the Bear River basin is given by the following expression:

$$Q_i = Q_{is} + Q_{ig} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (3.7)$$

in which the terms Q_{is} and Q_{ig} are given by Equations 3. 5 and 3. 6, respectively.

Precipitation

The ultimate source of water input to any hydrologic unit is precipitation in one form or another. Precipitation is considered to be any moisture which emanates from the atmosphere and falls to the earth.

Precipitation input to the hydrologic system varies with respect to both time and space and it is therefore necessary to convert point measurements from climatological stations into an integrated or averaged monthly value over a finite area. Common spatial integration techniques include the Thiessen weighting procedures and the isohyetal method (Linsley, Kohler, and Paulhus, 1958). A modified isohyetal technique was used to estimate precipitation as a function of time for each subbasin. Some precipitation data are available for all subbasins adopted in this study.

Two forms of precipitation, rain and snow, are considered in this study. Air temperature is used as the criterion for establishing the occurrence of these two forms. This criterion is not an ideal index for determining the form of precipitation since no one temperature exists below which it always snows and above which it always rains. However, the surface air temperature appears to be the most suitable single index of precipitation form now available.

Based on investigations by the U. S. Army (1956) at a surface air temperature of 35°F, there is a 50 percent chance that precipitation will be as snow, whereas at 32°F the probability is 95 percent of precipitation falling as snow. However, in this study a double standard was used because average monthly temperatures provided the criteria. Snow was assumed to fall below about 35°F, and snowmelt was assumed to occur above about 30°F. This assumption provided for the occurrence of snowfall and snowmelt during the same month. These threshold temperatures varied in the different subbasins.

A part of the precipitation falling on an area is stored on the vegetative cover. Because most of this water later returns to the atmosphere through the evaporation process, vegetative interception is regarded as a loss. Interception losses which occur over a long time period, such as a month, are generally expressed as a fraction of the total precipitation for that period (U. S. Army, 1956). That part of the precipitation which reaches the ground, namely the difference between the total precipitation and the interception losses, is generally labeled as "effective precipitation" for the area.

The magnitude of the interception loss is basically a function of the type and density of the vegetative cover within the area. Interception losses for forested areas may be considerable, while interception losses for sparsely timbered and grass covered areas might be small. Since the model of this study includes only the valley floors, which are essentially flat, agriculturally oriented areas, interception losses are neglected, and all precipitation is assumed to be effective.

Some of the precipitation which reaches the ground is retained in depression storage. This form of storage includes puddles and other depressions in the soil surface. Water leaves depression storage through either direct evaporation or as infiltration into the soil. Thus, for models involving large time increments, such as a month, abstractions to depression storage need not be treated separately but can be assumed to be a part of the total evapotranspiration and infiltration loss from the total precipitation quantity.

Temperature

Air temperature is an important parameter in a hydrologic system because it can be utilized as a criterion for establishing the form of precipitation, and as an index of the energy available for the snowmelt and evapotranspiration processes. Temperature varies according to both time and space. To obtain average temperature values for the valley floor, or a portion thereof, within a particular subbasin, requires that point measurements be utilized for estimating an effective or average temperature value for an area. One approach to this problem of spatial integration is to construct isothermal lines for particular time periods and to relate these to selected index stations (Riley and Chadwick, 1967). However, in this study average temperatures for a particular area and a given time period (one month) are estimated by an arithmetic average of temperature measurements taken in the subbasin.

Snowmelt

Although rational formulas which include the various factors involved in the snowmelt process have been developed, data limitations often prohibit a strictly analytical approach to the process. Rational models include fundamental processes, such as those which relate to energy transfer, and requirements for input data are high. An additional restriction to the analytical approach for snowmelt computation is a large modeling time increment such as a month. Many of the short-term, transient phenomena which occur within a snowpack cannot be represented in a macroscopic model of this scale. An empirical relationship was, therefore, adopted for this study model.

Riley et al. (1966) proposed a relationship which states that the rate of melt is proportional to the available energy and the quantity of precipitation stored as snow. As a differential equation the relationship is written:

$$\frac{d[W_s(t)]}{dt} = -k_s(T_a - T_b)\frac{RI_s}{RI_h}W_s(t) \quad . \quad . \quad (3.9)$$

in which the undefined terms are:

k_s = a constant

T_a = surface air temperature in degrees F

RI_s = the radiation index on a surface possessing a known degree and aspect of slope

RI_h = the radiation index for a horizontal surface at the same latitude as the particular watershed under study

W_s = snow storage in terms of water equivalent

T_b = assumed base temperature in degrees F at which melt begins to occur. In this study T_b was taken as being equal to 32°F.

Riley et al. (1966) report reasonable agreement between predicted snowmelt rates from Equation 3.9 and observed values. They used a value of k_s equal to 0.10 based on studies using data from several snow courses in the Rocky Mountain area where average snow depths are high. It has been found, however, that the value of k_s is somewhat inversely dependent upon snowpack depth. In other words, as the snow depth decreases pack melt rates increase for a given energy input. Thus, k_s is relatively larger for areas of shallow snowpack depth and relatively smaller for areas where depths tend to be large. The radiation index parameter allows adjustment to be made for variation of the total insolation with land surface slope and aspect. However, since only the valley floors are included in the modeling area, it is assumed that the topographic surface of the area is essentially horizontal. This assumption simplified Equation 3.9 in that RI_s becomes equal to RI_h and their ratio goes to unity.

The independent variables on the right side of Equation 3.9 can be expressed as either continuous functions of time or as step functions consisting of mean constant values for a given time increment. For this study a time increment was utilized and integration was performed in steps over each successive time period. Hence, the final values of $W_s(t)$ at the end of a particular time period became the initial value for the integration process over the following period. On this basis, and setting the ratio RI_s/RI_h equal to unity, the differential form of Equation 3.9 becomes:

$$\int_{W_s(0)}^{W_s(1} \frac{dW_s}{W_s} = - k_s(T_a-32) \int_0^1 dt \quad . \quad .. \quad (3.10)$$

or

$$W_s(1) = W_s(0) \exp\left[-k_s(T_a-32)\right] \quad . \quad . \quad (3.11)$$

Canal Diversions

Canal diversions profoundly affect the time and spatial distribution of water within an irrigated area. A portion of this diverted water is evaporated directly to the atmosphere, a second part enters the soil profile through canal seepage and infiltration on the irrigated lands, and the remainder returns to the source as overland flow. Some of the water which enters the soil profile is lost through plant consumptive use. The remainder either percolates downward to the groundwater basin or is intercepted by drainage systems. Irrigation practices, therefore, alter the distribution characteristics of a hydrologic system. The irrigation efficiency factor used in this study includes both the conveyance and application efficiencies. Thus, multiplying total diversions by this factor provides an estimate of that quantity of water which returns directly to the stream as overland flow and/or interflow. This composite irrigation efficiency factor is given by the following expression.

$$Eff = 100 \frac{W_{dr}}{W_{tr}} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (3.12)$$

in which

Eff = water conveyance and application efficiency in percent

W_{dr} = rate at which diverted water enters the soil through seepage and infiltration

W_{tr} = total rate at which water is diverted from the stream or reservoir

Records of water diversion to the agriculture lands within each subbasin were found to be lacking. Adjustment of these records was necessary in many cases to get a realistic application rate for the irrigated acreage.

As already indicated, a portion of the water diverted for irrigation returns to the streams as overland flow and interflow. Although the large time increment allows this water to be treated in the model as a single identity, it is important to distinguish between the two components. Overland flow (often termed tailwater) is surface return flow or runoff from the end of the field resulting from the application of water to the irrigated land at rates exceeding the infiltration capacity of the soil. Interflow is defined as that part of the soil water which does not enter the groundwater basin, but rather which moves largely in a lateral direction through the upper and more porous portion of the soil profile until it enters a surface or subsurface drainage channel. Both the overland flow and the interflow return to the stream channels in short distances and times consisting of usually only a few days. The distribution of canal diversion within the hydrologic system can now be expressed as follows:

$$OF_r = (1 - Eff/100)\ W_{tr} + N_r \quad . \quad . \quad . \quad (3.13)$$

or

$$OF_r = (W_{tr} - W_{dr}) + N_r \quad . \quad . \quad . \quad . \quad . \quad . \quad (3.14)$$

in which

OF_r = total of overland flow (from irrigation applications at rates exceeding infiltration capacity rates) and interflow rates

N_r = interflow rate

All other quantities have been previously defined under Equation 3.12.

It is pointed out that evapotranspiration losses do not appear as such in Equation 3.13 and 3.14. These losses are, however, considered because they are abstracted from the infiltration quantity represented by W_{dr}. The evapotranspiration process will be further discussed in a subsequent section.

Available Soil Moisture

The usual definition of available soil moisture capacity is the difference between the field capacity and the wilting point of the soil. Water within this range is available for plant use, and is termed available soil moisture. The field capacity is defined as the soil moisture content after gravity drainage has occurred. Most of the gravity water drains rapidly from the soil thus affording plants little opportunity for its use. The wilting point represents the soil moisture content when plants are no longer able to abstract water in sufficient quantities to meet their needs, and permanent wilting occurs. Available soil moisture can be expressed in several units but in this report it carries the unit of depth in inches.

Sources of available water. Basically, moisture in the soil is derived from infiltration, which is the passage of water through the soil surface into the soil profile. The water available for infiltration at the soil surface is derived from three sources, namely, effective precipitation in the form of rain, P_r, snowmelt, W_{sr}, and irrigation water, W_{dr}. As springtime temperatures rise to the point at which melting occurs, all snow cover on the land is assumed to melt and enter the soil mantle through the infiltration process. In the case of irrigated crops, the most important source of available soil moisture is water which is diverted to the agriculture lands. The rate at which water from this source enters the soil profile through canal seepage and infiltration has been designated as W_{dr}. Thus, the total water available for infiltration into the soil, W_{gr}, can be written as:

$$W_{gr} = W_{dr} + P_r + W_{sr} \quad . \ . \ . \ . \ . \ . \ . \quad (3.15)$$

in which all quantities are as previously defined.

Available soil moisture quantities. The maximum quantity of water in a soil available for use by plants is a function of the moisture holding capacity of the soil and the average rooting depth or extraction pattern of the plant.

The basic forces involved in the absorption of water by plants are osmotic, imbibitional, metabolic, and transpiration pull (Thorne and Peterson, 1954). These forces basically define the soil moisture tension or "pull" that must be exerted by the plant to remove water from the soil. Of these forces the principal one is the osmotic pressure created within plant root cells. Opposing these forces are those exerted on the moisture by the soil particles. The forces exerted by the plants vary with different plants, soils, and climates, but the average maximum force which plants can exert in obtaining sufficient water for growth is approximately 15 atmospheres of pressure. At field capacity where water is readily available for plant use, the average soil moisture tension is only about 0.1 atmosphere. However, the soil moisture tension or "pull" plants exert in their quest for water is in itself no indication of the amount of available water contained by the soil. The actual amount of water held by the soil at any given tension value is a function of the soil type.

Determination of the soil depth effectively utilized by a plant is based on the average rooting depth or the average moisture extraction pattern. The soil moisture available for extraction depends on the moisture holding capacity of the soil and the extraction pattern. The typical agriculture crop extracts 70 percent of its moisture from the upper 50 percent of the soil penetrated by the plant roots. Average or typical rooting depths for various plants are reported by McCulloch et al. (1967). Illustrative depths include 4 to 6 feet for alfalfa, 4 feet for grains and corn, and 2 to 3 feet for pasture. The average available soil moisture capacity of the irrigated lands was estimated for each subbasin.

Under normal circumstances, additions to available soil moisture storage occur through the infiltration process, F_r. Abstractions or depletions from available soil moisture storage occur through evapotranspirational losses, ET_r, and deep percolation, G_r. The assumption is made, however, that deep percolation does not occur until the soil moisture capacity is reached. Thus, the soil moisture storage existing at any time, t, can be stated:

$$M_s(t) = (F_r - ET_r - G_r)\, dt \quad . \ . \ . \ . \quad (3.16)$$

Each of the three terms on the right side of this equation is discussed in the following sections.

Infiltration

As already indicated, additions to available soil moisture occur through the process of infiltration, F_r. Factors which influence the infiltration rate include various soil properties and surface characteristics. A moisture gradient induced by the adhesive properties of the soil particles also influences infiltration rate.

In this study, the rate of infiltration into the soil is given by the following equations

$$F_r = W_{gr}, \ (W_{gr} \le R_{tr}) \quad . \ . \ . \ . \ . \ . \ . \quad (3.17)$$

and

$$F_r = R_{tr}, \ (W_{gr} > R_{tr}) \quad . \ . \ . \ . \ . \ . \ . \ . \quad (3.18)$$

for which all terms were previously defined. The quantity W_{gr} is Equation 3.17 is given by Equation 3.15.

Evapotranspiration

The second term on the right side of Equation 3.16 represents depletion from the soil moisture storage through the evapotranspiration process, ET_r. Consumptive use, or evapotranspiration, is the sum of all water used and lost by growing vegetation due to transpiration through plant foliage and evaporation from the plant and surrounding environment such as adjacent soil surfaces. Potential evapotranspiration is defined as that rate of consumptive use by actively growing plants which occurs under conditions of complete crop cover and non-limiting soil moisture supply.

The evapotranspiration process depends upon many interrelated factors whose individual effects are difficult to determine. Included among these factors are type and density of crop, soil moisture supply, soil salinity, and climate. Climatological parameters usually considered to influence evapotranspiration rates are precipitation, temperature, daylight hours, solar radiation, humidity, wind velocity, cloud cover, and length of growing season. Numerous relationships have been developed for estimating the potential evapotranspiration rate.

Perhaps one of the most universally applied evapotranspiration equations is that proposed by Blaney and Criddle (1950). This equation is written as follows:

$$U = kf \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (3.19)$$

in which

U = monthly crop potential consumptive use in inches

k = monthly coefficient which varies with type of crop and

F = monthly consumptive use factor and is given by the following equation:

$$f = \frac{tp}{100} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (3.20)$$

in which

t = mean monthly temperature in degrees F

p = monthly percentage of daylight hours of the year

A modification to the Blaney-Criddle formula was proposed by Phelan et al. (1962), wherein the monthly coefficient, k, is subdivided into two parts, a crop coefficient, k_c, and a temperature coefficient, k_t. The relationship describing k_t is an empirical one, depending upon only temperature, and is expressed as:

$$k_t = (0.0173T_a - 0.314) \quad . \; . \; . \; . \; . \; . \; . \quad (3.21)$$

where T_a is the mean monthly temperature in degrees F. The crop coefficient, k_c, is basically a function of the physiology and stage of growth of the crop. Typical curves which indicate values of k_c throughout the growth cycle of particular crops are shown by Figure 3.3 which is for alfalfa. Similar k_c curves are available for many agriculture crops (Soil Conservation Service, 1964).

Thus, the modified Blaney-Criddle equation for estimating potential evapotranspiration rates is written as follows:

$$ET_{cr} = k_c \, k_t \frac{T_a p}{100} \quad . \; . \; . \; . \; . \; . \; . \; . \quad (3.22)$$

Because of its simplicity, low data requirements (only surface air temperature is needed), and applicability to the irrigated areas of the Western United States, Equation 3.22 was adopted for this study model. Since the time increment selected for use was one month, the variables on the right of Equation 3.22 represent mean monthly values although these parameters could be expressed as continuous functions instead of the indicated step functions. Thus, Equation 3.22 estimates the mean potential evapotranspiration rate during each month.

The growing season was assumed to begin and end when the mean monthly air temperature reached a value of 32°F. Evapotranspiration losses from the agriculture area during the non-cropping season were estimated from Equation 3.22. For many crops it was necessary to extend the k_c curves to include the non-growing season (West, 1959). Because the k_c curve for grass pasture seems to represent a reasonable set of values for native vegetation (Riley et al., 1967), this curve was used as a guide in the development of a similar k_c curve for phreatophytes.

Effects of soil moisture on evapotranspiration. As was discussed earlier, as the moisture content of a soil is reduced by evapotranspiration, the moisture tension which plants must overcome to obtain sufficient water for growth is increased. It is generally conceded that some reduction in the evapotranspiration rate occurs as the available quantity of water decreases in the plant root zone. Recent studies by the U. S. Salinity Laboratory in California (Gardner and Ehlig, 1963) indicate that transpiration occurs at the full potential rate through approximately the first one-third of the available soil moisture range, and that thereafter the actual evapotranspiration rate lags the potential rate. When this critical point in the available moisture range is reached, the plants begin to wilt because soil moisture becomes a limiting factor. Thereafter, an essentially linear relationship exists between available soil moisture quantity and actual transpiration rate. The actual evapotranspiration rate is expressed by Riley, Chadwick, and Bagley (1966) in accordance with the end conditions which accompany the two following equations:

$$ET_r = ET_{cr}, \; [M_{es} < M_s(t) \le M_{cs}] \quad . \quad (3.23)$$

and

$$ET_r = ET_{cr} \frac{M_s(t)}{M_{es}}, \; (0 \le M_s(t) \le M_{es}) \; . \quad (3.24)$$

in which

ET_r = actual evapotranspiration rate

ET_{cr} = potential evapotranspiration rate

M_{es} = limiting or threshold content of available water within the root zone below which the actual becomes less than the potential evapotranspiration rate

$M_s(t)$ = quantity of water available for plant consumption which is stored in the root zone at any instant of time

M_{cs} = root zone storage capacity of water available to plants

Because they are differential with respect to time, both Equations 3.23 and 3.24 are easily programmed on the computer. In the integrated form Equation 3.24 appears as:

$$M_s(2) = M_s(1) \exp\left[-\frac{ET_{cr}}{M_{es}}(t_2 - t_1)\right] \quad . \; . \quad (3.25)$$

in which $M_s(1)$ and $M_s(2)$ are the soil moisture storage values at time t_1 and t_2, respectively. Hence, when conditions are such that the available soil moisture storage reduces the potential evapotranspiration rate, the actual consumptive use rate can be expressed by combining Equation 3.22 and 3.24 to read:

$$ET_r = \frac{M_s}{M_{es}} k_c k_t \frac{T_a P}{100} \quad . \; . \; . \; . \; . \; . \; . \quad (3.26)$$

Equation 3.26 is programmed on the computer to estimate actual evapotranspiration rate. The equation reduces to Equation 3.22 when $M_s > M_{es}$ so that $ET_r = ET_{cr}$.

Effects of slope and elevation on evapotranspiration. In that they affect the available energy supply, land slope (degree and aspect) and elevation influence the evapotranspiration process. Riley and Chadwick (1967) considered the effects of slope by introducing a radiation index parameter. These same authors also introduced an elevation correction into Equation 3.26. This adjustment is necessary for watershed studies since surface air temperature becomes a less reliable index of the available energy with increased elevation above the valley floor. However, because the model of this study was confined to the relatively flat valley floor areas, the effect of both slope and elevation on the evapotranspiration rate is neglected.

Deep Percolation

The final independent term, G_r, of Equation 3.16 represents the rate of deep percolation. Percolation is simply the movement of water through the soil. Deep percolation is defined as water movement through the soil from the plant root zone to the underlying groundwater basin. The dominant potential forces causing water to percolate downward from the plant root zone are gravity and capillary. Water is removed quickly by gravity from a saturated soil under normal drainage conditions. Thus, the rate of deep percolation, G_r, is most rapid immediately after irrigation when the gravity force dominates, and decreases constantly, continuing at slower rates through the unsaturated conditions. Because the capillary potential applies through all moisture regimes, deep percolation continues, though at low rates, even when the moisture content of the soil is less than field capacity (Willardson and Pope, 1963).

Because of a lack of data in the study area regarding deep percolation rates in the unsaturated state, and in order to simplify the model, the assumption was made that deep percolation occurs only when the available soil moisture is at its capacity level. In most cases, this assumption causes only slight deviation from prototype conditions. Thus, for this model, the deep percolation rate is expressed as:

$$G_r = F_r - ET_{cr}, \ [M_s(t) = M_{cs}] \quad . \quad . \quad (3.27)$$

$$G_r = 0, \ [M_s(t) < M_{cs} \qquad (3.28)$$

in which all terms are as previously defined.

River Outflow

Using the continuity of mass principle (Equation 2.1) the hydrologic balance is maintained by properly accounting for the quantities of flow at various points within the system. The appropriate translation or routing of inflow water through the system in relationship to the chronological abstractions and additions occurring in space and time concentrates the water at the outlet point as both surface and subsurface outflow. As mentioned earlier, active network delays on the computer simulate the long transport time necessary for groundwater inflows and deep percolating waters to be routed to the outflow gaging station.

Thus, the total rate of water outflow from a subbasin is obtained through the summation of various quantities as follows:

$$Q_o = Q_{is} - W_{tr} + OF_r + Q_{ob} - Q_e \quad . \quad . \quad (3.29)$$

in which

Q_o = total rate of outflow from the system

Q_{is} = rate of total surface inflow to the subbasin including both measured and unmeasured flows

W_{tr} = total rate at which water is diverted from the stream or reservoir

OF_r = total of overland flow and interflow rates

Q_{ob} = rate of outflow from the groundwater basin of routed deep percolating waters and subsurface inflows to the subbasin

Q_e = rate of water diversions from surface sources for use outside the boundaries of the subbasin. Exports to other drainage basins fall within this category.

If subbasins are selected such that there exists no flow of subsurface water past the gaged outflow point, the hydrograph of surface outflow, Q_{so}, is given by Equation 3.29. This situation is assumed to exist at reservoir sites within the basin because of construction measures taken to eliminate subsurface flows under the dams which create the reservoir. For this reason, whenever possible, subbasins were terminated at the outfall of a reservoir. These sites thus enabled a check to be made on groundwater inflow rates to the subbasin as predicted from verification studies involving models for one or more upstream subbasins.

For many subbasins the termination or outlet point was taken at a Geological Survey gaging station, and in several of these cases groundwater flow occurs in the streambed alluvium beneath the surface channel. For these basins, the total system outflow can be written as:

$$Q_{to} = Q_{so} + Q_{go} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \quad (3.30)$$

in which

Q_{so} = rate of surface outflow from the subbasin

Q_{go} = rate of subsurface or groundwater outflow from the subbasin

Surface outflow rates, Q_{so}, can be compared to the recorded values, but subsurface outflow rates, Q_{go}, are unmeasured and must be predicted or estimated. In this study it was assumed that the subsurface outflow rates were directly proportional to the total outflow rates, and Q_{go} was therefore estimated by the following relationship:

$$Q_{go} = k_d \, Q_o \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (3.31)$$

in which

k_d = a coefficient determined by model verification representing the percentage of total outflow which leaves the basin as subsurface flow.

Because of storage and permeability effects, fluctuations in groundwater flow rates tend to be much less extreme than in the case of surface flows. The value of k_d in Equation 3.31 was, therefore, not maintained as a constant, but was expressed as an inverse function of the surface flow rate, Q_{so}. During the spring runoff period, for example, the predicted increases in subsurface outflow rate, Q_{go}, from Equation 3.31 were considerably less extreme than the increases in observed or computed surface flow rate, Q_{so}. Relationships expressing k_d as a function of Q_{so} were developed for each subbasin through the model verification process.

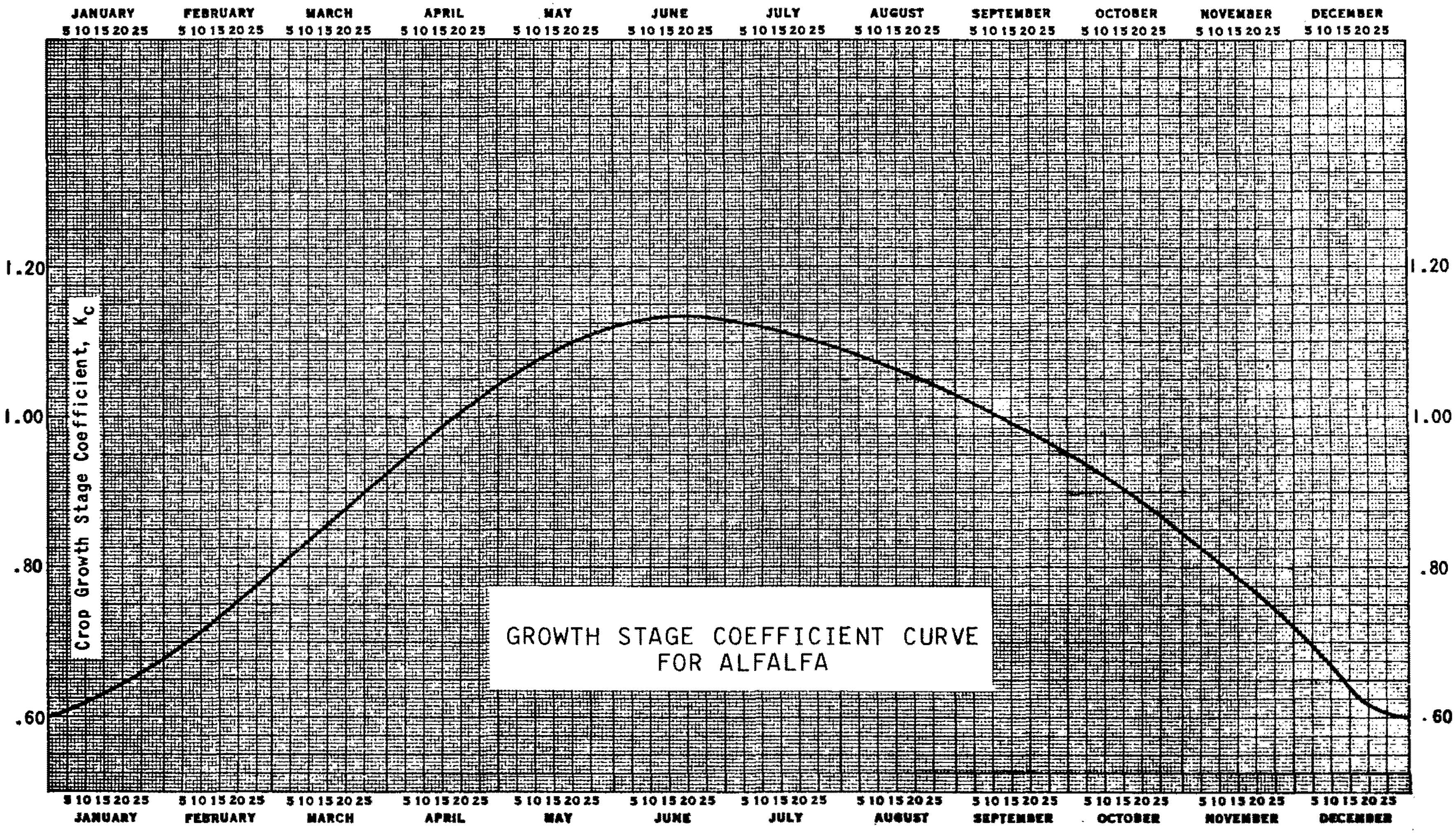


Figure 3.3. Crop growth stage coefficient curve for alfalfa. (Adapted from U.S. Soil Conservation Service Technical Release No. 21)

CHAPTER IV

THE COMPUTER MODEL

A computer model of a hydrologic system is produced by programming the mathematical relationships and logic functions of the hydrologic model as described in the previous chapter. The model does not directly simulate the real physical system, but is analogous to the prototype, because both systems are described by the same mathematical relationships. A mathematical function which describes a basic process, such as evapotranspiration, is applicable to many different hydrologic systems. The simulation program developed for the computer incorporates general equations of the various basic processes which occur within the system. The computer model, therefore, is free of the geometric restrictions which are encountered in simulation by means of network analyzers and physical models. The model is applied to a particular prototype system by establishing, through a verification procedure, appropriate constant values for the equations required by the system.

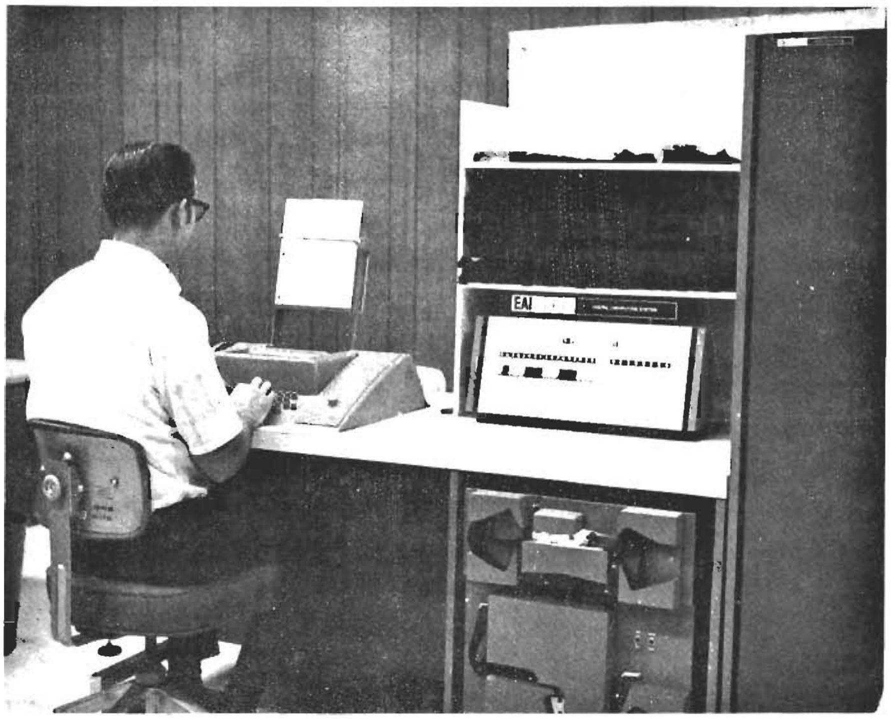
Electronic computers fall into one of three general classifications, namely analog, digital, and hybrid. The computing components of an analog computer execute the basic operations of addition, multiplication, function generation, and, most important in the study of dynamic or time variant systems, high-speed integration. By connecting computing components through a program "patch panel," it is possible to form an electronic model of a differential equation or a series of differential equations which describe the dynamic performance or operation of a physical system.

The general-purpose digital computer processes information which is reported by combinations of discrete or instructive data, as compared with the analog computer which operates on continuous data. While the analog computer is a "parallel" system in which all problem variables are operated on simultaneously, the digital computer is basically a "sequential" system performing step by step operations at high speed.

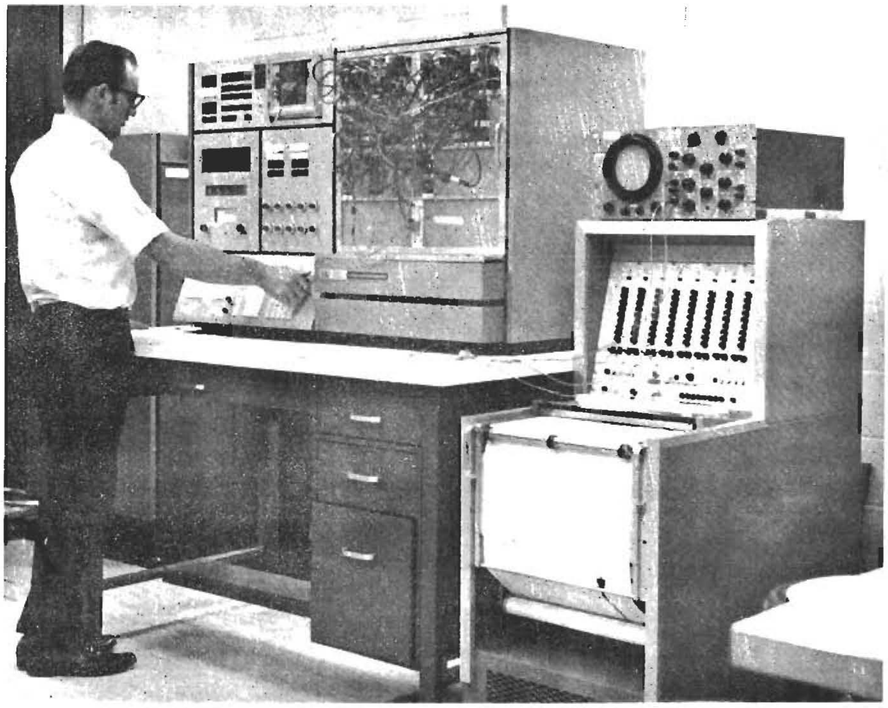
The digital computer is useful in processing large quantities of data or in solving complex mathematical problems which can be converted to a large number of simple arithmetic operations by the operator or by the computer. The digital computer can perform sequences of arithmetic and logical operations, not only on data, but also in its own program, and is, therefore, an immensely powerful device for processing or manipulating large amounts of discrete data and for performing precise arithmetic calculations at high speed.

In analog simulation, the operator communicates with, or controls, the simulation by means of hardware controls, while viewing the continuous problem solution. The digital computer programmer communicates with the computer primarily through "software" or programming languages. The design of software has become of equal or greater significance than hardware design. The development of "higher-order" or problem-oriented languages, in which one programming statement triggers a large number of sequential computer operations, has helped to simplify the interface problem between the user and the digital system.

The hybrid computer combines the memory and logic capabilities of the digital with the high speed and nonlinear solution capabilities of the analog. In addition, the high speed iterative solutions and graphic display which are characteristics of the hybrid computer provide close interaction between the hydrologist and the model. These features make the hybrid a very powerful computer in the development and verification of simulation



The console of the digital unit.



A view of the analog unit showing the servo-set pots, digital voltmeter, program board, and output devices.

Figure 4.1. Two views of the hybrid computer facility at the Utah Water Research Laboratory.

models. Two views of the Electronic Associates Incorporated (EAI) 590 hybrid computer available at the Utah Water Research Laboratory are shown by Figure 4.1.

The computer simulation model of the Bear River hydrologic system was programmed on the hybrid computer. The digital portion of the model was coded in FORTRAN IV (EAI subset), and the analog portion was programmed for the EAI 580 computer. Because an analog computer operates within specific voltage limits, in this case ± 10 volts, it was necessary to scale the analog component of the model such that these limits were not exceeded. The basic data were input to the digital computer, which processed and controlled the operation of the hydrologic mass balance model programmed on the analog component of the hybrid computer. Monthly values of input and output data were printed as stipulated in the program by the on-line printer as the simulation proceeded. Graphical output at various points within the model was obtained by connecting the x-y plotter to the appropriate terminals on the analog patch-board.

As mentioned earlier, the computer program is general in nature, and is applied to a particular prototype system by a verification procedure.

A general view of the program control structure is shown by Figure 4.2. As illustrated by this figure, the program contains several subroutines, each of which is controlled by the main program, labeled OPVER. Program OPVER performs the following two functions: (1) establishes the various options available for performing the hydrologic simulation, and (2) controls the operation of the modified pattern search for calibrating the model for a particular subbasin. The five options available through OPVER are as follows:

1. Simulation of an entire system of subbasins without exiting from the simulation subroutine, HYDSM.
2. Input only basic data which are considered to be common for all subbasins that may be subsequently run.
3. Input and operate with data for a particular subbasin. Option 2 must have been previously selected.
4. Rerun the last simulation performed. Options 2 and 3 must have been previously selected.
5. Perform pattern search on subbasin data presently in memory. Options 2 and 3 must have been previously specified.

The subroutine interaction is illustrated by Figure 4.3. Program OPVER establishes the entry and exit conditions for HYDSM, which in turn calls the particular subroutines needed to perform the operations specified by OPVER. OPVER also calls the analog potentiometer subroutine POTST without going through HYDSM during the pattern search operation. A listing of the digital program, a flow chart of the analog program, flow charts for OPVER and the primary subroutines, program notations, and general instructions for use of the model are given in Appendix B.

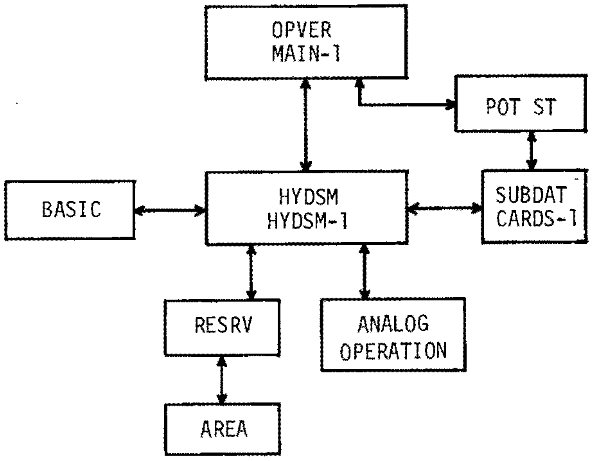


Figure 4.2. General view of the program control structure.

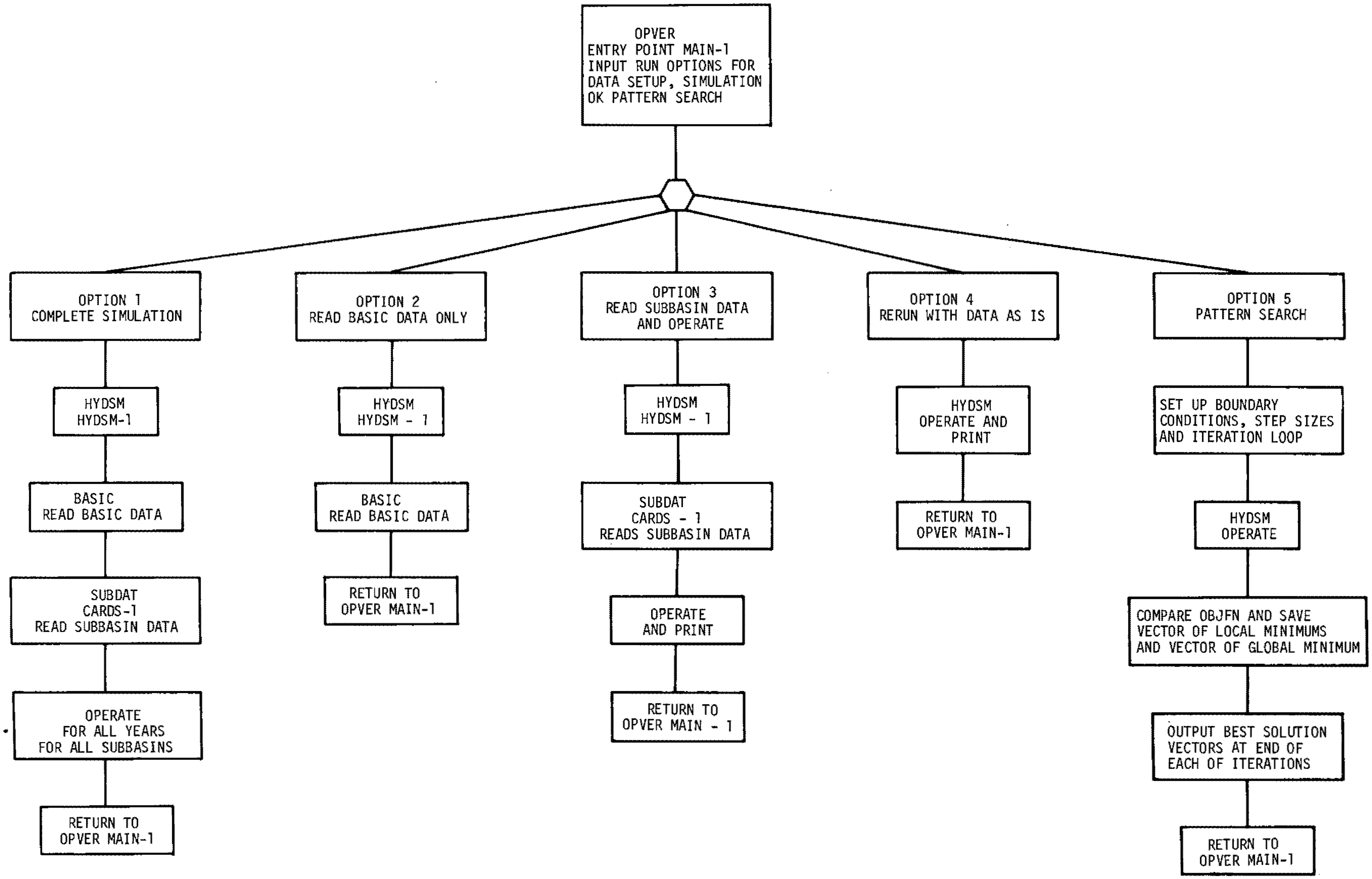


Figure 4.3. A flow diagram of the subroutine interaction for program OPVER.

CHAPTER V

APPLICATION OF THE HYDROLOGIC MODEL TO THE BEAR RIVER BASIN

Verification

The general hydrologic model discussed in the previous chapter is applied to a particular basin through a verification procedure whereby the values of certain model parameters are established for a particular prototype system. Verification of a simulation model is performed in two steps, namely calibration, or system identification, and testing of the model. Data from the prototype system are required in both phases of the verification process. Model calibration involves adjustment of the model parameters until a close fit is achieved between observed and computed output functions. It therefore follows that the accuracy of the model cannot exceed that provided by the historical data from the prototype system.

Evaluation of the model parameters can follow any desired pattern, whether it be random or specified. In this study, each unknown system coefficient is assigned an initial value, an upper and lower bounds, and the number of increments to cover the range. The first selected variable is varied through the specified range while all other variables remain at their initial value. The values of the objective function (measure of error) for each value of the variable are printed, and the value which produced the minimum is stored. After completion of the runs for the first variable, the variable is reset to the initial value and the second variable is taken through the same procedure. After all coefficients have been varied, the set of values which produced each local minimum is run and the resultant objective function value is compared with the smallest attained in all previous runs. The vector which produced the minimum objective function value is selected as the initial vector for the next phase and the process is repeated until a coefficient vector is found which produces a reasonable correspondence between computed and observed outflows. The algorithm used to implement the many trials required for model calibration is included in Appendix B as part of the digital computer source program for the model.

It should be noted that the choice of the variable vector for each phase is based on the judgment and experience of the programmer. However, selection of all variable vectors following the first choice is tempered by the experience gained during the first phase and subsequent phases of the procedure. Thus, model verification effectively uses all previous experience, including that gained during the verification procedure.

Calibration of the model of this study was based on three years of prototype data. Model output was compared to measured output by computing the sum of the squared deviations, which became the objective function for the pattern search procedure described previously. The final parameter vector that was selected to represent the system was that which minimized the objective function in the calibration procedure. The three years of data required 36 monthly solutions of the simultaneous system of equations in terms of water quantities as a function of time. Ideally, calibration data should cover a wide range of input values, such as those corresponding to a dry, a wet, and an average year.

Comparisons between the observed and computed output values from the calibrated model are shown by Figures 5.1 through 5.9. The verified model coefficients are shown in detail in Appendix C. When values of the model coefficients which produce acceptable reproductions of the output function from a prototype system have been established, the model is said to be calibrated for that system. It is then assumed that the model is capable of predicting realistic system outputs corresponding to various input functions and system parameters.

Sensitivity Analysis

A sensitivity analysis is performed by changing one system variable while holding the remaining variables constant and noting the changes in the model output functions. If small changes in a particular system parameter induce large changes in the output or response function, the system is said to be sensitive to that parameter. Thus, through sensitivity analyses it is possible to establish the relative importance with respect to system response of various system processes and input functions. This kind of information is useful from the standpoint of system management, system modeling, and the assignment of priorities in the collection of field data.

The computer model that was developed under this study performs a sensitivity analysis during calibration. The final phase of the model calibration procedure sets out the most meaningful sensitivity analysis since at this stage all parameters are near their final values. Careful study of the outputs from the verification procedure in Table 5.1 reveals the results of the sensitivity analysis. For example, a seven-fold increase in variable 11 reduced the objective function by about 40 percent, while increasing variable two by something less than double produced a four-fold change in the objective function. On the other hand, a four-fold increase in parameter 13 caused very little change in the objective function. Therefore, variable 13 would be given a low priority for more thorough scrutinization. However, variable two would be given a high priority for additional study. Table 5.1 shows the sensitivity of the variables for the Evanston subbasin. Similar analyses were made for each subbasin of the Bear River basin. Table 5.1 also indicates the gradient of the objective function for each variable parameter, or the rate of change of the objective function per unit change in any variable. This information is useful for establishing parameter values which minimize the objective function, and for estimating the sensitivity of this function to changes in the variable parameters. For each phase of the calibration procedure, initial values of the gradient for each variable are set equal to zero.

Table 5.2 is a printout from the computer program and represents a phase of the calibration process. The table presents the variable parameter number, the terminal values at each end of the range, the increment by which each parameter is changed during the calibration procedure, and the number of runs needed to cover the range. In this case, the initial and final vectors are almost identical because they represent the last phase of the verification procedure. Previous phases in the calibration procedure would show more differences between corresponding parameter values in the initial and final vectors.

Management Opportunities

Opportunities for management of water in the Bear River basin are widely varied and range from a change in cropping patterns to water storage and export. Actual implementation of a management scheme will depend on benefits gained as compared to the costs of implementation. The simulation model developed under this study does not make comparisons of benefits and costs, but does predict changes in the system output associated with given management alternatives. The management schemes tested in this study do not begin to cover the possible combinations, but do demonstrate the capability of

Table 5.1. Sensitivity of Evanston subbasin variables.

```
     6.45    .75    .900    .380  1.000    .000    .700    .030    .000 32.000 24.000
10.00  7.00 11.00    .20    .00    .00    .00    .00    .00    .00  2.50   2.50

    P     L       PAR              OBJ                OBA               GRAD

    1     1       .600           7.63027             .60905             .00000
    1     2       .700           7.01659             .50651           -6.13677
    1     3       .800           6.72995             .48210           -2.86648
    1     4       .900           6.54957             .57975           -1.80375
    2     1       .300          15.25176            7.05924             .00000
    2     2       .340           9.33559            2.53776         -147.90411
    2     3       .380           6.59475             .57975          -68.52113
    2     4       .420           8.31256             .30632           42.94525
    2     5       .460          14.22400           -1.53450          147.78604
    2     6       .500          24.27461           -2.69560          251.26504
    3     1      1.000           6.46163             .59928             .00000
    4     1       .000           6.43422            1.47819             .00000
    5     1       .200          11.90100           -3.66823             .00000
    5     2       .300           9.92734           -2.69660          -19.73664
    5     3       .400           8.45101           -1.55891          -14.76330
    5     4       .500           7.28981            -.72883          -11.61198
    5     5       .600           6.66571             .39421           -6.24101
    5     6       .700           6.47435            1.44889           -1.91360
    6     1       .020           6.24164           -1.55891             .00000
    6     2       .030           6.42178            1.47819           18.01357
    6     3       .040           7.97232            4.49089          155.05401
    6     4       .050          10.71584            7.38151          274.35217
    6     5       .060          15.00296           10.44792          428.71179
    6     6       .070          20.46119           13.54362          545.82373
    7     1       .020           6.47415            1.45866             .00000
    8     1     31.000           6.39105            1.42936             .00000
    8     2     31.500           6.39207            1.41950             .00204
    8     3     32.000           6.38694            1.43913            -.01025
    8     4     32.500           6.45121            1.37077             .12852
    8     5     33.000           6.34556            1.38053            -.21129
    9     1     23.000           8.45782            1.48307             .00000
    9     2     23.500           7.19685            1.42446           -2.52193
    9     3     24.000           6.44771            1.58073           -1.49828
    9     4     24.500           8.79396            1.55143            4.69251
    9     5     25.000          15.29298            1.75651           12.99803
    9     6     25.500          19.65886            1.70768            8.73176
    9     7     26.000          19.78175             .97526             .24578
   10     1     10.000           6.48482             .80435             .00000
   11     1      1.000          10.98001            -.11360             .00000
   11     2      2.000           9.36678             .18913           -1.61322
   11     3      3.000           9.94035            1.42448             .57357
   11     4      4.000           8.32566            1.47819           -1.61469
   11     5      5.000           6.94916             .46257           -1.37650
   11     6      6.000           6.54289            1.40983            -.40626
   11     7      7.000           6.52198             .71159            -.02090
   12     1      8.300           7.69265            4.59342             .00000
   12     2      9.000           7.16197            2.76725            -.53068
   12     3     10.000           6.59547            2.42057            -.46650
   12     4     11.000           6.42254            1.61003            -.27492
   12     5     12.000           6.95988            -.17219             .53933
   13     1       .000           6.65158            -.67024             .00000
   13     2       .100           6.37926             .74577           -2.72316
   13     3       .200           6.51555             .75065            1.36284
   13     4       .300           6.58709            1.49284             .71543
   13     5       .400           6.76384            2.20085            1.76745
   14     1       .200           6.60894             .91178             .00000
   15     1       .000           6.51977             .95085             .00000
   16     1       .000           6.37089            1.94206             .00000
   17     1       .000           6.50641            1.74674             .00000
   18     1       .000           6.39482            1.70280             .00000
   19     1       .000           6.37797            1.71745             .00000
   20     1      2.500           6.62894             .84831             .00000
   21     1      2.000           6.81623             .86784             .00000
   21     2      2.500           6.64224            1.28288            -.34798
   21     3      3.000           6.63550            1.46354            -.01349
   21     4      3.500           6.71831            2.23991             .16563
   21     5      4.000           7.09720            3.07487             .75776
```

Table 5.2. Computer printout showing summary of calibration process.

```
  PR  NP     PH        PL       XIN       DD


   1   3    .900      .600     .900     .100
   2   5    .500      .300     .380     .040
   3   1   1.000     1.000    1.000     .000
   4   1    .000      .000     .000     .000
   5   5    .700      .200     .700     .100
   6   5    .070      .020     .030     .010
   7   1    .000      .000     .000     .000
   8   4  33.000    31.000   32.000     .500
   9   6  26.000    23.000   24.000     .500
  10   1  10.000    10.000   10.000     .000
  11   6   7.000     1.000    7.000    1.000
  12   4  12.000     8.000   11.000    1.000
  13   4    .400      .000     .200     .100
  14   1    .000      .000     .000     .000
  15   1    .000      .000     .000     .000
  16   1    .000      .000     .000     .000
  17   1    .000      .000     .000     .000
  18   1    .000      .000     .000     .000
  19   1    .000      .000     .000     .000
  20   1   2.500     2.500    2.500     .000
  21   4   4.000     2.000    2.500     .500

                                   XIN
           I

           1    .900    .900
           2    .380    .380
           3   1.000   1.000
           4    .000    .000
           5    .700    .700
           6    .030    .030
           7    .000    .000
           8  32.000  33.000
           9  24.000  24.000
          10  10.000  10.000
          11   7.000   7.000
          12  11.000  11.000
          13    .200    .200
          14    .000    .000
          15    .000    .000
          16    .000    .000
          17    .000    .000
          18    .000    .000
          19    .000    .000
          20   2.500   2.500
          21   2.500   2.500
```

the model to rapidly test many possible schemes. It is again emphasized that a simulation model does not of itself produce an optimum solution in terms of management objectives. The technique does, however, facilitate a rapid evaluation of many possible alternatives. An analytical optimizing procedure, used in conjunction with a simulation model, could produce system optimization in terms of a specific objective function.

The ability of the model to predict outflow characteristics under various management conditions is demonstrated for the Evanston subbasin. The predicted total annual outflows under actual conditions for 1954, 1955, and 1956 are given in Appendix C as being 72,183; 92,544; and 150,918 acre-feet, respectively. The computed outflow hydrograph on a mean monthly basis is shown by Figure 5.1. Studies were then conducted to investigate the changes induced in this hydrograph by three entirely different sets of assumed conditions within the subbasin.

Case 1

Conditions were changed in the model to represent the removal of all phreatophytes from the subbasin. In addition, it was assumed that sufficient irrigation water was applied to support potential evapotranspiration rates and to maintain available soil moisture levels at no less than 2.5 inches. Precipitation, temperature, and stream inflow data for the years 1954, 1955, and 1956 were input to the model. The computed outflow hydrograph under these conditions for this three-year period is shown by Figure 5.10. The corresponding predicted total annual outflows from the subbasin are 93,341; 113,227; and 163,983 acre-feet, respectively, as shown in Appendix D, Evanston 1-1. The negative surface outflow quantities in this case indicate diversions of more irrigation water than was available in the river, and are, therefore, an indication of the storage required to satisfy the water requirements during the irrigation season. In the restricted case where irrigation diversions are limited to the water available in the stream, the computed total annual outflows are 111,313; 125,508; and 181,826 acre-feet for 1954, 1955, and 1956, respectively (Appendix D, Evanston 1-2). Corresponding mean monthly discharge values during this three-year period are shown by Figure 5.10. It is interesting to note that total outflow quantities under the

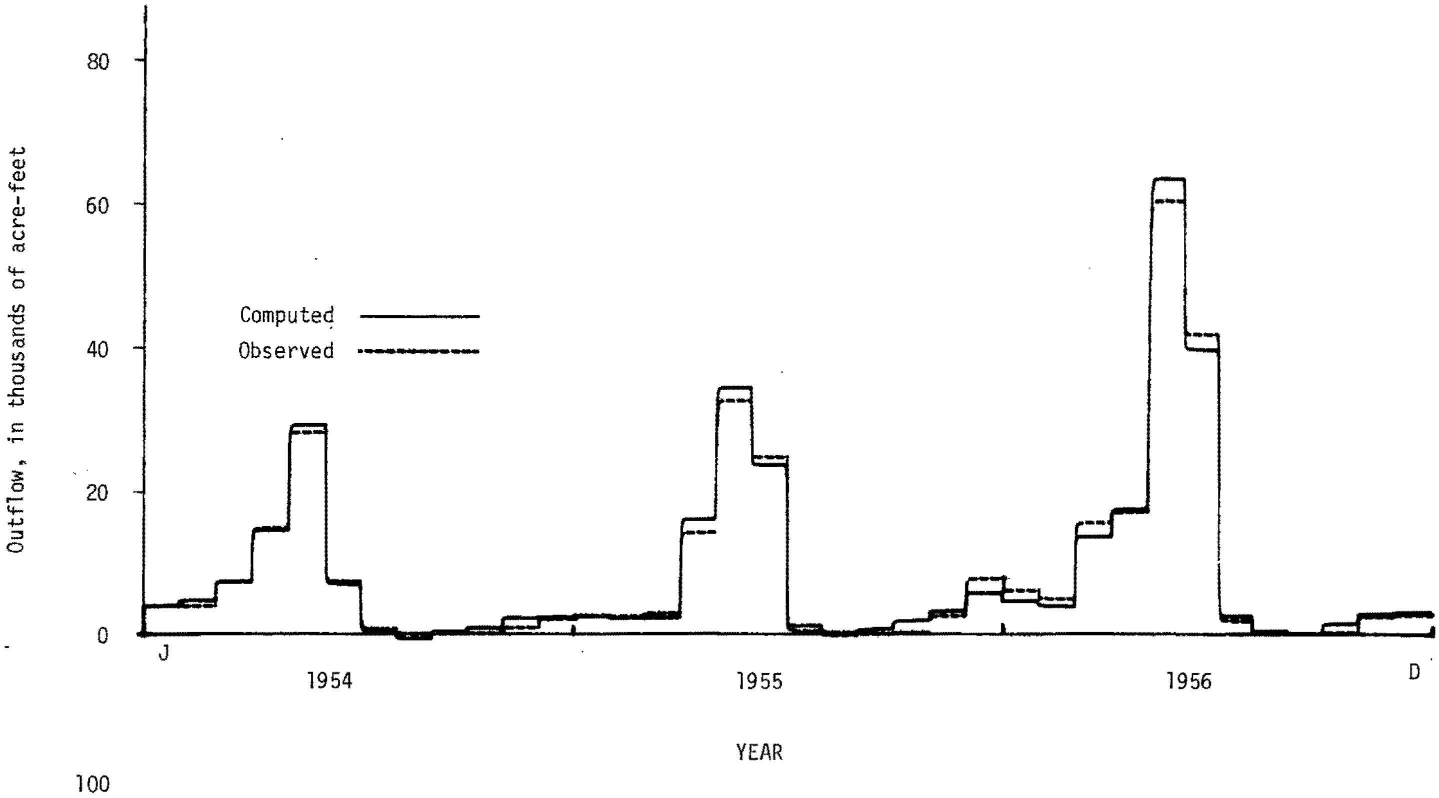


Figure 5.1. Computed and observed monthly outflow from Evanston subbasin 1954, 1955, and 1956.

Figure 5.2. Computed and observed monthly outflow from Randolph subbasin 1954, 1955, and 1956.

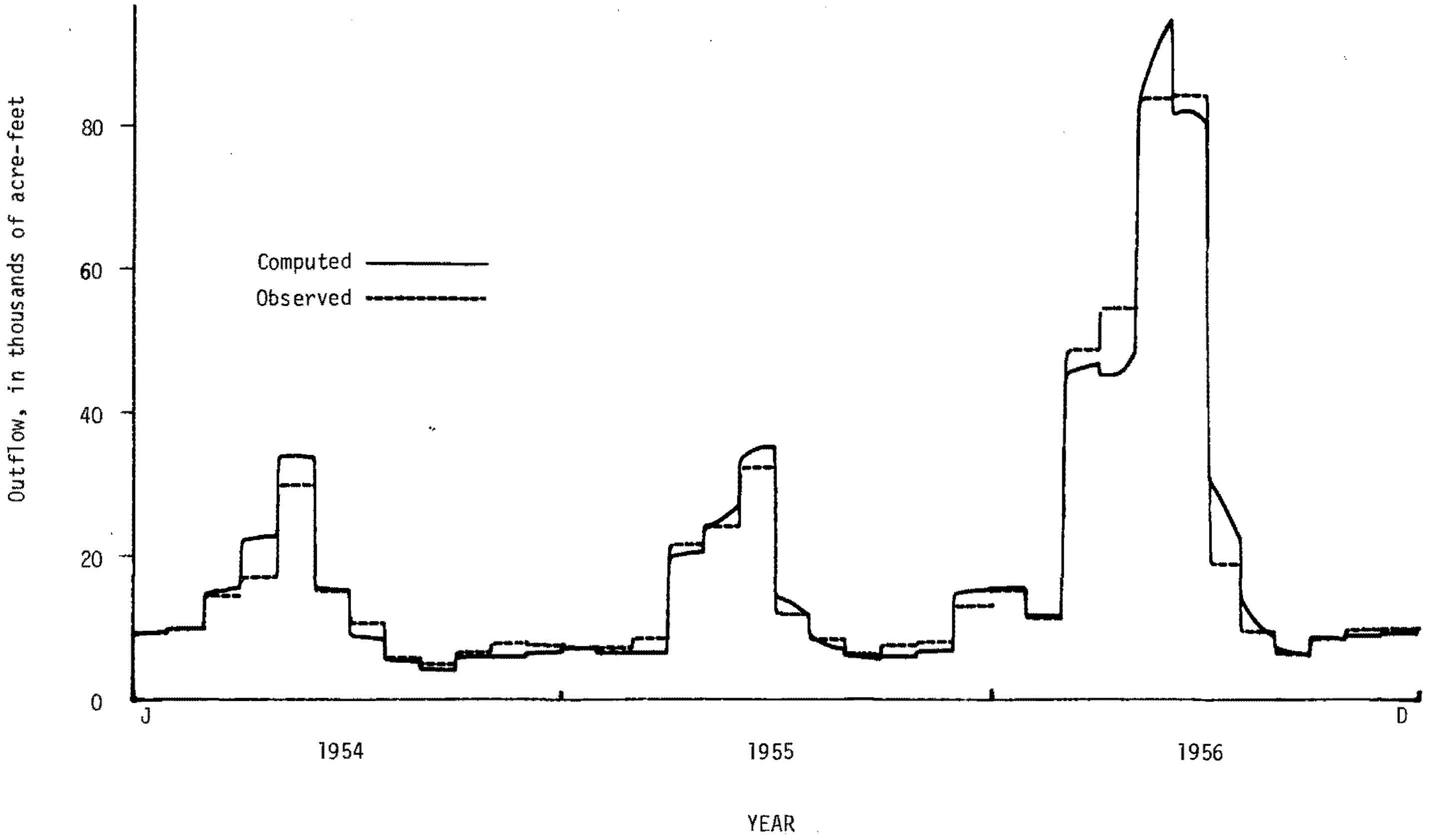


Figure 5.3. Computed and observed monthly outflow from Cokeville subbasin 1954, 1955, and 1956.

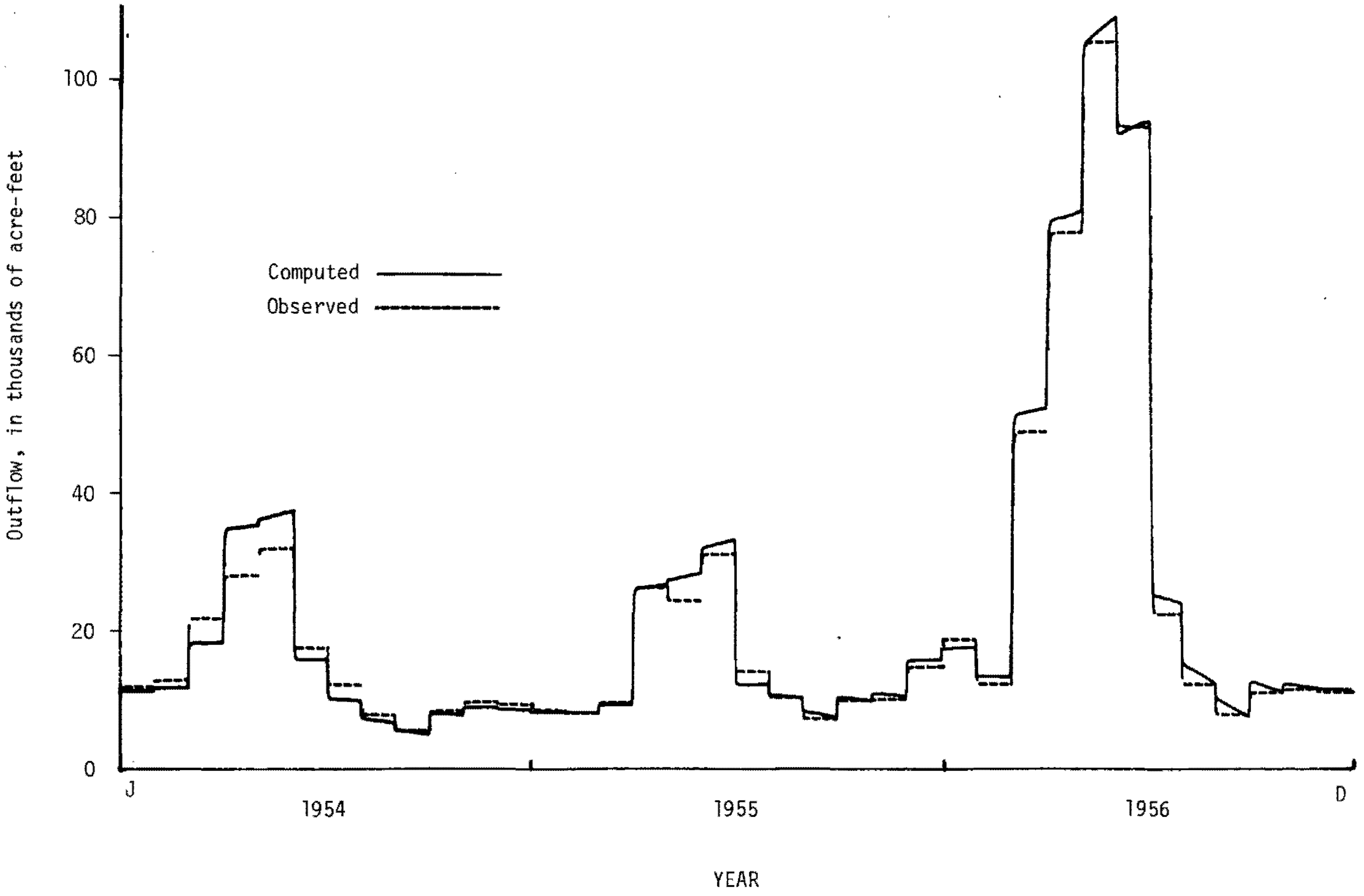


Figure 5.4. Computed and observed monthly outflow from Thomas Fork subbasin 1954, 1955, and 1956.

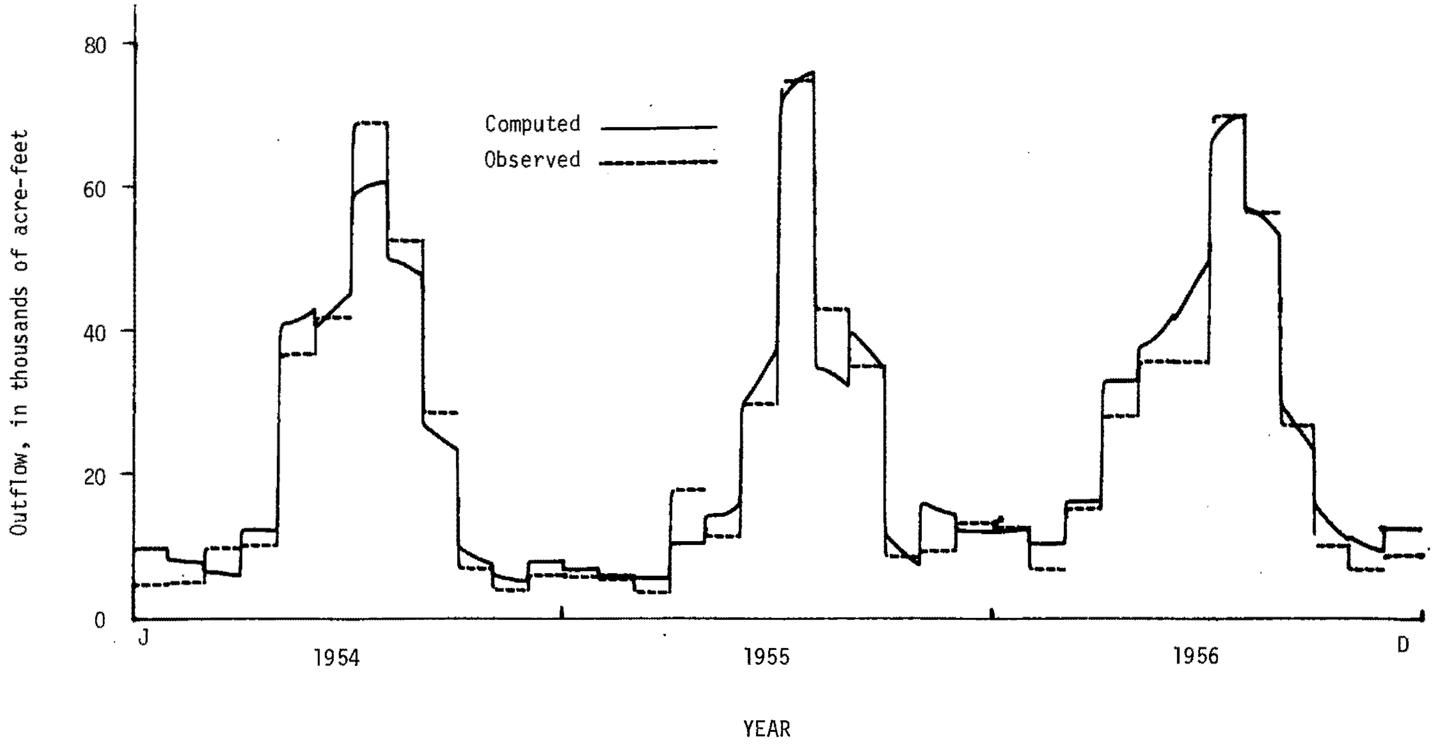


Figure 5.5. Computed and observed monthly outflow from Bear Lake subbasin 1954, 1955, and 1956.

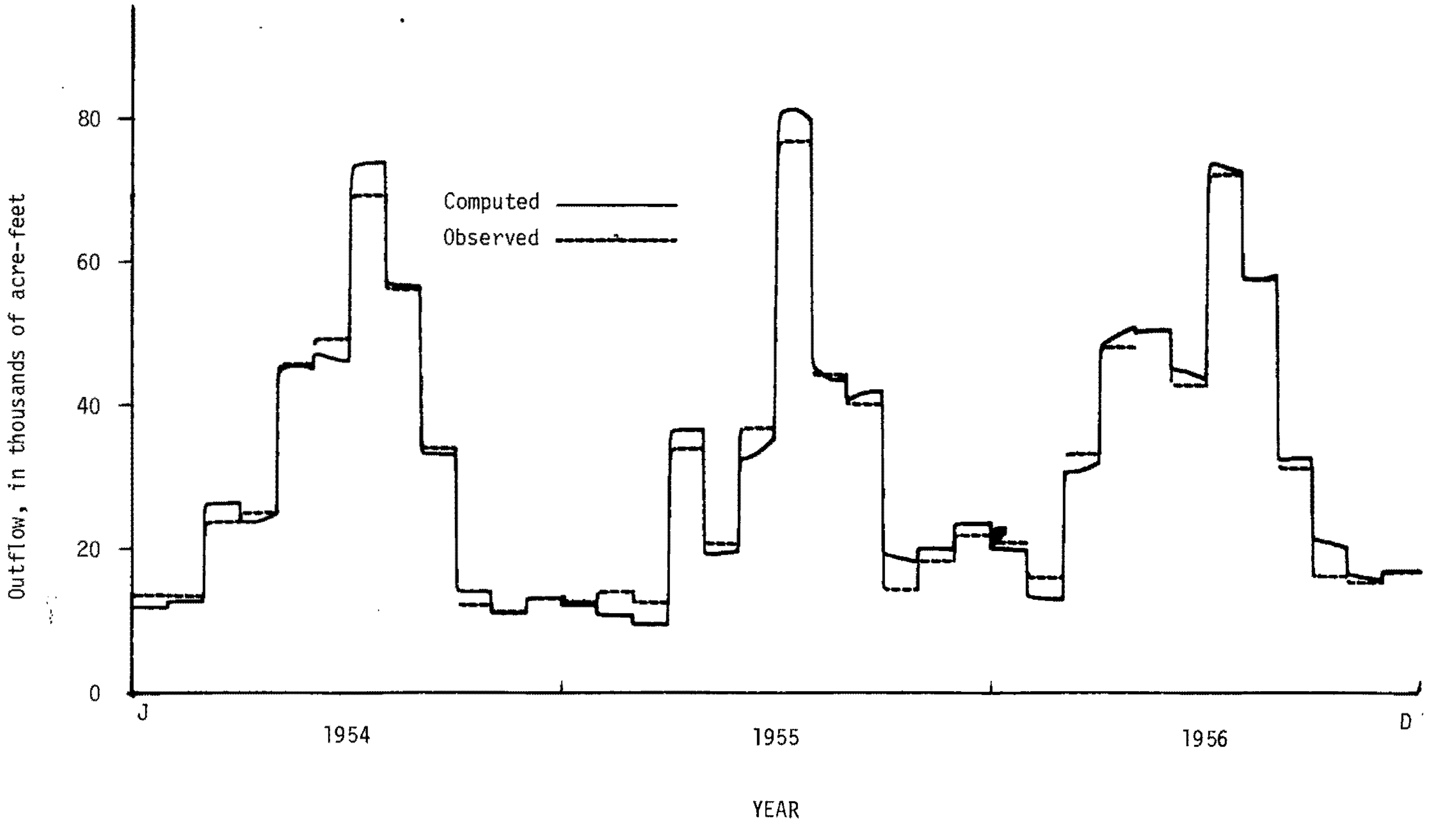


Figure 5.6. Computed and observed monthly outflow from Soda subbasin 1954, 1955, and 1956.

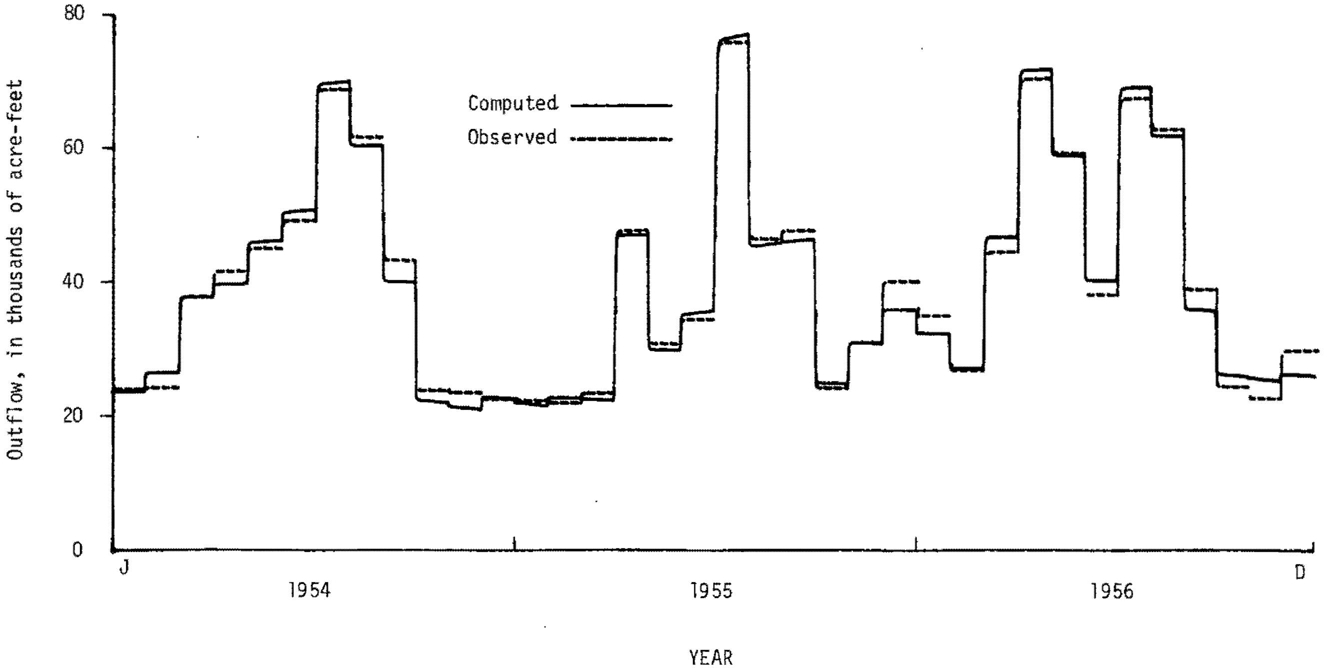


Figure 5.7. Computed and observed monthly outflow from Oneida subbasin 1954, 1955, and 1956.

Figure 5.8. Computed and observed monthly outflow from Cache Valley subbasin 1954, 1955, and 1956.

Figure 5.9. Computed and observed monthly outflow from Tremonton subbasin 1954, 1955, and 1956.

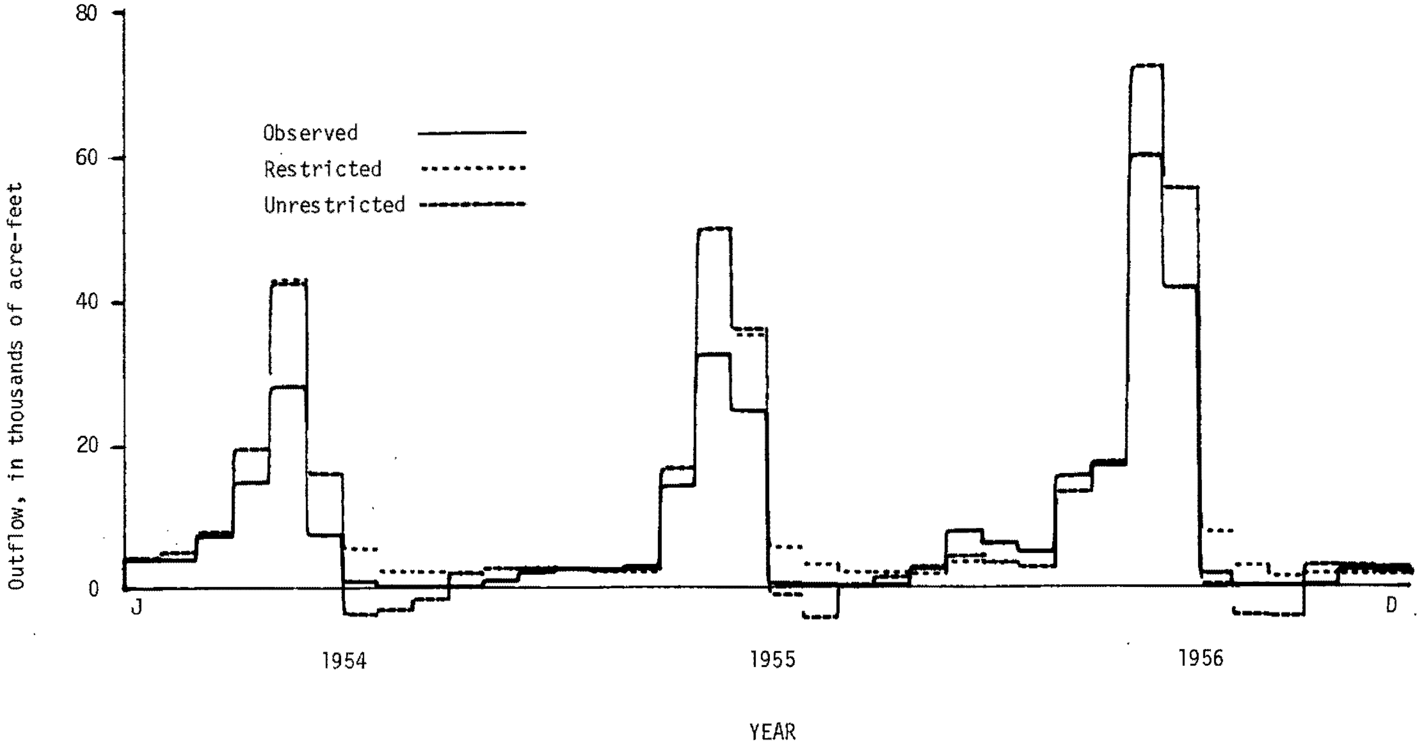


Figure 5.10. Management of Evanston subbasin, Case 1.

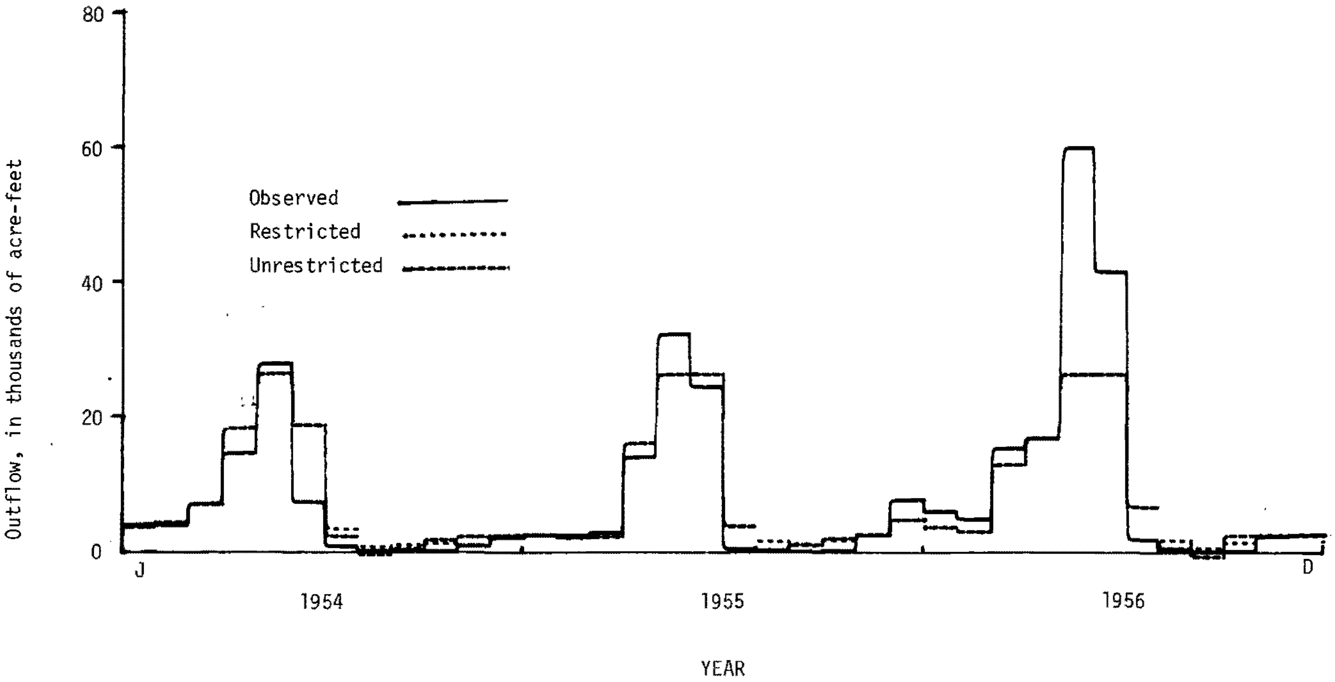


Figure 5.11. Management of Evanston subbasin, Case 2.

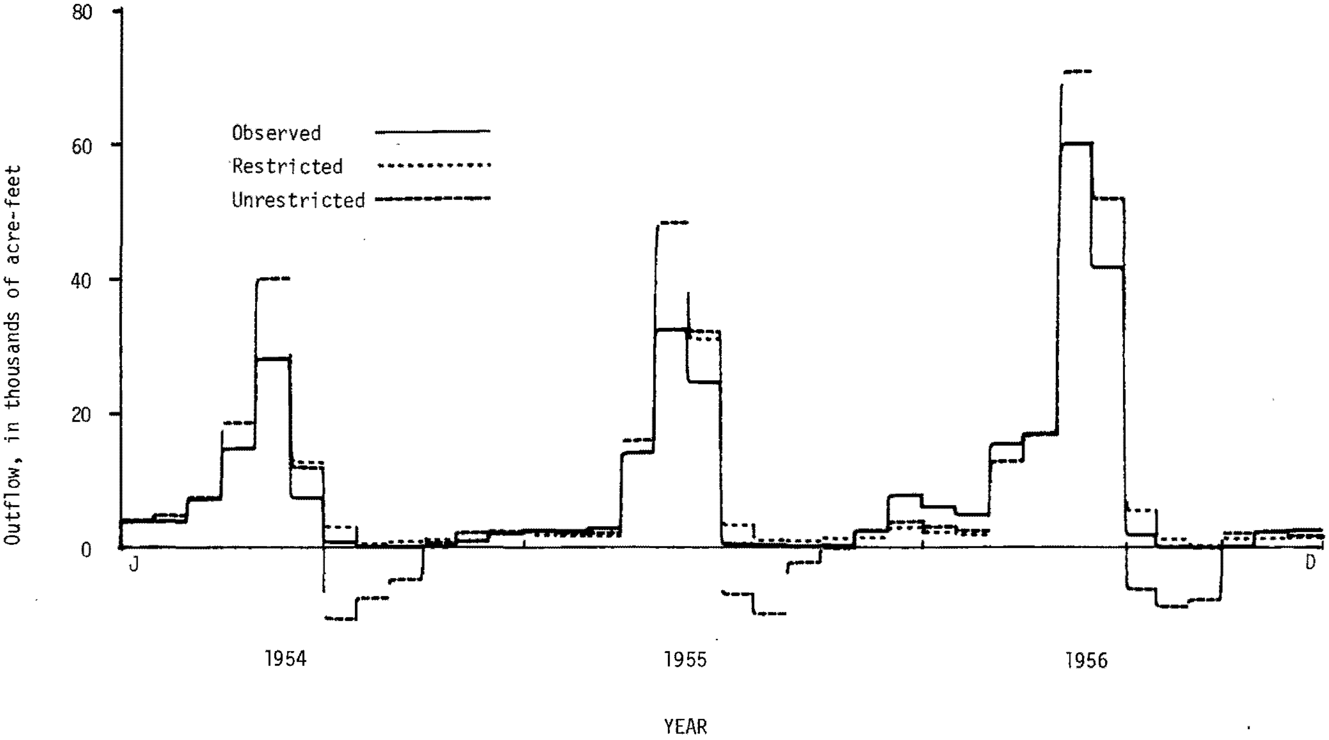


Figure 5.12. Management of Evanston subbasin, Case 3.

restricted water supply case appreciably exceed those of the unrestricted case. Under the conditions of restricted supply, water storage in the plant root zone was considerably reduced, and average evapotranspiration losses were approximately 20 percent below potential.

Cases 2 and 3

Under Case 2 crop acreages within the subbasin were reduced to 25 percent of the present area and phreatophytes were reduced to 75 percent. For Case 3 the cropland was increased to 125 percent of the present area while phreatophyte acreage was held at the present value. For both of these cases the model was operated under the two assumptions of first an unrestricted and then a restricted irrigation water supply. Model output functions for the four conditions described previously are given by Appendix D and Figures 5.11 and 5.12.

For the conditions of unrestricted irrigation water supply, the sum of the negative flows during the irrigation period indicate storage requirements either by reservoir or in soil moisture. The operation of the model with 30 or more years of historical streamflow, precipitation, and temperature data would provide a realistic estimate of reservoir storage requirements to meet crop needs within the subbasin. A study of this nature would also facilitate the establishment and testing of suitable operating rules for any proposed reservoir or system of reservoirs within the subbasin. The effects of water export on reservoir operation could also be predicted.

The testing of various possible management alternatives for each subbasin within the Bear River model could be accomplished in the same manner as has been demonstrated for the Evanston subbasin. Using the model, management effects as reflected in the output functions of a particular subbasin may be traced throughout the entire Bear River basin.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Increasing demands upon the available water resources of the nation have produced a need for the efficient utilization of these supplies. Related to good management practices is the evaluation of various alternatives in terms of their likely downstream effects on both water quantity and quality. Quantitative evaluation of these downstream consequences is difficult because of the complex and variable nature of the parameters which describe a hydrologic system. However, the advent of modern high-speed computers has made possible the application of simulation techniques to complex systems of this nature.

In this report, a general hydrologic model is proposed and is synthesized on a hybrid computer. The basis of the model is a fundamental and logical mathematical representation of the various hydrologic processes. Spatial definition is achieved by dividing the modeled area into specific space increments, or subbasins, for which average values of space variable model parameters are applied. Temporal resolution is obtained by selecting a specific time increment over which average values of time varying parameters are used. The ultimate in modeling would utilize continuous time and space definition. However, the practical limitations of this approach are obvious. The complexity of a model designed to represent a hydrologic system largely depends upon the magnitude of the time and spatial increments used in the model. In model development it is, therefore, necessary to select increments which are consistent with time, budget, and computer capability constraints, and at the same time provide sufficient resolution to consider the kinds of questions which might be asked of the model.

Computer simulation of hydrologic systems has many practical applications in the areas of both research and project planning and management. As a research tool the computer is valuable in the process of investigating and improving mathematical relationships. In this respect, the computer is applied not only for its calculating potential, but also for its ability to yield optimum solutions. Simulation is also ideal for investigations of hydrologic sensitivity. Problems range from the influence of a single factor upon a particular process to the effects of an entire process, such as evapotranspiration, upon the system as a whole.

In many ways computer simulation can assist in planning and development work. Models can provide the designer with runoff estimates from the input of recorded precipitation data. In addition, simulated streamflow records from statistically generated input information enable the establishment of synthetic flow frequency distribution patterns.

In the area of water resource management, computer simulation permits the rapid evaluation of the effects of various management alternatives upon the entire system. These alternatives might involve such variables as watershed treatment, including urbanization, the construction of storage reservoirs, and changes in irrigation practices within a basin.

In this study the computer model was applied to the hydrologic system of the Bear River basin of western Wyoming, southern Idaho, and northern Utah. To provide spatial resolution the basin was divided into 10 subareas or subbasins, and each was modeled separately. The submodels then were linked into a single model of the entire basin. The time increment selected for the model was one month, and time varying quantities, therefore, were expressed in terms of mean monthly values. The model was calibrated for the Bear River hydrologic system by adjusting model parameters until close agreement was achieved between simulated and corresponding gaged outflow hydrographs for each subbasin. Data for one subbasin was inadequate for satisfactory model calibration. The calibration procedure was incorporated into the hybrid computer program of the model so that this process was implemented largely by the computer itself. Differences between observed and computed hydrographs were evaluated on the basis of the sums-of-squares. This technique of model verification is accomplished more quickly and is more objective than was the case with the manual procedure used for previous studies of this nature. The agreement achieved between observed and computed outflow hydrographs from each subbasin in the model is illustrated by Figures 5.1 to 5.9, inclusive.

The utility of the model for predicting the effects of various possible water resource management alternatives within the Bear River basin was demonstrated for the number 1 or Evanston subbasin. For example, on the assumption that all phreatophytes were eliminated from this subbasin the model predicted that the average annual discharge would be approximately 139,500 acre-feet. This figure may then be compared with the average annual discharge of 107,500 acre-feet under present conditions. Similarly, to meet the annual consumptive use demands of the existing crops within the subbasin during the dry year of 1954 would require an estimated 8,660 acre-feet of reservoir storage. These and other management studies are illustrated by Figures 5.10, 5.11, and 5.12.

Because of its fast turn-around and graphical display capabilities and its ability to solve differential equations, the hybrid computer is very efficient for model development and verification. However, for operational studies many models, once verified, can be readily programmed for solution on the more common all-digital computer. The analog component of the Bear River model developed under this study, for example, now could be reprogrammed for general application of the entire model on a digital computer.

In conclusion, it is again emphasized that a model is limited by the availability of the field data used in the verification process. As further data become available, the model can be improved in terms of both the accuracy with which it defines individual processes and its time and spatial resolution. Modeling is, therefore, a continuous process, with each phase providing further insight and understanding of the system, and thus leading towards additional refinement and improvement of the model.

For each simulation study certain constraints or boundary conditions limit the degree of achievement during any particular phase of the overall program. The most important of these limiting features are the extent to which research information and basic input data are available, the degree of accuracy established by the time and spatial increments adopted for the model, equipment limitations, and the necessary time limit imposed upon the investigation period.

The model presented by this report represents a particular phase in the development of a simulation model of the hydrologic system of the Bear River basin. Further development of the model will continue and other related dimensions, such as water quality and economics, will be added. However, the model is now capable of answering many questions pertaining to the management of the water resources of the basin. The study has demonstrated the soundness and validity of the computer simulation approach to hydrologic problems within the Bear River basin, and has provided a firm basis for extending the model to include additional dimensions encountered in the comprehensive planning and management of water resource systems.

BIBLIOGRAPHY

Blaney, Harry F., and Wayne D. Criddle. 1950. Determining water requirements in irrigated areas from climatological and irrigation data. Technical Paper 96, Soil Conservation Service. U.S. Department of Agriculture. February. 48 p.

Chow, Ven Te. 1964. Handbook of applied hydrology. McGraw-Hill Book Company, Inc., New York. 1453 p.

Gardner, W. R., and C. F. Ehlig. 1963. The influence of soil water on transpiration by plants. Journal of Geophysical Research 68(20):5719-5724.

Linsley, Ray K., Jr., Max A. Kohler, and Joseph L. H. Paulhus. 1958. Hydrology for engineers. McGraw-Hill Book Company, Inc., New York. 340 p.

McCullock, Allan W., Jack Keller, Roger M. Sherman, and Robert C. Mueller. 1967. Ames Irrigation Handbook, W. R. Ames Company, Milipitas, California.

Phelan, John T. 1962. Estimating monthly "k" values for the Blaney-Criddle formula. Presented at the Agriculture Research Service-Soil Conservation Service Workshop on Consumptive Use, Phoenix, Arizona. March 6-8. 11 p.

Riley, J. Paul, D. G. Chadwick, and J. M. Bagley. 1966. Application of electronic analog computer to solution of hydrologic and river-basin-planning problems: Utah Simulation Model II. Utah Water Research Laboratory, Utah State University, Logan, Utah.

Riley, J. Paul, J. M. Bagley, D. G. Chadwick, and E. K. Israelsen. 1967. The development of an electronic analog device for hydrologic investigations and conservation planning in the Sevier River Basin: Utah Simulation Model I. Utah Water Research Laboratory, Utah State University, Logan, Utah.

Riley, J. Paul, and D. G. Chadwick. 1967. Application of an electronic analog computer to the problems of river basin hydrology. Utah Water Research Laboratory, Utah State University, Logan, Utah. December.

Soil Conservation Service. Department of Agriculture. 1964. Irrigation water requirements. Technical Release No. 21, Washington, D. C. April. 61 p.

Thorne, D. W., and H. W. Peterson. 1954. Irrigated soils. McGraw-Hill Book Company, Inc. New York. 392 p.

U.S. Army, Corps of Engineers. 1956. Snow hydrology; summary report of snow investigations. North Pacific Division, Portland, Oregon. 437 p.

U.S. Bureau of Reclamation, Department of Interior. 1970. Bear River Investigations. Status Report, Salt Lake City, Utah. June.

West, A. J. 1959. Snow evaporation and condensation. Proceedings of the Western Snow Conference, Cheyenne, Wyoming. pp. 66-74.

Willardson, Lyman S., and Wendall L. Pope. 1963. Separation of evapotranspiration and deep percolation. Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers 89(IR3):77-88.

APPENDIX A

SUBBASIN INPUT DATA

```
 EVANSTON
 1 EVANS 7  1    2599  2   6623  3  19635  4     314
 1 EVANS 7
 1 EVANS 6  1     632  2    609  3   3523  4     261  5   2434
    90    36   100    00    70     79    00  3200  2400   159  2000   200
  1000   700  1100    20    00     00    00    00    00    00   250   250
     1     1     1     2     2      5
(10X12F4.1)
1TR        4 221 242 247 406 497 546 652 593 537 438 344 174
1TR        5 122 147 203 342 473 549 621 630 521 420 229 204
1TR        6 202 107 252 355 483 589 626 569 531 397 223 166
(10X12F4.2)
1A         4  69  34  75  14  76 143 111 160  70  69 142  73
1A         5  67  81  49  19 129 115 137 115 128  40  62 180
1A         6 121  35   7  39 232  67  71  36   2  94  14  83
(10X12F5.0)
 1 1954  5  492  555  881 2970 1430 2040  202   77   53   70  170  160
 1 1955  5  165  147  194 3870 2070 1860  163  103   52   75  222 1080
 1 1956  5  645  488 2560 2170 3720  652  266  216   43   68  101  145
(6X12F6.0)
1-4   54     0     0     0 10524 36633 34202 11129  3394  2500  2631     0     0
1-4   55     0     0     0     0 36964 41595 11260  5551  2789  2631     0     0
1-4   56     0     0     0     0 21047 44726 17154  5157  2157  3167     0     0
1-4   54
1-4   55
1-4   56
(8X12F6.0)
  020554  4000  3670  4960 12520 24520  5380   654    38     0    63   423  1800
  020555  2640  2400  1560  9510 28740 20530   424   136     0   214  2010  7600
  020656  5980  4830 14500 14880 57090 37330  1310    57     0     9  1360  2750
  019554     0    20  2350  2200  3450  1670   112     0     0   110   603   392
  019555     0     0  1380  4660  3670  3640    23    80     2   102   599     8
  019556     0     0   984  2050  3040  4050   531     0     0   242  1120     0
(8X12F6.0)
  010554     0     0     0    54  1090  1010  1260   562   545   427    90     0
  010555     0     0     0     0   333  1360  1210   494   778   718     0     0
  010556     0     0     0     0     0  1520  1650  1060   535   530     0     0
  011554  2340  2220  2500  7660 34160 15670  6120  2300  2200  1970  1930  2030
  011555  1950  1720  1900  3360 37470 33100  6740  3870  2010  2010  2050  2430
  011556  2150  1830  2370  6900 52640 50910  9460  2750  1420  2080  2200  2190
  012054   492   500   536  2250  6110  1540   431   238   293   354   386   341
  012055   328   305   367   802  6960  3490   557   460   314   404   458   641
  012056   500   430   652  2650 10780  4960   627   410   272   407   449   440
  016054   492   555   881  2970  1430  2040   202    77    53    70   173   158
  016055   165   147   194  3870  2070  1880   163   103    52    75   222  1080
  016056   645   488  2560  2170  3720   652   266   216    43    68   101   145
  017054     0    26   181   758   533    80     0     0     0     0     0     0
  017055     0     0     0   743  1400   233     5     6     0     0     0   231
  017056   123    86   548  1320  2420   270     0     0     0     0     0     0
```

```
RANDOLPH                                                    1
 2 RANDH 7  1    1916  2   5518  3  40025  4    1213
 2 RANDH 7
 2 RANDH 8  1     884  2   2145  3    765  4     608  5   2073
   130    45   100    00    50     02    00  3200  2650   188  2000   200
  1000   140  1400    00    00   4000   100    00    20    30   250   200
     1     1     1     2     1      6
       1.0         1         1.0         1.0.000246548.000246548
(10X12F4.1)
2WTR       4 218 199 276 418 500 547 646 590 528 426 347 131
2WTR       5  78 115 197 350 476 544 621 628 522 428 257 264
2WTR       6 193 106 275 396 505 562 640 571 525 423 249 170
(10X12F4.2)
2A         4  93  47 102  19 105 194 150 217  95 121 192  99
2A         5  78 110  67  26 175 157 186 157 174  54 112 245
2A         8 164  48   9  53 314  92  96  51   3 127  19 113
(10X12F5.2)
 2 1954  5  585  571  702  843 1250  976  742  559  489  464  429  411
 2 1955  5  390  330  395  446 1410  960  657  542  447  443  436  636
 2 1956  5  567  467  843 2010 2920 1980 1550 1220 1010  966  757  660
(10X12F5.2)
 2       4                          85  359  105  048  038
 2       5                        1165 1160  110  052  032
 2       6                        1458 1205  154  045  052
 2       4                   200 1465
 2       5                   500  835       240
 2       6                   300  142       446
(8X12F6.0)
  026554  4890  5670 10300  8430  3290  2100   610   480   396   626   689  1820
  026555  2480  2280  2000  8300  4430  9310  1790  1850   764   447  1540  7600
  026556  9400  6170 30010 17070 40530 31890  2760  1440   531   849  2460  3420
(8X12F6.0)
  024054   299   265   340   151   304   216   179   241   214   154   220   308
  024055   290   253   280   258   257   204   234   192   173   114   284   318
  024056   287   258   474   217   289   245   249   198   184   120   220   300
  023054   585   571   702   843  1250   976   742   559   489   464   429   411
  023055   390   330   395   446  1410   960   657   542   447   443   436   636
  023056   567   467   843  2010  2920  1980  1550  1220  1010   966   757   660
  021554    26    19    38   182   231   304  1170   369     0     0    22    12
  021555    12    17    25   126   557   248  1430   884    32    32    23    57
  021556    70    58   146   542  2220   868  1580   824     6     6    24    15
  021054   552   585   937  2560  4490  1220   697   515   474   760   604   534
  021055   457   443   531  1630  7520  2840   914   638   571   622   622  1680
  021056   988   764  1550  4860 11460  2790  1040   688   630   908   621   573
  019554     0    20  2350  2200  3450  1870   112     0     0   110   603   392
  019555     0     0  1380  4660  3670  3840    23    80     2   102   599     8
  019556     0     0   984  2050  3040  4050   531     0     0   242  1120     0
  020554  4000  3870  4960 12520 24520  5380   654    38     0    63   423  1800
  020555  2640  2400  1580  9510 28740 20530   424   136     0   214  2010  7800
  020556  5980  4830 14500 14880 57090 37330  1310    57     0     9  1360  2750
```

```
COKEVILLE                                                       1
 3 COKEV 7  1     577  2   9076  3  16982  4     510
 3 COKEV 7
 3 COKEV 6  2      66  3   1344  4     15  5     603
    40    35   100    00    25     05    00  3300  2500   156  2100
  2000   100  1100    20    00   2200   600    06    06    07   250   500
     2     1     1     2     1      3     1
         5         1           1           1  .000411734.000411734.000411734
(10X12F4.1)
3WTR       4 218 199 276 418 500 547 646 590 528 426 347 131
3WTR       5  76 115 197 350 476 544 621 628 522 428 257 264
3WTR       6 193 106 275 396 505 562 640 571 525 423 249 170
3BRTR      4 171 170 226 394 486 532 643 564 520 408 330 117
3BRTR      5  61  87 168 321 467 533 610 610 508 420 231 204
3BRTR      6 174 162 213 373 502 570 637 593 541 420 245 129
(10X12F4.2)
3A         4 225  28 108  28  48 135  45 133  34  67 115  99
3A         5  97 157  31  79 181 169  61 218 142  67 184 201
3A         6 144  91  33  79 247 115  97  42  10  52  24 203
(10X12F5.2)
3          4  329  384  589 1270  491  411  250  168  167  241  368  254
3          5  267  253  335 2350 1370 1290  420  276  192  273  396 1320
3          6  746  469 6190 2450 2140  780  396  295  197  403  374  371
(10X12F5.2)
 3         4                           1429  976  674  533
 3         5                       805 1077 1057  664  352
 3         8                      1662 2094 1037  765  564
3          4                       500
3          5
3          6
(10X12F5.0)
3          4 9250 984314466170772991014950104l0 5610 4760 6570 7790 7410
3          5 7090 7130 6480215602402032290116800 8090 6150 7600 805012980
3          615210111604871054570640008448018740 9330 6180 8540 9750 9790
(6X12F6.0)
  032054  3700  3400  3620  8360 34930 24590 16073 10489  8036  5090  4250  3970
  032055  3730  3050  3250  5000 24247 29141 15865  9970  7345  4810  4260  4830
  032056  4330  3670  4100 19440 52471 51579 20652 11018  8605  5760  4800  4410
  027054   329   384   589  1270   491   411   250   168   167   241   368   254
  027055   267   253   335  2350  1370  1290   420   276   192   273   396  1320
  027056   746   469  6190  2450  2140   760   396   295   197   403   374   371
  026554  4890  5670 10300  8430  3290  2100   610   480   396   628   889  1820
  026555  2460  2280  2000  8300  4430  9310  1790  1850   764   447  1540  7600
  026556  9400  6170 30010 17070 40530 31890  2760  1440   531   849  2460  3420
(10X12F5.0)
3GI       54 1228 1149 3287 3367 1069  654                436  753 1188
3GI       55  891 1208  911 2931 1069 2179 1069 1129      337  970 2238
3GI       56 1683 1406 5505 463410001 7327 1624 1307      753  990 1010
```

```
THOMAS FORK                                                    1
 4 THFRK 7  1     425  2   7435  3  13064  4     319
 4 THFRK 7
 4 THFRK 8  1     291  2    720  3    199  5     924
    60    35   100    00    20     01    00  3200  2150   243  2400   250
  2000   300   800    00    50     00    00    00    00    00   250   300
     1     1     1     2     1      2     1
     1         1           1           1  .000564892.000564892.000564892
(10X12F4.1)
4BRTR      4 171 170 226 394 468 532 643 584 520 408 330 117
4BRTR      5  61  87 168 321 467 533 610 619 508 409 231 204
4BRTR      6 174 162 213 373 502 570 637 593 541 427 245 129
(10X12F4.2)
 4     PR54 194  90 384  29  93 241  36  76 172 153  88 184
 4     PR55 182 248 136 116  95 308 199 202 246 189 270 542
 4     PR56 301 201  63 168 187 129  92   8   8  99  48 260
(10X12F5.2)
 4 1954  5  720  720  850 2320 2930 2090 1220  800  770  770  720  580
 4 1955  5  570  550  540 1390 2350 3370 1550  930  710  750  770  970
 4 1956  5  95   68   91  642  818  455  205  121   98   97   85   86
(10X12F5.2)
 4       4                             670  540  116  168
 4       5                        286 1061  612  181  228
 4       6                        338  976  653  204  223
4        4                        300
4        5
4        6                                  200  400  200
(8X12F6.0)
  044054 12130 13120 22110 26290 32260 17610 12260  7950  5730  8690  9990  9440
  044055  8620  8160  9930 26550 24500 31420 14160 10450  7350 10290 10370 15000
  044056 19000 12420 49230 78310106000 93650 22610 12450  8000 11390 11810 11210
(8X12F6.0)
  041054   776   716   889  4270  7100  2810  1350   704   520   601   602   642
  041055   560   500   559  1610  4420  4617  1700   883   636   704   807  1800
  041056  1150   855  1470 17930 19130  5970  2470  1450  1110  1110   899   897
  038054  9780 10390 15160 26120 29910 14950 10410  5610  4760  6570  7790  7410
  038055  7090  7130  8480 21560 24020 32290 11680  8090  6150  7600  8050 12980
  038056 15210 11160 48710 54570 84000 84480 18740  9330  6180  8540  9750  9790
(10X12F5.0)
4GI       54  735  809 1332 2005 2938 1357  672  435  324  510  520  522
4GI       55  572  510  535 1805 2204 3000 1083  610  473  510  560 1319
4GI       56 1407  909 4009 4009 5765 5280 2365  859  523  672  722  722
```

* See Appendix B for an explanation of the variables.

```
BEAR LAKE                                                     1
 5 BRLKE 7  1   8959  2  12347  3  20121  4  10098  5     42 11      46
 5 BRLKE 7
 5 BRLKE 6  1  21283  2   7307  3   3100  4   2636  5   8030
   20    40   100    00    20    24    03  3500  3100   155  2000   100
  1000   250   600    40    00    00    00    00    00    00   250   350
    3     1     1     2     1     4     1
.333333333       100       100       100.000232498.000232498       100       100
(10X12F4.1)
  MONTTR54 235 235 277 426 516 548 676 626 551 438 360 174 422
  MONTTR55 138 124 192 331 495 555 639 661 552 442 264 241
  MONTTR56 230 115 257 406 516 590 661 621 567 439 263 193
  LIFTTR54 139 250 279 431 529 568 686 624 560 437 365 194
  LIFTTR55 136 125 199 333 495 576 653 661 543 442 232 253
  LIFTTR56 229 120 267 409 529 604 661 622 550 435 270 203
  LAKETR54 277 276 310 452 520 548 670 624 559 445 370 216
  LAKETR55 178 147 216 349 494 552 632 640 543 444 301 303
  LAKETR56 261 167 293 420 515 561 647 607 561 447 288 239
(10X12F4.2)
 5     PR54 223  52 170  36 148 190  47  55 116 164 137 181
 5     PR55 104 185  99 140 149 154  94 208 241  73 175 397
 5     PR56 200  62  23  69 311  82  58  62  22 115  16 180
(8X12F6.3)
  LOGR54   6830   5760   6800 12530 28260 17430 12140   8800   7090   6640   6000   5460
  LOGR55   5320   4610   5090  8040 29680 28500 15090 10220   7780   7370   6490   6660
  LOGR56   8010   6300   8200 22630 49230 41860 18920 12560   9620   8870   7640   7130
(10X12F5.2)
 5       4                              361   401   261   160   135
 5       5                              295   574   291   122   136
 5       6                              496   816   402   190   205
  BRLKCN54                             1200   400
  BRLKCN55                             1400   700   150          100
  BRLKCN56                             1100  1000   300   200   100   100
(8X12F6.0)
  PESC54   4840   5160   9950 10370 36940 41940 69190 52610 28620   7009   3989   6191
  PESC55   5823   5436   3600 18046 11429 30318 75045 42977 35064   8643   9554 13363
  PESC56  12652   6856 15459 28261 35872 35643 70171 56506 26899 10121   6893   8897
(8X12F6.0)
  HARE54 12130 13120 22110 26290 32260 17610 12260   7950   5730   8690   9990   9440
  HARE55   8620   8180   9930 26550 24500 31420 14160 10450   7350 10290 10370 15000
  HARE56 19000 12420 49230 78310106000 93650 22610 12450   8000 11390 11810 11210
  MONT54    443    398    513   1380   1800   1250    752    492    460    471    429    358
  MONT55    350    305    332    825   1450   2010    956    573    425    461    456    596
  MONT56    582    391    559   3820   5030   2710   1260    745    580    598    504    529
  046054- 9550-10450-20520-26010-11510-  768- 2160- 2190-  732- 4710- 7930- 5370
  046055- 6020- 6130- 7540-22980-11770- 7390- 2680- 5570- 1650- 7630- 6630-10480
  046056-13620- 8320-39340-74140-85450-67020-10650- 7130-  935- 5180- 8380- 7350
  059554     71     56     61     60 32540 35840 65770 53300 26120   3730    714    155
  059555    123    111    123    119   9990 14780 70520 34440 34070   3340   6590    841
  059556    762    805    881   3190   4570 18740 82860 51790 20880   3230    825   3420
(10X12F5.2)
```

```
   SODA                                                       1
 6 SODA  7  1   2677  2   3703  3   6098  4   3022
 6 SODA  7
 6 SODA  8  1    848  3   2886  5   1890
   20    35   100    00   230    31    00  3600  2400    92  2500   240
  1000   100   600    00    00    00    00    00    00    00   250   300
    2     1     1     1     1     1     1
     .50       100       100       100 .8899      .8899          100
(10X12F4.1)
  MONTTR54 235 235 277 426 515 548 676 626 551 438 360 174
  MONTTR55 138 124 192 331 495 555 639 661 552 442 264 241
  MONTTR56 230 115 257 406 516 590 661 621 567 439 263 193
  GRACTR54 151 261 288 444 521 543 672 627 566 447 388 213
  GRACTR55 138 154 234 364 491 553 645 655 552 460 286 255
  GRACTR56 148 146 279 417 520 590 659 615 566 441 273 201
(10X12F4.2)
 6     PR54 172 104 263 132 164 294  73 165 181  60 176  34
 6     PR55  87  93  95 191 281 425  59 256 184 195 158 380
 6     PR56 210  84  23  93 290  73  55  16  38 147  32 133
(10X12F5.2)
  GEOR   54 1530 1330 1490 1470 1880 1910 1910 1830 1680 1640 1550 1510
  GEOR   55 1350 1160 1300 1280 1540 2040 2060 1890 1720 1720 1490 1620
  GEOR   56 1450 1320 1420 1680 3290 2970 2390 2130 2020 1900 1700 1650
(10X12F5.2)
 6 1954   4     0     0     0     0  200  700  300  500  400     0     0     0
 6 1955   4     0     0     0     0     0 1300 1100 1400  400     0     0     0
 6 1956   4     0     0     0     0 1000 1600 1600 1700 1000     0     0     0
(10X12F5.2)
 6 1954   6 1217 1200 2107 2216 4023 4325 6085 4930 2988 1089 1005 1181
 6 1955   6 1128 1259 1117 2998 1830 3245 6754 3880 3531 1276 1632 1943
 6 1956   6 1840 1424 2933 4230 4434 3749 6337 5048 2748 1437 1362 1493
(10X12F5.2)
 6 1954   3  554  584  994 1030 3376 3813 6183 4734 2535  752  482  670
 6 1955   3  624  574  426 1681 1128 2788 6705 3901 3199  991  996 1303
 6 1956   3 1226  711 1468 2604 3405 3358 6310 5099 2515 1094  765  939
(10X12F5.2)
```

* See Appendix B for an explanation of the variables.

```
   ONEIDA                                                     1
 7 ONEID 7  1  11873  2   5381  3   2367  4   7927  5     36  6   1471  7   1363
 7 ONEID 7 11    466
 7 ONEID 8  1    597  3   1233  5   1005
   40    60   100    00    50    02    00  3200  2200    78  2000   200
  1000   450   700    50   300    00    00    00    00    00   250   500
    1     1     1     1     1     1     1
      1       100         1         1  .38713    .38713          1
(10X12F4.1)
  GRACTR54 151 281 288 444 521 543 672 627 566 447 388 213
  GRACTR55 138 154 234 364 491 553 645 655 552 460 286 255
  GRACTR56 148 146 279 417 520 590 659 616 566 441 273 201
(10X12F4.2)
 7     PR54 146  89 223 112 139 250  62 140 154  51 149  29
 7     PR55  73  79  80 162 238 360  50 217 158 166 134 322
 7     PR56 178  71  23  79 246  62  47  14  33 125  27 113
(10X12F5.2)
  COTTON54  612  576 1160 3930 1160  469  171  148  158  260  371  332
  COTTON55  376  353  473 2360 4210 2020  326  314  182  185  363 1090
  COTTON56 1070  817 2840 9100 4270  637  297  295  127  387  451  507
(10X12F5.2)
 7 1954   4     0     0     0     0  640  510  530  330  240     0     0     0
 7 1955   4     0     0     0     0  260  750  550  490  260     0     0     0
 7 1956   4     0     0     0     0  470  800  800  480  310     0     0     0
(10X12F5.2)
 7 1954   6 2420 2440 3804 4180 4520 4940 6910 6190 4340 2390 2360 2260
 7 1955   6 2240 2210 2370 4800 3090 3470 7630 4650 4800 2430 3130 4030
 7 1956   6 3510 2700 4480 7090 5950 3820 6790 6310 3910 2450 2270 3000
(10X12F5.2)
 7 1954   3 1467 1443 2547 2952 4761 5040 7040 5710 3470 1280 1200 1400
 7 1955   3 1340 1490 1340 3700 2540 3950 7830 4510 4100 1490 1920 2250
 7 1956   3 2230 1730 3210 5800 5550 4390 7340 6060 3180 1700 1620 1770
(10X12F4.2)
  GRWATR54 300 300 300 300 320 300 300 300 300 300 300 300
  GRWATR55 300 300 300 300 300 300 300 300 300 300 320 300
  GRWATR56 300 300 300 300 300 300 300 300 300 300 300 300
```

```
  CACHE VALLEY                                                1
8 CACHE 7  1  52429  2  27563  3   6058  4  50020  5   9469  6   4827  7    289
8 CACHE 7  8    392 10      3 11    683 13    275
8 CACHE 8  1   7515  2  15863  3  15771  4   5776  5   7775
   20    50   100    00    80    17    00  3100  2500   116  1000   200
  1000   350   700    00    00    43    00    00    00    00   250   300
    5     1     1     1     3     4     1
     20       100         1         1  .000078943.000078943         1
(10X12F4.1)
  PRESTR54 176 297 351 491 587 610 230 680 603 484 405 268
  PRESTR55 159 192 287 240 544 613 695 710 601 498 318 299
  PRESTR56 300 204 366 467 571 643 706 662 612 486 313 237
  LEWITR54 272 300 350 486 564 602 715 662 587 475 400 250
  LEWITR55 144 169 272 413 542 601 681 701 585 474 295 284
  LEWITR56 208 194 367 470 570 630 698 655 596 478 308 215
  RICHTR54 296 315 363 496 567 607 732 687 625 494 427 251
  RICHTR55 167 215 308 419 542 613 697 726 811 508 334 312
  RICHTR56 318 213 360 460 569 632 704 679 827 494 324 244
  LOUSTR54 297 308 366 522 592 611 741 696 625 493 416 267
  LOUSTR55 175 206 304 422 565 621 716 735 620 512 316 318
  LOUSTR56 309 208 374 487 582 660 730 694 645 503 308 257
  LOGATR54 279 300 382 498 566 603 725 685 612 493 416 255
  LOGATR55 155 197 292 420 547 615 696 707 598 500 330 314
  LOGATR56 309 205 385 476 577 651 721 680 623 409 321 249
(10X12F4.2)
 8     PR54 170  82 295  92  96 197  31  22 142  68 199 125
 8     PR55 205 184 100 211 168 227  24 168 225 108 215 411
 8     PR56 303  66   9  86 303  89  47  23  21 148  71 174
(8X12F6.3)
  LOGR54   6830   5760   6800 12530 28260 17430 12140   8800   7090   6640   6000   5460
  LOGR55   5320   4610   5090   8040 29680 28500 15090 10220   7780   7370   6490   8860
  LOGR56   8010   6300   8200 22630 49230 41660 18920 12560   9620   8870   7640   7130
(10X12F5.2)
  CANALS54                        980   550   640   340   150
  CANALS55                        400   450   800   300   250
  CANALS56                  200   800  1300  1000   500   250
(8X12F6.0)
  BEAR54 63030 86650 84070 91320 20330 12890   2800   2130 15890 35020 45200 46950
  BEAR55 53740 46300 84810115000 88340 46200   2020   4840 13380 38060 59630105400
  BEAR56111400 70920117300158200152800 32390   4690   8830   9290 39830 58810 67510
  ECNL54      0      3      0    662   9050   8810   9680   9560   6700   2170    533      2
  ECNL55      0      0      0      0   5900   7010 10030   8640   6460   2720     35      0
  ECNL56      0      0      0    631   5650   9210   9980   9580   6590   2990    424      0
  WCNL54   1720   1460     26   1702 38270 34550 39030 39240 25910 11030   5060   3180
  WCNL55   1550    924    452      0 21100 29710 42140 35340 30910 13380   5260   1530
  WCNL56   1180    978    728      0 27390 40890 40640 40680 31790 16480   4340   3190
(8X12F6.0)
  ONID54 24140 24280 37850 41650 39350 41860 60190 56920 40080 23750 23450 22470
  ONID55 22370 22050 23570 47840 26890 26190 67710 39620 42970 24180 31160 40120
  ONID56 34880 26900 44600 70650 54810 28360 58530 55390 35150 24410 22620 29850
  LOGN54   6830   5760   6800 12530 28260 17430 12140   8800   7090   6640   6000   5460
  LOGN55   5320   4610   5090   8040 29680 28500 15090 10220   7780   7370   6490   8860
  LOGN56   8010   6300   8200 22630 49230 41860 18920 12560   9620   8870   7640   7130
  BLFK54   5050   4400   5630 10280   8860   5870   5160   4720   4290   4240   4010   3910
  BLFK55   4070   3610   4030   7720 15140   7440   5710   5160   4590   4660   4330   6830
  BLFK56   7080   5380   7600 20380 19290 10770   8580   7340   6300   6100   5650   5460
  LBNP54   3390   3060   5180 11480   4920   1610   1000    829    809   1950   2620   2340
  LBNP55   2560   2450   3660 13960 18540   3860   1160    964   1080   1930   2850   9840
  LBNP56   7300   4540   9590 17140 14170   3320   1400   1060    956   1840   3100   3340
(10X12F3.2)
  GWATER54 43 43 43 43 43 43 43 43 43 43 43 43
  GWATER55 43 43 43 43 43 43 43 43 43 43 43 43
  GWATER56 43 43 43 43 43 43 43 43 43 43 43 43
```

```
   TREMONTON                                                  1
10 BRTRE 7  1   17803  2  13750  3    1158  4  16645  5   6513  6   6612  7      72
10 BRTRE 7  6    2093 10    507 11     217 13     217
10 BRTRE 8  1     934  2   3092  3    4525  4   2698  5   9506
    30     55   100     00     40     11     00  3600  2600    111  2000    200
  1000    100   600     00     00   2400   1700    03    04     05   250    550
     2      2     1      1      1      4      1
      .5          .5.000177549          1.,000177549,000177549          1.
(10X12F4.1)
  CORITR54 307 335 368 525 592 624 747 705 523 512 433 291
  CORITR55 165 222 322 458 569 640 718 735 616 504 311 317
  CORITR56 316 224 393 508 610 667 746 665 630 510 327 276
  GARLTR54 265 324 368 490 599 623 756 700 626 496 431 291
  GARLTR55 140 205 305 422 559 624 723 731 611 499 301 279
  GARLTR56 312 197 374 461 565 663 743 690 630 506 322 261
(14X12F4.2)
421731       1954 162  70 201  34 116  76  16  16 225  29 192 113 1253
421731       1955 316 144  63 159 145 215  16 126 163  43 194 294 1818
421731       1956 330  30  15 150 223  76  57  00  00 127  11 153 1172
423122       1954 105  47 173  56  53 129  52  16 172  70 139 106 1120
423122       1955 141 185  90  84 120 222  09 229 120  38  77 129 1444
423122       1956 241  46  08  82 190  48  13  01  09  69  54 113  673
(8X12F6.0)
10109054  6830  5760  6800 12530 28280 17430 12140  8800  7090  6640  6000  5460
10109055  5320  4610  5090  6040 29680 28500 15090 10220  7760  7370  6490  8660
10109056  8010  6300  6200 22630 49230 41660 18920 12560  9620  8870  7640  7130
(10X12F5.2)
10 1954  4     0     0     0    50   980   900  1010  1010   560   270   120    66
10 1955  4     0     0     0     0   560   760  1080   910   770   330   110
10 1956  4     0     0     0     0   680  1040  1050  1040   790   400   100    66
(8X12F6.0)
  BRCO54 73220 72490 92750104200 31040 21140  7540  6970 20510 44010 55270 55520
  BRCO55 63970 58910 96400127700 97970 55870  7280 10360 16490 45820 68370111100
  BRCO56130500 79540124500165600162500 44720  7690 14000 15150 46820 64750 76990
(8X12F6.0)
  BEAR54 63030 66650 64070 91320 20330 12890  2800  2130 15890 35020 45200 46950
  BEAR55 53740 48300 64810115000 88340 46200  2020  4840 13360 36060 59830105400
  BEAR56111400 70920117300156200152800 32390  4690  6630  9290 39830 58610 67510
  MLAO54  3670  5350  5840  3250  1990  1480  1420  1260  1260  1690  2510  3270
  MLAO55  2990  2960  5760  5980  3090  2480  1230  1420  1320  1670  3410  4720
  MLAD56  4910  3460  7520  3990  2510  1350  1120  1140  1050  1350  2160  3020
  ECNL54     0     0     0   662  9050  8810  9680  9560  6700  2170   533     2
  ECNL55     0     0     0     0  5900  7010 10030  8640  6460  2720    35     0
  ECNL56     0     0     0   631  5650  9210  9980  9580  6590  2990   424     0
  WCNL54  1720  1460    28  1760 38270 34550 39030 39240 25910 11030  5060  3180
  WCNL55  1550   924   452     0 21100 29710 42140 35340 30910 13380  5260  1530
  WCNL56  1160   978   728     0 27390 40890 40640 40680 31790 16480  4340  3190
(10X12F3.2)
```

* See Appendix B for an explanation of the variables.

APPENDIX B

COMPUTER PROGRAM

APPENDIX B

USER INSTRUCTIONS FOR THE HYDROLOGIC SIMULATION PROGRAM, OPVER

The computer program titled OPVER is a main driving program for linking the various subroutines required for simulating the hydrology of a river basin. In addition, a pattern search algorithm is incorporated within it. A flow chart of OPVER is shown in Figure B.1.

The operating instructions for OPVER are summarized as follows:

1. Load OPVER with the core image loader. Upon loading, the teletype should type MAIN 1 and the computer should be in PAUSE mode.
2. Ready the card reader, line printer, and analog computer. Insure that the proper patch panels are in place on the analog computer, and that a properly set-up card deck is in the read hopper.
3. Place the analog computer in SP and DIG MODE and set logic mode to R and time selector to 10^1. Insure that counter 0 is set to 1 for FAST operation (line printer output only) or 10 for SLOW operation (x-y plotter output).
4. Push RUN-SINGLE-RUN (RSR) buttons whereupon card reader should start and option selected will be performed. For options 1 and 2, go to step 5. For option 3, go to step 7. For option 4 go to step 9, and for option 5 go to step 11.
5. Teletype will type HYDSM 1 and computer PAUSES.
6. Insure proper data for option specified is in card reader and RSR. For option 1 and 2, BASIC data (Group 2 cards) should be read by the card reader.
7. Teletype will type CARDS (I) for options 1 and 3 and MAIN 1 for option 2, and then PAUSE. Insure that data for subbasin I (Group 3 cards) are in hopper and RSR to continue for option 1 and 3. For option 2, return to step 2.
8. Teletype will type RESET DB. Set SSW D if desire reruns each year, SSW B if desire reruns each subbasin, and SSW C if desire acre-feet table.
9. Push RSR and analog computer will operate for specified time after which teletype will print MAIN 1, CARDS (I+1), or RESET DB and computer will PAUSE. For MAIN 1, CARDS (I+1), and RESET DB return to stpes 2, 7, and 8, resepctively. Set or reset SSW D, B, and C as specified in step 8 and set SSW E if desire to use recorded inflow for QRIV and QGLI rather tha than upstream subbasin simulated outflow for these inflow values. (When using SSW E option, all inflow data must be acre-feet.)
10. Analog computer will operate for specified time and teletype will respond as in step 8. Follow appropriate option outlined in step 8 to continue.
11. Card reader should have input the information necessary for the pattern search operation of the program (Group 4 cards) and upon completing all phases specified teletype will print MAIN 1. Return to step 2 to continue further operation.

The operating procedure is shown schematically in Figure B.2. The input data necessary for a run may be classified as:

1. Control cards for OPVER specifying the desired option.
2. Basic data consisting of labels for row and column headings for printed output and other data that is common to all subbasins that may subsequently be run.
3. Subbasin data needed to define the specific simulation desired.
4. Boundary conditions and options necessary to control the pattern search.

The deck set up for a typical pattern seach run is shown in Figure B.3. Detailed instructions for preparing the cards for each of the four groups of data are given in Tables B.1, B.2, B.3, and B.4 respectively. Notation used in the program is given in Table B.5. A list of input data for a sample problem is shown in Figure B. 4. Input data for each subbasin is listed in Appendix A. Representative output may be observed in Appendix C. The program for the analog portion of the model is shown as Figure B.5 and a listing of OPVER and all of its subroutines is given in Figure B.6. Flow charts for the major subroutines HYDSM, BASIC, SUBDAT and RESRV are also included in Figures B.7, B.8, B.9, and B.10 respectively.

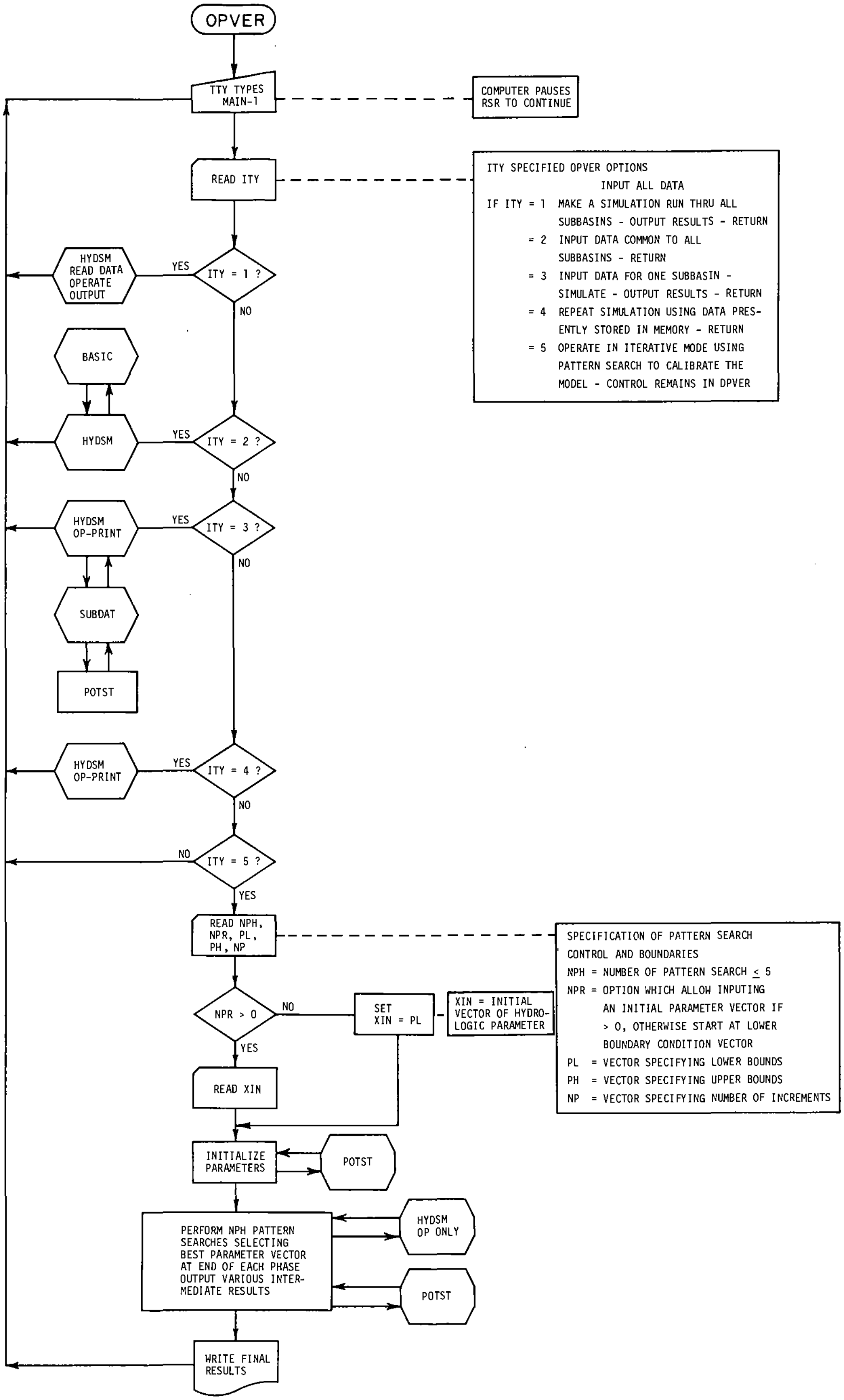


Figure B.1. Flow chart of hydrologic simulation program OPVER.

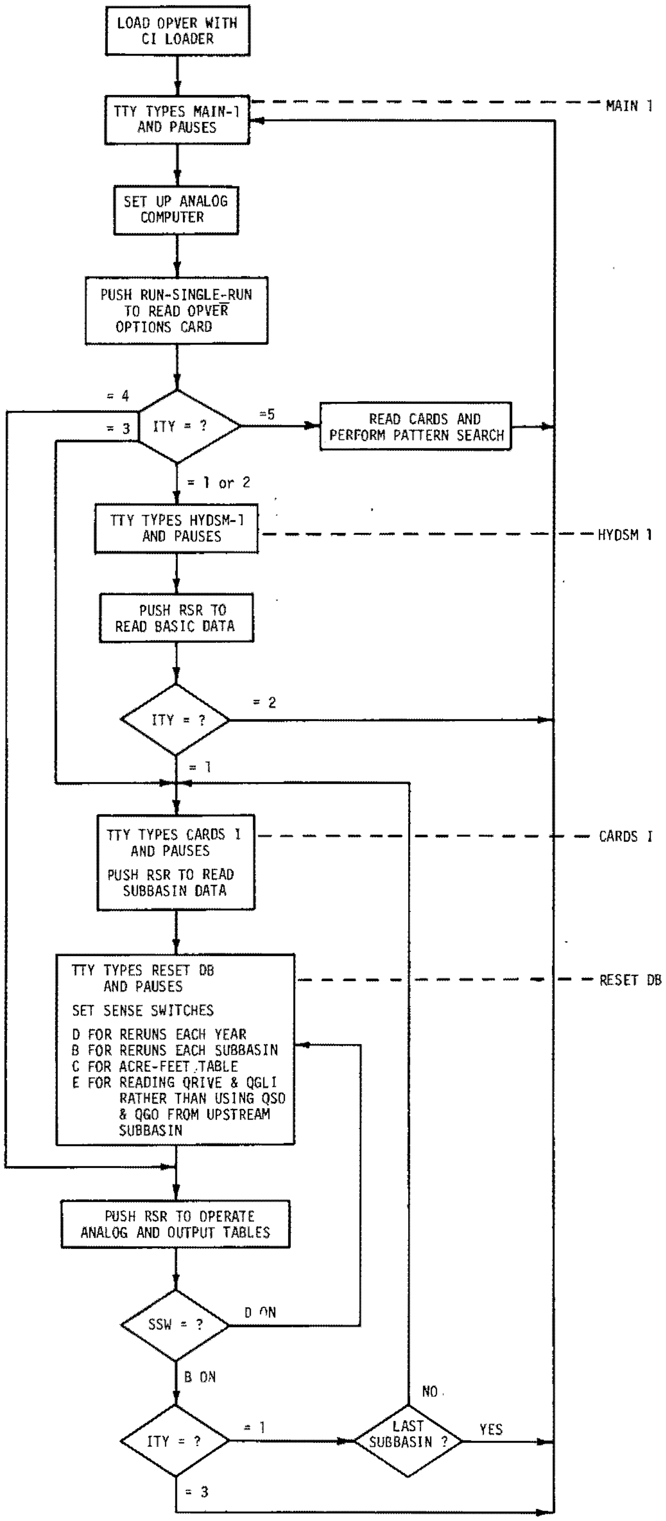


Figure B.2. Schematic diagram of operating procedures for OPVER.

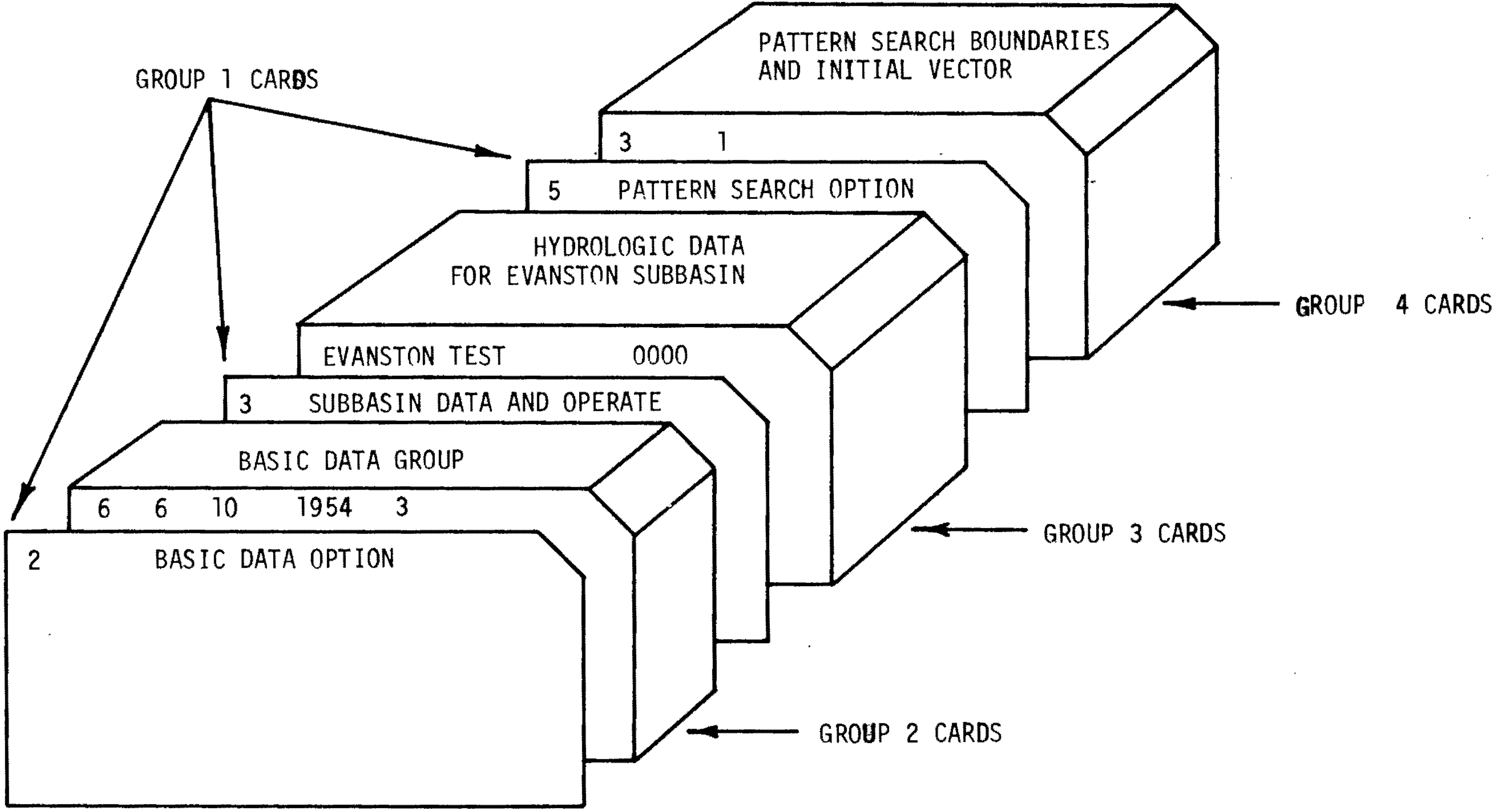


Figure B.3. Deck setup for typical OPVER run.

Table B.1. Preparation instructions for OPVER option control cards - group 1 cards.

Column	Format	Mnemonic	Description
1-5	I5	ITY	OPVER option specifiction: if ITY = 1 simulation = 2 read basic data only = 3 read subbasin data and operate for specified period = 4 rerun last subbasin = 5 perform pattern search

Table B.2. Preparation instructions for BASIC data - group 2 cards.

Card	Format	Mnemonic	Description
1	(5I5)	INP	Input device number for subbasin data
		IOUT	Output device number for simulation output
		NSB	Number of subbasins
		LYRO	First year of simulation
		NYR	Number of years of simulation
2	(13(1XA3))	V_k	13 element vector of column headings for output tables; i.e. JAN., FEB., ANN
3	(20A4)	$VARLB_i$	20 element vector of row titles for output tables. Must correspond to elements as shown in sample output shown in Figure
4	(12F5.3)	PDL_k	Vector of proportion of daylight hours for months in the same order as vector V
$5_1 - 5_{14}$	(10X12F5.2)	WKC_{jk}	Array of consumptive use coefficient for crops for modified Blaney-Criddle equation. Fourteen cards required, one for each crop. j is crop, k is month
$6_1 - 6_7$	(10X12F5.2)	PKC_{jk}	Array of consumptive use coefficient for phreatophytes. Seven cards required, one for each phreatophyte. j is phreatophyte, k is month

Table B.3. Preparation of subbasin data cards - group 3 cards.

Card	Format	Mnemonic	Description
1	(10A4, 4I5)	BASID	40 column page heading
		IRES	>0 specifies reservoir operation option of HYDSM
		MANG	>0 specifies management option of HYDSM
		JRES	>0 specifies reservoir operation on canal diversions - not presently implemented
		JCONV	>0 specifies conversion factors to be read from card for converting input data to inches
2*	(10X10F7.0)	RES_l	10 element vector of reservoir operating parameters. Needed only if IRES > 0. See Table B.5-C for detailed element breakdown.
3*	(10X3F7.0)	CTM	Temperature for management of canal diversions
		CMS	Management parameter for soil moisture storage
		BAREA	Base area for which the model parameters were developed. Needed only if MANG > 0
4*	(10X10F7.0)	$RESC_l$	10 element vector of canal reservoir parameters. Needed only if JRES > 0. Not implement at present
5	(10X7(I3, F10.0))	Il_j, DCA_j	Vectors of crop number and area in acres for j^{th} crop corresponding to WKC_{jk}. Exactly 2 cards are required. If $DCA_j = 0$, neither Il_j nor DCA_j need be punched
6	(10X7(I3, F10.0)	Il_j, DCA_j	Vector of phreatophyte no and area in acres for phreatophyte j corresponding to j^{th} phreatophyte in PKC_{jk}. One card required

* These cards are required only if an option parameter for them is greater than zero.

Table B.3. Continued.

Card	Format	Mnemonic	Description
7	(12F6.2)	DIG_l	10 element vector of digital model parameters. See Table B.5-A for detailed element breakdown.
		SKAL	Scale factor for soil moisture phase of analog simulation
		SKF	Scale factor for channel phase of analog simulation. If SKF is read as 0, it is set to 2.0 by the program
8	(12F6.2)	PH_l	12 element vector of analog model parameters. See Table B.4-B for detailed breakdown
9	(8I5)	N_l	Vector of the number of stations with NYR years of data of type l which are to be read in and used by the program. Data types correspondence is as follows: l = 1 temperature stations = 2 precipitation stations = 3 stream correlation station = 4 canal diversion stations = 5 gage outflow stations = 6 gage river inflow stations = 7 subsurface inflow stations = 8 minimum monthly outflow stations (used only if IRES > 0)
10*	(8F10.2)	CVR_j	Vector of conversion factors to convert input data to inches. Needed only if JCON > 0. If JCONV = 0, program assumes that all input flow data is in acre-feet
11_l*-11_8*	(10A4)	FMT_l	40 character format specification card followed by (NYR* N_l) cards of input data for type l above. A set of these cards for a particular type data are included only if N_l 0

Table B. 4. Preparation instructions for pattern search specifiction cards - group 4 cards.

Card	Format	Mnemonic	Description
1	(3I5)	NPH	Number of phases to be run during pattern search. $1 \leq NPH \leq 5$
		NPR	Option specifying initial search vector If NPR = 0 start at lower boundary > 0 Input initial vector from cards
		NWC	Option specifying monthly weighting coefficients for calculating $OBJ = \Sigma W_R (DIFF_R)^2$ If NWC = 0 use $W_R = 1.0$ > 0 Input W_R from cards
2	(12F6. 2)	W_R	Vector of monthly weighting coefficients for calculating OBJ Needed only if NWC > 0
3	(9F6. 2)	PL_l	Vector of lower bounds for the digital parameters. See Table B. 5-A for a detailed description l = 1 to 9
4	(9F6. 2)	PH_l	Vector of upper bounds for the digital parameters. l = 1 to 9
5	(9I5)	NP_l	Number of steps for each digital parameter. l = 1 to 9
6	(12F6. 2)	PH_l	Vector of lower bounds for the analog parameters. See Table B. 5-B for a detailed description. l = 10 to 21
7	(12F6. 2)	$P\ PH_l$	Vector of upper bounds for the analog parameters l = 10 to 21
8	(12I5)	NP_l	Number of steps for each of the analog parameters l = 10 to 21
9*	(9F6. 2)	XIN_l	Vector of initial digital parameter l = 1 to 9 needed only if NPR > 0
10*	(12F6. 2)	XIN_l	Vector of initial analog parameters l = 10 to 21 Needed only if NPR > 0

* These cards are required only if an option parameter is greater than zero

Table B. 5. Notation for OPVER and its subroutines.

A. Digital parameters, DIG(I). Input by SUBDAT.

I	Mnemonic	Description
1	KS	Snowmelt rate exponent
2	CIR	Irrigation efficiency (decimal)
3	CKC	Consumptive use coefficient (=1.00)
4	C1	Precipitation ungaged inflow coefficient
5	C2	Snowmelt ungaged inflow coefficient
6	COR	Surface stream ungaged inflow coefficient
7	PTH	Precipitation threshold for runoff (inches)
8	TS	Snowfall temperature (°F)
9	TSM	Snowmelt temperature (°F)
10	SNW	Initial snow water content (inches)

B. Analog parameters, PH(I). Input by SUBDAT.

I	Mnemonic	Description
10	KG	Smoothing coefficient for groundwater inflow (≤ 1.0)
11	DTA	Cropland groundwater return flow delay time (months)
12	MCS	Soil moisture capacity (inches)
13	QGTIC	Initial cropland groundwater return flow (inches)
14	QG2IC	Initial groundwater inflow (inches)
15	QH	Threshold separating high and medium Groundwater outflow ranges
16	QM	Threshold separarting medium and low groundwater outflow ranges
17	CGH	Fraction groundwater outflow, high range
18	CGM	Fraction groundwater outflow, medium range
19	CGS	Fraction groundwater outflow, low range
20	MES	Critical soil moisture level (inches)
21	MIC	Initial soil moisture storage (inches)

Table B.5. Continued.

C. Reservoir operation parameters, RES(I). Input by SUBDAT when IRES > 0.

I	Mnemonic	RES(I) Description
1	STI	Initial storage volume in reservoir (acre-feet) at time 0
2	STMN	Minimum usable storage (acre-feet)
3	STMX	Maximum storage (acre-feet)
4	ER	Desired accuracy level for successive area computation
5	CA	Reservoir area at STMN = 0, (acres)
6	C1	Constant in area equation one
7	C2	Exponent in area equation one
8	STB	Break point storage between area equation one and two (acre-feet)
9	C3	Constant in area equation two
10	C4	Exponent in area equation two

D. Subbasin hydrologic input data, DUM(J,K,L). Input by SUBDAT. J is the year, K is the month, and L is the data type.

L	Mnemonic	Description
1	TEMP	Subbasin monthly temperature data (^{o}F)
2	PPT	Subbasin monthly precipitation data (inches)
3	QCOR	Surface streamflow data for correlating to obtain monthly ungaged surface inflow (acre-feet)
4	QCNL	Subbasin monthly canal diversions (acre-feet)
5	QGAG	Subbasin monthly gaged surface outflow to be used for verification with OPVER (acre-feet)
6	QRIV	Subbasin measured monthly surface inflows (acre-feet)
7	QGLI	Subbasin measured or estimated monthly groundwater inflows (acre-feet)
8	QR	Minimum monthly outflow values for the reservoir when IRES > 0 (acre-feet)

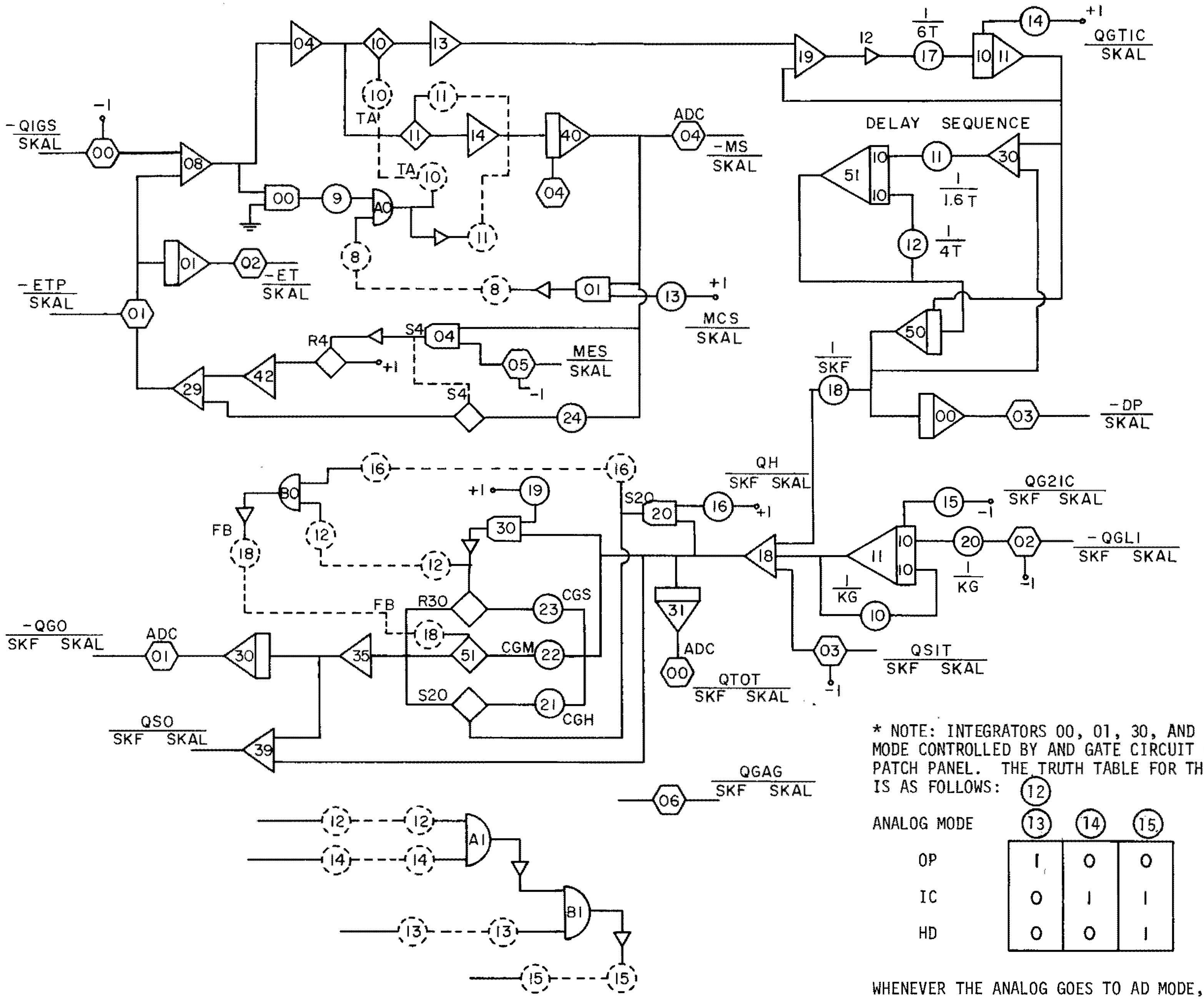
Table B.5. Continued.

E. Labels on tables of printed output, OUT(K,L). K is the month and L is the data type.

L	Mnemonic	Description
1	TEMP	Monthly temperatures (^{o}F)
2	F	Blaney-Criddle F
3	PPT	Monthly precipitation (inches)
4	QRIV	Measured monthly surface inflow
5	QUNG	Monthly unmeasured surface inflow
6	QCNL	Monthly canal diversions
7	QSIT	Surface water available for transfer through the basin
8	QIGS	Surface water applied to soil moisture storage of the agricultural area
9	QGLI	Monthly measured or estimated groundwater inflow
10	SNW	Snow storage at end of month
11	SNMT	Monthly snowmelt
12	ETPH	Evapotranspiration from the phreatophyte area
13	ETP	Potential evapotranspiration from the crop area
14	ET	Actual evapotranspiration from the crop area
15	MS	Soil moisture storage at end of month
16	DP	Monthly deep percolation after delay
17	QTO	Total monthly outflow from basin
18	QGO	Groundwater outflow from basin
19	QSO	Surface outflow from basin
20	QGAG	Gaged surface outflow from basin
21	DIFF	Difference between QSO and QGAG
	OBJ	Sum of squared differences $(DIFF)^2$
	OBA	Algebraic sum of annual differences

```
    2                  INITIAL DATA IN                                                      GROUP 1 CONTROL CARD
    6    6   10 1954     3
 JAN FEB MAR APR MAY JUN JLY AUG SEP OCT NOV DEC ANN
TEMP    F PPTQRIVQUNGQCNLQSITQIGSQGLI SNWSNMTETPH ETP  ET   MS   DP QTO QGO QSOQGAG
   66   67    83    90   101   102   104    96    84    78    66    63
A1   ALFA 1    63    74    86    99   112   119   110   105    99    90    79    65
A2   PAST 2    55    66    81    86   102    99    93    91    87    80    74    58
A3   AOHA 3    55    66    81    94   109   115   110   105    95    84    77    62
A4   SMGR 4    29    29    28    74   118   127    73    40    19    22    29    29
A5   CORN 5    29    29    28    22    60    73    93   106   109    99    29    29
A6   SUBT 6    29    29    28    22    58    95   106   120   111   102    29    29
A7   POTA 7    29    29    28    22    30    42    88   131   134    22    29    29
A8   ORCH 8    64    74    86    98   108   113   111   106    99    90    78    65      GROUP 2 CARDS-BASIC DATA
A9   PEAS 9                                                                             READ BY SUBROUTINE BASIC
A10  TOMA10    29    29    28    45    50    75   101    97    83    40    29    29
A11  SMTR11    29    29    28    37    62    77    82    78    61    40    29    29
A12  IDLE12
A13  BEAN13    29    29    28    22    67   111    89    75    20    25    29    29
A14  BLAN14
C1   HWMC 1   185   185   185   185   185   185   185   185   185   185   185   185
C2   HWGW 2    65    80   113   136   141   142   142   141   136   125   102    75
C3   MWGT 3    56    53    53    55    61    68    77    82    83    81    76    69
C4   LWGT 4    35    33    33    34    38    42    48    51    51    50    47    42
B1   OPWT 5   101   130   149   156   155   151   144   141   138   137   128   112
UR   URBN 6
B1   OPWT 5   100   100   100   100   100   100   100   100   100   100   100   100
    3                  SUBBASIN DATA IN OP AND PRINT                                        GROUP 1 CONTROL CARD
 EVANSTON
 1 EVANS 7  1    2599  2   8823  3  19835  4    314
 1 EVANS 7
 1 EVANS 8  1     632  2    609  3   3523  4    261  5   2434
    90    38   100    00    70    79    00  3200  2400   159  2000   200
  1000   700  1100    20    00    00    00    00    00    00   250   250
    1     1     1     2     2     5
(10X12F4.1)
1TR       4 221 242 247 406 497 548 652 593 537 438 344 174
1TR       5 122 147 203 342 473 549 621 630 521 420 229 204
1TR       6 202 107 252 355 483 589 626 569 531 397 223 166
(10X12F4.2)
1A        4  69  34  75  14  78 143 111 160  70  89 142  73
1A        5  57  81  49  19 129 115 137 115 128  40  82 180
1A        6 121  35   7  39 232  67  71  38   2  94  14  83
(10X12F5.0)
 1 1954  5   492   555   881  2970  1430  2040   202    77    53    70   170   160
 1 1955  5   165   147   194  3870  2070  1880   163   103    52    75   222  1080
 1 1956  5   645   488  2560  2170  3720   652   266   216    43    68   101   145
(8X12F6.0)
1-4    54     0     0     0 10524 36833 34202 11129  3394  2500  2631     0     0
1-4    55     0     0     0     0 36964 41595 11260  5551  2789  2631     0     0
1-4    56     0     0     0     0 21047 44726 17154  5157  2157  3157     0     0
1-4    54                                                                               GROUP 3 CARDS
1-4    55                                                                               SUBBASIN HYDROLOGIC DATA,
1-4    56                                                                               READ BY SUBROUTINE SUBDAT
(8X12F6.0)
  020554  4000  3870  4960 12520 24520  5380   654    38     0    63   423  1800
  020555  2640  2400  1580  9510 28740 20530   424   136     0   214  2010  7800
  020556  5980  4830 14500 14880 57090 37330  1310    57     0     9  1360  2750
  019554     0    20  2350  2200  3450  1870   112     0     0   110   603   392
  019555     0     0  1380  4660  3670  3840    23    80     2   102   599     8
  019556     0     0   984  2050  3040  4050   531     0     0   242  1120     0
(8X12F6.0)
  010554     0     0     0    54  1090  1010  1260   562   545   427    90     0
  010555     0     0     0     0   333  1360  1210   494   778   718     0     0
  010556     0     0     0     0     0  1520  1650  1060   535   530     0     0
  011554  2340  2220  2500  7660 34160 15670  6120  2300  2200  1970  1930  2030
  011555  1950  1720  1900  3360 37470 33100  6740  3870  2010  2010  2050  2430
  011556  2150  1830  2370  6900 52640 50910  9460  2750  1420  2080  2200  2190
  012054   492   500   536  2250  6110  1540   431   238   293   354   386   341
  012055   328   305   367   802  6960  3490   557   460   314   404   458   641
  012056   500   430   652  2650 10780  4960   627   410   272   407   449   440
  016054   492   555   881  2970  1430  2040   202    77    53    70   173   158
  016055   165   147   194  3870  2070  1880   163   103    52    75   222  1080
  016056   645   488  2560  2170  3720   652   266   216    43    68   101   145
  017054     0    26   181   758   533    80     0     0     0     0     0     0
  017055     0     0     0   743  1400   233     5     6     0     0     0   231
  017056   123    86   548  1320  2420   273     0     0     0     0     0     0
    5                  OPTIMAL VERIFICATION   OP ONLY                                   GROUP 1 CONTROL CARD
    1     1
    60    30   100    00    20    02    00  3100  2300
    90    50   100    00    70    07    00  3300  2600
    3     5     1     1     5     5     1     4     6
  1000   100   800    00    00    00    00    00    00    00   250   200                GROUP 4 CARDS-PATTERN
  1000   700  1200    40    00    00    00    00    00    00   250   400                SEARCH SPECIFICATIONS
    1     6     4     4     1     1     1     1     1     1     1     4                 READ BY OPVER
    90    38   100    00    70    03    00  3200  2400
  1000   700  1100    20    00    00    00    00    00    00   250   250
```

Figure B.4. List of typical input data for OPVER.



* NOTE: INTEGRATORS 00, 01, 30, AND 31 HAVE IC MODE CONTROLLED BY AND GATE CIRCUIT ON THE LOGIC PATCH PANEL. THE TRUTH TABLE FOR THIS CIRCUIT IS AS FOLLOWS: ⑫

ANALOG MODE	⑬	⑭	⑮
OP	1	0	0
IC	0	1	1
HD	0	0	1

WHENEVER THE ANALOG GOES TO AD MODE, INTEGRATORS 00, 01, 30, AND 31 GO TO IC MODE.

Figure B.5. Analog computer program for use with OPVER.

```
C     OPTIMAL VERIFICATION BY MODIFIED PATTERN SEARCH = OPVER
      REAL MIC,MS,MES
      COMMON WKC(14,12),WK(12),POL(12),N(8),OO(12),FMT(10),CVR(8),
     1V(13),A(10),BASIO(10),PV(15),DUM( 3,12,8),PKC(7,12),SWKC(12),
     2SPKC(12),I1(14),DCA(14),CAC(14),PCA(14),PAC(7),PPA(7),OUT(13,21)
     3,DIG(10),RES(10),RESC(10),ROUT(4,13,2),XIM(21)
     4,MIC,MS,EMS2,SKAL,SKF,XIN(8,21),PH(21),PL(21),DR(21),NP(21)
      COMMON INP,IOUT,NSB,LYRO,NYR,IRES,MANG,JRES,CTM,CONV,CONV1,CONPV
     1,MES,SKAL1,SKAL2,SKAL3,SPAC,SCAC,NYB,W(12),CHS,BAREA
      CALL QSHYIN(IERR,580)
      CALL QSC(1,IERR)
      DO 65 L=1,12
   65 W(L)=1.0
    1 TYPE 200
  200 FORMAT(6HMAIN 1/)
      OCT 25000
  100 FORMAT(16I5)
      READ(6,100)ITY
      IF(ITY)99,99,2
    2 GOTO(5,6,7,8,9),ITY
C     ITY=1 OPERATE AS ORIGINAL PROGRAM RETURN AFTER 30
C         2 INITIAL DATA ONLY
C         3 SUBBASIN DATA IN OP AND PRINT
C         4 OPERATE AND PRINT
C         5 OPTIMAL VERIFICATION OPERATE ONLY
    5 IENT=1
      IRET=0
      J   .80
    6 IENT=1
      IRET=1
      J   .80
    7 IENT=2
      IRET=2
      J   .80
    8 IENT=3
      IRET=2
      J   .80
C     READ NO OF PHASES (NPH) AND OPTIONS FOR READING XIN (NPR)
C     AND WEIGHTING COEFFICIENTS (NWC)
    9 READ(6,100)NPH,NPR,NWC
C     IF NWC > 0 READ MONTHLY WEIGHTING COEFFICIENTS FOR OBJ
      IF(NWC .GT. 0) READ(6,101)(W(L),L=1,12)
C      INPUT DIG BOUNDS AND LEVELS
      READ(6,101)(PL(L),L=1,9)
      READ(6,101)(PH(L),L=1,9)
      READ(6,100)(NP(L),L=1,9) .
  101 FORMAT(12F6.2)
C      INPUT BOUNDS FOR ANALOG
   11 READ(6,101)(PL(L),L=10,21)
      READ(6,101)(PH(L),L=10,21)
      READ(6,100)(NP(L),L=10,21)
C      COMPUTE INCREMENTS
      DO20L=1,21
      XL=NP(L)
      XIM(L)=PL(L)
      XIN(1,L)=PL(L)
   20 DR(L)=(PH(L)-PL(L))/XL
C      IF NPR GT 0 INPUT XIN(1,L)
      LA  NPR
      A   /0
      OCT 027407
      J   .13
      READ(6,101)(XIN(1,L),L=1,9)
      READ(6,101)(XIN(1,L),L=10,21)
C     SET XIM AT INITIAL VECTOR
      DO 14 L=1,21
   14 XIM(L)=XIN(1,L)
   13 WRITE(6,102)
  102 FORMAT(1H1,9X,36HPR  NP     PH        PL       XIN        DO///)
      DO21L=1,21
   21 WRITE(6,103)L,NP(L),PH(L),PL(L),XIN(1,L),DR(L)
  103 FORMAT(7X,2I4,4F8.3)
      WRITE(6,108)
  108 FORMAT(1H1)
      ROBJ=500000.0
      ROBA=0.0
C      DO FOR EACH PHASE
   25 DO70K=1,NPH
C      SET ALL PARAMETERS TO INITIAL LEVEL AND OPERATE
C      DIGITAL
      DO 27 L=1,9
   27 DIG(L)=XIN(K,L)
C      ANALOG
      DO 28L=10,21
      VAL=XIN(K,L)
      CALL POTST(L,VAL)
   28 CONTINUE
C      OPERATE WITH PHASE INITIAL DATA
      CALL HYDSM(3,3,OBJ,OBA)
  104 FORMAT(1H0,F10.2,F6.2,9F7.3)
      WRITE(6,104)OBJ,OBA,(XIN(K,L),L=1,9)
      WRITE(6,101)(XIN(K,L),L=10,21)
      WRITE(6,104)ROBJ,ROBA,(XIM(L),L=1,9)
      WRITE(6,101)(XIM(L),L=10,21)
C      CHECK ROBJ AGAINST OBJ OF XIN(K,L)
      IF(OBJ-ROBJ)160,170,170
  160 ROBJ=OBJ
      ROBA=OBA
      J   .180
  170 IF(K-1)171,171,175
  171 ROBJ=OBJ
      ROBA=OBA
      J   .180
  175 DO 176 L=1,21
  176 XIN(K,L)=XIM(L)
```

```
C      RESET PARAMETERS TO XIM
C      DIGITAL
      DO 177 L=1,9
  177 DIG(L)=XIN(K,L)
C      ANALOG
      DO 178 L=10,21
      VAL=XIN(K,L)
      CALL POTST(L,VAL)
  178 CONTINUE
C      OPERATE WITH BEST VECTOR
  180 WRITE(6,108)
      CALL HYDSM(3,2,ROBJ,ROBA)
      WRITE(6,104)ROBJ,ROBA,(XIN(K,L),L=1,9)
      WRITE(6,101)(XIN(K,L),L=10,21)
  106 FORMAT(1H04X1HP4X1HL5X3HPAR13X3HOBJ15X3HOBA15X4HGRAD/)
      WRITE(6,106)
C      DO FOR EACH PARAMETER
   35 DO60I=1,21
      XIN(K+1,I)=XIN(K,I)
      PAR=PL(I)
      NT=NP(I)+1
      IF(NP(I).LE.1)NT=1
C      DO FOR EACH LEVEL
   38 DO 50 J=1,NT
      IF(I-9)40,40,41
   40 DIG(I)=PAR
      J   .45
   41 CALL POTST(I,PAR)
   45 CALL HYDSM(3,3,OBJ,OBA)
      IF(J-1)55,55,56
   55 GRAD=0.
      POBJ=OBJ
      OBJ1=OBJ
      GO TO 57
   56 GRAD=(OBJ-OBJ1)/DR(I)
      OBJ1=OBJ
   57 WRITE(6,107)I,J,PAR,OBJ,OBA,GRAD
  107 FORMAT(1X2I5,F10.3,3F18.5)
C      CHECK OBJECTIVE FUNCTION IMPROVEMENT
      IF(OBJ-POBJ)46,48,48
   46 POBJ=OBJ
      POBA=OBA
      XIN(K+1,I)=PAR
C      CHECK OBJ AGAINST MINIMUM ROBJ
      IF(OBJ-ROBJ)140,48,48
  140 ROBJ=OBJ
      ROBA=OBA
      DO 150 L=1,21
  150 XIM(L)=XIN(K,L)
      XIM(I)=PAR
   48 PAR=PAR+DR(I)
   50 CONTINUE
C      RESET PARAMETERS
      IF(I-9)52,52,53
   52 DIG(I)=XIN(K,I)
      J   .60
   53 VAL=XIN(K,I)
      CALL POTST(I,VAL)
   60 CONTINUE
      WRITE(6,108)
   70 CONTINUE
C      END OF ALL PHASES OPERATE AND PRINT LAST TIME
      K=NPH+1
C      SET ALL PARAMETERS TO INITIAL LEVEL AND OPERATE
C      DIGITAL
      DO 127 L=1,9
  127 DIG(L)=XTN(K,L)
C      ANALOG
      DO128L=10,21
      VAL=XIN(K,L)
      CALL POTST(L,VAL)
  128 CONTINUE
C      OPERATE AND RETURN OBJ
      CALL HYDSM(3,3,OBJ,OBA)
      WRITE(6,104)OBJ,OBA,(XIN(K,L),L=1,9)
      WRITE(6,101)(XIN(K,L),L=10,21)
      WRITE(6,104)ROBJ,ROBA,(XIM(L),L=1,9)
      WRTTE(6,101)(XIM(L),L=10,21)
      IF(OBJ-ROBJ)240,240,208
  208 DO 209 L=1,21
  209 XIN(K,L)=XIM(L)
C RESET PARMETERS TO XIM
C      DIGITAL
      DO 227 L=1,9
  227 DIG(L)=XIN(K,L)
C      ANALOG
      DO228L=10,21
      VAL=XIN(K,L)
      CALL POTST(L,VAL)
  228 CONTINUE
  240 WRITE(6,108)
C      OPERATE AND PRINT WITH FINAL DATA
      CALL HYDSM(3,2,OBJ,OBA)
      WRITE(6,104)OBJ,OBA,(XIN(K,L),L=1,9)
      WRITE(6,101)(XIN(K,L),L=10,21)
C      WRITE OUT XIN TABLE
      WRITE(6,201)
  201 FORMAT(1H1,32X,3HXIN/10X,3H  I/)
      NPP=NPH+1
      DO 78 I=1,21
   78 WRITE(6,202)I,(XIN(L,I),L=1,NPP)
  202 FORMAT(10X,I3,6F7.3)
      J   .1
   80 CALL HYDSM(IENT,IRET,OBJ,OBA)
      J   .1
   99 STOP
      END
```

Figure B.6. List of digital computer program OPVER with all subroutines.

```
C      HYDROLOGIC SIMULATION MODEL - SUBROUTINE HYDSM
       SUBROUTINE HYDSM(IENT,IRET,OBJ,OBA)
       REAL MIC,MES,KS,KG,MS,MCS,NETPH
       COMMON WKC(14,12),WK(12),POL(12),N(8),DD(12),FMT(10),CVR(8),
      1V(13),A(10),BASID(10),PV(15),DUM( 3,12,8),PKC(7,12),SWKC(12),
      2SPKC(12),I1(14),DCA(14),CAC(14),PCA(14),PAC(7),PPA(7),OUT(13,21)
      3,DIG(10),RES(10),RESC(10),ROUT(4,13,2),XIM(21)
      4,MIC,MS,EMS2,SKAL,SKF,XIN(8,21),PH(21),PL(21),DR(21),NP(21)
       COMMON INP,IOUT,NSB,LYRO,NYR,IRES,MANG,JRES,CTM,CONV,CONV1,CONPV
      1,MES,SKAL1,SKAL2,SKAL3,SPAC,SCAC,NYB,W(12),CMS,BAREA
       DIMENSION P(15),VARLB(21)
       DATA P(1),P(2),P(3),P(4),P(5),P(6),P(7),P(8),P(9),P(10),P(11),
      1P(12),P(13),P(14),P(15),VARLB(21)/4HP010,4HP011,4HP012,4HP013,
      24HP014,4HP015,4HP016,4HP017,4HP018,4HP019,4HP020,4HP021,4HP022,
      34HP023,4HP024,4HDIFF/
C      OPT VER EXTRACT
       NLL=21
       GOTO(7,8,15),IENT
     7 TYPE 510
   510 FORMAT(7HHYDSM-1/)
       OCT 25000
       DO 2 I=1,10
     2 A(I)=0.
       CALL QWBDAR(A,0,8,IERR)
       CALL QSTDA
       CALL QRBADR(A,0,10,IERR)
C      INP IS INPUT DEVICE, IOUT IS OUTPUT DEVICE, NSB IS NO OF SUB-
C      BASINS LYRO IS THE BEGINNING YEAR OF SIMULATION AND NYR IS THE NO
C      OF YEARS
CSR
       CALL BASIC(VARLB)
CSR
       WRITE(6,207)
       IF(IRET.EQ.1)RETURN
C      INITIALIZE QRIV AND QGLI
C      OPT VER EXTRACT
     8 DO 3 J=1,NYR
       DO 1 K=1,12
       DUM(J,K,6)=0.
     1 DUM(J,K,7)=0.
     3 CONTINUE
C      REPEAT PROCEDURES FOR EACH SUB-BASIN
       DO 30 I=1,NSB
CSR
    24 CALL SUBDAT(P,VARLB,I)
CSR
       WRITE(IOUT,207)
   207 FORMAT(1H1)
C      IF SSW B ON DO ALL NYR YEARS BEFORE PARAMETER CHANGES
C      BYPASS SSW A,D AND G
C      IF SSW D ON PAUSE EVERY YEAR TO ALLOW SETTING SSW A FOR RERUNS
       SNW2=DIG(10)
       EMS2=MIC
    14 TYPE 245
   245 FORMAT(6HRESET DB)
       OCT 25000
C       ENTRY POINT FOR OPT VER
    15 PMIC=MIC*SKAL1
       PMES=-MES*SKAL1
       CALL QWJDAR(PMIC,04,IERR)
       CALL QWJDAR(PMES,05,IERR)
C       INITIALIZE OBJECTIVE FUNCTION
       OBJ=0.0
       OBA=0.0
C      SET ANALOG TO INITIAL MODE
       CALL QSIC(IERR)
C      REPEAT PROCEDURES FOR EACH YEAR
       DO 125 J=NYB,NYR
       IFF=1
       SNW1=DIG(10)
       EMS1=MS
C      IF SSW D ON PAUSE EVERY YEAR TO ALLOW SETTING SSW A, C, AND E
C      IF SSW B ON IGNORE  SSW D
       OCT 023500
       OCT 023420
       J   .166
   106 FORMAT(5HSET A)
       TYPE 106
       OCT 025000
   166 JJ=LYRO+J-1
C      INITIALIZE ANNUAL VALUES
       DO 23 L=1,21
    23 OUT(13,L)=0.
       STORMM=0.0
C      REPEAT CALCULATIONS FOR EACH MONTH
       DO 20 K=1,12
       TEMP=DUM(J,K,1)
       PPT=DUM(J,K,2)
       QCOR=DUM(J,K,3)
       QGAG=DUM(J,K,5)
       QRIV=DUM(J,K,6)
       QGLI=DUM(J,K,7)
       OUT(K,2)=TEMP*POL(K)
       EKT=.0173*TEMP-.314
       IF(EKT.LT..3) EKT=.3
       ETF=EKT*OUT(K,2)*DIG(3)
       ETP=SWKC(K)*ETF
       ETPH=SPKC(K)*ETF
       NETPH=ETPH*(SPAC/SCAC)
       RPMT=0.
       RPSM=PPT
       SNMT=0.
       IF(TEMP.GT.DIG(8))GOTO9
       DIG(10)=DIG(10)+PPT
       RPSM=0.
     9 IF(TEMP.LT.DIG(9))GOTO10
       SNMT=DIG(10)*(1.-EXP(-DIG(1)*(TEMP-DIG(9))))
       IF(DIG(10).LT.SNMT)SNMT=DIG(10)
       DIG(10)=DIG(10)-SNMT
    10 RPMT=RPSM+SNMT
C      MANAGEMENT STUDY CANAL DIVERSIONS
C       PUT LEACHING WATER REQD IN DUM(J,K,4)
       LA  MANG
       A   /0
       OCT 027410
       J   .4
       QCNL=DUM(J,K,4)
       J   .6
     4 ETP1=ETP
       NLL=19
       DTM=TEMP-CTM
       LA  DTM
       SKP
       J   .35
       J   .36
    35 ETP1=0.0
    36 ETN=ETP1-RPMT-(MS-CMS)
       IF(ETN.LT.0.)ETN=0.
       QCNL=DUM(J,K,4)+ETN/DIG(2)
     6 PC=(RPSM-DIG(7))*DIG(4)
       IF(PC.LT.0.) PC=0
       SC=DIG(5)*SNMT
       QUNG=SC+PC+DIG(6)*QCOR
       QIN=QRIV+QUNG
       WAD=QIN-NETPH
       IF(MANG.LT.2) GO TO 87
       IF(WAD.LT.0.)WAD=0.
       IF(QCNL.GT.WAD) QCNL=WAD
    87 QDIV=DIG(2)*QCNL
       QIGS=RPMT+QDIV
       QSIT=WAD-QDIV
       A(1)=-QIGS*SKAL1
       A(2)=-ETP*SKAL1
       A(3)=-QGLI*SKAL3
       A(4)=QSIT*SKAL3
       PGAG=QGAG*SKAL3
       CALL QWJDAR(PGAG,08,IERR)
C       TRANSFER DATA FROM DIGITAL TO ANALOG
       CALL QWBDAR(A,00,4,IERR)
       CALL QSTDA
C      TEST SENSE LINE TO PROCEED COMPUTATIONS
    11 CALL QRLBB(ITEST,IERR)
       IF(ITEST.EQ.'200) GO TO 11
    12 CALL QRLBB(ITEST,IERR)
       IF(ITEST.NE.'200) GO TO 12
       CALL QSOP(IERR)
    13 CALL QRLBB(ITEST,IERR)
       IF(ITEST.EQ.'200) GO TO 13
       CALL QRBADR(A,0,5,IERR)
       CALL QSH (IERR)
C      TRANSFER RESULTS BACK TO DIGITAL
       QTO=A(1)*SKAL2
       QGO=-A(2)*SKAL2
       ET=-A(3)*SKAL
       DP=-A(4)*SKAL
       MS=-A(5)*SKAL
       QSO=QTO-QGO
C      IF IRES GT 0 OPERATE RESERVOIR
       LA  IRES
       A   /0
       OCT 027410
       J   .33
       J   .34
    33 CALL RESRV(J,K,QSO,ETF,IFF)
C      OUTPUT THE RESULTS OF SIMULATION
C      CALCULATE OUTPUT ARRAY IN INCHES
C      ACCUMULATE SUMS FOR ANNUAL VALUES
    34 CALL DOUT(OUT,K,1,TEMP)
       CALL DOUT(OUT,K,3,PPT)
       CALL DOUT(OUT,K,4,QRIV)
       CALL DOUT(OUT,K,5,QUNG)
       CALL DOUT(OUT,K,6,QCNL)
       CALL DOUT(OUT,K,7,QSIT)
       CALL DOUT(OUT,K,8,QIGS)
       CALL DOUT(OUT,K,9,QGLI)
       CALL DOUT(OUT,K,10,DIG(10))
       CALL DOUT(OUT,K,11,SNMT)
       CALL DOUT(OUT,K,12,ETPH)
       CALL DOUT(OUT,K,13,ETP)
       CALL DOUT(OUT,K,14,ET)
       CALL DOUT(OUT,K,15,MS)
       CALL DOUT(OUT,K,16,DP)
       CALL DOUT(OUT,K,17,QTO)
       CALL DOUT(OUT,K,18,QGO)
       CALL DOUT(OUT,K,19,QSO)
       CALL DOUT(OUT,K,20,QGAG)
       DXX=QSO-QGAG
       CALL DOUT(OUT,K,21,DXX)
       OUT(13,2)=OUT(13,2)+OUT(K,2)
C       CALCULATE OBJ
       OBJ=OBJ+OUT(K,21)*OUT(K,21)*W(K)
C      IF SSW D ON KEEP QRIV AND QGLI UNCHANGED
C      IF SSW B ON DO SAME
       OCT 023500
       J   .26
       J   .20
    26 OCT 023420
       J   .21
       J   .20
C      IF SSW E ON USE RECORDED INFLOW FOR QRIV AND QGLI
    21 OCT 023410                                     FOR NEXT BASIN
       J   .22
       DUM(J,K,6)=0.0
       DUM(J,K,7)=0.0
       J   .20
    22 DUM(J,K,6)=QSO*CONV
       DUM(J,K,7)=QGO*CONV
    20 CONTINUE
       OUT(13,1)=OUT(13,1)/12.
       OUT(13,10)=OUT(12,10)
```

Figure B.6. (cont'd)

```
      OUT(13,15)=OUT(12,15)
      OUT(13,21)=OUT(13,19)-OUT(13,20)
      OBA=OBA+OUT(13,21)
C      SKIP PRINTING IF OPT VER
      IF(IRET.EQ.3)GOTO75
      LL=1
   76 WRITE(6,206)(BASID(L),L=1,10),JJ
  206 FORMAT(1X10A4,8I5)
  225 FORMAT(1H0,7X3HVAR,7(7XA3))
      WRITE(IOUT,225)(V(K),K=1,6)
  160 DO 80 L=1,NLL
  226 FORMAT(7XA4,7F10.2)
   80 WRITE(IOUT,226)VARLB(L),(OUT(K,L),K=1,6)
      WRITE(IOUT,225)(V(K),K=7,13)
      DO 85 L=1,NLL
   85 WRITE(IOUT,226)VARLB(L),(OUT(K,L),K=7,13)
      IF(MANG.GT.0) GO TO 86
      WRITE(6,209)OBJ,OBA
  209 FORMAT(//////1H0,10X,4HOBJ=,F20.3/1H ,10X,4HOBA=,F20.3)
   86 WRITE(IOUT,207)
      IFF=2
      CALL RESRV(J,K,DSO,ETF,IFF)
      IFF=1
      IF(LL)75,75,77
C     IF SSW C ON OUTPUT ACRE-FT TABLE
   77 OCT 023440
      J    .75
      LL=0
      DO 78 L=3,NLL
      DO 78 K=1,13
      IF(L-12)82,81,82
   81 OUT(K,L)=CONPV*OUT(K,L)
      J    .78
   82 OUT(K,L)=CONV*OUT(K,L)
   78 CONTINUE
      J    .76
C     IF SSW A ON ENTER PARAMETER VALUE CHANGES ON TTY
C      IF SSW B ON AND J LT NYR SKIP CHANGES
   75 CONTINUE
      IF(J.EQ.NYR)GOTO79
      J    .125
   79 NYB=1
      MIC=EMS2
      MS=EMS2
      DIG(10)=SNW2
C      RETURN POINT FOR OPT VER
  206 IF(IRET.GT.1)RETURN
  125 CONTINUE
   30 CONTINUE
      RETURN
      END



C     HYDROLOGIC SIMULATION OUTPUT ARRAY ALLOCATOR
      SUBROUTINE DOUT(OUT,K,L,OXX)
      DIMENSION OUT(13,21)
      OUT(K,L)=OXX
      OUT(13,L)=OUT(13,L)+OXX
      RETURN
      END



C     BASIC DATA FOR B-C EVAPOTRANSPIRATION - SUBROUTINE BASIC
      SUBROUTINE BASIC(VARLB)
      REAL MIC,MS,MES
      COMMON WKC(14,12),WK(12),POL(12),N(8),DD(12),FMT(10),CVR(8),
     1V(13),A(10),BASID(10),PV(15),DUM( 3,12,8),PKC(7,12),SWKC(12),
     2SPKC(12),I1(14),OCA(14),CAC(14),PCA(14),PAC(7),PPA(7),OUT(13,21)
     3,DIG(10),RES(10),RESC(10),ROUT(4,13,2),XIM(21)
     4,MIC,MS,EMS2,SKAL,SKF,XIN(6,21),PH(21),PL(21),DR(21),NP(21)
      COMMON INP,IOUT,NSB,LYRD,NYR,IRES,MANG,JRES,CTM,CONV,CONV1,CONPV
     1,MES,SKAL1,SKAL2,SKAL3,SPAC,SCAC,NYB,W(12),CMS,BAREA
      DIMENSION VARLB(21)
CSR
    1 READ(5,100)INP,IOUT,NSB,LYRD,NYR
  100 FORMAT(16I5)
  110 FORMAT(13(1XA3))
      READ(6,110)(V(I),I=1,13)
  111 FORMAT(20A4)
      READ(6,111)(VARLB(I),I=1,20)
  102 FORMAT(12F5.3)
      READ(6,102)   (POL(K),K=1,12)
C     READ USE COEFFICANTS
      DO 52 I=1,14
   52 READ(6,220)(WKC(I,J),J=1,12)
  220 FORMAT(10X12F5.2)
      DO 53 I=1,7
   53 READ(6,220)(PKC(I,J),J=1,12)
C      WRITE INITIAL DATA
      WRITE(5,208)
      WRITE(6,110)(V(I),I=1,13)
      WRITE(6,111)(VARLB(I),I=1,20)
      WRITE(6,102)(POL(K),K=1,12)
      DO 500 I=1,14
  500 WRITE(6,220)(WKC(I,J),J=1,12)
      DO 501 I=1,7
  501 WRITE(6,220)(PKC(I,J),J=1,12)
CSR
  206 FORMAT(1X10A4,8I5)
      RETURN
      END
```

```
C     SUBBASIN DATA INPUT - SUBROUTINE SUBDAT
      SUBROUTINE SUBDAT(P,VARLB,I)
      REAL MIC,MS,MES
      COMMON WKC(14,12),WK(12),POL(12),N(8),DD(12),FMT(10),CVR(8),
     1V(13),A(10),BASID(10),PV(15),DUM( 3,12,8),PKC(7,12),SWKC(12),
     2SPKC(12),I1(14),OCA(14),CAC(14),PCA(14),PAC(7),PPA(7),OUT(13,21)
     3,DIG(10),RES(10),RESC(10),ROUT(4,13,2),XIM(21)
     4,MIC,MS,EMS2,SKAL,SKF,XIN(6,21),PH(21),PL(21),DR(21),NP(21)
      COMMON INP,IOUT,NSB,LYRD,NYR,IRES,MANG,JRES,CTM,CONV,CONV1,CONPV
     1,MES,SKAL1,SKAL2,SKAL3,SPAC,SCAC,NYB,W(12),CMS,BAREA
      DIMENSION P(15),VARLB(21)
CSR
   24 TYPE 202,I
  202 FORMAT(6HCARDS=,I3/)
C     OPT VER EXTRACT
      OCT 25000
      NYB=1
  201 FORMAT(10A4,8I5)
C     OPT VER EXTRACT
      READ(6,201)(BASID(L),L=1,10),IRES,MANG,JRES,JCONV
C     IF IRES GT 0 INPUT RES PARAMETERS
      IF(IRES.GT.0)READ(6,350)(RES(L),L=1,10)
C     IF MANG GT 0  READ MANAGEMENT PARAMETERS
      IF(MANG.GT.0)READ(6,350) CTM,CMS,BAREA
C     IF JRES GT 0 READ CANAL RESERVOIR PARAMETERS
      IF(JRES.GT.0)READ(6,350)(RESC(L),L=1,10)
  350 FORMAT(10X10F7.0)
  215 FORMAT(6F10.2)
C     INPUT CROP ACREAGES FOR BASIN
      DO54J=1,14
   54 CAC(J)=0.0
  221 FORMAT(10X,I3,F7.0,I3,F7.0,I3,F7.0,I3,F7.0,I3,F7.0,I3,F7.0,
     1I3,F7.0)
      READ(6,221)(I1(J),OCA(J),J=1,14)
      SCAC=0.0
      DO 55J=1,14
      L=I1(J)
      IF(L.LE.0)GOTO55
      CAC(L)=OCA(J)
      SCAC=SCAC+CAC(L)
   55 CONTINUE
C     COMPUTE CROP PROPORTIONS
   57 DO 60J=1,14
   60 PCA(J)=CAC(J)/SCAC
C     INPUT PHREATOPHYTE ACREAGES
      DO 61 J=1,7
   61 PAC(J)=0.0
      READ(6,221)(I1(J),OCA(J),J=1,7)
      SPAC=0.0
      DO 62 J=1,7
      L=I1(J)
      IF(L.LE.0)GOTO62
      PAC(L)=OCA(J)
      SPAC=SPAC+PAC(L)
   62 CONTINUE
      CONV=SCAC/12.
      CONV1=12./SCAC
      CONPV=SPAC/12.
C     COMPUTE PHREATOPHYTE PROPORTIONS
      DO 66 J=1,7
   66 PPA(J)=PAC(J)/SPAC
C     COMPUTE WEIGHTED USE COEF.
C     CROPS
      DO 70 J=1,12
      SCKC=0.0
      DO 69L=1,14
   69 SCKC=SCKC+WKC(L,J)*PCA(L)
   70 SWKC(J)=SCKC
C     PHREATOPHYTES
      DO 72J=1,12
      SCKC=0.0
      DO 71L=1,7
   71 SCKC=SCKC+PKC(L,J)*PPA(L)
   72 SPKC(J)=SCKC
   73 READ(6,104)(DIG(L),L=1,10),SKAL,SKF
      IF(SKF.LE.0.)SKF=2.0
  104 FORMAT(12F6.2)
      READ(6,104)(PH(L),L=10,21)
      MIC=PH(21)
      MES=PH(20)
      RMES=10.*MES-SKAL
      LA   RMES
      SKP
      J    .30
      RMES=SKAL-PH(12)
      LA   RMES
      SKP
      J    .30
      J    .31
   30 RMES=10.*MES
      TYPE 105,PH(12),SKAL,RMES
  105 FORMAT(11H SKAL ERROR,3F10.5/)
      OCT 025000
      J    .73
   31 MS=MIC
      READ(6,100)(N(L),L=1,8)
C     OPT VER EXTRACT
      WRITE(6,206)(BASID(L),L=1,10)
C     OPT VER EXTRACT
      WRITE(6,100)IRES,MANG,JRES,JCONV
  100 FORMAT(15I5)
      IF(IRES.GT.0)WRITE(6,224)(RES(L),L=1,10)
      IF(MANG.EQ.0) GO TO 32
      BCONV=BAREA/SCAC
      DIG(4)=DIG(4)*BCONV
```

Figure B. 6. (cont'd)

```
      DIG(5)=DIG(5)*BCONV
      PH(15)=PH(15)*BCONV
      PH(16)=PH(16)*BCONV
      PH(17)=PH(17)*BCONV
      PH(18)=PH(18)*BCONV
      PH(19)=PH(19)*BCONV
      WRITE(6,215) CTM,CHS,BAREA,BCONV
C     OPT VER EXTRACT
   32 IF(JRES.GT.0)WRITE(6,224)(RESC(L),L=1,10)
  206 FORMAT(1X10A4,8I5)
      WRITE(IOUT,222)(CAC(J),J=1,14),SCAC
  222 FORMAT(1X7F9.0/1X8F9.0)
      WRITE(IOUT,223)(PCA(J),J=1,14),CONV
  223 FORMAT(1X,7F9.5/1X7F9.5)
      WRITE(IOUT,222)(PAC(J),J=1,7),SPAC
      WRITE(IOUT,223)(PPA(J),J=1,7),CONPV
      WRITE(IOUT,224)(SWKC(J),J=1,12)
  224 FORMAT(1X13F6.2)
      WRITE(IOUT,224)(SPKC(J),J=1,12)
      WRITE(IOUT,224)(DIG(L),L=1,10),SKAL,SKF
      WRITE(6,224)(PH(L),L=10,21)
C     INITIALIZE DUM EXCEPT FOR QRIV AND QGLI
      DO 86 II=1,NYR
      DO 86 JJ=1,12
      DUM(II,JJ,8)=0.
      DO 86  J=1,5
   86 DUM(II,JJ,J)=0.
C     READ DATA FOR BASIN I
C     IF JCONV GT 0 - READ CONVERSION FACTORS FOR INPUT DATA
      IF(JCONV.GT.0)READ(6,215)(CVR(J),J=1,8)
  165 DO 97 J=1,8
      NN=N(J)
      IF(J-5)232,232,235
  232 IF(NN)97,97,92
  235 CVRS=CONV1
      IF(J.EQ.8)CVRS=1.0
      IF(NN)91,91,92
   92 READ(6,201)(FMT(L),L=1,10)
      DO 94 L=1,NN
      DO93II=1,NYR
      READ(INP,FMT)(DD(JJ),JJ=1,12)
      DO95JJ=1,12
   95 DUM(II,JJ,J)=DUM(II,JJ,J)+DD(JJ)
   93 CONTINUE
   94 CONTINUE
      IF(J-3)16,17,17
C     OPT VER EXTRACT
   16 XC=FLOAT(NN)
      CVRS=1./XC
      GOTO400
   17 CVRS=CONV1
      IF(J.EQ.8)CVRS=1.0
C     OPT VER EXTRACT
C     IF JCONV GT 0 - USE CONVERSION FACTORS READ ON INPUT
  400 IF(JCONV.GT.0)CVRS=CVR(J)
C     SCALE INPUT DATA TO INCHES
   91 DO96II=1,NYR
      DO300JJ=1,12
  300 DUM(II,JJ,J)=DUM(II,JJ,J)*CVRS
C     OPT VER EXTRACT
C     IFSSW 8 ON PRINT INPUT DATA
      L=LYRO+II-1
  230 FORMAT(1XI2,I5,12F6.2)
      WRITE(IOUT,230)J,L,(DUM(II,JJ,J),JJ=1,12)
   96 CONTINUE
   97 CONTINUE
  162 SKAL1=1./SKAL
      SKAL2=SKF*SKAL
      SKAL3=1./SKAL2
C     DETERMINE POT VALUES
      CALL POTST(22,SKF)
      DO 19 L=10,21
      VAL=PH(L)
      CALL POTST(L,VAL)
   19 CONTINUE
      WRITE(6,303)
  303 FORMAT(41H0POTS 10 THRU 24 SHOULD BE SET AS FOLLOWS)
      WRITE(6,302)(PV(L),L=1,15)
      WRITE(6,301)
      CALL QSPS(IERR)
      DO 5 L=1,15
      PADR=P(L)
      CALL QRAR(PADR,PVAL,IERR)
    5 PV(L)=PVAL
      WRITE(6,302)(PV(L),L=1,15)
  301 FORMAT(35H0POTS 10 THRU 24 ARE SET AS FOLLOWS  )
  302 FORMAT(1X5F8.5)
CSR
      RETURN
      END


C     POTENTIOMETER SETTING ALGORITHM - SUBROUTINE POTST
      SUBROUTINE POTST(IXP,XV)
      REAL MIC,MS,MES
      COMMON WKC(14,12),WK(12),POL(12),N(8),DD(12),FMT(10),CVR(8),
     1V(13),A(10),BASID(10),PV(15),DUM( 3,12,8),PKC(7,12),SWKC(12),
     2SPKC(12),I1(14),OCA(14),CAC(14),PCA(14),PAC(7),PPA(7),OUT(13,21)
     3,DIG(10),RES(10),RESC(10),ROUT(4,13,2),XIM(21)
     4,MIC,MS,EMS2,SKAL,SKF,XIN(6,21),PH(21),PL(21),DR(21),NP(21)
      COMMON INP,IOUT,NSB,LYRO,NYR,IRES,MANG,JRES,CTM,CONV,CONV1,CONPV
     1,MES,SKAL1,SKAL2,SKAL3,SPAC,SCAC,NY8
      DIMENSION PT(15)
      DATA PT(1),PT(2),PT(3),PT(4),PT(5),PT(6),PT(7),PT(8),PT(9),PT(10),
     1PT(11),PT(12),PT(13),PT(14),PT(15)
     2       /4HP010,4HP011,4HP012,4HP013,4HP014,4HP015,4HP016,4HP017,
     34HP018,4HP019,4HP020,4HP021,4HP022,4HP023,4HP024/
      ITS=IXP-9
      GOTO(5,10,15,20,25,30,35,40,45,50,55,60,70),ITS
    5 PVAL=1./XV
      PV(1)=PVAL
      PADR=PT(1)
      CALL QWPR(PADR,PVAL,IERR)
      PV(11)=PVAL
      PADR=PT(11)
      J    .100
   10 PVAL=1./(1.5*XV*XV)
      PV(2)=PVAL
      PADR=PT(2)
      CALL QWPR(PADR,PVAL,IERR)
      PVAL=1./(4.0*XV)
      PV(3)=PVAL
      PADR=PT(3)
      CALL QWPR(PADR,PVAL,IERR)
      PVAL=1./(6.0*XV)
      PV(8)=PVAL
      PADR=PT(8)
      J    .100
   15 PVAL=XV/SKAL
      PV(4)=PVAL
      PADR=PT(4)
      J    .100
   20 PVAL=XV/SKAL
      PV(5)=PVAL
      PADR=PT(5)
      J    .100
   25 PVAL=XV/(SKAL*SKF)
      PV(6)=PVAL
      PADR=PT(6)
      J    .100
   30 PVAL=XV/(SKF*SKAL)
      PV(7)=PVAL
      PADR=PT(7)
      J    .100
   35 PVAL=XV/(SKF*SKAL)
      PV(10)=PVAL
      PADR=PT(10)
      J    .100
   40 PVAL=XV
      PV(12)=PVAL
      PADR=PT(12)
      J    .100
   45 PVAL=XV
      PV(13)=PVAL
      PADR=PT(13)
      J    .100
   50 PVAL=XV
      PV(14)=PVAL
      PADR=PT(14)
      J    .100
   55 PVAL=0.1*SKAL/XV
      PV(15)=PVAL
      PADR=PT(15)
      J    .100
   60 EMS2=XV
      MS=XV
      MIC=XV
      J    .101
C      OPTION FOR SETING POT 18
   70 PVAL=1./XV
      PV(9)=PVAL
      PADR=PT(9)
  100 CALL QWPR(PADR,PVAL,IERR)
  101 RETURN
      END


C     RESERVOIR OPERATION ALGORITHM - SUBROUTINE RESRV
      SUBROUTINE RESRV(J,K,QSO,ETF,IFF)
      REAL MIC,MES,KS,KG,MS,MCS
      COMMON WKC(14,12),WK(12),POL(12),N(8),DD(12),FMT(10),CVR(8),
     1V(13),A(10),BASID(10),PV(15),DUM( 3,12,8),PKC(7,12),SWKC(12),
     2SPKC(12),I1(14),OCA(14),CAC(14),PCA(14),PAC(7),PPA(7),OUT(13,21)
     3,DIG(10),RES(10),RESC(10),ROUT(4,13,2),XIM(21)
     4,MIC,MS,EMS2,SKAL,SKF,XIN(6,21),PH(21),PL(21),DR(21),NP(21)
      COMMON INP,IOUT,NSB,LYRO,NYR,IRES,MANG,JRES,CTM,CONV,CONV1,CONPV
     1,MES,SKAL1,SKAL2,SKAL3,SPAC,SCAC,NY8
C     J IS YEAR,K IS MONTH,QSO IS SUBBASIN SURFACE OUTFLOW,
C     ETF IS MOD. B-C EVAP TEMP. FACTOR
C     IFF=1 OPERATE RESERVOIR RULES
C     IFF=2 PRINT JTH YEAR DATA
C     RETURN IF IRES =0
      LA   IRES
      A    /0
      OCT 027410
      J    .5
      J    .99
C      IFF=1 OPERATE
    5 LA   IFF
      S    /2
      OCT 027402
      J    .70
C     IF 1ST MONTH OF 1ST YR INITIALIZE RESV AND EXTREMES
      JJ=K+J
      LA   JJ
      S    /2
      OCT 027410
      J    .7
      STI=RES(1)
      SMAX=STI
      SMIN=STI
      JMN=LYRO-1
      JMX=JMN
      KMN=12
      KMX=12
C     IF 1ST 73
C     IF 1ST MONTH OF ANY YR INIT ANNUAL TOTALS
    7 LA   K
      S    /1
```

Figure B.6. (cont'd)

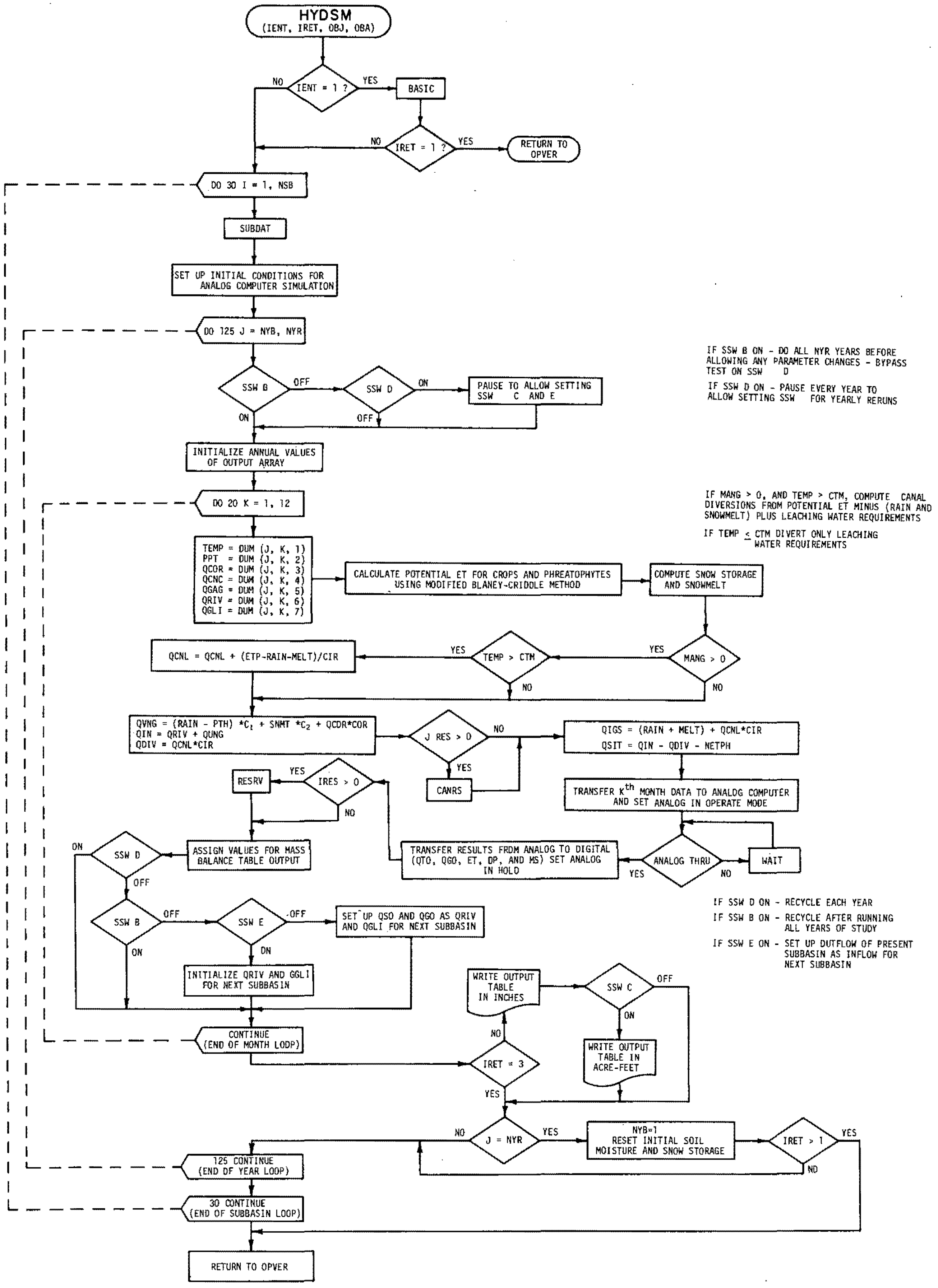
```
      OCT 027410
      J   .9
      DO 8 L=1,4
      ROUT(L,13,2)=0.0
    8 ROUT(L,13,1)=0.0
C     SET UP INITIAL MONTHLY VALUES
    9 QIN=QSO*CONV
      QR=DUM(J,K,8)
      SI=STI
      IC=0
      EVAP=ETF*PKC(7,K)
      OCS=DUM(J,K,2)-EVAP
C      OPERATE RESERVOIR ITERATION
   10 IC=IC+1
      CALL AREA(SI,AR,RES)
   11 OTS=QIN-QR+OCS*AR/12.0
      ST=SI+OTS
C     CHECK EOM ST AGAINST STMAX AND STMIN
      IF(ST.GT.RES(3))GOTO13
      IF(ST.LT.RES(2))GOTO14
      QRR=QR
      J   .20
   13 QRR=QR+ST-RES(3)
      ST=RES(3)
      J   .20
   14 QDM=RES(2)-ST
      QOD=QR-QDM
      IF(QOD.LT.0.0)GOTO15
      QRR=QOD
      ST=RES(2)
      J   .20
   15 QRR=0.0
      ST=RES(2)+QOD
      IF(RES(5).LE.0.0)ST=0.0
C     COMPUTE AVERAGE STORAGE FOR MONTH
   20 SA=(STI+ST)/2.0
C     COMPUTE AVE AREA FOR MONTH
      CALL AREA(SA,AT,RES)
C     CHECK AGAINST GUESSED AVERAGE
      ER=RES(4)
      AC=(AT-AR)/AR
      AK=ABS(AC)
      AC=ER-AK
      LA  AC
      SKP
      J   .21
      J   .25
C     CHECK ITERATIONS
   21 ICC=IC-30
      LA  ICC
      SKN
      J   .23
      SI=SA
      J   .10
   23 WRITE(6,100)SI,SA,ST
C     IC EXCEEDS 30
  100 FORMAT(12H EXCESS ITER,3F20.3)
C     SET UP FOR NEXT MONTH
   25 QR=QRR
      QSO=QR/CONV
C     COMPUTE OUTPUT ARRAY
      DA=ST/12.0
      CALL RSOUT(1,K,1,ST,DA,ROUT)
      DM=ST-STI
      CALL RSOUT(2,K,1,DM,DM,ROUT)
      DM=EVAP*AR/12.0
      CALL RSOUT(3,K,1,DM,DM,ROUT)
      DM=DUM(J,K,2)*AR/12.0
      CALL RSOUT(4,K,1,DM,DM,ROUT)
      CALL RSOUT(1,K,2,QIN,QIN,ROUT)
      CALL RSOUT(2,K,2,QR,QR,ROUT)
      CALL RSOUT(3,K,2,EVAP,EVAP,ROUT)
C      INITIALIZE NEXT MONTHS ST
      STI=ST
C        CHECK EXTREMES
      EMX=ST-SMAX
      LA  EMX
      SKP
      J   .30
      SMAX=ST
      JMX=LYRO+J-1
      KMX=K
      J   .33
   30 EMN=SMIN-ST
      LA  EMN
      SKP
      J   .33
      SMIN=ST
      JMN=LYRO+J-1
      KMN=K
   33 RETURN
```

```
C     IFF=2 PRINT RES DATA
   70 JR=LYRO+J-1
      WRITE(6,102)(BASID(L),L=1,10),JR
  102 FORMAT(1X10A4,I5///10X,22HRESERVOIR DATA (AC-FT))
      WRITE(6,103)(V(L),L=1,6)
  103 FORMAT(/4X5HMONTH,7(7XA3))
      WRITE(6,104)(ROUT(1,K,1),K=1,6)
      WRITE(6,105)(ROUT(2,K,1),K=1,6)
      WRITE(6,106)(ROUT(3,K,1),K=1,6)
      WRITE(6,107)(ROUT(4,K,1),K=1,6)
      WRITE(6,108)(ROUT(1,K,2),K=1,6)
      WRITE(6,109)(ROUT(2,K,2),K=1,6)
      WRITE(6,110)(ROUT(3,K,2),K=1,6)
      WRITE(6,103)(V(L),L=7,13)
      WRITE(6,104)(ROUT(1,K,1),K=7,13)
      WRITE(6,105)(ROUT(2,K,1),K=7,13)
      WRITE(6,106)(ROUT(3,K,1),K=7,13)
      WRITE(6,107)(ROUT(4,K,1),K=7,13)
      WRITE(6,108)(ROUT(1,K,2),K=7,13)
      WRITE(6,109)(ROUT(2,K,2),K=7,13)
      WRITE(6,110)(ROUT(3,K,2),K=7,13)
  104 FORMAT(/2X8HSTORAGE ,/2X8HAT EOM  ,7F10.0)
  105 FORMAT(/2X8HCHANGE  ,/2X8HIN STOR ,7F10.0)
  106 FORMAT(/2X8HEVAP    ,/2X8HVOLUME  ,7F10.0)
  107 FORMAT(/2X8HPRECIP  ,/2X8HVOLUME  ,7F10.0)
  108 FORMAT(/2X8H        ,/2X8HINFLOW  ,7F10.0)
  109 FORMAT(/2X8H        ,/2X8HOUTFLOW ,7F10.0)
  110 FORMAT(/2X8HEVAP    ,/2X8H(INCHES),7F10.2/)
C     J=NYR WRITE EXTREMES
      JE=NYR-J
      LA  JE
      A   /0
      OCT 027410
      J   .75
      WRITE(6,120)J,SMAX,V(KMX),JMX
      WRITE(6,121)J,SMIN,V(KMN),JMN
  120 FORMAT(//10X15HMAX STORAGE FOR,I3,7H YEARS=,F10.0,5HAC-FT,2XA3,I5)
  121 FORMAT(//10X15HMIN STORAGE FOR,I3,7H YEARS=,F10.0,5HAC-FT,2XA3,I5)
   75 LA  JRES
      A   /0
      OCT 027410
      J   .99
      WRITE(6,125)
  125 FORMAT(1H1)
   99 RETURN
      END
```

```
C     RESERVOIR OPERATION OUTPUT ARRAY ALLOCATOR
      SUBROUTINE RSOUT(L,K,N,DM,DA,ROUT)
      DIMENSION ROUT(4,13,2)
      ROUT(L,K,N)=DM
      ROUT(L,13,N)=ROUT(L,13,N)+DA
      RETURN
      END
```

```
C     RESERVOIR SURFACE AREA ALGORITHM - SUBROUTINE AREA
      SUBROUTINE AREA(SI,AR,RES)
      DIMENSION RES(10)
      IF(SI.LT.0.0)GOTO10
      IF(SI.LT.RES(8))GOTO1
      C2=RES(10)
      AR=RES(9)*SI**C2
      J   .12
    1 C2=RES(7)
      AR=RES(6)*SI**C2+RES(5)
      J   .12
   10 AR=RES(5)
   12 RETURN
      END
```

Figure B.6. (cont'd)



IF SSW B ON - DO ALL NYR YEARS BEFORE ALLOWING ANY PARAMETER CHANGES - BYPASS TEST ON SSW D

IF SSW D ON - PAUSE EVERY YEAR TO ALLOW SETTING SSW FOR YEARLY RERUNS

IF MANG > 0, AND TEMP > CTM, COMPUTE CANAL DIVERSIONS FROM POTENTIAL ET MINUS (RAIN AND SNOWMELT) PLUS LEACHING WATER REQUIREMENTS

IF TEMP ≤ CTM DIVERT ONLY LEACHING WATER REQUIREMENTS

IF SSW D ON - RECYCLE EACH YEAR

IF SSW B ON - RECYCLE AFTER RUNNING ALL YEARS OF STUDY

IF SSW E ON - SET UP OUTFLOW OF PRESENT SUBBASIN AS INFLOW FOR NEXT SUBBASIN

Figure B.7. Flow chart of subroutine HYDSYM.

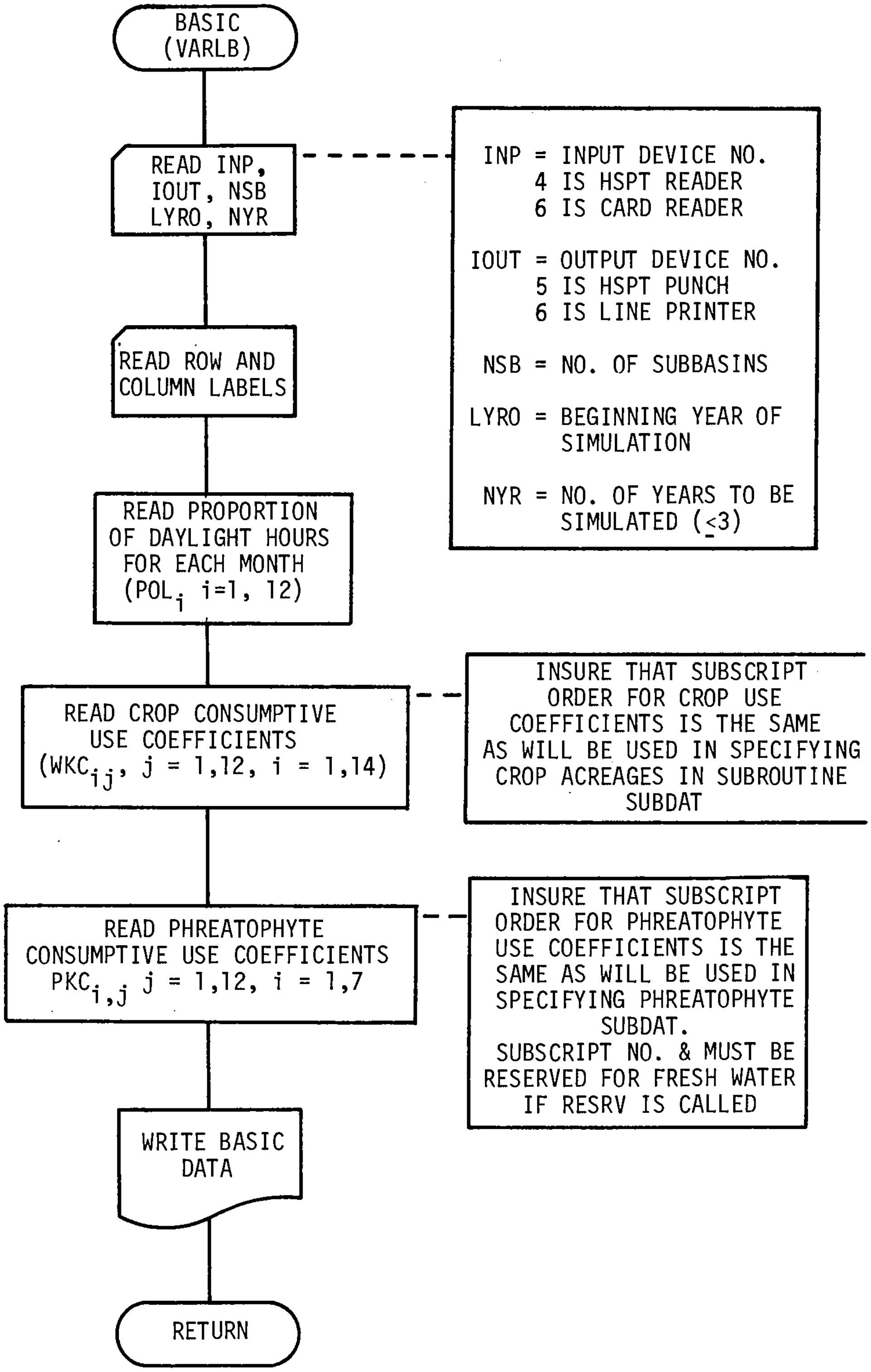


Figure B.8. Flow chart of subroutine BASIC.

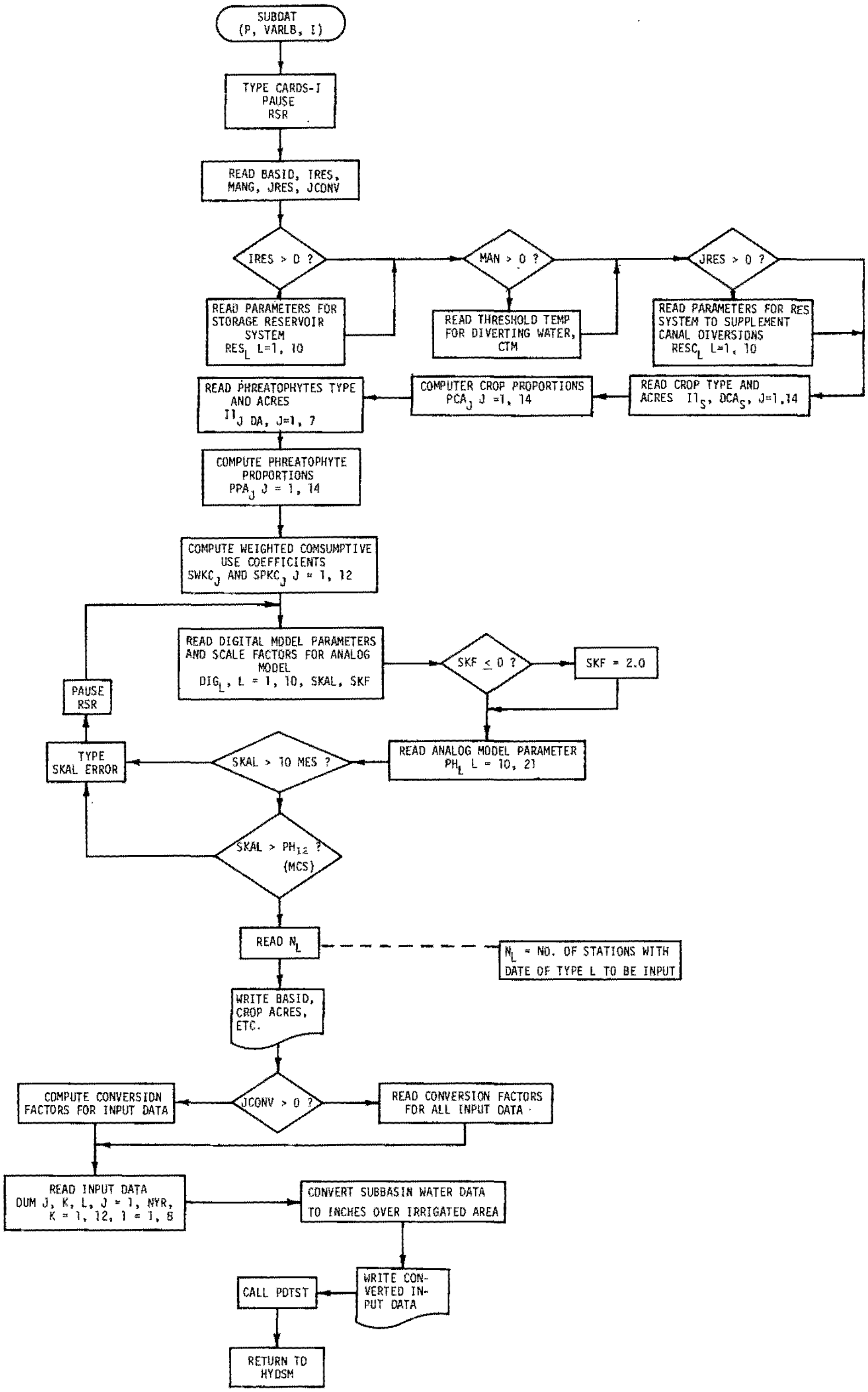


Figure B.9. Flow chart of subroutine SUBDAT.

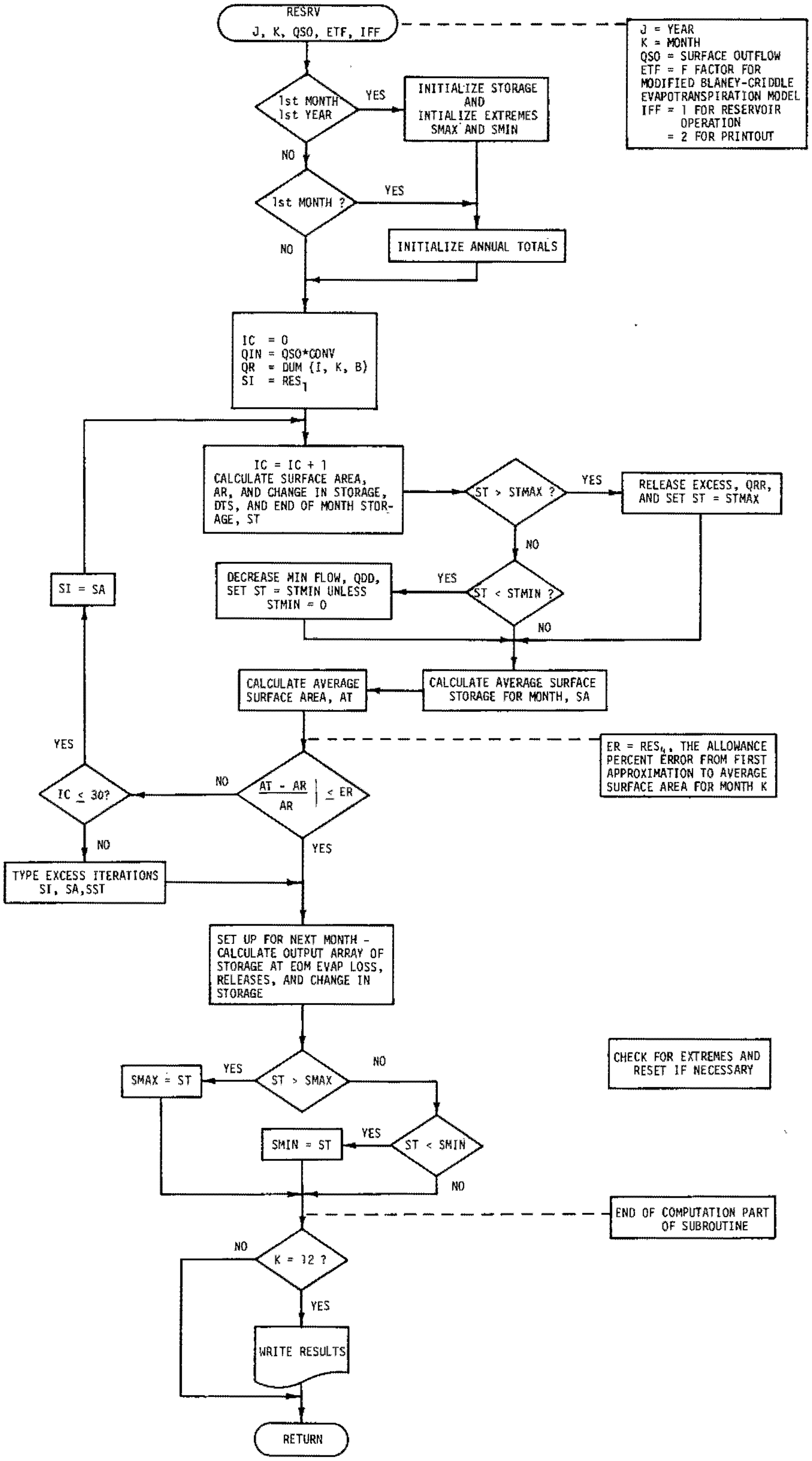


Figure B.10. Flow chart of subroutine RESRV.

APPENDIX C

MODIFIED INPUT DATA, MODEL COEFFICIENTS, AND OUTPUT DATA

APPENDIX C

MODIFIED INPUT DATA, MODEL COEFFICIENTS, AND OUTPUT DATA

This appendix includes modified input data, model variable values for each subbasin, and model output for each subbasin. The first printout page lists the modified input data and the coefficients for the subbasin. Modified data includes the input data from Appendix A but in a scaled and summed, where necessary, form. The next three printout pages list the subbasin outputs for the three modeled years. Four printout pages are listed on one page of text in this appendix. The modified input data and the output data for one subbasin occupies one page of text.

The modified input data pages list the name of the subbasin on the first line and indicate the use of program options on the second line. The third and fourth lines list the acreages of the crops in the subbasin according to the land use table and the total crop acreage. The fifth and sixth lines give the fraction of the total crop acreage for each crop. The seventh line lists a conversion factor for converting inches over the total crop area to acre-feet. The eighth line lists acreage for each phreatophyte. The ninth line gives the total phreatophyte acreage. Lines ten and eleven list the fraction of total phreatophyte acreage for each phreatophyte and the conversion factor from inches over the phreatophyte acreage to acre-feet. Lines twelve and thirteen give weighted values for crop and phreatophyte consumptive use coefficients. Lines fourteen and fifteen are the verified values of the model variables. The next twenty-four lines represent the input data for the years of modeling, in this case 1954, 1955, and 1956. The input data beginning with number one are temperature, precipitation, streamflow for correlation purposes, canal diversion, gaged outflow, gaged river inflow, groundwater inflow, and reservoir storage or a dummy variable for any desired data. The last two groups of data are the calculated and actual potentiometer settings. The variables listed on the output data printouts are defined in Appendix B and are given here in units of acre-feet. The variables are given for each month and an annual summary or average.

```
EVANSTON
   0    0      0    0
   2599.     8823.    19835.      314.        0.        0.        0.
      0.        0.        0.        0.        0.        0.        0.   31571.
   .08232    .27946    .62826    .00994    .00000    .00000    .00000
   .00000    .00000    .00000    .00000    .00000    .00000    .00000
32630.916
    632.      609.     3523.      261.     2434.        0.        0.
   7459.
   .08472    .08164    .47231    .03499    .32631    .00000    .00000
621.58325
   .55   .66   .80   .91  1.07  1.10  1.04  1.00   .92   .82   .75   .60
   .81   .90   .99  1.04  1.07  1.10  1.12  1.13  1.12  1.10  1.03   .92
   .90   .38  1.00   .00   .70   .79   .00 32.00 24.00  1.59 20.00  2.00
 10.00  7.00 11.00   .20   .00   .00   .00   .00   .00   .00  2.50  2.50
 1 1954 22.10 24.20 24.70 40.60 49.70 54.80 65.20 59.30 53.70 43.80 34.40 17.40
 1 1955 12.20 14.70 20.30 34.20 47.30 54.90 62.10 63.00 52.10 42.00 22.90 20.40
 1 1956 20.20 10.70 25.20 35.50 48.30 58.90 62.60 56.90 53.10 39.70 22.30 16.60
 2 1954   .69   .34   .75   .14   .78  1.43  1.11  1.60   .70   .89  1.42   .73
 2 1955   .57   .81   .49   .19  1.29  1.15  1.37  1.15  1.28   .40   .82  1.80
 2 1956  1.21   .35   .07   .39  2.32   .67   .71   .38   .02   .94   .14   .83
 3 1954   .18   .21   .33  1.12   .54   .77   .07   .02   .02   .02   .06   .06
 3 1955   .06   .05   .07  1.47   .78   .71   .06   .03   .01   .02   .06   .41
 3 1956   .24   .18   .97   .82  1.41   .24   .10   .08   .01   .02   .03   .05
 4 1954   .00   .00   .00  4.00 14.00 13.00  4.23  1.29   .95  1.00   .00   .00
 4 1955   .00   .00   .00   .00 14.04 15.81  4.27  2.10  1.06  1.00   .00   .00
 4 1956   .00   .00   .00   .00  7.99 17.00  6.52  1.96   .81  1.19   .00   .00
 5 1954  1.52  1.47  2.77  5.59 10.63  2.75   .29   .01   .00   .06   .39   .83
 5 1955  1.00   .91  1.12  5.38 12.31  9.26   .16   .08   .00   .12   .99  2.96
 5 1956  2.27  1.83  5.86  6.43 22.65 15.72   .89   .02   .00   .09   .94  1.04
 6 1954  1.26  1.25  1.55  5.20 16.46  7.73  3.04  1.20  1.17  1.07   .98   .96
 6 1955   .92   .82   .93  3.33 16.33 15.22  3.29  1.87  1.19  1.21  1.03  1.66
 6 1956  1.29  1.07  2.33  4.95 26.43 22.18  4.56  1.68   .66  1.17  1.04  1.05
 7 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

POTS 10 THRU 24 SHOULD BE SET AS FOLLOWS
  .10000  .01275  .03571  .54999  .01000
  .00000  .00000  .02380  .50000  .00000
  .10000  .00000  .00000  .00000  .79999

POTS 10 THRU 24 ARE SET AS FOLLOWS
  .10009  .01275  .03564  .54956  .00994
  .00000  .00000  .02374  .49975  .00000
  .10015  .00000  .00000  .00000  .79968
```

```
EVANSTON                                  1954

     VAR       JAN       FEB       MAR       APR       MAY       JUN
    TEMP     22.10     24.20     24.70     40.60     49.70     54.80
       F      1.45      1.62      2.05      3.65      5.01      5.58
     PPT   1815.33    694.51   1973.18    368.32   2052.11   3762.20
    QRIV   3323.99   3300.99   4097.99  13691.99  43322.98  20339.99
    QUNG    388.67   1233.27   3225.36   5228.42   1129.70   1611.59
    QCNL       .00       .00       .00  10523.99  36832.98  34201.98
    QSIT   3490.69   4259.69   6942.17  13998.39  28618.47   6528.77
    QIGS       .00   1135.46   3613.38   8484.77  16048.65  16758.96
    QGLI       .00       .00       .00       .00       .00       .00
     SNW   5998.48   5757.53   4117.33       .00       .00       .00
    SNMT       .00   1135.46   3613.38   4117.32       .00       .00
    ETPH    221.98    274.58    381.18    924.90   1837.67   2426.05
     ETP    637.78    848.33   1308.78   3434.08   7740.16  10347.55
      ET    629.46    809.31   1342.43   3449.22   7746.30  10360.51
      MS   5968.36   6352.48   8664.80  13726.24  22005.66  28428.79
      DP    571.65    552.38    520.27    475.31    423.92    386.11
     QTO   4086.03   4765.98   7399.48  14413.51  28955.49   6859.90
     QGO     77.07     64.23     64.23     38.53     38.53     51.38
     QSO   3930.95   4701.73   7335.22  14374.97  28916.95   6808.52
    QGAG   3999.99   3689.99   7309.99  14719.99  27969.99   7249.99
    DIFF    -69.03    611.73     25.22   -345.01    946.96   -441.47

     VAR       JLY       AUG       SEP       OCT       NOV       DEC       ANN
    TEMP     65.20     59.30     53.70     43.80     34.40     17.40     40.82
       F      6.78      5.69      4.51      3.41      2.27      1.09     43.16
     PPT   2920.31   4209.46   1841.64   2341.51   3735.90   1920.56  27835.07
    QRIV   6012.99   3178.99   3090.99   2820.99   2578.99   2528.99 110287.89
    QUNG    159.57     60.82     41.86     55.29    134.29    126.39  13395.31
    QCNL  11126.99   3393.99   2499.99   2630.99       .00       .00 101212.92
    QSIT     90.66   -816.36    237.80    834.38   2275.90   2486.50  68825.86
    QIGS   7149.33   5499.16   2791.64   3341.29   3735.90       .00  68558.56
    QGLI       .00       .00       .00       .00       .00       .00       .00
     SNW       .00       .00       .00       .00       .00   1920.56   1920.56
    SNMT       .00       .00       .00       .00       .00       .00   8868.16
    ETPH   3852.89   2864.47   1945.06   1042.13    437.39    188.68  16397.23
     ETP  15229.57  10709.16   6739.40   3300.81   1359.16    526.05  62180.89
      ET  15222.63  10720.21   6789.25   3320.76   1374.55    552.38  62317.25
      MS  20361.33  15171.44  11259.75  11311.14  13674.85  13161.00  13161.00
      DP    314.73    237.65    211.96    134.88     89.92     64.23   3963.87
     QTO    334.00   -706.54    359.69    912.08   2299.48   2492.17  72093.26
     QGO     64.23     25.69     77.07     51.38     51.38     64.23    668.00
     QSO    269.77   -732.23    282.61    860.70   2248.09   2427.94  71425.26
    QGAG    765.99     36.00       .00    172.99   1025.99   2191.99  69334.93
    DIFF   -496.22   -770.23    282.61    687.70   1222.09    235.94   2090.31



     OBJ=                 .695
     OBA=                 .794
```

```
EVANSTON                                  1955

     VAR       JAN       FEB       MAR       APR       MAY       JUN
    TEMP     12.20     14.70     20.30     34.20     47.30     54.90
       F       .80       .98      1.66      3.07      4.77      5.59
     PPT   1499.62   2131.04   1289.14    499.87   3393.88   3025.55
    QRIV   2442.99   2171.99   2460.99   8774.99  48232.97  40062.98
    QUNG    130.34    116.12    153.25   7645.06   1635.79   1485.19
    QCNL       .00       .00       .00       .00  38963.99  41594.98
    QSIT   2450.80   2121.33   2300.97  16018.24  34206.55  23304.96
    QIGS       .00       .00       .00   7339.54  17440.90  18831.64
    QGLI       .00       .00       .00       .00       .00       .00
     SNW   3420.19   5551.23   6840.36       .70       .00       .00
    SNMT       .00       .00       .00   6839.67       .70       .00
    ETPH    122.54    168.79    313.27    601.81   1615.69   2437.11
     ETP    352.07    515.31   1075.64   2234.47   6806.02  10394.72
      ET    366.11    526.69   1091.93   2267.36   6840.63  10392.63
      MS  12881.30  12293.88  11214.79  16346.88  26983.59  28987.60
      DP     38.53     12.84     12.84     12.84     12.84     19.26
     QTO   2427.94   2093.94   2260.94  15955.06  34145.39  23277.44
     QGO     25.69     64.23     51.38     38.53     25.69     25.69
     QSO   2402.25   2029.71   2209.55  15916.52  34119.69  23251.75
    QGAG   2639.99   2399.99   2959.99  14169.99  32409.98  24369.99
    DIFF   -237.74   -370.28   -750.44   1746.53   1709.70  -1118.24

     VAR       JLY       AUG       SEP       OCT       NOV       DEC       ANN
    TEMP     62.10     63.00     52.10     42.00     22.90     20.40     37.17
       F      5.45      6.04      4.37      3.27      1.51      1.28     39.88
     PPT   3604.35   3025.55   3367.57   1052.36   2157.35   4735.64  29781.96
    QRIV   8674.99   4932.99   3153.99   3206.99   2729.99   4381.99 131227.87
    QUNG    128.76     81.36     41.07     59.24    175.37    853.19  12704.83
    QCNL  11259.99   5550.99   2788.99   2630.99       .00       .00 100789.93
    QSIT   1097.05   -411.64    333.08   1337.28   2614.20   5013.74  90386.35
    QIGS   7883.15   5134.93   4427.39   2052.14       .00       .00  63109.68
    QGLI       .00       .00       .00       .00       .00       .00       .00
     SNW       .00       .00       .00       .00   2157.35   6893.00   6693.00
    SNMT       .00       .00       .00       .00       .00       .00   6840.38
    ETPH   3427.91   3316.83   1802.17    929.18    291.17    221.45  15246.17
     ETP  13549.73  12400.38   6244.31   2943.04    904.80    616.74  58037.26
      ET  13552.81  12396.65   6275.40   2941.79    931.35    629.46  58212.87
      MS  23335.25  16044.99  14246.51  13366.54  12448.03  11850.68  11850.68
      DP     89.92    263.34    449.61    629.46    732.23    809.31   3083.10
     QTO   1156.16   -192.69    732.23   1926.94   3314.33   5780.82  92878.53
     QGO     38.53     25.69     64.23     38.53     51.36     51.38    501.00
     QSO   1117.62   -218.38    668.00   1888.40   3262.95   5729.43  92377.53
    QGAG    446.99    215.99      2.00    315.99   2608.99   7807.99  90347.92
    DIFF    670.62   -434.38    666.00   1572.40    653.95  -2078.56   2029.61



     OBJ=                 3.048
     OBA=                 1.565
```

```
EVANSTON                                  1956

     VAR       JAN       FEB       MAR       APR       MAY       JUN
    TEMP     20.20     10.70     25.20     35.50     48.30     58.90
       F      1.33       .71      2.09      3.19      4.87      6.00
     PPT   3183.40    920.82    184.16   1026.03   6103.72   1762.71
    QRIV   3417.99   2833.99   6129.99  13039.99  69559.96  56311.98
    QUNG    509.54    385.51   7191.35   4372.22   2938.86    515.07
    QCNL       .00       .00       .00       .00  21046.99  44725.98
    QSIT   3724.84   3098.11  12932.45  16787.21  62794.32  38931.89
    QIGS       .00       .00   7384.22   4823.09  14101.70  18758.58
    QGLI       .00       .00       .00       .00       .00       .00
     SNW  10075.40  10997.22   3797.16       .12       .00       .00
    SNMT       .00       .00   7384.22   3797.04       .12       .00
    ETPH    202.90    121.40    388.89    625.00   1706.68   2899.27
     ETP    562.95    375.09   1335.27   2320.57   7186.33  12365.91
      ET    523.04    365.38   1348.85   2325.17   7208.75  12370.95
      MS  11266.17  10900.06  16963.50  19449.25  25418.35  28987.60
      DP    802.89    757.92    674.42    552.38    423.92    321.15
     QTO   4470.50   3815.34  13539.96  17278.23  63152.26  39193.96
     QGO     38.53     51.38     51.38     64.23     51.38     25.69
     QSO   4431.96   3763.95  13488.58  17214.00  63100.68  39168.28
    QGAG   5979.99   4829.99  15463.99  16929.99  60129.98  41379.98
    DIFF  -1548.03  -1066.04  -1995.41    284.00   2970.90  -2211.70

     VAR       JLY       AUG       SEP       OCT       NOV       DEC       ANN
    TEMP     62.60     56.90     53.10     39.70     22.30     16.60     37.49
       F      6.51      5.46      4.46      3.09      1.47      1.04     40.27
     PPT   1867.95    999.74     52.61   2473.06    368.32   2183.86  21128.24
    QRIV  12002.99   4435.99   2269.99   3084.99   2749.99   2774.99 180612.87
    QUNG    210.13    170.63     33.97     53.71     79.78    114.54  16575.41
    QCNL  17153.99   5156.99   2156.99   3156.99       .00       .00  93397.92
    QSIT   2199.78     58.74   -406.55   1145.46   2546.24   2709.34 146521.62
    QIGS   8356.48   2959.40    872.27   3672.72       .00       .00  60958.46
    QGLI       .00       .00       .00       .00       .00       .00       .00
     SNW       .00       .00       .00       .00    368.32   2551.98   2551.98
    SNMT       .00       .00       .00       .00       .00       .00  11181.38
    ETPH   3494.82   2588.23   1890.86    793.59    283.54    188.20  15175.41
     ETP  13814.22   9676.43   6551.62   2513.60    881.10    501.86  58108.97
      ET  13829.01   9673.24   6564.44   2530.71    905.66    526.69  58289.95
      MS  23547.21  16860.73  11208.37  12325.99  11465.29  10957.86  10957.86
      DP    244.07    263.34    321.15    366.11    398.23    436.77   5562.43
     QTO   2402.25    282.61   -167.00   1464.47   2916.10   3095.95 151444.68
     QGO     51.38     64.23     12.84     77.07     51.36     64.23    603.77
     QSO   2350.86    218.38   -179.84   1387.39   2864.71   3031.71 150840.90
    QGAG   1640.99     57.00       .00    250.99   2479.99   2749.99 152112.87
    DIFF    509.88    161.36   -179.84   1136.39    384.71    281.72  -1271.96



     OBJ=                 6.392
     OBA=                 1.082
```

```
RANDOLPH
   0    0      0    1
   1916.     5518.    40025.     1213.        0.        0.        0.
      0.        0.        0.        0.        0.        0.        0.   48672.
  .03936    .11337    .02234    .02492    .00000    .00000    .00000
  .00000    .00000    .00000    .00000    .00000    .00000    .00000
$4056.000
    884.     2146.      765.      608.     2073.        0.        0.
   6475.
  .13652    .33127    .11614    .09389    .32015    .00000    .00000
539.58325
    .54   .65   .79   .92  1.08  1.13  1.07  1.01   .92   .82   .75   .60
    .89  1.02  1.19  1.29  1.32  1.32  1.32  1.31  1.29  1.24  1.13   .98
   1.30   .45  1.00   .00   .50   .02   .00 32.00 26.50  1.86 20.00  2.00
  10.00  1.40 14.00   .00   .00 40.00  1.00   .00   .20   .30  2.50  2.00
 1 1954 21.80 19.90 27.60 41.80 50.00 54.70 64.60 59.00 52.80 42.60 34.70 13.10
 1 1955  7.80 11.50 19.70 35.00 47.60 54.40 62.10 62.80 52.20 42.80 25.70 26.40
 1 1956 19.30 10.60 27.50 39.60 50.50 56.20 64.00 57.10 52.50 42.30 24.90 17.00
 2 1954   .93   .47  1.02   .19  1.05  1.94  1.50  2.17   .95  1.21  1.92   .99
 2 1955   .78  1.10   .67   .26  1.75  1.57  1.86  1.57  1.74   .54  1.12  2.45
 2 1956  1.64   .48   .09   .53  3.14   .92   .96   .51   .03  1.27   .19  1.13
 3 1954  5.85  5.71  7.02  8.43 12.50  9.76  7.42  5.59  4.69  4.64  4.29  4.11
 3 1955  3.90  3.30  3.95  4.46 14.10  9.60  6.57  5.42  4.47  4.43  4.36  6.36
 3 1956  5.67  4.67  8.43 20.10 29.20 19.80 15.50 12.20 10.10  9.66  7.57  6.60
 4 1954   .00   .00   .00  2.00 15.50  3.59  1.05   .48   .36   .00   .00   .00
 4 1955   .00   .00   .00  5.00 20.00 11.60  3.50   .52   .32   .00   .00   .00
 4 1956   .00   .00   .00  3.00 16.00 12.05  6.00   .45   .52   .00   .00   .00
 5 1954  1.20  1.39  2.53  2.07   .81   .51   .15   .11   .09   .15   .21   .44
 5 1955   .61   .56   .49  2.04  1.09  2.29   .44   .45   .18   .11   .37  1.87
 5 1956  2.31  1.02  7.39  4.20  9.99  7.66   .56   .35   .13   .20   .60   .84
 6 1954  1.34  1.31  2.29  4.55  8.44  2.45   .67   .42   .29   .38   .56   .85
 6 1955   .93   .84  1.03  4.10 10.39  7.05   .90   .60   .30   .37   .97  2.58
 6 1956  1.94  1.57  4.56  6.05 18.98 11.65  1.54   .73   .45   .55  1.01  1.05
 7 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

POTS 10 THRU 24 SHOULD BE SET AS FOLLOWS
  .10000  .31687  .17857  .69999  .00000
  .00000 1.00000  .11904  .50000  .02500
  .10000  .00000  .19999  .29999  .79999

POTS 10 THRU 24 ARE SET AS FOLLOWS
  .09997  .31678  .17797  .69958  .00006
  .00000  .99835  .11877  .49969  .02496
  .09946  .00000  .19995  .29974  .79966
```

```
RANDOLPH                                1954

   VAR       JAN       FEB       MAR       APR       MAY       JUN
  TEMP     21.80     19.90     27.60     41.80     50.00     54.70
     F      1.43      1.33      2.29      3.76      5.05      5.57
   PPT   3772.07   1906.31   4137.11    770.63   4258.79   7866.63
  QRIV   5461.99   5349.99   9326.98  18455.97  34244.94   9965.98
  QUNG    474.55    463.19   7202.98   2770.71   1014.00    791.73
  QCNL       .00       .00       .00   6112.00  62867.99  14561.03
  QSIT   5729.19   5591.44  16085.89  16497.06   4960.98   1680.70
  QIGS       .00       .00  13267.04   8594.78  32549.39  14421.10
  QGLI       .00       .00       .00       .00       .00       .00
   SNW  11397.35  13303.67   4173.74       .00       .00       .00
  SNMT       .00       .00  13267.04   4173.74       .00       .00
  ETPH    207.35    221.74    444.07   1079.21   1987.36   2524.53
   ETP    957.07   1060.90   2228.49   5792.89  12250.83  16261.33
    ET    772.38    772.38   2119.10   5822.57  12259.10  16259.64
    MS   7406.95   6674.17  17853.92  20685.99  40965.99  39104.35
    DP     49.51     49.51     49.51     59.41     59.41     59.41
   QTO   5703.75   5525.50  16061.60  16437.89   4931.36   1663.59
   QGO   1227.89   1148.67   3267.77   3366.79   1069.45    653.55
   QSO   4475.85   4376.83  12793.82  13071.09   3861.91   1010.03
  QGAG   4869.99   5569.99  10299.98   8429.98   3289.99   2099.99
  DIFF   -414.13  -1293.15   2493.84   4641.10    571.91  -1069.95

   VAR       JLY       AUG       SEP       OCT       NOV       DEC       ANN
  TEMP     64.50     59.00     52.80     42.60     34.70     13.10     40.21
     F      6.71      5.66      4.43      3.32      2.29       .82     42.71
   PPT   6084.00   8801.51   3853.19   4907.75   7787.51   4015.43  58163.00
  QRIV   3553.99   1721.99   1176.99   1550.99   2300.99   3456.99  96567.78
  QUNG    601.91    453.48    396.67    376.39    348.00    333.40  15227.02
  QCNL   4258.79   1946.67   1541.27       .00       .00       .00  93267.95
  QSIT  -1605.96  -1542.83   -971.72    981.00   2228.52   3659.39  53313.85
  QIGS   8000.45   9677.81   4546.77   4907.75   7787.51       .00 103752.42
  QGLI       .00       .00       .00       .00       .00       .00       .00
   SNW       .00       .00       .00       .00       .00   4015.43   4015.43
  SNMT       .00       .00       .00       .00       .00       .00  17440.79
  ETPH   3845.40   2842.00   1651.81    946.39    420.47    130.99  16501.37
   ETP  23463.17  16528.21   9959.17   4688.04   2105.14    610.99  95902.25
    ET  23498.26  16546.81   9991.46   4693.71   2119.10    653.55  95508.09
    MS  23775.52  16683.49  11457.01  11734.27  17436.02  16804.27  16804.27
    DP     49.51     59.41     59.41     49.51     49.51     59.41    653.55
   QTO  -1523.98  -1564.57  -1010.03    970.42   2198.32   3624.25  52918.12
   QGO   -455.50   -435.70   -277.26    435.70    752.57   1188.28  11942.22
   QSO  -1166.47  -1128.86   -732.77    534.72   1445.74   2435.97  40975.89
  QGAG    609.99    479.99    395.99    627.99    868.99   1819.99  39502.89
  DIFF  -1778.47  -1608.86  -1128.77    -93.27    556.74    615.97   1472.99


        OBJ=                 2.361
        OBA=                  .363
```

```
RANDOLPH                                1955

   VAR       JAN       FEB       MAR       APR       MAY       JUN
  TEMP      7.80     11.50     19.70     35.00     47.60     54.40
     F       .51       .77      1.63      3.15      4.80      5.54
   PPT   3163.67   4461.59   2717.51   1054.55   7098.00   6367.91
  QRIV   3788.99   3442.99   4190.99  16629.97  42153.92  28621.95
  QUNG    316.36    267.69    320.42   7540.79   1143.90    778.75
  QCNL       .00       .00       .00  20280.00  81119.98  47049.59
  QSIT   4031.17   3582.54   4194.44  14382.17   5044.44   5738.31
  QIGS       .00       .00       .00  24538.56  43602.20  27540.23
  QGLI       .00       .00       .00       .00       .00       .00
   SNW   7179.11  11640.71  14358.23       .22       .00       .00
  SNMT       .00       .00       .00  14358.00       .22       .00
  ETPH     74.19    128.14    316.96    662.59   1749.40   2490.08
   ETP    342.43    613.08   1589.20   3556.61  10783.95  16039.40
    ET    376.28    653.55   1604.17   3564.64  10823.26  16041.79
    MS  16447.79  15853.85  14269.27  35192.92  56819.64  56819.64
    DP     59.41     49.51     39.60     49.51     99.02   5129.41
   QTO   3980.74   3525.23   4158.98  14298.98   5089.80  10813.35
   QGO   1148.67   1168.47    911.01   2931.09   1089.25   2237.92
   QSO   2832.07   2356.75   3247.96  11367.89   4000.54   6575.42
  QGAG   2479.99   2279.99   1999.99   8299.98   4429.99   9339.98
  DIFF    352.07     76.76   1247.97   3067.90   -429.44   -734.55

   VAR       JLY       AUG       SEP       OCT       NOV       DEC       ANN
  TEMP     62.10     62.80     52.20     42.80     25.70     26.40     37.33
     F      6.45      6.02      4.38      3.33      1.69      1.66     39.99
   PPT   7544.15   6367.91   7057.43   2190.23   4542.71   9937.19  62502.92
  QRIV   3681.99   2471.99   1224.99   1526.99   3973.99  10498.98 122207.75
  QUNG    532.95    439.67    362.60    359.36    353.68    515.92  12932.13
  QCNL  14195.99   2109.11   1297.91       .00       .00       .00 166852.53
  QSIT  -5670.68  -1343.88   -795.53    927.74   4016.25  10750.90  44857.68
  QIGS  13932.35   7317.02   7641.50   2190.23       .00       .00 126762.07
  QGLI       .00       .00       .00       .00       .00       .00       .00
   SNW       .00       .00       .00       .00   4542.71  14479.91  14479.91
  SNMT       .00       .00       .00       .00       .00       .00  14358.23
  ETPH   3497.63   3306.44   1799.07    958.61    311.41    263.99  15558.56
   ETP  21341.21  19226.95   9675.50   4748.58   1559.14   1231.31  90707.37
    ET  21359.35  19230.35   9684.49   4772.92   1594.27   1247.69  90972.82
    MS  49412.69  37559.58  35509.80  32984.70  31410.23  30192.24  30192.24
    DP  11318.37   6030.52    455.50   -306.97    178.24    178.24  23280.41
   QTO   5584.92   4634.29   -415.89    574.33   4099.57  10852.96  67197.29
   QGO   1168.47   1089.25     19.80    277.26    990.23   2257.73  15289.21
   QSO   4416.44   3545.03   -435.70    297.07   3109.33   8595.23  51928.08
  QGAG   1789.99   1849.99    763.99    446.99   1539.99   7599.98  42790.91
  DIFF   2626.44   1695.04  -1199.70   -149.92   1569.33    995.24   9117.16


        OBJ=                 3.972
        OBA=                 2.610
```

```
RANDOLPH                                1956

   VAR       JAN       FEB       MAR       APR       MAY       JUN
  TEMP     19.30     10.60     27.50     39.60     50.50     56.20
     F      1.27       .71      2.28      3.56      5.10      5.73
   PPT   6651.83   1946.87    365.03   2149.87  12735.83   3731.51
  QRIV   7891.98   6376.99  18496.96  24558.96  77018.87  47262.92
  QUNG    459.95    378.83   9211.09   4825.08   2368.70   1606.17
  QCNL       .00       .00       .00  12168.00  64895.99  48874.79
  QSIT   8168.36   6637.70  27265.59  22981.13  48145.63  24175.23
  QIGS       .00       .00  17054.51  14014.42  41939.03  25725.16
  QGLI       .00       .00       .00       .00       .00       .00
   SNW  21131.75  23078.63   6389.15       .00       .00       .00
  SNMT       .00       .00  17054.51   6389.14       .00       .00
  ETPH    163.57    118.11    442.46    927.30   2038.74   2700.21
   ETP    847.31    565.10   2216.42   4977.49  12567.58  17392.92
    ET    861.30    574.33   2237.92   5010.58  12575.97  17438.02
    MS  29330.74  28845.52  43609.92  52690.36  56819.64  56819.64
    DP     49.51     19.80     49.51     49.51   1495.25  12586.07
   QTO   8119.92   6575.15  27211.64  22953.63  49551.32  36638.67
   QGO   1663.59   1386.32   5505.70   4693.71   9941.95   7367.34
   QSO   6456.32   5188.82  21705.93  18259.92  39609.37  29271.32
  QGAG   9399.98   6169.99  30009.95  17069.97  40529.92  31889.94
  DIFF  -2943.65   -981.16  -8304.02   1189.94   -928.56  -2618.62

   VAR       JLY       AUG       SEP       OCT       NOV       DEC       ANN
  TEMP     64.00     57.10     52.50     42.30     24.90     17.00     38.45
     F      6.65      5.48      4.41      3.29      1.64      1.07     41.22
   PPT   3693.75   2068.55    121.67   5151.11    770.63   4583.27  44169.79
  QRIV   6259.99   2986.99   1829.99   2250.99   4101.99   4297.99 203334.59
  QUNG   1287.35    989.66    819.31    783.61    614.07    535.39  23849.25
  QCNL  24335.99   1825.19   2109.11       .00       .00       .00 154209.03
  QSIT  -7194.33    532.76   -125.15   2106.41   4414.34   4663.38 141771.00
  QIGS  14844.95   2889.89   1070.78   5151.11       .00       .00 122689.84
  QGLI       .00       .00       .00       .00       .00       .00       .00
   SNW       .00       .00       .00       .00    770.63   5353.91   5353.91
  SNMT       .00       .00       .00       .00       .00       .00  23443.66
  ETPH   3760.48   2622.54   1625.35    928.19    301.72    169.99  16018.72
   ETP  22945.00  15250.10   9816.85   4597.91   1510.61    792.89  93482.17
    ET  22983.33  15269.41   9842.92   4614.49   1594.27    811.99  93834.60
    MS  46739.33  36450.52  27896.85  28261.28  26736.32  25924.33  25924.33
    DP  14536.64   5099.70    -99.02   -148.53    326.77    168.33  34113.57
   QTO   7307.92   5584.92   -277.28   1901.25   4594.68   4713.51 174875.37
   QGO   1623.98   1326.91     19.80    732.77    990.23   1010.03  36262.38
   QSO   5683.94   4258.00   -297.07   1166.47   3604.45   3703.47 138613.00
  QGAG   2759.99   1439.99    530.99    848.99   2459.99   3419.99 146529.62
  DIFF   2923.94   2618.00   -828.06    319.47   1144.45    283.48  -7916.64


        OBJ=                10.438
        OBA=                  .659
```

```
COKEVILLE
  0    0     0   1
   577.    9076.    18982.     510.       0.       0.       0.
     0.       0.       0.       0.       0.       0.       0.   29145.
 .01979   .31140   .55129   .01749   .00000   .00000   .00000
 .00000   .00000   .00000   .00000   .00000   .00000   .00000
$2428.750
     0.      68.    1344.      15.     803.       0.       0.
  2230.
 .00000   .03049   .60269   .00672   .36008   .00000   .00000
185.83331
   .54   .65   .80   .91  1.07  1.10  1.04   .99   .91   .81   .75   .60
   .72   .81   .89   .93   .97   .99  1.02  1.04  1.04  1.02   .95   .84
   .40   .35  1.00   .00   .25   .05   .00 33.00 25.00  1.56 21.00  2.00
 20.00  1.00 11.00   .20   .00 22.00  0.00   .06   .08   .07  2.50  5.00
 1 1954 19.45 18.45 25.10 40.60 49.40 53.95 64.44 58.70 52.40 41.70 33.85 12.40
 1 1955  6.95 10.10 18.25 33.55 47.15 53.85 61.55 61.90 51.50 42.40 24.40 23.40
 1 1956 18.35 13.40 24.40 38.45 50.35 56.60 63.85 58.20 53.30 42.15 24.70 14.95
 2 1954  2.25   .28  1.08   .28   .48  1.35   .45  1.33   .34   .67  1.15   .99
 2 1955   .97  1.57   .31   .79  1.81  1.69   .61  2.18  1.42   .67  1.84  2.01
 2 1956  1.44   .91   .33   .79  2.47  1.15   .97   .42   .10   .52   .24  2.03
 3 1954  3.29  3.64  5.89 12.70  4.91  4.11  2.50  1.68  1.67  2.41  3.68  2.54
 3 1955  2.67  2.53  3.35 23.50 13.70 12.90  4.20  2.76  1.92  2.73  3.96 13.20
 3 1956  7.46  4.69 61.90 24.50 21.40  7.60  3.96  2.95  1.97  4.03  3.74  3.71
 4 1954   .00   .00   .00   .00  5.00 14.29  9.76  6.74  5.33   .00   .00   .00
 4 1955   .00   .00   .00   .00  8.05 10.77 10.57  6.64  3.52   .00   .00   .00
 4 1956   .00   .00   .00   .00 18.62 20.94 10.37  7.65  5.64   .00   .00   .00
 5 1954  3.80  4.05  5.95  7.03 12.31  6.15  4.28  2.30  1.95  2.70  3.20  3.05
 5 1955  2.91  2.93  3.49  8.87  9.88 13.29  4.80  3.33  2.53  3.12  3.31  5.34
 5 1956  6.26  4.59 20.05 22.46 34.58 34.78  7.71  3.84  2.54  3.51  4.01  4.03
 6 1954  3.67  3.89  5.97  7.44 15.93 11.15  6.97  4.58  3.54  2.45  2.26  2.48
 6 1955  2.66  2.29  2.29  6.44 12.37 16.36  7.44  4.98  3.41  2.27  2.55  5.66
 6 1956  5.96  4.24 16.59 16.04 39.17 34.67  9.80  5.25  3.84  2.88  3.14  3.37
 7 1954   .50   .47  1.35  1.38   .44   .26   .00   .00   .00   .17   .31   .48
 7 1955   .36   .49   .37  1.20   .44   .89   .44   .46   .00   .13   .39   .92
 7 1956   .69   .57  2.26  1.90  4.11  3.01   .66   .53   .00   .31   .40   .41
 8 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

POTS 10 THRU 24 SHOULD BE SET AS FOLLOWS
  .05000  .62500  .25000  .52380  .00952
  .00000  .52380  .16666  .50000  .14285
  .05000  .06000  .08000  .07000  .83999

POTS 10 THRU 24 ARE SET AS FOLLOWS
  .04925  .62463  .24945  .52325  .00939
  .00000  .52337  .16595  .49969  .14239
  .05047  .25944  .07928  .06935  .83947
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COKEVILLE                                     1954

      VAR        JAN        FEB        MAR        APR        MAY        JUN
     TEMP      19.45      18.45      25.10      40.60      49.40      53.95
        F       1.28       1.23       2.08       3.65       4.98       5.50
      PPT    5464.68     680.04    2623.04     680.04    1165.79    3278.81
     QRIV    8918.98    9453.98   14508.98   18079.97   38710.95   27100.96
     QUNG     399.52     466.31     838.35    4552.44     602.13     499.10
     QCNL        .00        .00        .00        .00   12143.75   34706.82
     QSIT    9286.74    9864.19   15243.65   22385.31   34575.88   14819.53
     QIGS        .00        .00     492.34   12720.81    5439.63   15426.20
     QGLI    1227.99    1148.99    3286.99    3366.99    1068.99     653.99
      SNW    9253.53    9933.58   12064.29      23.52        .00        .00
     SNMT        .00        .00     492.34   12040.76      23.52        .00
     ETPH      51.76      56.10     103.87     247.10     486.89     633.14
      ETP     511.66     590.04    1218.95    3145.41    7012.23    9130.64
       ET     510.53     610.15    1232.75    3193.95    7010.52    9127.37
       MS   11861.37   11069.90   10322.77   19885.98   18317.01   24617.77
       DP     410.91     105.84      12.45      12.45      24.90      24.90
      QTO    9899.40   10546.91   16499.01   24468.35   36683.84   16436.75
      QGO     722.22     772.02    1319.92    2004.78    2938.69    1344.82
      QSO    9177.18    9774.88   15179.09   22463.56   33745.15   15091.92
     QGAG    9249.98    9842.98   14467.98   17076.97   29909.96   14949.96
     DIFF     -72.80     -68.09     711.11    5386.58    3835.19     141.94

      VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
     TEMP      64.44      58.70      52.40      41.70      33.85      12.40      39.20
        F       6.70       5.63       4.40       3.25       2.23        .78      41.75
      PPT    1092.93    3230.23     825.77    1627.26    2793.06    2404.46   25868.17
     QRIV   16932.98   11136.98    8598.98    5958.99    5506.99    6043.99  170952.68
     QUNG     303.59     204.01     202.80     292.66     446.88     308.45    9116.30
     QCNL   23704.59   16369.77   12945.23        .00        .00        .00   99870.15
     QSIT    7913.19    4841.42    3765.91    5999.74    5835.15    6315.64  140826.34
     QIGS    9369.54    8959.65    5356.60    1627.26    2793.06        .00   62205.10
     QGLI        .00        .00        .00     435.99     752.99    1187.99   13130.97
      SNW        .00        .00        .00        .00        .00    2404.46    2404.46
     SNMT        .00        .00        .00        .00        .00        .00   12556.62
     ETPH    1026.77     770.15     505.04     251.91     118.72      36.79    4288.09
      ETP   13568.77    9553.47    5780.52    2632.29    1225.18     342.86   54710.04
       ET   13560.32    9575.65    5790.21    2652.29    1251.43     361.11   54876.34
       MS   20527.26   19885.98   19481.28   18485.12   20035.40   19730.33   19730.33
       DP      24.90      12.45      24.90      24.90      12.45      37.35     728.44
      QTO    9015.31    5516.27    4171.44    6338.11    6263.39    6973.16  152812.00
      QGO     672.41     423.37     410.91     473.17     473.17     560.34   12115.88
      QSO    8342.89    5092.90    3760.53    5864.93    5790.21    6412.82  140696.12
     QGAG   10409.98    5609.99    4759.99    6569.99    7789.99    7409.99  138047.71
     DIFF   -2067.08    -517.08    -999.46    -705.05   -1999.77    -997.18    2648.40



            OBJ=              9.372
            OBA=              1.090
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COKEVILLE                                     1955

      VAR        JAN        FEB        MAR        APR        MAY        JUN
     TEMP       6.95      10.10      18.25      33.55      47.15      53.85
        F        .45        .67       1.51       3.01       4.76       5.49
      PPT    2355.88    3813.13     752.91    1918.71    4396.03    4104.58
     QRIV    6476.99    5582.99    5584.99   15649.98   30046.96   39740.94
     QUNG     324.23     307.23     406.81    5109.10    1739.95    1566.55
     QCNL        .00        .00        .00        .00   19551.43   26157.63
     QSIT    6782.73    5859.51    5916.42   20601.35   24512.66   31522.11
     QIGS        .00        .00        .00   10940.01   11544.08   13259.79
     QGLI     890.99    1207.99     910.99    2930.99    1068.99    2178.99
      SNW    4760.34    8573.48    9326.39     305.09        .04        .00
     SNMT        .00        .00        .00    9021.30     305.04        .04
     ETPH      18.49      30.71      75.38     157.72     431.25     630.20
      ETP     182.82     323.00     884.84    2007.74    6210.96    9088.25
       ET     211.68     336.20     909.00    2004.78    6213.59    9102.47
       MS   19537.32   19232.24   18317.01   26709.72   26753.30   26734.62
       DP      12.45      24.90      24.90      24.90    1220.30    4408.97
      QTO    7595.77    6773.93    6898.45   21940.57   27294.97   37580.39
      QGO     610.15     535.43     535.43    1805.55    2216.47    3013.40
      QSO    6985.62    6238.49    6363.01   20135.02   25278.50   34566.99
     QGAG    7089.99    7129.99    8479.99   21559.97   24019.96   32289.96
     DIFF    -104.37    -891.49   -2116.97   -1424.94    1058.53    2277.03

      VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
     TEMP      61.55      61.90      51.50      42.40      24.40      23.40      36.24
        F       6.40       5.94       4.32       3.30       1.61       1.47      38.98
      PPT    1481.53    5294.67    3448.82    1627.26    4468.89    4881.78   38544.23
     QRIV   18074.97   12095.98    8300.99    5529.99    6195.99   13749.98  167030.71
     QUNG     510.03     335.16     233.15     331.52     480.89    1602.97   12947.65
     QCNL   25671.88   18126.89    8549.19        .00        .00        .00   98057.03
     QSIT    8680.69    5910.51    5058.60    5597.75    6591.30   15283.52  142317.15
     QIGS   10466.69   10939.08    6441.04    1627.26        .00        .00   65217.96
     QGLI    1060.99    1128.99        .00     336.99     969.99    2237.99   14931.97
      SNW        .00        .00        .00        .00    4468.89    9350.68    9350.68
     SNMT        .00        .00        .00        .00        .00        .00    9326.39
     ETPH     919.15     876.22     483.32     283.75      85.58      69.43    4041.26
      ETP   12146.59   10869.28    5531.94    2756.04     883.14     647.02   51531.66
       ET   12159.46   10870.67    5541.17    2764.36     909.00     659.96   51682.38
       MS   25059.82   25115.85   26105.80   24916.62   24113.46   23416.14   23416.14
       DP    3748.07     659.96       6.22      74.71      24.90      12.45   10322.77
      QTO   14021.04    7994.23    6101.52    6363.01    7296.92   16349.58  166210.43
      QGO    1108.23     622.60     473.17     473.17     572.79    1319.92   13286.37
      QSO   12912.81    7371.63    5628.34    5889.83    6724.12   15029.66  152924.06
     QGAG   11679.98    8089.99    6149.99    7599.99    8049.99   12979.98  155119.71
     DIFF    1232.82    -718.35    -521.64   -1710.15   -1325.86    2049.68   -2195.66



            OBJ=             13.579
            OBA=               .186
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COKEVILLE                                     1956

      VAR        JAN        FEB        MAR        APR        MAY        JUN
     TEMP      18.35      13.40      24.40      38.45      50.35      56.60
        F       1.21        .89       2.02       3.46       5.08       5.77
      PPT    3497.39    2210.16     801.48    1918.71    5999.01    2793.06
     QRIV   14475.98   10308.98   40299.94   38959.94   95140.89   84228.89
     QUNG     905.92     569.54    7516.97    6921.88    2617.03     922.92
     QCNL        .00        .00        .00        .00   45223.32   50858.01
     QSIT   15333.06   10837.77   47716.13   45670.21   81418.39   66638.09
     QIGS        .00        .00        .00   17705.36   21900.24   20593.36
     QGLI    1682.99    1405.99    5504.99    4633.99   10008.96    7326.99
      SNW   12848.08   15058.24   15859.73      73.07        .00        .00
     SNMT        .00        .00        .00   15786.65      73.07        .00
     ETPH      48.84      40.75     100.78     211.60     511.33     713.41
      ETP     482.72     426.54    1183.01    2693.56    7384.36   10288.20
       ET     504.30     435.82    1182.94    2702.10    7384.08   10272.97
       MS   22924.28   22525.82   21330.42   26753.30   26753.30   26734.62
       DP      12.45      12.45      31.13     635.05    9027.76   13921.43
      QTO   16748.05   12290.20   49982.67   49634.01   95457.68   56990.28
      QGO    1369.72     921.45    4009.57    3997.11    5864.93    5341.94
      QSO   15378.32   11368.75   45973.10   45636.89   89592.76   81648.32
     QGAG   15209.98   11159.98   48709.93   54569.93   83999.89   84479.90
     DIFF     168.34     208.78   -2736.83   -8933.03    5592.87   -2831.57

      VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
     TEMP      63.85      58.20      53.30      42.15      24.70      14.95      38.22
        F       6.64       5.58       4.47       3.28       1.63        .94      41.01
      PPT    2355.88    1020.07     242.87    1282.94     582.89    4930.36   27614.86
     QRIV   23807.97   12752.98    9332.98    7011.99    7633.99    6200.99  352155.31
     QUNG     480.89     358.24     239.23     489.39     454.17     450.53   21926.73
     QCNL   25186.13   18579.93   13698.14        .00        .00        .00  153545.53
     QSIT   14469.68    5854.06    4250.65    7241.88    8001.53    8607.16  316038.43
     QIGS   11171.03    7523.04    5037.22    1262.94        .00        .00   85193.20
     QGLI    1623.99    1306.99        .00     752.99     989.99    1000.99   36239.93
      SNW        .00        .00        .00        .00     582.89    5513.26    5513.26
     SNMT        .00        .00        .00        .00        .00        .00   15859.73
     ETPH    1004.03     754.17     527.21     259.49      86.63      44.36    4302.65
      ETP   13268.26    9355.29    6034.31    2711.54     894.00     413.37   55117.20
       ET   13261.47    9376.41    6039.26    2714.55     909.00     435.82   55218.78
       MS   24636.45   22824.67   21828.50   20396.51   19487.51   19089.04   19089.04
       DP    9189.63    1599.70     -49.80     136.97      37.35      24.90   34679.06
      QTO   29287.30   11530.63    6898.45    9152.28    9463.58    9886.95  387322.12
      QGO    2340.99     846.74     547.89     672.41     722.22     747.12   27382.13
      QSO   26946.31   10683.89    6350.56    8479.87    8741.36    9139.83  359940.00
     QGAG   18739.97    9329.98    6179.99    8539.99    9749.98    9789.98  360459.31
     DIFF    8226.33    1353.90     170.57     -60.11   -1008.62    -650.15    -519.28



            OBJ=             47.028
            OBA=              -.027
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THOMAS FORK
   0    0     0    1
     425.     7435.    13064.      319.        0.        0.        0.
       0.        0.        0.        0.        0.        0.        0.    21243.
   .02000    .34999    .61497    .01501    .00000    .00000    .00000
   .00000    .00000    .00000    .00000    .00000    .00000    .00000
31770.250
     291.      720.      199.        0.      924.        0.        0.
    2134.
   .13636    .33739    .09325    .00000    .43298    .00000    .00000
177.83331
   .54   .65   .80   .91  1.06  1.09  1.03   .99   .91   .81   .75   .60
   .96  1.13  1.32  1.43  1.45  1.44  1.42  1.41  1.38  1.34  1.22  1.05
   .69   .35  1.00   .00   .20   .01   .00 32.00 21.50  2.43 24.00  2.50
 20.00  3.00  8.00   .00   .50   .00   .00   .00   .00   .00  2.50  3.00
 1 1954 17.10 17.00 22.60 39.40 46.80 53.20 64.30 58.40 52.00 40.80 33.00 11.70
 1 1955  6.10  8.70 16.80 32.10 46.70 53.30 61.00 61.90 50.80 40.90 23.10 20.40
 1 1956 17.40 16.20 21.30 37.30 50.20 57.00 63.70 59.30 54.10 42.70 24.50 12.90
 2 1954  1.94   .90  3.64   .29   .93  2.41   .36   .76  1.72  1.53   .88  1.84
 2 1955  1.82  2.48  1.36  1.16   .95  3.08  1.99  2.02  2.46  1.89  2.70  5.42
 2 1956  3.01  2.01   .63  1.68  1.67  1.29   .92   .08   .08   .99   .48  2.60
 3 1954  7.20  7.20  8.50 23.20 29.30 20.90 12.20  8.00  7.70  7.70  7.20  5.80
 3 1955  5.70  5.50  5.40 13.90 23.50 33.70 15.50  9.30  7.10  7.50  7.70  9.70
 3 1956  9.50  6.80  9.10 64.20 81.80 45.50 20.50 12.10  9.80  9.70  8.50  8.60
 4 1954   .00   .00   .00   .00  3.00  6.70  5.40  1.16  1.68   .00   .00   .00
 4 1955   .00   .00   .00   .00  2.66 10.61  6.12  1.81  2.28   .30   .00   .00
 4 1956   .00   .00   .00   .00  3.38  9.76  8.53  6.04  4.23   .00   .00   .00
 5 1954  6.85  7.41 12.48 15.98 18.22  9.94  6.92  4.49  3.23  4.90  5.64  5.33
 5 1955  4.86  4.62  5.80 14.99 13.83 17.74  7.99  5.90  4.15  5.81  5.85  6.47
 5 1956 10.73  7.01 27.80 44.23 59.87 52.90 12.77  7.03  4.51  6.43  6.67  6.33
 6 1954  5.96  6.27  9.06 18.29 20.90 10.03  6.64  3.56  2.96  4.05  4.74  4.54
 6 1955  4.33  4.31  5.10 13.08 16.06 20.84  7.55  5.06  3.83  4.69  5.00  8.34
 6 1956  9.24  6.78 28.34 40.95 58.25 51.09 11.98  6.08  4.11  5.45  6.01  6.03
 7 1954   .41   .45   .75  1.13  1.65   .76   .37   .24   .18   .28   .29   .29
 7 1955   .32   .28   .30  1.01  1.24  1.69   .61   .34   .26   .28   .31   .74
 7 1956   .79   .51  2.26  2.26  3.25  2.98  1.33   .48   .29   .37   .40   .40
 8 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

POTS 10 THRU 24 SHOULD BE SET AS FOLLOWS
  .05000  .06944  .08333  .33333  .00000
  .00833  .00000  .05555  .39990  .00000
  .05000  .00000  .00000  .00000  .95999

POTS 10 THRU 24 ARE SET AS FOLLOWS
  .04925  .06999  .08294  .33294  .00000
  .00836  .00000  .05487  .39978  .00000
  .04919  .00000  .00000  .00000  .95904
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THOMAS FORK                                   1954

     VAR        JAN        FEB        MAR        APR        MAY        JUN
    TEMP      17.10      17.00      22.60      39.40      48.80      53.20
       F       1.12       1.13       1.87       3.54       4.92       5.42
     PPT    3434.28    1593.22    6797.75     513.37    1646.33    4266.30
    QRIV   10555.99   11105.99   16048.99   32389.99   37009.99   17759.99
    QUNG     127.45     127.45    1708.81    2077.71     518.71     369.98
    QCNL        .00        .00        .00        .00    5310.75   11860.67
    QSIT   10625.58   11164.51   17624.89   34134.37   34993.25   13131.11
    QIGS        .00        .00    7791.71    8848.44    3505.27    8417.53
    QGLI     734.99     808.99    1331.99    2004.99    2937.99    1356.99
     SNW    7735.99    9329.21    8335.25        .18        .00        .00
    SNMT        .00        .00    7791.71    8335.07        .18        .00
    ETPH      57.86      68.93     132.90     333.32     676.69     847.62
     ETP     328.27     396.83     799.98    2099.96    4938.51    6387.42
      ET     342.29     425.27     834.99    2105.62    4947.70    6399.86
      MS    4989.20    4584.67   11586.14   13961.48   12540.42   13961.46
      DP      31.11      10.37      10.37      31.11     394.15    1006.13
     QTO   11461.67   11954.37   18489.08   35305.59   37042.99   15973.74
     QGO      25.93      51.86      51.86      25.93      25.93      25.93
     QSO   11435.74   11902.50   18437.22   35279.66   37017.06   15947.80
    QGAG   12129.99   13119.99   22109.99   28289.99   32259.99   17609.99
    DIFF    -694.25   -1217.48   -3672.77    6989.66    4757.07   -1662.18

     VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
    TEMP      64.30      58.40      52.00      40.80      33.00      11.70      38.19
       F       6.66       5.60       4.36       3.18       2.17        .73      40.80
     PPT     637.28    1345.38    3044.82    2708.48    1557.81    3257.25   30802.33
    QRIV   11759.99    6313.99    5279.99    7170.99    8391.99    8051.99  171839.90
    QUNG     215.97     141.62     136.30     136.30     127.45     102.67    5790.48
    QCNL    9559.34    2053.48    2974.01        .00        .00        .00   31758.27
    QSIT    7275.63    4754.56    3744.91    7009.54    8377.51    8113.19  160949.00
    QIGS    3983.06    2064.11    4065.73    2708.48    1557.81        .00   42962.16
    QGLI     671.99     434.99     323.99     509.99     519.99     521.99   12158.99
     SNW        .00        .00        .00        .00        .00    3257.25    3257.25
    SNMT        .00        .00        .00        .00        .00        .00   16126.96
    ETPH    1354.56     982.32     630.48     297.76     141.93      41.47    5565.91
     ETP    9781.61    6850.23    4126.87    1805.47     870.62     235.51   38621.31
      ET    9796.88    6690.29    3578.53    1830.75     881.66     254.12   38088.03
      MS    6183.94    3578.53    4078.41    5009.94    5694.53    5487.08    5487.08
      DP    1265.45    1166.91     777.94     394.15     129.65       5.18    5222.58
     QTO   10022.48    7014.44    5341.66    8051.69    9088.95    8648.11  178395.03
     QGO      51.86      64.82      51.86      25.93      25.93      51.86     479.73
     QSO    9970.62    6949.61    5290.00    8025.76    9063.02    8596.25  177915.28
    QGAG   12259.99    7949.99    5729.99    8689.99    9989.99    9439.99  179579.87
    DIFF   -2289.37   -1000.38    -439.99    -664.23    -926.97    -843.74   -1664.57


     OBJ=               31.319
     OBA=                -.940
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THOMAS FORK                                   1955

     VAR        JAN        FEB        MAR        APR        MAY        JUN
    TEMP       6.10       8.70      16.80      32.10      46.70      53.30
       F        .40        .58       1.39       2.88       4.71       5.43
     PPT    3221.85    4390.21    2497.53    2053.48    1681.73    5452.36
    QRIV    7669.99    7629.99    9038.99   23169.99   28439.99   36899.99
    QUNG     100.90      97.36      95.59    2696.84     420.60     598.57
    QCNL        .00        .00        .00        .00    5062.91   18782.34
    QSIT    7750.25    7692.08    9035.79   25845.21   26485.35   30071.09
    QIGS        .00        .00        .00   15307.40    3476.71   12026.19
    QGLI     571.99     509.99     534.99    1804.99    2203.99    2999.99
     SNW    6479.11   10869.33   13276.87      22.96        .00        .00
    SNMT        .00        .00        .00   13253.91      22.96        .00
    ETPH      20.64      35.28      98.79     221.61     603.28     851.64
     ETP     117.10     203.08     594.67    1396.18    4402.18    6417.68
      ET     134.64     217.82     591.23    1415.85    4408.33    6423.61
      MS    5362.61    5155.16    4574.29   13961.46   13846.67   13987.39
      DP       5.18       5.18      20.74      31.11     321.54    1016.51
     QTO    8233.21    8194.32    9555.71   26631.54   28044.80   32829.14
     QGO      51.86      51.86      51.66      51.86      25.93      51.86
     QSO    8181.35    8142.45    9503.85   26579.67   28018.87   32777.28
    QGAG    8619.99    8179.99    9929.99   26549.99   24499.99   31419.99
    DIFF    -438.64     -37.54    -426.14      29.68    3518.87    1357.28

     VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
    TEMP      61.00      61.90      50.80      40.90      23.10      20.40      35.14
       F       6.34       5.94       4.26       3.19       1.52       1.28      37.97
     PPT    3522.79    3575.90    4354.81    3345.77    4779.67    9594.75   48380.91
    QRIV   13379.99    6972.99    6785.99    8303.99    8856.99   14779.99  173928.84
    QUNG     274.38     164.63     125.68     132.76     726.22     171.71    5803.29
    QCNL   10833.92    3204.15    4036.16        .00        .00        .00   41919.50
    QSIT    8669.35    6884.43    4904.92    8136.95    9483.86   14879.39  159838.68
    QIGS    7314.67    4697.35    5767.47    3345.77    2949.56        .00   54885.13
    QGLI    1082.99     609.99     472.99     509.99     559.99    1318.99   13180.99
     SNW        .00        .00        .00        .00    1830.10   11424.85   11424.85
    SNMT        .00        .00        .00        .00    2949.56        .00   16226.43
    ETPH    1193.15    1131.73     594.10     299.81      99.35      72.30    5221.65
     ETP    8616.05    7892.16    3888.71    1817.89     609.43     410.64   36365.81
      ET    8609.22    7893.51    3905.26    1835.94     611.98     425.27   36469.91
      MS   12664.89    9480.51   11378.69   12908.64   13961.46   13572.49   13572.49
      DP    1763.33    2214.54    1981.15    1338.06     643.09     280.05    9620.54
     QTO   12265.54   10515.17    7973.90   10307.72   10839.32   15947.80  181338.25
     QGO      25.93      51.86      25.93      25.93      51.86      25.93     492.69
     QSO   12239.61   10463.31    7947.97   10281.79   10787.46   15921.87  180843.53
    QGAG   14159.99   10449.99    7349.99   10289.99   10369.99   14999.99  176819.87
    DIFF   -1920.38      13.31     597.97      -8.19     417.46     921.87    4025.66


     OBJ=               37.596
     OBA=                1.333
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THOMAS FORK                                   1956

     VAR        JAN        FEB        MAR        APR        MAY        JUN
    TEMP      17.40      16.20      21.30      37.30      50.20      57.00
       F       1.14       1.08       1.76       3.35       5.07       5.81
     PPT    5328.45    3556.20    1115.25    2974.01    3310.36    2283.62
    QRIV   16359.99   12014.99   50179.99   72499.98  103129.98   93449.98
    QUNG     168.17     120.37     161.89    5421.52    1448.39     805.46
    QCNL        .00        .00        .00        .00    5983.44   17277.63
    QSIT   16469.28   12069.67   50215.81   77637.12  101756.23   84201.62
    QIGS        .00        .00        .00   24399.14    5406.20    8330.79
    QGLI    1406.99     908.99    4008.99    4008.99    5764.99    5279.99
     SNW   16753.30   20311.50   21426.76       1.63        .00        .00
    SNMT        .00        .00        .00   21425.12       1.63        .00
    ETPH      58.88      65.69     125.26     284.37     727.90    1086.63
     ETP     334.03     378.16     753.96    1791.57    5312.24    7585.64
      ET     342.29     383.78     757.19    1830.75    5321.12    7582.33
      MS   13214.63   12867.15   12125.51   13961.48   13968.64   13961.46
      DP     259.31     280.05     280.05     394.15    2375.31    5030.69
     QTO   17711.14   13393.56   52044.31   80504.01  106205.26   93404.87
     QGO      51.86      77.79      25.93      90.75      38.89      90.75
     QSO   17659.27   13315.77   52018.37   80413.25  106166.37   93314.12
    QGAG   18999.99   12419.99   49229.99   78309.98  105999.98   93649.98
    DIFF   -1340.71     895.77    2788.38    2103.26     166.37    -335.86

     VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
    TEMP      63.70      59.30      54.10      42.70      24.50      12.90      38.04
       F       6.62       5.69       4.54       3.33       1.61        .81      42.86
     PPT    1628.82     141.62     141.62    1752.54     849.71    4602.84   27686.69
    QRIV   21209.99   10779.99    7289.99    9649.99   10648.99   10686.99  414900.75
    QUNG     362.90     214.20     173.48     171.71     292.32     152.24    9491.88
    QCNL   15100.22   13692.30    7488.15        .00        .00        .00   56541.76
    QSIT   14963.33    8232.11    4145.98    9483.93   10835.94   10793.51  398804.43
    QIGS    8913.70    3863.92    2762.47    1752.54     709.26        .00   54158.03
    QGLI    2364.99     858.99     522.99     671.99     721.99     721.99   27241.97
     SNW        .00        .00        .00        .00     140.45    4743.10    4743.10
    SNMT        .00        .00        .00        .00     709.26        .00   22136.01
    ETPH    1324.47    1019.76     698.64     337.77     105.37      45.72    5798.51
     ETP    9564.35    7111.34    4559.90    2048.06     646.37     259.67   40345.31
      ET    9553.12    7141.50    4574.29    2079.69     653.47     259.31   40478.90
      MS   11337.20    8137.27    6316.88    6036.82    6109.43    5850.12    5850.12
      DP    5619.00    4698.76    2826.52    1109.86     114.09    -243.75   22944.09
     QTO   24764.48   13964.05    9050.05   12071.06   12096.99   11500.57  446710.43
     QGO      25.93      77.79      25.93      51.86      77.79      25.93     661.25
     QSO   24738.55   13886.26    9024.12   12019.20   12019.20   11474.64  446049.18
    QGAG   22609.99   12449.99    7999.99   11389.99   11809.99   11209.99  436079.81
    DIFF    2128.55    1436.26    1024.12     629.20     209.20     264.64    9969.37


     OBJ=               44.965
     OBA=                6.965
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BEAR LAKE
   0   0     0   1
    8959.    12347.    20121.    10098.       42.        0.        0.
       0.        0.        0.       46.        0.        0.        0.   51613.
   .17358    .23922    .38984    .19564    .00081    .00000    .00000
   .00000    .00000    .00000    .00069    .00000    .00000    .00000
$4301.083
   21283.     7307.     3100.     2636.     6030.        0.        0.
   42356.
   .50247    .17261    .07318    .06223    .18958    .00000    .00000
$3529.666
   .51   .60   .71   .68  1.09  1.14   .98   .86   .78   .71   .67   .55
  1.29  1.37  1.46  1.52  1.53  1.53  1.53  1.53  1.51  1.49  1.43  1.34
   .20   .40  1.00   .00   .20   .24   .00 35.00 31.00  1.55 20.00  1.00
 10.00  2.50  6.00   .40   .00   .00   .00   .00   .00   .00  2.50  3.50
 1 1954 21.70 25.43 28.86 43.63 52.13 55.46 67.73 62.46 55.66 44.00 36.50 19.45
 1 1955 15.06 13.20 20.23 33.76 49.46 56.10 64.13 65.39 54.59 44.26 26.56 26.56
 1 1956 24.00 13.40 27.23 41.16 52.00 59.16 65.63 61.66 55.93 44.03 27.36 21.16
 2 1954  2.23   .52  1.70   .36  1.48  1.90   .47   .55  1.16  1.64  1.37  1.81
 2 1955  1.04  1.85   .99  1.40  1.49  1.54   .94  2.08  2.41   .73  1.75  3.97
 2 1956  2.00   .62   .23   .89  3.11   .82   .58   .62   .22  1.15   .16  1.80
 3 1954  5.83  5.76  6.80 12.53 28.26 17.43 12.14  8.80  7.09  6.64  6.00  5.46
 3 1955  5.32  4.61  5.09  8.04 29.68 28.50 15.09 10.22  7.78  7.37  5.49  8.86
 3 1956  8.01  6.30  8.20 22.63 49.23 41.86 18.92 12.56  9.62  8.87  7.64  7.13
 4 1954   .00   .00   .00   .00 15.61  8.01  2.61  1.60  1.35   .00   .00   .00
 4 1955   .00   .00   .00   .00 16.95 12.74  4.41  1.22  2.36   .00   .00   .00
 4 1956   .00   .00   .00   .00 15.98 18.16  7.02  3.90  3.05  1.00   .00   .00
 5 1954  1.12  1.19  2.31  2.41  8.58  9.75 16.08 12.23  6.65  1.62   .92  1.43
 5 1955  1.35  1.26   .83  4.19  2.65  6.97 17.44  9.99  8.15  2.00  2.22  3.10
 5 1956  2.94  1.59  3.59  6.57  8.34  8.28 16.31 13.13  6.25  2.35  1.60  2.06
 6 1954   .71   .72   .50   .86 12.80 12.53 17.81 13.84  7.34  1.90   .74  1.06
 6 1955   .71   .57   .66  1.04  5.61  9.49 19.28  9.27  9.34  1.50  2.50  1.38
 6 1956  1.56  1.23  2.62  2.59  7.00 11.17 17.68 13.45  6.63  2.33  1.11  1.81
 7 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

POTS 10 THRU 24 SHOULD BE SET AS FOLLOWS
  .10000  .10000  .10000  .29999  .02000
  .00000  .00000  .06666 1.00000  .00000
  .10000  .00000  .00000  .00000  .79999

POTS 10 THRU 24 ARE SET AS FOLLOWS
  .09997  .09985  .09979  .29974  .01965
  .00000  .00000  .06597  .99945  .00000
  .09997  .00000  .00000  .00000  .79943
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BEAR LAKE                                     1954

     VAR        JAN        FEB        MAR        APR        MAY        JUN
    TEMP      21.70      25.43      28.86      43.63      52.13      55.46
       F       1.43       1.70       2.39       3.92       5.26       5.65
     PPT    9591.41    2236.56    7311.83    1548.36    6365.60    8172.85
    QRIV    3093.97    3123.97    2163.98    3719.97   55089.61   53931.61
    QUNG    7050.33    5945.81    7019.36   17682.98   29576.15   17998.26
    QCNL        .00        .00        .00        .00   67139.89   34451.66
    QSIT    8176.90    8591.66    5463.18   12106.32   41039.94   38338.07
    QIGS        .00        .00        .00   25292.28   35254.02   21982.80
    QGLI        .00        .00        .00        .00        .00        .00
     SNW   16258.05   18494.66   25806.49    2062.58      38.11        .22
    SNMT        .00        .00        .00   23743.90    2032.47      29.89
    ETPH    1965.40    2478.13    3720.16    9296.63   16771.84   19811.13
     ETP     947.23    1321.15    2207.60    8622.04   14582.65   17931.53
      ET    1018.56    1323.08    2205.14    6646.93   14627.48   17935.17
      MS   14133.92   12831.84   10626.69   25884.20   25884.20   25884.20
      DP    1722.11    1407.09     861.05     388.52     808.55    4641.30
     QTO    9826.64    7938.52    6247.91   12411.81   41740.24   42905.82
     QGO      21.00      21.00      42.00      31.50      21.00      42.00
     QSO    9807.64    7917.52    6205.90   12380.31   41719.24   42863.82
    QGAG    4839.96    5159.96    9949.93   10369.92   36939.73   41939.70
    DIFF    4967.67    2757.55   -3744.02    2010.38    4779.50     924.10

     VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
    TEMP      67.73      62.46      55.66      44.00      36.50      19.46      42.75
       F       7.04       5.99       4.67       3.43       2.40       1.22      45.16
     PPT    2021.50    2365.59    4989.25    7053.77    5892.48    7784.95   65333.41
    QRIV   76821.45   59551.57   31577.77    8180.94    3202.97    4582.98  304840.75
    QUNG   12531.67    9083.88    7318.72    6854.20    6193.55    5636.13  132893.06
    QCNL   11226.62    6881.73    5806.46        .00        .00        .00  125505.54
    QSIT   51950.39   41023.25   20309.55    6934.36    5526.24    8468.61  245932.46
    QIGS    6512.06    5118.28    7311.83    7053.77    5892.48        .00  114417.32
    QGLI        .00        .00        .00        .00        .00        .00        .00
     SNW        .00        .00        .00        .00        .00    7784.95    7784.95
    SNMT        .22        .00        .00        .00        .00        .00   25806.48
    ETPH   32712.40   24859.51   16264.35    8100.78    3868.28    1750.48  141599.06
     ETP   25639.72   17581.86   10298.81    4748.10    2206.98     871.16  104959.76
      ET   24760.62    8715.57    5103.33    3591.23    2194.64     903.05   89024.04
      MS    7739.00    4053.26    6394.91    9766.64   13545.69   12684.83   12684.83
      DP    8421.55    8096.03    4966.82    1827.12      63.02    -325.52   32877.65
     QTO   60284.46   49038.22   25191.15    8673.57    5523.36    8033.02  277616.75
     QGO      73.50      42.00      31.50      42.00      52.50      21.00     441.02
     QSO   60210.96   48996.21   25159.65    8631.56    5470.85    8012.02  277375.75
    QGAG   69189.50   52609.63   28619.80    7008.95    3988.97    6190.95  276806.93
    DIFF   -8978.55   -3613.41   -3460.14    1622.61    1481.88    1821.06     568.80


          OBJ*               10.153
          OBA*                 .132
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BEAR LAKE                                     1955

     VAR        JAN        FEB        MAR        APR        MAY        JUN
    TEMP      15.06      13.20      20.23      33.76      49.46      56.10
       F        .99        .88       1.67       3.03       4.99       5.72
     PPT    4473.12    7957.00    4258.07    6021.51    6408.61    6623.66
    QRIV    3072.97    2465.98    2844.97    4513.96   24169.63   40819.71
    QUNG    5491.62    4758.71    5254.20   10691.22   34057.25   29506.10
    QCNL        .00        .00        .00        .00   72903.34   54795.78
    QSIT    7199.98    5938.54    5491.62   10509.43   14400.56   28030.06
    QIGS        .00        .00        .00   12959.28   52868.89   28975.53
    QGLI        .00        .00        .00        .00        .00        .00
     SNW   12258.08   20215.08   24473.18   17535.39     436.43       2.88
    SNMT        .00        .00        .00   12959.28   17098.94     433.55
    ETPH    1364.61    1286.15    2607.55    4695.75   14665.17   20377.43
     ETP     657.68     685.68    1547.36    3487.27   12750.96   18444.10
      ET     693.04     693.04    1522.60    3496.72   12747.83   18491.71
      MS   12044.29   11361.74    9849.64   19342.26   25884.20   25884.20
      DP    -189.01     105.00     189.01     178.51     483.03    5491.86
     QTO    6972.45    5953.89    5628.37   10595.19   14816.47   33423.69
     QGO      63.00      52.50      63.00      21.00      52.50      21.00
     QSO    6909.45    5901.38    5565.36   10574.19   14763.97   33402.69
    QGAG    5822.95    5435.96    3599.97   18045.87   11428.91   30017.78
    DIFF    1086.49     465.42    1965.39   -7471.67    3335.04    3384.90

     VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
    TEMP      64.13      65.39      54.59      44.26      26.56      26.56      39.11
       F       5.66       6.27       4.58       3.45       1.75       1.67      41.73
     PPT    4043.01    8946.25   10365.60    3139.79    7526.89   17075.29   86838.81
    QRIV   82955.42   39892.71   40194.71    6460.95   10785.92    5956.95  264134.06
    QUNG   15577.37   10549.69    8030.98    7607.75    6699.36    9145.81  147570.03
    QCNL   18967.77    5247.32   10150.55        .00        .00        .00  162064.68
    QSIT   62220.78   20593.86   28668.34    5834.75   14824.50   12713.84  216424.25
    QIGS   11633.00   11045.17   14425.83    3139.79        .00        .00  134847.46
    QGLI        .00        .00        .00        .00        .00        .00        .00
     SNW        .00        .00        .00        .00    7526.89   24602.19   24602.19
    SNMT       2.87        .00        .00        .00        .00        .00   30494.66
    ETPH   28724.87   27749.81   15499.12    8233.95    2660.78    2388.93  130453.93
     ETP   22514.33   19625.66    9813.49    4826.16    1519.38    1188.89   97060.96
      ET   22534.48   18082.18    9261.60    4851.31    1522.60    1071.07   94968.23
      MS   14994.98    7991.02   13199.36   11529.75   10017.65    9030.59    9030.59
      DP   12359.31   13356.87    8967.58    3717.24     441.02    -609.04   44491.42
     QTO   74481.39   33885.72   37560.96    9503.12   15205.00   12054.79  260081.09
     QGO      42.00      52.50      21.00      63.00      42.00      21.00     514.53
     QSO   74439.39   33833.21   37539.96    9440.12   15162.99   12033.79  259566.56
    QGAG   75044.48   42976.69   35063.75    8642.93    9553.93   13362.90  258996.12
    DIFF    -605.08   -9143.47    2476.21     797.18    5609.06   -1329.11     570.44


          OBJ*               21.376
          OBA*                 .284
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BEAR LAKE                                     1956

     VAR        JAN        FEB        MAR        APR        MAY        JUN
    TEMP      24.00      13.40      27.23      41.16      52.00      59.16
       F       1.56        .89       2.26       3.70       5.25       6.03
     PPT    8602.16    2666.67     959.24    3827.96   13376.36    3526.88
    QRIV    6723.95    5295.96   11309.91   11179.91   30149.79   48079.66
    QUNG    8268.39    6503.23    8464.52   29767.09   51768.66   43224.80
    QCNL        .00        .00        .00        .00   68731.29   78107.65
    QSIT   12818.62   10493.54   16264.78   33024.93   37762.80   36833.37
    QIGS        .00        .00        .00   35863.25   45621.49   34842.03
    QGLI        .00        .00        .00        .00        .00        .00
     SNW   33204.35   35671.02   36860.26    4824.96      72.35        .25
    SNMT        .00        .00        .00   32035.30    4752.61      72.09
    ETPH    2173.72    1305.64    3509.66    7922.07   16663.31   23228.03
     ETP    1047.63     696.07    2082.69    5642.93   14488.28   21024.24
      ET     861.05     546.03    1323.08    5512.86   14511.95   21022.38
      MS    8190.53    7739.00    6394.91   25884.20   25884.20   25884.20
      DP    -441.02      42.00     262.51     262.51    1869.12    8915.08
     QTO   12369.81   10469.18   16444.07   33203.17   39556.10   45657.00
     QGO      42.00      21.00      31.50      42.00      21.00      42.00
     QSO   12327.81   10448.18   16412.57   33161.17   39535.09   45615.00
    QGAG   12651.91    6855.95   15458.69   28260.80   35871.74   35642.74
    DIFF    -324.10    3592.23     953.88    4900.37    3663.35    9972.25

     VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
    TEMP      65.83      61.66      55.93      44.03      27.36      21.16      41.06
       F       6.82       5.92       4.69       3.43       1.80       1.33      43.75
     PPT    2494.62    2666.67     946.23    4946.24     688.17    7741.94   52473.18
    QRIV   76079.46   57854.59   28524.60   10037.92    4778.96    7808.94  297823.66
    QUNG   19530.40   12965.18    9930.33    9156.14    7886.46    7360.01  214825.15
    QCNL   30193.59   16774.21   13118.30    4301.08        .00        .00  211226.09
    QSIT   53176.76   40011.95   16749.39    9356.25    9924.52   13265.60  289882.16
    QIGS   14572.32    9376.35    6193.55    6666.67        .00        .00  153135.62
    QGLI        .00        .00        .00        .00        .00        .00        .00
     SNW        .00        .00        .00        .00     688.17    8430.12    8430.12
    SNMT        .25        .00        .00        .00        .00        .00   36860.25
    ETPH   30355.65   24098.12   16458.42    8117.37    2740.90    1903.35  136476.16
     ETP   23792.52   17043.17   10420.89    4757.82    1565.13     947.23  103508.64
      ET   23868.07   16738.09    7959.52    3969.26    1407.09     777.05   98496.46
      MS   16654.09    9293.11    7570.99   10269.67    8915.08    8159.03    8159.03
      DP   15803.53   15688.03   10059.86    3958.76     388.52    -693.04   56115.66
     QTO   68863.51   55632.65   26745.25   13262.37   10227.67   12537.82  344968.68
     QGO      42.00      42.00      21.00      42.00      42.00      42.00     430.52
     QSO   68821.51   55590.65   26724.25   13220.38   10185.66   12495.82  344538.12
    QGAG   70170.50   56505.60   26898.80   10120.92    6892.95    8896.93  314227.62
    DIFF   -1348.97    -914.94    -174.55    3099.44    3292.71    3598.88   30310.50


          OBJ*               31.479
          OBA*                7.312
```

```
SODA
0    0    0    1
  2677.     3703.     6098.     3022.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.   15500.
 .17270    .23890    .39341    .19496    .00000    .00000    .00000
 .00000    .00000    .00000    .00000    .00000    .00000    .00000
91291.666
   846.        0.     2866.        0.     1890.        0.        0.
  5624.
 .15078    .00000    .51315    .00000    .33605    .00000    .00000
466.66662
   .51   .60   .71   .89  1.09  1.14   .96   .88   .78   .71   .67   .55
   .90   .98  1.05  1.08  1.11  1.13  1.15  1.17  1.16  1.15  1.09  1.00
   .20   .35  1.00   .00  2.30   .31   .00 36.00 24.00   .92 25.00  2.40
 10.00  1.00  8.00   .00   .00   .00   .00   .00   .00   .00  2.50  3.00
 1 1954 19.30 24.80 28.25 43.50 51.80 54.55 67.40 62.65 55.85 44.25 37.40 19.35
 1 1955 13.80 13.90 21.30 34.75 49.30 55.40 64.20 65.80 55.20 45.10 27.50 24.80
 1 1956 16.90 13.05 26.80 41.15 51.80 59.00 66.00 61.85 56.65 44.00 26.80 19.70
 2 1954  1.72  1.04  2.63  1.32  1.64  2.94   .73  1.65  1.81   .60  1.76   .34
 2 1955   .87   .93   .95  1.91  2.81  4.25   .59  2.56  1.64  1.95  1.58  3.80
 2 1956  2.10   .84   .23   .93  2.90   .73   .55   .16   .38  1.47   .32  1.33
 3 1954 15.30 13.30 14.90 14.70 16.80 19.10 19.10 16.30 16.80 16.40 15.50 15.10
 3 1955 13.50 11.80 13.00 12.60 15.40 20.40 20.60 18.90 17.20 17.20 14.90 16.20
 3 1956 14.50 13.20 14.20 16.60 32.90 29.70 23.90 21.30 20.20 19.00 17.00 16.50
 4 1954   .00   .00   .00   .00  2.00  7.00  3.00  5.00  4.00   .00   .00   .00
 4 1955   .00   .00   .00   .00   .00 13.00 11.00 14.00  4.00   .00   .00   .00
 4 1956   .00   .00   .00   .00 10.00 16.00 16.00 17.00 10.00   .00   .00   .00
 5 1954 10.83 10.67 16.75 19.72 35.80 38.48 54.15 43.87 26.59  9.69  8.94 10.50
 5 1955 10.03 11.20  9.94 26.67 16.26 28.87 60.10 34.52 31.42 11.35 14.52 17.29
 5 1956 16.37 12.67 26.10 37.64 39.45 33.36 56.39 44.92 24.45 12.78 12.12 13.28
 6 1954  4.93  5.01  8.84  9.16 30.04 33.93 55.02 42.12 23.44  6.69  4.28  5.96
 6 1955  5.55  5.10  3.79 14.95 10.03 24.81 59.66 34.71 28.46  8.81  8.68 11.59
 6 1956 10.91  6.32 13.06 23.17 30.30 29.88 56.15 45.37 22.38  9.73  6.80  8.35
 7 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

POTS 10 THRU 24 SHDULO BE SET AS FOLLOWS
  .10000  .62500  .25000  .23999  .00000
  .00000  .00000  .16666  .41666  .00000
  .10000  .00000  .00000  .00000  .99999

POTS 10 THRU 24 ARE SET AS FOLLOWS
  .09997  .62475  .24957  .23956  .00006
  .00006  .00000  .16595  .41638  .00006
  .10028  .00000  .00000  .00000  .99822
```

```
SODA                                        1954

   VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      19.30      24.80      28.25      43.50      51.80      54.55
     F       1.27       1.66       2.34       3.91       5.23       5.56
   PPT    2221.66    1343.33    3397.08    1704.99    2118.33    3797.49
  QRIV    6367.97    6482.91   11425.56   11839.37   38605.55   43828.66
  QUNG    6128.37    8941.99   15774.28   13059.33    7675.46    7648.52
  QCNL        .00        .00        .00        .00    2583.33    9041.66
  QSIT   12332.12   13194.14   26653.15   24025.28   43988.33   46448.22
  QIGS        .00     702.80    4264.38    4823.76    3086.68    6962.32
  QGLI        .00        .00        .00        .00        .00        .00
   SNW    3409.99    4050.52    3163.22      64.43        .24        .00
  SNMT        .00     702.80    4264.38    3118.76      64.16        .24
  ETPH     162.21     230.77     346.69     873.41    1568.49    1864.36
   ETP     253.27     367.40     649.91    1974.91    4311.62    5168.74
    ET     260.16     366.30     666.17    1978.81    4312.36    5179.59
    MS    3634.36    3949.73    7580.47    7761.50    6539.53    7765.45
    OP      19.70      19.70      15.76     417.83    1789.60     643.97
   QTO   12317.49   13166.93   26829.62   24398.48   45741.24   46961.64
   QGO      28.38      47.30      47.30      47.30      37.84      37.84
   QSO   12289.11   13121.63   26782.51   24351.17   45703.39   46923.79
  QGAG   13988.85   13793.44   24218.99   25471.89   46242.51   49713.87
  DIFF   -1699.73    -671.81    2563.52   -1120.71    -539.11   -2790.07

   VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      67.40      62.65      55.85      44.25      37.40      19.35      42.42
     F       7.00       6.01       4.69       3.45       2.46       1.21      44.84
   PPT     942.91    2131.24    2337.91     774.99    2273.33     439.16   23482.48
  QRIV   71070.71   54415.14   30288.10    8643.89    5540.36    7701.33  296409.50
  QUNG    7647.95    7327.62    6726.99    6566.62    6208.45    6048.28   97748.04
  QCNL    3874.99    6458.33    5166.66        .00        .00        .00   27124.99
  QSIT   74121.14   56935.67   33530.93   14367.11   11323.38   13574.61  370694.00
  QIGS    2299.16    4391.66    4146.24     774.99    2273.33        .00   33725.39
  QGLI        .00        .00        .00        .00        .00        .00        .00
   SNW        .00        .00        .00        .00        .00     439.16     439.16
  SNMT        .00        .00        .00        .00        .00        .00    8150.41
  ETPH    3241.28    2546.66    1675.82     843.60     423.43     173.01   13969.76
   ETP    7615.86    5321.69    3120.72    1449.19     714.26     260.41   31228.03
    ET    7497.40    4312.38    3003.69    1458.46     717.41     271.96   30044.80
    MS    2569.79    2672.57    3823.59    3161.36    4736.10    4470.06    4470.06
    OP     323.23     260.16       7.88      23.65      23.65      19.70    3464.88
   QTO   74378.01   57141.06   33489.96   14351.49   11295.76   13547.35  373621.00
   QGO      37.84      37.84      56.76      18.92      56.76      37.84     491.94
   QSO   74340.17   57103.24   33433.21   14332.57   11239.00   13509.51  373129.00
  QGAG   69944.25   56668.07   34345.67   12517.55   11552.00   13575.04  372032.00
  DIFF    4395.91     435.17    -912.46    1815.02    -313.00     -65.53    1097.01



         OBJ=              25.764
         OBA=                .649
```

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SODA                                        1955

   VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      13.80      13.90      21.30      34.75      49.30      55.40
     F        .91        .93       1.76       3.12       4.97       5.65
   PPT    1123.74    1201.24    1227.08    2467.08    3629.58    5489.58
  QRIV    7172.59    6597.66    4896.67   19322.31   12965.63   32046.76
  QUNG    5405.62    4644.83    5205.41   18249.21    7885.71    8179.45
  QCNL        .00        .00        .00        .00        .00   16791.66
  QSIT   12462.22   11113.34    9840.68   37094.22   19452.03   32411.51
  QIGS        .00        .00        .00    5706.03    4377.10   11371.42
  QGLI        .00        .00        .00        .00        .00        .00
   SNW    1562.91    2764.16    3991.24     752.29       4.77        .01
  SNMT        .00        .00        .00    5706.03     747.52       4.76
  ETPH     115.98     129.34     261.40     477.29    1399.50    1937.62
   ETP     181.09     217.13     490.02    1079.23    3798.66    5371.86
    ET     193.15     228.62     496.67    1080.06    3807.83    5380.62
    MS    4298.62    4079.81    3598.91    7765.45    7765.45    7761.50
    OP      19.70      19.70      19.70      19.70     382.35    1643.75
   QTO   12431.02   11097.09    9819.93   37056.56   19761.78   34000.83
   QGO      37.84      18.92      37.84      18.92      37.84      37.84
   QSO   12393.18   11078.17    9782.09   37037.64   19743.94   33962.99
  QGAG   12965.83   14471.62   12839.39   34460.62   21035.00   37299.77
  DIFF    -572.65   -3393.44   -3057.29    2577.01   -1291.05   -3336.77

   VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      64.20      65.80      55.20      45.10      27.50      24.80      39.25
     F       6.67       6.31       4.63       3.51       1.81       1.56      41.89
   PPT     762.08    3306.66    2376.66    2518.74    2040.83    4908.33   31051.64
  QRIV   77070.85   44840.18   36771.02   11391.08   11448.55   14977.38  279501.00
  QUNG    8248.59    7567.87    6887.16    6887.16    8329.18    8500.55   95990.75
  QCNL   14208.33   18083.32    5166.66        .00        .00        .00   54249.99
  QSIT   77459.73   43214.82   40222.07   17390.43   19497.26   23256.18  343414.43
  QIGS    5735.00    9635.82    4184.99    2518.74    1027.38     875.56   45432.07
  QGLI        .00        .00        .00        .00        .00        .00        .00
   SNW        .00        .00        .00        .00    1013.44    5046.21    5046.21
  SNMT        .01        .00        .00        .00    1027.38     875.56    8361.28
  ETPH    2886.79    2864.04    1627.75     887.80     280.47     221.74   13089.78
   ETP    6782.93    5984.91    3031.22    1525.13     473.11     333.76   29269.10
    ET    6787.87    5995.55    3035.22    1537.32     480.90     338.99   29362.86
    MS    6724.60    7765.45    7765.45    7761.50    7761.50    7761.50    7761.50
    OP    4056.16    1328.40    1896.03    1659.52     922.39     654.34   12621.81
   QTO   77492.87   44483.00   42061.12   19015.49   20368.33   23859.23  351467.12
   QGO      28.38      66.22      37.84      37.84      47.30      28.38     435.16
   QSO   77464.48   44416.78   42023.28   18977.65   20321.03   23830.85  351031.93
  QGAG   77634.10   44598.80   40587.21   14667.02   18759.08   22333.88  351652.25
  DIFF    -169.61    -182.02    1436.07    4310.62    1561.94    1496.97    -620.29



         OBJ=              65.334
         OBA=                .369
```

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SODA                                        1956

   VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      18.90      13.05      26.80      41.15      51.80      59.00
     F       1.24        .87       2.22       3.70       5.23       6.01
   PPT    2712.49    1064.99     297.08    1201.24    3745.83     942.91
  QRIV   14092.30    8172.61   16873.97   29931.77   39138.89   38598.65
  QUNG    5606.03    5265.49   14700.72   18347.06   13581.14   11893.86
  QCNL        .00        .00        .00        .00   12916.66   20666.66
  QSIT   19739.48   13336.67   31245.78   47529.18   46590.70   40998.20
  QIGS        .00        .00    3919.48    6253.45    8435.11    8176.89
  QGLI        .00        .00        .00        .00        .00        .00
   SNW    7758.70    8643.70    5221.30     169.12        .65        .00
  SNMT        .00        .00    3919.48    5052.20     168.45        .65
  ETPH     158.85     121.43     328.90     749.63    1566.49    2262.96
   ETP     246.02     203.65     616.55    1695.03    4311.62    6273.84
    ET     260.16     212.86     634.63    1706.82    4324.21    6283.31
    MS    7513.17    7323.96    7765.45    7761.50    7765.45    7765.45
    OP     476.98     130.08     382.35    2731.70    4324.21    3819.65
   QTO   20179.12   13405.44   31569.50   50216.03   50878.26   44757.35
   QGO      37.84      18.92      37.84      28.38      37.84      28.38
   QSO   20141.28   13386.52   31531.66   50187.65   50840.42   44728.97
  QGAG   21149.94   16368.22   33713.47   48621.89   50966.78   43093.01
  DIFF   -1008.66   -2981.69   -2181.81    1565.76    -128.35    1635.95

   VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      66.00      61.85      56.65      44.00      26.80      19.70      40.47
     F       6.86       5.93       4.75       3.43       1.76       1.24      43.30
   PPT     710.41     206.66     490.83    1898.74     413.33    1717.91   15422.49
  QRIV   72530.53   58610.64   28908.76   12575.02    8793.32   10793.36  339019.75
  QUNG    9569.95    8528.66    8088.41    7607.91    7214.71    6606.87  117211.00
  QCNL   20666.66   21958.32   12916.66        .00        .00        .00   89124.98
  QSIT   71763.40   56985.14   30740.44   19352.13   15734.69   17224.09  411257.87
  QIGS    7943.74    7892.08    5011.66    1898.74     177.23        .00   49708.39
  QGLI        .00        .00        .00        .00        .00        .00        .00
   SNW        .00        .00        .00        .00     236.09    1954.01    1954.01
  SNMT        .00        .00        .00        .00     177.23        .00    9318.01
  ETPH    3083.73    2468.95    1735.89     830.80     273.33     176.14   13779.13
   ETP    7245.67    5159.29    3232.59    1427.20     461.07     265.12   31139.90
    ET    7256.95    5175.65    3240.20    1426.95     465.13     275.92   31262.83
    MS    7765.45    7765.45    7765.45    7761.50    7481.63    7225.41    7225.41
    OP    2085.24    1245.62    2246.65    1773.83     607.04      86.72   19910.30
   QTO   73791.46   58200.65   32931.80   21087.32   16300.34   17274.76  430591.68
   QGO      37.84      66.22      18.92      47.30      18.92      47.30     425.71
   QSO   73753.62   58134.42   32912.88   21040.02   16281.42   17227.46  430166.00
  QGAG   72840.87   58024.42   31586.99   16517.64   15655.56   17161.34  425699.93
  DIFF     912.74     110.00    1325.89    4522.37     625.86      66.12    4466.04



         OBJ=              91.265
         OBA=               3.826
```

```
ONEIDA
0   0      0   1
11873.    5361.     2367.     7927.      36.     1471.     1363.
    0.       0.        0.      466.       0.        0.        0.    30884.
.38443   .17423    .07664    .25667    .00116    .04762    .04413
.00000   .00000    .00000    .01508    .00000    .00000    .00000
$2573.666
  597.       0.     1233.        0.     1005.        0.        0.
 2835.
.21058   .00000    .43492    .00000    .35449    .00000    .00000
236.25000
  .48   .55   .63   .81  1.04  1.12   .95   .87   .77   .67   .59   .50
  .99  1.08  1.14  1.16  1.20  1.22  1.23  1.24  1.23  1.22  1.17  1.08
  .40   .60  1.00   .00   .50   .02   .00 32.00 22.00   .78 20.00  2.00
10.00  4.50  7.00   .50  3.00   .00   .00   .00   .00   .00  2.50  5.00
 1 1954 15.10 26.10 28.80 44.40 52.10 54.30 67.20 62.70 56.60 44.70 38.80 21.30
 1 1955 13.80 15.40 23.40 36.40 49.10 55.30 64.50 65.50 55.20 46.00 28.60 25.50
 1 1956 14.80 14.60 27.90 41.70 52.00 59.00 65.90 61.60 56.60 44.10 27.30 20.10
 2 1954  1.46   .89  2.23  1.12  1.39  2.50   .62  1.40  1.54   .51  1.49   .29
 2 1955   .73   .79   .80  1.62  2.38  3.60   .50  2.17  1.56  1.66  1.34  3.22
 2 1956  1.78   .71   .23   .79  2.46   .62   .47   .14   .33  1.25   .27  1.13
 3 1954  6.12  5.76 11.60 39.30 11.60  4.69  1.71  1.48  1.58  2.60  3.71  3.32
 3 1955  3.76  3.53  4.73 23.60 42.10 20.20  3.26  3.14  1.82  1.85  3.63 10.90
 3 1956 10.70  8.17 28.40 91.00 42.70  6.37  2.97  2.95  1.27  3.87  4.51  5.07
 4 1954   .00   .00   .00   .00  6.40  5.10  5.30  3.30  2.40   .00   .00   .00
 4 1955   .00   .00   .00   .00  2.80  7.50  5.50  4.90  2.60   .00   .00   .00
 4 1956   .00   .00   .00   .00  4.70  8.00  8.00  4.80  3.10   .00   .00   .00
 5 1954  9.36  9.44 14.72 16.18 17.49 19.12 26.75 23.96 16.80  9.25  9.13  8.74
 5 1955  8.67  8.55  9.17 16.58 11.96 13.43 29.53 18.04 18.58  9.40 12.11 15.60
 5 1956 13.58 10.45 17.34 27.44 23.03 14.78 26.28 24.42 15.13  9.48  8.78 11.61
 6 1954  5.67  5.58  9.86 11.42 18.43 19.51 27.25 22.10 13.43  4.95  4.64  5.41
 6 1955  5.18  5.76  5.18 14.32  9.83 15.29 30.31 17.45 15.87  5.76  7.43  8.71
 6 1956  8.63  6.69 12.42 22.45 21.48 16.99 28.41 23.46 12.31  6.58  6.27  6.65
 7 1954  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00
 7 1955  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00
 7 1956  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00
 8 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

POTS 10 THRU 24 SHOULD BE SET AS FOLLOWS
  .10000  .03086  .05555  .34999  .02500
  .07500  .00000  .33703  .50000  .00000
  .10000  .00000  .00000  .00000  .79999

POTS 10 THRU 24 ARE SET AS FOLLOWS
  .09997  .03045  .05517  .34924  .02465
  .07427  .00000  .03717  .49969  .00000
  .09899  .00000  .00000  .00000  .79974
```

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ONEIDA                                    1954

   VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      15.10      26.10      28.80      44.40      52.10      54.30
     F        .99       1.74       2.39       3.99       5.26       5.53
   PPT    3757.55    2290.56    5739.27    2882.50    3577.39    6434.16
  QRIV   14616.35   14377.23   25376.86   29412.05   47435.89   50215.68
  QUNG     315.01    3542.96    4007.53    2263.37     597.12     241.40
  QCNL        .00        .00        .00        .00   16471.46   13125.69
  QSIT   14661.35   17766.22   29189.84   31168.76   37270.77   41582.82
  QIGS        .00    6492.95    6820.88    3363.45   13460.33   14309.58
  QGLI    7720.99    7720.99    7720.99    7720.99    7720.99    7720.99
   SNW    5765.01    1562.62     461.01        .06        .00        .00
  SNMT        .00    6492.95    6820.88     460.94        .06        .00
  ETPH      70.01     133.96     194.54     506.65     879.35     998.85
   ETP     373.91     750.45    1173.70    3822.38    8316.98    9987.35
    ET     389.56     768.57    1168.70    3832.85    8331.74    9990.55
    MS   12503.89   18008.12   18008.12   17566.26   18033.25   18020.69
    DP    1313.22    1237.82    1112.15    1137.28    1313.22    1595.97
   QTO   23700.85   26515.80   37775.58   39773.70   46031.92   50631.35
   QGO      25.13      50.26      37.70      50.26      50.26      25.13
   QSO   23675.71   26465.53   37737.69   39723.42   45981.66   50606.21
  QGAG   24111.50   24310.76   37900.89   41647.14   45034.71   49219.34
  DIFF    -435.78    2154.76    -162.99   -1923.71     946.95    1386.87

   VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      67.20      62.70      56.60      44.70      38.80      21.30      42.67
     F       6.98       6.01       4.75       3.48       2.56       1.34      45.08
   PPT    1595.67    3603.13    3963.44    1312.56    3834.76     746.36   39737.39
  QRIV   70142.56   56891.19   34573.10   12753.19   11956.11   13948.80  381698.87
  QUNG      88.01      76.18      81.32     133.83     190.96     170.89   11708.62
  QCNL   13640.42    8493.09    6176.79        .00        .00        .00   57907.47
  QSIT   60316.08   50505.86   30022.06   12422.60   11893.37   14016.34  351035.87
  QIGS    9779.92    8698.99    7669.52    1312.56    3834.76        .00   75742.93
  QGLI    7720.99    7720.99    7720.99    7720.99    7720.99    7720.99   92651.98
   SNW        .00        .00        .00        .00        .00     746.36     746.36
  SNMT        .00        .00        .00        .00        .00        .00   13794.84
  ETPH    1730.22    1365.64     926.28     464.41     253.70     103.35    7627.01
   ETP   14642.84   10426.99    6318.00    2768.47    1408.56     522.40   60618.98
    ET   14684.22   10430.38    6339.91    2777.24    1420.04     540.36   60672.17
    MS   13176.21   11467.14   12792.93   11366.60   13785.70   13283.03   13283.03
    DP    2029.52    2387.67    2463.07    2230.59    1815.89    1262.95   19899.41
   QTO   69833.31   60358.00   39962.20   22142.57   21149.80   22745.78  460620.93
   QGO      50.26      50.26      25.13      50.26      50.26      50.26     515.23
   QSO   69783.04   60307.73   39937.07   22092.31   21099.53   22695.51  460105.68
  QGAG   68847.31   61673.64   43241.28   23812.60   23513.69   22517.35  465830.00
  DIFF     935.74   -1365.90   -3304.22   -1720.29   -2414.15     178.15   -5724.30


        OBJ=              5.111
        OBA=             -2.224
```

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ONEIDA                                    1955

   VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      13.80      15.40      23.40      36.40      49.10      55.30
     F        .91       1.03       1.94       3.27       4.95       5.64
   PPT    1878.77    2033.19    2058.93    4169.33    6125.32    9265.19
  QRIV   13351.00   14845.51   13351.00   36864.69   25307.11   39355.55
  QUNG     193.53     181.70    1683.61    3127.20    2173.07    1039.76
  QCNL        .00        .00        .00        .00    7206.26   19302.49
  QSIT   13480.55   14948.16   14876.55   39703.12   22480.93   27768.42
  QIGS        .00        .00    2880.29    7994.21   10461.17   20846.69
  QGLI    7720.99    7720.99    7720.99    7720.99    7720.99    7720.99
   SNW    2625.13    4658.33    3636.96      12.09        .00        .00
  SNMT        .00        .00    2880.29    3824.67      12.09        .00
  ETPH      63.98      79.04     158.06     288.77     755.49    1045.38
   ETP     341.72     442.79     953.63    2178.63    7145.46   10452.64
    ET     364.43     464.96    1011.62    2218.02    7150.46   10442.95
    MS   12943.73   12491.33   14432.88   18008.12   18008.12   18020.69
    DP     766.57     377.00     113.10       6.28       6.28     314.16
   QTO   21715.30   22796.04   22456.74   47125.23   29858.55   35551.28
   QGO      50.26      50.26      25.13      50.26      50.26      50.26
   QSO   21665.04   22745.78   22431.61   47074.96   29808.28   35501.00
  QGAG   22318.08   22019.18   23613.33   47824.47   30787.00   34573.10
  DIFF    -653.04     726.59   -1181.71    -749.50    -978.72     927.90

   VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      64.50      65.50      55.20      46.00      28.60      25.50      39.89
     F       6.70       6.28       4.63       3.58       1.88       1.60      42.47
   PPT    1286.63    5584.65    4014.91    4272.28    3448.71    6287.20   52425.56
  QRIV   78013.67   44935.07   40850.07   14845.51   19129.78   22417.71  363266.62
  QUNG     167.80     161.62      93.68      95.22    1788.15    3775.56   14480.95
  QCNL   14155.16   12610.96    6691.53        .00        .00        .00   59966.41
  QSIT   68119.06   36013.82   36058.35   14439.41   20760.88   26069.55  334638.75
  QIGS    9779.92   13151.43    8029.83    4272.28    3202.60    6429.02   87047.45
  QGLI    7720.99    7720.99    7720.99    7720.99    7720.99    7720.99   92651.98
   SNW        .00        .00        .00        .00     246.10    2104.28    2104.28
  SNMT        .00        .00        .00        .00    3202.60    6429.02   16348.89
  ETPH    1569.29    1516.29     870.48     501.32     157.04     123.73    7128.92
   ETP   13280.86   11577.24    5937.37    2988.48     870.67     625.41   56794.93
    ET   13283.03   11573.95    5944.06    3022.29     911.08     640.90   57027.82
    MS   14539.70   16110.54   18033.25   18020.69   18026.97   18020.69   18020.69
    DP    1118.43    2136.34    2789.81    2946.89    2701.84    2324.84   15601.59
   QTO   76719.89   45604.66   46320.96   24856.99   30926.72   35865.44  439797.87
   QGO      50.26      50.26      50.26      37.70      75.40      50.26     590.63
   QSO   76669.62   45554.39   46270.70   24819.29   30851.32   35815.17  439207.18
  QGAG   76020.98   46429.59   47824.47   24211.14   31185.54   40152.63  446959.37
  DIFF     648.63    -875.19   -1553.77     608.15    -334.22   -4337.45   -7752.18


        OBJ=              9.282
        OBA=             -5.236
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ONEIDA                                    1956

   VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      14.80      14.60      27.90      41.70      52.00      59.00
     F        .97        .97       2.31       3.75       5.26       6.01
   PPT    4581.12    1827.30     591.94    2033.19    6331.21    1595.67
  QRIV   22218.45   17236.73   31982.61   57787.91   55297.04   43739.46
  QUNG     550.76     420.53    5584.33    5113.74    2196.07     327.88
  QCNL        .00        .00        .00        .00   12096.23   20589.33
  QSIT   22700.59   17582.33   37378.48   62474.74   49362.28   30487.33
  QIGS        .00        .00    6244.99    2892.53   13589.27   13949.26
  QGLI    7720.99    7720.99    7720.99    7720.99    7720.99    7720.99
   SNW    6685.41    8512.71     859.66        .32        .00        .00
  SNMT        .00        .00    6244.99     859.33        .32        .00
  ETPH      66.61      74.94     168.46     426.89     875.08    1226.41
   ETP     366.46     419.79    1137.02    3220.66    8276.57   12262.71
    ET     377.00     439.83    1162.42    3229.64    8281.47   12277.69
    MS   17656.25   17247.63   18008.12   17706.52   18026.97   18020.69
    DP    2123.77    2073.51    1979.26    1972.97    2086.87    2249.44
   QTO   32296.49   27119.00   46823.63   71931.95   58925.39   40226.10
   QGO      50.26      50.26      50.26      87.96      87.96      50.26
   QSO   32246.23   27068.73   46773.36   71844.00   58837.42   40175.83
  QGAG   34971.64   26901.26   44636.17   70640.73   59282.42   38060.31
  DIFF   -2725.41     167.46    2137.19    1203.26    -444.98    2115.52

   VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      65.90      61.60      56.60      44.10      27.30      20.10      40.46
     F       6.85       5.91       4.75       3.43       1.80       1.26      43.32
   PPT    1209.62     360.31     649.30    3217.08     694.88    2908.24   26199.91
  QRIV   73131.59   60378.39   31683.71   16937.83   16140.73   17635.27  444169.56
  QUNG     152.87     151.84      65.37     199.20     537.88     260.96   15563.47
  QCNL   20589.33   12353.59    7978.36        .00        .00        .00   73606.84
  QSIT   59279.08   51809.51   26035.76   16689.20   16528.73   17798.70  408126.56
  QIGS   13563.21    7772.46    5636.32    3217.08     611.48        .00   69476.64
  QGLI    7720.99    7720.99    7720.99    7720.99    7720.99    7720.99   92651.98
   SNW        .00        .00        .00        .00      83.40    2991.65    2991.65
  SNMT        .00        .00        .00        .00     611.48        .00    9716.13
  ETPH    1651.78    1308.55     926.28     447.82     149.90      97.53    7442.31
   ETP   13978.98    9991.12    6318.00    2669.58     831.10     492.97   59965.03
    ET   13986.77    9990.55    6339.91    2676.71     841.97     515.23   60119.23
    MS   17605.98   15413.09   14734.49   15293.71   15086.35   14589.97   14589.97
    DP    2469.36    2500.77    2299.71    1891.29    1413.75     917.37   23977.32
   QTO   69204.98   61790.60   35802.60   26050.83   25397.36   26189.06  521758.06
   QGO      50.26      37.70      62.83      50.26      25.13      75.40     678.60
   QSO   69154.71   61752.91   35739.78   26000.56   25372.22   26113.66  521079.43
  QGAG   67651.70   62869.25   38957.01   24410.41   22616.98   29890.29  520888.12
  DIFF    1503.01   -1116.34   -3217.24    1590.15    2755.24   -3776.63     191.32


        OBJ=             17.795
        OBA=             -5.161
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```
   CACHE VALLEY
   0    0    0    1
   52429.    27563.     6058.    50020.     9469.     4827.      289.
     392.        0.        3.      683.        0.      275.        0.  152008.
   .34490    .18132    .03965    .32906    .06229    .03175    .00190
   .00257    .00000    .00001    .00449    .00000    .00180    .00000
$12667.33
    7515.    15563.    15771.     5776.     7775.        0.        0.
   52700.
   .14259    .30100    .29925    .10960    .14753    .00000    .00000
$4391.666
   .46   .52   .59   .80  1.06  1.13   .93   .61   .71   .66   .56   .48
   .81   .89  1.01  1.10  1.14  1.16  1.16  1.19  1.18  1.13  1.03   .90
   .20   .50  1.00   .00   .80   .17   .00 31.00 25.00  1.16 10.00  2.00
 10.00  3.50  7.00   .00   .00   .43   .00   .00   .00   .00  2.50  3.00
 1 1954 26.40 30.40 36.83 49.89 57.11 60.65 62.85 66.19 61.04 46.77 41.27 25.62
 1 1955 16.40 19.68 29.26 38.27 54.79 61.25 69.69 71.57 60.29 49.83 31.90 30.54
 1 1956 30.46 20.48 37.04 47.19 57.37 64.31 71.17 67.39 62.05 47.40 31.46 24.04
 2 1954  1.70   .82  2.95   .92   .96  1.97   .31   .22  1.42   .88  1.99  1.25
 2 1955  2.05  1.84  1.00  2.11  1.68  2.27   .24  1.68  2.25  1.08  2.15  4.11
 2 1956  3.03   .68   .09   .86  3.03   .59   .47   .23   .21  1.48   .71  1.74
 3 1954  6.83  5.76  6.60 12.53 26.26 17.43 12.14  8.80  7.09  6.64  6.00  5.46
 3 1965  5.32  4.61  5.09  8.04 29.68 28.50 15.09 10.22  7.78  7.37  6.49  8.88
 3 1956  8.01  6.30  6.20 22.63 49.23 41.66 18.92 12.56  9.62  6.87  7.64  7.13
 4 1954   .00   .00   .00   .00  9.60  5.50  6.40  3.40  1.50   .00   .00   .00
 4 1955   .00   .00   .00   .00  4.00  4.50  6.00  3.00  2.50   .00   .00   .00
 4 1956   .00   .00   .00  2.00  6.00 13.00 10.00  5.00  2.60   .00   .00   .00
 5 1954  5.11  5.37  6.63  7.40  5.34  4.44  4.06  4.02  3.62  3.80  4.00  3.95
 5 1955  4.36  3.86  6.73  9.07  9.10  6.54  4.27  3.65  4.00  4.27  5.14  8.44
 5 1956  6.66  5.87  9.31 12.53 14.67  6.51  4.38  4.64  3.76  4.68  5.01  5.68
 6 1954  3.11  2.96  4.37  5.99  6.40  5.27  6.19  5.62  4.12  2.88  2.64  2.69
 6 1955  2.70  2.56  2.66  6.12  7.12  5.20  7.06  4.41  4.45  3.01  3.53  5.18
 6 1956  4.52  3.40  5.52 10.32 10.85  6.65  8.90  6.02  4.10  3.25  3.07  3.61
 7 1954   .43   .43   .43   .43   .43   .43   .43   .43   .43   .43   .43   .43
 7 1955   .43   .43   .43   .43   .43   .43   .43   .43   .43   .43   .43   .43
 7 1956   .43   .43   .43   .43   .43   .43   .43   .43   .43   .43   .43   .43
 8 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

POTS 10 THRU 24 SHOULD BE SET AS FOLLOWS
  .10000  .05102  .07142  .69999  .00000
  .00000  .02150  .04761  .50000  .00000
  .10000  .00000  .00000  .00000  .39999

POTS 10 THRU 24 ARE SET AS FOLLOWS
  .09997  .05035  .07055  .69958  .00000
  .00000  .02117  .04699  .49957  .00000
  .09936  .00000  .00006  .00000  .39959
```

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CACHE VALLEY                                  1954

   VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      26.40      30.40      35.83      49.89      57.11      60.65
     F       1.74       2.03       2.97       4.49       5.76       6.16
   PPT   21534.46   10367.21   37368.62   11653.94   12160.63   24954.64
  QRIV   39409.67   37499.86   55459.62   75939.76   81069.75   66769.78
  QUNG   21786.07   32357.66   23730.28   26148.50   60864.43   37534.57
  QCNL        .00        .00        .00        .00  124139.64   69670.31
  QSIT   59326.35   67466.96   75117.96   92115.54   60393.21   46217.85
  QIGS    6847.54   24942.27   48727.19   13111.22   74240.60   59789.80
  QGLI    5446.95    5446.95    5446.95    5446.95    5446.95    5446.95
   SNW   27381.01   12825.94    1467.37      10.06        .01        .00
  SNMT    6847.54   24942.27   11358.57    1457.28      10.07        .01
  ETPH    1869.56    2391.47    4072.13   11972.71   19491.05   23251.31
   ETP    3083.46    4088.43    6904.56   25123.15   52526.82   65624.46
    ET    3123.53    4113.17    6896.52   25251.16   52543.44   65656.10
    MS   43822.28   64836.57   68726.98   76727.66   68726.96   82897.40
    OP      92.77      77.31      61.85     896.86    2876.12    4638.91
   QTO   61233.67   71583.00   60005.82   98126.51   68501.31   56130.67
   QGO      61.85     123.70      61.85     123.70     123.70      61.85
   QSO   61171.62   71439.29   79943.96   98004.81   68377.60   56069.02
  QGAG   64749.79   68109.76   64097.75   93761.71   67649.79   56249.82
  DIFF   -3577.96    3329.50   -4153.77    4243.09     727.61    -180.80

   VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      62.85      66.19      61.04      48.77      41.27      25.62      47.35
     F       6.53       6.54       5.12       3.60       2.72       1.62      49.56
   PPT    3926.87    2766.81   17987.60    6613.78   25207.98   15634.16  192416.65
  QRIV   76489.75   71266.78   52268.62   36579.86   36079.88   34179.69  665035.50
  QUNG   26142.62   18950.32   15267.92   14296.67   12920.67   13673.62  306675.81
  QCNL   61070.90   43068.92   19080.99        .00        .00        .00  336950.93
  QSIT   37743.88   38670.54   38303.31   40790.28   44027.69   45909.21  646281.87
  QIGS   44462.32   24321.26   27468.10    6613.78   25207.98    2395.01  362146.93
  QGLI    5446.95    5446.95    5446.95    5446.95    5446.95    5446.95   65363.39
   SNW        .00        .00        .00        .00        .00   13439.14   13439.14
  SNMT        .00        .00        .00        .00        .00    2395.01   49010.76
  ETPH   26353.23   29614.09   19732.94   10086.47    4972.65    1944.50  155954.09
   ETP   59795.42   58516.39   34262.91   16866.32    7794.60    2972.32  337561.31
    ET   59688.39   58527.64   32688.69   13636.41    7437.72    2999.83  332764.81
    MS   67619.92   33462.03   26343.77   23349.20   41209.03   40714.21   40714.21
    OP    5721.32    5535.77    4263.26    2675.10    1267.97     340.18   28467.47
   QTO   48770.46   49698.24   47904.53   48770.46   50628.03   51553.81  732886.75
   QGO     123.70     154.63     123.70     123.70     154.63      92.77    1329.82
   QSO   48646.75   49543.61   47780.82   48646.75   50471.39   51461.03  731556.87
  QGAG   51509.83   50929.84   48499.85   48219.85   50792.83   50131.84  734702.25
  DIFF   -2863.08   -1386.22    -719.02     426.90    -321.43    1329.16   -3145.37



   OBJ=                 .451
   OBA=                -.248
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CACHE VALLEY                                  1955

   VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      16.40      19.58      29.26      38.27      54.79      61.25
     F       1.08       1.31       2.42       3.44       5.53       6.24
   PPT   25968.02   23307.88   12867.33   26728.06   21281.11   28754.83
  QRIV   34319.69   32719.89   36349.86   77559.76   90249.71   85989.79
  QUNG   11456.33    9927.36   45542.71   41231.33   65716.18   61377.85
  QCNL        .00        .00        .00        .00   50669.32   57002.99
  QSIT   44614.82   41106.97   76633.60  112967.87  113045.07   75053.43
  QIGS        .00        .00   43227.10   56625.10   46668.17   57262.15
  QGLI    5446.95    5446.95    5446.95    5446.95    5446.95    5446.95
   SNW   39407.16   62715.05   32155.27    2258.22       5.82        .00
  SNMT        .00        .00   43227.10   29897.04    2252.40       5.82
  ETPH    1161.40    1540.29    3258.99    5823.20   17566.16   23012.71
   ETP    1915.48    2633.27    5526.07   12220.18   47393.31   67208.96
    ET    1948.34    2659.64    5535.77   12262.19   47394.25   67202.42
    MS   38796.79   36163.53   73682.45   68726.98   68726.98   78615.17
    OP    -154.63    -216.48    -154.63      92.77    1932.88    5303.82
   QTO   49791.02   46203.59   83778.81  118323.26  120240.68   85665.29
   QGO     123.70      61.85     154.63      61.85     123.70     123.70
   QSO   49667.32   46141.74   83624.17  118261.40  120116.98   85541.59
  QGAG   55289.82   49223.85   85261.73  114999.65  115339.64   82919.73
  DIFF   -5622.51   -3082.10   -1637.56    3261.76    4777.33    2621.65

   VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      69.69      71.57      60.29      49.83      31.90      30.54      44.45
     F       7.24       6.87       5.08       3.86       2.10       1.92      47.15
   PPT    3840.15   21281.11   28501.49   13680.71   27234.75   52062.72  284508.06
  QRIV   89689.73   55963.62   56419.62   36139.88   44829.85   65649.79  687881.37
  QUNG   32495.50   22006.21   16753.60   15870.89   13975.86   46975.98  383331.67
  QCNL  101338.65   38001.99   31668.32        .00        .00        .00  278681.25
  QSIT   37624.67   25566.15   38182.08   43346.35   55924.69  110325.79  778591.37
  QIGS   53709.46   40282.10   44335.65   13680.71   27234.75   34870.57  420095.68
  QGLI    5446.95    5446.95    5446.95    5446.95    5446.95    5446.95   65363.39
   SNW        .00        .00        .00        .00        .00   17192.14   17192.14
  SNMT        .00        .00        .00        .00        .00   34870.57  110252.92
  ETPH   33691.21   33404.88   19157.37   10664.41    2881.00    2299.96  155281.56
   ETP   76445.25   65564.06   33263.53   17829.21    4516.08    3515.87  338031.00
    ET   76480.25   65594.26   33245.55   17813.43    4546.13    3556.50  338238.75
    MS   56069.02   30679.71   41951.25   37869.00   60630.62   68726.98   68726.98
    OP    7344.94    7174.65    5535.77    3340.01    1499.91     278.33   31977.58
   QTO   50440.46   38070.03   49017.86   51955.86   62656.28  115818.25  871961.37
   QGO     154.63     123.70     154.63     123.70      61.85     185.55    1453.52
   QSO   50285.84   37946.32   48863.24   51832.14   62594.42  115632.68  870507.87
  QGAG   54189.82   48819.85   50749.84   54159.82   65124.80  106929.67  883008.00
  DIFF   -3903.98  -10873.52   -1886.60   -2327.68   -2530.37    8703.01  -12500.13



   OBJ=                2.375
   OBA=               -1.235
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CACHE VALLEY                                  1956

   VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      30.46      20.48      37.04      47.19      57.37      64.31
     F       2.01       1.37       3.07       4.24       5.79       6.56
   PPT   38382.00    8360.43    1140.05   10893.90   38382.00   11273.92
  QRIV   57269.82   43119.88   69989.78  130799.60  137499.56   84309.75
  QUNG   46649.84   13566.70   37266.05   50648.72  106036.96   90143.26
  QCNL        .00        .00        .00   25334.88  101338.65  164675.31
  QSIT  101961.14   55075.46  102761.85  158419.15  173156.78   65338.46
  QIGS   37000.93        .00   25649.81   25956.54   89079.87   93611.60
  QGLI    5446.95    5446.95    5446.95    5446.95    5446.95    5446.95
   SNW   18573.21   26933.65    2423.90      28.59        .04        .00
  SNMT   37000.93        .00   24509.75    2395.31      28.54        .04
  ETPH    2158.62    1611.09    4493.96   10361.82   19710.40   26776.88
   ETP    3560.00    2754.31    7620.14   21744.64   53117.98   75575.03
    ET    3602.89    2614.27    7685.13   21741.05   53100.11   75598.65
    MS   88726.98   85990.01   88726.98   88726.98   88726.98   88742.45
    OP      92.77    2752.42    6757.35    9788.11   11456.12   13360.07
   QTO  107313.57   63151.10  114735.84  173495.43  169824.40   83995.29
   QGO      92.77      61.65     123.70     123.70     123.70     185.55
   QSO  107220.79   63089.25  114612.12  173371.71  169700.71   83809.73
  QGAG  112579.65   71897.76  118027.62  158830.50  185839.43   82489.75
  DIFF   -5358.86   -8808.52   -3415.49   14541.21    3861.26    1319.98

   VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      71.17      67.39      62.05      47.40      31.48      24.04      46.70
     F       7.40       6.47       5.21       3.69       2.07       1.51      49.43
   PPT    5953.64    2913.48    2660.13   18747.64    8993.80   22041.15  169742.15
  QRIV   87429.73   76349.76   52025.83   41219.87   39009.88   45779.85  864802.75
  QUNG   40743.19   27047.28   20716.14   19101.06   16452.32   15354.06  483925.43
  QCNL  126673.31   63336.65   31668.32        .00        .00        .00  513026.93
  QSIT   29441.84   42735.32   36367.99   50959.52   52619.11   59323.46  928159.62
  QIGS   69290.29   34581.80   16494.30   18747.64    8993.80        .00  421406.62
  QGLI    5446.95    5446.95    5446.95    5446.95    5446.95    5446.95   65363.39
   SNW        .00        .00        .00        .00        .00   22041.15   22041.15
  SNMT        .00        .00        .00        .00        .00        .00   63934.57
  ETPH   35394.41   28993.40   20539.81    9361.40    2643.07    1610.45  164055.21
   ETP   80309.85   56905.60   35663.89   15650.77    4456.61    2767.41  360128.12
    ET   80315.07   56919.49   35657.79   15679.53    4484.28    2814.27  360412.75
    MS   77717.29   55450.50   38363.62   41379.12   48033.50   43203.76   43203.76
    OP   15942.40   16638.24   14442.49   10406.63    5999.66    2613.25  110251.54
   QTO   50687.88   64635.55   56099.94   66583.69   63893.32   67202.421101618.50
   QGO      61.85     154.63      92.77      61.85     154.63      61.65    1296.89
   QSO   50626.03   64480.92   56007.17   66522.04   63738.69   67140.561100319.75
  QGAG   55309.82   58889.82   47669.85   59299.82   63573.61   70699.781085106.75
  DIFF   -4683.79    5591.10    8337.31    7222.22     164.88   -3559.22   15212.93



   OBJ=                5.700
   OBA=                -.034
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TREMONTON
0     0     0     1
17803.   13750.    1158.   16645.    6513.    8612.      72.
 2093.       0.     507.     217.       0.     217.       0.   67587.
.26340   .20344   .01713   .24627   .09636   .12742   .00106
.03096   .00000   .00750   .00321   .00000   .00321   .00000
$5632.250
  934.    3092.    4525.    2698.    9506.       0.       0.
20755.
.04500   .14897   .21801   .12999   .45801   .00000   .00000
$1729.583
   .44   .50   .56   .71   .98  1.08   .95   .87   .78   .72   .53   .46
   .81   .95  1.09  1.16  1.18  1.18  1.18  1.18  1.16  1.13  1.04   .91
   .30   .55  1.00   .00   .40   .11   .00 35.00 28.00  1.11 20.00  2.00
 10.00  1.00  6.00   .00   .00 24.00 17.00   .03   .04   .05  2.50  5.50
 1 1954 29.60 32.95 37.70 50.75 59.55 62.35 75.15 70.25 62.45 50.50 43.20 29.10
 1 1955 15.70 21.35 31.35 44.00 56.40 63.20 72.05 73.30 61.35 50.15 30.60 29.80
 1 1956 31.40 21.05 38.35 49.45 59.75 66.50 74.55 68.75 63.00 50.80 32.45 26.85
 2 1954  1.33   .58  1.87   .45   .84  1.03   .34   .17  1.99   .49  1.65  1.09
 2 1955  2.28  1.64   .76  1.21  1.32  2.18   .12  1.77  1.11   .40  1.35  2.11
 2 1956  2.85   .38   .11  1.16  2.06   .62   .35   .00   .04   .98   .32  1.33
 3 1954  1.21  1.02  1.20  2.22  5.01  3.09  2.15  1.56  1.25  1.17  1.06   .96
 3 1955   .94   .81   .90  1.42  5.26  5.06  2.67  1.81  1.38  1.30  1.15  1.57
 3 1956  1.42  1.11  1.45  4.01  8.74  7.43  3.35  2.23  1.70  1.57  1.35  1.26
 4 1954   .00   .00   .00   .50  9.80  9.00 10.10 10.10  6.60  2.70  1.20   .66
 4 1955   .00   .00   .00   .00  5.60  7.60 10.80  9.10  7.70  3.30  1.10   .00
 4 1956   .00   .00   .00   .00  6.80 10.40 10.50 10.40  7.90  4.00  1.00   .66
 5 1954 13.00 12.87 16.46 18.50  5.51  3.75  1.33  1.23  3.64  7.81  9.81  9.85
 5 1955 11.35 10.10 17.11 22.67 17.39  9.91  1.29  1.84  2.92  8.13 12.13 19.72
 5 1956 23.17 14.12 22.10 29.40 28.85  7.94  1.36  2.48  2.68  8.31 11.49 13.66
 6 1954 12.14 13.04 15.96 17.22 12.36 10.24  9.39  9.26  8.83  8.86  9.46  9.48
 6 1955 10.34  9.26 16.16 21.47 21.02 15.16  9.83  8.92  9.24  9.91 12.16 19.82
 6 1956 20.86 13.37 22.29 28.90 33.44 14.88 10.01 10.65  8.65 10.76 11.67 13.08
 7 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

POTS 10 THRU 24 SHOULD BE SET AS FOLLOWS
  .10000  .62500  .25000  .29999  .00000
  .00000  .59999  .16666  .50000  .42499
  .10000  .03000  .04000  .05000  .79999

POTS 10 THRU 24 ARE SET AS FOLLOWS
  .09967  .62475  .24957  .29986  .00006
  .00000  .59954  .16607  .49993  .42486
  .09997  .02978  .03979  .04949  .79968
```

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TREMONTON                                 1956

  VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      31.40      21.05      38.35      49.45      59.75      66.50
     F       2.07       1.41       3.18       4.45       6.03       6.78
   PPT   16080.07    2140.25     647.70    6533.40   11630.59    3491.09
  QRIV  117490.01   75350.01  125548.03  162821.03  188350.03   83840.01
  QUNG    7290.64     693.00    5172.39    2689.38    5415.62    4604.62
  QCNL        .00        .00        .00        .00   38299.28   58575.39
  QSIT  123909.35   75351.18  128618.60  160656.78  163795.03   44558.07
  QIGS   16023.86        .00   11323.66    7033.61   32696.00   35708.45
  QGLI        .00        .00        .00        .00        .00        .00
   SNW    9036.73   11176.98     501.00        .00        .00        .00
  SNMT   16023.86        .00   12675.98     500.20        .00        .00
  ETPH     871.29     699.81    2101.78    4853.58    8905.94   11672.07
   ETP    1567.86    1221.24    3556.23    9761.28   24098.85   34698.18
    ET    1595.07    1333.80    3602.65    9762.93   24118.57   34775.28
    MS   33345.22   32148.92   33345.22   30608.85   33358.97   33345.22
    DP    5922.80   10367.95    3437.65    4248.93    2062.59    4097.68
   QTO  130658.29   85583.79  131950.84  164759.81  165639.84   48567.14
   QGO    5280.23    4482.69    5252.73    5142.72    5142.72    2667.61
   QSO  125378.06   81101.09  126698.10  159617.06  160497.09   45899.53
  QGAG  130500.03   79540.01  124500.01  165600.03  162500.03   44720.00
  DIFF   -5121.97    1561.08    2198.09   -5982.95   -2002.92    1179.52

  VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      74.55      68.75      63.00      50.80      32.45      26.85      48.57
     F       7.75       6.60       5.29       3.96       2.14       1.69      51.37
   PPT    1971.28      28.16     253.45    5519.60    1830.48    7490.89   57617.87
  QRIV   56430.00   60030.01   48720.00   60850.00   65734.01   73720.011118690.50
  QUNG    2081.20    1381.60    1058.19     975.70    1379.90     784.30   33526.51
  QCNL   59138.62   58575.39   44494.76   22529.00    5632.25    3717.28  292961.87
  QSIT   10485.45   17362.13   17031.33   44827.44   62851.27   71650.45  921104.62
  QIGS   34497.51   32244.61   24725.56   17910.55    4446.51    2044.50  218654.75
  QGLI        .00        .00        .00        .00        .00        .00        .00
   SNW        .00        .00        .00        .00     481.70    7972.59    7972.59
  SNMT        .00        .00        .00        .00    1348.77        .00   28549.61
  ETPH   15499.52   11833.00    8274.74    4407.29    1164.89     801.33   71083.23
   ETP   40504.36   28624.66   18228.75    9163.75    1942.01    1316.54  174663.68
    ET   40454.28   28628.76   18274.55    9254.16    1993.03    1347.55  175141.50
    MS   27308.71   31035.12   33345.22   33345.22   33358.97   33345.22   33345.22
    DP    2310.10     137.50     453.77    4372.69    7384.07    3327.64   49103.42
   QTO   12678.06   17353.26   17270.76   49089.67   70045.59   74858.31  968455.37
   QGO     715.03     935.04     935.04    2475.10    3520.15    3987.67   40536.79
   QSO   11963.02   16418.22   16335.72   45614.56   66525.43   70870.64  927918.62
  QGAG    7690.00   14000.00   15150.00   46820.00   64750.00   76990.01  932759.50
  DIFF    4273.02    2418.22    1185.72    -205.44    1775.43   -6119.37   -4840.90


      OBJ=             16.964
      OBA=              -.367
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TREMONTON                                 1954

  VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      29.60      32.95      37.70      50.75      59.55      62.35
     F       1.95       2.20       3.12       4.56       6.01       6.35
   PPT    7519.05    3294.86   10532.30    2534.51    4759.25    5829.37
  QRIV   68420.01   73460.00   89938.01   97012.01   69640.01   57730.00
  QUNG    2851.16    4289.46    1760.22    1436.55    3108.66    1917.30
  QCNL        .00        .00        .00    2816.12   55196.03   50690.25
  QSIT   70449.82   76654.03   89698.54   91711.59   33557.39   21765.04
  QIGS    5249.66    9139.67   13062.87    4229.01   35117.22   33709.00
  QGLI        .00        .00        .00        .00        .00        .00
   SNW    8521.17    2676.36     145.79        .15        .00        .00
  SNMT    5249.66    9139.67    2530.56     145.63        .15        .00
  ETPH     821.34    1095.42    1999.67    5188.06    8833.45   10002.62
   ETP    1477.98    1880.32    3383.46   10433.98   23902.70   29740.42
    ET    1512.56    1897.58    3382.64   10422.96   23898.55   29728.81
    MS   33358.97   33345.22   33345.22   27198.70   33345.22   33345.22
    DP      82.50    2227.59    7054.06    7714.09    1760.07    3973.92
   QTO   70375.60   78763.48   96556.78   99279.40   35256.56   25603.63
   QGO    3520.15    4125.18    4125.18    4070.18    1925.08    1375.06
   QSO   66855.45   74638.31   92431.59   95209.21   33331.47   24228.57
  QGAG   73220.01   72490.01   92750.00  104200.01   31040.00   21140.00
  DIFF   -6364.55    2148.29    -318.41   -8990.79    2291.47    3088.56

  VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      75.15      70.25      62.45      50.50      43.20      29.10      50.29
     F       7.61       6.74       5.24       3.93       2.85       1.83      52.66
   PPT    1914.96     957.48   11208.17    2787.96    9321.37    6167.31   66826.59
  QRIV   52930.00   52190.00   49760.00   49910.00   53303.01   53402.00  767694.62
  QUNG    1335.40     968.00     779.90     730.40     660.00    1293.99   21131.07
  QCNL   56885.71   56885.71   37172.84   15207.07    6758.69    3717.28  285329.62
  QSIT    7187.78    9421.25   21992.92   37935.50   48005.53   51782.99  560162.12
  QIGS   33202.09   32244.61   31653.23   11151.85   13038.65    3777.98  225575.81
  QGLI        .00        .00        .00        .00        .00        .00        .00
   SNW        .00        .00        .00        .00        .00    4433.82    4433.82
  SNMT        .00        .00        .00        .00        .00    1733.48   18799.18
  ETPH   15790.48   12449.61    8101.91    4341.01    2240.18     868.48   71732.25
   ETP   41264.72   30116.27   17848.01    9025.93    3734.64    1426.87  174235.31
    ET   41279.32   30168.83   17848.28    9047.90    3767.68    1457.56  174412.71
    MS   25314.87   27418.71   33345.22   33345.22   33345.22   33303.97   33303.97
    DP    4455.19     673.77     453.77    5857.75    5362.73    6737.79   46353.30
   QTO   11550.51    9955.44   22275.98   43644.42   53269.85   58357.58  604889.25
   QGO     715.03     605.02    1237.55    2255.10    2805.12    3052.63   29811.32
   QSO   10835.48    9350.41   21038.43   41389.33   50464.73   55304.95  575078.00
  QGAG    7540.00    6970.00   20510.00   44010.00   55270.00   35520.00  584659.62
  DIFF    3295.47    2380.41     528.42   -2620.67   -4805.26    -215.05   -9581.68


      OBJ=              5.915
      OBA=             -1.701
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TREMONTON                                 1955

  VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      15.70      21.35      31.35      44.00      56.40      63.20
     F       1.03       1.43       2.60       3.98       5.69       6.44
   PPT   12869.68    9265.04    4308.67    5843.18    7462.72   12306.46
  QRIV   58280.01   52204.00   91042.01  122980.01  118430.03   85400.01
  QUNG     585.20     507.10    8389.80    5368.17    3301.99    3135.00
  QCNL        .00        .00        .00        .00   31540.59   42805.09
  QSIT   58429.56   52201.31   97956.81  122781.46   96655.03   54658.24
  QIGS        .00        .00   19574.77   18052.61   24903.04   35849.27
  QGLI        .00        .00        .00        .20        .00        .00
   SNW   17303.51   26568.56   11302.45      93.01        .01        .00
  SNMT        .00        .00   19574.77   11209.43      92.99        .01
  ETPH     435.64     709.78    1474.99    3566.67    7729.63   12333.97
   ETP     783.93    1218.36    2495.70    7173.12   20915.83   30725.60
    ET     797.53    1333.80    2543.86    7177.81   20928.42   30718.86
    MS   32533.94   31378.89   33345.22   33358.97   33345.22   33345.22
    DP    3327.64     453.77    2062.59   12114.28   11027.98    5197.73
   QTO   61657.73   52197.31   99829.42  134755.96  107502.26   59677.64
   QGO    3190.14    2695.11    4015.17    4730.20    4427.69    3135.13
   QSO   58467.59   49502.19   95814.25  130025.76  103074.56   56542.50
  QGAG   63970.01   56910.01   96400.01  127700.01   97970.01   55870.00
  DIFF   -5502.42   -7407.81    -585.77    2325.74    5104.54     672.50

  VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      72.05      73.30      61.35      50.15      30.60      29.80      45.77
     F       7.49       7.03       5.15       3.91       2.01       1.87      48.66
   PPT     704.03    9997.24    6279.95    2281.06    7631.69   11912.20   91861.93
  QRIV   55420.00   50240.00   52070.01   55830.00   68535.01  111650.03  920080.62
  QUNG    1659.89    1124.19     855.80     810.70    2367.21    3546.63   31651.72
  QCNL   60828.28   51253.46   43368.32   18586.42    6195.47        .00  254577.59
  QSIT    9308.58    9424.21   21311.66   42153.88   66396.20  114307.26  745383.87
  QIGS   34159.57   38186.64   30132.52   12503.58    7540.78    6430.09  227332.81
  QGLI        .00        .00        .00        .00        .00        .00        .00
   SNW        .00        .00        .00        .00    3498.41    6984.52    8980.52
  SNMT        .00        .00        .00        .00    4133.27    6430.09   41440.58
  ETPH   14315.75   13750.59    7761.57    4264.28    1098.48     889.37   66330.73
   ETP   37410.85   33253.40   17098.26    8866.39    1831.30    1461.19  163243.90
    ET   37429.15   33248.96   17174.51    8892.89    1897.58    1553.81  163687.25
    MS   30155.08   33358.97   33358.97   33345.22   33345.22   33345.22   33345.22
    DP    4083.93    1072.54    3327.64    9927.93    5747.75    5073.97   63417.81
   QTO   13255.58   10367.95   24448.58   51922.30   72053.18  119245.28  806913.25
   QGO     825.03     605.02    1375.06    2750.12    3685.16    4867.71   36301.60
   QSO   12430.55    9762.93   23073.52   49172.17   68368.03  114377.56  770611.62
  QGAG    7280.00   10380.00   16490.00   45820.00   68370.01  111100.03  758259.87
  DIFF    5150.54    -617.06    6583.52    3352.17      -1.98    3277.54   12351.82


      OBJ=             12.524
      OBA=               .491
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ONEIDA
0    0     0    1
 11873.     5361.     2367.     7927.       36.     1471.     1363.
     0.        0.        0.      466.        0.        0.        0.    30884.
  .38443    .17423    .07664    .25687    .00116    .04762    .04413
  .00000    .00000    .00000    .01508    .00000    .00000    .00000
$2573.666
    597.        0.     1233.        0.     1005.        0.        0.
   2835.
  .21058    .00000    .43492    .00000    .35449    .00000    .00000
236.25000
   .48   .55   .63   .81  1.04  1.12   .95   .87   .77   .67   .59   .50
   .99  1.08  1.14  1.18  1.20  1.22  1.23  1.24  1.23  1.22  1.17  1.08
   .40   .60  1.00   .00   .50   .02   .00 32.00 22.00   .78 20.00  2.00
 10.00  4.50  7.00   .50  3.00   .00   .00   .00   .00   .00  2.50  5.00
 1 1954 15.10 26.10 26.80 44.40 52.10 54.30 67.20 62.70 56.60 44.70 38.80 21.30
 1 1955 13.80 15.40 23.40 36.40 49.10 55.30 64.50 65.50 55.20 46.00 28.60 25.50
 1 1956 14.80 14.60 27.90 41.70 52.00 59.00 65.90 61.60 56.60 44.10 27.30 20.10
 2 1954  1.46   .89  2.23  1.12  1.39  2.50   .62  1.40  1.54   .51  1.49   .29
 2 1955   .73   .79   .80  1.62  2.38  3.60   .50  2.17  1.56  1.66  1.34  3.22
 2 1956  1.78   .71   .23   .79  2.46   .82   .47   .14   .33  1.25   .27  1.13
 3 1954  6.12  5.75 11.60 39.30 11.60  4.69  1.71  1.48  1.58  2.60  3.71  3.32
 3 1955  3.76  3.53  4.73 23.60 42.10 20.20  3.26  3.14  1.82  1.85  3.63 10.90
 3 1956 10.70  6.17 28.40 91.20 42.70  6.37  2.97  2.95  1.27  3.87  4.51  5.07
 4 1954   .00   .00   .00   .00  6.40  5.10  5.30  3.30  2.40   .00   .00   .00
 4 1955   .00   .00   .00   .00  2.80  7.50  5.50  4.90  2.60   .00   .00   .00
 4 1956   .00   .00   .00   .00  4.70  8.00  6.00  4.80  3.10   .00   .00   .00
 5 1954  9.36  9.44 14.72 16.18 17.49 19.12 26.75 23.96 16.80  9.25  9.13  8.74
 5 1955  8.67  8.55  9.17 18.58 11.96 13.43 29.53 18.04 18.58  9.40 12.11 15.60
 5 1956 13.56 10.45 17.34 27.44 23.03 14.78 26.28 24.42 15.13  9.48  6.78 11.61
 6 1954  5.67  5.58  9.66 11.42 18.43 19.51 27.25 22.10 13.43  4.95  4.64  5.41
 6 1955  5.16  5.76  5.18 14.32  9.63 15.29 30.31 17.45 15.87  5.76  7.43  8.71
 6 1956  8.63  6.69 12.42 22.45 21.48 16.99 28.41 23.46 12.31  6.58  6.27  6.85
 7 1954  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00
 7 1955  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00
 7 1956  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00  3.00
 8 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

POTS 10 THRU 24 SHOULD BE SET AS FOLLOWS
  .10000  .03086  .05555  .34999  .02500
  .07500  .00000  .03703  .50000  .00000
  .10000  .00000  .00000  .00000  .79999

POTS 10 THRU 24 ARE SET AS FOLLOWS
  .09997  .03045  .05517  .34924  .02465
  .07427  .00000  .03717  .49969  .00000
  .09899  .00000  .00000  .00000  .79974
```

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ONEIDA                                        1954

   VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      15.10      26.10      26.80      44.40      52.10      54.30
     F        .99       1.74       2.39       3.99       5.28       5.53
   PPT    3757.55    2290.56    5739.27    2882.50    3577.39    6434.16
  QRIV   14616.35   14377.23   25376.66   29412.05   47435.69   50215.68
  QUNG     315.01    3542.96    4087.53    2263.37     597.12     241.40
  QCNL        .00        .00        .00        .00   16471.46   13125.69
  QSIT   14661.35   17766.22   29189.64   31166.76   37270.77   41582.82
  QIGS        .00    6492.95    6820.68    3363.45   13460.33   14309.56
  QGLI    7720.99    7720.99    7720.99    7720.99    7720.99    7720.99
   SNW    5765.01    1562.62     481.01        .06        .00        .00
  SNMT        .00    6492.95    6820.68     480.94        .06        .00
  ETPH      70.01     133.96     194.54     506.65     879.35     998.85
   ETP     373.91     750.45    1173.70    3622.38    8316.96    9967.35
    ET     389.56     766.57    1168.70    3632.85    8331.74    9990.55
    MS   12503.69   18008.12   18008.12   17568.28   18033.25   18020.69
    DP    1313.22    1237.82    1112.15    1137.26    1313.22    1595.97
   QTO   23700.85   26515.80   37775.56   39773.70   46031.92   50631.35
   QGO      25.13      50.26      37.70      50.26      50.26      25.13
   QSO   23675.71   26465.53   37737.89   39723.42   45981.66   50606.21
  QGAG   24111.50   24310.76   37900.89   41647.14   45034.71   49219.34
  DIFF    -435.78    2154.76    -162.99   -1923.71     946.95    1386.87

   VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      67.20      62.70      56.60      44.70      38.60      21.30      42.67
     F       6.98       6.01       4.75       3.46       2.56       1.34      45.08
   PPT    1595.67    3603.13    3963.44    1312.56    3834.76     746.36   39737.39
  QRIV   70142.56   56891.19   34573.10   12753.19   11956.11   13948.60  381698.67
  QUNG      86.01      76.18      81.32     133.63     190.96     170.89   11706.62
  QCNL   13640.42    6493.09    6176.79        .00        .00        .00   67907.47
  QSIT   60316.08   50505.66   30022.06   12422.60   11893.37   14016.34  351035.87
  QIGS    9779.92    6698.99    7669.52    1312.56    3834.76        .00   75742.93
  QGLI    7720.99    7720.99    7720.99    7720.99    7720.99    7720.99   92651.98
   SNW        .00        .00        .00        .00        .00     746.36     746.36
  SNMT        .00        .00        .00        .00        .00        .00   13794.84
  ETPH    1730.22    1365.64     926.28     464.41     253.70     103.35    7627.01
   ETP   14642.64   10426.99    6318.00    2766.47    1406.56     522.40   60510.06
    ET   14664.22   10430.38    6339.91    2777.24    1420.04     540.36   60672.17
    MS   13176.21   11467.14   12792.93   11366.60   13765.70   13263.03   13263.03
    DP    2029.52    2387.67    2463.07    2230.59    1815.89    1262.95   19899.41
   QTO   69833.31   60358.00   39962.20   22142.57   21149.80   22745.78  460620.93
   QGO      50.26      50.26      25.13      50.26      50.26      50.26     515.23
   QSO   69783.04   60307.73   39937.07   22092.31   21099.53   22695.51  460105.68
  QGAG   68847.31   61673.64   43241.28   23812.60   23513.69   22517.35  465830.00
  DIFF     935.74   -1365.90   -3304.22   -1720.29   -2414.15     178.15   -5724.30


                    OBJ=             5.111
                    OBA=            -2.224
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ONEIDA                                        1955

   VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      13.80      15.40      23.40      36.40      49.10      55.30
     F        .91       1.03       1.94       3.27       4.95       5.64
   PPT    1878.77    2033.19    2058.93    4169.33    6125.32    9265.19
  QRIV   13351.00   14845.51   13351.00   36864.69   25307.11   39355.55
  QUNG     193.53     181.70    1683.61    3127.20    2173.07    1039.76
  QCNL        .00        .00        .00        .00    7206.28   19302.49
  QSIT   13480.55   14948.16   14876.55   39703.12   22400.93   27768.42
  QIGS        .00        .00    2880.29    7994.21   10461.17   20846.69
  QGLI    7720.99    7720.99    7720.99    7720.99    7720.99    7720.99
   SNW    2625.13    4658.33    3836.96      12.09        .00        .00
  SNMT        .00        .00    2880.29    3824.87      12.09        .00
  ETPH      83.98      79.04     158.06     288.77     755.49    1045.38
   ETP     341.72     442.79     953.63    2178.63    7145.46   10452.64
    ET     364.43     464.96    1011.62    2218.02    7150.46   10442.95
    MS   12943.73   12491.33   14432.88   18008.12   18008.12   18020.69
    DP     766.57     377.00     113.10       6.28       6.28     314.16
   QTO   21715.30   22796.04   22456.74   47125.23   29858.55   35551.28
   QGO      50.26      50.26      25.13      50.26      50.26      50.26
   QSO   21665.04   22745.78   22431.61   47074.96   29808.28   35501.00
  QGAG   22318.08   22019.18   23613.33   47824.47   30787.00   34573.10
  DIFF    -653.04     726.59   -1181.71    -749.50    -978.72     927.90

   VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      64.50      65.50      55.20      46.00      28.60      25.50      39.89
     F       6.70       6.28       4.63       3.58       1.88       1.60      42.47
   PPT    1286.83    5584.85    4014.91    4272.28    3448.71    8287.20   52425.56
  QRIV   78013.67   44935.07   40850.07   14845.51   19129.78   22417.71  363266.62
  QUNG     167.80     161.62      93.68      95.22    1788.15    3775.56   14480.95
  QCNL   14155.16   12610.96    6691.53        .00        .00        .00   59966.41
  QSIT   68119.06   36013.82   36058.35   14439.41   20760.88   26069.55  334638.75
  QIGS    9779.92   13151.43    8029.83    4272.28    3202.60    6429.02   87047.45
  QGLI    7720.99    7720.99    7720.99    7720.99    7720.99    7720.99   92651.98
   SNW        .00        .00        .00        .00     246.10    2104.28    2104.28
  SNMT        .00        .00        .00        .00    3202.60    6429.02   16348.89
  ETPH    1569.29    1516.29     870.48     501.32     157.04     123.73    7128.92
   ETP   13280.86   11577.24    5937.37    2988.48     870.67     625.41   56794.93
    ET   13283.03   11573.95    5944.06    3022.29     911.08     640.90   57027.82
    MS   14539.70   16110.54   18033.25   18020.69   18026.97   18020.69   18020.69
    DP    1118.43    2136.34    2789.81    2946.89    2701.84    2324.84   15601.59
   QTO   76719.89   45604.66   46320.96   24856.99   30926.72   35865.44  439797.87
   QGO      50.26      50.26      50.26      37.70      75.40      50.26     590.63
   QSO   76669.62   45554.39   46270.70   24819.29   30851.32   35815.17  439207.18
  QGAG   76020.98   46429.59   47824.47   24211.14   31185.54   40152.63  446959.37
  DIFF     648.63    -875.19   -1553.77     608.15    -334.22   -4337.45   -7752.18


                    OBJ=             9.282
                    OBA=            -5.236
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ONEIDA                                        1956

   VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      14.80      14.60      27.90      41.70      52.00      59.00
     F        .97        .97       2.31       3.75       5.26       6.01
   PPT    4581.12    1827.30     591.94    2033.19    6331.21    1595.67
  QRIV   22216.45   17236.73   31982.61   57787.91   55297.04   43739.46
  QUNG     550.76     420.53    5564.33    5113.74    2198.07     327.88
  QCNL        .00        .00        .00        .00   12096.23   20589.33
  QSIT   22700.59   17582.33   37378.48   62474.74   49362.26   30487.33
  QIGS        .00        .00    8244.99    2892.53   13589.27   13949.26
  QGLI    7720.99    7720.99    7720.99    7720.99    7720.99    7720.99
   SNW    6685.41    8512.71     859.86        .32        .00        .00
  SNMT        .00        .00    8244.99     859.33        .32        .00
  ETPH      68.61      74.94     188.46     426.89     875.08    1226.41
   ETP     366.46     419.79    1137.02    3220.68    8276.57   12262.71
    ET     377.00     439.83    1162.42    3229.64    8281.47   12277.69
    MS   17656.25   17247.83   18008.12   17706.52   18026.97   18020.69
    DP    2123.77    2073.51    1979.26    1972.97    2086.07    2249.44
   QTO   32296.49   27119.00   46823.63   71931.95   58925.39   40226.10
   QGO      50.26      50.26      50.26      87.96      87.96      50.26
   QSO   32246.23   27068.73   46773.38   71844.00   56837.42   40175.83
  QGAG   34971.64   26901.26   44636.17   70640.73   59282.42   38060.31
  DIFF   -2725.41     167.46    2137.19    1203.26    -444.98    2115.52

   VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      65.90      61.60      56.60      44.10      27.30      20.10      40.46
     F       6.85       5.91       4.75       3.43       1.80       1.26      43.32
   PPT    1209.62     360.31     849.30    3217.08     694.88    2908.24   26199.91
  QRIV   73131.59   60378.39   31693.71   16937.83   16140.75   17635.27  444169.56
  QUNG     152.87     151.84      65.37     199.20     537.88     260.96   15563.47
  QCNL   20589.33   12353.59    7978.36        .00        .00        .00   73606.84
  QSIT   59279.00   51809.51   26035.76   16689.20   16528.73   17798.70  408126.56
  QIGS   13563.21    7772.46    5636.32    3217.08     611.48        .00   69476.64
  QGLI    7720.99    7720.99    7720.99    7720.99    7720.99    7720.99   92651.98
   SNW        .00        .00        .00        .00      83.40    2991.65    2991.65
  SNMT        .00        .00        .00        .00     611.48        .00    9716.13
  ETPH    1651.78    1308.55     926.28     447.82     149.90      97.53    7442.31
   ETP   13978.96    9991.12    6318.00    2669.58     831.10     492.97   59965.03
    ET   13986.77    9990.55    6339.91    2676.71     841.97     515.23   60119.23
    MS   17605.98   15413.09   14734.49   15293.71   15086.35   14589.97   14589.97
    DP    2469.36    2500.77    2299.71    1891.29    1413.75     917.37   23977.32
   QTO   69204.98   61790.60   35802.60   26050.83   25397.36   26189.06  521758.06
   QGO      50.26      37.70      62.83      50.26      25.13      75.40     678.60
   QSO   69154.71   61752.91   35739.78   26000.56   25372.22   26113.66  521079.43
  QGAG   67651.70   62869.25   38957.01   24410.41   22616.98   29890.29  520888.12
  DIFF    1503.01   -1116.34   -3217.24    1590.15    2755.24   -3776.63     191.32


                    OBJ=            17.795
                    OBA=            -5.161
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CACHE VALLEY
0    0    0    1
52429.    27563.     6058.    50020.     9469.     4827.      289.
  392.       0.        3.      683.        0.      275.        0.   152008.
.34490    .18132    .03985    .32906    .06229    .03175    .00190
.00257    .00000    .00001    .00449    .00000    .00180    .00000
$12667.33
  7515.   16863.    15771.     5776.     7775.        0.        0.
 52700.
 .14259   .30100    .29925    .10960    .14753    .00000    .00000
$4391.666
  .46   .52   .59   .80  1.06  1.13   .93   .61   .71   .66   .56   .48
  .81   .89  1.01  1.10  1.14  1.16  1.16  1.19  1.16  1.13  1.03   .90
  .20   .50  1.00   .00   .80   .17   .00 31.00 25.00  1.16 10.00  2.00
10.00  3.50  7.00   .00   .00   .43   .00   .00   .00   .00  2.50  3.00
1 1954 28.40 30.40 35.83 49.89 57.11 60.65 62.85 66.19 61.04 48.77 41.27 25.82
1 1955 16.40 19.58 29.26 38.27 54.79 61.25 69.69 71.57 60.29 49.83 31.90 30.54
1 1956 30.46 20.48 37.04 47.19 57.37 64.31 71.17 67.39 62.05 47.40 31.48 24.04
2 1954  1.70   .82  2.95   .92   .96  1.97   .31   .22  1.42   .68  1.99  1.25
2 1955  2.05  1.84  1.00  2.11  1.68  2.27   .24  1.68  2.25  1.08  2.15  4.11
2 1956  3.03   .66   .09   .86  3.03   .89   .47   .23   .21  1.48   .71  1.74
3 1954  6.83  5.76  6.80 12.53 26.26 17.43 12.14  8.60  7.09  6.64  8.00  5.46
3 1955  6.32  4.61  5.09  6.04 29.68 28.50 15.09 10.22  7.78  7.37  6.49  8.86
3 1956  8.01  6.30  8.20 22.63 49.23 41.86 18.92 12.56  9.82  8.87  7.64  7.13
4 1954   .00   .00   .00   .00  9.80  5.50  6.40  3.40  1.50   .00   .00   .00
4 1955   .00   .00   .00   .00  4.00  4.50  6.00  3.00  2.50   .00   .00   .00
4 1956   .00   .00   .00  2.00  6.00 13.00 10.00  5.00  2.50   .00   .00   .00
5 1954  5.11  5.37  6.63  7.40  5.34  4.44  4.06  4.02  3.82  3.80  4.00  3.95
5 1955  4.36  3.88  8.73  9.07  9.10  6.54  4.27  3.85  4.00  4.27  5.14  8.44
5 1956  8.88  5.67  9.31 12.53 14.67  6.51  4.36  4.64  3.76  4.68  5.01  5.58
6 1954  3.11  2.96  4.37  5.99  6.40  5.27  6.19  5.62  4.12  2.88  2.64  2.69
6 1955  2.70  2.56  2.86  6.12  7.12  5.20  7.06  4.41  4.45  3.01  3.53  5.18
6 1956  4.52  3.40  5.52 10.32 10.85  6.65  8.90  6.02  4.10  3.25  3.07  3.81
7 1954   .43   .43   .43   .43   .43   .43   .43   .43   .43   .43   .43   .43
7 1955   .43   .43   .43   .43   .43   .43   .43   .43   .43   .43   .43   .43
7 1956   .43   .43   .43   .43   .43   .43   .43   .43   .43   .43   .43   .43
8 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
8 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
8 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

POTS 10 THRU 24 SHOULD BE SET AS FOLLOWS
  .10000  .05102  .07142  .69999  .00000
  .00000  .02150  .04761  .50000  .00000
  .10000  .00000  .00000  .00000  .39999

POTS 10 THRU 24 ARE SET AS FOLLOWS
  .09997  .05035  .07055  .69956  .00000
  .00000  .02117  .04699  .49957  .00000
  .09936  .00000  .00000  .00000  .39959
```

```
CACHE VALLEY                           1954

  VAR        JAN        FEB        MAR        APR        MAY        JUN
 TEMP      28.40      30.40      35.83      49.89      57.11      60.65
    F       1.74       2.03       2.97       4.49       5.76       6.18
  PPT   21534.46   10387.21   37368.62   11653.94   12160.63   24954.64
 QRIV   39409.87   37499.88   65459.82   75939.76   81089.75   66769.78
 QUNG   21786.07   32357.66   23730.28   26148.50   60864.43   37534.57
 QCNL        .00        .00        .00        .00  124139.64   69670.31
 QSIT   59326.35   67466.06   75117.96   92115.54   60393.21   46217.85
 QIGS    8847.54   24942.27   48727.19   13111.22   74240.60   59789.80
 QGLI    5446.95    5446.95    5446.95    5446.95    5446.96    5446.95
  SNW   27361.01   12825.94    1467.37      10.06        .01        .00
 SNMT    8847.54   24942.27   11358.57    1457.28      10.07        .01
 ETPH    1689.56    2391.47    4072.13   11972.71   19491.05   23251.31
  ETP    3083.46    4088.43    6904.86   25125.15   52526.62   65624.46
   ET    3123.53    4113.17    6896.52   25251.16   52543.44   65656.10
   MS   43622.28   64636.57   88726.98   78727.66   88726.98   82897.40
   DP      92.77      77.31      61.85     896.65    2876.12    4638.91
  QTO   61233.67   71563.00   80005.82   98128.51   68501.31   56130.87
  QGO      61.85     123.70      61.85     123.70     123.70      61.85
  QSO   61171.82   71439.29   79943.96   98004.81   68377.60   56069.02
 QGAG   64749.79   68109.78   84097.75   93761.71   87649.79   56249.82
 DIFF   -3577.96    3329.50   -4153.77    4243.09     727.81    -180.80

  VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
 TEMP      62.85      66.19      61.04      48.77      41.27      25.82      47.35
    F       6.53       6.54       5.12       3.80       2.72       1.62      49.56
  PPT    3926.87    2786.81   17987.60    6613.78   25207.98   15834.16  192418.65
 QRIV   78489.75   71266.78   52268.62   36579.86   36879.88   34179.89  665035.50
 QUNG   26142.82   18950.32   15267.92   14298.67   12920.87   13873.82  306875.81
 QCNL   61070.90   43068.92   19000.99        .00        .00        .00  336950.93
 QSIT   37743.88   38870.54   38303.31   40790.28   44027.89   45909.21  646281.67
 QIGS   44462.32   24321.28   27488.10    6613.78   25207.98    2395.01  362146.93
 QGLI    5446.95    5446.95    5446.95    5446.95    5446.95    5446.95   65363.39
  SNW        .00        .00        .00        .00        .00   13439.14   13439.14
 SNMT        .00        .00        .00        .00        .00    2395.01   49010.78
 ETPH   26353.23   29814.09   19732.94   10088.47    4972.65    1944.50  155954.09
  ETP   59795.42   58516.39   34262.91   16866.32    7794.80    2972.32  337561.31
   ET   59588.39   58527.64   32686.89   13838.41    7437.72    2999.83  332764.81
   MS   87619.92   33482.03   28343.77   23349.20   41209.03   40714.21   40714.21
   DP    5721.32    5535.77    4283.28    2875.10    1287.97     340.18   28467.47
  QTO   48770.46   49698.24   47904.53   48770.46   50626.03   51553.81  732686.75
  QGO     123.70     154.63     123.70     123.70     154.63      92.77    1329.82
  QSO   48646.75   49543.61   47780.82   48646.75   50471.39   51461.03  731356.87
 QGAG   51509.83   50929.84   48499.85   48219.85   50792.83   50131.84  734702.25
 DIFF   -2863.08   -1386.22    -719.02     426.90    -321.43    1329.16   -3145.37


OBJ=                 .451
OBA=                -.246
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CACHE VALLEY                           1955

  VAR        JAN        FEB        MAR        APR        MAY        JUN
 TEMP      16.40      19.58      29.26      38.27      54.79      61.25
    F       1.08       1.31       2.42       3.44       5.53       6.24
  PPT   25966.02   23307.88   12667.33   26728.06   21281.11   28754.83
 QRIV   34319.89   32719.89   36349.88   77559.76   90249.71   65989.79
 QUNG   11456.33    9927.36   45542.71   41231.33   65716.18   61377.85
 QCNL        .00        .00        .00        .00   50669.32   57002.99
 QSIT   44614.82   41106.97   78633.80  112967.87  113045.07   75053.43
 QIGS        .00        .00   43227.10   56625.10   48866.17   57262.15
 QGLI    5446.95    5446.95    5446.95    5446.95    5446.95    5446.95
  SNW   39407.16   62715.05   32155.27    2258.22       5.82        .00
 SNMT        .00        .00   43227.10   29897.04    2252.40       5.82
 ETPH    1161.40    1540.29    3258.99    5823.20   17566.16   23812.71
  ETP    1915.48    2633.27    5526.07   12220.18   47393.31   67208.96
   ET    1948.34    2659.64    5535.77   12282.19   47394.25   67202.42
   MS   38796.79   36183.53   73662.45   88726.98   88726.98   78815.17
   DP    -154.63    -216.48    -154.63      92.77    1932.86    5303.82
  QTO   49791.02   46203.59   83778.81  118323.26  120240.68   85665.29
  QGO     123.70      61.85     154.63      61.85     123.70     123.70
  QSO   49667.32   46141.74   83624.17  118261.40  120116.98   85541.59
 QGAG   55289.82   49223.85   85261.73  114999.65  113339.64   82919.73
 DIFF   -5622.51   -3082.10   -1637.56    3261.76    4777.33    2621.85

  VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
 TEMP      69.69      71.57      60.29      49.83      31.90      30.54      44.45
    F       7.24       6.87       5.06       3.88       2.10       1.92      47.15
  PPT    3040.15   21281.11   26501.49   13680.71   27234.75   52082.72  284508.08
 QRIV   89869.73   55963.82   56419.82   36139.88   44829.85   65649.79  687881.37
 QUNG   32495.50   22008.21   16753.80   15670.89   13975.88   46975.98  383331.87
 QCNL  101338.65   38001.99   31668.32        .00        .00        .00  278681.25
 QSIT   37824.67   25566.15   38182.08   43346.35   55924.69  110325.79  776591.37
 QIGS   53709.48   40282.10   44335.65   13680.71   27234.75   34870.57  420095.68
 QGLI    5446.95    5446.95    5446.95    5446.95    5446.95    5446.95   65363.39
  SNW        .00        .00        .00        .00        .00   17192.14   17192.14
 SNMT        .00        .00        .00        .00        .00   34870.57  110252.92
 ETPH   33891.21   33404.88   19157.37   10664.41    2881.00    2299.96  155281.56
  ETP   78445.28   65564.06   33263.53   17829.21    4516.08    3515.67  338031.00
   ET   76480.25   65594.26   33245.55   17813.43    4546.13    3556.50  338238.75
   MS   56069.02   30879.71   41951.25   37869.00   60630.62   88726.98   88726.98
   DP    7344.94    7174.85    5535.77    3340.01    1499.91     278.33   31977.58
  QTO   50440.46   38070.03   49017.88   51955.86   62656.28  115818.25  871961.37
  QGO     154.63     123.70     154.63     123.70      61.85     185.55    1453.52
  QSO   50285.84   37946.32   48863.24   51832.14   62594.42  115632.68  870507.87
 QGAG   54189.82   48619.85   50749.84   54159.82   65124.80  106929.67  883008.00
 DIFF   -3903.98  -10673.52   -1886.60   -2327.68   -2530.37    8703.01  -12500.13


OBJ=                2.375
OBA=               -1.235
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CACHE VALLEY                           1956

  VAR        JAN        FEB        MAR        APR        MAY        JUN
 TEMP      30.46      20.48      37.04      47.19      57.37      64.31
    F       2.01       1.37       3.07       4.24       5.79       6.56
  PPT   38382.00    8360.43    1140.05   10893.90   38382.00   11273.92
 QRIV   57269.82   43119.86   69989.78  130799.60  137499.56   84309.75
 QUNG   46849.84   13566.70   37266.05   50648.72  106036.96   90143.26
 QCNL        .00        .00        .00   25334.66  101338.65  184675.31
 QSIT  101961.14   55075.46  102761.85  156419.15  173156.78   85338.46
 QIGS   37000.93        .00   25649.81   25956.54   89079.87   93611.60
 QGLI    5446.95    5446.95    5446.95    5446.95    5446.95    5446.95
  SNW   18573.21   28933.85    2423.90      28.59        .04        .00
 SNMT   37000.93        .00   24509.75    2395.31      28.54        .04
 ETPH    2158.62    1611.09    4493.96   10361.82   19710.40   26776.68
  ETP    3560.00    2754.31    7620.14   21744.64   53117.98   75575.03
   ET    3602.89    2814.27    7685.13   21741.05   53108.11   75598.85
   MS   88726.98   85990.01   88726.98   88726.98   88726.98   88742.45
   DP      92.77    2752.42    6757.35    9788.11   11458.12   13360.07
  QTO  107313.57   63151.10  114735.84  173495.43  169824.40   83995.29
  QGO      92.77      61.85     123.70     123.70     123.70     185.55
  QSO  107220.79   63089.25  114612.12  173371.71  169700.71   83809.73
 QGAG  112579.65   71897.76  118027.62  158830.50  165839.43   82489.75
 DIFF   -5358.86   -8808.52   -3415.49   14541.21    3861.26    1319.98

  VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
 TEMP      71.17      67.39      62.05      47.40      31.48      24.04      46.70
    F       7.40       6.47       5.21       3.69       2.07       1.51      49.43
  PPT    5953.64    2913.46    2660.13   18747.64    8993.80   22041.15  169742.15
 QRIV   87429.73   76349.76   52025.83   41219.87   39089.88   45779.85  864802.75
 QUNG   40743.19   27047.28   20716.14   19101.08   16452.32   15354.05  483925.43
 QCNL  128673.31   63338.65   31668.32        .00        .00        .00  513026.93
 QSIT   29441.84   42735.32   36367.99   50959.52   52619.11   59323.46  928159.62
 QIGS   69290.29   34581.80   18494.30   18747.64    8993.80        .00  421486.62
 QGLI    5446.95    5446.95    5446.95    5446.95    5446.95    5446.95   65363.39
  SNW        .00        .00        .00        .00        .00   22041.15   22041.15
 SNMT        .00        .00        .00        .00        .00        .00   63934.57
 ETPH   35394.41   28993.40   20539.81    9361.40    2843.07    1810.45  164055.21
  ETP   80309.85   56905.60   35683.89   15650.77    4456.61    2767.41  360126.12
   ET   80315.07   56919.49   35657.79   15679.53    4484.26    2814.27  360412.75
   MS   77717.29   55450.50   38363.82   41379.12   46033.50   43203.76   43203.76
   DP   15942.40   16838.24   14442.49   10406.63    5999.66    2613.25  110251.54
  QTO   50687.88   64635.55   56099.94   66583.89   63893.32   67202.421101618.50
  QGO      61.85     154.63      92.77      61.85     154.63      61.85    1298.89
  QSO   50626.03   64480.92   56007.17   66522.04   63738.69   67140.561100319.75
 QGAG   55309.82   58889.82   47669.85   59299.82   63573.81   70699.781085106.75
 DIFF   -4683.79    5591.10    8337.31    7222.22     164.88   -3559.22   15212.93


OBJ=                5.700
OBA=                -.034
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   TREMONTON
   0     0     0     1
   17803.    13750.     1158.    16645.     6513.     8612.       72.
    2093.        0.      507.      217.        0.      217.        0.    67587.
   .26340    .20344    .01713    .24627    .09636    .12742    .00106
   .03096    .00000    .00750    .00321    .00000    .00321    .00000
$5632.250
     934.     3092.     4525.     2698.     9506.        0.        0.
   20755.
   .04500    .14897    .21801    .12999    .45831    .00000    .00000
$1729.583
   .44   .50   .56   .71   .98  1.08   .95   .87   .78   .72   .53   .46
   .81   .95  1.09  1.16  1.18  1.18  1.18  1.18  1.16  1.13  1.04   .91
   .30   .55  1.00   .00   .40   .11   .00 36.00 28.00  1.11 20.00  2.00
 10.00  1.00  6.00   .00   .00 24.00 17.00   .03   .04   .05  2.50  5.50
 1 1954 29.60 32.95 37.70 50.75 59.55 62.35 75.15 70.25 62.45 50.50 43.20 29.10
 1 1955 15.70 21.35 31.35 44.00 56.40 63.20 72.05 73.30 61.35 50.15 30.60 29.80
 1 1956 31.40 21.05 38.35 49.45 59.75 66.50 74.55 68.75 63.00 50.80 32.45 26.85
 2 1954  1.33   .58  1.87   .45   .84  1.03   .34   .17  1.99   .49  1.65  1.09
 2 1955  2.28  1.64   .76  1.21  1.32  2.18   .12  1.77  1.11   .40  1.35  2.11
 2 1956  2.85   .38   .11  1.16  2.06   .62   .35   .00   .04   .98   .32  1.33
 3 1954  1.21  1.02  1.20  2.22  5.01  3.09  2.15  1.56  1.25  1.17  1.06   .96
 3 1955   .94   .81   .90  1.42  5.26  5.06  2.67  1.81  1.38  1.30  1.15  1.57
 3 1956  1.42  1.11  1.45  4.01  8.74  7.43  3.35  2.23  1.70  1.57  1.35  1.26
 4 1954   .00   .00   .00   .50  9.80  9.00 10.10 10.10  6.60  2.70  1.20   .66
 4 1955   .00   .00   .00   .00  5.60  7.60 10.80  9.10  7.70  3.30  1.10   .00
 4 1956   .00   .00   .00   .00  6.80 10.40 10.50 10.40  7.90  4.00  1.00   .66
 5 1954 13.00 12.87 16.46 18.50  5.51  3.75  1.33  1.23  3.64  7.81  9.81  9.85
 5 1955 11.35 10.10 17.11 22.67 17.39  9.91  1.29  1.84  2.92  8.13 12.13 19.72
 5 1956 23.17 14.12 22.10 29.40 28.85  7.94  1.36  2.48  2.68  8.31 11.49 13.66
 6 1954 12.14 13.04 15.96 17.22 12.36 10.24  9.39  9.26  8.83  8.86  9.46  9.48
 6 1955 10.34  9.26 16.16 21.47 21.02 15.16  9.83  8.92  9.24  9.91 12.16 19.82
 6 1956 20.86 13.37 22.29 28.90 33.44 14.88 10.01 10.65  8.65 10.76 11.67 13.08
 7 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

POTS 10 THRU 24 SHOULD BE SET AS FOLLOWS
  .10000  .62500  .25000  .29999  .00000
  .00000  .59999  .16666  .50000  .42499
  .10000  .03000  .04000  .05000  .79999

POTS 10 THRU 24 ARE SET AS FOLLOWS
  .09967  .62475  .24957  .29986  .00006
  .00000  .59954  .16607  .49993  .42486
  .09997  .02978  .03979  .04949  .79988
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TREMONTON                                         1954

   VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      29.60      32.95      37.70      50.75      59.55      62.35
     F       1.95       2.20       3.12       4.56       6.01       6.35
   PPT    7519.05    3294.86   10532.30    2534.51    4759.25    5829.37
  QRIV   68420.01   73460.00   89938.01   97012.01   69640.01   57730.00
  QUNG    2851.16    4269.46    1760.22    1436.55    3108.66    1917.30
  QCNL        .00        .00        .00    2816.12   55196.03   50690.25
  QSIT   70449.82   76654.03   89698.54   91711.59   33557.39   21765.04
  QIGS    5249.66    9139.67   13062.87    4229.01   35117.22   33709.00
  QGLI        .00        .00        .00        .00        .00        .00
   SNW    8521.17    2676.36     145.79        .15        .00        .00
  SNMT    5249.66    9139.67    2530.56     145.63        .15        .00
  ETPH     821.34    1095.42    1999.67    5188.06    8633.45   10002.62
   ETP    1477.98    1880.32    3383.46   10433.98   23902.70   29740.42
    ET    1512.56    1897.58    3382.64   10422.96   23898.55   29728.81
    MS   33358.97   33345.22   33345.22   27198.70   33345.22   33345.22
    DP      82.50    2227.59    7054.06    7714.09    1760.07    3973.92
   QTO   70375.60   78763.48   96556.78   99279.40   35256.56   25603.83
   QGO    3520.15    4125.18    4125.18    4070.18    1925.08    1375.06
   QSO   66855.45   74638.31   92431.59   95209.21   33331.47   24228.57
  QGAG   73220.01   72490.01   92750.00  104200.01   31040.00   21140.00
  DIFF   -6364.55    2148.29    -318.41   -8990.79    2291.47    3088.56

   VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      75.15      70.25      62.45      50.50      43.20      29.10      50.29
     F       7.81       6.74       5.24       3.93       2.85       1.83      52.66
   PPT    1914.96     957.48   11208.17    2787.96    9321.37    6167.31   66826.59
  QRIV   52930.00   52190.00   49760.00   49910.00   53303.01   53402.00  767694.62
  QUNG    1335.40     968.00     779.90     730.40     660.00    1293.99   21131.07
  QCNL   56885.71   56885.71   37172.84   15207.07    6758.69    3717.28  285329.62
  QSIT    7187.78    9421.25   21992.92   37935.50   46005.53   51782.99  560162.12
  QIGS   33202.09   32244.61   31653.23   11151.85   13038.65    3777.98  225575.81
  QGLI        .00        .00        .00        .00        .00        .00        .00
   SNW        .00        .00        .00        .00        .00    4433.82    4433.82
  SNMT        .00        .00        .00        .00        .00    1733.48   16799.18
  ETPH   15790.48   12449.61    8101.91    4341.01    2240.18     868.48   71732.25
   ETP   41264.72   30116.27   17848.01    9025.93    3734.64    1426.87  174235.31
    ET   41279.32   30168.83   17848.28    9047.90    3767.66    1457.56  174412.71
    MS   25314.87   27418.71   33345.22   33345.22   33345.22   33303.97   33303.97
    DP    4455.19     673.77     453.77    5857.75    5362.73    6737.79   46353.30
   QTO   11550.51    9955.44   22275.98   43644.42   53269.85   58357.58  604889.25
   QGO     715.03     605.02    1237.55    2255.10    2805.12    3052.63   29811.32
   QSO   10835.48    9350.41   21038.43   41389.33   50464.73   55304.95  575078.00
  QGAG    7540.00    6970.00   20510.00   44010.00   55270.00   35520.00  584659.62
  DIFF    3295.47    2380.41     528.42   -2620.67   -4805.26    -215.05   -9581.68




    OBJ=            5.915
    OBA=           -1.701
```

```
TREMONTON                                         1956

   VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      31.40      21.05      38.35      49.45      59.75      66.50
     F       2.07       1.41       3.18       4.45       6.03       6.78
   PPT   16080.07    2140.25     647.70    6533.40   11630.59    3491.99
  QRIV  117490.01   75358.01  125548.03  162821.03  188350.03   83840.01
  QUNG    7290.64     693.00    5172.39    2689.36    5415.62    4604.60
  QCNL        .00        .00        .00        .00   38299.28   58575.39
  QSIT  123909.35   75351.18  128618.69  160656.78  163795.03   44558.07
  QIGS   16023.86        .00   11323.66    7033.61   32696.00   35708.45
  QGLI        .00        .00        .00        .00        .00        .00
   SNW    9836.73   11176.98     501.00        .80        .00        .00
  SNMT   16023.86        .00   10675.98     500.20        .80        .00
  ETPH     871.29     699.81    2101.78    4853.58    8905.94   11670.07
   ETP    1567.86    1201.24    3556.23    9761.28   24098.85   34698.18
    ET    1595.07    1333.80    3602.65    9762.93   24118.57   34775.28
    MS   33345.22   32148.92   33345.22   30608.85   33358.97   33345.22
    DP    6902.80   10367.95    3437.65    4248.93    2062.59    4097.68
   QTO  130658.29   85583.79  131950.84  164759.81  165639.84   48567.14
   QGO    5280.23    4482.69    5252.73    5142.72    5142.72    2667.61
   QSO  125378.06   81101.09  126698.10  159617.06  160497.09   45899.53
  QGAG  130500.03   79540.01  124500.01  165600.03  162500.03   44720.00
  DIFF   -5121.97    1561.08    2198.09   -5982.95   -2002.92    1179.52

   VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      74.55      68.75      63.00      50.80      32.45      26.85      48.57
     F       7.75       6.60       5.29       3.96       2.14       1.69      51.37
   PPT    1971.28      28.16     253.45    5519.60    1830.48    7490.89   57617.87
  QRIV   56430.00   60030.01   48720.02   60650.02   65734.01   73720.011118690.50
  QUNG    2081.20    1381.60    1058.19     975.70    1379.90     784.30   33526.51
  QCNL   59138.62   58575.39   44494.76   22529.00    5632.25    3717.28  290961.87
  QSIT   10485.45   17362.13   17031.33   44827.44   62851.27   71658.45  921104.62
  QIGS   34497.51   32244.61   24725.56   17910.55    4446.51    2044.50  218654.75
  QGLI        .00        .00        .00        .00        .00        .00        .00
   SNW        .00        .00        .00        .00     481.70    7972.59    7972.59
  SNMT        .00        .00        .00        .00    1348.77        .00   28549.61
  ETPH   15499.52   11833.00    8274.74    4407.29    1164.89     801.33   71283.23
   ETP   40504.36   28624.66   18228.75    9163.75    1942.01    1316.54  174663.68
    ET   40454.28   28628.76   18274.55    9254.16    1993.83    1347.55  175141.50
    MS   27308.71   31035.12   33345.22   33345.22   33358.97   33345.22   33345.22
    DP    2310.10     137.50     453.77    4372.69    7384.07    3327.64   49103.42
   QTO   12678.06   17353.26   17270.76   49089.67   70045.59   74858.31  968455.37
   QGO     715.03     935.04     935.04    2475.10    3520.15    3987.67   40536.79
   QSO   11963.02   16418.22   16335.72   46614.56   66525.43   73873.64  927918.62
  QGAG    7690.00   14000.00   15150.00   46820.00   64750.00   76994.01  932759.50
  DIFF    4273.02    2418.22    1185.72    -205.44    1775.43   -6119.37   -4840.90




    OBJ=           16.964
    OBA=            -.387
```

```
TREMONTON                                         1955

   VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      15.70      21.35      31.35      44.00      56.40      63.20
     F       1.03       1.43       2.69       3.96       5.69       6.44
   PPT   12869.68    9265.04    4308.67    5843.18    7462.72   12306.46
  QRIV   58280.01   52204.00   91042.01  122980.01  118430.03   85400.01
  QUNG     585.20     507.10    8389.80    5368.17    3301.99    3135.00
  QCNL        .00        .00        .00        .00   31540.59   42805.09
  QSIT   58429.56   52001.31   97956.81  122781.48   96655.03   54658.24
  QIGS        .00        .00   19574.77   18052.61   24903.04   35849.27
  QGLI        .00        .00        .00        .00        .00        .00
   SNW   17303.51   26568.56   11302.45      93.01        .01        .00
  SNMT        .00        .00   19574.77   11209.43      92.99        .01
  ETPH     435.64     709.78    1474.99    3566.67    7729.63   10333.97
   ETP     783.93    1218.36    2495.70    7173.12   20915.83   30725.60
    ET     797.53    1333.80    2543.86    7177.81   20928.42   30718.86
    MS   32533.94   31378.89   33345.22   33358.97   33345.22   33345.22
    DP    3327.64     453.77    2062.59   12114.28   11027.98    5197.73
   QTO   61657.73   52197.31   99829.42  134755.96  107502.26   59677.64
   QGO    3190.14    2695.11    4015.17    4730.20    4427.69    3135.13
   QSO   58467.59   49502.19   95814.25  130025.76  103074.56   56542.50
  QGAG   63970.01   56910.01   96400.01  127700.01   97970.01   55870.00
  DIFF   -5502.42   -7407.81    -585.77    2325.74    5104.54     672.50

   VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      72.05      73.30      61.35      50.15      30.60      29.80      45.77
     F       7.49       7.03       5.15       3.91       2.01       1.87      48.66
   PPT     704.73    9997.24    6279.95    2281.06    7631.69   11912.20   91661.93
  QRIV   55420.00   50240.00   52070.01   55830.00   68535.01  111650.03  920080.62
  QUNG    1659.89    1124.19     855.80     810.70    2367.21    3546.63   31651.72
  QCNL   60828.28   51253.46   43368.32   18586.42    6195.47        .00  254577.59
  QSIT    9308.58    9424.21   21311.66   42153.88   66396.20  114307.26  745383.87
  QIGS   34159.57   38186.64   30132.52   12503.58    7540.78    6433.09  227332.81
  QGLI        .00        .00        .00        .00        .00        .00        .00
   SNW        .00        .00        .00        .00    3498.41    6980.52    8980.52
  SNMT        .00        .00        .00        .00    4133.27    6433.09   41440.58
  ETPH   14315.75   13750.59    7761.57    4264.28    1098.48     889.37   66330.73
   ETP   37410.85   33263.40   17098.26    8866.39    1831.32    1461.19  163243.90
    ET   37429.15   33248.96   17174.51    8882.89    1897.58    1553.81  163687.25
    MS   30155.08   33358.97   33358.97   33345.22   33345.22   33345.22   33345.22
    DP    4083.93    1072.54    3327.64    9927.93    5747.75    5073.97   63417.81
   QTO   13255.58   10367.95   24448.58   51922.30   72053.16  119245.28  806913.25
   QGO     825.03     605.02    1375.06    2750.12    3685.16    4867.71   36301.60
   QSO   12430.55    9762.93   23073.52   49172.17   68368.03  114377.56  770611.62
  QGAG    7280.00   10380.00   16490.00   45820.00   68370.01  111100.03  758259.87
  DIFF    5150.54    -617.06    6583.52    3352.17      -1.98    3277.54   12351.82




    OBJ=           12.524
    OBA=             .491
```

APPENDIX D

MANAGEMENT OPPORTUNITIES

```
EVANSTON CASE 1  -1
   3    1    0    0
   35.00       2.50  31571.70     1.00
   2599.      8823.   19835.     314.        0.        0.        0.
      0.        0.       0.        0.        0.        0.        0.   31571.
  .08232    .27946   .52826   .00994    .00000    .00002    .00000
  .06330    .03000   .00000   .00000    .00000    .00000    .00040
$2530,916
      0.        0.       0.        0.        0.        0.        0.
      0.
  .00003    .20000   .00000   .00300    .00030    .00000    .00000
  .00020
  .55   .66   .80   .91  1.07  1.10  1.04  1.00   .92   .82   .75   .60
  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
  .90   .38  1.00   .00   .70   .79   .00 32.00 24.00  1.59 20.00  2.00
 10.00  7.00 11.00   .20   .00   .00   .00   .00   .00   .00  2.50  2.50
 1 1954 22.10 24.20 24.70 40.60 49.70 54.80 65.20 59.30 53.70 43.80 34.40 17.40
 1 1955 12.20 14.70 24.30 34.20 47.30 54.90 62.10 63.00 52.10 42.00 22.90 20.40
 1 1956 20.20 10.70 25.20 35.50 48.30 58.00 62.60 56.90 53.10 39.70 22.30 16.60
 2 1954   .69   .34   .75   .14   .78  1.43  1.11  1.60   .70   .89  1.42   .73
 2 1955   .57   .81   .49   .19  1.29  1.15  1.37  1.15  1.28   .40   .82  1.80
 2 1956  1.21   .35   .07   .39  2.32   .67   .71   .38   .02   .94   .14   .83
 3 1954   .18   .21   .33  1.12   .54   .77   .07   .02   .02   .02   .06   .06
 3 1955   .08   .05   .07  1.47   .78   .71   .06   .03   .01   .02   .06   .41
 3 1956   .24   .18   .97   .82  1.41   .24   .10   .08   .01   .02   .03   .05
 4 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 4 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 4 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 5 1954  1.52  1.47  2.77  5.59 10.63  2.75   .29   .01   .00   .03   .39   .83
 5 1955  1.00   .21  1.12  5.30 12.31  9.25   .16   .00   .00   .12   .99  2.96
 5 1956  2.27  1.63  5.85  6.43 22.85 15.72   .69   .02   .00   .09   .94  1.04
 6 1954  1.26  1.25  1.55  5.20 16.46  7.73  3.04  1.20  1.17  1.07   .98   .96
 6 1955   .92   .82   .93  3.33 18.33 15.22  3.29  1.87  1.19  1.21  1.03  1.66
 6 1956  1.29  1.97  2.33  4.95 26.43 22.16  4.56  1.68   .66  1.17  1.04  1.05
 7 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .02   .00   .00

POTS 10 THRU 24 SHOULD BE SET AS FOLLOWS
  .10000  .01275  .23571  .54999  .01000
  .00000  .00000  .02380  .50000  .00000
  .19990  .00000  .00002  .05000  .79999

POTS 10 THRU 24 ARE SET AS FOLLOWS
  .09957  .01257  .03543  .54907  .00976
  .00003  .10000  .02355  .49975  .00000
  .09948  .00037  .00000  .00006  .79937
```

```
EVANSTON CASE 1  -1                          1954

     VAR        JAN        FEB        MAR        APR        MAY        JUN
    TEMP      22.10      24.20      24.70      40.60      49.70      54.80
       F       1.45       1.62       2.05       3.65       5.01       5.58
     PPT    1815.33     894.51    1973.18     368.32    2052.11    3762.20
    QRIV    3323.99    3300.99    4097.99   13691.99   43322.98   20339.99
    QUNG     398.67    1233.27    3225.39    5220.42    1129.70    1611.59
    QCNL        .00        .00        .00        .02    5567.75   17245.33
    QSIT    3712.87    4534.27    7323.35   18920.42   41956.93   15398.35
    QIGS        .00    1135.46    3513.38    4485.65    4547.86   10315.43
    QGLI        .00        .02        .30        .00        .00        .00
     SNW    5909.48    5757.53    4117.33        .09        .00        .00
    SNMT        .00    1135.46    3613.39    4117.32        .00        .00
    ETPH        .00        .00        .00        .00        .00        .00
     ETP     837.78     948.33    1308.78    3434.08    7740.16   10347.55
      ET     523.04     809.31    1297.47    3530.60    7746.37   13315.55
      MS    5999.29    6378.17    8671.23    9769.58    6609.40    6609.40
      DP     552.39     525.69     520.27     475.31     411.08     346.84
     QTO    4226.42    5022.89    7771.99   19333.63   42302.77   15699.14
     QGO      64.23      64.23      25.69      25.69      25.69      64.23
     QSO    4162.19    4958.66    7746.30   19307.94   42277.07   15633.91

     VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
    TEMP      65.20      59.30      53.70      43.80      34.40      17.40      40.82
       F       5.78       5.69       4.51       3.41       2.27       1.09      43.16
     PPT    2920.31    4209.46    1641.64    2341.51    3735.90    1920.56   27635.07
    QRIV    2912.99    3176.99    3090.99    2820.99    2578.99    2523.99  110267.89
    QUNG     159.57      60.82      41.88      55.29     134.29     120.39   13395.31
    QCNL   32398.25   17036.90   12834.32    2372.34        .00        .00   88334.90
    QSIT   -4104.55   -3236.19   -1732.77    1974.80    2713.29    2655.39   90115.95
    QIGS   15197.45   10683.48    6707.28    3243.90    3735.90        .09   63654.92
    QGLI        .00        .00        .00        .00        .00        .00        .00
     SNW        .00        .00        .00        .00        .00    1920.56    1920.56
    SNMT        .00        .00        .00        .00        .02        .00    8866.18
    ETPH        .00        .00        .00        .00        .00        .00        .00
     ETP   15229.57   10729.18    6739.40    3300.81    1359.16     526.05   62180.89
      ET   15197.13   10688.98    6744.29    3301.49    1348.85     525.69   62098.87
      MS    6592.99    6609.40    6635.09    6564.44    8953.86    8465.69    8465.69
      DP     295.46     237.65     211.96     128.46     109.19      64.23    3879.57
     QTO   -3866.72   -3044.56   -1535.78    2068.24    2749.10    2684.87   93341.00
     QGO      25.69      64.23      51.38      77.07      38.53      64.23     598.92
     QSO   -3892.42   -3108.79   -1657.15    1991.17    2710.56    2623.63   92750.07
```

See Appendix B for definition of the variables

```
EVANSTON CASE 1  -1                          1955

     VAR        JAN        FEB        MAR        APR        MAY        JUN
    TEMP      12.20      14.70      24.30      34.20      47.30      54.90
       F        .80        .92       1.53       3.07       4.77       5.59
     PPT    1499.82    2131.04    1289.14     490.87    3393.88    3025.55
    QRIV    2442.03    2171.99    2450.99    9774.99   48232.97   40802.98
    QUNG     132.34     116.12     153.25    7845.06    1635.79    1485.19
    QCNL        .03        .02        .00        .00        .00   14775.03
    QSIT    2573.34    2268.12    2614.25   15620.26   49058.77   35932.53
    QIGS        .03        .00        .03    7339.54    3394.58    8641.20
    QGLI        .00        .20        .00        .00        .00        .00
     SNW    3420.19    5551.23    6840.38        .70        .00        .00
    SNMT        .00        .07        .30    5839.67        .70        .00
    ETPH        .00        .00        .03        .00        .02        .00
     ETP     352.07     515.31    1075.54    2234.47    6806.32   10394.72
      ET     372.54     525.69    1095.50    2207.35    6821.37   10418.32
      MS    8125.26    7517.93    6539.75   11722.22    5332.80    5563.75
      DP      38.53      32.11      12.84      15.26      32.11      38.53
     QTO    2569.25    2273.79    2562.12   15384.03   49943.53   35905.32
     QGO      51.38      51.38      64.23      25.69      38.53      25.69
     QSO    2517.86    2222.42    2517.85   15359.34   49804.39   35379.63

     VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
    TEMP      62.10      63.70      52.10      42.00      22.90      20.40      37.17
       F       6.45       6.04       4.37       3.27       1.51       1.28      39.88
     PPT    3504.35    3025.55    3357.57    1052.36    2157.35    4735.54   29781.96
    QRIV    5872.09    4932.90    3153.90    3206.99    2729.99    4381.99  131227.87
    QUNG     128.75      81.36      41.07      59.24     175.37     853.19   12744.83
    QCNL   20273.47   24602.99    7416.24    1958.57        .00    2129.77   80161.07
    QSIT   -1190.15   -4334.76     375.14    1351.09    2005.37    4425.08  113471.51
    QIGS   13538.27   12374.55    5135.52    2936.82        .00     833.31   55273.71
    QGLI        .00        .00        .00        .03        .00        .00        .00
     SNW        .00        .00        .00        .02    2157.35    6893.02    6893.00
    SNMT        .00        .00        .00        .00        .00        .00    6843.38
    ETPH        .00        .00        .00        .00        .30        .00        .00
     ETP   13540.73   12400.32    6244.31    2943.34     904.80     615.74   58037.26
      ET   13535.06   12441.61    6230.44    2941.79     847.85     571.65   58065.14
      MS    6092.98    6635.32    6534.71    6592.98    5767.97    6069.86    6069.86
      DP      19.26      32.11      32.11      38.53      32.11      32.11     359.69
     QTO   -1194.73   -4354.86     346.81    1351.70    2690.41    4419.11  113227.03
     QGO      25.69      25.69      77.07      51.39      64.23      51.38     552.38
     QSO   -1220.39   -4380.57     259.77    1316.31    2826.17    4367.73  112674.64
```

```
EVANSTON CASE 1  -1                          1956

     VAR        JAN        FEB        MAR        APR        MAY        JUN
    TEMP      20.20      10.70      25.20      35.50      48.32      58.90
       F       1.33        .71       2.09       3.19       4.87       6.00
     PPT    3193.40     922.92     104.18    1026.05    6173.72    1762.71
    QRIV    3417.99    2833.99    6129.99   13039.99   59559.96   58311.98
    QUNG     509.54     385.51    7191.35    1372.22    2939.08     515.07
    QCNL    1335.33    1453.65        .00        .00        .00    9766.26
    QSIT    3422.12    2867.12   13321.35   17412.22   72498.54   55115.67
    QIGS     527.42     552.39    7384.22    4823.09    6133.84    5473.89
    QGLI        .00        .00        .05        .00        .05        .00
     SNW   10076.41   10907.22    3767.16        .12        .05        .00
    SNMT        .00        .00    7384.22    3707.04        .12        .00
    ETPH        .00        .00        .00        .00        .00        .00
     ETP     542.35     375.80    1335.27    2320.37    7184.33   12355.91
      ET     552.38     398.23    1303.01    2453.06    7205.75   12441.61
      MS    6024.07    6224.01   12133.30   14583.40   13469.31    6500.21
      DP      38.53      38.53      38.53      38.53      32.11      38.53
     QTO    3417.17    2646.33   13283.34   17426.69   72452.96   55071.95
     QGO      51.38      51.38      64.23      25.69      51.38      38.53
     QSO    3365.72    2594.94   13219.01   17401.00   72401.57   55033.42

     VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
    TEMP      62.80      55.90      53.10      39.70      22.30      16.60      37.49
       F       6.51       5.45       4.40       3.09       1.47       1.04      40.27
     PPT    1867.05     999.74      52.51    2473.05     358.32    2183.66   21126.24
    QRIV   12002.29    4435.09    2269.99    3004.99    2743.99    2774.99  180612.87
    QUNG     210.13     173.63      33.97      53.71      79.78     114.34   16575.41
    QCNL   31642.41   22816.49   17204.35        .03        .00    2417.12   66633.32
    QSIT     197.70   -4963.62   -4233.57    3138.71    2829.76    1971.54  164257.62
    QIGS   13851.30    9673.01    6590.18    2473.35        .00     919.52   58367.89
    QGLI        .00        .00        .00        .00        .00        .00        .00
     SNW        .00        .00        .00        .00     358.32    2551.38    2551.98
    SNMT        .00        .00        .00        .00        .00        .00   11181.38
    ETPH        .00        .00        .00        .00        .00        .00        .00
     ETP   13814.72    9675.43    5551.62    2513.58     881.10     541.86   58106.97
      ET   13829.01    9718.20    5551.59    2524.29     953.47     552.34   58094.60
      MS    6563.71    5538.75    6635.09    5659.42    5058.78    6069.86    6069.86
      DP      32.11      32.11      32.11      25.69      38.53      32.11     417.50
     QTO     167.03   -4085.11   -4252.11    3121.64    2800.45    1952.53  163982.65
     QGO      77.07      25.69      25.69      64.23      51.38      51.38     578.08
     QSO      89.92   -4113.80   -4277.80    3057.41    2749.10    1901.24  163404.56
```

```
EVANSTON CASE 1  -2
   0    2    0    0
    35.00       2.50  31571.00        1.00
    2599.     3823.   19835.      314.        0.         0.         0.
       0.        0.       0.        0.        0.         0.         0.    31571.
   .08232    .27946   .52826    .03304    .00000    .00000    .00000
   .00000    .00000   .00000    .03000    .00000    .00000    .00000
52630.916
       0.        0.       0.        0.        0.         0.         0.
       0.
   .00000    .00000   .00000    .00000    .00000    .00000    .00000
   .00000
   .55   .56   .80   .91  1.07  1.16  1.04  1.00   .92   .32   .75   .63
   .00   .30   .00   .30   .00   .00   .30   .00   .00   .03   .00   .03
   .90   .36  1.00   .90   .79   .79   .30 32.00 24.00  1.59 24.00  2.00
 10.00  7.30 11.00   .29   .00   .06   .30   .30   .35   .30  2.50  2.50
 1 1954 22.10 24.20 24.70 40.60 49.70 54.80 65.20 59.30 53.70 43.80 34.40 17.40
 1 1955 12.20 14.70 22.30 34.20 47.30 54.90 62.10 63.20 52.10 42.00 22.90 20.40
 1 1956 20.20 19.70 25.20 35.50 48.30 58.90 62.60 56.90 53.10 39.70 22.30 16.60
 2 1954   .59   .34   .75   .14   .78  1.43  1.11  1.52   .70   .89  1.42   .73
 2 1955   .57   .81   .49   .19  1.29  1.15  1.37  1.15  1.28   .40   .82  1.60
 2 1956  1.21   .35   .37   .34  2.32   .57   .71   .36   .42   .94   .14   .83
 3 1954   .18   .21   .33  1.12   .54   .77   .07   .02   .02   .02   .06   .36
 3 1955   .06   .05   .37  1.47   .78   .71   .06   .03   .01   .02   .08   .41
 3 1956   .24   .10   .97   .92  1.41   .24   .10   .08   .01   .02   .03   .05
 4 1954   .00   .30   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 4 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 4 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 5 1954  1.52  1.47  2.77  5.59 10.63  2.75   .29   .01   .00   .06   .39   .93
 5 1955  1.00   .91  1.12  5.38 12.31  9.26   .15   .08   .08   .12   .99  2.96
 5 1956  2.27  1.83  5.88  5.43 22.65 13.72   .69   .02   .00   .09   .94  1.04
 6 1954  1.25  1.25  1.55  5.20 16.46  7.73  3.84  1.20  1.17  1.07   .96   .96
 6 1955   .92   .82   .93  3.33 18.33 15.22  3.29  1.37  1.19  1.21  1.03  1.66
 6 1956  1.29  1.07  2.33  4.95 26.43 22.15  4.56  1.69   .66  1.17  1.04  1.95
 7 1954   .00   .00   .00   .00   .02   .00   .22   .00   .00   .00   .00   .00
 7 1955   .00   .00   .00   .00   .30   .00   .30   .00   .00   .00   .00   .00
 7 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .02   .00   .00
 8 1954   .00   .00   .00   .00   .00   .00   .00   .03   .00   .00   .00   .00
 8 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .03   .00   .00
 8 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .03   .00   .00

POTS 19 THRU 24 SHOULD BE SET AS FOLLOWS
  .10940   .01275   .03571   .54909   .01040
  .00022   .00400   .02380   .50000   .00000
  .10000   .20000   .10000   .00000   .74900

POTS 19 THRU 24 ARE SET AS FOLLOWS
  .00057   .01257   .03540   .54907   .00976
  .00040   .00290   .02366   .49975   .00000
  .00948   .00000   .00000   .10000   .79937
```

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EVANSTON CASE 1  -2                          1954

     VAR        JAN        FEB        MAR        APR        MAY        JUN
    TEMP      22.10      24.20      24.70      40.60      49.70      54.80
       F       1.45       1.62       2.05       3.65       5.01       5.58
     PPT    1815.33     894.51    1973.18     368.32    2052.11    3762.20
    QRIV    3323.99    3390.99    4007.09   13601.99   43322.98   20339.99
    QUNG     388.67    1233.27    3225.46    5228.42    1129.70    1611.59
    QCNL        .00        .00        .00        .00    6652.27   17177.72
    QSIT    3712.87    4534.27    7323.39   18920.42   41924.82   15424.05
    QIGS        .00    1135.46    3613.38    4485.65    4573.97   10289.74
    QGLI        .00        .00        .00        .00        .00        .00
     SNW    5996.48    5757.53    4117.33        .00        .00        .00
    SNMT        .00    1135.46    3613.38    4117.32        .00        .00
    ETPH        .00        .00        .00        .00        .00        .00
     ETP     637.78     840.33    1308.78    3434.08    7740.16   10347.55
      ET     629.45     899.31    1342.43    3449.22    7746.33   10334.82
      MS    5999.23    5378.17    8634.60    9737.47    6835.09    5596.56
      DP     552.38     539.54     520.27     468.68     417.50     346.84
     QTO    4226.02    5022.89    7797.68   19346.48   42315.01   15736.68
     QSD      25.69      64.23      64.23      25.69      38.53      64.23
     QSO    4200.73    4958.66    7733.45   19320.79   42277.07   15672.45

     VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
    TEMP      65.20      59.30      53.70      43.80      34.40      17.40      40.82
       F       5.78       5.59       4.51       3.41       2.27       1.39      43.16
     PPT    2220.31    4209.46    1841.54    2341.51    3735.96    1920.56   27835.07
    QRIV    4012.99    3176.99    3090.99    2320.99    2575.99    2526.99  110247.89
    QUNG     150.87      60.82      41.86      55.23     134.29     126.39   13395.31
    QCNL    6172.57    3237.82    3132.86    2875.29        .00        .00   41249.56
    QSIT    5466.99    2007.45    1942.37    1763.30    2713.29    2655.39  108008.39
    QIGS    6025.89    5439.83    3032.13    3434.50    3735.99        .00   45772.50
    QGLI        .00        .00        .00        .00        .00        .00        .00
     SNW        .00        .00        .00        .00        .00    1920.56    1920.56
    SNMT        .00        .00        .00        .00        .00        .00    6666.18
    ETPH        .00        .00        .00        .00        .00        .00        .00
     ETP   15229.57   12769.18    6731.40    3360.81    1359.16     525.85   62180.89
      ET    9656.81    5177.44    3295.06    1985.47    1194.79     545.96   46156.64
      MS    3489.52    3314.33    3146.79    4531.25    7220.33    6546.48    6666.48
      DP     314.73     244.87     211.95     141.37     139.19      64.23    3930.95
     QTO    5318.35    2183.85    2061.00    1875.55    2749.10    2659.17  111312.93
     QSD      38.53      51.38      31.38      64.23      51.38      25.69     565.23
     QSO    5279.81    2132.46    2029.71    1811.32    2697.71    2633.45  110747.79
```

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EVANSTON CASE 1  -2                          1955

     VAR        JAN        FEB        MAR        APR        MAY        JUN
    TEMP      12.20      14.70      22.30      34.20      47.30      54.90
       F        .80        .60       1.59       3.27       4.77       5.59
     PPT    1499.62    2131.24    1249.14     499.37    3373.95    3825.55
    QRIV    2442.99    2171.99    2469.39    8774.99   46232.97   43852.98
    QUNG     107.34     116.12     133.25    7845.06    1635.79    1445.19
    QCNL        .21     777.56    1316.43        .00        .00   17752.95
    QSIT    2572.34    1952.66    2113.25   16620.05   43065.77   34602.05
    QIGS        .00     265.46     541.00    7339.54    3394.56    7771.57
    QGLI        .00        .00        .00        .00        .00        .00
     SNW    3420.10    5551.23    5840.36        .77        .00        .00
    SNMT        .00        .01        .26    5834.67        .79        .02
    ETPH        .00        .00        .00        .00        .00        .00
     ETP     352.27     515.31    1275.64    2234.47    6806.02   10394.72
      ET     372.54     526.60    1091.93    2325.17    6847.26   10498.98
      MS    6251.82    6376.29    5556.01   13540.35    7288.33    5483.94
      DP      57.80      34.53      19.28      25.69      19.25      32.11
     QTO    2456.40    1978.32    2136.70   15610.22   49792.14   34774.85
     QSD      64.23      64.23      64.23      25.69      38.53      38.53
     QSO    2492.17    1914.09    2042.55   15584.53   49753.60   34735.31

     VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
    TEMP      62.10      63.20      52.10      42.00      22.90      20.40      37.17
       F       6.45       5.04       4.37       3.27       1.51       1.28      39.88
     PPT    3504.30    3923.58    3367.37    1052.36    2137.35    4735.04   29781.96
    QRIV    8674.09    4952.00    3153.99    3286.00    2729.99    4381.99  131227.07
    QUNG     128.78      81.36      41.07      59.24     175.37     653.19   12784.83
    QCNL    8803.75    5914.35    3125.07    3266.24    2975.37    4783.54   47817.28
    QSIT    5458.35    3166.97    1960.94    2425.27    1801.33    3417.45  125762.17
    QIGS    6946.76    4931.01    4541.70    2293.54    1104.04    1817.74   42988.07
    QGLI        .00        .00        .00        .00        .00        .00        .00
     SNW        .24        .00        .00        .00    2157.35    5893.00    6893.00
    SNMT        .00        .25        .00        .02        .07        .00    6840.38
    ETPH        .00        .00        .06        .00        .07        .04        .00
     ETP   13849.73   12402.38    6244.31    2943.24     784.83     616.74   58337.26
      ET    9724.62    5987.20    3406.45    1991.17     730.23     623.04   44037.01
      MS    3757.43    2781.21    4320.89    4374.15    4759.54    6016.47    6019.47
      DP      25.69      32.11      25.69      32.11      38.53      38.53     385.38
     QTO    5433.97    3370.25    1965.47    2016.66    1786.47    3474.26  125558.06
     QSD      51.38      51.38      77.07      51.38      64.23      64.23     655.15
     QSO    5382.58    3318.87    1888.40    1965.47    1730.24    3442.03  124932.90
```

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EVANSTON CASE 1  -2                          1956

     VAR        JAN        FEB        MAR        APR        MAY        JUN
    TEMP      20.20      19.70      25.20      35.50      48.30      58.90
       F       1.33        .71       2.09       3.19       4.87       5.26
     PPT    3163.43     929.52     154.16    1020.05    6143.72    1752.71
    QRIV    3417.99    2833.99    6120.99   13839.99   69559.96   47311.98
    QUNG     509.54     385.51    7191.35    4372.22    2352.86     515.27
    QCNL    1470.55    1333.33        .00        .00        .00    3819.59
    QSIT    3368.73    2712.00   13321.35   17412.22   72495.80   55475.57
    QIGS     558.01     527.42    7384.22    4823.00    6173.54    5114.19
    QGLI        .00        .00        .00        .00        .00        .00
     SNW   10076.40   10097.22    3797.15        .12        .00        .00
    SNMT        .00        .00    7384.22    3797.04        .11        .00
    ETPH        .00        .00        .00        .00        .06        .02
     ETP     562.93     375.69    1335.27    2320.57    7188.36   12070.21
      ET     552.36     372.54    1342.43    2425.17    7222.33   12074.95
      MS    6069.80    6224.01   12293.86   14966.09   13329.41    5066.71
      DP      38.53      38.53      38.53      38.53      32.11      38.53
     QTO    3352.87    2697.71   13295.69   17448.59   72441.12   55431.85
     QSD      64.23      38.53      51.38      64.23      38.53      51.38
     QSO    3288.64    2659.17   13244.50   17342.46   72401.57   55381.27

     VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
    TEMP      62.60      55.90      53.10      39.70      22.30      16.60      37.49
       F       6.51       5.46       4.46       3.20       1.47       1.24      40.27
     PPT    1667.46     939.74      52.51    2473.25     366.32    2143.66   21126.24
    QRIV   12002.98    4475.99    2260.99    3864.99    2749.99    3774.00  136612.67
    QUNG     212.13     170.63      33.97      53.71      79.78     114.34   16575.41
    QCNL   12212.12    4605.63    2303.96    3143.21    2822.78    2563.34   34607.35
    QSIT    7572.14    2855.11    1428.46    1946.94    1754.06    1741.52  182127.54
    QIGS    6074.94    2757.27     326.19    3580.77    1473.31    1404.02   46519.65
    QGLI        .00        .00        .00        .00        .00        .00        .00
     SNW        .00        .00        .00        .00     466.32    2551.99    2551.99
    SNMT        .00        .00        .00        .00        .00        .43   11181.38
    ETPH        .00        .00        .00        .00        .00        .00        .00
     ETP   13314.22    9678.43    5551.62    2018.60     601.10     531.60   58136.97
      ET    9544.77    4349.57    1785.63    1845.50     523.04     372.54   41521.91
      MS    3559.41    2319.75    1451.62    4072.26    4596.11    5319.35    5310.35
      DP      32.11      32.11      25.50      25.69      25.69      32.11     398.23
     QTO    7540.75    2839.02    1400.24    1914.32    1734.24    1772.76  101626.12
     QSD      51.38      25.69      64.23      64.23      64.23      54.23     642.01
     QSO    7489.37    2813.33    1335.41    1849.86    1672.21    1708.55  101183.01
```

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EVANSTON CASE 2  -1
   0   1   0   0
    35.00      2.50  31571.00      3.99
    650.     2206.     4959.       79.        0.        0.        0.
      0.        0.        0.        0.        0.        0.        0.     7894.
  .08234    .27945    .62819    .01000    .00000    .00000    .00000
  .00000    .00000    .00000    .00000    .00000    .00000    .00000
657.83325
    474.      456.     2646.      195.     1824.        0.        0.
   5595.
  .08471    .09150    .47292    .03485    .32600    .00000    .00000
466.25000
   .55   .66   .80   .91  1.07  1.10  1.04  1.00   .92   .82   .75   .60
   .81   .90   .99  1.04  1.07  1.10  1.12  1.13  1.12  1.10  1.03   .92
   .90   .38  1.00   .00  2.79   .79   .03 32.00 24.00  1.50 20.00  2.00
 10.00  7.00 11.00   .20   .00   .02   .00   .00   .00   .00  2.50  2.50
 1 1954 22.10 24.20 24.70 40.60 49.70 54.80 65.20 59.30 53.70 43.80 34.40 17.40
 1 1955 12.20 14.70 20.30 34.20 47.30 54.90 62.10 63.00 52.10 42.00 22.90 20.40
 1 1956 20.20 10.70 25.20 35.50 48.30 58.90 62.60 56.90 53.10 39.70 22.30 16.60
 2 1954   .69   .34   .75   .14   .78  1.43  1.11  1.60   .70   .89  1.42   .73
 2 1955   .57   .81   .49   .19  1.29  1.15  1.37  1.15  1.28   .40   .82  1.00
 2 1956  1.21   .35   .07   .39  2.32   .67   .71   .38   .02   .94   .14   .83
 3 1954   .74   .84  1.33  4.51  2.17  3.10   .30   .11   .08   .10   .25   .24
 3 1955   .25   .22   .29  5.80  3.14  2.85   .24   .13   .07   .11   .33  1.64
 3 1956   .98   .74  3.89  3.29  5.65   .39   .40   .32   .06   .10   .15   .22
 4 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 4 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 4 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 5 1954  6.08  5.91 11.11 22.37 42.51 11.02  1.16   .05   .00   .26  1.55  3.33
 5 1955  4.01  3.64  4.49 21.54 49.26 37.04   .67   .32   .00   .48  3.96 11.86
 5 1956  4.29  7.34 23.53 25.73 91.40 62.90  2.79   .08   .00   .38  3.76  4.18
 6 1954  5.05  5.01  6.22 20.21 65.85 30.91 12.18  4.82  4.69  4.28  3.92  3.84
 6 1955  3.71  3.30  3.74 13.33 73.32 69.90 13.18  7.49  4.79  4.87  4.15  6.86
 6 1956  5.19  4.30  9.31 19.82105.74 88.64 18.24  5.74  3.45  4.68  4.18  4.21
 7 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

POTS 10 THRU 24 SHOULD BE SET AS FOLLOWS
  .10000  .01275  .03571  .54999  .01000
  .00000  .00000  .42380  .50000  .00000
  .10000  .00000  .00000  .00000  .79990

POTS 10 THRU 24 ARE SET AS FOLLOWS
  .09967  .01257  .03540  .54907  .00976
  .00000  .00000  .42368  .49975  .00000
  .09948  .00000  .00000  .00000  .79937
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```
EVANSTON CASE 2  -1                          1954

     VAR       JAN        FEB        MAR        APR        MAY        JUN
    TEMP     22.10      24.20      24.70      40.60      49.70      54.80
       F      1.45       1.62       2.05       3.65       5.01       5.58
     PPT    453.92     223.66     493.37      92.09     513.10     940.70
    QRIV   3323.99    3390.99    4097.99   13691.99   43322.97   20339.99
    QUNG    388.67    1233.27    3225.36    5228.42    1129.70    1611.59
    QCNL       .00        .00        .00        .00    1709.85    4447.32
    QSIT   3546.19    4328.37    7037.54   18226.92   42424.98   18442.38
    QIGS       .00     283.91     903.49    1121.59    1162.85    2630.68
    QGLI       .00        .00        .00        .00        .00        .00
     SNW   1499.85    1439.61    1029.49        .00        .00        .00
    SNMT       .00     283.91     903.49    1029.49        .00        .00
    ETPH    166.48     205.90     285.81     693.49    1377.94    1819.21
     ETP    159.46     212.11     327.23     858.64    1935.36    2587.32
      ET    157.39     202.36     335.66     876.89    1981.85    2584.11
      MS   1504.85    1594.79    2180.12    2417.08    1601.21    1047.79
      DP    134.99     133.30     130.08     117.24     104.39      86.72
     QTO   3668.19    4448.72    7156.50   18340.95   26310.91   18507.98
     QGO      6.42       6.42       5.42       9.63       9.63      22.48
     QSO   3661.76    4442.30    7150.08   18331.31   26301.28   18485.49

     VAR       JLY        AUG        SEP        OCT        NOV        DEC        ANN
    TEMP     65.20      59.30      53.70      43.80      34.40      17.40      40.82
       F      6.78       5.69       4.51       3.41       2.27       1.39      43.16
     PPT    730.19    1052.53     460.48     585.47     934.12     480.21    6959.87
    QRIV   6012.99    3176.99    3090.99    2820.99    2578.99    2528.99  110287.85
    QUNG    159.57      60.82      41.86      55.29     134.29     126.39   13395.31
    QCNL   8890.82    4259.63    3214.05     690.29        .00        .00   22411.97
    QSIT   2208.71    -529.02     452.81    1032.42    2385.26    2513.73  102870.25
    QIGS   3844.70    2571.19    1681.82     847.78     934.12        .00   16042.15
    QGLI       .00        .00        .00        .00        .00        .00        .00
     SNW       .00        .00        .00        .00        .00     480.21     480.21
    SNMT       .00        .00        .00        .00        .00        .00    2216.89
    ETPH   2889.35    2148.19    1458.71     781.56     328.03     141.66   12296.38
     ETP   3807.92    2677.61    1685.03     825.29     339.83     131.52   15547.37
      ET   3812.73    2682.06    1712.03     841.56     343.69     144.54   15674.93
      MS   1551.03    1647.79    1622.09    1634.94    2229.18    2108.72    2108.72
      DP     73.87      59.42      52.99      32.12      27.30      15.06     968.44
     QTO   2270.93    -481.81     485.02    1856.58    2396.20    2518.26   87478.48
     QGO     16.26       6.42      19.27      12.84       9.63      15.06     141.33
     QSO   2254.67    -488.23     465.75    1843.73    2386.57    2502.20   87337.15
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EVANSTON CASE 2  -1                          1955

     VAR       JAN        FEB        MAR        APR        MAY        JUN
    TEMP     12.20      14.70      20.30      34.20      47.30      54.90
       F       .50        .95       1.68       3.07       4.77       5.59
     PPT    374.96     532.84     322.31     124.98     848.60     756.50
    QRIV   2442.99    2171.99    2463.99    8774.99   40232.97   40062.98
    QUNG    130.34     116.12     153.25    7545.98    1635.79    1483.19
    QCNL       .00        .00        .00        .00        .00    3796.58
    QSIT   2491.44    2163.05    2379.35   16168.82   40657.12   38277.96
    QIGS       .00        .00        .00    1835.17     848.78    2199.21
    QGLI       .00        .00        .00        .00        .00        .00
     SNW    855.19    1388.02    1713.36        .17        .00        .00
    SNMT       .00        .00        .00    1710.18        .17        .00
    ETPH     91.93     125.07     234.99     451.24    1211.64    1827.51
     ETP     89.93     128.84     268.94     558.70    1791.76    2599.11
      ET     93.15     131.59     273.02     566.93    1795.61    2598.55
      MS   2012.36    1883.88    1509.25    2881.23    2044.49    1646.18
      DP      9.63       9.63       8.03       4.81       8.03       5.42
     QTO   2482.93    2155.30    2370.51   16172.40   25284.41   26290.84
     QGO     12.84       6.42      19.27      12.84       9.63      12.84
     QSO   2470.09    2148.87    2351.23   16159.95   25274.78   26277.99

     VAR       JLY        AUG        SEP        OCT        NOV        DEC        ANN
    TEMP     62.10      63.00      52.10      42.00      22.90      20.40      37.17
       F      6.43       5.04       4.37       3.27       1.51       1.28      39.88
     PPT    991.23     756.50     642.02     253.13     539.42    1184.69    7446.66
    QRIV   8874.99    4932.99    3153.99    3206.99    2729.99    4301.99  131227.98
    QUNG    128.75      81.36      41.07      59.24     175.37     853.19   12704.83
    QCNL   6539.64    6130.27    1354.55    1235.52        .00     549.43   20106.12
    QSIT   3748.04     197.42    1138.75    2299.89    2687.00    4862.31  124859.17
    QIGS   3386.29    3986.01    1540.79     732.63        .00     203.78   13843.68
    QGLI       .00        .00        .00        .00        .00        .00        .00
     SNW       .00        .00        .00        .00     539.42    1723.52    1723.52
    SNMT       .00        .00        .00        .00        .00        .00    1710.36
    ETPH   2570.85    2487.43    1351.55     696.95     218.37     166.09   11433.23
     ETP   3387.90    3100.46    1561.24     735.64     226.22     154.20   14511.31
      ET   3388.74    3099.65    1557.85     735.56     208.78     138.11   14497.70
      MS   1659.03    1659.03    1647.79    1649.40    1439.79    1517.70    1517.70
      DP      8.03       8.03       8.03       6.03       9.63       8.03      96.36
     QTO   3742.05     189.51    1130.65    2091.05    2685.29    4856.65   90452.06
     QGO     19.27      12.84      12.84       9.63       9.63      12.84     150.96
     QSO   3722.79     176.66    1117.80    2081.42    2675.65    4843.81   90301.09
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EVANSTON CASE 2  -1                          1956

     VAR       JAN        FEB        MAR        APR        MAY        JUN
    TEMP     20.20      10.70      25.20      35.50      48.30      58.90
       F      1.33        .71       2.09       3.19       4.87       6.30
     PPT    795.07     230.24      46.34     256.55    1526.17     443.74
    QRIV   3417.99    2833.99    6129.99   13039.99   69559.96   59311.98
    QUNG    590.54     385.51    7191.35    4372.22    2938.88     515.07
    QCNL    333.88     350.79        .00        .00        .00    2205.34
    QSIT   3548.53    2995.17   13029.75   15943.58   71219.14   55814.94
    QIGS    126.87     133.30    1846.34    1205.96    1526.22    1278.78
    QGLI       .00        .00        .00        .00        .00        .00
     SNW   2519.50    2749.74     949.44        .03        .00        .00
    SNMT       .00        .00    1846.34     949.41        .03        .00
    ETPH    152.16      91.03     201.03     468.62    1279.72    2174.07
     ETP    145.73      93.78     333.85     580.22    1797.36    3091.99
      ET    138.11      91.54     335.65     581.38    1839.36    3073.22
      MS   1511.28    1559.46    3073.95    3716.37    3457.79    1647.79
      DP      8.03       8.03       9.63       9.63       8.03       6.03
     QTO   3542.49    2987.23   13012.12   15927.64   26290.84   26310.91
     QGO      9.63      12.84       6.42      12.84       9.63      22.48
     QSO   3532.85    2974.38   13005.69   15914.79   26281.22   26288.43

     VAR       JLY        AUG        SEP        OCT        NOV        DEC        ANN
    TEMP     62.60      56.90      53.10      39.70      22.30      15.60      37.49
       F      6.51       5.46       4.46       3.29       1.47       1.04      40.27
     PPT    467.35     249.97      13.15     618.36      92.09     546.20    5282.39
    QRIV  12082.99    4435.99    2269.39    3884.99    2749.99    2774.39  180612.84
    QUNG    219.13     170.63      33.97      53.71      73.78     114.54   16575.41
    QCNL   7952.04    5687.87    4259.22       1.24        .00     532.52   21222.89
    QSIT   6508.53     594.21    -732.50    2543.07    2617.13    2552.03  177743.31
    QIGS   3457.82    2411.36    1631.56     618.03        .00     262.36   14432.51
    QGLI       .00        .00        .00        .00        .00        .00        .00
     SNW       .00        .00        .00        .00      92.09     638.09     638.09
    SNMT       .00        .00        .00        .00        .00        .00    2795.79
    ETPH   2620.83    1941.03    1418.07     595.10     212.65     135.15   11380.11
     ETP   3454.03    2419.40    1638.24     628.47     220.30     125.48   14528.77
      ET   3444.95    2418.49    1634.94     626.35     202.36     117.24   14484.85
      MS   1652.61    1651.07    1654.21    1659.03    1442.22    1536.97    1536.97
      DP      4.81       3.21       4.81       4.81       8.03       3.21      80.30
     QTO   6597.60     494.65    -741.35    2531.11    2514.62    2550.38  103217.65
     QGO     19.27      12.84       5.42      15.06       9.63      16.06     134.17
     QSO   6578.33     481.81    -746.41    2515.05    2504.99    2534.32  103083.48
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EVANSTON CASE 2  -2
   0    2    0    0
    35.00      2.50  31571.00      3.99
    650.     2206.     4959.       79.        0.        0.        0.
      0.        0.        0.        0.        0.        0.        0.    7894.
   .08234    .27945    .62819    .01000    .00000    .00000    .00000
   .00000    .00000    .00000    .00000    .00000    .00000    .00000
557.83325
    474.      456.     2646.      193.     1824.        0.        0.
   5595.
   .08471    .08150    .47292    .03485    .32600    .00000    .00000
466.25000
   .55   .66   .80   .91  1.07  1.10  1.04  1.00   .92   .82   .75   .60
   .81   .90   .99  1.04  1.07  1.10  1.12  1.13  1.12  1.10  1.03   .92
   .90   .38  1.00   .00  2.79   .79   .30 32.00 24.00  1.59 20.00  2.00
 10.00  7.00 11.00   .20   .00   .00   .00   .00   .00   .00  2.50  2.50
 1 1954 22.10 24.20 24.70 40.60 49.70 54.80 65.20 59.30 53.70 43.80 34.40 17.40
 1 1955 12.20 14.70 20.30 34.20 47.30 54.90 62.10 63.00 52.10 42.00 22.90 20.40
 1 1956 20.20 10.70 25.20 35.50 48.30 58.90 62.60 56.90 53.10 39.70 22.30 16.60
 2 1954   .69   .34   .75   .14   .78  1.43  1.11  1.60   .70   .89  1.42   .73
 2 1955   .57   .81   .49   .19  1.29  1.15  1.37  1.15  1.28   .40   .82  1.80
 2 1956  1.21   .35   .07   .39  2.32   .57   .71   .38   .02   .94   .14   .83
 3 1954   .74   .84  1.33  4.51  2.17  3.10   .30   .11   .08   .10   .25   .24
 3 1955   .25   .22   .29  5.88  3.14  2.85   .24   .15   .07   .11   .33  1.64
 3 1956   .98   .74  3.89  3.29  5.65   .99   .40   .32   .06   .10   .15   .22
 4 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 4 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 4 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 5 1954  6.08  5.91 11.11 22.37 42.51 11.02  1.16   .05   .00   .26  1.53  3.33
 5 1955  4.01  3.64  4.49 21.54 49.26 37.04   .67   .32   .00   .46  3.96 11.86
 5 1956  9.09  7.34 23.53 25.73 91.40 62.90  2.70   .08   .00   .38  3.76  4.18
 6 1954  5.05  5.01  6.22 20.81 65.85 30.91 12.18  4.82  4.69  4.28  3.92  3.84
 6 1955  3.71  3.30  3.74 13.33 73.32 60.90 13.18  7.49  4.79  4.87  4.15  6.66
 6 1956  5.19  4.30  9.31 19.82105.74 86.64 16.24  6.74  3.45  4.68  4.18  4.21
 7 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

POTS 10 THRU 24 SHOULD BE SET AS FOLLOWS
  .10000  .01275  .03571  .54999  .01000
  .00020  .00000  .42380  .50000  .00000
  .10000  .00000  .20000  .60000  .79999

POTS 10 THRU 24 ARE SET AS FOLLOWS
  .09967  .01257  .03540  .54907  .00976
  .00000  .00000  .42358  .49975  .00000
  .09948  .00000  .00000  .00000  .79937
```

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EVANSTON CASE 2  -2                        1954

      VAR       JAN       FEB       MAR       APR       MAY       JUN
     TEMP     22.10     24.20     24.70     40.60     49.70     54.80
        F      1.45      1.62      2.05      3.65      5.01      5.58
      PPT    453.90    223.66    493.37     92.99    513.10    940.70
     QRIV   3323.99   3300.99   4097.99  13691.99  43322.97  20339.99
     QUNG    388.67   1233.27   3225.36   5228.42   1129.70   1611.59
     QCNL       .00       .00       .00       .00   1642.23   4320.53
     QSIT   3546.19   4328.37   7037.54  18226.92  42450.67  18490.56
     QIGS       .00    283.91    903.49   1121.59   1137.15   2582.50
     QGLI       .00       .00       .00       .00       .00       .00
      SNW   1499.85   1439.61   1029.49       .00       .00       .00
     SNMT       .00    283.91    903.49   1029.49       .00       .00
     ETPH    166.49    205.90    285.81    693.49   1377.94   1819.21
      ETP    159.46    212.11    327.23    858.64   1935.36   2587.32
       ET    157.39    202.36    324.41    862.44   1941.70   2584.11
       MS   1500.03   1594.79   2172.96   2442.78   1649.40   1659.03
       DP    138.11    136.51    130.08    117.24    105.99     91.54
      QTO   3671.40   4442.30   7146.86  18321.66  26310.91  18575.43
      QGO      6.42     16.06     16.06     12.84      9.63     22.48
      QSO   3664.97   4426.24   7130.80  18306.83  26301.28  18552.95

      VAR       JLY       AUG       SEP       OCT       NOV       DEC       ANN
     TEMP     65.20     59.30     53.70     43.80     34.40     17.40     40.82
        F      6.78      5.69      4.51      3.41      2.27      1.09     43.16
      PPT    738.19   1052.53    460.48    585.47    934.12    480.21   6959.87
     QRIV   8012.99   3176.99   3090.99   2820.99   2578.99   2528.99 110287.85
     QUNG    159.57     60.82     41.86     55.29    134.29    125.39  13395.31
     QCNL   5283.22   1089.63   1674.15   2094.73       .00       .00  16104.51
     QSIT   3275.60    675.57   1037.97   1298.73   2385.26   2513.73 105267.07
     QIGS   2737.82   1466.59   1096.66   1381.47    934.12       .00  13645.32
     QGLI       .00       .00       .00       .00       .00       .00       .00
      SNW       .00       .00       .00       .00       .00    480.21    480.21
     SNMT       .00       .00       .00       .00       .00       .00   2216.89
     ETPH   2889.35   2148.19   1458.71    781.56    328.03    141.66  12296.38
      ETP   3897.92   2677.61   1685.03    625.29    339.83    131.52  15547.37
       ET   3163.89   1736.12   1931.07    703.44    342.06    131.69  13180.75
       MS   1238.25    978.07   1043.92   1724.68   2328.75   2211.51   2211.51
       DP     73.87     59.42     52.99     33.72     27.30     16.06    962.89
      QTO   3340.55    725.92   1072.83   1316.95   2396.20   2518.26  89839.35
      QGO     16.06     12.84      9.63     12.84     12.84     16.06    163.81
      QSO   3324.49    713.08   1063.19   1304.10   2383.36   2502.20  89675.54
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EVANSTON CASE 2  -2                        1955

      VAR       JAN       FEB       MAR       APR       MAY       JUN
     TEMP     12.20     14.70     20.33     34.20     47.30     54.90
        F       .80       .98      1.68      3.07      4.77      5.59
      PPT    374.96    532.84    322.33    124.98    846.60    756.50
     QRIV   2442.99   2171.99   2469.99   8774.99  48232.97  40062.98
     QUNG    139.34    115.12    153.25   7845.06   1635.79   1485.19
     QCNL       .00       .00       .00       .00       .00   3623.30
     QSIT   2481.44   2163.05   2379.35  16166.62  45657.12  38343.61
     QIGS       .00       .00       .00   1935.17    848.78   2133.36
     QGLI       .00       .00       .00       .00       .00       .00
      SNW    855.18   1388.02   1710.36       .17       .00       .00
     SNMT       .00       .00       .00   1710.18       .17       .00
     ETPH     91.90    125.07    234.90    451.24   1211.64   1827.51
      ETP     63.03    128.84    268.94    558.70   1701.78   2599.11
       ET     93.15    131.69    276.23    573.35   1737.73   2624.26
       MS   2121.57   2005.94   1723.27   2984.31   2110.33   1623.49
       DP     14.45      8.03      8.03      8.03      8.03      8.03
      QTO   2482.93   2158.51   2373.72  16172.80  26310.91  26284.41
      QGO     12.84     12.84      6.42     12.84      9.63     22.48
      QSO   2470.08   2145.66   2367.30  16159.95  26301.28  26261.93

      VAR       JLY       AUG       SEP       OCT       NOV       DEC       ANN
     TEMP     67.10     63.00     52.10     42.00     22.90     20.40     37.17
        F      6.45      6.04      4.37      3.27      1.51      1.28     39.88
      PPT    991.23    756.50    842.42    265.13    539.42   1184.09   7446.66
     QRIV   8674.99   4932.99   3153.99   3206.99   2729.99   4381.99 131227.98
     QUNG    128.76     81.36     41.07     59.24    175.37    853.19  12704.83
     QCNL   6233.11   2526.92   1843.52   1915.97       .00    592.94  16645.79
     QSIT   3864.53   1566.69   1142.98   1841.32   2687.00   4877.98 126174.10
     QIGS   3269.81   1716.74   1542.56    991.20       .00    191.11  12526.76
     QGLI       .00       .00       .02       .00       .00       .00       .00
      SNW       .00       .00       .00       .00    539.42   1723.52   1723.52
     SNMT       .00       .00       .00       .00       .00       .00   1710.36
     ETPH   2570.65   2487.43   1351.55    696.85    218.37    166.09  11433.23
      ETP   3387.92   3100.46   1561.24    735.64    226.22    154.20  14511.31
       ET   3297.19   2314.30   1193.65    793.44    240.99    165.61  13339.75
       MS   1596.40   1016.62   1389.22   1697.56   1453.46   1492.00   1492.00
       DP      3.21      6.42      6.43      8.03      6.42      9.63     96.36
      QTO   3860.91   1557.85   1137.07   1834.09   2682.08   4869.50  91724.84
      QGO     19.27      6.42     16.06      6.42     16.06      6.42    147.75
      QSO   3841.64   1551.43   1121.01   1827.67   2666.02   4863.08  91577.09
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EVANSTON CASE 2  -2                        1956

      VAR       JAN       FEB       MAR       APR       MAY       JUN
     TEMP     20.20     10.70     25.20     35.50     48.30     58.90
        F      1.33       .71      2.39      3.19      4.87      5.00
      PPT    795.97    230.24     46.04    256.55   1526.17    443.74
     QRIV   3417.99   2833.99   6129.99  13039.99  69559.96  56311.96
     QUNG    509.54    385.51   7191.35   4372.22   2938.86    513.07
     QCNL    401.53    367.69       .00       .00       .00   2205.34
     QSIT   3622.89   2988.75  13229.75  16943.58  71219.14  55614.94
     QIGS    152.57    139.72   1646.34   1205.96   1526.20   1276.78
     QGLI       .00       .00       .02       .00       .00       .00
      SNW   2519.50   2749.74    949.44       .03       .00       .00
     SNMT       .00       .00   1846.34    949.41       .03       .00
     ETPH    152.16     91.03    291.60    468.62   1279.70   2174.07
      ETP    145.75     93.78    333.85    580.22   1797.38   3491.99
       ET    138.11     91.54    335.66    581.38   1801.97   3098.04
       MS   1504.85   1569.09   3073.95   3714.76   3457.79   1645.16
       DP      9.63      9.63     14.45      9.63      9.63      6.42
      QTO   3613.58   2980.60  13024.96  16930.85  26290.84  26312.91
      QGO     16.06      9.63      6.42     22.48     12.84     12.84
      QSO   3597.52   2971.17  13018.54  16908.36  26277.99  26300.07

      VAR       JLY       AUG       SEP       OCT       NOV       DEC       ANN
     TEMP     62.50     55.92     53.10     39.70     22.30     15.60     37.49
        F      6.51      5.46      4.46      3.09      1.47      1.04     40.27
      PPT    467.06    249.97     13.15    616.36     92.09    540.00   5262.39
     QRIV  12922.99   4435.99   2269.99   3084.99   2749.99   2774.99 130612.84
     QUNG    218.13    170.63     33.97     53.71     79.78    114.54  16575.41
     QCNL   7456.23   2665.50    885.89   2543.55       .00    273.94  17204.77
     QSIT   5696.93   1652.67    549.25   1577.20   2517.13   2646.39 179270.21
     QIGS   3452.42   1262.90    349.79   1504.31       .30    195.99  12905.63
     QGLI       .00       .00       .00       .00       .00       .00       .00
      SNW       .00       .00       .00       .00     92.09    638.39    638.09
     SNMT       .00       .00       .00       .00       .00       .00   2795.79
     ETPH   2620.83   1941.03   1418.37    595.16    212.65    133.15  11380.11
      ETP   3454.03   2419.42   1638.08    628.47    220.38    125.48  14528.77
       ET   3444.95   1679.06    786.95    464.14    213.60    113.84  12954.30
       MS   1651.09   1048.74    613.50   1742.55   1538.58   1533.76   1533.76
       DP      3.21      8.03      4.81      3.21      6.42      6.42     91.54
      QTO   6597.60   1641.37    542.84   1564.28   2611.41   2643.53 104753.03
      QGO     19.27      6.42     19.27      6.42     12.84      6.42    150.96
      QSO   6578.33   1634.94    523.56   1557.85   2598.56   2637.11 104602.06
```

```
EVANSTON CASE 3  -1
   0    1    0    0
   35.00      2.50  31571.00         .80
   3250.    11029.    24794.      393.        0.        0.        0.
      0.        0.        0.        0.        0.        0.        0.   39466.
  .08234    .27945    .62823    .00995    .00000    .00000    .00000
  .00000    .00000    .00000    .00000    .00000    .00000    .00000
$3288.833
    632.      609.     3523.      261.     2434.        0.        0.
   7459.
  .08472    .08164    .47231    .03499    .32631    .00000    .00000
621.58325
   .55   .66   .80   .91  1.07  1.10  1.04  1.06   .92   .82   .75   .60
   .81   .90   .99  1.04  1.07  1.10  1.12  1.13  1.12  1.10  1.03   .92
   .90   .38  1.00   .00   .56   .79   .00 32.00 24.00  1.59 20.00  2.00
 10.00  7.00 11.00   .20   .00   .00   .00   .00   .00   .00  2.50  2.50
 1 1954 22.10 24.20 24.70 40.60 49.70 54.80 65.20 59.30 53.70 43.80 34.40 17.40
 1 1955 12.20 14.70 20.30 34.20 47.30 54.90 62.10 63.00 52.10 42.00 22.90 20.40
 1 1956 20.20 10.70 25.20 35.50 48.30 58.90 62.60 56.90 53.10 39.70 22.30 15.60
 2 1954   .60   .34   .75   .14   .78  1.43  1.11  1.60   .72   .89  1.42   .73
 2 1955   .57   .81   .49   .19  1.29  1.15  1.37  1.15  1.28   .40   .82  1.80
 2 1956  1.21   .35   .07   .39  2.32   .67   .71   .38   .02   .94   .14   .83
 3 1954   .14   .16   .26   .90   .43   .62   .06   .02   .01   .02   .05   .04
 3 1955   .05   .04   .05  1.17   .62   .57   .04   .03   .01   .02   .06   .32
 3 1956   .19   .14   .77   .65  1.13   .19   .06   .05   .01   .02   .03   .04
 4 1954   .00   .06   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 4 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 4 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 5 1954  1.21  1.10  2.22  4.47  8.50  2.23   .23   .01   .00   .05   .31   .66
 5 1955   .80   .72   .90  4.30  9.85  7.40   .13   .06   .03   .09   .79  2.37
 5 1956  1.61  1.46  4.70  5.14 18.28 12.58   .55   .01   .00   .07   .75   .83
 6 1954  1.01  1.00  1.24  4.16 13.17  5.18  2.43   .96   .93   .85   .78   .76
 6 1955   .74   .66   .74  2.66 14.66 12.18  2.63  1.49   .95   .97   .83  1.33
 6 1956  1.03   .86  1.86  3.96 21.15 17.73  3.64  1.34   .69   .93   .83   .84
 7 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

POTS 10 THRU 24 SHOULD BE SET AS FOLLOWS
  .10000  .01275  .03571  .54999  .01000
  .00000  .00006  .02380  .50000  .00000
  .10000  .00000  .00000  .00000  .79999

POTS 10 THRU 24 ARE SET AS FOLLOWS
  .09967  .01257  .03543  .54907  .00976
  .00000  .00000  .02355  .49975  .00000
  .09948  .00000  .00000  .00000  .79937
```

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EVANSTON CASE 3  -1                       1954

   VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      22.10      24.20      24.70      40.60      49.70      54.80
     F       1.45       1.62       2.05       3.65       5.01       5.58
   PPT    2269.79    1118.20    2466.62     460.43    2565.26    4703.03
  QRIV    3323.99    3300.99    4097.99   13691.99   43322.98   20339.99
  QUNG     388.67    1233.27    3225.36    5228.42    1129.70    1611.59
  QCNL        .00        .00        .00        .00    8358.13   21473.51
  QSIT    3490.69    4259.89    6942.17   17995.51   39438.90   11365.59
  QIGS        .00    1419.41    4516.99    5607.39    5741.38   12862.96
  QGLI        .00        .00        .00        .00        .00        .00
   SNW    7498.53    7197.32    5146.95        .00        .00        .00
  SNMT        .00    1419.41    4516.99    5146.95        .00        .00
  ETPH     221.98     274.58     381.18     924.90    1837.67    2420.05
   ETP     797.27    1060.48    1636.06    4292.84    9675.77   12935.22
    ET     786.87    1011.70    1678.13    4311.77    9683.42   12895.17
    MS    7467.32    7973.17   10807.54   12156.47    8294.34    8238.14
    DP     650.52     666.43     650.37     586.14     521.90     457.67
   QTO    4111.04    4865.80    7531.55   18515.74   39922.06   11755.00
   QGO      96.35      32.11      80.29      96.35      48.17      48.17
   QSO    4014.68    4833.68    7451.26   18419.39   39873.88   11706.63

   VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      65.20      59.30      53.70      43.80      34.40      17.40      40.82
     F       6.78       5.69       4.51       3.41       2.27       1.09      43.16
   PPT    3650.60    5262.13    2302.18    2927.06    4670.14    2400.84   34795.82
  QRIV    8012.99    3176.99    3090.99    2820.99    2578.99    2528.99  110287.90
  QUNG     159.57      60.82      41.87      55.29     134.29     126.39   13395.31
  QCNL   40450.87   21254.86   16090.66    2965.53        .00        .00  110593.54
  QSIT  -11051.65   -7703.49   -4926.54     707.25    2275.90    2406.50   65260.41
  QIGS   19021.93   13338.97    8416.63    4053.96    4670.14        .00   79649.76
  QGLI        .00        .00        .00        .00        .00        .00        .00
   SNW        .00        .00        .00        .00        .00    2400.84    2400.84
  SNMT        .00        .00        .00        .00        .00        .00   11083.36
  ETPH    3852.89    2864.47    1945.06    1042.13     437.39     188.38   16397.23
   ETP   19038.00   13387.15    9424.66    4126.22    1699.06     657.59   77730.35
    ET   19053.71   13433.14    8390.69    3998.62    1686.16     690.52   77610.98
    MS    8270.25    8230.11    8294.34    8366.60   11441.86   10743.30   10743.30
    DP     393.43     297.08     264.96     176.64     136.49      60.29    4922.00
   QTO  -10727.23   -7467.32   -4753.39     818.99    2344.57    2473.04   69389.87
   QGO      32.11      32.11      32.11      80.29      64.23      80.29     722.64
   QSO  -10759.36   -7499.43   -4785.50     738.70    2280.34    2392.75   68667.23
```

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EVANSTON CASE 3  -1                       1955

   VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      12.20      14.70      20.30      34.20      47.30      54.90
     F        .80        .98       1.68       3.07       4.77       5.59
   PPT    1874.63    2863.95    1611.52     624.87    4242.59    3782.15
  QRIV    2442.99    2171.99    2468.99    8774.99   48232.98   40062.99
  QUNG     139.34     116.12     153.25    7845.06    1635.79    1485.19
  QCNL        .00        .00        .00        .00        .00   18473.71
  QSIT    2450.82    2121.33    2300.97   16010.24   48252.88   32091.05
  QIGS        .00        .00        .00    9174.95    4243.47   13802.16
  QGLI        .00        .00        .00        .00        .00        .00
   SNW    4275.48    6939.43    8550.95        .00        .00        .00
  SNMT        .00        .00        .00    8550.08        .00        .00
  ETPH     122.54     166.79     313.27     801.81    1615.89    2437.11
   ETP     440.12     644.17    1344.51    2793.25    8508.03   12994.19
    ET     457.67     682.49    1397.11    2705.39    8719.90   13144.08
    MS   10293.86    9851.31    8294.34   14790.11   16414.10    8037.40
    DP      72.25      48.17      48.17      40.14      32.11      32.11
   QTO    2473.04    2119.75    2248.22   15978.46   48192.32   32021.15
   QGO      64.23      80.29      54.23      32.11      32.11      80.29
   QSO    2408.81    2039.46    2183.99   15946.34   48160.20   31940.86

   VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      62.10      63.00      52.10      42.00      22.90      20.40      37.17
     F       6.45       6.04       4.37       3.27       1.51       1.28      39.88
   PPT    4505.70    3782.15    4209.70    1315.53    2696.84    5919.89   37229.57
  QRIV    8574.99    4932.99    3153.99    3296.99    2729.99    4381.99  131227.87
  QUNG     128.75      81.35      41.97      59.24     175.37     853.19   12704.84
  QCNL   33202.70   30712.96    9421.08    6346.41     126.77    3221.58  101305.31
  QSIT   -7241.21   -9973.39   -2187.10     -74.57    2560.22    3855.53   90194.53
  QIGS   17122.76   13453.08    7759.71    3727.17      48.17    1148.26   69509.65
  QGLI        .00        .00        .00        .00        .00        .00        .00
   SNW        .00        .00        .00        .00    2696.84    8616.74    8616.74
  SNMT        .00        .00        .00        .00        .00        .00    8552.96
  ETPH    3427.31    3316.83    1802.17     929.10     291.17     221.45   15246.17
   ETP   16934.08   15501.26    7985.77    3670.99    1131.26     772.97   72550.53
    ET   16909.25   15552.90    7908.93    3765.77    1172.28     786.87   73233.82
    MS    8270.25    8238.14    8173.90    8173.90    7373.86    7459.29    7459.29
    DP      40.14      48.17      48.17      48.17      48.17      48.17     554.02
   QTO   -7258.55  -10004.60   -2232.16     -96.35    2537.26    3854.10   89832.67
   QGO      32.11      32.11      32.11      32.11      80.29      64.23     626.29
   QSO   -7290.67  -10036.72   -2264.28    -128.47    2456.98    3789.86   89206.37
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EVANSTON CASE 3  -1                       1956

   VAR        JAN        FEB        MAR        APR        MAY        JUN
  TEMP      20.20      10.70      25.20      35.50      48.30      58.90
     F       1.33        .71       2.39       3.19       4.87       6.00
   PPT    3979.48    1151.09     239.21    1282.64    7630.09    2203.51
  QRIV    3417.99    2833.99    6129.99   13039.99   69559.98   58311.98
  QUNG     509.54     385.51    7191.35    4372.22    2938.88     515.07
  QCNL    2807.34    1669.26        .00        .00        .00   12208.67
  QSIT    2961.85    2463.79   12932.45   15787.21   73792.18   51288.46
  QIGS     762.79     634.32    9230.81    5029.21    7530.24    6842.81
  QGLI        .00        .00        .00        .00        .00        .00
   SNW   12596.22   13747.31    4746.72        .15        .00        .00
  SNMT        .00        .00    9230.81    4746.57        .15        .00
  ETPH     202.90     121.40     388.89     625.00    1706.66    2849.27
   ETP     728.73     468.89    1669.18    2900.37    8385.95   15458.33
    ET     558.42     465.70    1718.28    3002.98    9233.76   15560.93
    MS    7587.76    7780.46   15225.96   13357.27   16837.60    8125.72
    DP      72.24      48.17      48.17      48.17      48.17      48.17
   QTO    2954.81    2456.98   12911.23   15740.28   70835.15   51211.36
   QGO      64.23      54.23      48.17      48.17      64.23      32.11
   QSO    2890.57    2392.75   12863.06   15791.10   70770.92   51179.25

   VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
  TEMP      62.60      56.90      53.10      39.70      22.30      15.60      37.49
     F       6.81       5.46       4.46       3.09       1.47       1.04      40.27
   PPT    2335.07    1249.75      65.77    3091.50     460.43    2729.73   26403.30
  QRIV   12002.99    4435.99    2269.99    3084.99    2749.99    2774.99  180612.84
  QUNG     212.13     170.53      33.98      53.71      79.78     114.54   16575.41
  QCNL   39552.83   28352.99   21506.13     386.87     147.90    2831.41  108663.21
  QSIT   -6311.49   -8755.73   -7759.23    2198.10    2490.03    1633.40  140720.78
  QIGS   17365.20   12023.89    5239.10    3238.51      56.20    1075.93   73127.87
  QGLI        .00        .00        .00        .00        .00        .00        .00
   SNW        .00        .00        .00        .00     460.43    3193.16    3193.16
  SNMT        .00        .00        .00        .00        .00        .00   13977.53
  ETPH    3494.82    2588.23    1890.85     793.59     283.54     184.20   15175.41
   ETP   17258.71   12096.15    8189.93    3142.16    1101.43     627.36   72637.71
    ET   17231.04   12148.44    8322.37    3243.86    1075.93     690.52   73332.29
    MS    8204.34    8173.90    8125.72    8165.87    7146.14    7587.76    7587.76
    DP      40.14      40.14      48.17      32.11      48.17      40.14     562.05
   QTO   -6343.20   -8784.14   -7834.55    2183.99    2473.04    1621.93  140465.90
   QGO      32.11      32.11      64.23      96.35      64.23      64.23     674.46
   QSO   -6375.32   -8816.25   -7868.79    2087.63    2408.81    1557.69  139791.43
```

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EVANSTON CASE 3  -2
   0    2    0    0
    35.00       2.50  31571.00          .80
    3250.    11029.    24794.      393.        0.        0.        0.
      0.        0.        0.        0.        0.        0.        0.   39486.
   .08234    .27945    .62823    .00995    .00000    .00000    .00000
   .00000    .00000    .00000    .00000    .00000    .00000    .00000
$3288.833
     632.      600.     3523.      261.     2434.        0.        0.
    7459.
   .08472    .08164    .47231    .03499    .32631    .00000    .00000
621.58325
   .55   .66   .80   .91  1.07  1.10  1.04  1.00   .92   .52   .75   .60
   .81   .90   .99  1.04  1.07  1.10  1.12  1.13  1.12  1.10  1.03   .92
   .90   .38  1.00   .00   .56   .79   .00 32.00 24.00  1.59 20.00  2.00
 10.00  7.00 11.00   .20   .00   .00   .00   .00   .00   .00  2.50  2.50
 1 1954 22.10 24.20 24.70 40.60 49.70 54.80 65.20 59.30 53.70 43.80 34.40 17.40
 1 1955 12.20 14.70 20.30 34.20 47.30 54.90 62.10 63.00 52.10 42.00 22.90 20.40
 1 1956 20.20 10.70 25.20 35.50 48.30 58.90 62.60 56.90 53.10 39.70 22.30 16.60
 2 1954   .69   .34   .75   .14   .78  1.43  1.11  1.60   .70   .89  1.42   .73
 2 1955   .57   .81   .49   .19  1.29  1.15  1.37  1.15  1.28   .40   .82  1.80
 2 1956  1.21   .35   .07   .39  2.32   .67   .71   .38   .02   .94   .14   .83
 3 1954   .14   .16   .26   .90   .43   .62   .06   .02   .01   .02   .05   .04
 3 1955   .05   .04   .05  1.17   .62   .57   .04   .03   .01   .02   .06   .32
 3 1956   .19   .14   .77   .65  1.13   .19   .08   .06   .01   .02   .03   .04
 4 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 4 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 4 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 5 1954  1.21  1.18  2.22  4.47  8.50  2.20   .23   .31   .00   .05   .31   .66
 5 1955   .80   .72   .90  4.30  9.85  7.40   .13   .06   .00   .09   .79  2.37
 5 1956  1.81  1.46  4.70  5.14 18.28 12.58   .55   .01   .00   .07   .75   .83
 6 1954  1.01  1.30  1.24  4.16 13.17  6.18  2.43   .96   .93   .85   .78   .76
 6 1955   .74   .66   .74  2.66 14.66 12.18  2.63  1.49   .95   .97   .83  1.33
 6 1956  1.03   .86  1.86  3.96 21.15 17.73  3.64  1.34   .69   .93   .83   .84
 7 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 7 1955   .00   .00   .00   .20   .00   .00   .00   .00   .00   .00   .00   .00
 7 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1954   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1955   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 8 1956   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

POTS 10 THRU 24 SHOULD BE SET AS FOLLOWS
   .10000  .01275  .03571  .54999  .01000
   .00000  .00000  .02380  .50000  .00000
   .10000  .00090  .00000  .00000  .79999

POTS 10 THRU 24 ARE SET AS FOLLOWS
   .09967  .01257  .03540  .54907  .00976
   .00000  .00000  .02368  .49975  .00000
   .09948  .00000  .00000  .00000  .79937
```

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EVANSTON CASE 3  -2                           1954

       VAR        JAN        FEB        MAR        APR        MAY        JUN
      TEMP      22.10      24.20      24.70      40.60      49.70      54.60
         F       1.45       1.62       2.05       3.65       5.01       5.58
       PPT    2769.29    1118.20    2466.62     460.43    2565.28    4703.03
      QRIV    3323.99    3300.99    4097.99   13691.99   43322.98   20339.99
      QUNG     358.67    1233.27    3225.36    5228.42    1129.72    1611.59
      QCNL        .00        .00        .00        .00    9393.50   19525.53
      QSIT    3490.69    4259.69    6942.17   17995.51   39045.46   12135.83
      QIGS        .00    1419.41    4516.99    5607.39    6134.82   12122.73
      QGLI        .00        .00        .00        .00        .00        .00
       SNW    7498.53    7197.32    5146.95        .00        .00        .00
      SNMT        .00    1419.41    4516.99    5146.95        .00        .00
      ETPH     221.98     274.58     381.18     924.90    1637.67    2426.05
       ETP     797.27    1060.48    1636.05    4292.84    9675.77   12935.22
        ET     786.87    1075.93    1846.75    4440.24    9715.54   12598.09
        MS    7467.32    7844.70   10542.57   11753.03    8189.96    7844.70
        DP     682.49     666.43     650.37     594.17     537.96     465.70
       QTO    4094.98    4865.80    7499.43   18515.74   39472.41   12477.65
       QGO      32.11      64.23      64.23      80.29      48.17      80.29
       QSO    4062.86    4801.56    7435.20   18435.44   39424.24   12397.35

       VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
      TEMP      65.20      59.30      53.70      43.80      34.40      17.40      40.82
         F       6.78       5.69       4.51       3.41       2.27       1.09      43.16
       PPT    3650.60    5262.13    2302.18    2927.06    4670.14    2400.64   34795.82
      QRIV    8012.99    3176.99    3390.99    2820.99    2578.99    2528.99  110287.90
      QUNG     159.57      60.82      41.87      55.29     134.29     126.30   13395.31
      QCNL    4319.68     373.35    1187.80    1834.16        .00    1141.01   37775.03
      QSIT    2878.20     231.47     736.43    1137.17    2275.90    2032.92   92931.45
      QIGS    5292.36    5404.00    2753.54    3624.04    4670.14     433.58   51978.72
      QGLI        .00        .00        .00        .00        .00        .00        .00
       SNW        .00        .00        .00        .00        .00    2400.84    2400.84
      SNMT        .00        .00        .00        .00        .00        .00   11083.36
      ETPH    3852.89    2864.47    1945.06    1042.13     437.39     188.88   16397.23
       ETP   19038.00   13387.15    8424.66    4126.22    1699.06     657.59   77736.35
        ET   10357.89    5026.38    3195.69    1967.19    1429.22     714.61   53154.47
        MS    2834.37    3227.80    2834.37    4512.50    7788.49    7563.67    7563.67
        DP     393.43     297.08     264.96     168.61     136.49      80.29    4938.06
       QTO    3002.99     465.70     915.34    1252.58    2328.51    2071.57   96962.75
       QGO      32.11      80.29      64.23      64.23      64.23      64.23     738.70
       QSO    2970.86     385.41     851.11    1188.34    2264.26    2007.34   96224.04
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EVANSTON CASE 3  -2                           1955

       VAR        JAN        FEB        MAR        APR        MAY        JUN
      TEMP      12.20      14.70      20.30      34.20      47.30      54.90
         F        .83        .98       1.68       3.07       4.77       5.59
       PPT    1874.63    2663.95    1611.52     624.87    4242.59    3782.15
      QRIV    2442.99    2171.99    2450.99    8774.99   48232.98   40062.99
      QUNG     130.34     116.12     153.25    7845.06    1635.79    1485.19
      QCNL    1732.65     993.10    1648.13        .00        .00   22192.58
      QSIT    1792.39    1743.95    1674.68   15018.24   48252.88   30677.88
      QIGS     658.49     377.38     626.29    9174.95    4243.47   12215.33
      QGLI        .00        .00        .00        .00        .00        .00
       SNW    4275.48    6939.43    8550.96        .00        .00        .00
      SNMT        .00        .00        .00    8550.08        .00        .00
      ETPH     122.54     166.79     313.27     601.81    1615.89    2437.11
       ETP     442.12     644.17    1344.61    2793.25    8508.03   12994.19
        ET     433.58     650.37    1236.52    2906.63    8655.66   13347.73
        MS    7844.70    7595.79    7017.67   13304.57    9030.93    9141.78
        DP      72.26      48.17      40.14      32.11      40.14      32.11
       QTO    1798.58    1718.28    1637.99   15994.51   48240.49   30624.04
       QGO      48.17      32.11      64.23      32.11      32.11      32.11
       QSO    1750.41    1686.16    1573.75   15962.40   48208.37   30591.92

       VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
      TEMP      62.10      63.20      52.10      42.00      22.90      20.40      37.17
         F       6.45       6.04       4.37       3.27       1.51       1.28      39.88
       PPT    4305.73    3702.15    4209.70    1315.53    2696.84    5919.89   37229.57
      QRIV    8674.99    4932.99    3153.99    3206.99    2729.99    4381.99  131227.87
      QUNG     128.76      81.36      41.07      59.24     175.37     853.19   12704.84
      QCNL    5375.64    1607.53    1392.90    2337.06    2614.20    5013.74   44997.75
      QSIT    3333.02    1052.47     863.59    1448.98    1620.80    3148.51  111507.39
      QIGS    6549.52    4427.21    4739.00    2273.51     993.39    1905.22   48112.82
      QGLI        .00        .00        .00        .00        .00        .00        .00
       SNW        .00        .00        .00        .00    2696.84    8616.74    8616.74
      SNMT        .00        .00        .00        .00        .00        .00    8550.06
      ETPH    3427.91    3316.83    1802.17     929.18     291.17     221.45   15240.17
       ETP   16938.08   15501.26    7805.77    3670.99    1131.05     770.97   72550.53
        ET   10968.12    5700.85    3259.92    2007.34     778.84     562.85   50207.69
        MS    3797.89    2545.31    4119.07    4287.68    4568.71    5925.67    5925.67
        DP      40.14      48.17      48.17      48.17      48.17      48.17     545.99
       QTO    3292.04    1043.61     835.05    1429.22    1605.87    3099.33  111319.28
       QGO      96.35      64.23      64.23      80.29      64.23      64.23     674.46
       QSO    3195.69     979.38     770.82    1348.93    1541.64    3035.10  110644.81
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EVANSTON CASE 3  -2                           1956

       VAR        JAN        FEB        MAR        APR        MAY        JUN
      TEMP      20.20      10.70      25.20      35.50      48.30      58.90
         F       1.33        .71       2.09       3.19       4.87       6.00
       PPT    3979.48    1151.09     230.21    1282.64    7630.09    2203.51
      QRIV    3417.99    2833.99    6129.99   13039.99   69559.98   56311.98
      QUNG     309.54     385.51    7191.35    4372.22    2935.88     515.07
      QCNL    3724.64    3098.11        .00        .00        .00   12546.75
      QSIT    2309.28    1920.83   12932.45   15787.21   70792.18   51160.00
      QIGS    1415.36    1177.28    9230.81    6029.21    7630.24    6971.28
      QGLI        .00        .00        .00        .00        .00        .00
       SNW   12596.22   13747.31    4746.72        .15        .00        .00
      SNMT        .00        .00    9230.81    4746.57        .15        .00
      ETPH     202.93     121.40     388.89     625.00    1706.66    2899.27
       ETP     726.74     458.89    1669.18    2900.87    8985.95   15458.33
        ET     594.17     457.67    1718.28    3967.22    9153.49   15552.98
        MS    6816.94    7567.76   15167.40   18130.33   16709.13    8165.87
        DP      48.17      48.17      48.17      48.17      48.17      40.14
       QTO    2280.34    1910.99   12927.29   16749.28   70819.09   51131.07
       QGO      48.17      32.11      80.29      80.29      64.23      64.23
       QSO    2232.16    1878.87   12847.00   16668.98   70754.85   51066.83

       VAR        JLY        AUG        SEP        OCT        NOV        DEC        ANN
      TEMP      62.64      56.90      53.10      39.70      22.30      15.60      37.49
         F       6.31       5.46       4.45       3.09       1.47       1.04      40.27
       PPT    2338.47    1249.75      65.77    3091.50     460.43    2729.73   26439.30
      QRIV   12002.99    4435.99    2269.99    3094.99    2749.99    2774.99  180612.84
      QUNG     212.13     170.63      33.96      53.71      79.78     114.54   16575.41
      QCNL    8718.30    2018.40     413.10    2345.12    2546.24    2709.34   38120.00
      QSIT    5405.34    1251.40     256.12    1453.97    1578.57    1679.79  167527.18
      QIGS    5648.02    2016.74     222.75    3982.64     957.57    1029.55   46321.48
      QGLI        .00        .00        .00        .00        .00        .00        .00
       SNW        .00        .00        .00        .00     460.43    3190.15    3190.15
      SNMT        .00        .00        .00        .00        .00        .00   13977.53
      ETPH    3494.82    2528.23    1890.86     793.59     263.54     180.20   15175.41
       ETP   17258.71   12096.16    8189.03    3142.16    1101.43     627.36   72637.71
        ET   10478.33    3581.10    1292.72    1075.93     674.46     401.45   48047.78
        MS    3358.27    1806.60     786.87    3733.66    4119.07    4737.33    4737.33
        DP      40.14      48.17      40.14      48.17      32.11      32.11     521.99
       QTO    5379.58    1220.46     224.82    1445.28    1567.59    1654.05  167330.89
       QGO      64.23      64.23      96.35      48.17      80.29      64.23     756.87
       QSO    5315.44    1156.23     128.47    1397.11    1477.40    1589.81  166513.21
```