Effects of Shasta Lake Carryover Storage and Annual Releases on Meeting Sacramento River Temperature Objectives: Initial Studies

Prepared for:

Sacramento River Council

Prepared by:

Anthony A. Finnerty

Balance Hydrologics, Inc.

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A report prepared for:

Sacramento River Council
250 Overhill Drive
Redding, CA 96001
Attn: Tryg Sletteland
(916) 244-0817

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Balance Hydrologics, Inc. Assignment 9245

by

Anthony A. Finnerty, Ph. D.
Hydrologist

BALANCE HYDROLOGICS, Inc.
1760 Solano Avenue, Suite 209
Berkeley, CA 94707
(510) 527-0727

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1. Introduction

1.1 Purpose

The numbers of returning salmon on the Sacramento River have declined greatly, in part because river temperatures below Shasta Dam have not been kept cool enough for successful spawning and rearing of fry. The Bureau of Reclamation manages the Sacramento and Trinity Divisions of the Central Valley Project (CVP) to balance goals such as water delivery, power generation, navigation, river temperature control, and environmental support. Some agencies and groups, including the Sacramento River Council, have sought to alter the balance to provide longer and more reliable temperature control to assist the ailing salmon resource.

In hearings before the State Water Resources Control Board (SWRCB), attention was focused on the role of carryover storage in maintaining cool temperatures in the Sacramento River for salmon and steelhead spawning. Carryover storage in the Sacramento River system is defined as the reservoir storage on September 30 of each year that is carried over into the next water year. Balance Hydrologics, Inc., has been retained by the Sacramento River Council to evaluate how carryover storage in Shasta Lake might be managed to meet water temperature objectives for salmon spawning habitat in the Sacramento River from Keswick Dam to Red Bluff.

1.2 Approach

Most salmon and steelhead spawning in the Sacramento River since construction of Shasta Dam takes place in the 59 mile reach between Keswick Dam and Red Bluff Diversion Dam. The SWRCB issued Water Rights Order (WR) 90-5 to establish the objective that river temperatures be maintained at or below 56 °F in this reach during periods important to health of the salmon. Our goal is defined by the river temperature objective: to find what values of carryover storage in Shasta Lake best promote compliance with WR90-5.

We first attempted to identify the effects of Shasta carryover temperatures on Sacramento River temperatures in the salmon spawning reaches between Keswick Dam and Red Bluff Diversion Dam by examining available records of reservoir storage and river temperatures. There are so many hydrologic and operational parameters that interact with each other and that influence river temperatures, however, that we could not separate the effects of carryover storage from other parameters. We turned to the simulations described in the October 1992 CVP-Operations Criteria and Plans (OCAP) but, again, too many model parameters were varied in each simulation to isolate the effects of carryover storage on river temperatures.

The only approach remaining to us was to employ the Reclamation computer codes to simulate the thermal response of the Sacramento River to changes in Shasta carryover storage. To do so, we ported the Fortran source code, obtained from Reclamation through a Freedom of Information Act request by the Sierra Club Legal Defense Fund, to a Macintosh personal computer, as described in Appendix A. The codes obtained are those used by Reclamation to produce their April 1992 Forecast.

Hydrologic and operational conditions used for the April 1992 Forecast were adopted as the base conditions from which we varied Shasta carryover storage in our simulations. The Reclamation temperature model simulates temperatures from January to December so, in reality, we varied the January 1 storage value, which was related to carryover storage as described in Section 2.3.

An important consequence of using the April 1992 Forecast as the base model is the use of 3,825 thousand acre-feet (taf) for the total calendar year inflow to Shasta Lake. According to a table of computed inflows to Shasta Lake for the period 1922-1991, obtained from Reclamation, this value of inflow corresponds approximately to a lower quartile runoff year. The simulated 1992 inflow value is mid-way between those used to define *dry* and *critically dry* water years in the 1992 CVP-OCAP (p. 104). Consequently, the April 1992 Forecast and our simulations apply to a lower quartile dry year. In comparison, the lower decile dry year was discussed as an appropriate target for protection of salmon in the Trinity River in recent hearings before the SWRCB.

The results of the simulations are presented as two series of plots: (1) monthly average river temperatures at various points along the Sacramento River, for each value of carryover storage, and (2) monthly average temperatures as a function of carryover storage. Examination of these plots showed us that other operational parameters, in addition to carryover storage, will have to be varied from those incorporated in the April 1992 Forecast to achieve temperature objectives downstream of Balls Ferry. We ran two additional series of simulations aimed at elucidating the role of total annual Shasta releases on river temperatures. The April 1992 Forecast was also used as the base model for these simulations. For one series, we assumed carryover storage of 1,200 taf, for the other, 1,900 taf.

1.3 Disclaimers

Our use of the April 1992 version of the Reclamation river temperature program should not be construed as an endorsement of the model or its approach. In Section 5 and Appendix A, we discuss several important limitations to the model. Although we believe the model has utility for exploring effects of hydrologic and operational variables on CVP operations on an annual time scale, and effects on river temperatures on an average monthly basis, it is not adequate for assuring suitable river temperatures in daily operations nor for accounting for normal weather variations.

We appreciate the access to computer codes and data files provided by the Bureau of Reclamation.

2. Simulation of Effects of Carryover Storage on River Temperatures

Our simulations are intended only to elucidate the influence of carryover storage and total annual releases on river temperatures. The operational parameters contained in each individual model are not necessarily recommended for operation of the Shasta and Trinity Divisions of the CVP. The information on carryover storage obtained from the collection of model runs, however, may be useful for developing modified operation procedures intended to improve compliance with water temperature objectives for salmon in the Sacramento River.

2.1 Parameters That Affect Sacramento River Temperatures

According to the 1992 Long-Term CVP-OCAP, temperatures on the Sacramento River below Shasta Dam are influenced by:

- the ratio of the Spring Creek Powerplant releases (primarily Trinity transfers) to Shasta releases;
- relative temperatures of the releases;
- total storage at Shasta Lake;
- the depth of releases from Shasta Dam;
- the percent of total releases from each depth;
- ambient air temperatures and other climatic conditions;
- tributary accretions and temperatures;
- residence times in Keswick Reservoir;
- residence times in the Sacramento River.

A complete parametric analysis of all these factors would require hundreds of runs of the computer model. We have focused our study on one parameter: carryover storage at Shasta Lake, with a limited extension to exploring the role of total annual releases. While the Reclamation models (and, presumably, operation of the river) would benefit from a more complete parametric analysis, our scope has been limited to carryover storage.

2.2 The Role Of Carryover Storage

In the Mediterranean climate of northern California, streamflows and reservoir inflows are usually near their annual minima at the beginning of each new water year on October 1. Reservoir storage may continue to decline for the next month because October water demands are still high and significant runoff from the new wet season usually does not begin before November or December.

Cool temperatures can be maintained in the Sacramento River during the summer and autumn only if the base of the warm water at the surface of Shasta Lake is kept above the lowest dam outlet. The higher the reservoir level at the start of the water year, the more likely that levels can be kept high enough that warm water need not be released when the salmon would be harmed. Runoff during the wet season and spring snowmelt is more likely to raise storage to sufficiently high levels if more storage is carried over into the wet season. Greater carryover storage can compensate, at least in part, for unusually dry years with low runoff to the reservoir.

Figure 1 illustrates measured positions of the cool pool and warm surface waters in Shasta Lake over a calendar year, for a year with high storage (1966) and a year with low storage (1991), relative to outlet elevations. Reservoir temperatures remain relatively low at the lowest outlet in a high storage year, but in a year with low reservoir levels, warm water extends to below the lowest outlet in late summer and autumn, making it impossible to maintain cool river temperatures with Shasta releases.

2.3 The Base Model

The base model for parametric analysis of carryover storage is the April 1992 Forecast issued by Reclamation. This base model was selected because it represents a real situation of low carryover storage (1,340 taf) going into a dry year (3,825 taf anticipated Shasta inflow, midway between the 1992 CVP-OCAP criteria for dry and critically dry years). Daily storage records for Shasta Lake (Figure 2) show that 1,340 taf carryover storage is well below the lower decile value. In fact, since initial filling of the reservoir was completed in 1945, carryover storage was lower than the 1991 figure only in the drought years of 1976 and 1977. The reservoir inflow is slightly more than the lower quartile value.

The operational parameters contained within the April 1992 Forecast are those Reclamation chose at that time to contend with the drought conditions. Note, however, that actual operations in 1992 differed from those forecasted in April because inflows to Shasta Lake were greater than predicted.

A printout of the electronic file containing input parameters and results of the April 1992 Forecast model, obtained from Reclamation, is included in Appendix B. We have made no changes to the file other than insertion of page breaks at appropriate points. The model, as run by Reclamation, covered the time period January 1992 through December 1992. Initial Shasta

Lake storage in the simulation was 1,302 taf, slightly less than the actual September 30, 1991 carryover figure of 1,340 taf.

Note that we refer to carryover storage for the April 1992 simulation as 1,200 taf for comparison with our simulations because, on average, historical storage on September 30 has been about 100 taf less than on January 1 (Figure 2). The simulations are actually initiated with January 1 storage values.

Monthly values for reservoir inflows, releases through each outlet, Trinity transfers via the Spring Creek Powerplant, and Cottonwood Creek accretions are summarized in Table 1. None of these values were changed in our model runs exploring the effects of carryover storage. The only input parameter changed was the value of storage at the beginning of January. The January 1 storage figures used in our models, and equivalent carryover (September 30) storage, are shown in Table 2.

2.4 Effects of Carryover Storage on River Temperatures

The simulated effects of increasing carryover storage on river temperatures at various points downstream of Shasta Dam are shown in Figure 3. Four separate plots appear in the figure, one for the unmodified April 1992 Forecast (1,200-1,300 taf carryover storage) and others for carryover of 1,600, 1,900, and 3,100 taf. The simulation for 2,400 taf carryover is not shown, as it differs little from simulations for 1,900 and 3,100 taf.

A horizontal line at 56 °F is shown in each plot for comparison of river temperature profiles to the temperature objective. Within each plot, separate temperature profiles are shown for each month between May and October. Other months were omitted because temperature profiles remain below the 56 °F objective for the monthly average conditions in the simulations.

The locations of major tributaries and several compliance points are marked on the plots in Figure 3. Note that we modified the Reclamation temperature model to add river temperature calculations at Balls Ferry Bridge and Jellys Ferry Bridge, as described in Appendix A.

Increasing carryover storage affects river temperatures most strongly in October. Simulated temperatures are much higher than for other months at lowest values of carryover storage. October is the latest month of the year in which significant river heating takes place. River temperatures in October are especially high for low values of carryover storage because the reservoir has run out of accessible cool water. This fact is illustrated by the position of the October water temperature at zero distance from Shasta Dam, that is, as it is released from the dam. Even at 2,400 taf carryover (not illustrated, but nearly identical to the 1,900 taf case in Figure 3), release temperature for October is higher than for other months, indicating the relative scarcity of cool water in the reservoir in the late summer. Similar constraints would occur in September if the reservoir were operated so that accessible cool water would be depleted.

Note that, for carryover storage of 1,600 taf or greater, average October simulated river temperatures at Bend Bridge and Red Bluff Diversion Dam are lower than in other months. This reversal takes place because river heating is less than in preceding months as a result of lower ambient air temperatures and less insolation. An October hot spell could raise the river temperatures for part of the month, however.

For all values of carryover of 1,600 taf or greater, river temperatures are highest in July and second highest in August. These are the two hottest months of the year at the Redding weather station (Figure 7).

For the hydrologic conditions and operating procedures contained in the April 1992 forecast and for models with greater carryover storage, Sacramento River temperatures are expected to exceed the 56 °F objective at some point below Cottonwood Creek in every month between May and October, inclusive. Even with 3,100 taf of carryover, average monthly temperatures in July and August will exceed the temperature objective at Jellys Ferry. River temperatures at Bend Bridge and Red Bluff Diversion Dam exceed the temperature objective in every warm month, regardless of carryover storage, with one exception (Bend Bridge in October with 3,100 taf carryover).

Another view of the simulated data is obtained by plotting river temperatures as a function of Shasta carryover storage (Figure 4). Separate plots for every month from April to November are shown, with temperatures at each of four compliance points represented on each plot. Note that river temperatures are higher at compliance points more distant from Shasta Dam, as is expected from river warming. The sole exception of the cases plotted is November, when river water actually cools as it flows away from the dam.

As early as April, temperatures at Red Bluff Diversion Dam are above 56 °F for all values of carryover (Figure 4). This universal temperature exceedance extends to Bend Bridge in May and June, and to Jellys Ferry in July.

The temperature curves for each compliance point generally turn up to higher temperatures at low values of carryover storage in every month. This effect is accentuated in September and October when, for low carryover conditions, the cool pool in the reservoir is the smallest.

For operations as specified in the April 1992 Forecast, compliance with temperature objectives cannot be attained below Balls Ferry Bridge in July and August, no matter how much storage is carried over in Shasta Lake. This noncompliance for all values of carryover extends below Jellys Ferry Bridge through September and below Bend Bridge through October. The flat shapes of the temperature curves at high values of carryover suggest that, even if Shasta Lake was full at 4,500 taf, the modeled conditions will not produce better temperature compliance.

A unique value of carryover storage to achieve river temperature compliance in a critically dry year cannot be specified because, except for Balls Ferry, complete compliance is not reached for any value of carryover. At Balls Ferry, the most upstream of the compliance points, at least 1,600 taf of carryover is needed for temperature compliance in all months, with October being the worst case. At Jellys Ferry, the next compliance point downstream, 1,800 taf are needed for compliance in October, but compliance in July and August is not possible at any value of carryover storage. At Bend Bridge, 2,300 taf are needed for October compliance, but temperatures are too high in May through September for all values of carryover storage. There is no compliance at Red Bluff Diversion Dam in any warm month at any value of carryover.

The fact that better river temperature compliance has been obtained in some years of actual CVP operations suggests that one or more of the operational parameters specified in the April 1992 Forecast works against compliance, even with high carryover storage. This possibility led us to a limited expansion of our work scope, to a partial exploration of one of these operational parameters: total annual release from Shasta Dam.

3. Simulation of Effects of Total Shasta Releases on River Temperatures

Our investigation of effects of total annual Shasta releases on river temperatures should be regarded as a reconnaissance study. We believe that there are likely synergistic effects between carryover storage and Shasta releases, which can be explored only with an expanded program of simulations. We started with the same base model (April 1992 Forecast) as for the parametric investigation of carryover storage, but limited the reconnaissance study to using only the original figure for carryover (1,302 taf January storage, equivalent to carryover storage in most years of about 1,200 taf) and one higher value, 1900 taf..

We varied the total annual Shasta release in both sets of simulations, from the base model value of 3,025 taf, to cover the range of 1,400 taf (WR90-5 minimum release in a critically dry year) to 4,200 taf. The monthly pattern of releases was proportioned in the same way as in the base model, but minimum monthly release was not allowed to go below the WR90-5 monthly specifications. In an effort to make the most efficient use of the available cool pool in the reservoir, the computer program was allowed to adjust releases between the three outlets of Shasta Dam to try to meet monthly release temperature targets. This procedure approximately reproduced the outlet release values that were assigned in the base model (Table 1), but river temperatures estimated at 3,025 taf total annual release in the new simulations tended to be slightly higher than for the unmodified base model.

The results of the simulations for the 1,200 taf value of carryover storage are shown for the months April through November in Figure 5. Reducing total annual release increases river temperatures at all compliance points from April through July. Despite greater retention behind the dam, which would be expected to increase cool water reserves, lower release rates slow river flows, increasing residence times so that high ambient air temperatures and insolation increase river warming.

In August and later months, the temperature curves develop a minimum (Figure 5). In August, for example, river temperatures are lowest for total annual release of about 3,400 taf. Lower releases cause more river warming, as for earlier months. Greater releases also cause higher river temperatures, however, but the likely reason is different. Greater releases exhaust the cool pool in the reservoir so that warmer water enters the river at Shasta Dam.

In order to minimize cool pool exhaustion in later months, smaller releases are needed. For example, in September (Figure 5) the river temperatures begin to climb when total annual release exceeds about 2,700 taf, compared to 3,400 taf in August. Even more water is released by the time October arrives, so the upturn in river temperatures takes place at an even lower total annual release of about 1,700 taf.

All of these simulations follow a monthly release pattern like that in Table 1. Late summer river temperatures could be lower for any given value of total annual release if less of the water is released early in the water year and more later.

For comparison, the results of simulations for 1,900 taf carryover storage are shown in Figure 6. The differences from the simulations starting with 1,200 taf carryover storage are slight in April through July because the cool pool in the reservoir is not used up in these early months for either value of carryover. In August, September and October, on the other hand, significantly lower temperatures are achieved in the Sacramento River at higher values of total annual release (Figure 6) when compared to the simulations starting with 1,200 taf carryover storage (Figure 5). Overall compliance with the 56 °F river temperature criterion is not markedly improved, however, although the magnitudes of temperature exceedances are less at higher total annual releases compared to the 1,200 taf carryover case.

4. Discussion of Simulation Results

The foregoing simulations indicate that, in a critically dry year with CVP operations as indicated in Table 1, no amount of carryover storage will achieve temperature compliance within the entire reach of the Sacramento River (to Red Bluff Diversion Dam) specified by the SWRCB in WR90-5. For CVP operations as specified in the April 1992 Forecast, complete compliance can be attained only as far downstream as Balls Ferry. Complete compliance at Balls Ferry requires at least 1,600 taf of Shasta carryover storage.

Greater carryover storage improves compliance farther downstream, but cannot by itself achieve complete compliance in a quartile dry year for the simulated CVP operations. Other operational parameters must be changed, in addition to increasing carryover, to further reduce river temperatures.

Of those operational parameters listed in Section 2.1, for example, Spring Creek Powerplant releases could be adjusted from the values incorporated in the April 1992 Forecast to minimize warm water and maximize cool water transfers to the Sacramento River in the warmest months. The SWRCB, however, specifically prohibits the use of transfers from the Trinity River for meeting temperature objectives in the Sacramento River, and there are problems with heating of transferred water as it passes through Whiskeytown Reservoir on the way to the Spring Creek Powerplant.

The only controllable factor besides carryover storage that can significantly influence river temperatures appears to be the Shasta release schedule, including which outlets are used at what times, how much is released early in the water year versus late, and how much is released each year. Our reconnaissance exploration of total annual releases in a single monthly release pattern indicates that limited improvements in river temperature management can be obtained by adjusting total annual releases. We suspect that the pattern of releases, that is, how much water is released early in the water year versus the amount released later at any given value of total annual release, may also be important to achieving better temperature compliance.

Our simulations, together with those of Reclamation and with observations of historical operations, suggest that the adverse effects of Shasta Dam on salmon in the Sacramento River cannot be easily mitigated by changes in CVP operations. Despite the size of Shasta Lake, the location of the reservoir in a very hot region of the Central Valley makes it very likely that river temperatures in reaches now used for salmon spawning will exceed temperature criteria during critical periods, even in water years starting with a nearly full reservoir. These findings underline the fact that every possible avenue for reducing river temperatures in the summer should be pursued aggressively, *even in wet years*, to minimize adverse effects on salmon in the Sacramento River.

5. Limitations of the Reclamation Simulation Model

The simulations performed by Reclamation and by us are useful for developing general guidelines for management of Sacramento River temperatures, but they are inadequate for actual daily protection of salmon.

One problem arises from inaccuracy of the river temperature model. Verification of the model reported by Reclamation (1990, p. 16) suggests that random errors are about 1 to 2 °F:

> "The predicted temperatures are generally within 1-2 °F of the measured temperatures. This is an acceptable difference since most measured temperatures are accurate to only about 0.5-1.0 °F."

Errors in the predicted temperatures in the spawning reaches on the Sacramento River, however, appear to be systematic rather than random. As shown in model verification data for 1987 in Appendix F of Reclamation (1990), average monthly temperatures in the Sacramento River, measured in June through October at Cottonwood Creek, were all 0.3 to 2.1 degrees higher than predicted by the temperature model.

Regardless of whether model errors are systematic or random, to prevent exceedance of the 56 °F temperature guideline it appears that CVP Shasta Division operations should be based on a simulation target of 54 °F to account for documented underestimation of river temperatures in spawning reaches. The fact that the verification of the river temperature model has been accomplished over a limited range of operations also suggests that the conservative engineering approach to managing operations is to account for errors by reducing target temperatures.

Perhaps a greater problem with using the Reclamation temperature model for managing salmon in the Sacramento River is the fact that is uses monthly averages, whereas river temperatures (and salmon mortality) respond to daily fluctuations. Consider, for example, average daily temperatures as measured at Redding (Figure 7). The average monthly air temperatures, as used in the Reclamation model, are located at about the midpoint of each month as shown in Figure 7. That means that the average monthly air temperature is exceeded on half the days of the month, on average. Hence, river temperatures are likely to exceed those estimated in the simulation 50 percent of the time.

The problem of monthly averages is aggravated by the fact that actual daily air temperatures in any year vary by much more than indicated by daily averages shown in Figure 7. Every year has hot spells and cool periods that are not reflected in daily average values or, especially, in monthly average values of air temperature. Yet each day of river temperatures above 56 °F causes egg and fry mortality during critical periods for salmon. The Reclamation mortality model (1992 Biological Assessment) does not account for these expected, normal temperature excursions for periods shorter than one month. It might be noted, for example, that river temperatures substantially above lethal levels were experienced on the Trinity River for seven consecutive days during a warm spell in October 1990—an event that was neither anticipated in Reclamation models nor reported by Reclamation to regulatory agencies.

6. Recommendations

Although the scope of our simulations and exploration of effects of CVP Shasta Division operations on Sacramento River temperatures were necessarily limited, the results suggest several recommendations.

1. Simulations using monthly average values are useful for investigating overall Shasta and Trinity Division operations and large scale issues such as carryover storage requirements. Such models do not account for normal daily and weekly temperature variations, which are of primary concern in reducing mortality of incubating salmon and steelhead. The monthly model is not sufficient to direct daily operations.

2. The existing model appears to contain systematic errors and assumptions that result in predicted temperatures being about 2 °F cooler than temperatures measured in the spawning reaches of the Sacramento River. The model also includes no provisions for random error, as is prudent in simulating compliance with thresholds of lethality. Inasmuch as WR90-5 specifically requires that river temperatures in the reach above Red Bluff Diversion Dam meet temperature objectives on a daily, rather than monthly, basis, immediate adjustments to the model may be warranted. As an interim measure pending such adjustments, it appears prudent to reduce target temperatures for management of the river by about 2 °F , from 56 °F to 54 °F.

3. Reclamation should develop and use a simulation model for predicting daily river temperatures in the reach above Red Bluff Diversion Dam. This model should be used to adjust operations on a daily basis to respond to daily weather conditions, taking into account actual reservoir storage and temperatures, accretions and transfers from the Trinity Division, and measured water temperatures at critical points along the river. A higher certainty of temperature compliance and, in all probability, more river miles of reliably suitable temperatures, can likely be attained with a daily model.

4. Pending development and verification of a daily river temperature model, the monthly temperature model should be used to systematically explore the relationships among Shasta carryover storage, total annual releases, monthly releases patterns, and possibly other operational parameters in order to find combinations that allow river temperature guidelines to be met in dry years, for as much of the spawning reach as possible.

5. Reclamation should provide verification of changes made to the river temperature model since the 1990 draft report. If adequate verification cannot be obtained, then

Shasta and Trinity Division operations should be adjusted to a lower river temperature objective, to account for uncertain temperature simulations. Whenever Reclamation releases information that depends on river temperature simulations, explicit reference should be made to documentation of current verification.

6. It is not clear whether the Reclamation river temperature model has received review outside the Bureau or by allied federal or other water allocation agencies. Porting of the Reclamation model to personal computers allows for outside review, analysis, and verification. Independent review of the models, and of uses of the model to forecast annual operations and the effects of CVP modifications such as the Shasta temperature curtain, is warranted and should be done.

7. Achieving temperature compliance in the Sacramento River is very difficult, even in water years that start with a nearly-full reservoir. To protect salmon, Reclamation should pursue every means available, *every year*, to maintain suitable temperatures in the spawning reaches. All reasonable means of reducing river temperatures in the future should be explored.

7. References Cited

CVP-OCAP (1992) Long-Term Central Valley Project Operations Criteria and Plan, CVP-OCAP, U.S. Department of Interior, Bureau of Reclamation, Mid-Pacific Region, Sacramento, California, October 1992.

Reclamation (1992) Biological Assessment for U.S. Bureau of Reclamation Long-Term Operations Criteria and Plan, U.S. Department of Interior, Bureau of Reclamation, Mid-Pacific Region, Sacramento, California, October 1992.

SWRCB (1990) Water Rights Order WR90-5, State Water Resources Control Board, Sacramento, California, May 2, 1990.

Reclamation (1990) U.S. Bureau of Reclamation monthly temperature model, Sacramento River basin. U.S. Bureau of Reclamation, Mid-Pacific Region, Sacramento, California. Draft report, June 1990.

Table 1. Values of base model parameters used in simulations

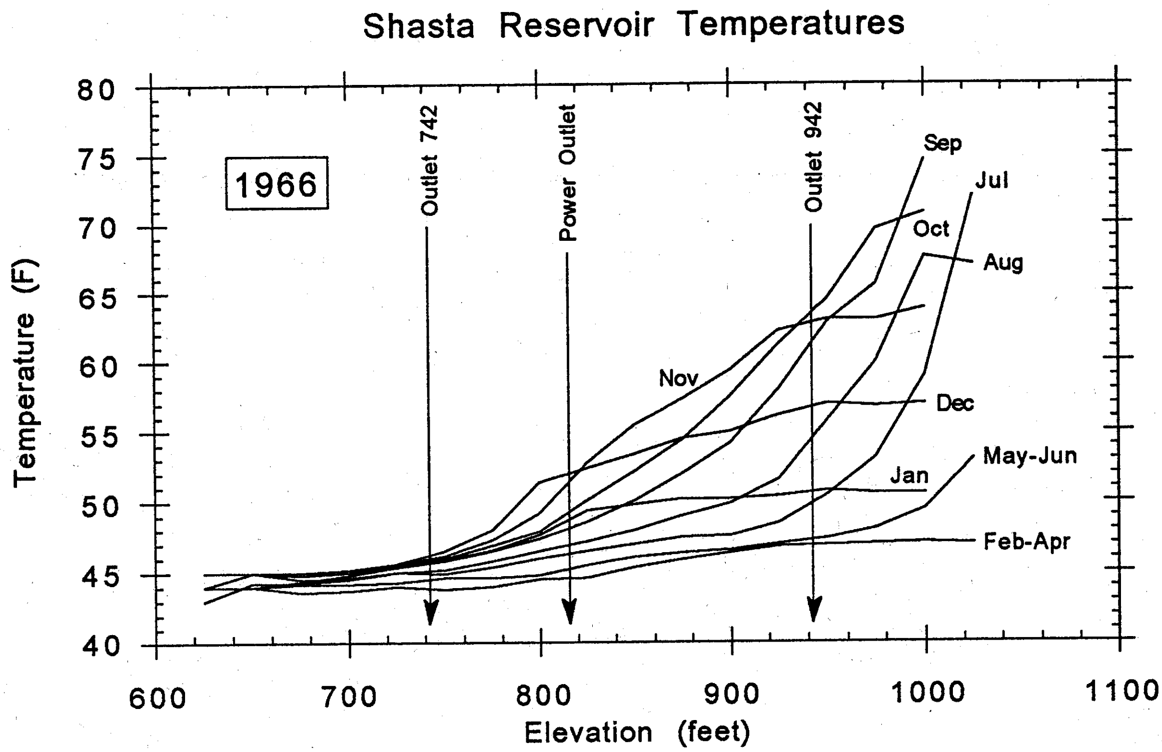
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Volumes, taf												
Reservoir Inflows	238	761	588	375	300	210	185	190	188	220	250	320
Low Bypass Release	0	0	0	0	0	0	84	219	406	190	0	0
Powerplant Release	197	137	163	89	125	296	360	210	0	10	143	127
High Outlet Release	0	0	0	45	125	99	0	0	0	0	0	0
Total Shasta Release	197	137	163	133	250	395	445	429	406	200	143	127
Spring Cr. Transfers	0	33	81	60	100	100	102	40	0	20	70	83
Cottonwood Cr. Accretions	70	55	59	28	88	51	50	40	71	30	81	315
Temperatures, °F												
Reservoir Inflows	42.5	44.8	46.9	49.6	54.4	61.1	67.2	65.9	61.5	54.6	48.8	43.1
Spring Cr. Transfers	44.0	44.2	45.7	47.2	49.8	54.0	57.7	60.1	—	61.9	56.7	49.7
Cottonwood Cr. Accretions	44.0	47.4	52.0	56.3	61.5	68.6	75.3	74.2	68.8	61.7	53.5	46.5
Average Air Temperature	44.7	48.6	51.5	58.6	65.7	73.9	82.0	80.5	75.1	64.5	51.7	46.8

These volumes and temperatures are those used in the Reclamation April 1992 Forecast. They were extracted from the simulation output and computer program listings obtained from Reclamation under a Freedom of Information Act request. These values were used without change in simulations of the effects of carryover storage on river temperatures. In simulations of the effects of annual Shasta releases, the values for releases from different outlets were changed.

Table 2. Values of carryover storage used in simulations

Carryover Storage, taf (Sept. 30)	January 1 Storage, taf (used in simulations)
1,200	1,302
1,600	1,700
1,900	2,000
2,400	2,500
3,100	3,200

Values for storage on January 1 are those used in the simulations, which ran from January through December rather than by water year. The top value, 1,302 taf, was used in the April 1992 Forecast. The equivalent values for carryover storage were obtained from the observation that, on average, January storage is about 100 taf greater than September 30 storage.



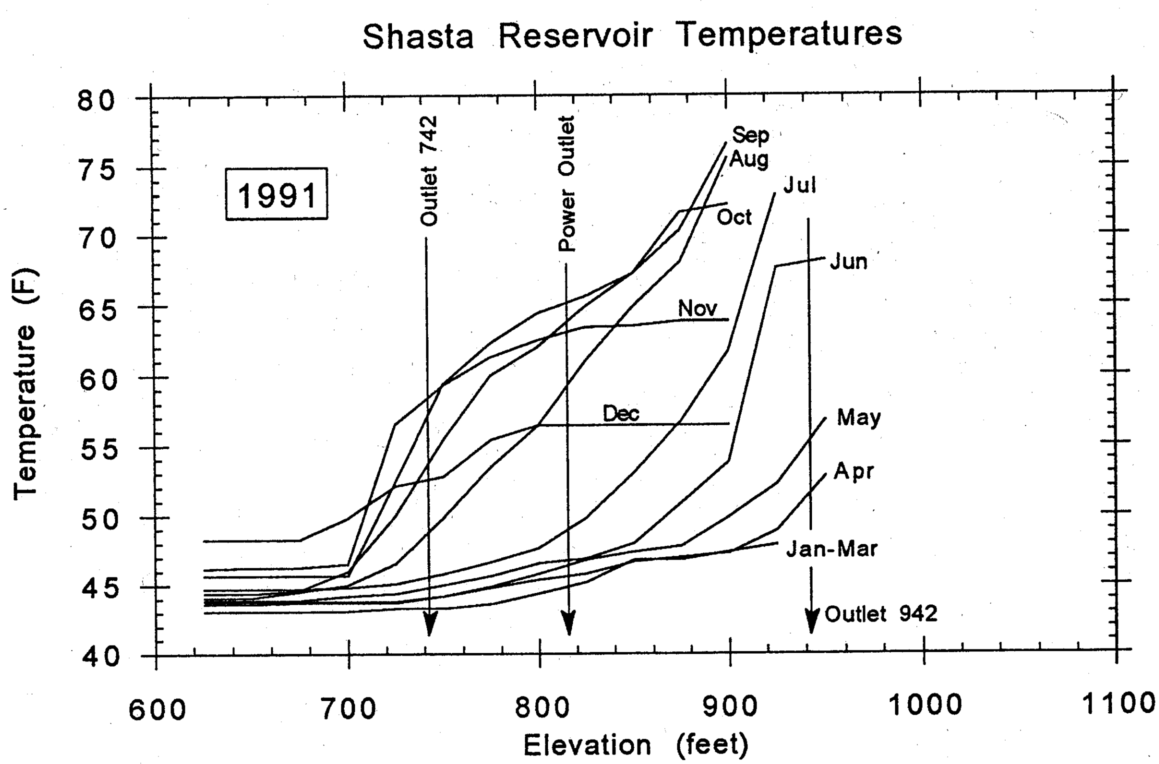


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Figure 1. Observed reservoir temperature profiles.
Observations made near the beginning of each month. 1966 was a wet year and 1991 was critically dry.

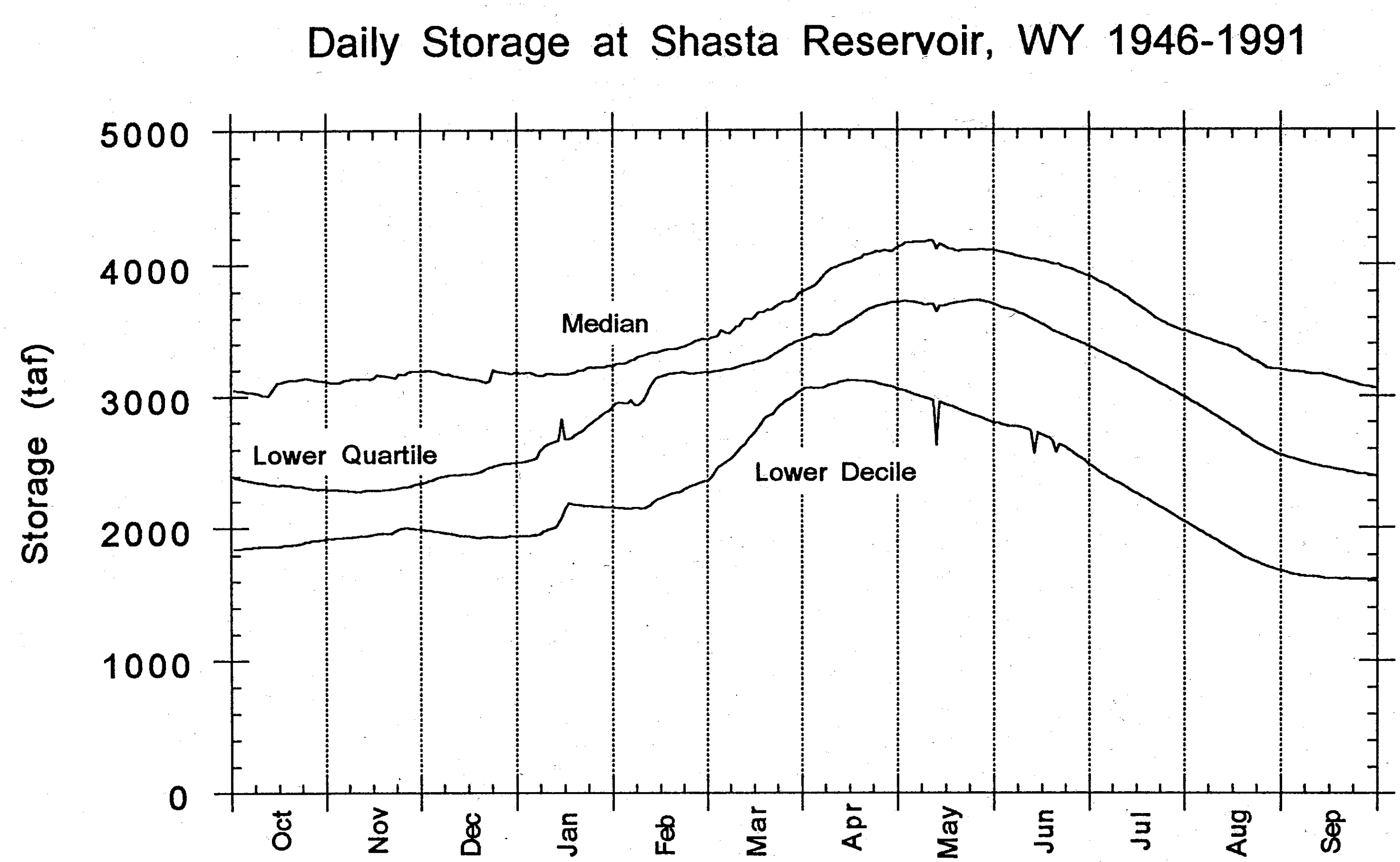

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Figure 2. Observed daily storage at Shasta Reservoir.
Separate curves represent median, lower quartile, and lower decile storage values derived from daily observations for water years 1946-1991.

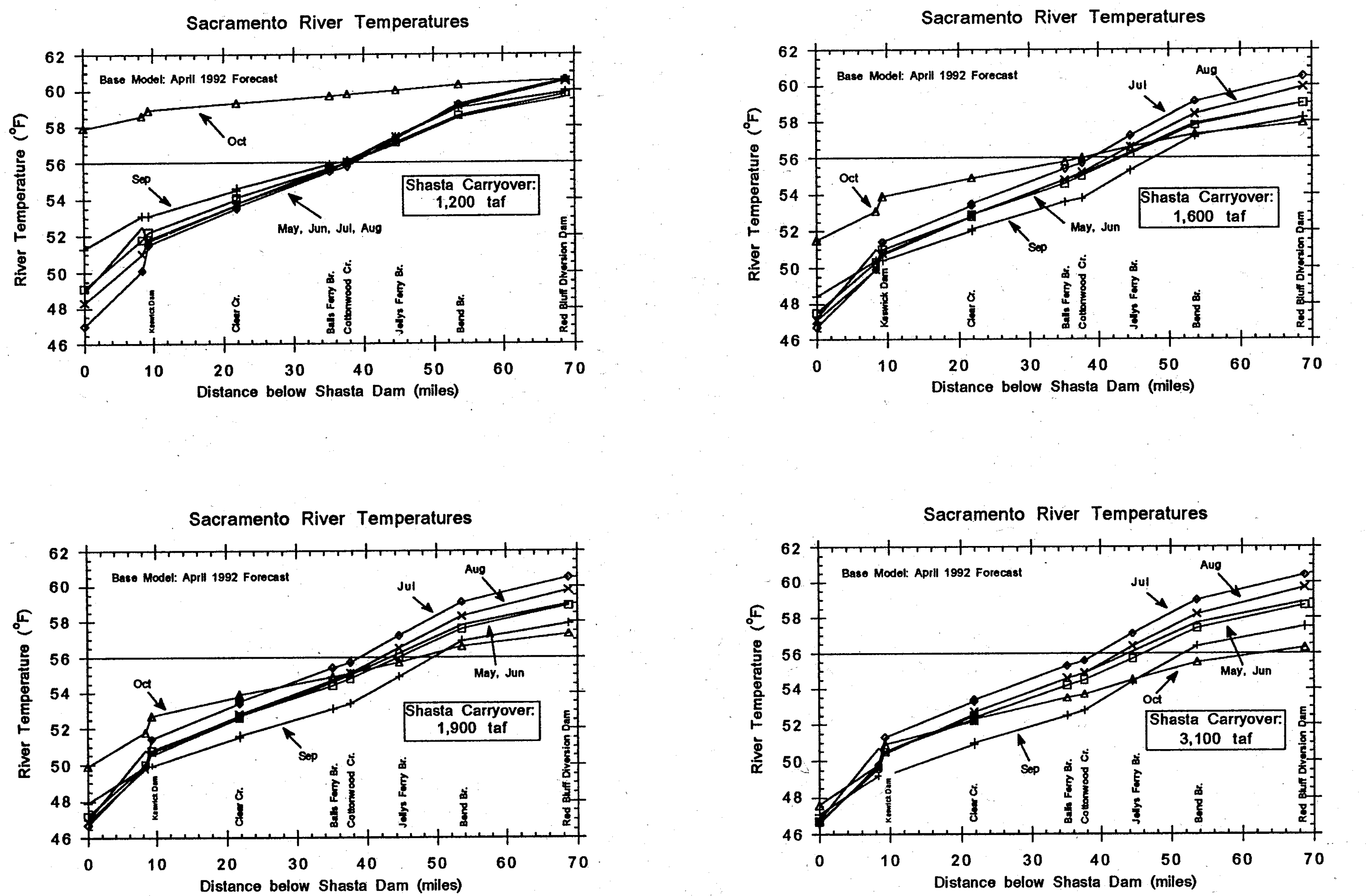

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Figure 3. Simulated temperatures downstream of Shasta Dam. Monthly average temperatures are estimated at different points on the Sacramento for four different values of carryover storage, using the Reclamation April 1992 Forecast as the base model.

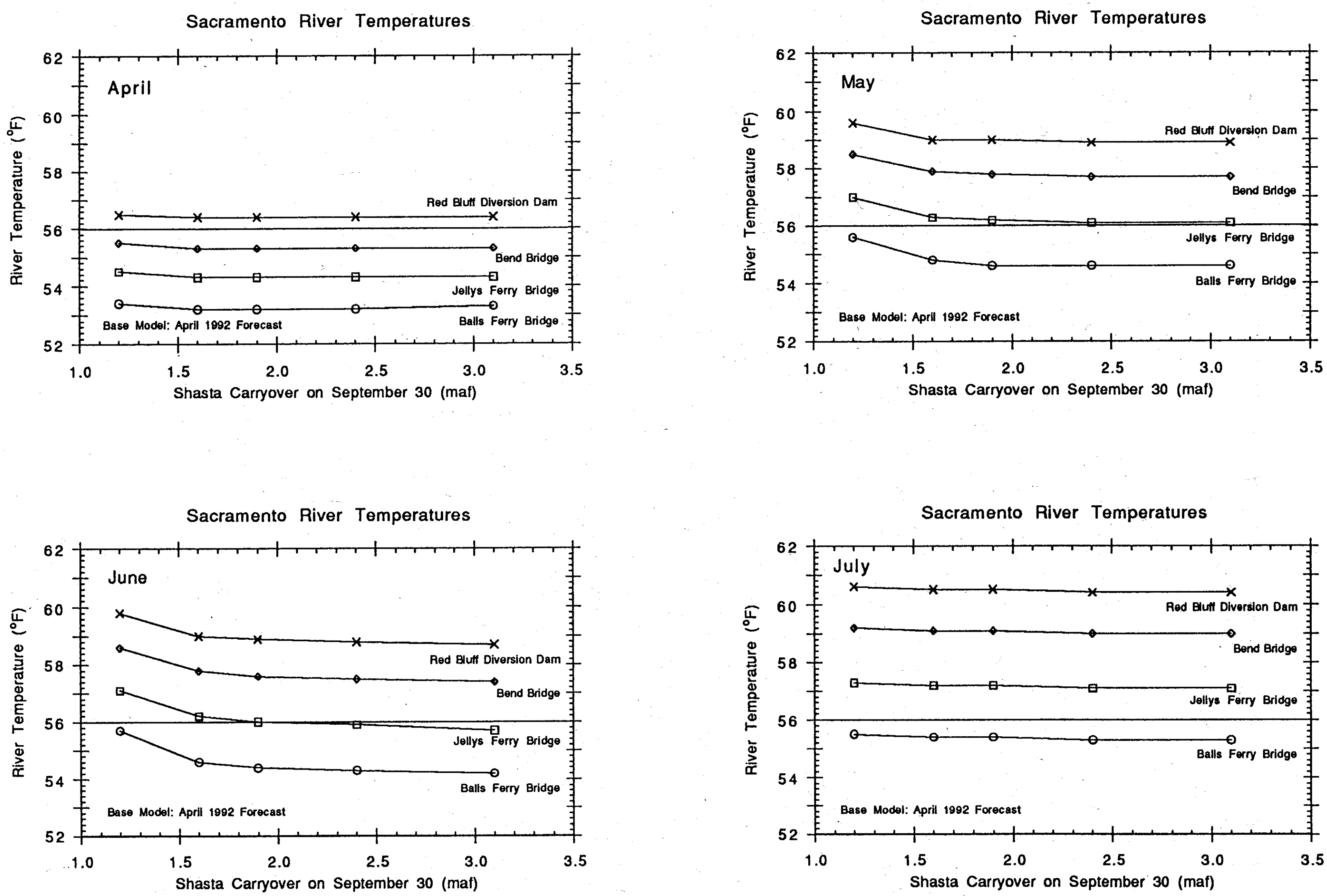

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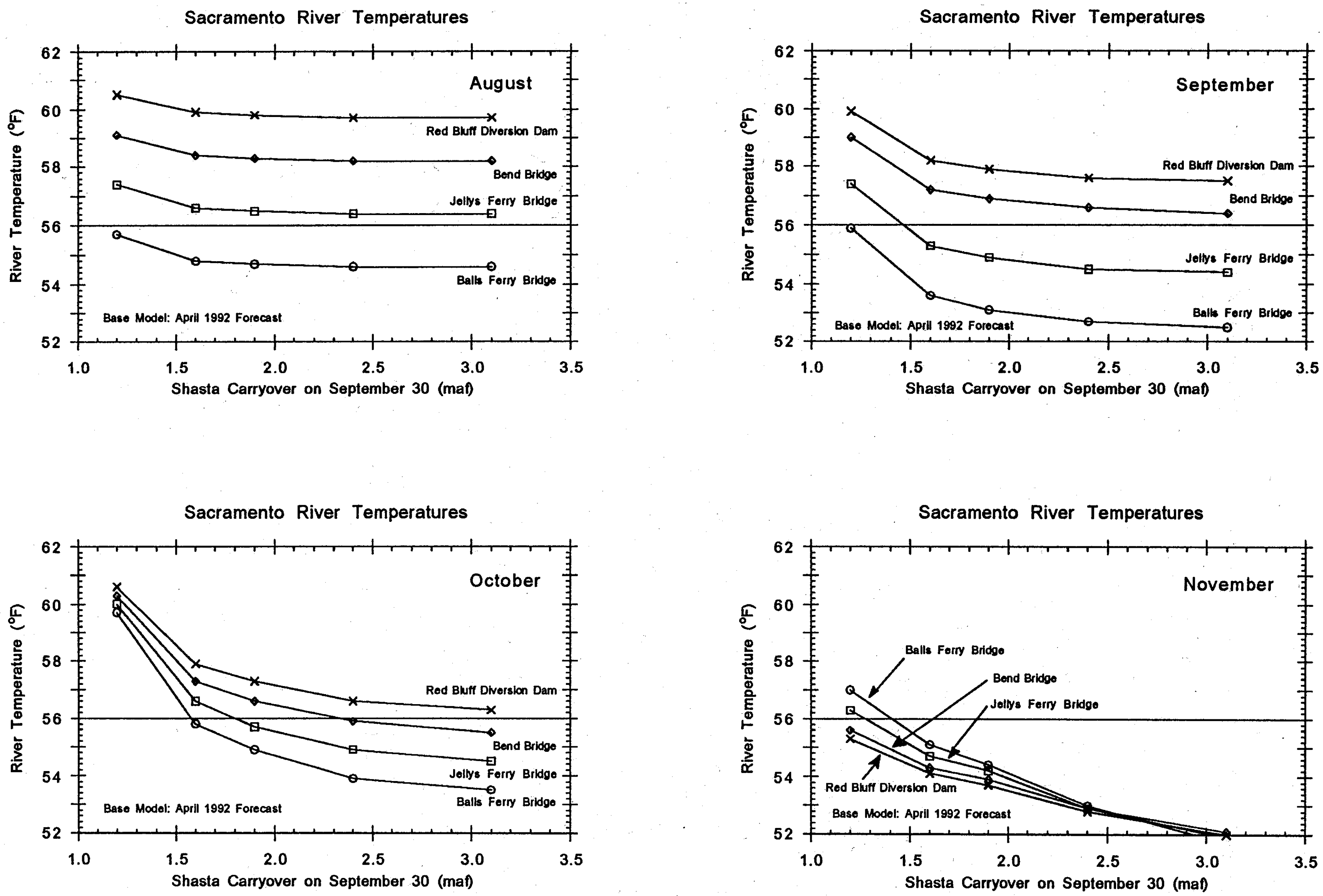
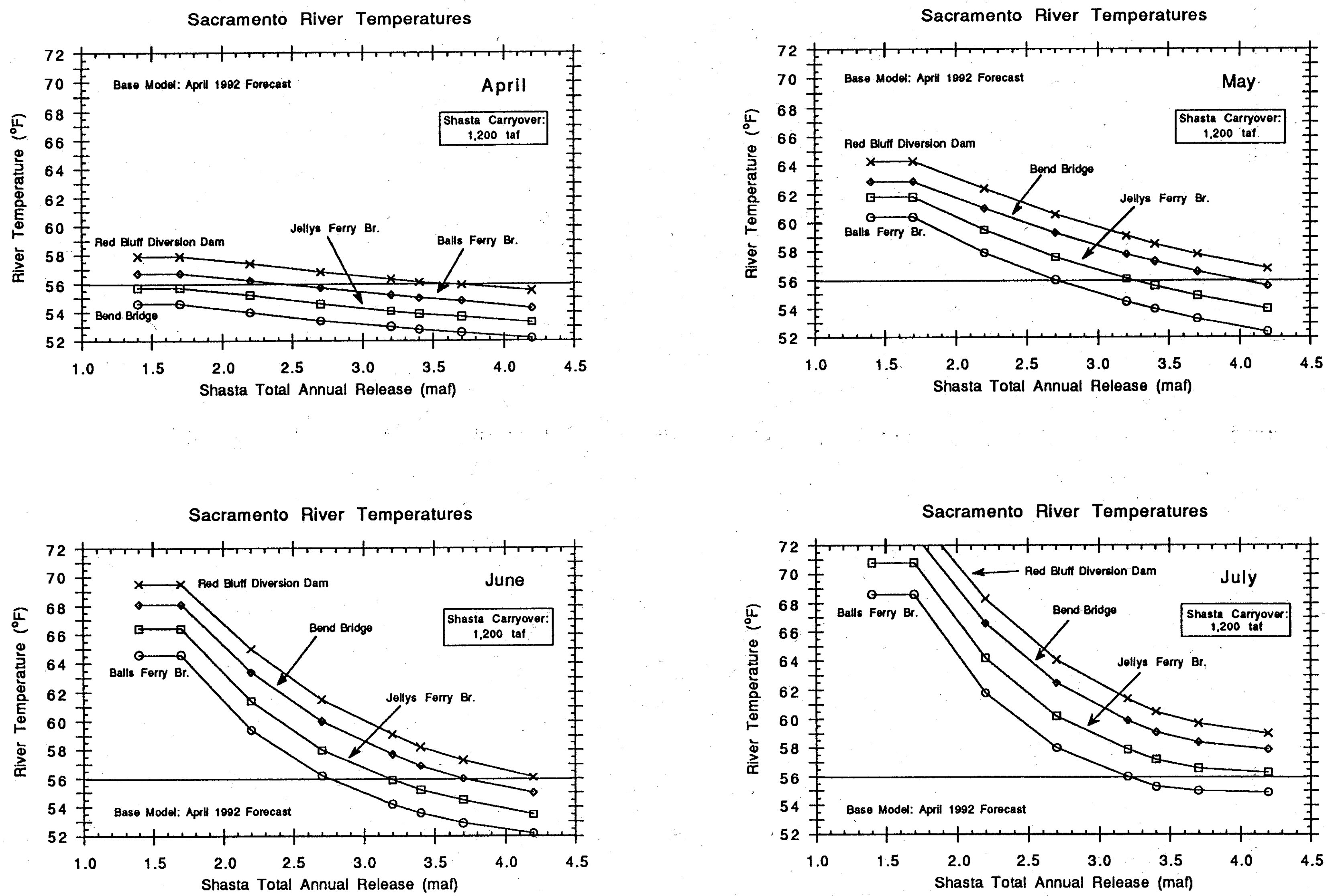
Figure 4. Simulated temperatures as a function of Shasta carryover. Average monthly temperatures at different compliance points, using the Reclamation April 1992 Forecast as the base model. (Continued on next page.)



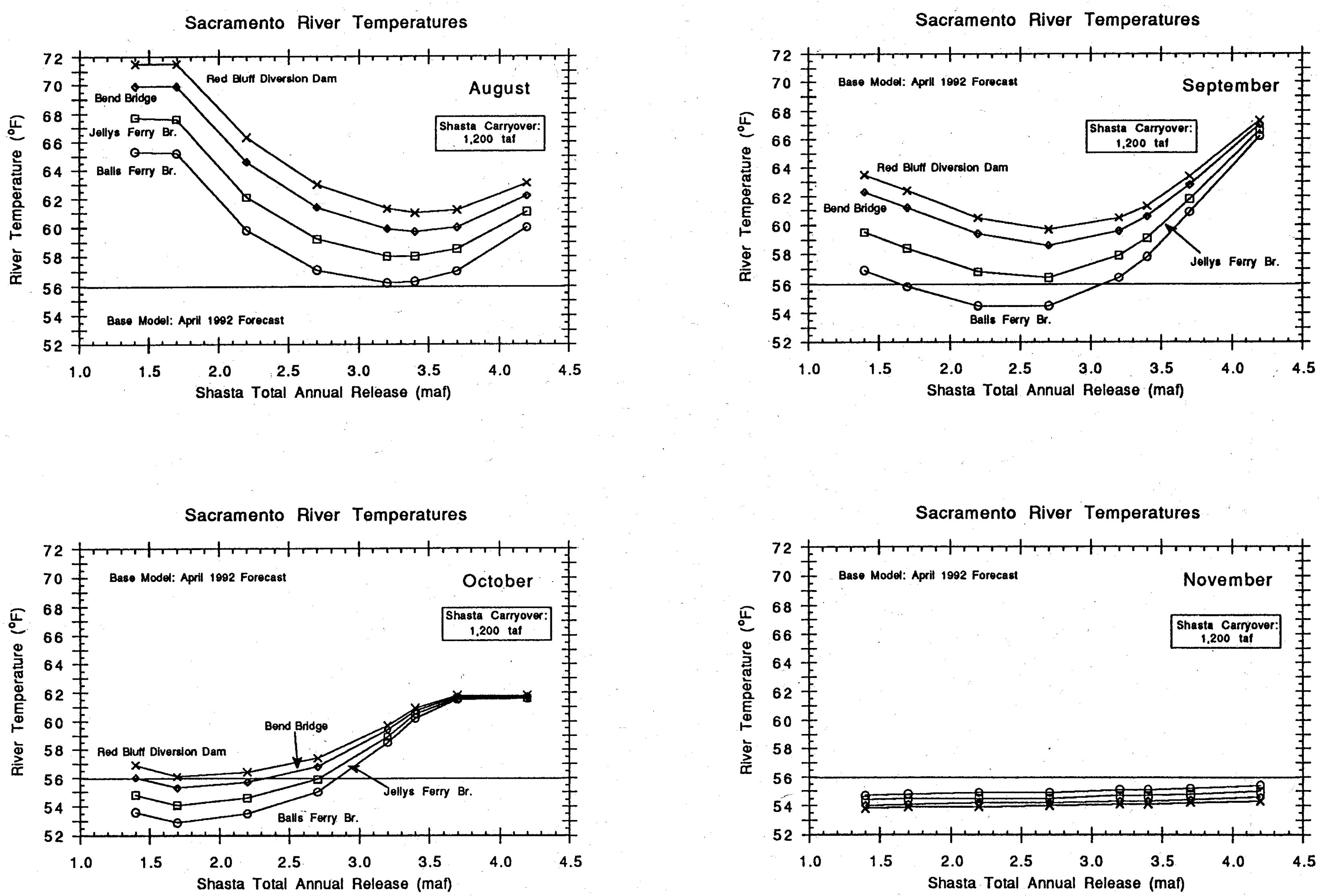
Balance Hydrologics,Inc.

Figure 4 (continued).



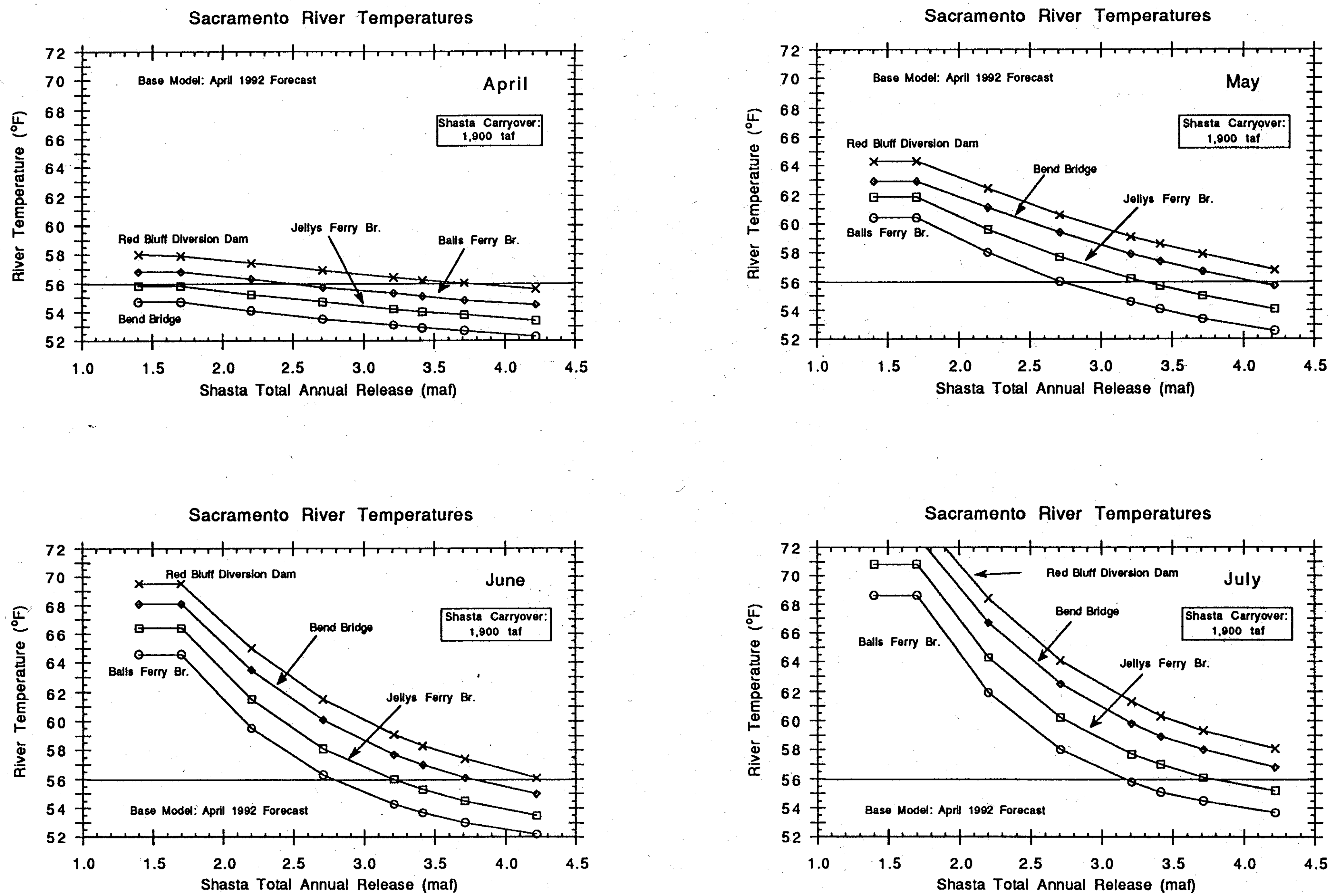
Balance Hydrologics, Inc.

Figure 5. Simulated temperatures as a function of total annual Shasta releases for 1,200 taf carryover storage.
Average monthly temperatures at different compliance points, using the Reclamation April 1992 Forecast as the base model. Total annual release in the base model is 3,025 taf. (Continued on the next page.)



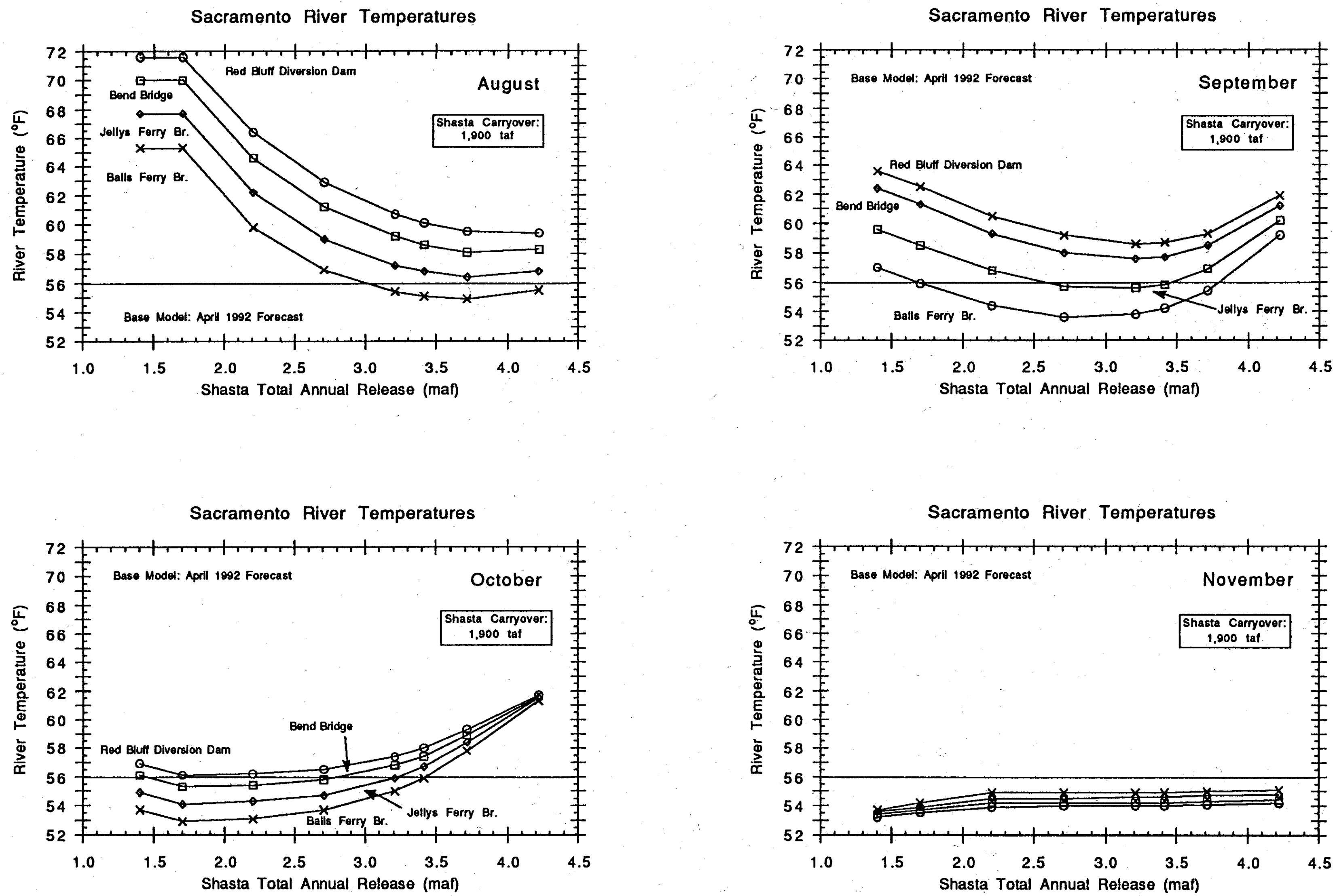
Balance Hydrologics, Inc.

Figure 5 (continued).



Balance Hydrologics, Inc.

Figure 6. Simulated temperatures as a function of total annual Shasta releases for 1,900 taf carryover storage.
Average monthly temperatures at different compliance points, using the Reclamation April 1992 Forecast as the base model. Total annual release in the base model is 3,025 taf. (Continued on the next page.)



Balance Hydrologics, Inc.

Figure 6 (continued).

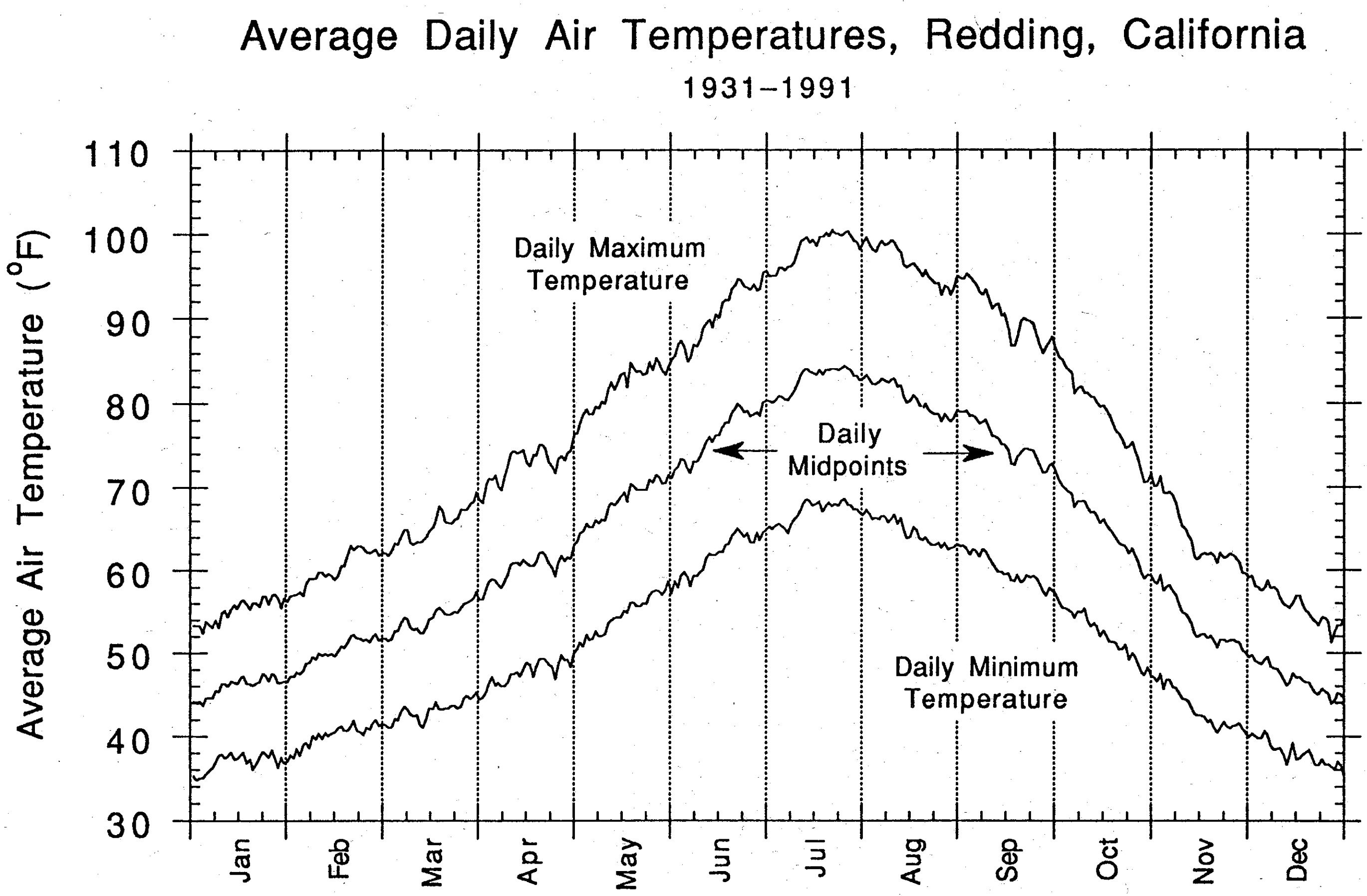


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Figure 7. Daily average air temperatures at Redding, California. Data obtained from U.S. Geological Survey database, for the years 1931-1991. Averages for each day were calculated using all the years.

Appendix A

The Reclamation Model and Computer Programs

Appendix A

The Reclamation Model and Computer Programs

Reclamation employs a computer model (Reclamation, 1990) to simulate the effects of natural conditions and operational decisions on Sacramento River temperatures in the critical salmon spawning reaches. This results of these simulations are used, in part, for setting both long-term and monthly operations of the Shasta Division of the CVP (CVP-OCAP, 1992). Reclamation has also presented simulations to explain where and when river temperature objectives are exceeded in actual operations. We also have used this software in our evaluation of carryover storage needs, so the software and its limitations are described below.

A.1 Software Description

There are two important computational components to the Reclamation software: the reservoir temperature model and the river temperature model. The reservoir model estimates temperature stratification in one dimension, that is, it assumes that the temperature at any particular level below one geographic point is the same for that level everywhere else in the reservoir. The temperatures are obtained by estimating thermal energy gains and losses from solar radiation, atmospheric interactions, water inflows and outflows, and mixing and diffusion between reservoir levels. Releases through different outlets can be assigned automatically by the program to meet release temperature specifications, or can be set at fixed values. The program operates on monthly average values of all parameters.

The reservoir model was provided by the Hydraulic Engineering Center of the Army Corps of Engineers in 1972. It was written in the Fortran programming language to run on mainframe computers of that time.

The river temperature model performs two functions: it calculates flow-weighted average temperatures at points where flows mix, and it calculates warming or cooling in reaches between mixing points. Factors influencing the calculations include climatic parameters (air temperature, solar radiation, relative humidity, wind speed, cloud cover, solar altitude, solar reflectivity, and river shading), river flow rate, and surface area of each reach. The latter factor changes with flow rate. The warming model assumes both steady state flow and slug flow. Regulating reservoirs like Keswick are treated as stream reaches.

Simulation of Sacramento River temperatures requires that the reservoir temperature model be run three times, for Clair Engle, Whiskeytown and Shasta reservoirs, followed by the Sacramento River temperature model. In practice, Reclamation has modified the Army Corps of Engineers reservoir program to create two versions, one of which is used for the Trinity Division of the CVP to account for heating in Lewiston Reservoir, releases to the Trinity River, and transfers to the Sacramento River via Whiskeytown Reservoir and Spring Creek Powerhouse. The other version is used for Shasta Lake and heating in Keswick Reservoir before mixing with Trinity transfers and release to the Sacramento River.

For temperature estimates for the entire length of the Sacramento River below Keswick Reservoir, additional computations must be made for major tributaries and any reservoirs on those tributaries. A single run of the temperature models requires a great deal of file manipulation on mainframe computers. Each program requires a lot of data; the river temperature program requires data generated by the reservoir temperature programs. For the Shasta and Trinity Divisions alone, 27 magnetic tapes are used in each run.

The reservoir and river temperature models are described, along with their verification, in a draft report (Reclamation, 1990). Additionally, we received copies of the computer program source code files along with input data and output results for the April 1992 Forecast, through a Freedom of Information Act request filed by the Sierra Club Legal Defense Fund. SCLDF informs us that they have not been advised of any verification changes to the computer codes, nor of any changes in the codes subsequent to the April 1992 Forecast.

Comparison of these documents and files revealed that alterations have been made to the computer programs used in the April 1992 Forecast that could change the river temperature estimates from those done by methods documented and verified by Reclamation (1990). Judging from the format of the printouts, all of the river temperature simulations presented in the 1992 CVP-OCAP were likely run using the modified programs as well.

One of the changes was removal of all code for estimation of river temperatures below Red Bluff Diversion Dam. This modification should not affect river temperature estimates above that point. There are three other changes in the Sacramento River temperature model, however, that could change temperature estimates and have not been tested for accuracy and verified.

First, accretions from several tributaries in the reach from Keswick Dam to Red Bluff Diversion Dam were removed from the program. These include Cow Creek, Battle Creek and Paynes

Creek. Accretions from the largest tributary, Cottonwood Creek, have been retained. On average, these three omitted tributaries contribute a total of 300 to 700 cfs to the Sacramento River from June through October. Water in small tributaries tends to get very warm in the summer, so effects on the Sacramento River, which is operated at or above the 56 °F temperature objective, could be significant.

Second, the way in which the program calculates surface areas of reaches as flows change was modified. Reach surface areas are important in the river heating calculations. We do not know the significance of the changes on temperature calculations, but they differ from the verified model.

Third, whereas the verified program divided the river between Keswick Dam and Red Bluff Diversion Dam into 23 separate reaches and calculated heating functions in each of them, the program used in the April 1992 Forecast and all the models in the 1992 CVP-OCAP divided the same river segment into only two reaches, split at Cottonwood Creek, then approximated the thermal effects in two subreaches of each reach by an area-weighting scheme. Again, we do not know the effects of these changes on temperature calculations, but they have not been verified.

We suspect that the changes were made to the original, verified model because it is too cumbersome for routine use. More than 40 magnetic tapes must be mounted and dismounted for each computer run. The modified program reduces the use of magnetic tapes and, by eliminating calculations downstream of Red Bluff Diversion Dam, also reduces the CPU processing time of each run. Because of these modifications, however, the river temperature simulations made for the April 1992 Forecast and the 1992 CVP-OCAP should be regarded as presently unverified.

A.2 Porting of the Program for Use on Microcomputers

We do not have access to the Reclamation computers for running the Sacramento River temperature simulations. It was not our intention at the beginning of this task to run any simulations, and certainly not to convert the programs to run on any other computer. Our inability to separate out the effects of carryover storage from all the other operational parameters that affect Sacramento River temperatures, however, left us with the choice of abandoning the project or of attempting to run the Reclamation programs on computers accessible to us.

The program source code files obtained from Reclamation were on a floppy disk in MS-DOS format. All files on the floppy disk were dated April 30, 1992. They included:

TRINO	Fortran source code for Program C095, modified (by Reclamation?) for simulating temperatures in Clair Engle, Lewiston and Whiskeytown Reservoirs;
TRINTP	Fortran source code for Program TRINTP, for simulating Trinity River temperatures;
SHAS1	Fortran source code for Program C095, modified (by Reclamation?) for simulating temperatures in Shasta and Keswick Reservoirs;
USRTMCT	Fortran source code for Program USRTEMP, for simulating Sacramento River temperatures and printing of Trinity River temperatures.

Supporting data files, a batch job submittal file for the Reclamation computer system, input files as used for the April 1992 Forecast, and a text file showing program output for the April 1992 Forecast were also supplied.

We translated the files into Macintosh format for use on a Macintosh PowerBook 170. A text editor was used to remove line-feed characters, which are not used by the Macintosh operating system. The batch-job submittal file was examined to learn the sequence for use of data files and program files.

The program source code files were studied to understand program functioning and data input/output (I/O) requirements. All I/O computer instructions were changed to access files on hard disk instead of magnetic tape. Output that was directed to a printer in the original code was redirected to disk files as well. Each of the four stand-alone programs was converted into a subroutine, and a new program was written to call each subroutine in the sequence that had been determined from the batch-job submittal file.

The modified source code files were compiled and linked using the Absoft MacFortran 2.4 compiler on the Macintosh PowerBook 170, creating a single executable program, named SacTrin, with exactly the same numerical code as the Reclamation simulation, in exactly the same order. When Program SacTrin is run using the April 1992 Forecast input file obtained from Reclamation, temperatures and other estimates are identical to the printout supplied by Reclamation.

After this verification, we made one addition to the Reclamation model. Code was added to calculate Sacramento River temperatures at two additional control points: Balls Ferry Bridge and Jellys Ferry Bridge. These temperatures were calculated as the reach-length weighted averages of temperatures at the adjacent control points in the original Reclamation model.

A printout of the output of Program SacTrin for the April 1992 Forecast follows, for comparison to the output for the same model obtained from Reclamation (Appendix B). Except for the added control points, the outputs are identical.

```
1
                    CLAIR ENGLE LAKE TEMPERATURE PREDICTIONS
                      OPERATIONAL TEMPERATURE CONTROL STUDY
          APRIL 1992 FORECAST - MOST PROBABLE  (December 1992 by Balance Hydrologics, Inc.)
0THE OUTPUT UNITS ON INFLOW AND OUTFLOW ARE IN CFS, EVAP AND PRECIP IN INCHES, STORAGE IN AF, AND TEMPERATURE IN DEGREES F

    NYR     IYR    NPER    IPER   MSTRT   NLAYR   LAYER   NOUTL   NMINQ   IDERV   METRC   IDGST     NIC     NIT    NOTL   INTER
      1    1992      12       1       1      89       5       4       2       0       0       0       1       0       1      10
   MREL     NMO
      0       3

    STORA     CISA      COSA   STRMX   STRMN      TIN    TAIR     EVAP    PRCP    QMIN    TMAX    TMIN   CSOUT    SOLR     DEP
  540300.-1000.000-1000.0002750000.       0.      -1.     -1.    -1.00   -1.00     -1.     -1.     -1.    .504     -1.   32.81
0       AIR TEMP COEF    INFLO MIXING COEF        DIFFUSION COEF        EVAP HEAT COEF       INSOLATION COEF
            .130                .143                   .011                  .591                  .353

 QOMIN=      -3.0      -1.0      -3.0      -1.0

 STCAP=       34.      135.      332.      670.     1180.     1894.     2858.     4131.     5709.     7572.
            9772.    12373.    15350.    18661.    22343.    26436.    30935.    35832.    41177.    47023.
           53372.    60220.    67590.    75503.    83948.    92906.   102515.   112929.   124146.   136155.
          148879.   162231.   176197.   190764.   205933.   221704.   238215.   255615.   273850.   292859.
          312631.   333151.   354442.   376526.   399523.   423559.   448632.   474737.   501769.   529611.
          558432.   588413.   619492.   651603.   684978.   719868.   756079.   793406.   831913.   871671.
          912729.   955140.   998904.  1044021.  1090567.  1138623.  1188236.  1239455.  1292413.  1347253.
         1403878.  1462182.  1522106.  1583586.  1646673.  1711416.  1777740.  1845564.  1915058.  1986396.
         2059404.  2133898.  2209810.  2287070.  2366177.  2447654.  2531322.  2616989.  2704308.

 TSTRT=      44.0      44.0      44.0      44.0      44.0      44.0      44.0      44.0      44.0      44.0
             44.0      44.0      44.0      44.0      44.0      44.0      44.0      44.0      44.0      44.0
             45.0      45.0      45.0      45.0      45.0      45.0      45.0      45.0      45.0      45.0
             45.0      45.0      45.0      45.0      45.0      45.0      45.0      45.0      45.0      45.0
             45.0      45.0      45.0      45.0      45.0      45.0      45.0      45.0      45.0      45.0
             46.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0
             -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0
             -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0
             -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0

 STOUT=    12372.    12373.   190764.   190765.

                                            RESERVOIR TEMPERATURES
 YEAR  PER     1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16    17    18    19    20
 1992    1  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.1  44.1  44.1  44.2  44.2
            44.6  44.7  44.7  44.7  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8
            44.8  44.8  44.8  44.9  45.2  45.6  46.0  46.4  46.8  47.0  47.0
 1992    2  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.1  44.1  44.1  44.2  44.2  44.3
```

		44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.5	44.5	44.5	44.5	44.5	44.5
		44.5	44.5	44.5	44.5	44.5	44.6	44.7	44.9	45.3	46.0	47.0	47.9	48.8	49.5	49.7					
1992	3	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.1	44.1	44.1	44.2	44.2	44.2	44.3
		44.3	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.5	44.5	44.5	44.5	44.5	44.5
		44.5	44.5	44.6	44.6	44.7	44.7	44.9	45.0	45.2	45.4	45.5	45.8	46.6	47.8	49.3	50.8	52.1	53.0	53.3	
1992	4	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.1	44.1	44.1	44.1	44.2	44.2	44.2	44.3
		44.3	44.3	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.5	44.5	44.5	44.6	44.6	44.6	44.7
		44.7	44.8	44.9	45.0	45.1	45.3	45.4	45.6	45.8	46.1	46.2	46.4	46.6	46.8	47.1	47.9	49.1	50.6	52.0	53.3
		54.2	54.6																		
1992	5	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.1	44.1	44.1	44.1	44.1	44.2	44.2	44.2	44.2	44.3
		44.3	44.3	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.5	44.5	44.5	44.5	44.8	44.9	45.0	45.1	45.2	45.3
		45.4	45.6	45.7	45.9	46.1	46.3	46.5	46.7	47.0	47.3	47.7	48.2	48.8	49.3	49.8	50.1	50.6	51.7	53.3	55.1
		56.9	58.4	59.4	59.7																
1992	6	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.1	44.1	44.1	44.1	44.1	44.1	44.2	44.2	44.2	44.3	44.3
		44.3	44.3	44.4	44.4	44.4	44.4	44.4	44.4	44.5	44.5	44.6	44.6	44.7	44.8	46.2	46.3	46.5	46.7	46.9	47.1
		47.3	47.6	47.9	48.3	48.7	49.1	49.6	50.1	50.7	51.5	52.5	53.8	55.4	57.2	59.0	60.5	61.9	63.6	65.1	66.3
		66.9	66.9																		
1992	7	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.1	44.1	44.1	44.1	44.2	44.6	44.6	44.7	44.7	44.7	44.8	44.8	44.9
		45.0	45.2	45.4	45.6	45.9	46.1	46.3	46.5	46.7	46.9	47.1	47.3	47.5	47.8	48.1	48.3	48.6	48.9	49.3	49.7
		50.2	50.7	51.3	52.0	52.9	53.9	55.0	56.3	57.7	59.3	61.1	63.2	65.2	66.9	68.4	69.8	70.9	71.5		
1992	8	44.0	44.0	44.0	44.0	44.1	44.1	44.1	44.2	44.2	44.3	44.4	44.5	46.2	46.3	46.4	46.5	46.6	46.6	46.7	46.8
		46.9	47.1	47.2	47.3	47.5	47.6	47.8	48.0	48.2	48.4	48.6	48.9	49.2	49.5	49.9	50.3	50.7	51.3	51.8	52.5
		53.3	54.1	55.1	56.2	57.4	58.7	60.1	61.7	63.4	65.3	67.1	68.7	69.9	71.0	71.8	72.2				
1992	9	44.0	44.0	44.1	44.1	44.1	44.2	44.3	44.4	44.5	44.7	44.9	45.2	46.9	47.0	47.1	47.1	47.2	47.3	47.4	47.5
		47.6	47.7	47.9	48.0	48.2	48.4	48.5	48.8	49.0	49.2	49.5	49.9	50.2	50.6	51.1	51.6	52.2	52.8	53.5	54.3
		55.2	56.2	57.3	58.5	59.7	61.0	62.4	63.8	65.1	66.1	66.8	67.3	67.6	67.7	67.7	67.7				
1992	10	44.0	44.1	44.1	44.2	44.3	44.4	44.5	44.7	44.9	45.1	45.4	45.7	47.2	47.3	47.4	47.5	47.6	47.7	47.8	47.9
		48.0	48.2	48.3	48.5	48.7	48.9	49.1	49.3	49.6	49.9	50.2	50.6	51.0	51.5	52.0	52.6	53.2	53.9	54.7	55.5
		56.5	57.5	58.5	59.6	60.7	61.7	62.6	63.5	64.2	64.4	64.4	64.4	64.4	64.4	64.4					
1992	11	44.1	44.2	44.3	44.4	44.5	44.6	44.8	45.0	45.2	45.5	45.8	46.1	46.9	47.1	47.3	47.5	47.6	47.7	47.9	48.0
		48.1	48.3	48.4	48.6	48.8	49.0	49.2	49.4	49.7	50.1	50.4	50.8	51.3	51.8	52.8	53.5	54.1	54.9	55.6	56.3
		56.9	57.5	58.1	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2				
1992	12	44.1	44.3	44.4	44.6	44.7	44.8	45.0	45.2	45.5	45.7	46.0	46.3	46.8	47.0	47.2	47.4	47.6	47.7	47.9	48.0
		48.2	48.3	48.5	48.7	48.9	49.1	49.3	49.6	49.9	50.3	50.7	51.2	51.7	52.2	53.3	53.4	53.4	53.5	53.5	53.5
		53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5						

FLOWS AND TEMPERATURES FOR 1992

	YEAR	1	2	3	4	5	6	7	8	9	10	11	12
INFLO	1357.0	484.7	2814.3	2789.2	3445.1	3252.7	1512.5	406.6	195.2	168.1	178.9	369.7	666.8
EVAP	4.3	.4	.5	1.6	4.7	6.1	7.0	9.2	8.5	7.0	3.5	1.8	1.1
PRCP	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
OUTFL	1165.1	372.4	336.7	535.1	1235.2	1954.9	3302.3	2288.3	1292.9	556.3	289.5	273.9	1543.4
REQDQ	1165.1	372.4	336.7	535.1	1235.2	1954.9	3302.3	2288.3	1292.9	556.3	289.5	273.9	1543.4
STMX		2750000.	2750000.	2750000.	2750000.	2750000.	2750000.	2750000.	2750000.	2750000.	2750000.	2750000.	2750000.
STOR		546984.	684340.	821969.	950246.	1025604.	913969.	792166.	719403.	692238.	683403.	688085.	633579.
STMN		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TA	54.2	40.0	43.3	45.9	50.9	58.2	65.6	71.7	70.5	64.1	55.9	44.3	39.8

TMPIN	43.4	36.7	40.3	40.3	41.3	43.8	54.2	60.7	62.2	61.1	52.1	41.3	37.7
TMPMX	67.3	80.0	80.0	80.0	80.0	80.0	80.0	40.0	40.0	40.0	40.0	80.0	80.0
TPOUT	46.1	44.9	44.6	44.5	44.5	44.6	45.4	44.7	45.2	46.5	47.0	52.4	53.7
TMPMN	67.3	80.0	80.0	80.0	80.0	80.0	80.0	40.0	40.0	40.0	40.0	80.0	80.0
TLEW		40.4	44.1	48.4	49.4	50.5	50.7	52.2	55.7	57.8	53.3	44.8	50.1
RELEASES THRU OUTLET 1													
QOMN		-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
QOUTL		.0	.0	.0	.0	.0	.0	587.1	587.1	541.1	289.5	.0	.0
TOUTL		.0	.0	.0	.0	.0	.0	44.4	45.3	46.5	47.0	.0	.0
RELEASES THRU OUTLET 2													
QOMN		.0	.0	.0	.0	.0	.0	1364.5	705.8	15.1	.0	.0	.0
QOUTL		.0	.0	.0	.0	.0	.0	1364.5	705.8	15.1	.0	.0	.0
TOUTL		.0	.0	.0	.0	.0	.0	44.3	45.2	46.5	.0	.0	.0
RELEASES THRU OUTLET 3													
QOMN		-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
QOUTL		365.9	333.1	317.1	299.1	300.9	1657.0	.0	.0	.0	.0	200.0	300.9
TOUTL		44.9	44.6	44.5	44.5	44.6	45.4	.0	.0	.0	.0	52.4	53.7
RELEASES THRU OUTLET 4													
QOMN		6.5	3.6	217.9	936.1	1654.0	1645.3	336.7	.0	.0	.0	73.9	1242.5
QOUTL		6.5	3.6	217.9	936.1	1654.0	1645.3	336.7	.0	.0	.0	73.9	1242.5
TOUTL		44.9	44.6	44.5	44.5	44.6	45.4	46.9	.0	.0	.0	52.4	53.7

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1
                                WHISKEYTOWN LAKE TEMPERATURE PREDICTIONS
                                OPERATIONAL TEMPERATURE CONTROL STUDY
                 APRIL 1992 FORECAST - MOST PROBABLE  (December 1992 by Balance Hydrologics, Inc.)
0THE OUTPUT UNITS ON INFLOW AND OUTFLOW ARE IN CFS, EVAP AND PRECIP IN INCHES, STORAGE IN AF, AND TEMPERATURE IN DEGREES F

    NYR     IYR    NPER    IPER   MSTRT   NLAYR   LAYER   NOUTL   NMINQ   IDERV   METRC   IDGST     NIC     NIT    NOTL   INTER
      1    1992      12       1       1      53       5       2       1       0       0       1       1       1       0      10
   MREL     NMO
      0       3

   STORA      CISA      COSA    STRMX    STRMN      TIN     TAIR     EVAP     PRCP     QMIN     TMAX     TMIN    CSOUT     SOLR      DEP
 147500.-1000.000-1000.000 274389.       0.      -1.      -1.    -1.00    -1.00      -1.      80.      40.     .504      -1.    32.81
0    AIR TEMP COEF     INFLO MIXING COEF       DIFFUSION COEF        EVAP HEAT COEF       INSOLATION COEF
         .489                 .160                  .037                  .281                  .000

 QOMIN=      -3.0      -1.0

 STCAP=        1.        3.        6.       13.       27.       52.       89.      145.      227.      343.
             501.      714.      994.     1351.     1797.     2356.     3055.     3901.     4898.     6064.
            7418.     8975.    10751.    12774.    15076.    17676.    20589.    23861.    27542.    31646.
           36185.    41191.    46701.    52723.    59265.    66340.    73960.    82126.    90837.   100107.
          109952.   120383.   131413.   143043.   155276.   168102.   181513.   195518.   210125.   225323.
          241096.   257450.   274389.

 TSTRT=      43.0      43.0      43.0      43.0      43.0      43.0      43.0      43.0      43.0      43.0
             43.0      43.0      43.0      43.0      43.0      43.0      43.0      43.0      43.0      43.0
             44.0      44.0      44.0      44.0      44.0      44.0      44.0      44.0      44.0      44.0
             44.0      44.0      44.0      44.0      44.0      44.0      44.0      44.0      44.0      44.0
             45.0      45.0      45.0      45.0      45.0      -1.0      -1.0      -1.0      -1.0      -1.0
             -1.0      -1.0      -1.0

 STOUT=       13.    17676.

                                           RESERVOIR TEMPERATURES
 YEAR  PER     1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16    17    18    19    20
 1992    1  43.0  43.0  43.1  43.1  43.3  43.3  43.3  43.3  43.3  43.4  43.4  43.4  43.4  43.5  43.5  43.6  43.6  43.7  43.8  43.8
            43.9  43.9  43.9  43.9  44.0  44.0  44.0  44.0  44.0  44.0  44.1  44.1  44.2  44.2  44.3  44.4  44.6  44.7  44.9  45.2
            45.5  45.7  45.9  46.0  46.1  46.1
 1992    2  43.2  43.3  43.4  43.5  43.7  43.7  43.8  43.8  43.8  43.8  43.8  43.8  43.8  43.8  43.8  43.8  43.9  43.9  43.9  43.9
            44.0  44.0  44.1  44.1  44.2  44.3  44.6  44.7  44.8  44.9  45.0  45.2  45.3  45.5  45.7  45.8  46.0  46.2  46.4  46.5
            46.6  46.7  46.8  46.9  47.1  47.3  47.4  47.5  47.6
 1992    3  43.4  43.6  43.7  43.8  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.1  44.1  44.1  44.2  44.2  44.3  44.4
            44.6  44.7  44.9  45.1  45.4  45.9  46.7  46.8  46.9  47.0  47.0  47.1  47.2  47.3  47.4  47.5  47.6  47.7  47.8  47.8
            47.9  48.0  48.2  48.5  48.8  49.1  49.3  49.5  49.6  49.6
 1992    4  43.6  43.9  44.0  44.1  44.5  44.5  44.5  44.5  44.5  44.5  44.6  44.6  44.7  44.7  44.8  44.9  45.0  45.1  45.3  45.4
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		45.7	45.9	46.1	46.4	46.7	47.2	48.0	48.1	48.2	48.3	48.4	48.6	48.7	49.0	49.2	49.5	49.8	50.1	50.4	50.8
		51.1	51.4	51.6	51.8	52.1	52.5	52.9	53.2	53.5	53.6	53.6									
1992	5	44.0	44.4	44.7	44.8	45.5	45.5	45.5	45.5	45.5	45.6	45.6	45.7	45.7	45.8	45.9	46.0	46.2	46.4	46.6	46.9
		47.2	47.6	48.1	48.5	49.1	50.2	52.1	52.3	52.5	52.6	52.8	53.1	53.3	53.5	53.8	54.1	54.3	54.6	54.8	55.0
		55.1	55.2	55.5	55.9	56.6	57.6	58.5	59.3	59.9	60.3	60.6									
1992	6	44.6	45.3	45.7	45.9	47.0	47.0	47.0	47.0	47.1	47.1	47.2	47.3	47.4	47.6	47.7	48.0	48.2	48.5	48.9	49.4
		49.9	50.5	51.2	51.9	52.7	54.0	56.1	56.2	56.3	56.5	56.7	56.9	57.1	57.3	57.5	57.7	57.9	58.1	58.3	58.4
		58.6	58.9	59.4	60.1	61.2	62.6	63.9	65.0	65.9	66.6	67.0									
1992	7	45.7	46.8	47.4	47.8	49.4	49.5	49.5	49.5	49.6	49.7	49.8	49.9	50.1	50.3	50.5	50.8	51.1	51.5	52.0	52.6
		53.2	53.9	54.6	55.4	56.3	57.6	59.7	59.9	60.0	60.1	60.3	60.4	60.6	60.7	60.9	61.0	61.2	61.3	61.4	61.5
		61.7	62.2	62.9	63.7	65.0	66.6	68.2	69.6	70.6	71.4	71.8									
1992	8	47.2	48.9	49.8	50.4	52.5	52.6	52.7	52.7	52.7	52.8	52.9	53.0	53.2	53.5	53.7	54.0	54.3	54.8	55.2	55.7
		56.3	56.9	57.6	58.2	58.9	59.8	61.0	61.2	61.4	61.6	61.8	62.0	62.2	62.5	62.8	63.1	63.5	64.0	64.4	64.9
		65.4	65.8	66.3	67.0	68.0	69.1	70.2	71.1	71.7	72.2	72.5									
1992	9	49.2	51.5	52.7	53.4	55.6	55.6	55.7	55.7	55.7	55.8	55.9	56.0	56.2	56.4	56.6	56.8	57.1	57.4	57.7	58.1
		58.5	58.9	59.4	59.8	60.2	60.6	61.0	61.3	61.6	61.9	62.2	62.5	62.9	63.2	63.5	63.9	64.3	64.7	65.1	65.6
		66.0	66.5	66.9	67.4	67.8	68.2	68.4	68.6	68.7	68.7	68.8									
1992	10	51.5	54.2	55.5	56.1	58.0	58.0	58.1	58.1	58.1	58.1	58.2	58.3	58.4	58.5	58.7	58.8	59.0	59.2	59.5	59.8
		60.1	60.4	60.8	61.1	61.5	61.9	62.5	62.5	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6
		62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6										
1992	11	52.9	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4
		53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4
		53.4	53.4	53.4	53.4	53.4															
1992	12	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9
		47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9
		47.9	47.9	47.9	48.4	48.9															

FLOWS AND TEMPERATURES FOR 1992

	YEAR	1	2	3	4	5	6	7	8	9	10	11	12
INFLO	1035.9	196.8	1593.5	1475.1	1339.4	1865.4	1762.9	1750.0	738.4	31.9	48.8	174.8	1454.0
EVAP	4.3	.3	.6	1.1	4.7	6.0	7.1	9.4	8.6	7.1	3.7	1.7	1.0
PRCP	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
OUTFL	1008.9	55.3	646.4	1374.3	1058.8	1676.8	1731.0	1709.3	701.0	50.4	375.7	1277.2	1450.7
REQDQ	1008.9	55.3	646.4	1374.3	1058.8	1676.8	1731.0	1709.3	701.0	50.4	375.7	1277.2	1450.7
STMX		274389.	274389.	274389.	274389.	274389.	274389.	274389.	274389.	274389.	274389.	274389.	274389.
STOR		156145.	208596.	214509.	230026.	240038.	240066.	240013.	239963.	236991.	215908.	149904.	149907.
STMN		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TA	60.3	46.4	48.1	50.6	55.9	64.6	72.3	78.7	77.2	71.2	62.5	50.4	46.1
TMPIN	50.0	41.9	46.0	46.4	49.9	51.0	51.5	52.7	56.4	61.6	57.0	46.6	49.3
TMPMX	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
TPOUT	52.0	43.2	44.2	45.7	47.1	49.7	53.8	57.5	59.5	54.1	61.2	56.7	49.6
TMPMN	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
RELEASES THRU OUTLET 1													
QOMN		-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
QOUTL		50.4	52.2	48.8	50.4	50.4	50.4	50.4	50.4	50.4	50.4	100.8	100.8
TOUTL		43.1	43.6	43.8	44.2	45.0	46.2	48.2	51.0	54.1	56.9	56.3	49.5
RELEASES THRU OUTLET 2													

QOMN	4.9	594.2	1325.5	1008.3	1626.3	1680.6	1658.9	650.5	.0	325.3	1176.4	1349.9
QOUTL	4.9	594.2	1325.5	1008.3	1626.3	1680.6	1658.9	650.5	.0	325.3	1176.4	1349.9
TOUTL	44.0	44.2	45.7	47.2	49.8	54.0	57.7	60.1	.0	61.9	56.7	49.7

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TRINITY RIVER TEMPERATURES - F
1976 ACCRETIONS

LOCATION	J	F	M	A	M	J	J	A	S	O	N	D
LEWISTON-CFS	366.	333.	317.	299.	301.	1657.	587.	587.	541.	289.	200.	301.
LEWISTON-F	40.4	44.1	48.4	49.4	50.5	50.7	52.2	55.7	57.8	53.3	44.8	50.1
RUSH CR	40.4	44.0	48.1	49.4	51.4	50.9	53.1	56.3	58.1	53.6	45.0	49.8
GRASS V CR	40.5	44.0	47.7	49.4	52.7	51.2	54.2	57.0	58.6	53.9	45.2	49.3
INDIAN CR	40.5	43.8	47.4	49.4	53.4	51.5	56.4	58.4	59.4	54.6	45.6	48.5
DOUGLAS CI	40.6	43.8	47.2	49.4	54.5	51.8	57.0	58.9	59.7	54.8	45.7	48.2
READING CR	40.7	43.8	47.1	49.5	55.1	52.0	57.4	59.3	59.8	55.0	45.8	48.0
BROWNS CR	40.8	43.8	46.8	49.5	56.0	52.5	58.7	60.3	60.4	55.5	46.1	47.4
CANYON CR	40.9	43.8	46.6	49.5	57.3	53.4	60.8	62.0	61.4	56.3	46.5	46.3
N FORK	41.2	43.8	46.4	49.7	57.3	54.5	62.6	63.7	62.7	57.3	47.1	45.0
BIG BAR BR	41.2	43.8	46.4	49.8	57.5	54.8	63.7	64.3	63.3	57.7	47.5	44.5
BIG FRENCH	41.3	43.8	46.4	49.8	57.6	55.2	64.4	64.9	63.9	58.1	47.7	44.1
BURNT RNCH	41.3	43.8	46.4	49.9	57.8	55.5	65.4	65.3	64.4	58.4	48.0	43.7
NEW RIVER	42.2	43.4	46.6	50.3	58.8	56.6	66.8	66.1	65.1	58.7	48.4	42.2
SHARBER CR	42.3	43.4	46.7	50.3	59.0	56.8	67.5	66.3	65.4	58.9	48.6	42.0
S.F.TRINTY	43.0	43.2	46.8	50.6	60.0	58.3	68.9	67.3	66.3	59.2	49.0	40.7
WILLOW CR	43.0	43.2	46.8	50.6	60.0	58.6	69.1	67.4	66.5	59.2	49.1	40.6
HOOPA	43.1	43.2	46.9	50.7	60.2	59.0	69.5	67.6	66.7	59.2	49.3	40.4
MILL CR	43.2	43.2	46.9	50.7	60.3	59.4	69.7	67.8	66.9	59.3	49.4	40.2
MOUTH	43.2	43.2	46.9	50.7	60.4	59.6	69.9	67.9	67.0	59.3	49.5	40.2

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1
                    SHASTA LAKE TEMPERATURE PREDICTIONS
                    OPERATIONAL TEMPERATURE CONTROL STUDY
          APRIL 1992 FORECAST - MOST PROBABLE  (December 1992 by Balance Hydrologics, Inc.)
0THE OUTPUT UNITS ON INFLOW AND OUTFLOW ARE IN CFS, EVAP AND PRECIP IN INCHES, STORAGE IN AF, AND TEMPERATURE IN DEGREES F

     NYR     IYR    NPER    IPER   MSTRT   NLAYR   LAYER   NOUTL   NMINQ   IDERV   METRC   IDGST     NIC     NIT    NOTL   INTER
       1    1992      12       1       1      97       5       3       2       0       0       1       1       0       0      10
    MREL     NMO
       0       3

    STORA     CISA      COSA   STRMX   STRMN      TIN    TAIR    EVAP    PRCP    QMIN    TMAX    TMIN   CSOUT    SOLR     DEP
 1301900.-1000.000-1000.0004950000.      0.      -1.     -1.   -1.00   -1.00     -1.     40.     40.    .504     -1.   32.81
0     AIR TEMP COEF    INFLO MIXING COEF      DIFFUSION COEF      EVAP HEAT COEF     INSOLATION COEF
          .331               .035                 .018                 .176                .110

 QOMIN=     -3.0      -2.0      -2.0

 STCAP=      495.      806.     1234.     1801.     2531.     3449.     4578.     5931.     7518.     9341.
           11404.    13721.    16318.    19234.    22507.    26171.    30251.    34766.    39735.    45173.
           51102.    57541.    64522.    72089.    80306.    89247.    98967.   109582.   121069.   133466.
          146785.   161066.   176346.   192688.   210146.   228752.   248514.   269414.   291443.   314621.
          339002.   364674.   391736.   420274.   450366.   482176.   515543.   550512.   587127.   625450.
          665511.   707355.   751027.   796358.   843589.   892763.   943929.   996795.  1051713.  1108729.
         1167888.  1228773.  1291854.  1357174.  1424780.  1494336.  1566238.  1640529.  1717255.  1795883.
         1876996.  1960627.  2046829.  2135150.  2226093.  2319700.  2416019.  2514928.  2616622.  2721146.
         2828544.  2938672.  3051750.  3167820.  3286929.  3408655.  3533478.  3661442.  3792590.  3926232.
         4063108.  4203254.  4346717.  4492742.  4642178.  4794860.  4950723.

 TSTRT=     46.6      46.6      46.6      46.6      46.6      46.6      46.6      46.6      46.6      46.6
            46.6      46.6      46.6      46.6      46.6      46.6      46.6      46.6      46.6      46.6
            46.6      46.6      46.6      46.6      46.6      46.6      46.8      46.8      46.8      46.9
            46.9      47.0      47.1      47.3      47.4      47.5      47.6      47.7      47.8      47.9
            48.0      48.4      48.8      49.2      49.6      50.0      50.0      50.0      50.0      50.0
            50.0      50.0      50.0      50.0      50.0      50.0      50.0      50.0      50.0      50.0
            50.0      50.0      50.0      50.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0
            -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0
            -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0
            -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0

 STOUT=   125918.   420274.  1748411.

                                        RESERVOIR TEMPERATURES
 YEAR  PER     1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16    17    18    19    20
 1992    1  44.7  44.7  44.7  44.7  44.7  44.7  44.7  44.7  44.7  44.7  44.7  44.7  44.7  44.7  44.7  44.8  44.8  44.8  44.8  44.8
            44.9  44.9  44.9  44.9  45.0  45.0  45.0  45.1  45.1  45.2  45.3  45.3  45.4  45.5  45.6  45.8  46.0  46.1  46.3  46.4
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		46.5	46.6	46.7	46.8	47.2	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3
		47.3	47.3	47.3	47.3																
1992	2	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.8	44.8	44.8	44.8	44.8	44.8	44.9
		44.9	44.9	44.9	45.0	45.0	45.0	45.1	45.1	45.2	45.2	45.3	45.3	45.4	45.4	45.4	45.5	45.5	45.5	45.5	45.5
		45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.6	45.6	45.8	45.9	46.1	46.3	46.5	46.6
		46.7	46.8	46.9	47.0	47.1	47.3	47.7	48.2	48.7	49.1	49.3	49.5	49.5							
1992	3	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9
		44.9	44.9	45.0	45.0	45.0	45.1	45.1	45.2	45.2	45.2	45.3	45.3	45.4	45.4	45.4	45.4	45.4	45.5	45.5	45.5
		45.5	45.5	45.5	45.5	45.5	45.6	45.6	45.7	45.7	45.8	45.9	46.0	46.1	46.2	46.3	46.5	46.6	46.7	46.8	46.9
		47.0	47.2	47.3	47.4	47.5	47.6	47.6	47.7	48.0	48.3	49.0	49.9	50.8	51.6	52.2	52.6	52.7			
1992	4	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9	44.9
		44.9	45.0	45.0	45.0	45.1	45.1	45.1	45.2	45.2	45.2	45.3	45.3	45.3	45.4	45.4	45.4	45.4	45.4	45.5	45.5
		45.5	45.5	45.5	45.6	45.7	45.8	45.8	45.9	46.0	46.1	46.2	46.3	46.4	46.5	46.6	46.7	46.8	46.9	47.0	47.1
		47.3	47.4	47.5	47.7	47.9	48.2	48.5	49.0	49.6	50.5	51.0	51.5	52.4	53.9	55.5	56.9	57.9	58.7	59.1	59.2
1992	5	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9	44.9	44.9
		45.0	45.0	45.0	45.0	45.1	45.1	45.1	45.2	45.2	45.3	45.3	45.3	45.3	45.4	45.4	45.4	45.4	45.5	45.5	45.5
		45.6	45.6	45.6	45.7	46.0	46.1	46.2	46.2	46.3	46.4	46.5	46.6	46.7	46.8	46.9	47.0	47.1	47.3	47.4	47.6
		47.8	48.1	48.3	48.7	49.2	49.7	50.4	51.2	52.4	54.1	55.3	56.3	57.3	59.0	61.0	62.8	64.2	65.2	65.9	66.1
1992	6	44.7	44.7	44.7	44.7	44.7	44.7	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9	44.9	44.9	44.9
		45.0	45.0	45.0	45.1	45.1	45.1	45.2	45.2	45.2	45.3	45.3	45.3	45.3	45.4	45.4	45.4	45.5	45.5	45.5	45.6
		45.7	45.8	45.9	46.0	46.7	46.8	46.9	47.0	47.1	47.2	47.3	47.5	47.6	47.8	48.0	48.3	48.6	48.9	49.3	49.8
		50.4	51.1	51.9	52.8	53.9	55.2	56.6	58.3	60.3	62.5	64.1	66.0	68.2	70.2	71.8	73.0	73.7	74.0		
1992	7	44.7	44.7	44.7	44.7	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9	44.9	44.9	44.9	45.0
		45.0	45.0	45.1	45.1	45.1	45.2	45.2	45.2	45.3	45.4	45.5	45.5	45.6	45.6	45.7	45.8	45.9	46.0	46.2	46.4
		46.6	46.9	47.4	47.9	48.6	48.8	49.1	49.3	49.7	50.0	50.5	51.0	51.5	52.2	52.9	53.6	54.5	55.5	56.6	57.8
		59.2	60.6	62.1	63.8	65.6	67.4	69.1	70.7	72.9	75.2	77.3	79.0	80.2	81.0	81.3					
1992	8	44.7	44.7	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9	44.9	44.9	44.9	45.0	45.0
		45.0	45.1	45.1	45.1	45.2	45.3	45.4	45.5	45.7	47.0	47.4	47.6	47.9	48.2	48.5	48.9	49.2	49.7	50.1	50.6
		51.1	51.8	52.5	53.4	54.1	54.7	55.3	56.0	56.8	57.6	58.5	59.4	60.5	61.5	62.6	63.7	64.8	66.0	67.1	68.0
		68.7	69.4	70.4	71.7	73.2	74.9	76.5	77.9	78.9	79.6	80.0	80.2								
1992	9	44.7	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9	44.9	44.9	44.9	45.0	45.0	45.1
		45.1	45.2	45.3	45.5	45.9	46.3	46.9	47.5	48.2	55.5	56.6	56.9	57.3	57.6	58.0	58.4	58.9	59.3	59.8	60.3
		60.8	61.4	61.9	62.5	63.1	63.7	64.3	64.8	65.1	65.2	65.5	65.9	66.4	66.9	67.5	68.2	68.9	69.7	70.4	71.2
		72.1	72.8	73.6	74.1	74.5	74.8	74.9	75.0	75.0											
1992	10	44.7	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9	44.9	44.9	45.0	45.0	45.1	45.2	45.3
		45.5	45.7	46.1	46.6	47.4	48.3	49.5	50.7	52.0	59.4	59.8	60.0	60.0	60.1	60.2	60.4	60.5	60.6	60.8	60.9
		61.2	61.5	61.8	62.2	62.6	63.0	63.4	63.8	64.2	64.6	65.0	65.4	65.8	66.2	66.6	66.9	67.0	67.1	67.1	67.1
		67.1	67.1	67.1	67.1	67.1	67.1	67.1	67.1	67.1	67.1										
1992	11	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9	44.9	44.9	45.0	45.0	45.1	45.2	45.4	45.5	45.8
		46.1	46.5	47.0	47.7	48.6	49.5	50.5	51.5	52.6	54.0	54.1	54.2	54.3	54.5	54.7	54.9	55.2	55.5	55.8	56.2
		56.6	57.2	57.9	58.5	58.9	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
		59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0									
1992	12	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9	44.9	44.9	44.9	45.0	45.1	45.1	45.2	45.4	45.5	45.7	46.0	46.3
		46.6	47.0	47.4	47.9	48.1	48.2	48.2	48.3	48.4	48.4	48.5	48.6	48.7	48.8	48.9	49.1	49.2	49.4	49.6	49.8
		50.1	50.4	50.8	51.3	52.3	52.9	52.9	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0
		53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0							

FLOWS AND TEMPERATURES FOR 1992

	YEAR	1	2	3	4	5	6	7	8	9	10	11	12
INFLO	5340.7	3877.2	13702.5	9556.4	6302.1	4879.0	3529.2	3008.7	3090.1	3159.4	3578.0	4201.4	5204.3
EVAP	4.6	.8	1.0	1.8	4.7	6.2	7.1	9.5	9.0	7.7	3.9	1.9	1.1
PRCP	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
OUTFL	4166.6	3195.8	2457.8	2644.4	2241.9	4069.1	6638.2	7229.1	6983.5	6816.3	3251.1	2409.9	2062.2
REQDQ	4166.6	3195.8	2457.8	2644.4	2241.9	4069.1	6638.2	7229.1	6983.5	6816.3	3251.1	2409.9	2062.2
STMX		4950000.	4950000.	4950000.	4950000.	4950000.	4950000.	4950000.	4950000.	4950000.	4950000.	4950000.	4950000.
STOR		1342896.	1966118.	2388450.	2622236.	2661183.	2464081.	2189315.	1936637.	1708641.	1723578.	1827714.	2019325.
STMN		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TA	62.0	44.7	48.6	51.5	58.6	65.7	73.9	82.0	80.5	75.1	64.5	51.7	46.8
TMPIN	50.6	42.5	44.8	46.9	49.6	54.4	61.1	67.2	65.9	61.5	54.6	48.8	43.1
TMPMX	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
TPOUT	49.8	47.9	45.7	45.5	46.9	48.9	49.1	47.0	48.3	51.3	57.9	60.6	55.0
TMPMN	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
TKES		47.5	46.6	47.4	50.9	52.5	51.8	50.1	51.0	53.1	58.6	59.1	53.3
RELEASES THRU OUTLET 1													
QOMN		-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
QOUTL		.0	.0	.0	.0	.0	.0	1374.3	3561.7	6816.3	3090.1	0.0	.0
TOUTL		.0	.0	.0	.0	.0	.0	45.3	46.0	51.3	57.7	55.3	.0
RELEASES THRU OUTLET 2													
QOMN		3195.8	2457.8	2644.4	1494.0	2036.2	4977.8	5854.8	3421.8	.0	161.0	2409.9	2062.2
QOUTL		3195.8	2457.8	2644.4	1494.0	2036.2	4977.8	5854.8	3421.8	.0	161.0	2409.9	2062.2
TOUTL		47.9	45.7	45.5	45.6	45.8	46.3	47.4	50.6	.0	62.5	60.6	55.0
RELEASES THRU OUTLET 3													
QOMN		.0	.0	.0	747.8	2032.9	1660.4	.0	.0	.0	.0	.0	.0
QOUTL		.0	.0	.0	747.8	2032.9	1660.4	.0	.0	.0	.0	.0	.0
TOUTL		.0	.0	.0	49.5	52.0	57.6	.0	.0	.0	.0	.0	.0

1

OPERATIONAL TEMPERATURE CONTROL STUDY

LOCATION	J	F	M	A	M	J	J	A	S	O	N	D
TLO-TAF	0.	0.	0.	0.	0.	0.	120.	80.	33.	18.	0.	0.
TLO-F	.0	.0	.0	.0	.0	.0	44.3	45.2	46.5	.0	.0	.0
TPO-TAF	23.	19.	33.	73.	120.	196.	21.	0.	0.	0.	16.	95.
TPO-F	44.9	44.6	44.5	44.5	44.6	45.4	46.9	.0	.0	.0	52.4	53.7
TR-TAF	23.	19.	33.	73.	120.	196.	141.	80.	33.	18.	16.	95.
TR-F	44.9	44.6	44.5	44.5	44.6	45.4	44.7	45.2	46.5	47.0	52.4	53.7
LEW-TAF	23.	18.	19.	18.	19.	99.	36.	36.	32.	18.	12.	19.
LEW-F	40.4	44.1	48.4	49.4	50.5	50.7	52.2	55.7	57.8	53.3	44.8	50.1
DC-F	40.6	43.8	47.2	49.4	54.5	51.8	57.0	58.9	59.7	54.8	45.7	48.2
NF-F	41.2	43.8	46.4	49.7	57.3	54.5	62.6	63.7	62.7	57.3	47.1	45.0
SC-TAF	0.	33.	81.	60.	100.	100.	102.	40.	0.	20.	70.	83.
SC-F	44.0	44.2	45.7	47.2	49.8	54.0	57.7	60.1	.0	61.9	56.7	49.7
S742-TAF	0.	0.	0.	0.	0.	0.	84.	219.	406.	190.	0.	0.
S742-F	.0	.0	.0	.0	.0	.0	45.3	46.0	51.3	57.7	55.3	.0
S815-TAF	197.	137.	163.	89.	125.	296.	360.	210.	0.	10.	143.	127.
S815-F	47.9	45.7	45.5	45.6	45.8	46.3	47.4	50.6	.0	62.5	60.6	55.0
S942-TAF	0.	0.	0.	45.	125.	99.	0.	0.	0.	0.	0.	0.
S942-F	.0	.0	.0	49.5	52.0	57.6	.0	.0	.0	.0	.0	.0
SH-TAF	197.	137.	163.	133.	250.	395.	445.	429.	406.	200.	143.	127.
SH-F	47.9	45.7	45.5	46.9	48.9	49.1	47.0	48.3	51.3	57.9	60.6	55.0
KASC-F	47.5	46.6	47.4	50.9	52.5	51.8	50.1	51.0	53.1	58.6	59.1	53.3
KES-F	47.5	46.1	46.8	49.8	51.7	52.2	51.5	51.8	53.1	58.9	58.3	51.9
ACL-F	47.2	46.7	47.8	51.7	53.7	54.0	53.5	53.7	54.5	59.3	57.7	51.3
BCL-F	47.2	46.7	47.9	51.8	53.8	54.1	53.6	53.8	54.6	59.3	57.6	51.2
BFB-F	46.9	47.2	48.8	53.4	55.6	55.7	55.5	55.7	55.9	59.7	57.0	50.6
CC-F	46.8	47.3	48.9	53.7	56.0	56.0	55.8	56.0	56.1	59.8	56.9	50.5
JFB-F	46.5	47.5	49.5	54.5	57.0	57.1	57.3	57.4	57.4	60.0	56.3	49.4
BB-F	46.0	47.7	50.2	55.5	58.5	58.6	59.2	59.1	59.0	60.3	55.6	48.0
RB-F	45.8	48.0	50.8	56.5	59.6	59.8	60.6	60.5	59.9	60.6	55.3	47.8

Appendix B

Printout of the Reclamation April 1992 Forecast Simulation

1

PRDG 095

ROWELL

EXT 4923

20302

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1
                              CLAIR ENGLE LAKE TEMPERATURE PREDICTIONS
                              OPERATIONAL TEMPERATURE CONTROL STUDY
                              APRIL 1992 FORECAST - MOST PROBABLE
0THE OUTPUT UNITS ON INFLOW AND OUTFLOW ARE IN CFS, EVAP AND PRECIP IN INCHES, STORAGE IN AF, AND TEMPERATURE IN DEGREES F

     NYR     IYR    NPER    IPER   MSTRT   NLAYR   LAYER   NOUTL   NMINQ   IDERV   METRC   IDGST     NIC     NIT    NOTL   INTER
       1    1992      12       1       1      89       5       4       2       0       0       0       1       0       1      10
    MREL     NMO
       0       3

     STORA      CISA      COSA   STRMX    STRMN     TIN     TAIR     EVAP     PRCP     QMIN    TMAX    TMIN   CSOUT    SOLR     DEP
   540300.-1000.000-1000.0002750000.       0.     -1.      -1.    -1.00    -1.00      -1.     -1.     -1.    .504     -1.   32.81
0      AIR TEMP COEF    INFLO MIXING COEF       DIFFUSION COEF        EVAP HEAT COEF        INSOLATION COEF
           .130                .143                  .011                  .591                  .353

 QOMIN=      -3.0      -1.0      -3.0      -1.0

 STCAP=       34.      135.      332.      670.     1180.     1894.     2858.     4131.     5709.     7572.
            9772.    12373.    15350.    18661.    22343.    26436.    30935.    35832.    41177.    47023.
           53372.    60220.    67590.    75503.    83948.    92906.   102515.   112929.   124146.   136155.
          148879.   162231.   176197.   190764.   205933.   221704.   238215.   255615.   273850.   292859.
          312631.   333151.   354442.   376526.   399523.   423559.   448632.   474737.   501769.   529611.
          558432.   588413.   619492.   651603.   684978.   719868.   756079.   793406.   831913.   871671.
          912729.   955140.   998904.  1044021.  1090567.  1138623.  1188236.  1239455.  1292413.  1347253.
         1403878.  1462182.  1522106.  1583586.  1646673.  1711416.  1777740.  1845564.  1915058.  1986396.
         2059404.  2133898.  2209810.  2287070.  2366177.  2447654.  2531322.  2616989.  2704308.

 TSTRT=      44.0      44.0      44.0      44.0      44.0      44.0      44.0      44.0      44.0      44.0
             44.0      44.0      44.0      44.0      44.0      44.0      44.0      44.0      44.0      44.0
             45.0      45.0      45.0      45.0      45.0      45.0      45.0      45.0      45.0      45.0
             45.0      45.0      45.0      45.0      45.0      45.0      45.0      45.0      45.0      45.0
             45.0      45.0      45.0      45.0      45.0      45.0      45.0      45.0      45.0      45.0
             46.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0
             -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0
             -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0
             -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0

 STOUT=    12372.    12373.   190764.   190765.

                                            RESERVOIR TEMPERATURES
 YEAR  PER     1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16    17    18    19    20
 1992    1  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.0  44.1  44.1  44.1  44.2  44.2
            44.6  44.7  44.7  44.7  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8
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       44.8 44.8 44.8 44.9 45.2 45.6 46.0 46.4 46.8 47.0 47.0
1992  2 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.1 44.1 44.1 44.2 44.2 44.3
       44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.5 44.5 44.5 44.5 44.5 44.5
       44.5 44.5 44.5 44.5 44.5 44.6 44.7 44.9 45.3 46.0 47.0 47.9 48.8 49.5 49.7
1992  3 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.1 44.1 44.1 44.2 44.2 44.2 44.3
       44.3 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.5 44.5 44.5 44.5 44.5 44.5
       44.5 44.5 44.6 44.6 44.7 44.7 44.9 45.0 45.2 45.4 45.5 45.8 46.6 47.8 49.3 50.8 52.1 53.0 53.3
1992  4 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.1 44.1 44.1 44.1 44.2 44.2 44.2 44.3
       44.3 44.3 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.5 44.5 44.5 44.6 44.6 44.6 44.7
       44.7 44.8 44.9 45.0 45.1 45.3 45.4 45.6 45.8 46.1 46.2 46.4 46.6 46.8 47.1 47.9 49.1 50.6 52.0 53.3
       54.2 54.6
1992  5 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.1 44.1 44.1 44.1 44.1 44.2 44.2 44.2 44.2 44.3
       44.3 44.3 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.4 44.5 44.5 44.5 44.5 44.8 44.9 45.0 45.1 45.2 45.3
       45.4 45.6 45.7 45.9 46.1 46.3 46.5 46.7 47.0 47.3 47.7 48.2 48.8 49.3 49.8 50.1 50.6 51.7 53.3 55.1
       56.9 58.4 59.4 59.7
1992  6 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.1 44.1 44.1 44.1 44.1 44.1 44.2 44.2 44.2 44.3 44.3
       44.3 44.3 44.4 44.4 44.4 44.4 44.4 44.4 44.5 44.5 44.6 44.6 44.7 44.8 46.2 46.3 46.5 46.7 46.9 47.1
       47.3 47.6 47.9 48.3 48.7 49.1 49.6 50.1 50.7 51.5 52.5 53.8 55.4 57.2 59.0 60.5 61.9 63.6 65.1 66.3
       66.9 66.9
1992  7 44.0 44.0 44.0 44.0 44.0 44.0 44.0 44.1 44.1 44.1 44.1 44.2 44.6 44.6 44.7 44.7 44.7 44.8 44.9 44.9
       45.0 45.2 45.4 45.6 45.9 46.1 46.3 46.5 46.7 46.9 47.1 47.3 47.5 47.8 48.1 48.3 48.6 48.9 49.3 49.7
       50.2 50.7 51.3 52.0 52.9 53.9 55.0 56.3 57.7 59.3 61.1 63.2 65.2 66.9 68.4 69.8 70.9 71.5
1992  8 44.0 44.0 44.0 44.0 44.1 44.1 44.1 44.2 44.2 44.3 44.4 44.5 46.2 46.3 46.4 46.5 46.6 46.6 46.7 46.8
       46.9 47.1 47.2 47.3 47.5 47.6 47.8 48.0 48.2 48.4 48.6 48.9 49.2 49.5 49.9 50.3 50.7 51.3 51.8 52.5
       53.3 54.1 55.1 56.2 57.4 58.7 60.1 61.7 63.4 65.3 67.1 68.7 69.9 71.0 71.8 72.2
1992  9 44.0 44.0 44.1 44.1 44.1 44.2 44.3 44.4 44.5 44.7 44.9 45.2 46.9 47.0 47.1 47.1 47.2 47.3 47.4 47.5
       47.6 47.8 47.9 48.0 48.2 48.4 48.6 48.8 49.0 49.2 49.5 49.9 50.2 50.6 51.1 51.6 52.2 52.8 53.5 54.3
       55.2 56.2 57.3 58.5 59.7 61.0 62.4 63.8 65.1 66.1 66.8 67.3 67.6 67.7 67.7 67.7
1992 10 44.0 44.1 44.1 44.2 44.3 44.4 44.5 44.7 44.9 45.1 45.4 45.7 47.2 47.3 47.4 47.5 47.6 47.7 47.8 47.9
       48.0 48.2 48.3 48.5 48.7 48.9 49.1 49.3 49.6 49.9 50.2 50.6 51.0 51.5 52.0 52.6 53.2 53.9 54.7 55.5
       56.5 57.5 58.5 59.6 60.7 61.7 62.6 63.5 64.2 64.4 64.4 64.4 64.4 64.4 64.4
1992 11 44.1 44.2 44.3 44.4 44.5 44.6 44.8 45.0 45.2 45.5 45.8 46.1 46.9 47.1 47.3 47.5 47.6 47.7 47.9 48.0
       48.1 48.3 48.4 48.6 48.8 49.0 49.2 49.4 49.7 50.1 50.4 50.8 51.3 51.8 52.8 53.5 54.1 54.9 55.6 56.3
       56.9 57.5 58.1 58.2 58.2 58.2 58.2 58.2 58.2 58.2 58.2 58.2 58.2 58.2 58.2 58.2
1992 12 44.1 44.3 44.4 44.6 44.7 44.8 45.0 45.2 45.5 45.7 46.0 46.3 46.8 47.0 47.2 47.4 47.6 47.7 47.9 48.0
       48.2 48.3 48.5 48.7 48.9 49.1 49.3 49.6 49.9 50.3 50.7 51.2 51.7 52.2 53.3 53.4 53.5 53.5 53.5 53.5
       53.5 53.5 53.5 53.5 53.5 53.5 53.5 53.5 53.5 53.5 53.5 53.5 53.5 53.5
```

FLOWS AND TEMPERATURES FOR 1992

	YEAR	1	2	3	4	5	6	7	8	9	10	11	12
INFLO	1357.0	484.7	2814.3	2789.2	3445.1	3252.7	1512.5	406.6	195.2	168.1	178.9	369.7	666.8
EVAP	4.3	.5	.5	1.6	4.7	6.1	7.0	9.2	8.5	7.0	3.5	1.8	1.1
PRCP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OUTFL	1165.1	372.4	336.7	535.1	1235.2	1954.9	3302.3	2288.3	1292.9	556.3	289.5	273.9	1543.4
REQDQ	1165.1	372.4	336.7	535.1	1235.2	1954.9	3302.3	2288.3	1292.9	556.3	289.5	273.9	1543.4
STMX		2750000.	2750000.	2750000.	2750000.	2750000.	2750000.	2750000.	2750000.	2750000.	2750000.	2750000.	2750000.

STOR		546984.	684340.	821969.	950246.	1025604.	913969.	792166.	719403.	692238.	683403.	688085.	633579.
STMN		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TA	54.2	40.0	43.3	45.9	50.9	58.2	65.6	71.7	70.5	64.1	55.9	44.3	39.8
TMPIN	43.4	36.7	40.3	40.3	41.3	43.8	54.2	60.7	62.2	61.1	52.1	41.3	37.7
TMPMX	67.3	80.0	80.0	80.0	80.0	80.0	80.0	40.0	40.0	40.0	40.0	80.0	80.0
TPOUT	46.1	44.9	44.6	44.5	44.5	44.6	45.4	44.7	45.2	46.5	47.0	52.4	53.7
TMPMN	67.3	80.0	80.0	80.0	80.0	80.0	80.0	40.0	40.0	40.0	40.0	80.0	80.0
TLEW		40.4	44.1	48.4	49.4	50.5	50.7	52.2	55.7	57.8	53.3	44.8	50.1
RELEASES THRU OUTLET 1													
QOMN		-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
QOUTL		0.0	0.0	0.0	0.0	0.0	0.0	587.1	587.1	541.1	289.5	0.0	0.0
TOUTL		0.0	0.0	0.0	0.0	0.0	0.0	44.4	45.3	46.5	47.0	0.0	0.0
RELEASES THRU OUTLET 2													
QOMN		0.0	0.0	0.0	0.0	0.0	0.0	1364.5	705.8	15.1	0.0	0.0	0.0
QOUTL		0.0	0.0	0.0	0.0	0.0	0.0	1364.5	705.8	15.1	0.0	0.0	0.0
TOUTL		0.0	0.0	0.0	0.0	0.0	0.0	44.3	45.2	46.5	0.0	0.0	0.0
RELEASES THRU OUTLET 3													
QOMN		-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
QOUTL		365.9	333.1	317.1	299.1	300.9	1657.0	0.0	0.0	0.0	0.0	200.0	300.9
TOUTL		44.9	44.6	44.5	44.5	44.6	45.4	0.0	0.0	0.0	0.0	52.4	53.7
RELEASES THRU OUTLET 4													
QOMN		6.5	3.6	217.9	936.1	1654.0	1645.3	336.7	0.0	0.0	0.0	73.9	1242.5
QOUTL		6.5	3.6	217.9	936.1	1654.0	1645.3	336.7	0.0	0.0	0.0	73.9	1242.5
TOUTL		44.9	44.6	44.5	44.5	44.6	45.4	46.9	0.0	0.0	0.0	52.4	53.7

1

WHISKEYTOWN LAKE TEMPERATURE PREDICTIONS
OPERATIONAL TEMPERATURE CONTROL STUDY
APRIL 1992 FORECAST - MOST PROBABLE
0THE OUTPUT UNITS ON INFLOW AND OUTFLOW ARE IN CFS, EVAP AND PRECIP IN INCHES, STORAGE IN AF, AND TEMPERATURE IN DEGREES F

NYR	IYR	NPER	IPER	MSTRT	NLAYR	LAYER	NOUTL	NMINQ	IDERV	METRC	IDGST	NIC	NIT	NOTL	INTER
1	1992	12	1	1	53	5	2	1	0	0	1	1	1	0	10

MREL	NMO
0	3

STORA	CISA	COSA	STRMX	STRMN	TIN	TAIR	EVAP	PRCP	QMIN	TMAX	TMIN	CSOUT	SOLR	DEP
147500.	-1000.000	-1000.000	274389.	0.	-1.	-1.	-1.00	-1.00	-1.	80.	40.	.504	-1.	32.81

0

AIR TEMP COEF	INFLO MIXING COEF	DIFFUSION COEF	EVAP HEAT COEF	INSOLATION COEF
.489	.160	.037	.281	0.000

QOMIN= -3.0 -1.0

STCAP=	1.	3.	6.	13.	27.	52.	89.	145.	227.	343.
	501.	714.	994.	1351.	1797.	2356.	3055.	3901.	4898.	6064.
	7418.	8975.	10751.	12774.	15076.	17676.	20589.	23861.	27542.	31646.
	36185.	41191.	46701.	52723.	59265.	66340.	73960.	82126.	90837.	100107.
	109952.	120383.	131413.	143043.	155276.	168102.	181513.	195518.	210125.	225323.
	241096.	257450.	274389.							

TSTRT=	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0
	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0
	45.0	45.0	45.0	45.0	45.0	-1.0	-1.0	-1.0	-1.0	-1.0
	-1.0	-1.0	-1.0							

STOUT= 13. 17676.

RESERVOIR TEMPERATURES

YEAR	PER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1992	1	43.0	43.0	43.1	43.1	43.3	43.3	43.3	43.3	43.3	43.4	43.4	43.4	43.4	43.5	43.5	43.6	43.6	43.7	43.8	43.8
		43.9	43.9	43.9	43.9	44.0	44.0	44.0	44.0	44.0	44.0	44.1	44.1	44.2	44.2	44.3	44.4	44.6	44.7	44.9	45.2
		45.5	45.7	45.9	46.0	46.1	46.1														
1992	2	43.2	43.3	43.4	43.5	43.7	43.7	43.8	43.8	43.8	43.8	43.8	43.8	43.8	43.8	43.8	43.8	43.9	43.9	43.9	43.9
		44.0	44.0	44.1	44.1	44.2	44.3	44.6	44.7	44.8	44.9	45.0	45.2	45.3	45.5	45.7	45.8	46.0	46.2	46.4	46.5
		46.6	46.7	46.8	46.9	47.1	47.3	47.4	47.5	47.6											
1992	3	43.4	43.6	43.7	43.8	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.1	44.1	44.1	44.2	44.2	44.3	44.4
		44.6	44.7	44.9	45.1	45.4	45.9	46.7	46.8	46.9	47.0	47.0	47.1	47.2	47.3	47.4	47.5	47.6	47.7	47.8	47.8

		47.9	48.0	48.2	48.5	48.8	49.1	49.3	49.5	49.6	49.6										
1992	4	43.6	43.9	44.0	44.1	44.5	44.5	44.5	44.5	44.5	44.5	44.6	44.6	44.7	44.7	44.8	44.9	45.0	45.1	45.3	45.4
		45.7	45.9	46.1	46.4	46.7	47.2	48.0	48.1	48.2	48.3	48.4	48.6	48.7	49.0	49.2	49.5	49.8	50.1	50.4	50.8
		51.1	51.4	51.6	51.8	52.1	52.5	52.9	53.2	53.5	53.6	53.6									
1992	5	44.0	44.4	44.7	44.8	45.5	45.5	45.5	45.5	45.5	45.6	45.6	45.7	45.7	45.8	45.9	46.0	46.2	46.4	46.6	46.9
		47.2	47.6	48.1	48.5	49.1	50.2	52.1	52.3	52.5	52.6	52.8	53.1	53.3	53.6	53.8	54.1	54.3	54.6	54.8	55.0
		55.1	55.2	55.5	55.9	56.6	57.6	58.5	59.3	59.9	60.3	60.6									
1992	6	44.6	45.3	45.7	45.9	47.0	47.0	47.0	47.0	47.1	47.1	47.2	47.3	47.4	47.6	47.7	48.0	48.2	48.5	48.9	49.4
		49.9	50.5	51.2	51.9	52.7	54.0	56.1	56.2	56.3	56.5	56.7	56.9	57.1	57.3	57.5	57.7	57.9	58.1	58.3	58.4
		58.6	58.9	59.4	60.1	61.2	62.6	63.9	65.0	65.9	66.6	67.0									
1992	7	45.7	46.8	47.4	47.8	49.4	49.5	49.6	49.6	49.6	49.7	49.8	49.9	50.1	50.3	50.5	50.8	51.1	51.5	52.0	52.6
		53.2	53.9	54.6	55.4	56.3	57.6	59.7	59.9	60.0	60.1	60.3	60.4	60.6	60.7	60.9	61.0	61.2	61.3	61.4	61.5
		61.7	62.2	62.9	63.7	65.0	66.6	68.2	69.6	70.6	71.4	71.8									
1992	8	47.2	48.9	49.8	50.4	52.5	52.6	52.7	52.7	52.7	52.8	52.9	53.0	53.2	53.5	53.7	54.0	54.3	54.8	55.2	55.7
		56.3	56.9	57.6	58.2	58.9	59.8	61.0	61.2	61.4	61.6	61.8	62.0	62.2	62.5	62.8	63.1	63.5	64.0	64.4	64.9
		65.4	65.8	66.3	67.0	68.0	69.1	70.2	71.1	71.7	72.2	72.5									
1992	9	49.2	51.5	52.7	53.4	55.6	55.6	55.7	55.7	55.7	55.8	55.9	56.0	56.2	56.4	56.6	56.8	57.1	57.4	57.7	58.1
		58.5	58.9	59.4	59.8	60.2	60.6	61.0	61.3	61.6	61.9	62.2	62.5	62.9	63.2	63.5	63.9	64.3	64.7	65.1	65.6
		66.0	66.5	66.9	67.4	67.8	68.2	68.4	68.6	68.7	68.7	68.8									
1992	10	51.5	54.2	55.5	56.1	58.0	58.0	58.1	58.1	58.1	58.1	58.2	58.3	58.4	58.5	58.7	58.8	59.0	59.2	59.5	59.8
		60.1	60.4	60.8	61.1	61.5	61.9	62.5	62.5	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6
		62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6										
1992	11	52.9	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4
		53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4
		53.4	53.4	53.4	53.4	53.4															
1992	12	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9
		47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9
		47.9	47.9	47.9	48.4	48.9															

FLOWS AND TEMPERATURES FOR 1992

	YEAR	1	2	3	4	5	6	7	8	9	10	11	12
INFLO	1035.9	196.8	1593.5	1475.1	1339.4	1865.4	1762.9	1749.9	738.4	31.9	48.8	174.8	1454.0
EVAP	4.3	.3	.6	1.1	4.7	6.0	7.1	9.4	8.6	7.1	3.7	1.7	1.0
PRCP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OUTFL	1008.9	55.3	646.4	1374.3	1058.8	1676.8	1731.0	1709.3	701.0	50.4	375.7	1277.2	1450.7
REQDQ	1008.9	55.3	646.4	1374.3	1058.8	1676.8	1731.0	1709.3	701.0	50.4	375.7	1277.2	1450.7
STMX		274389.	274389.	274389.	274389.	274389.	274389.	274389.	274389.	274389.	274389.	274389.	274389.
STOR		156145.	208596.	214509.	230026.	240039.	240067.	240013.	239963.	236992.	215908.	149905.	149907.
STMN		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TA	60.3	46.4	48.1	50.6	55.9	64.6	72.3	78.7	77.2	71.2	62.5	50.4	46.1
TMPIN	50.0	41.9	46.0	46.4	49.9	51.0	51.5	52.7	56.4	61.6	57.0	46.6	49.3
TMPMX	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
TPOUT	52.0	43.2	44.2	45.7	47.1	49.7	53.8	57.5	59.5	54.1	61.2	56.7	49.6
TMPMN	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0

RELEASES THRU OUTLET 1

```
 QOMN              -3.0    -3.0    -3.0    -3.0    -3.0    -3.0    -3.0    -3.0    -3.0    -3.0    -3.0    -3.0
QOUTL              50.4    52.2    48.8    50.4    50.4    50.4    50.4    50.4    50.4    50.4   100.8   100.8
TOUTL              43.1    43.6    43.8    44.2    45.0    46.2    48.2    51.0    54.1    56.9    56.3    49.5
RELEASES THRU OUTLET  2
 QOMN               4.9   594.2  1325.5  1008.3  1626.3  1680.6  1658.9   650.5     0.0   325.3  1176.4  1349.9
QOUTL               4.9   594.2  1325.5  1008.3  1626.3  1680.6  1658.9   650.5     0.0   325.3  1176.4  1349.9
TOUTL              44.0    44.2    45.7    47.2    49.8    54.0    57.7    60.1     0.0    61.9    56.7    49.7
1
0END-OF-FILE ENCOUNTERED, FILENAME -    MP1TRN
 ERROR NUMBER   65   DETECTED BY INPC=   AT ADDRESS 000151
 CALLED FROM C095    AT  LINE 53
```

TRINITY RIVER TEMPERATURES - F
APRIL 1992 FORECAST, 1976 ACCRETIONS

LOCATION	J	F	M	A	M	J	J	A	S	O	N	D
LEWISTON-CFS	366.	333.	317.	299.	301.	1657.	587.	587.	541.	289.	200.	301.
LEWISTON-F	40.4	44.1	48.4	49.4	50.5	50.7	52.2	55.7	57.8	53.3	44.8	50.1
RUSH CR	40.4	44.0	48.1	49.4	51.4	50.9	53.1	56.3	58.1	53.6	45.0	49.8
GRASS V CR	40.5	44.0	47.7	49.4	52.7	51.2	54.2	57.0	58.6	53.9	45.2	49.3
INDIAN CR	40.5	43.8	47.4	49.4	53.4	51.5	56.4	58.4	59.4	54.6	45.6	48.5
DOUGLAS CI	40.6	43.8	47.2	49.4	54.5	51.8	57.0	58.9	59.7	54.8	45.7	48.2
READING CR	40.7	43.8	47.1	49.5	55.1	52.0	57.4	59.3	59.8	55.0	45.8	48.0
BROWNS CR	40.8	43.8	46.8	49.5	56.0	52.5	58.7	60.3	60.4	55.5	46.1	47.4
CANYON CR	40.9	43.8	46.6	49.5	57.3	53.4	60.8	62.0	61.4	56.3	46.5	46.3
N FORK	41.2	43.8	46.4	49.7	57.3	54.5	62.6	63.7	62.7	57.3	47.1	45.0
BIG BAR BR	41.2	43.8	46.4	49.8	57.5	54.8	63.7	64.3	63.3	57.7	47.5	44.5
BIG FRENCH	41.3	43.8	46.4	49.8	57.6	55.2	64.4	64.9	63.9	58.1	47.7	44.1
BURNT RNCH	41.3	43.8	46.4	49.9	57.8	55.5	65.4	65.3	64.4	58.4	48.0	43.7
NEW RIVER	42.2	43.4	46.6	50.3	58.8	56.6	66.8	66.1	65.1	58.7	48.4	42.2
SHARBER CR	42.3	43.4	46.7	50.3	59.0	56.8	67.5	66.3	65.4	58.9	48.6	42.0
S.F.TRINTY	43.0	43.2	46.8	50.6	60.0	58.3	68.9	67.3	66.3	59.2	49.0	40.7
WILLOW CR	43.0	43.2	46.8	50.6	60.0	58.6	69.1	67.4	66.5	59.2	49.1	40.6
HOOPA	43.1	43.2	46.9	50.7	60.2	59.0	69.5	67.6	66.7	59.2	49.3	40.4
MILL CR	43.2	43.2	46.9	50.7	60.3	59.4	69.7	67.8	66.9	59.3	49.4	40.2
MOUTH	43.2	43.2	46.9	50.7	60.4	59.6	69.9	67.9	67.0	59.3	49.5	40.2

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1
                    SHASTA LAKE TEMPERATURE PREDICTIONS
                    OPERATIONAL TEMPERATURE CONTROL STUDY
                    APRIL 1992 FORECAST - MOST PROBABLE
0THE OUTPUT UNITS ON INFLOW AND OUTFLOW ARE IN CFS, EVAP AND PRECIP IN INCHES, STORAGE IN AF, AND TEMPERATURE IN DEGREES F


    NYR    IYR    NPER    IPER   MSTRT   NLAYR   LAYER   NOUTL   NMINQ   IDERV   METRC   IDGST     NIC     NIT    NOTL   INTER
      1   1992      12       1       1      97       5       3       2       0       0       1       1       0       0      10
   MREL    NMO
      0      3


   STORA     CISA     COSA   STRMX   STRMN     TIN    TAIR    EVAP    PRCP    QMIN    TMAX    TMIN   CSOUT    SOLR     DEP
 1301900.-1000.000-1000.0004950000.      0.     -1.     -1.   -1.00   -1.00     -1.     40.     40.    .504     -1.   32.81
0     AIR TEMP COEF    INFLO MIXING COEF     DIFFUSION COEF       EVAP HEAT COEF     INSOLATION COEF
          .331                .035               .018                .176               .110

 QOMIN=      -3.0      -2.0      -2.0

 STCAP=       495.      806.     1234.     1801.     2531.     3449.     4578.     5931.     7518.     9341.
            11404.    13721.    16318.    19234.    22507.    26171.    30251.    34766.    39735.    45173.
            51102.    57541.    64522.    72089.    80306.    89247.    98967.   109582.   121069.   133466.
           146785.   161066.   176346.   192688.   210146.   228752.   248514.   269414.   291443.   314621.
           339002.   364674.   391736.   420274.   450366.   482176.   515543.   550512.   587127.   625450.
           665511.   707355.   751027.   796358.   843589.   892763.   943929.   996795.  1051713.  1108729.
          1167888.  1228773.  1291854.  1357174.  1424780.  1494336.  1566238.  1640529.  1717255.  1795883.
          1876996.  1960627.  2046829.  2135150.  2226093.  2319700.  2416019.  2514928.  2616622.  2721146.
          2828544.  2938672.  3051750.  3167820.  3286929.  3408655.  3533478.  3661442.  3792590.  3926232.
          4063108.  4203254.  4346717.  4492742.  4642178.  4794860.  4950723.

 TSTRT=       46.6      46.6      46.6      46.6      46.6      46.6      46.6      46.6      46.6      46.6
              46.6      46.6      46.6      46.6      46.6      46.6      46.6      46.6      46.6      46.6
              46.6      46.6      46.6      46.6      46.6      46.6      46.8      46.8      46.8      46.9
              46.9      47.0      47.1      47.3      47.4      47.5      47.6      47.7      47.8      47.9
              48.0      48.4      48.8      49.2      49.6      50.0      50.0      50.0      50.0      50.0
              50.0      50.0      50.0      50.0      50.0      50.0      50.0      50.0      50.0      50.0
              50.0      50.0      50.0      50.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0
              -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0
              -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0
              -1.0      -1.0      -1.0      -1.0      -1.0      -1.0      -1.0

 STOUT=    125918.   420274.  1748411.
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RESERVOIR TEMPERATURES

YEAR	PER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1992	1	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.8	44.8	44.8	44.8	44.8
		44.9	44.9	44.9	44.9	45.0	45.0	45.0	45.1	45.1	45.2	45.3	45.3	45.4	45.5	45.6	45.8	46.0	46.1	46.3	46.4
		46.5	46.6	46.7	46.8	47.2	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3
		47.3	47.3	47.3	47.3																
1992	2	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.8	44.8	44.8	44.8	44.8	44.8	44.9
		44.9	44.9	44.9	45.0	45.0	45.0	45.1	45.1	45.2	45.2	45.3	45.3	45.4	45.4	45.4	45.5	45.5	45.5	45.5	45.5
		45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.6	45.6	45.8	45.9	46.1	46.3	46.5	46.6
		46.7	46.8	46.9	47.0	47.1	47.3	47.7	48.2	48.7	49.1	49.3	49.5	49.5							
1992	3	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9
		44.9	44.9	45.0	45.0	45.0	45.1	45.1	45.2	45.2	45.2	45.3	45.3	45.4	45.4	45.4	45.4	45.4	45.5	45.5	45.5
		45.5	45.5	45.5	45.5	45.5	45.6	45.6	45.7	45.7	45.8	45.9	46.0	46.1	46.2	46.3	46.5	46.6	46.7	46.8	46.9
		47.0	47.2	47.3	47.4	47.5	47.6	47.6	47.7	48.0	48.3	49.0	49.9	50.8	51.6	52.2	52.6	52.7			
1992	4	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9	44.9
		44.9	45.0	45.0	45.0	45.1	45.1	45.1	45.2	45.2	45.2	45.3	45.3	45.3	45.4	45.4	45.4	45.4	45.4	45.5	45.5
		45.5	45.5	45.5	45.6	45.7	45.8	45.8	45.9	46.0	46.1	46.2	46.3	46.4	46.5	46.6	46.7	46.8	46.9	47.0	47.1
		47.3	47.4	47.5	47.7	47.9	48.2	48.5	49.0	49.6	50.5	51.0	51.5	52.4	53.9	55.5	56.9	57.9	58.7	59.1	59.2
1992	5	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9	44.9	44.9
		45.0	45.0	45.0	45.0	45.1	45.1	45.1	45.2	45.2	45.3	45.3	45.3	45.3	45.4	45.4	45.4	45.4	45.5	45.5	45.5
		45.6	45.6	45.7	45.7	46.0	46.1	46.2	46.2	46.3	46.4	46.5	46.6	46.7	46.8	46.9	47.0	47.2	47.3	47.4	47.6
		47.8	48.1	48.3	48.7	49.2	49.7	50.4	51.2	52.4	54.1	55.3	56.3	57.3	59.0	61.0	62.8	64.2	65.2	65.9	66.1
1992	6	44.7	44.7	44.7	44.7	44.7	44.7	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9	44.9	44.9	44.9
		45.0	45.0	45.0	45.1	45.1	45.1	45.2	45.2	45.2	45.3	45.3	45.3	45.3	45.4	45.4	45.4	45.5	45.5	45.5	45.6
		45.7	45.8	45.9	46.0	46.7	46.8	46.9	47.0	47.1	47.2	47.3	47.5	47.6	47.8	48.0	48.3	48.6	48.9	49.3	49.8
		50.4	51.1	51.9	52.8	53.9	55.2	56.6	58.3	60.3	62.5	64.1	66.0	68.2	70.2	71.8	73.0	73.7	74.0		
1992	7	44.7	44.7	44.7	44.7	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9	44.9	44.9	44.9	45.0
		45.0	45.0	45.1	45.1	45.1	45.2	45.2	45.2	45.3	45.4	45.5	45.5	45.6	45.6	45.7	45.8	45.9	46.0	46.2	46.4
		46.6	46.9	47.4	47.9	48.6	48.8	49.1	49.3	49.7	50.0	50.5	51.0	51.5	52.2	52.9	53.6	54.5	55.5	56.6	57.8
		59.2	60.6	62.1	63.8	65.6	67.4	69.1	70.7	72.9	75.2	77.3	79.0	80.2	81.0	81.3					
1992	8	44.7	44.7	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9	44.9	44.9	44.9	45.0	45.0
		45.0	45.1	45.1	45.1	45.2	45.3	45.4	45.5	45.7	47.0	47.4	47.6	47.9	48.2	48.5	48.9	49.2	49.7	50.1	50.6
		51.1	51.8	52.5	53.4	54.1	54.7	55.3	56.0	56.8	57.6	58.5	59.4	60.5	61.5	62.6	63.7	64.8	66.0	67.1	68.0
		68.7	69.4	70.4	71.7	73.2	74.9	76.5	77.9	78.9	79.6	80.0	80.2								
1992	9	44.7	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9	44.9	44.9	44.9	45.0	45.0	45.1
		45.1	45.2	45.3	45.5	45.9	46.3	46.9	47.5	48.2	55.5	56.6	56.9	57.3	57.6	58.0	58.4	58.9	59.3	59.8	60.3
		60.8	61.4	61.9	62.5	63.1	63.7	64.3	64.8	65.1	65.2	65.5	65.9	66.4	66.9	67.5	68.2	68.9	69.7	70.4	71.2
		72.1	72.8	73.6	74.1	74.5	74.8	74.9	75.0	75.0											
1992	10	44.7	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9	44.9	44.9	45.0	45.0	45.1	45.2	45.3
		45.5	45.7	46.1	46.6	47.4	48.3	49.5	50.7	52.0	59.4	59.8	60.0	60.0	60.1	60.2	60.4	60.5	60.6	60.8	60.9
		61.2	61.5	61.8	62.2	62.6	63.0	63.4	63.8	64.2	64.6	65.0	65.4	65.8	66.2	66.6	66.9	67.1	67.1	67.1	67.1
		67.1	67.1	67.1	67.1	67.1	67.1	67.1	67.1	67.1	67.1										
1992	11	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9	44.9	44.9	45.0	45.0	45.1	45.2	45.4	45.5	45.8
		46.1	46.5	47.0	47.7	48.6	49.5	50.5	51.5	52.6	54.0	54.1	54.2	54.3	54.5	54.7	54.9	55.2	55.5	55.8	56.2
		56.6	57.2	57.9	58.5	58.9	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
		59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0									

1992	12	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.9	44.9	44.9	44.9	45.0	45.1	45.1	45.2	45.4	45.5	45.7	46.0	46.3
		46.6	47.0	47.4	47.9	48.1	48.2	48.2	48.3	48.4	48.4	48.5	48.6	48.7	48.8	48.9	49.1	49.2	49.4	49.6	49.8
		50.1	50.4	50.8	51.3	52.3	52.9	52.9	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0
		53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0							

FLOWS AND TEMPERATURES FOR 1992

	YEAR	1	2	3	4	5	6	7	8	9	10	11	12
INFLO	5340.7	3877.2	13702.5	9556.4	6302.1	4879.0	3529.2	3008.7	3090.1	3159.4	3578.0	4201.4	5204.3
EVAP	4.6	.8	1.0	1.8	4.7	6.2	7.1	9.5	9.0	7.7	3.9	1.9	1.1
PRCP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OUTFL	4166.6	3195.8	2457.8	2644.4	2241.9	4069.1	6638.2	7229.1	6983.5	6816.3	3251.1	2409.9	2062.2
REQDQ	4166.6	3195.8	2457.8	2644.4	2241.9	4069.1	6638.2	7229.1	6983.5	6816.3	3251.1	2409.9	2062.2
STMX		4950000.	4950000.	4950000.	4950000.	4950000.	4950000.	4950000.	4950000.	4950000.	4950000.	4950000.	4950000.
STOR		1342896.	1966118.	2388450.	2622236.	2661183.	2464082.	2189315.	1936637.	1708641.	1723578.	1827714.	2019325.
STMN		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TA	62.0	44.7	48.6	51.5	58.6	65.7	73.9	82.0	80.5	75.1	64.5	51.7	46.8
TMPIN	50.6	42.5	44.8	46.9	49.6	54.4	61.1	67.2	65.9	61.5	54.6	48.8	43.1
TMPMX	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
TPOUT	49.8	47.9	45.7	45.5	46.9	48.9	49.1	47.0	48.3	51.3	57.9	60.6	55.0
TMPMN	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
TKES		47.5	46.6	47.4	50.9	52.5	51.8	50.1	51.0	53.1	58.6	59.1	53.3
RELEASES THRU OUTLET 1													
QOMN		-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
QOUTL		0.0	.0	0.0	.0	0.0	0.0	1374.3	3561.7	6816.3	3090.1	0.0	0.0
TOUTL		0.0	45.2	0.0	45.2	0.0	0.0	45.3	46.0	51.3	57.7	0.0	0.0
RELEASES THRU OUTLET 2													
QOMN		3195.8	2457.8	2644.4	1494.0	2036.2	4977.8	5854.8	3421.8	0.0	161.0	2409.9	2062.2
QOUTL		3195.8	2457.8	2644.4	1494.0	2036.2	4977.8	5854.8	3421.8	0.0	161.0	2409.9	2062.2
TOUTL		47.9	45.7	45.5	45.6	45.8	46.3	47.4	50.6	0.0	62.5	60.6	55.0
RELEASES THRU OUTLET 3													
QOMN		0.0	0.0	0.0	747.8	2032.9	1660.4	0.0	0.0	0.0	0.0	0.0	0.0
QOUTL		0.0	0.0	0.0	747.8	2032.9	1660.4	0.0	0.0	0.0	0.0	0.0	0.0
TOUTL		0.0	0.0	0.0	49.5	52.0	57.6	0.0	0.0	0.0	0.0	0.0	0.0

1
0END-OF-FILE ENCOUNTERED, FILENAME - MP1SHA
ERROR NUMBER 65 DETECTED BY INPC= AT ADDRESS 000151
CALLED FROM C095 AT LINE 52

OPERATIONAL TEMPERATURE CONTROL STUDY
APRIL 1992 FORECAST - MOST PROBABLE

LOCATION	J	F	M	A	M	J	J	A	S	O	N	D
TLO-TAF	0.	0.	0.	0.	0.	0.	120.	80.	33.	18.	0.	0.
TLO-F	0.0	0.0	0.0	0.0	0.0	0.0	44.3	45.2	46.5	0.0	0.0	0.0
TPO-TAF	23.	19.	33.	73.	120.	196.	21.	0.	0.	0.	16.	95.
TPO-F	44.9	44.6	44.5	44.5	44.6	45.4	46.9	0.0	0.0	0.0	52.4	53.7
TR-TAF	23.	19.	33.	73.	120.	196.	141.	80.	33.	18.	16.	95.
TR-F	44.9	44.6	44.5	44.5	44.6	45.4	44.7	45.2	46.5	47.0	52.4	53.7
LEW-TAF	23.	18.	19.	18.	19.	99.	36.	36.	32.	18.	12.	19.
LEW-F	40.4	44.1	48.4	49.4	50.5	50.7	52.2	55.7	57.8	53.3	44.8	50.1
DC-F	40.6	43.8	47.2	49.4	54.5	51.8	57.0	58.9	59.7	54.8	45.7	48.2
NF-F	41.2	43.8	46.4	49.7	57.3	54.5	62.6	63.7	62.7	57.3	47.1	45.0
SC-TAF	0.	33.	81.	60.	100.	100.	102.	40.	0.	20.	70.	83.
SC-F	44.0	44.2	45.7	47.2	49.8	54.0	57.7	60.1	0.0	61.9	56.7	49.7
S742-TAF	0.	0.	0.	0.	0.	0.	84.	219.	406.	190.	0.	0.
S742-F	0.0	45.2	0.0	45.2	0.0	0.0	45.3	46.0	51.3	57.7	0.0	0.0
S815-TAF	197.	137.	163.	89.	125.	296.	360.	210.	0.	10.	143.	127.
S815-F	47.9	45.7	45.5	45.6	45.8	46.3	47.4	50.6	0.0	62.5	60.6	55.0
S942-TAF	0.	0.	0.	45.	125.	99.	0.	0.	0.	0.	0.	0.
S942-F	0.0	0.0	0.0	49.5	52.0	57.6	0.0	0.0	0.0	0.0	0.0	0.0
SH-TAF	197.	137.	163.	133.	250.	395.	445.	429.	406.	200.	143.	127.
SH-F	47.9	45.7	45.5	46.9	48.9	49.1	47.0	48.3	51.3	57.9	60.6	55.0
KASC-F	47.5	46.6	47.4	50.9	52.5	51.8	50.1	51.0	53.1	58.6	59.1	53.3
KES-F	47.5	46.1	46.8	49.8	51.7	52.2	51.5	51.8	53.1	58.9	58.3	51.9
ACL-F	47.2	46.7	47.8	51.7	53.7	54.0	53.5	53.7	54.5	59.3	57.7	51.3
BCL-F	47.2	46.7	47.9	51.8	53.8	54.1	53.6	53.8	54.6	59.3	57.6	51.2
CC-F	46.8	47.3	48.9	53.7	56.0	56.0	55.8	56.0	56.1	59.8	56.9	50.5
BB-F	46.0	47.7	50.2	55.5	58.5	58.6	59.2	59.1	59.0	60.3	55.6	48.0
RB-F	45.8	48.0	50.8	56.5	59.6	59.8	60.6	60.5	59.9	60.6	55.3	47.8

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16.22.14.JACK,CM300000,T700.
16.22.14.$USER,MPPWQ06,.
16.22.14.ABSC,  B.
16.22.14. YOUR PASSWORD EXPIRES AT 00.00.00 ON 92/06/01.
16.22.14.CHARGE,*.
16.22.14. CHARGE = 203000, PROJECT = 2723.
16.22.15.ZZZZZG1.
16.22.15.PROC2. SYSTEM PROLOGUE
16.22.15.     $NOEXIT.
16.22.15.          $COPY ( DOT )
16.22.15. EOI ENCOUNTERED.
16.22.15.          $DISMOTD.
16.22.16.$RETURN(TIDFIL,MOTD,PROC1,ZZZZZOU,DOT)
16.22.16.$ONEXIT.
16.22.16.HEADING,A.$1PROG 095
16.22.16.HEADING,A.$ ROWELL
16.22.16.HEADING,A.$ EXT 4923
16.22.16.HEADING,A.$ 20302
16.22.17.GET,TRINO,MP1TRN.
16.22.17.FTN,I=TRINO,L=0.
16.22.19.     7.967 CP SECONDS COMPILATION TIME
16.22.19.LGO,MP1TRN,A.
16.22.19.  CM LWA+1 =104003B, LOADER USED 121700B
16.22.21.FTN - FATAL ERROR   65
16.22.21.    113200 MAXIMUM EXECUTION FL.
16.22.21.     3.201 CP SECONDS EXECUTION TIME.
16.22.21.EXIT.
16.22.21.REPLACE,TAPE24,TAPE25,TAPE32.
16.22.21.REPLACE,TAPE28,TAPE29.
16.22.22.REPLACE,TAPE33,TAPE34,TAPE35,TAPE36.
16.22.22.REPLACE,TAPE37,TAPE38,TAPE39,TAPE40.
16.22.23.GET,TRINTP1,TAPE1=TRINAME.
16.22.23.GET,TAPE32,TAPE36,TAPE38.
16.22.23.REWIND,*,A.
16.22.23.  24 FILES PROCESSED.
16.22.23.FTN,I=TRINTP1,L=0.
16.22.24.      .515 CP SECONDS COMPILATION TIME
16.22.24.LGO,,A.
16.22.24.  CM LWA+1 = 30460B, LOADER USED  46200B
16.22.24.     END  TRINTP
16.22.24.    037400 MAXIMUM EXECUTION FL.
16.22.24.     0.153 CP SECONDS EXECUTION TIME.
16.22.24.REPLACE,TAPE41.
16.22.24.GET,SHAS1,MP1SHA.
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 16.22.25.REWIND,*,A.
 16.22.25.  27 FILES PROCESSED.
 16.22.25.FTN,I=SHAS1,L=0.
 16.22.27.     7.752 CP SECONDS COMPILATION TIME
 16.22.27.LGO,MP1SHA,A.
 16.22.27.  CM LWA+1 = 73301B, LOADER USED 111200B
 16.22.28.FTN - FATAL ERROR   65
 16.22.28.    102300 MAXIMUM EXECUTION FL.
 16.22.28.     2.103 CP SECONDS EXECUTION TIME.
 16.22.28.EXIT.
 16.22.28.REPLACE,TAPE22,TAPE23.
 16.22.29.REPLACE,TAPE16,TAPE17,TAPE18.
 16.22.29.REPLACE,TAPE19,TAPE20,TAPE30,TAPE31.
 16.22.30.GET,USRTMCT.
1    FULL  DAYFILE.  92/04/29. 16.22.35.*16.22.30* PAGE    2

 16.22.30.GET,TAPE21=REDKENR,TAPE26=ACRB8.
 16.22.30.GET,TAPE16,TAPE17,TAPE18,TAPE19,TAPE20.
 16.22.31.GET,TAPE22,TAPE23,TAPE24,TAPE25,TAPE32.
 16.22.31.GET,TAPE28,TAPE29,TAPE41,TAPE30,TAPE31.
 16.22.32.GET,TAPE33,TAPE34,TAPE35,TAPE36.
 16.22.32.GET,TAPE37,TAPE38,TAPE39,TAPE40.
 16.22.33.REWIND,*,A.
 16.22.33.  40 FILES PROCESSED.
 16.22.33.FTN,I=USRTMCT,L=0.
 16.22.34.     2.116 CP SECONDS COMPILATION TIME
 16.22.34.LGO,,A.
 16.22.34.  CM LWA+1 =166307B, LOADER USED 204100B
 16.22.35.     END  USRTEMP
 16.22.35.    175300 MAXIMUM EXECUTION FL.
 16.22.35.     0.354 CP SECONDS EXECUTION TIME.
 16.22.35.REPLACE,TAPE1.
 16.22.35.DAYFILE,A.
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