MANUAL FOR COMPARING METHODS OF DESIGNING HYDROLOGIC-DATA-COLLECTION NETWORKS

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ABSTRACT

This report describes a method, based on random subsampling of real data, for comparison of network-design technologies that have a common objective. Two such technologies, Network Analysis for Regional Information (NARI) and Network Analysis Using Generalized Least Squares (NAUGLS), were chosen to illustrate the comparison technique by using a data base from a network of gages in the central part of the United States. In general, the results for the illustrative example indicate that the NAUGLS method conveys more information than the NARI method to the network designer interested in maximizing regional information about mean annual flows given a limited budget.

INTRODUCTION

The World Meteorological Organization (WMO) has had a long and productive involvement with the hydrometeorological services of its member countries in the development and dissemination of technology for the design of hydrometeorological-data networks (Rodda,1969; World Meteorological Organization, 1972; Moss, 1982). However, to date, the testing of such technology has not been conducted in a formal sense under the aegis of WMO. At the Seventh Session of its Commission for Hydrology (World Meteorological Organization, 1984), WMO decided to create a new project that would compare several of the technologies that the services were using to design networks. This project, known as HYNET, incorporates the concept of using actual data for split-sample testing (Efron, 1982) that has been used successfully in other comparison projects (World Meteorological Organization, 1975; World Meteorological Organization, 1986).

The main difficulty in implementing the HYNET project has been the non-comensurate nature of the various technologies that are used by the hydromeorological services. To conduct a truly valid comparison of two or more technologies, the objective that the resulting data sets are to address must be the same for each technology. This communality of objective was absent in the responses of the member countries to an initial survey of interest in HYNET conducted by WMO. Therefore, it was decided to illustrate the conduct of an comparison of network-design technologies with two procedures developed and used in the United States of America that did exhibit a common objective. This approach was chosen to demonstrate the utility of such comparisons, with the hope that it would stimulate movement toward common objectives that would permit subsequent comparison of a broader international suite of network-design technologies.

Purpose and scope

The purpose of this report is to document how a study to compare network-design techniques by use of random resampling of real data can be conducted. Data obtained from a streamflow gaging station network in the central part of the United States are used to illustrate the method. The report describes the approach and compares two network-design technologies currently in use in the United States that select gages to be operated to optimize regional information.

Approach

The chosen approach takes advantage of randomly selected subsets of actual hydrologic data to simulate the design of a network and its subsequent implementation and evaluation. By repeated sampling from an existing data set, the statistics of the effectiveness, in a particular hydrologic context, of the network-design technologies in addressing their common objective can be developed and used as the basis for comparison.

The approach can be illustrated by a hypothetical example. Suppose that a data set exists in a particular region that has been determined to be homogeneous with respect to the underlying assumptions of the network-design technologies that are to be compared. This data set consists of the records from N stream-gages, each of which has been operated for M years. Thus, if an annual streamflow characteristic, like mean annual discharge or mean annual flood, is a variable of interest, there are NxM observations that can be derived from the data set. To conduct an experiment, n streamgages, where n is less than the minimum of N or 50, are randomly selected from the data set and m(i) observations, where i=1,n, are selected for each gage. The values of m(i), the lengths of record at each site, are set by the experimental design. This data subset is used in conjunction with each technology to design data networks that are to be operated during a hypothetical planning horizon, which also is defined by the experimental design. Because of data limitations, the network designs are constrained to operate no more than Np gages during the planning horizon. The planning horizon must be less than or equal to M minus the maximum of the m(i); it also must be less than or equal to 50 minus the maximum of the m(i). For each network design, the projected level of satisfaction of the objective at the end of the planning horizon is recorded.

For each network design -- that is, one for each technology being compared, actual data are selected from the remainder of the original data set to conform with each design. These data are incorporated with those used in the design to compute the actual level of satifaction of the design objective. For each technology, the difference between the projected and achieved levels of satisfaction is used as a measure of the validity of each network design for the given sample of streamflow data -- the smaller the absolute difference, the better the technique.

Because of the random nature of streamflow, a single simulation of the network-design comparison does not provide strong evidence of the superiority among the technologies. To strengthen the evidence, other random samples from the NxM data set with the same n and m(i) dimensions can be selected and the simulation repeated. By analyzing the statistics of a suite of simulations, stronger statements can be made concerning the relative utility of the technologies in the hydrologic setting of the experiment.

Other experiments can be conducted by changing n or m(i) or by selecting data sets from other hydrologic regimes. By conducting a broad set of experiments, the robustness of the individual technologies can be determined.

METHODS OF NETWORK DESIGN

The two U.S. technologies that have been incorporated into the current version of the HYNET programs are Network Analysis for Regional Information (NARI) as described by Moss and others (1982) and Network Analysis Using Generalized Least Squares (NAUGLS) as described by Tasker (1986). Each of these technologies has as its goal the definition of data networks that will serve as efficient information bases for the estimation of statistical parameters of streamflow at ungaged sites in a homogeneous region; each also uses a regression model of streamflow parameter against physiographic and climatic characteristics as the mechanism for estimation. Each of these technologies has the capability of being used to design networks for the estimation of any one of several streamflow characteristics. For the HYNET project, the estimation of mean annual discharge was chosen as the parameter of interest, and the common objective of the two technologies was to minimize its expected mean squared error of estimation at ungaged sites in a homogeneous region. The definition of a homogeneous region is discussed under Data Set Selection.

The NARI technology, which evolved from earlier work of Carter and Benson (1971), relies on ordinary least squares to calibrate the regression relation and is based on results of simulations using stochastic hydrology. NAUGLS conceptually improves on NARI by the use of generalized least squares (Stedinger and Tasker, 1985), which permits the individual values of the computed streamflow characteristics at each gaged site to be weighted in inverse relation to the estimate of its accuracy. NAUGLS does not rely on simulation and is much more mathematically elegant than NARI. However, NAUGLS does entail some simplifying assumptions in developing its weighting scheme. Thus, HYNET becomes a desirable approach to test whether the added elegance of NAUGLS in combination with its simplifying assumptions is a practical improvement over the more simplistic NARI.

DATA SET SELECTION

The larger the original data set, the more powerful and robust will be the conclusions that can be developed from it. However, there are two criteria that potentially limit the data-set size: (1) the records for each of the N streamgages must be representative of a homogeneous hydrologic region and (2) records for each streamgage should be continous for a common period of M years. Neither of these criteria is an absolute requirement, but significant deviations from either will weaken the resulting conclusions.

The definition of homogeneous hydrologic regions has been a topic of research within the hydrologic community (Wiltshire, 1986). The approach taken in each of the HYNET technologies is that homogeneity is relative to the level of sophistication contained in the underlying regression model. For example, if the logarithm of mean anual streamflow is to be regressed against the logarithm of basin drainage area, a homogeneous region for this model would consist only of stream reaches that are influenced similarly by precipitation regimes, soils, vegetation, and other morphological characteristics of the drainage upstream from the reach. Any significant inclusion of subareas that violate this assumption increases the inherent error of the underlying model and, thereby, decreases the ability of the model to to utilize the data in providing more accurate estimates. On the other hand, if concepts and variables that capture more of the understanding of the hydrologic processes are available, the homogeneous region expands to incorporate subregions with deviations that can be explained by the added complexity. Thus, in implementing HYNET, there is a trade off between the desirablity of large data sets and the added effort required to achieve homogeneity within the data set. An arbitrary selection has been made for the current version of HYNET to use two independent variables-- drainage area and mean annual precipitation-- in the regressions. Therefore, the data set should be as homogeneous as possible with respect to all other causal factors of annual discharge.

If the second criterion can not be met explicitly, there are two options for the implementation of HYNET. The first option is to remove streamgages and/or shorten the common time period to the point that the criterion is met. By exercising this option, the range of data availability -- that is, the number of gages and lengths of record -- over which the technologies can be compared will be reduced, and the robustness of the comparison will be impaired. The second option is to fill the gaps within the NxM matrix with statistically valid procedures (Kendall and others, 1983). A minimal amount (less than a few percent) of such synthetic data will not compromize the conclusions that can be drawn from the analysis.

STEPS IN EVALUATING A NETWORK DESIGN

The execution of an individual phase of the HYNET project is conducted in a series of steps, as illustrated in figure 1. Each of these steps is demonstrated herein by use of an example from the central part of the United States.

Identify data base

The current version of the HYNET program restricts the number of gaging stations to a maximum of 150 and the period of record at any station to a maximum of 50 years. The NxM data base for the implementation of HYNET must fall within these limits.

The United States Geological Survey operates and maintains records for approximately 7000 thousand gaging stations in the United States. These gages monitor streamflow from areas with climatic conditions ranging from arid to humid and with terrain ranging from mountains to plains. This demonstration study was limited to the upper central portion of the United States (figure 2) because of the region's roughly similar climate and topography. Only those stations that were operated, at least in part, for the purpose of collecting regional information and had complete record for the period 1955-1984 were considered. The 146 stations that form the potential data base for this example have drainage areas that range between 32 and 24,730 square kilometers and mean annual precipitation ranging between 77 and 117 cm as shown in figure 3.

Investigate regional homogeneity

To investigate the regional homogeneity of the potential data base, mean annual discharge was computed for each of the 146 gaging stations for the common period of record, 1955-1984, and a regression of the natural logarithms of these values against the natural logarithms of the independent variables, drainage area and mean annual precipitation, was performed. The resulting regression had a coefficient of determination of 0.99 and a standard error of estimation of 14 percent. A plot of the data-based estimates of mean annual discharge against those derived from the regression (figure 4) shows no unusual outliers. Figure 5, a map of residuals (the regression estimates minus the data-based estimates), shows a trend from east to west. However, because of the overall goodness of fit of the regression, it was felt that this trend was not a significant violation of the assumption of homogeneity. Thus, the conclusion from this step is that all 146 stations comprise a sufficiently homogeneous region for the purposes of the HYNET study.

Compile data

Because there are no discontinuities in the 146 records used in the U. S. example, there is no need to complete the data base with synthetic data. However, if it were necessary, synthetic data should be generated and added to the data base prior to its formatting for input to the HYNET program.

The data-base format is arranged sequentially by streamgage -- that is, all data for a particular gage are maintained as a separate record. Each record consists of ten lines of information. Table 1 shows the layout of the first two records (gages) of the U.S. example. The first line contains a gage number and name; lines two through ten, annual mean discharges for the years 1901-1990 with ten fields or values per line; line eleven contains the drainage area upstream from the gage and the mean annual precipitation on the drainage upstream from the gage. In lines two through eleven, column 1 is blank followed by up to ten fields of seven columns each. Years with no value of annual mean discharge, neither measured nor synthetic, are indicated by -1. There should be no negative or missing values in the concurrent records used for the HYNET analysis (1955-1984 in the example).

Table 1. Layout of records for HYNET example. [Annual means are shown in cubic meters per second, drainage area is in square kilometers, and mean annual precipitation is in centimeters. Values of -1.00 indicate missing values]

03086500	MAHONING R AT ALLIANCE OH								
-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
-1.00	1.671	2.625	1.068	2.027	2.486	2.537	1.940	1.923	2.656
3.511	3.228	1.747	1.175	2.832	3.851	2.220	3.030	3.002	2.710
1.957	1.407	1.543	1.875	1.708	1.492	2.226	2.138	1.716	2.461
2.682	2.478	3.455	3.596	4.474	2.945	2.246	3.908	3.398	2.945
3.426	2.860	2.741	3.936	2.945	-1.00	-1.00	-1.00	-1.00	-1.00
231.0	94.0								
03092000	KALE C NR PRICETOWN OH								
-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
-1.00	0.513	0.733	0.374	0.470	0.544	0.790	0.450	0.402	0.750
0.804	0.889	0.365	0.391	0.733	1.031	0.558	0.685	0.824	0.787
0.425	0.374	0.309	0.589	0.442	0.419	0.532	0.459	0.586	0.646
0.614	0.807	0.855	1.014	1.220	1.152	0.634	1.056	0.963	0.714
0.603	0.612	0.637	0.753	0.614	-1.00	-1.00	-1.00	-1.00	-1.00
56.7	96.5								

Design Experiments

Each experiment is characterized by an individual set of values for the parameters shown in table 2. The goal of the HYNET comparison is to test the network-design technologies over a range of conditions that bracket most situations encountered by hydromeorological services throughout the world. Therefore, for each hydrologic setting to be investigated, it is desireable to compare the technologies when the designs are based on the existence of either sparse or replete data sets and for conditions under which the designer expects either austere or abundant budgets during the planning horizon. To span this multidimensional space of potential experiments, it is convenient to separate the initial experimental design into two facets: (1) selection of the parameters that describe the data base available for performing the network design and (2) selection of the parameters that constrain the design outcomes.

The first dimension of data availability is the number of gages that can provide data for the initial regressions that serve as the basis of each network design. For the sparse situation, it is assumed that ten individual gage records are available in the homogeneous region; for the data-rich case, it is assumed that 30 records are available.

The second dimension of data availability is the temporal one, the lengths of the available records. In most actual situations, che records available at any given time are variable in length. The HYNET program mimics this charateristic by providing for the selection of three different lengths within any experiment. Therefore, selection of the three record lengths and the fractions of the records of each length comprise the second step in the experimental design. For the initial designs, it is assumed that records of 5, 8, and 10 years length are available to represent the sparse-data situation, with 30, 40, and 30 percent, respectively, of the records being of each length. To explore the data-rich condition, it was chosen that records of 10, 15, and 20 years be available with a respective distribution of 30, 40, and 30 percent in each category. Combining the sparse and replete characteristics in each dimension defines four data-availability conditions.

Table 2 -- Experimental design parameters

Symbol	Definition
NB	Number of gages with record available for the initial regressions
L1	Record length in the first category, in years
N1	Number of gages with record length of L1
L2	Record length in the second category, in years
N2	Number of gages with record length of L2
L3	Record length in the third category, in years
N3	Number of gages with record length of L3
PH	Length of planning horizon, in years
NP	Maximum number of gages operated during the planning horizon

As with data availability, there are two dimensions to design constraints: (1) the number of gages that can be operated in the future -- a budgetary constraint, and (2) the length of the planning horizon -- a time constraint. To represent austere budgets, it is assumed that 10 gages can be operated; under the abundant budget, funds for 40 gages are assumed. For the length of the planning horizon, values of 5 and 10 years are of interest.

Each of the two facets of experimental design contains four pairs of conditions. When the two facets are combined, sixteen scenarios result, each of which defines a desirable experiment for implementation of HYNET. These 16 basic experiments, enumerated in table 3, bracket the extremities of the HYNET sample space. In addition to these experiments, at least one experiment in the interior of the sample space would be desireable. Therefore, an experiment in which 20 records are available for the regression--six of which are 10 years long, eight of which are 12 years long, and six of which are 15 years long--is favored. The prefered planning horizon for the experiment is 10 years and the prefered budget would provide for 25 gages during the planning horizon.

Table 3 -- Basic experiments

Data availability	Design constraints	Design parameters NB, L3, PH, NP
Few, short records	Austere budget, short horizon	10, 10, 5, 10
	Austere budget, modest horizon	10, 10, 10, 10
	Adequate budget, short horizon	10, 10, 5, 40
	Adequate budget, modest horizon	10, 10, 10, 40
Few, long records	Austere budget, short horizon	10, 20, 5, 10
	Austere budget, modest horizon	10, 20, 10, 10
	Adequate budget, short horizon	10, 20, 5, 40
	Adequate budget, modest horizon	10, 20, 10, 40
Many, short records	Austere budget, short horizon	30, 10, 5, 10
	Austere budget, modest horizon	30, 10, 10, 10
	Adequate budget, short horizon	30, 10, 5, 40
	Adequate budget, modest horizon	30, 10, 10, 40
Many, long records	Austere budget, short horizon	30, 20, 5, 10
	Austere budget, modest horizon	30, 20, 10, 10
	Adequate budget, short horizon	30, 20, 5, 40
	Adequate budget, modest horizon	30, 20, 10, 40

For any given experiment, the minimum size of the actual data set is a function of the parameters of the experiment: (1) the minimum number of gaged records is equal to the sum of the number of gages available for the initial regressions and the number of gages that can be operated during the planning horizon, and (2) the minimum length of concurrent record equals the sum of the maximum length of record available for the initial regressions and the length of the planning horizon. To accomplish the full suite of experiments described in table 3, an actual data base comprised of at least 70 gages (N), that have concurrent records with a minimum of 30 years (M), is required. This limitation derives from the data-rich, abundant-budget scenario, which is the experiment with the greatest data demand. If the minimum data set is not available, those experiments listed in table 3 that fall within the constraints described above would be executed. Furthermore, when N is less than 70 and M is less than 30, one additional experiment that just fits within the constraints should be run.

As was discussed in the section on data-set selection, the larger the actual data set that is provided for the HYNET program, the more credible will be the results. If more than 70 gages are available from the homogeneous region or if concurrent records of length greater than 30 years exist, these additional data would be included in the data set.

Execute experiments

The computer program for comparison of the NARI and NAUGLS procedures consists of a main program (HN.F77) and 37 subprograms and functions (see Appendix A for listing). The program requires approximately 420K bytes of memory and will run 100 repetitions in about 120 minutes of CPU on a computer that can perform 4.5 million instructions per second.

In addition to the streamflow-data file, input to the HYNET program is made from the keyboard in response to prompts that appear on the computer screen. An example is shown in table 4.

HYNET computer program output consists of the values of 15 variables as shown in table 5. The first 10 variables are the parameters that define the experiment; the last five are the results of the experiment. Output for the seventeen experiments in the U.S. example are given in appendix C.

Table 4. Example of prompts and responses as they appear on the screen and are typed from keyboard, respectively, for running the HYNET program.

```
=============================================================

 Please enter total number of stations in file
146

 Please enter beginning year and ending year of
 complete record for all sites. -- example 1955 1984
1955 1984

 Please enter name of output file
ex1.out

 Please enter the number of stations with record
 available for the initial regressions, NB.
10

 Please enter length of planning horizon, PH, in years
 5

 Please enter maximum number of gages that can be operated at one time, NP
10

 There are 10 stations in network
 Please enter 3 pairs of number of station-rec length combinations
 N1   L1   N2   L2   N3   L3
3  5  4  8  3  10

 Please enter number of repetitions
100
=============================================================
```

Table 5 -- HYNET output variables

Variable number	Description
	Data Availability
1	Number of gages (NB)
2	Record length in the first category, in years (L1)
3	Number of gages in the first category (N1)
4	Record length in the second category, in years (L2)
5	Number of gages in the second category (N2)
6	Record length in the third category, in years (L3)
7	Number of gages in the third category (N3)
	Design Constraints
8	Planning horizon, in years (PH)
9	Maximum number of gages during the planning horizon (NP)
10	Number of repetitions in the experiment
	Results of the Experiment
11	Mean error of NARI designs, in percent
12	Mean error of NAUGLS designs, in percent
13	Root mean squared error of NARI designs, in percent
14	Root mean squared error of NAUGLS designs, in percent
15	Relative information content of NAUGLS to NARI

Output variables 11 through 14 are based on differences of the projected and realized standard error of estimate of mean annual discharge, expressed as percentages of the individual repetitions within the experiment. For example, if the network design for NARI indicated that the standard error of estimate would be 10 percent at the end of the planning horizon and the realization of the network design resulted in only 8 percent, the difference for this particular repetition would be 2 percent. The averages of 100 differences for each experiment, both for NARI and NAUGLS, are variables 11 and 12. Variables 13 and 14 are the averages of the squares of the 100 differences for each technology. Variable 15, the relative information of NAUGLS to that of NARI, is the ratio of the square of variable 13 to the square of variable 14.

Analyze Results

The primary measure of the reliability of a network-design technology is the reciprocal of the mean squared error -- that is, the root mean squared error squared. This measure is the equivalent of the technology's information content about the regional information at the end of the planning horizon if the network design is implemented. Therefore, if the information content of one technology exceeds the other by a significant amount, it can be said to be the superior technology for the conditions of the given experiment. One way of portraying the comparison of the two technologies is by the reciprocal of the ratio of their mean squared errors, which is a measure of their relative information contents (Matalas and Langbein, 1962). For example, if the mean squared error of NARI is divided by that of NAUGLS, the result is the relative information of NAUGLS to NARI. If the ratio is significantly greater than 1.0, NAUGLS is superior to NARI for the conditions of the experiment; if the ratio is significantly less than 1.0, then NARI is superior to NAUGLS; and if the ratio is approximately equal to 1.0, the choice between the technologies is an insensitive one. Relative information should be computed for each experiment, and the regions in the design sample space where one technology is superior to the other should be defined. The results for the U.S. example are summarized in table 6.

Table 6. Summary of results for comparison of Network Analysis for Regional Information (NARI) and Network Analysis Using Generalized Least Squares (NAUGLS).

EXP NO.	NB	L3	PH	NP	BIAS (in, percent) NARI	NAUGLS	RMSE(in, percent) NARI	NAUGLS	RELATIVE INFORMATION [mse(NARI)/mse(NAUGLS)]
1	10	10	5	10	1.62	- 0.65	4.07	3.20	1.6
2	10	10	10	10	2.15	- 0.25	4.20	2.75	2.3
3	10	10	5	40	0.91	- 0.82	3.74	2.93	1.6
4	10	10	10	40	1.65	- 0.18	3.83	2.57	2.2
5	10	20	5	10	1.26	- 0.16	3.03	2.26	1.8
6	10	20	10	10	1.80	0.11	3.06	1.95	2.5
7	10	20	5	40	0.44	- 0.37	3.08	2.24	1.9
8	10	20	10	40	1.33	- 0.02	2.79	1.86	2.2
9	30	10	5	10	0.71	- 0.08	2.24	1.70	1.7
10	30	10	10	10	1.12	0.20	2.40	1.75	1.9
11	30	10	5	40	0.62	- 0.18	2.08	1.71	1.5
12	30	10	10	40	1.16	0.18	2.33	1.76	1.8
13	30	20	5	10	0.74	0.21	1.40	1.02	1.9
14	30	20	10	10	0.94	0.39	1.49	1.06	2.0
15	30	20	5	40	0.65	0.24	1.39	1.04	1.8
16	30	20	10	40	0.97	0.34	1.47	1.04	2.0
17	20	15	10	25	1.14	0.39	2.15	1.55	1.9

Design, run, and analyze complementary experiments

If the basic experiments are not dense enough to define the regions of superiority, additional experiments, in the vicinities where shifts in dominance are suspected, should be performed until the shifts are reasonably well defined.

Write report

A report on each implementation of HYNET should be prepared following the anotated outline given in table 7. A sample report for the U.S. example is provided in Appendix D.

Table 7 -- Annotated outline of final report

I. The Homogeneous Region: Describe the climate and phisiography of the region.

II. The Hydrology of the Region: Describe seasonal characteristics of the surface-water hydrology and describe the sub-surface hydrology if it has a major impact on runoff.

III. The Available Data Base: Describe the availability of surface-water records in the region, the selection of candidate gages for the data base, the tests for homogeneity, and the results of the tests; describe the accuracy of the topographic maps used to compute drainage areas; and describe the accuracy of the estimates of mean annual precipitation.

IV. The Experiments: Describe which experiments were run and what their outcomes were.

V. Conclusions: Describe which technology was superior in which parts of the sample space.

SUMMARY

Comparing streamflow network design technologies by random resampling of real data is operational for comparing two network design technologies currently in use in the United States. The network design technologies, NARI and NAUGLS, are briefly summarized. These technologies have a common objective-- to maximize regional streamflow information. The use of the computer program described in the report is illustrated by an example using a streamflow network located in the central part of the United States. The program can be used for other networks by changing the input data. However, changes in the source code (Appendix A) would have to be made if technologies other than NARI and NAUGLS are to be compared.

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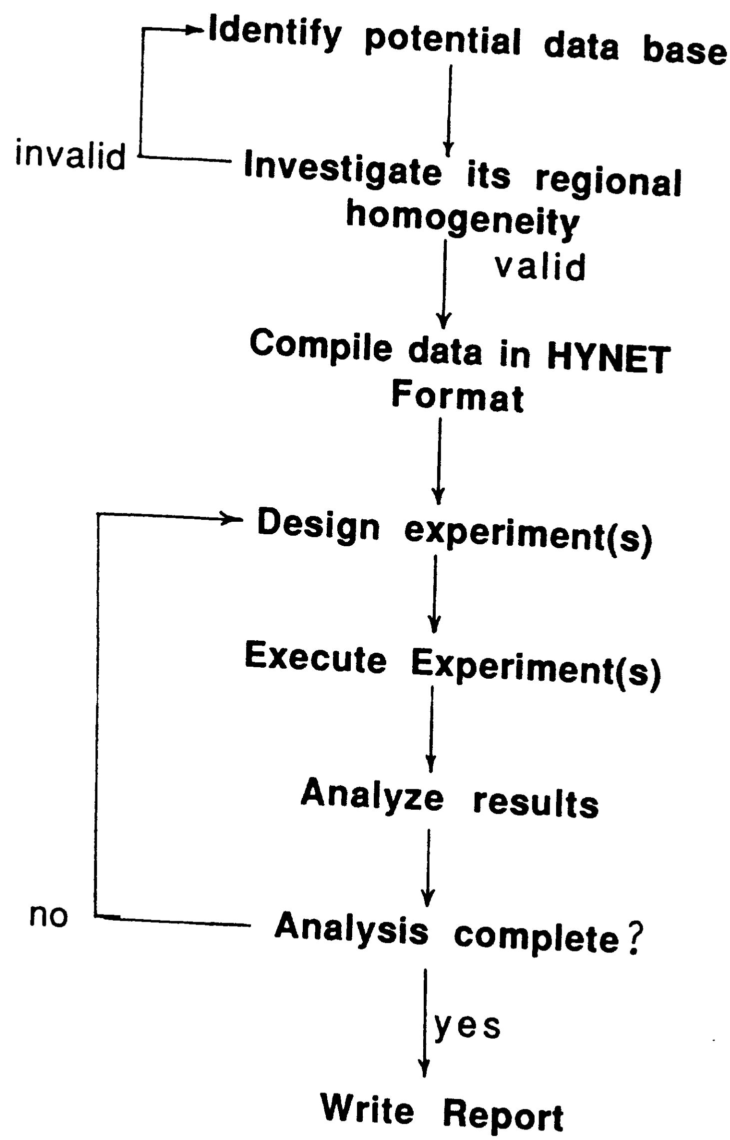

Figure 1. Flowchart for HYNET study.

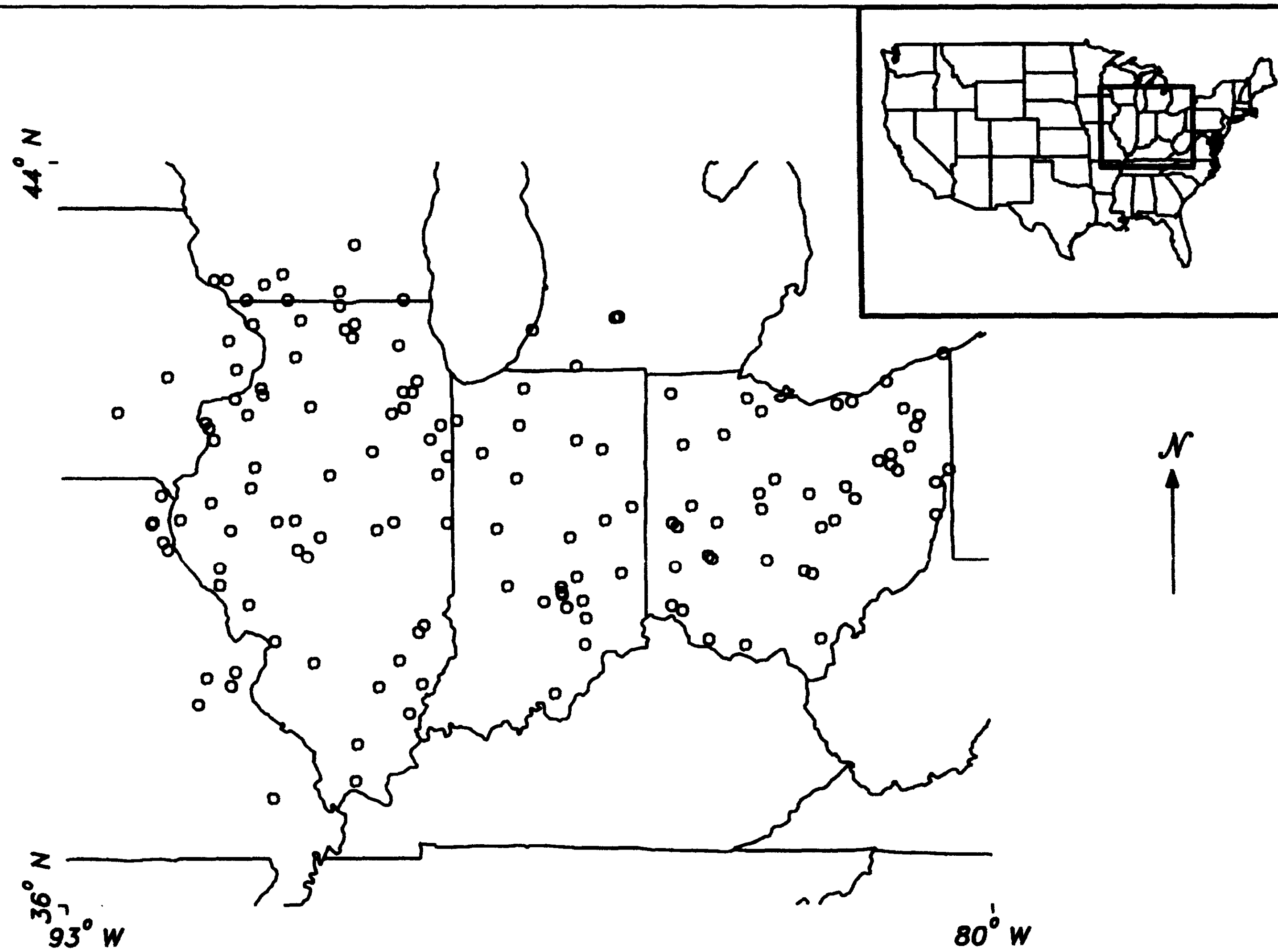

Figure 2. Location of gauging stations used in study

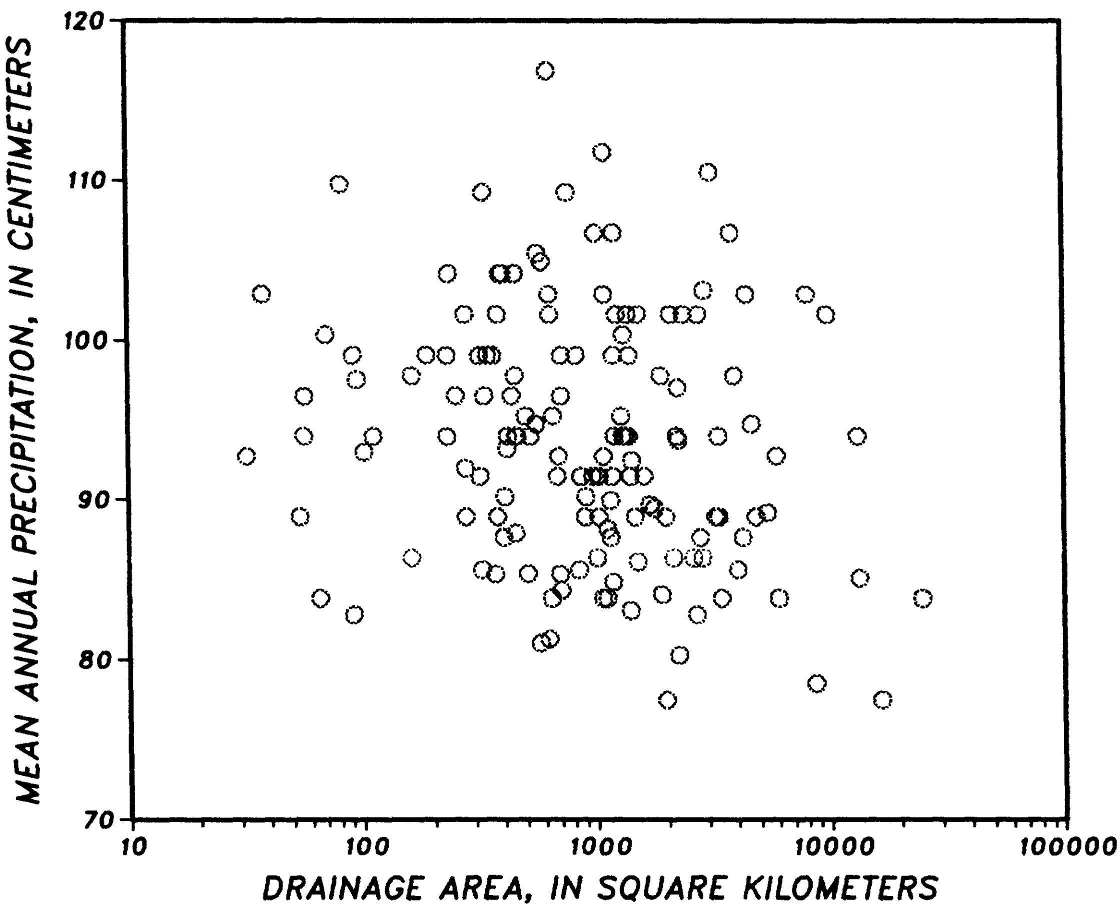

Figure 3. Plot of drainage area against mean annual precipitation for 146 stations in the United States.

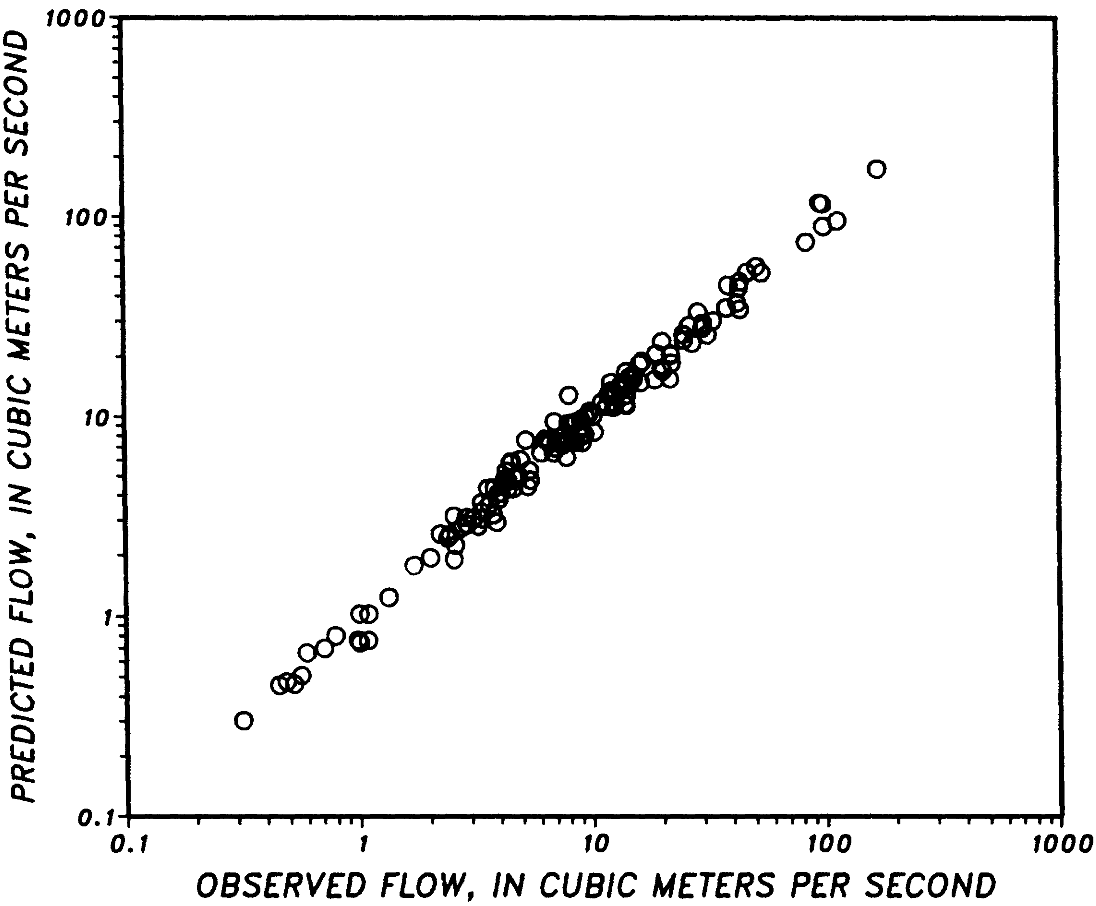

Figure 4. Predicted versus observed mean annual discharge using all data.

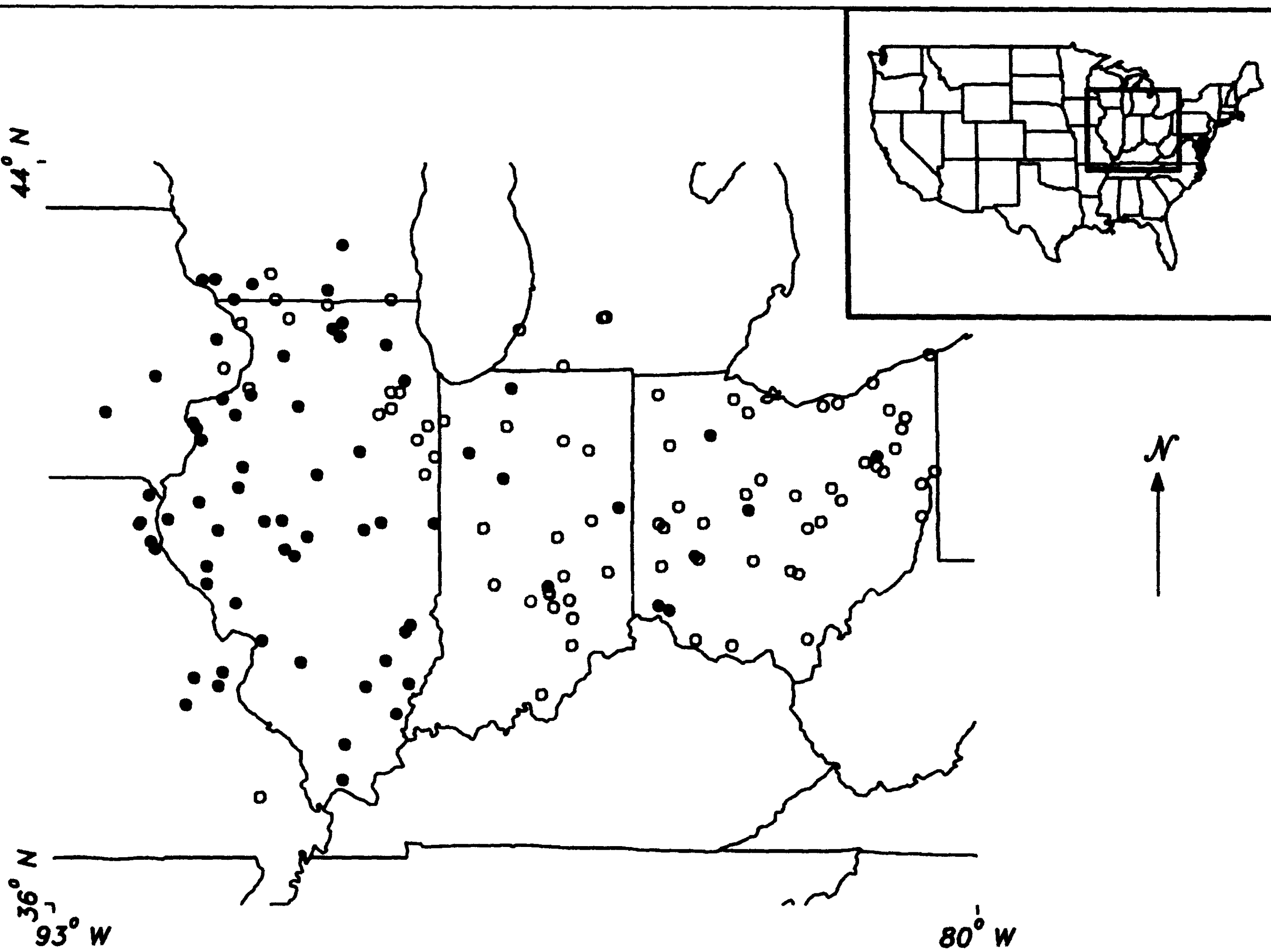

Figure 5. Positive residuals (open circles) and negative residuals (filled circles) computed from full regression model using all data.

Appendix A -- Program source code.

Table of contents

```
c program hn.f77
      include 'dimens.cmn'
      include 'gr.cmn'
      real*4  ynew(1,maxyr), danew(maxs), prnew(maxs), pick(200)
      integer*4 ipick(maxs),i,nstat,nph,nbud,n1,j1,n2,j2,n3,j3,nrep,
     +          irand,irep,ntot,npick,jhave,ipk,ii,ibeg,icount,lsta,
     +          ihave,j,jparm,jsave,k,jmax,j1b,j2b,j3b,nm,ns,nmean,
     +          minyr,isav,jend,nex,noall
      real*4 smean,ss,aa,vmean,se,varbar,rabar,recin,anb,serr,sserr,x1,
     +       x2,pred,err,errmean,prmse,obmse,bg0,bg1,bg2,
     +       gemean,gpmse,gomse,daall,prall,amall
      common /net1/ noall,daall(150), prall(150), amall(150)
      integer*4 jl,irank,ivsav
      common /c1/  jl(50), irank(50), ivsav(50,30)
      include 'nari.cmn'
      double precision stanew(1), staold(50)
      character*32 fileout
      open(5,file='hynet.dat')
      write(*,121)
  121 format(' Please enter total number of stations in file')
      read(*,*)noall
      do 41 i=1,noall
      call read5(amall(i),daall(i),prall(i))
   41 continue
      rewind(5)
c terminal queries
      write(*,122)
  122 format(' Please enter beginning year and ending year of',/,
     +' complete record for all sites. -- example 1955 1984')
      read (*,*)kbeg, kend
      kbeg=kbeg-1900
      ktot=kend-1900-kbeg+1
      write(*,98)
   98 format(' Please enter name of output file')
      read(*,97)fileout
   97 format(a32)
      open(6,file=fileout)
      endfile (6)
      rewind (6)
      write(*,100)
  100 format(' Please enter the number of stations with record ',/,
     +' available for the initial regression, NB')
      read(*,*)nstat
      write(*,200)
  200 format(' Please enter length of planning horizon, PH, in years')
      read(*,*)nph
      write(*,300)
  300 format(' Please enter maximum number of gauges that can be operate
     +d at one time, NP')
      read(*,*)nbud
      write(6,1177)nstat, nph, nbud
 1177 format(' Initial number of stations = ',i3,/,
     +' Planning horizon = ', i3,/,
     +' Number of stations to be operated in future = ', i3)
c read distribution of record lengths
      write(*,101)nstat
  101 format(' There are',i3,' stations in network',/,
     *' Please enter 3 pairs of number of station-rec length combination
     *s',/,' N1   L1   N2   L2   N3   L3')
      read(*,*)n1,j1,n2,j2,n3,j3
      write(*,103)
  103 format(' Please enter number of replications   ' )
      read(*,*)nrep
      write(6,108)nrep, n1, j1, n2, j2, n3, j3
      irand=971
c 108 format(1x,'nreps, irand, rec length dist',i5,i10,6i5)
  108 format(1x,' Number of replications = ',i5,/,
     +' Initial distribution of record lenghts',/,
     +1x,i2,' stations with ',i2,' years of record',/,
     +1x,i2,' stations with ',i2,' years of record',/,
     +1x,i2,' stations with ',i2,' years of record')
c     write(6,109)
  109 FORMAT(//,' rep no',t10,'pred ols mse',t23,'obs ols mse',
     *t36,'bias ols ',t50,'pred gls mse',t63,'obs gls mse',t76,
     *'bias gls',t86,'b1 ols',t96,'b2 ols',
     *t106,'b1 gls',t116,'b2 gls',/)
      snari=0.0
      ssnari=0.0
      sgls=0.0
      ssgls=0.0
      do 77 irep=1,nrep
```

```
      do 18 i=1,50
   18 ipick(i)=0
      rewind(5)
      ntot = nstat + nbud
c randomly pick stations
c ========= for picking with replacement =========
c     call randuv(irand,pick,50)
c     do 1 i=1,50
c     ipick(i)=pick(i)*146 + 1
c   1 continue
c ===============================================
c =====for picking without replacement ===========
      npick=1
c     call randuv(irand,pick,200)
      do 511 i=1,200
  511 pick(i)=ran2(irand)
      do 1 i=1,200
         if (npick.le.50)then
         jhave=0
         ipk=pick(i)*noall+1
c check to see if it is a repeat
            do 17 ii=1,npick
   17       if (ipick(ii).eq.ipk)jhave=1
               if (jhave.eq.0) then
               ipick(npick)=ipk
               npick=npick+1
               end if
         end if
    1 continue
      if (npick.lt.51)then
         write(*,5053)
 5053    format(' STOP-- fewer than 50 stations selected ')
         stop
      end if
c ==================================================
c randomly pick beginning year
      ibeg=ran2(irand)*ktot+kbeg
c load y matrices
      icount=0
c     jstart=1
      do 2 i=1,noall
      lsta=i
      ihave=0
      do 3 j=1,50
      if (ipick(j).eq.lsta)then
         jparm=j
c        jstart=jstart+1
         ihave=ihave+1
         if(ihave.eq.1)then
            call readin(yold,50,ktot,daold,prold,staold,jparm,ibeg,kbeg)
            jsave=jparm
         else
            daold(j)=daold(jsave)
            prold(j)=prold(jsave)
            staold(j)=staold(jsave)
            do 15 k=1,ktot
   15       yold(j,k)=yold(jsave,k)
         end if
      end if
    3 continue
      if (ihave.eq.0)then
c        icount=icount+1
         icount =1
         call readin(ynew,1,ktot,danew,prnew,stanew,icount,ibeg,kbeg)
      end if
    2 continue
      jmax=max(j1,j2,j3)
      ixtest=jmax+nph
      if(ixtest.gt.ktot)then
         write(*,5056)
 5056    format(' STOP -- Maximum record length +'planning horizon',/,
     +   '          exceeds total years of record.')
         stop
      end if
      j1b=jmax-j1
      j2b=jmax-j2
      j3b=jmax-j3
      nm=n1+n2
      ns=n1+1
      do 7 i=1,n1
      j1(i)=j1
```

```
      if(j1b.gt.0)then
         do 6 j=1,j1b
    6    yold(i,j)=-9.9999
      end if
    7 continue
      do 9 i=ns,nm
      jl(i)=j2
      if(j2b.gt.0)then
         do 8 j=1,j2b
    8    yold(i,j)=-9.9999
      end if
    9 continue
      ns=nm+1
      do 11 i=ns,nstat
      jl(i)=j3
      if (j3b.gt.0)then
         do 10 j=1,j3b
   10    yold(i,j)=-9.9999
      end if
   11 continue
      ns=nstat+1
      do 16 i=ns,50
      jl(i)=0
      do 14 j=1,jmax
   14 yold(i,j)=-9.9999
   16 continue
c write results
      do 12 i=1,nstat
c     write(6,2000)ibeg, staold(i), daold(i), prold(i)
c     write(6,2001)(yold(i,j),j=1,30)
 2000 format(1x,i2,2x,a8,2x,f8.4,2x,f8.4)
 2001 format(10f8.4)
      smean=0.0
      slogs=0.0
      nmean=0
      ss=0.0
      do 21 j=1,jmax
      if(yold(i,j).gt.-9.)then
         nmean=nmean+1
         smean=smean+10**yold(i,j)
         slogs=slogs+(yold(i,j))
         ss=ss+(yold(i,j))**2
      end if
   21 continue
      if(nmean.gt.0)then
      aa=smean/nmean
      al=slogs/nmean
      amean(i)=alog10(aa)
      vmean=(ss-nmean*al**2)/(nmean-1.0)
      stdev(i)=sqrt(vmean)
      end if
c ======
   12 continue
c
c     write(6,9003)(amean(i),daold(i),prold(i),i=1,nstat)
 9003 format(1x,'amean,da,pr',3f10.4)
c
      call lever
      call olsreg(amean,daold,prold,nstat,se)
c
c     write(1,9001)se
 9001 format(' olsreg',f10.4)
c
      minyr=6
      call eqcov(yold,jmax,nstat,minyr,varbar,rabar,recin)
c
c     write(1,9002)rabar
 9002 format(' eqcov',f10.4)
c
      call srpos(nstat,recin,varbar,rabar,0.0,recin)
c     write(1,9006)varbar
 9006 format(1x,' srpos ',g13.5)
      anb=nstat-2
      call modlvalu(recin,anb,se)
c     write(1,9004)recin
 9004 format(1x,' modlvalu',f10.2)
      call evalu8(ntot,jmax,nph,nbud,se)
c     write(1,9005)se
 9005 format(1x,' evalu8',f10.4)
c     NE=3
      NEX=2
```

```
C
C      WRITE(1,954)NSTAT,JMAX,RABAR
  954 FORMAT(' NSTAT JMAX RABAR ',2I5,F10.2)
C
      call glsreg(nstat,jmax,rabar,nex,0)
c
c     write(1,9007)rabar
 9007 format(1x,' glsreg',f10.2)
      isav=0
      jend=jmax+nph
      do 30 i=1,50
         smean=0.0
         nmean=0
         ss=0.0
         do 31 j=1,jend
         if(ivsav(i,j).gt.0)then
            nmean=nmean+1
            smean=smean+10**yold(i,j)
            ss=ss+yold(i,j)**2
         end if
   31    continue
      if(nmean.gt.0)then
         isav=isav+1
         aa=smean/nmean
c        vmean=(ss-nmean*aa**2)/(nmean-1.0)
         amean(isav)=alog10(aa)
c        stdev(isav)=sqrt(vmean)
         danew(isav)=daold(i)
         prnew(isav)=prold(i)
      end if
   30 continue
      call olsreg(amean,danew,prnew,isav,se)
c     call glsreg(isav,jend,rabar,nex)
c
      serr=0.0
      sserr=0.0
      do 51 i=1,noall
      x1=alog10(daall(i))
      x2=alog10(prall(i))
      pred=b0+b1*x1+b2*x2
      err=pred - (amall(i))
      err=err*2.302585
      serr=serr+err
      sserr=sserr+err**2
C     write(6,1012)pred, err, daall(i), prall(i)
 1012 format(1x,'pred err da pr',4f15.4)
   51 continue
      errmean=serr/noall
c     errvar=(sserr-noall*errmean**2)/(noall-1.0)
      prmse=semin**2
c     bias2=errmean**2
c     obmse=bias2 + errvar
      obmse=sserr/noall
c     write(6,1013) irep, prmse, obmse, errmean, anbsv, anysv,
c    *a, b1, b2
 1013 format(1x,i4,3g13.5,2f10.1,3f10.4)
c
c =========
c     write (1,7001)rabar,jmax,nph,nbud
 7001 format(' call glsnet args=',f10.3,3i5)
c =========
      call glsnet(rabar,jmax,nph,nbud)
c     write(1,9009)rabar
 9009 format(1x,' glsnet',g13.5)
      call netgls(bg0,bg1,bg2,gemean,gpmse,gomse,jend,rabar)
c     write(1,9010)bg1
 9010 format(1x,' netgls',g13.5)
c
c     write(6,1014)irep,prmse,obmse,errmean,gpmse,gomse,gemean,
c    *b1,b2,bg1,bg2
 1014 format(1x,i4,6e13.5,4f10.4)
      dnari=prmse-obmse
      dgls=gpmse-gomse
c
c
      snari=snari+dnari/nrep
      ssnari=ssnari+dnari**2/nrep
      sgls=sgls+dgls/nrep
      ssgls=ssgls+dgls**2/nrep
   77 continue
      sign1=snari/(abs(snari))
```

```
      sign2=sgls/(abs(sgls))
      snari=sign1*100.0*(exp(snari**2)-1.0)**.5
      sgls=sign2*100.0*(exp(sgls**2)-1.0)**.5
      rinfo=ssnari/ssgls
      ssnari=100.0*(exp(ssnari)-1.0)**.5
      ssgls=100.0*(exp(ssgls)-1.0)**.5
      write(6,1179)
 1179 format(//,' The following statistics are based on the differences
     +, in percent,'
     +,/,'  between projected and achieved mean square error:')
      write(6,1178)snari,ssnari,sgls,ssgls,rinfo
 1178 format(' Mean difference NARI =',f10.2,/,
     +' Root-Mean-Square difference NARI =',f10.2,/,
     +' Mean difference NAUGLS =',f10.2,/,
     +' Root-Mean-Square difference NAUGLS =',f10.2,
     +///,' Relative information of network output of NAUGLS to that of
     +NARI =',f10.2)
      stop
      end
C SUBROUTINE BHIND
C
      SUBROUTINE BHIND(IPHI,KFLAG,JEVENT)
      INTEGER*4 NRCV,NEV,I,IFLAG,K,IPHI,KFLAG,JEVENT
      REAL*4 NYRS,NBAS,POGAM,POSJO,SEAPP,AGAM
      INCLUDE 'TAB.CMN'
      INCLUDE 'MV.CMN'
      COMMON/PARST2/AGAM(41),SEAPP
      COMMON/N1SET/NYRS,NBAS
      COMMON/N2SET/NRCV
      COMMON/PROSET/POGAM(41),POSJO(100)
      REAL*4 CUT,SUM,DELT,CVS,RC,GAMMA,PXU,PXL,PTU,PTL,AM,AS,ZMU,ZSD,
     +       PRI,XMU,XSD
      CUT=0.0010
  100 CONTINUE
      KFLAG=1
      IPHI=0
      SUM=0.0
      DELT=SEAPP*.01
      NEV=4*JEVENT-3
      DO 150 I=1,NRCV
          CVS=CV(I)
          RC=RHOC(I)
          IFLAG=1
          DO 140 K=1,41
              GAMMA=AGAM(K)
              PXU=SEAPP+DELT
              PXL=SEAPP-DELT
              PTU=ALOG(PXU)
              PTL=ALOG(PXL)
              IF(JEVENT.NE.6) THEN
                  CALL OBSEMT(NBAS,NYRS,CVS,RC,GAMMA,NEV,AM,AS)
                  CALL LNMOM(AM,AS,ZMU,ZSD)
                  CALL PRICAL(ZMU,ZSD,PTU,PTL,PRI)
              ELSE
                  CALL OBSESD(NBAS,NYRS,CVS,RC,GAMMA,XMU,XSD)
                  CALL PRICAL(XMU,XSD,PTU,PTL,PRI)
              ENDIF
              PRI=PRI*POGAM(K)
              IF(IFLAG.GT.1) GO TO 110
              IF(PRI.LT.CUT) GO TO 120
              IFLAG=2
  110         IF(PRI.LT.CUT) GO TO 150
  120         CONTINUE
              IF(IFLAG.LT.2) GO TO 140
              IPHI=IPHI+1
              IF(IPHI.GT.500) THEN
C                 WRITE(6,610)
                  KFLAG=2
                  RETURN
              ENDIF
              CVARAY(IPHI)=CV(I)
              RCARAY(IPHI)=RHOC(I)
              GARAY(IPHI)=GAMMA
              PRIOR(IPHI)=PROBRC(I)*PRI
              SUM=SUM+PRIOR(IPHI)
C             IF(K.EQ.41.AND.SUM.GE.0.0001) WRITE(6,620) CVS,RC
              IF(K.EQ.41.AND.SUM.GE.0.0001) KFLAG=2
  140     CONTINUE
  150 CONTINUE
      IF(SUM.GT.0.0001) THEN
          DO 200 I=1,IPHI
```

```
            PRIOR(I)=PRIOR(I)/SUM
  200     CONTINUE
          RETURN
      ENDIF
      IF(CUT.LT..001) GO TO 300
      CUT=0.0001
      GO TO 100
  300 CONTINUE
C     WRITE(6,600)
  600 FORMAT('0** OBSERVED STANDARD ERROR APPEARS TO BE INCONSISTENT WIT
     *H THE OTHER PARAMETERS..'//' THE CONDITIONAL PROBABILITY  OF SUCH
     *A COMBINATION OF PARAMETERS IS NEARLY ZERO.')
  610 FORMAT('0NUMBER OF FEASIBLE PARAMETER COMBINATIONS(PHIS) EXCEEDS N
     *UMBER ALLOTTED')
  620 FORMAT('1************ WARNING ***** THE PRODUCT OF THE LIKELIHOOD
     1AND THE PRIOR FOR MODEL ERROR HAS NOT BEEN ZEROED OUT ***'///' CV
     2= ',F5.3,' RC = ',F5.3,///,' *** THE FOLLOWING TABLE OF FEASIBLE P
     3ARAMETER COMBINATIONS IS UNUSABLE IN THE ANALYSIS ***')
      KFLAG=2
      RETURN
      END
c *****************************************************************
c ****************************************************************
c Coefficient matrix sub
c
      subroutine coefmat(rabar)
      implicit double precision (a-h,o-z)
      double precision rho2
      real*4 rabar
      integer*4 i,j
      include 'dimens.cmn'
      include 'grl-5.cmn'
      do 1 i=1,nsites
      do 1 j=1,i
         if(i.eq.j)then
            rho=1.0
         else
            rho2=rabar
            if(rho2.lt.0.0)rho2=0.0
c
c approx. bias correction see Johnson and Kotz
c
            rho=rho2+.05
         end if
         sta(i,j)=rho*mcon(i,j)*sighat(i)*sighat(j)*aj/
     +               (mcon(i,i)*mcon(j,j))
         cov(i,j)=sta(i,j)
         cov(j,i)=sta(i,j)
    1 continue
      return
      end
C ***********************************************************
C ***************************************************************
C
C     SUBROUTINE DATAIN
C
       SUBROUTINE DATAIN(ANY,ANB,SEC,JEVENT)
       REAL*4 SEAPP,AGAM,POGAM,POSJO
       COMMON /PARST2/ AGAM(41),SEAPP
       COMMON /N1SET/ NYRS,NBAS
       INTEGER*4 NUMDSN
       COMMON /DSNN1/ NBDSN(99),NYDSN(99)
       COMMON /DSNN2/ NUMDSN
       COMMON /PROSET/ POGAM(41),POSJO(100)
       REAL*4 NBDSN, NYDSN, NYRS,NBAS,ANY,ANB,SEC,FI,XNY,DEL,XNB
       CHARACTER*6 EVENT(6)
       INTEGER*4 I,IT,K,J,JFLAG,JEVENT
       DATA EVENT /' MEAN ',' 2-YR ',' 10-YR',' 50-YR','100-YR','ST DEV'/
       NYRS=ANY
       NBAS=ANB
       DO 10 I=1,41
          POGAM(I)=1.0
          FI=I
          AGAM(I)=-0.05+FI*0.05
   10 CONTINUE
       POGAM(1)=0.5
 CC    WRITE(6,20)
 CC 20 FORMAT(' NETWORK EVALUATION AND DESIGN BASED ON STANDARD ERROR OF
 CC   1REGIONAL REGRESSION.')
       NUMDSN=90
       IT=0
```

```
      SEAPP=SEC*2.3026
      IF(IT.EQ.0)JEVENT=1
      IF(IT.EQ.1) JEVENT=6
      IF(IT.EQ.2)JEVENT=2
      IF(IT.EQ.10)JEVENT=3
      IF(IT.EQ.50)JEVENT=4
      IF(IT.EQ.100)JEVENT=5
CC    WRITE(6,30)NBAS,NVRS,EVENT(JEVENT),SEAPP
CC 30 FORMAT(////,' NB = ',F5.1, ' NY = ' ,F5.1,//,A6,' EVENT ANALYSIS.'
CC   *, /,' APPARENT STANDARD ERROR OF REGIONAL REGRESSION = ',F9.4,
CC   *' IN NATURAL (BASE E) LOG UNITS')
      K=0
      XNY=0.0
      DEL=5.0
      DO 50 I=1,10
          XNB=5.0
          XNY=XNY+DEL
          DO 40 J=1,9
              K=K+1
              XNB=XNB+DEL
              NBDSN(K)=XNB
              NYDSN(K)=XNY
   40     CONTINUE
   50 CONTINUE
      JFLAG=0
      CALL EDITIN(JFLAG)
      RETURN
      END
      SUBROUTINE DECOMP(N,NDIM,XLAM,B)
      implicit double precision (a-h,o-z)
C ---------------------------------------------------------------
C  CHOLESKY DECOMPOSITION  BB-TRANSPOSE = XLAM
C ---------------------------------------------------------------
      INCLUDE 'DIMENS.CMN'
      INTEGER*4 N,NDIM,IS,ISM,JS,JSM,KS
      DOUBLE PRECISION XLAM(NDIM,NDIM), B(MAXS,MAXS),BN,BH
      IF(XLAM(1,1).LE.0..OR.XLAM(2,2).LE.0.)
     1WRITE(1,96) NDIM,XLAM(1,1),XLAM(2,1),XLAM(2,2),XLAM(1,2)
   96 FORMAT( ' IN DECOMP/ NDIM,XLAM 1-1,2-1,2-2,1-2 = ',I5,4F10.4,
     1/,' COVARIANCE MATRIX NOT POSITIVE DEFINITE')
      B(1,1)=SQRT(XLAM(1,1))
      B(1,2)=0.
      B(2,1)=XLAM(2,1)/B(1,1)
C     WRITE(1,97)B(2,2)
   97 FORMAT(1X,' B22=',F10.3)
      B(2,2)=DSQRT(XLAM(2,2)-B(2,1)**2)
CC    WRITE(6,99) NDIM, B(1,1),B(2,1),B(2,2)
   99 FORMAT(I5,/(10F10.5))
      IF(N.LE.2)RETURN
C
      DO 4 IS=3,N
      B(IS,1)=XLAM(IS,1)/B(1,1)
      BN=XLAM(IS,IS)-B(IS,1)**2
      ISM=IS-1
      DO 3 JS=2,ISM
      JSM=JS-1
      BH=XLAM(IS,JS)
      DO 2 KS=1,JSM
    2 BH=BH-B(IS,KS)*B(JS,KS)
      B(IS,JS)=BH/B(JS,JS)
    3 BN=BN-B(IS,JS)**2
      IF( BN.LE.0.) WRITE(1,98)BN, IS, JS
   98 FORMAT(1X,' COVARIANCE MATRIX NOT POSITIVE DEFINITE BN=',F10.3,
     1 ' I=',I4,'     J=',I4)
      B(IS,IS)=DSQRT(DMAX1(BN, DBLE(0)))
CC    WRITE(6,99) N,BN,(B(IS,J), J=1,IS)
    4 CONTINUE
      RETURN
      END
      SUBROUTINE DZNOUT(IPHI,JEVENT,ICARD)
      INTEGER*4 IPHI,JEVENT,ICARD,I,NUMDSN,IDSN,KGIL,MGIL,KK,I13,ICR,K,
     +          IBACK
      REAL*4 NBDSN,NYDSN,NY,NB,Z(12),W(12),V(12),PCT(12),G,XCV,XRC,WX,
     +       X,YCUM,YBAR2,YMAX2,X1(100),X2(100),Y(100)
      COMMON/CONDIS/X(12),YCUM(500,14),YBAR2(12),YMAX2(500)
      COMMON/DSNN1/NBDSN(99),NYDSN(99)
      COMMON/DSNN2/NUMDSN
      INCLUDE 'TAB.CMN'
      DATA     PCT/.05,.10,.20,.30,.40,.50,.60,.70,.80,.90,.95,.99/
CC    WRITE(6,*) '1NETWORK DESIGN POINTS (AVG. REGR. ERROR IN NATURAL (B
CC   +ASE) LOG UNITS)')
```

```
      DO 600 IDSN=1,NUMDSN
      NB=NBDSN(IDSN)
      NY=NYDSN(IDSN)
      DO 510 I=1,IPHI
      G=GARAY(I)
      XCV=CVARAY(I)
      XRC=RCARAY(I)
      IF(JEVENT.NE.6) THEN
         CALL TRSEMT(NB,NY,XCV,XRC,G,JEVENT,X)
      ELSE
         CALL TRSESD(NB,NY,XCV,XRC,G,X)
      ENDIF
      DO 500 KGIL=1,12
         MGIL=KGIL+1
         KK=13-KGIL
         YCUM(I,MGIL)=X(KK)
  500 CONTINUE
      YMAX2(I)=1.0E36
      YCUM(I,1)=YMAX2(I)
  510 CONTINUE
      DO 520 I=1,12
      I13=13-I
      X(I)=1.0-PCT(I13)
  520 CONTINUE
      ICR=IPHI
      CALL MELIOR(YCUM,YBAR2,PRIOR,ICR)
      DO 530 I=1,12
      IBACK=13-I
      Z(I)=X(IBACK)
      Z(I)=1.0-Z(I)
      W(I)=YBAR2(IBACK)
      WX=EXP(W(I)*W(I)) - 1.
      WX=SQRT(WX)
      V(I)=WX*100.
  530 CONTINUE
C     WRITE(6,540) NB,NY,(Z(J),J=1,12),(W(J),J=1,12),(V(J),J=1,12)
  540 FORMAT(    'ONB = ' ,F5.1,3X,' NY = ' ,F5.1/' CONFIDENCE LEVEL
     *,    12(F8.4,1X),/,' AVER. REGRESS. ERROR',     12(F8.4,1X),
     */,' PERCENT REGR. ERROR ',12(F8.2,1X))
      IF(ICARD.EQ.1)WRITE(7,550) NB,NY,(Z(K),W(K),K=1,6),JEVENT,
     1                          NB,NY,(Z(K),W(K),K=7,12),JEVENT
  550 FORMAT(2F5.1,6(1X,F3.2,F7.4),3X,I1,/,    2F5.1,6(1X,F3.2,F7.4),
     1 3X,I1)
      Y(IDSN)=ALOG(W(6))
      X1(IDSN)=1.0/NB
      X2(IDSN)=1.0/NY
  600 CONTINUE
C     WRITE(6,700)
  700 FORMAT(1X,' NARI EQ ')
      CALL OLSREG(Y,X1,X2,NUMDSN,SE)
      RETURN
      END
C ***************************************************************
C ***************************************************************
C
      SUBROUTINE EDITIN(JFLAG)
      INCLUDE 'MV.CMN'
      INTEGER*4 JFLAG,NRCV,NUMDSN,I,L
      COMMON/N2SET/NRCV
      REAL*4 NYRS,NBAS,SUMTRC
      COMMON/N1SET/NYRS,NBAS
      COMMON/DSNN2/NUMDSN
      JFLAG=0
      IF(NUMDSN.LT.1 .OR. NUMDSN.GT.99) THEN
CC       WRITE(6,1000)
         JFLAG=1
      ENDIF
      IF(NBAS.LT.5.0 .OR. NBAS.GT.50.0) THEN
CC       WRITE(6,1010)
         JFLAG=1
      ENDIF
      IF(NYRS.LT.5.0 .OR. NYRS.GT.50.0) THEN
CC       WRITE(6,1020)
         JFLAG=1
      ENDIF
      IF(NRCV.LT.1 .OR. NRCV.GT.100) THEN
CC       WRITE(6,1040)
         JFLAG=1
      ENDIF
      IF(JFLAG.EQ.1) RETURN
      SUMTRC=0.0
```

```
      DO 10 I=1,NRCV
         SUMTRC=SUMTRC+PROBRC(I)
         IF(CV(I).GE..1 .AND. CV(I).LE.5.) GO TO 10
CC       WRITE(6,1050)
         JFLAG=1
         IF(RHOC(I).GT.-.001.AND.RHOC(I).LT..901) L=0
CC       IF(L.NE.0) WRITE(6,1070)
         IF(L.NE.0) JFLAG=1
         L=1
   10 CONTINUE
      IF(SUMTRC.GE..95.AND.SUMTRC.LE.1.05) RETURN
CC    WRITE(6,1080)
      JFLAG=1
 1000 FORMAT('0**NON-ALLOWABLE NUMBER OF DESIGN POINTS REQUESTED')
 1010 FORMAT('0**NON-ALLOWABLE NUMBER OF BASINS ENTERED')
 1020 FORMAT('0**NON-ALLOWABLE RECORD LENGTH ENTERED')
 1040 FORMAT('0**NON-ALLOWABLE NUMBER OF RHOC AND CV COMBINATIONS ENTERE
     *D')
 1050 FORMAT('0**NON-ALLOWABLE VALUE OF CV ENTERED')
 1070 FORMAT('0**NON-ALLOWABLE VALUE OF RHO ENTERED')
 1080 FORMAT('0**PRIOR PROBABILITIES OF RHOC AND CV DO NOT ADD TO 1')
      RETURN
      END
c ****************************************************************
c ****************************************************************
      subroutine eqcov(y,jmax,nstat,minyr,varbar,rabar,recin)
      include 'dimens.cmn'
      integer*4 jmax,nstat,minyr,ic(maxs,maxs),i,num,j,nr,k
      real*4 varbar,rabar,recin,y(maxs,maxyr),xr(maxs,maxs),sumssq,yy,
     +       avevar,qbar,ssq,sub,yx,sumcov,xrbar,prod,ssqi,ssqj,smqi,
     +       xnum,sdi,sdj,xnr,smqj
c initialize variables
      sumssq=0.0
      yy=0.0
      avevar=0.0
      do 19 i=1,nstat
      qbar=0.0
      ssq=0.0
      num=0
c compute avgerage var and harmonic mean rec length
      do 18 j=1,jmax
      if(y(i,j).gt.-9.)then
         qbar=qbar+y(i,j)
         ssq=ssq+y(i,j)**2
         num=num+1
      end if
   18 continue
         sub=num
         yy=yy+1.0/sub
      if(num.ge.minyr)then
         ssq=ssq-qbar**2/num
         sumssq=sumssq+ssq
         avevar=avevar+ssq/(num-1)
      end if
   19 continue
      yx=nstat
      recin=yx/yy
      varbar=avevar/nstat
c compute cov and rho s
      sumcov=0.0
      xrbar=0.0
      nr=0
      do 30 i=1,nstat
      do 30 j=1,i
      num=0
      prod=0.0
      ssqi=0.0
      ssqj=0.0
      smqi=0.0
      smqj=0.0
      do 20 k=1,jmax
         if(y(i,k).gt.-9..and.y(j,k).gt.-9.)then
         num=num+1
            if(i.ne.j)then
            prod=prod+y(i,k)*y(j,k)
            smqi=smqi+y(i,k)
            smqj=smqj+y(j,k)
            ssqi=ssqi+y(i,k)**2
            ssqj=ssqj+y(j,k)**2
            end if
         end if
```

```
   20 continue
      ic(i,j)=num
      if (i.ne.j.and.num.ge.minyr)then
         nr=nr+1
         xnum=num
         prod=prod-smqi*smqj/xnum
         sumcov=sumcov+prod*2.0
         sdi =sqrt((ssqi-smqi**2/xnum)/(xnum))
         sdj =sqrt((ssqj-smqj**2/xnum)/(xnum))
         xr(i,j)=prod/(xnum*sdi*sdj)
         xrbar=xrbar+xr(i,j)
      end if
   30 continue
      xnr=nr
      xrbar=xrbar/xnr
      rabar=0.0
c compute weighted rbar
      do 46 i=2,nstat
      j=i-1
      do 40 k=1,j
         if(ic(i,k).ge.minyr)then
          xr(i,k)=xr(i,k)*ic(i,k)/sqrt(float(ic(i,i))*float(ic(k,k)))
         else
            xr(i,k)=0.0
         end if
   40 rabar=rabar+xr(i,k)
   46 continue
      rabar=rabar/xnr
      return
      end
c ******************************************************************
c ******************************************************************
      subroutine evalu8(ntot, jmax, nph, nbud,se)
      include 'dimens.cmn'
      include 'gr.cmn'
      include 'nari.cmn'
      integer*4 iv,jlt,jl,irank,ivsav,nreg,kreg,i,j,jbeg,jend,k,ick,
     +          ntot,jmax,nph,nbud
      real*4 se,anb,sum,any,sepred
      common /c2/  iv(maxs,maxyr), jlt(maxs)
      common /c1/  jl(maxs), irank(maxs), ivsav(maxs,maxyr)
c initialize
      nreg=ntot + 1
      kreg=nreg - 7
      do 1 i=1,50
      do 1 j=1,jmax
      if (yold(i,j).gt.-9.0)then
         iv(i,j)=1
      else
         iv(i,j)=0
      end if
    1 continue
      semin=999.99
      jbeg=jmax+1
      jend=jmax+nph
c find optimum nb and ny for nbud
      do 4 k=1,kreg
         do 5 i=1,50
         jlt(i)=jl(i)
         do 5 j=jbeg,jend
    5    iv(i,j)=0
         nreg=nreg-1
         do 2 j=jbeg,jend
         call rank(jlt,irank)
            do 3 i=1,50
            if(irank(i).le.nreg)then
                ick=nreg-irank(i)+1
                if(ick.le.nbud)then
                    iv(i,j)=1
                    jlt(i)=jlt(i)+1
                end if
            end if
    3       continue
    2     continue
c calculate nb and ny
      anb=nreg-3
      sum=0.0
         do 6 i=1,50
    6    if(irank(i).le.nreg)sum=sum+1.0/float(jlt(i))
      any=float(nreg)/sum
      sepred=b0+b1*(1.0/anb)+b2*(1.0/any)
```

```
      sepred=exp(sepred)
      if(sepred.lt.semin)then
         semin=sepred
         anysv=any
         anbsv=anb
         do 7 i=1,50
         do 7 j=1,jend
         ivsav(i,j)=iv(i,j)
         if(irank(i).gt.nreg)ivsav(i,j)=0
    7    continue
      end if
c =====================================
C     write(1,200)sepred,anb,any
  200 format(' sepred,ny,nb ',f12.4,2f10.2)
c =====================================
    4 continue
c =====================================
c     write(6,201)se, semin, anbsv, anysv
  201 format(1x,' se semin nb ny ',2f12.4,2f10.2)
c     write(6,202)((ivsav(i,j),j=1,jend),i=1,50)
  202 format(30i2)
      return
      end
      FUNCTION GAUSCF(XX)
C THE VALUE OF GAUSCF IS THE VALUE OF THE CUMULATIVE NORMAL PROBABILITY FUNCTION
C THIS APPROXIMATION IS FROM M. ABRAMOWITZ AND I. STEGUN, N.B.S. HANDBOOK OF
C MATHEMATICAL FUNCTIONS , 1964 , P.932 , SEC. 26.2.17
C AS PROGRAMMED BY W. KIRBY SEPTEMBER , 1974
      REAL*4 XX,AX,T,D
      AX=ABS(XX)
      GAUSCF=1.
      IF(AX.GT.10.0)  GO TO 101
      T=1.0/(1.0+.2316419*AX)
      D=0.3989423*EXP(-XX*XX*.5)
      GAUSCF=1.-D*T*((((1.330274*T - 1.821256)*T + 1.781478)*T -
     1  0.3565638)*T + 0.3193815)
  101 CONTINUE
      IF(XX.LT.0)GAUSCF=1.-GAUSCF
      RETURN
      END
      FUNCTION GLS(GAMA2)
      implicit double precision (a-h,o-z)
C -------------------------------------------------------------
C    SUBROUTINE TO COMPUTE LIKELIHOOD FUNCTION
C       E IS N*1 MATRIX OF RESIDUALS
C       DET IS DETERMINANT OF COVARIANCE MATRIX
C -------------------------------------------------------------
C ----------------------------------------------------------
C GENERALIZED LEAST SQUARES
C
C      Y IS A N*1 MATRIX OF OBSERVED DEPENDENT VARIABLES
C      X IS A N*2 MATRIX OF OBSERVED IN DEPENDENT VARIABLES
C      B IS A 2*1 MATRIX OF PARAMETERS TO BE ESTIMATED
C      SINV IS THE INVERSE OF COVARIANCE MATRIX OF ERRORS (N*N)
C      E IS A N*1 MATRIX OF RESIDUALS
C ----------------------------------------------------------
       INCLUDE 'DIMENS.CMN'
       INCLUDE 'GR1-5.CMN'
       DOUBLE PRECISION GAMA2,WORK,C,WORK1,WORK2,WORK3,DET
       INTEGER*4 I,N
       COMMON /COVINVD/ WORK(1,MAXS),C(1,1)
       COMMON /WORKC/ WORK1(MAXP,MAXS), WORK2(MAXP,MAXS), WORK3(MAXS,1)
C
C      COMPUTE GLS FIT WITH GAMA2 VALUE
       DO 10 I = 1,NSITES
              COV(I,I)=GAMA2 +STA(I,I)
   10  CONTINUE
C
       CALL INVERT(NSITES,50,DET,COVINV,COV)
C
C      SOLVE (XT*COVINV*X)(-1)*XT*COVINV*YS
       N = NSITES
       NE=NEXP+1
       CALL MULTIPLY(WORK1,XT,COVINV,NE,N,N,3,3,50)
       CALL MULTIPLY(WORK2,WORK1,X,NE,N,NE,3,3,50)
       CALL INVERT(NE,3,DET,XTXINV,WORK2)
       CALL MULTIPLY(WORK1,XTXINV,XT,NE,NE,N,3,3,3)
       CALL MULTIPLY(WORK2,WORK1,COVINV,NE,N,N,3,3,50)
       DO 5 I=1,NSITES
     5 E(I,1)=YS(I,IYS)
       CALL MULTIPLY(BHAT,WORK2,E,NE,N,1,3,3,50)
```

```
      CALL MULTIPLY(WORK3,X,BHAT,N,NE,1,50,50,3)
C
      DO 2 I=1,N
      ET(1,I)=YS(I,IYS)-WORK3(I,1)
    2 E(I,1)=ET(1,I)
C
      CALL MULTIPLY(WORK,ET,COVINV,1,NSITES,NSITES,1,1,50)
      CALL MULTIPLY(C,WORK,E,1,NSITES,1,1,1,50)
           GLS = (NSITES -  3.)/C(1,1) - 1.
C
      RETURN
      END
C ***************************************************************
C ****************************************************************
      subroutine glsnet(rbar,jmax,nph,nbud)
      implicit double precision (a-h,o-z)
      real*4 rbar
      include 'dimens.cmn'
      include 'gr.cmn'
      include 'gr1-5.cmn'
      integer*4 jmax,nph,nbud,i,j,iv,jlt,icode(maxs),istat(maxs),ndrop,
     +          nstep,kstep,jstart,jend,iph,idrop,ix,isv,ihave,k,isum,
     +          nmean
      common /c2/  iv(maxs,maxyr), jlt(maxs)
      common /c3/ gamasd
      double precision work(50,3), work2(3,3),d(50,50),der(50)
      double precision omt(3,50),omega(50,3),omegat(3,50),tr(3,3),
     +slogs,          wm(3,3),det,trace,dermin,smean,ss,aa,al,vmean
c set iv
      do 1 i=1,50
      do 1 j=1,jmax
         if (yold(i,j).gt.-9.0) then
            iv(i,j)=1
         else
            iv(i,j)=0
         end if
    1 continue
c
         ndrop=50-nbud
c initialize
c
c      nstep=(nph+4)/5
       nstep=1
       if(nph.gt.9)nstep=2
       jhalf=nph/nstep
c
       do 2 kstep=1,nstep
       if(kstep.eq.1)then
         jstart=jmax+1
         jend=jmax+jhalf
       end if
       if(kstep.eq.2)then
         jstart=jmax+jhalf+1
         jend=jmax+nph
       end if
          iph=jend-jstart+1
          nsites=50
c ++++=====
c      write(1,712)ndrop
c 712 format(' ndrop=',i5)
c ========
c
          do 3 i=1,50
              x(i,1)=1
              x(i,2)=daold(i)
              x(i,3)=prold(i)
              xt(1,i)=1
              xt(2,i)=x(i,2)
              xt(3,i)=x(i,3)
              icode(i)=1
              istat(i)=i
c
              do 31 j=1,i
   31         mcon(i,j)=msv(i,j)
              do 32 j=jstart,jend
   32          iv(i,j)=1
    3     continue
        call multiply(sighat,x,bsv,50,3,1,50,50,3)
        do 44 i=1,50
   44 sighat(i)=dexp(sighat(i))*dexp(gamasd)
        call multiply(wm,xt,x,3,50,3,3,3,50)
```

```
c
             do 5 i=1,nsites
             do 5 j=1,i
    5        mcon(i,j)=mcon(i,j)+icode(i)*icode(j)*iph
c
      do 4 idrop=1,ndrop
c ==============
c     write(1,714)(mcon(ix,ix),ix=1,nsites)
  714 format(1x,40i3)
c ===============
             call coefmat(rbar)
c
             do 6 i=1,nsites
c               d(i)=cov(i,i)*mcon(i,i)
                cov(i,i)=cov(i,i)+gamasv
    6        continue
c ======================================
c     WRITE(1,711) KSTEP, IDROP, NSITES, RBAR, GAMASV
c 711 FORMAT(' KSTEP, IDROP, NSITES, RBAR, GAMASV ', 3I5,2F10.5)
c     write(1,712)ndrop
C ======================================
c
          call invert(nsites,50,det,covinv,cov)
c     write(1,9001)
 9001 format(1x,' m 1')
          call multiply(work,covinv,x,nsites,nsites,3,50,50,50)
c     write(1,9002)
 9002 format(1x,' m 2')
          call multiply(xtx,xt,work,3,nsites,3,3,3,50)
c     write(1,9003)
 9003 format(1x,' m 3')
          call inv3(xtx,xtxinv)
c
c comput omega
c
          call multiply(work,x,xtxinv,nsites,3,3,50,50,3)
c     write(1,9004)
 9004 format(1x,' m 4')
          call multiply(omega,covinv,work,nsites,nsites,3,50,50,50)
c     write(1,9005)
 9005 format(1x,' m 5')
c transpose
          do 7 i=1,nsites
          do 7 j=1,3
    7     omegat(j,i)=omega(i,j)
c compute dJ/dN
          do 8 i=1,nsites
              do 20 i1=1,nsites
              do 20 ij=1,i1
              if(i.ne.i1.and.i.ne.ij)then
                  d(i1,ij)=0.0
                  d(ij,i1)=0.0
              else
                  d(i1,ij)=sta(i1,ij)*mcon(i,i)
                  d(ij,i1)=d(i1,ij)
              end if
   20 continue
              call multiply(omt,omegat,d,3,nsites,nsites,3,3,50)
              call multiply(work2,omt,omega,3,nsites,3,3,3,50)
              call multiply(tr,wm,work2,3,3,3,3,3,3)
              trace=0.0
              do 21 j=1,3
   21         trace=trace+tr(j,j)
               der(i)=-trace/(mcon(i,i)**2)
              if(icode(i).eq.0)der(i)=-999999.
              do 22 j=1,3
   22         omt(j,i)=0.0
    8     continue
c     write(1,9006)work2
 9006 format(1x,'work2 ',3g13.5)
c     write(1,9007)tr
 9007 format(1x,'tr    ',3g13.5)
c
c find min der
c
          dermin=-999999.
          do 321 i=1,nsites
              if(der(i).gt.dermin)then
                  dermin=der(i)
                  isv=i
              end if
```

```
  321     continue
      if(dermin.gt.-999998.)then
c
          icode(isv)=0
          ihave=0
          do 501 j=jstart,jend
  501     iv(istat(isv),j)=0
          do 3211 j=1,jstart-1
 3211     if(iv(istat(isv),j).eq.1)ihave=1
          if(ihave.eq.1)then
             do 322 j=1,isv-1
  322        mcon(isv,j)=mcon(isv,j)-icode(j)*iph
             mcon(isv,isv)=mcon(isv,isv)-iph
             do 323 i=isv+1,nsites
  323        mcon(i,isv)=mcon(i,isv)-icode(i)*iph
          else
             do 324 i=isv+1,nsites
                sighat(i-1)=sighat(i)
                istat(i-1)=istat(i)
                icode(i-1)=icode(i)
c
                do 325 j=1,3
                   x(i-1,j)=x(i,j)
  325              xt(j,i-1)=x(i,j)
c
                do 326 j=1,isv-1
  326              mcon(i-1,j)=mcon(i,j)
                do 327 j=isv+1,i
  327              mcon(i-1,j-1)=mcon(i,j)
  324        continue
c
             nsites=nsites-1
           end if
       end if
    4     continue
c
c update msv
c
          do 42 i=1,50
          do 42 k=1,i
             isum=0
             do 43 j=jstart,jend
             isum=isum+iv(i,j)*iv(k,j)
   43        continue
          msv(i,k)=msv(i,k)+isum
   42        continue
    2 continue
c
c compute mean and sd
c =======
c        write(1,718)((iv(i,j),j=1,30),i=1,50)
  718 format(1x,30i2)
c        write(1,719)(istat(i),i=1,50)
  719 format(1x,25i3)
c ========
        do 51 i=1,nsites
           smean=0.0
           nmean=0
           ss=0.0
           slogs=0.0
           do 52 j=1,jend
           if(iv(istat(i),j).gt.0)then
              nmean=nmean+1
              smean=smean+10**yold(istat(i),j)
              slogs=slogs+(yold(istat(i),j))
              ss=ss+(yold(istat(i),j))**2
           end if
   52      continue
           aa=smean/nmean
           al=slogs/nmean
           vmean=(ss-nmean*al**2)/(nmean-1.0)
           amean(i)=alog10(sngl(aa))
           stdev(i)=sqrt(sngl(vmean))
           x(i,1)=1.0
           x(i,2)=daold(istat(i))
           x(i,3)=prold(istat(i))
           xt(1,i)=1.0
           xt(2,i)=daold(istat(i))
           xt(3,i)=prold(istat(i))
c
   51 continue
```

```
      return
      end
c ******************************************************************
c ******************************************************************
c Subroutine GLSREG
c
      subroutine glsreg(ns,jmax,rbar,nex,ihave)
      implicit double precision (a-h,o-z)
      include 'dimens.cmn'
      include 'gr.cmn'
      include 'gr1-5.cmn'
      common /c3/ gamasd
      double precision sum,ss,ybar
      integer*4 ns,jmax,nex,ihave,i,j,k,kk,iii
      real*4 rbar
c load mcon(i,j)
      nexp=nex
      ne=nex+1
      if(ihave.eq.0)then
      do 1 i=1,50
      do 1 j=1,i
         mcon(i,j)=0
         msv(i,j)=0
         do 2 k=1,jmax
         if(yold(i,k).gt.-9..and.yold(j,k).gt.-9.)then
          mcon(i,j)=mcon(i,j)+1
          msv(i,j)=msv(i,j)+1
         end if
    2    continue
    1 continue
      end if
c load y and x matrices
      nsites=ns
      do 3 i=1,nsites
      ys(i,2)=alog(stdev(i))
      ys(i,3)=amean(i)
      if(ihave.eq.0)then
      xt(1,i)=1.0
      xt(2,i)=daold(i)
      xt(3,i)=prold(i)
         do 31 kk=1,3
         x(i,kk)=xt(kk,i)
   31    continue
      end if
      sighat(i)=1.0
    3 continue
c regress ln(sigma) on x's
      aj=0.5
      iys=2
      call coefmat(rbar)
      call secant
      gamasd=gamasq/2.0
      do 32 iii=1,3
   32 bsv(iii,1)=bhat(iii,1)
      rsv=rbar
      call multiply(sighat,x,bhat,nsites,3,1,50,50,3)
      do 4 i=1,nsites
    4 sighat(i)=dexp(sighat(i))*dexp(gamasd)
c regress amean on x's
      aj=1.0
      iys=3
      sum=0.0
      ss=0.0
      do 5 i=1,nsites
      sum=sum+ys(i,3)
    5 ss=ss+ys(i,3)**2
      ybar=sum/nsites
      yvar=(ss-nsites*ybar**2)/(nsites-1.0)
      call coefmat(rbar)
      call secant
      gamasv=gamasq
c
c     write(6,100)bhat
  100 format(' gls bhat ',3f10.3)
c
      return
      end
C=========================== 11/19/80 ==========  HARTIV        ======
      SUBROUTINE  HARTIV  (SKU,PD)
C
C  VERSION FOR HARRIS 9/79 HAS LOCAL COPY OF TABLES NOT COMMON.
```

```
C   G387 - LOOK UP K OR P IN HARTERS TABLES.  WKIRBY 3/75. 9/76.G387.
C    HARTIV -- HARTER INTERPOLATE VECTOR PD BY 3-PT LAGRANGE INT W/R SKEW
C   REV 9/76 WK - NO LONGER USES SKEW TABLES IN HARTAB
C   ERROR IN IORDER MADE 9/76, CORRECTED 7/77. FOR SKU IN (-.05,-0.)
C
C    --  NOTE- ABS SKEW IS TRUNCATED AT 9. W/OUT COMMENT.
C
C
C   G387 --  HARTERS TABLES OF PEARSON TYPE III DISTRIBUTION.
C          TECHNOMETRICS FEB 69 AND FEB 71.  THESE TABLES IN HARTAB
C          HAVE BEEN CHECKED AGAINST ANOTHER SET OF TABLES LOANED BY
C          W. H. SAMMONS OF SOIL CONS. SERVICE.
C          W.KIRBY  USGS-WRD 3/73.
C
C     SKEWS = -0.1, 0.0(0.1)4.8,  5.0(0.2)9.0
C
C   TABULAR PROBABILITIES /     0.00010,
C        0.00050,  0.00100,  0.00200,  0.00500,  0.01000,  0.02000,
C        0.02500,  0.04000,  0.05000,  0.10000,  0.20000,  0.30000,
C        0.40000,  0.429624, 0.50000,  0.570376, 0.60000,  0.70000,
C        0.80000,  0.90000,  0.95000,  0.96000,  0.97500,  0.98000,
C        0.99000,  0.99500,  0.99800,  0.99900,  0.99950,  0.99990 /
C
C
C
      DIMENSION PD(31)
C
      DIMENSION PCT(31, 71)
C
      DIMENSION
     $  VM1(31),  V 0(31),  V 1(31),  V 2(31),  V 3(31),  V 4(31),
     $  V 5(31),  V 6(31),  V 7(31),  V 8(31),  V 9(31),  V10(31),
     $  V11(31),  V12(31),  V13(31),  V14(31),  V15(31),  V16(31),
     $  V17(31),  V18(31),  V19(31),  V20(31),  V21(31),  V22(31),
     $  V23(31),  V24(31),  V25(31),  V26(31),  V27(31),  V28(31),
     $  V29(31),  V30(31),  V31(31),  V32(31),  V33(31),  V34(31),
     $  V35(31),  V36(31),  V37(31),  V38(31),  V39(31),  V40(31),
     $  V41(31),  V42(31),  V43(31),  V44(31),  V45(31),  V46(31),
     $  V47(31),  V48(31)
C
      DIMENSION
     $  V50(31),  V52(31),  V54(31),  V56(31),  V58(31),  V60(31),
     $  V62(31),  V64(31),  V66(31),  V68(31),  V70(31),  V72(31),
     $  V74(31),  V76(31),  V78(31),  V80(31),  V82(31),  V84(31),
     $  V86(31),  V88(31),  V90(31)
C
      EQUIVALENCE
     $  (VM1(1),PCT(1, 1)),  (V 0(1),PCT(1, 2)),  (V 1(1),PCT(1, 3)),
     $  (V 2(1),PCT(1, 4)),  (V 3(1),PCT(1, 5)),  (V 4(1),PCT(1, 6)),
     $  (V 5(1),PCT(1, 7)),  (V 6(1),PCT(1, 8)),  (V 7(1),PCT(1, 9)),
     $  (V 8(1),PCT(1,10)),  (V 9(1),PCT(1,11)),  (V10(1),PCT(1,12)),
     $  (V11(1),PCT(1,13)),  (V12(1),PCT(1,14)),  (V13(1),PCT(1,15)),
     $  (V14(1),PCT(1,16)),  (V15(1),PCT(1,17)),  (V16(1),PCT(1,18)),
     $  (V17(1),PCT(1,19)),  (V18(1),PCT(1,20)),  (V19(1),PCT(1,21)),
     $  (V20(1),PCT(1,22)),  (V21(1),PCT(1,23)),  (V22(1),PCT(1,24)),
     $  (V23(1),PCT(1,25)),  (V24(1),PCT(1,26)),  (V25(1),PCT(1,27)),
     $  (V26(1),PCT(1,28)),  (V27(1),PCT(1,29)),  (V28(1),PCT(1,30)),
     $  (V29(1),PCT(1,31)),  (V30(1),PCT(1,32)),  (V31(1),PCT(1,33)),
     $  (V32(1),PCT(1,34)),  (V33(1),PCT(1,35)),  (V34(1),PCT(1,36)),
     $  (V35(1),PCT(1,37)),  (V36(1),PCT(1,38)),  (V37(1),PCT(1,39)),
     $  (V38(1),PCT(1,40)),  (V39(1),PCT(1,41)),  (V40(1),PCT(1,42)),
     $  (V41(1),PCT(1,43)),  (V42(1),PCT(1,44)),  (V43(1),PCT(1,45)),
     $  (V44(1),PCT(1,46)),  (V45(1),PCT(1,47)),  (V46(1),PCT(1,48)),
     $  (V47(1),PCT(1,49)),  (V48(1),PCT(1,50))
C
      EQUIVALENCE
     $  (V50(1),PCT(1,51)),  (V52(1),PCT(1,52)),  (V54(1),PCT(1,53)),
     $  (V56(1),PCT(1,54)),  (V58(1),PCT(1,55)),  (V60(1),PCT(1,56)),
     $  (V62(1),PCT(1,57)),  (V64(1),PCT(1,58)),  (V66(1),PCT(1,59)),
     $  (V68(1),PCT(1,60)),  (V70(1),PCT(1,61)),  (V72(1),PCT(1,62)),
     $  (V74(1),PCT(1,63)),  (V76(1),PCT(1,64)),  (V78(1),PCT(1,65)),
     $  (V80(1),PCT(1,66)),  (V82(1),PCT(1,67)),  (V84(1),PCT(1,68)),
     $  (V86(1),PCT(1,69)),  (V88(1),PCT(1,70)),  (V90(1),PCT(1,71))
C
C
C
      DATA  VM1  /
     #    -3.93453,    -3.45513,    -3.23322,    -2.99978,
     #    -2.66965,    -2.39961,    -2.10697,    -2.00688,
     #    -1.78462,    -1.67279,    -1.29178,    -0.83639,
     #    -0.51207,    -0.23763,    -0.16111,     0.01662,
```

```
#       0.19339,       0.26882,       0.53624,       0.84611,
#       1.27037,       1.61594,       1.71580,       1.91219,
#       1.99973,       2.25258,       2.48187,       2.75706,
#       2.94834,       3.12767,       3.50703     /
C
  DATA V0 /    -3.71902,
# -3.29053, -3.09023, -2.87816, -2.57583, -2.32635, -2.05375,
# -1.95996, -1.75069, -1.64485, -1.28155, -0.84162, -0.52440,
# -0.25335, -0.17733,  0.0     ,  0.17733,  0.25335,  0.52440,
#  0.84162,  1.28155,  1.64485,  1.75069,  1.95996,  2.05375,
#  2.32635,  2.57583,  2.87816,  3.09023,  3.29053,  3.71902 /
  DATA V1 /    -3.50703,
# -3.12767, -2.94834, -2.75706, -2.48187, -2.25258, -1.99973,
# -1.91219, -1.71580, -1.61594, -1.27037, -0.84611, -0.53624,
# -0.26882, -0.19339, -0.01662,  0.16111,  0.23763,  0.51207,
#  0.83639,  1.29178,  1.67279,  1.78462,  2.00688,  2.10697,
#  2.39961,  2.66965,  2.99978,  3.23322,  3.45513,  3.93453 /
  DATA V2 /    -3.29921,
# -2.96698, -2.80786, -2.63672, -2.38795, -2.17840, -1.94499,
# -1.86360, -1.67999, -1.58607, -1.25824, -0.84986, -0.54757,
# -0.28403, -0.20925, -0.03325,  0.14472,  0.22168,  0.49927,
#  0.83044,  1.30105,  1.69971,  1.81756,  2.05290,  2.15935,
#  2.47226,  2.76321,  3.12169,  3.37703,  3.62113,  4.15301 /
  DATA V3 /    -3.09631,
# -2.80889, -2.66915, -2.51741, -2.29423, -2.10394, -1.88959,
# -1.81427, -1.64329, -1.55527, -1.24516, -0.85285, -0.55839,
# -0.29897, -0.22492, -0.04993,  0.12820,  0.20552,  0.48600,
#  0.82377,  1.30936,  1.72562,  1.84949,  2.09795,  2.21081,
#  2.54421,  2.85636,  3.24371,  3.52139,  3.78820,  4.37394 /
  DATA V4 /    -2.89907,
# -2.65390, -2.53261, -2.39942, -2.20092, -2.02933, -1.83361,
# -1.76427, -1.60574, -1.52357, -1.23114, -0.85508, -0.56867,
# -0.31362, -0.24037, -0.06651,  0.11154,  0.18916,  0.47228,
#  0.81638,  1.31671,  1.75048,  1.88039,  2.14202,  2.26133,
#  2.61539,  2.94900,  3.36566,  3.66608,  3.95605,  4.59687 /
  DATA V5 /    -2.70836,
# -2.50257, -2.39867, -2.28311, -2.10825, -1.95472, -1.77716,
# -1.71366, -1.56740, -1.49101, -1.21618, -0.85653, -0.57840,
# -0.32796, -0.25558, -0.08302,  0.09478,  0.17261,  0.45812,
#  0.80829,  1.32309,  1.77428,  1.91022,  2.18505,  2.31084,
#  2.68572,  3.04102,  3.48737,  3.81090,  4.12443,  4.82141 /
  DATA V6 /    -2.52507,
# -2.35549, -2.26780, -2.16884, -2.01644, -1.88029, -1.72033,
# -1.66253, -1.52830, -1.45762, -1.20028, -0.85718, -0.58757,
# -0.34198, -0.27047, -0.09945,  0.07791,  0.15589,  0.44352,
#  0.79950,  1.32850,  1.79701,  1.93896,  2.22702,  2.35931,
#  2.75514,  3.13232,  3.60872,  3.95567,  4.29311,  5.04718 /
  DATA V7 /    -2.35015,
# -2.21328, -2.14053, -2.05701, -1.92580, -1.80621, -1.66325,
# -1.61099, -1.48852, -1.42345, -1.18347, -0.85703, -0.59615,
# -0.35565, -0.28516, -0.11578,  0.06097,  0.13901,  0.42851,
#  0.79002,  1.33294,  1.81864,  1.96660,  2.26790,  2.40670,
#  2.82359,  3.22281,  3.72957,  4.10022,  4.46189,  5.27389 /
  DATA V8 /    -2.18448,
# -2.07661, -2.01739, -1.94806, -1.83660, -1.73271, -1.60604,
# -1.55914, -1.44813, -1.38855, -1.16574, -0.85607, -0.60412,
# -0.36889, -0.29961, -0.13199,  0.04397,  0.12199,  0.41309,
#  0.77986,  1.33640,  1.83916,  1.99311,  2.30764,  2.45298,
#  2.89101,  3.31243,  3.84981,  4.24439,  4.63057,  5.50124 /
  DATA V9 /    -2.02891,
# -1.94611, -1.89894, -1.84244, -1.74919, -1.66001, -1.54886,
# -1.50712, -1.40720, -1.35299, -1.14712, -0.85426, -0.61146,
# -0.38186, -0.31368, -0.14807,  0.02693,  0.10486,  0.39729,
#  0.76902,  1.33889,  1.85856,  2.01848,  2.34623,  2.49811,
#  2.95735,  3.40109,  3.96932,  4.38807,  4.79899,  5.72899 /
  DATA V10 /    -1.88410,
# -1.82241, -1.78572, -1.74062, -1.66390, -1.58838, -1.49188,
# -1.45507, -1.36584, -1.31684, -1.12762, -0.85161, -0.61815,
# -0.39434, -0.32740, -0.16397,  0.00987,  0.08763,  0.38111,
#  0.75752,  1.34039,  1.87683,  2.04269,  2.38364,  2.54206,
#  3.02256,  3.48874,  4.08802,  4.53112,  4.96701,  5.95691 /
  DATA V11 /    -1.75053,
# -1.70603, -1.67825, -1.64305, -1.58110, -1.51808, -1.43529,
# -1.40314, -1.32414, -1.28019, -1.10726, -0.84809, -0.62415,
# -0.40638, -0.34075, -0.17968, -0.00719,  0.07032,  0.36458,
#  0.74537,  1.34092,  1.89395,  2.06573,  2.41984,  2.58480,
#  3.08660,  3.57530,  4.20582,  4.67344,  5.13449,  6.18480 /
  DATA V12 /    -1.62838,
# -1.59738, -1.57695, -1.55016, -1.50114, -1.44942, -1.37929,
# -1.35153, -1.28225, -1.24313, -1.08608, -0.84369, -0.62944,
# -0.41794, -0.35370, -0.19517, -0.02421,  0.05297,  0.34772,
```

```
#    0.73257,   1.34047,   1.90992,   2.08758,   2.45482,   2.62631,
#    3.14944,   3.66073,   4.32263,   4.81492,   5.30130,   6.41249 /
 DATA V13 /    -1.51752,
#   -1.49673,  -1.48216,  -1.46232,  -1.42439,  -1.38267,  -1.32412,
#   -1.30042,  -1.24028,  -1.20578,  -1.06413,  -0.83841,  -0.63400,
#   -0.42899,  -0.36620,  -0.21040,  -0.04116,   0.03560,   0.33054,
#    0.71915,   1.33904,   1.92472,   2.10823,   2.48855,   2.66657,
#    3.21103,   3.74497,   4.43839,   4.95549,   5.46735,   6.63980 /
 DATA V14 /    -1.41753,
#   -1.40413,  -1.39408,  -1.37981,  -1.35114,  -1.31815,  -1.26999,
#   -1.25004,  -1.19842,  -1.16827,  -1.04144,  -0.83223,  -0.63779,
#   -0.43949,  -0.37824,  -0.22535,  -0.05803,   0.01824,   0.31307,
#    0.70512,   1.33665,   1.93836,   2.12768,   2.52102,   2.70556,
#    3.27134,   3.82798,   4.55304,   5.09505,   5.63252,   6.86661 /
 DATA V15 /    -1.32774,
#   -1.31944,  -1.31275,  -1.30279,  -1.28167,  -1.25611,  -1.21716,
#   -1.20059,  -1.15682,  -1.13075,  -1.01810,  -0.82516,  -0.64080,
#   -0.44942,  -0.38977,  -0.23996,  -0.07476,   0.00092,   0.29535,
#    0.69050,   1.33330,   1.95083,   2.14591,   2.55222,   2.74325,
#    3.33035,   3.90973,   4.66651,   5.23353,   5.79673,   7.09277 /
 DATA V16 /    -1.24728,
#   -1.24235,  -1.23805,  -1.23132,  -1.21618,  -1.19680,  -1.16584,
#   -1.15229,  -1.11566,  -1.09338,  -0.99418,  -0.81720,  -0.64300,
#   -0.45873,  -0.40075,  -0.25422,  -0.09132,  -0.01631,   0.27740,
#    0.67532,   1.32900,   1.96213,   2.16293,   2.58214,   2.77964,
#    3.38804,   3.99016,   4.77875,   5.37087,   5.95990,   7.31818 /
 DATA V17 /    -1.17520,
#   -1.17240,  -1.16974,  -1.16534,  -1.15477,  -1.14042,  -1.11628,
#   -1.10537,  -1.07513,  -1.05631,  -0.96977,  -0.80837,  -0.64436,
#   -0.46739,  -0.41116,  -0.26808,  -0.10769,  -0.03344,   0.25925,
#    0.65959,   1.32376,   1.97227,   2.17873,   2.61076,   2.81472,
#    3.44438,   4.06926,   4.88971,   5.50701,   6.12196,   7.54272 /
 DATA V18 /    -1.11054,
#   -1.10901,  -1.10743,  -1.10465,  -1.09749,  -1.08711,  -1.06864,
#   -1.06001,  -1.03543,  -1.01973,  -0.94496,  -0.79868,  -0.64488,
#   -0.47538,  -0.42095,  -0.28150,  -0.12381,  -0.05040,   0.24094,
#    0.64335,   1.31760,   1.98124,   2.19332,   2.63810,   2.84848,
#    3.49935,   4.14700,   4.99937,   5.64190,   6.28285,   7.76632 /
 DATA V19 /    -1.05239,
#   -1.05159,  -1.05068,  -1.04898,  -1.04427,  -1.03695,  -1.02311,
#   -1.01640,  -0.99672,  -0.98381,  -0.91988,  -0.78816,  -0.64453,
#   -0.48265,  -0.43008,  -0.29443,  -0.13964,  -0.06718,   0.22250,
#    0.62662,   1.31054,   1.98906,   2.20670,   2.66413,   2.88091,
#    3.55295,   4.22336,   5.10768,   5.77549,   6.44251,   7.98888 /
 DATA V20 /    -0.99990,
#   -0.99950,  -0.99900,  -0.99800,  -0.99499,  -0.98995,  -0.97980,
#   -0.97468,  -0.95918,  -0.94871,  -0.89464,  -0.77686,  -0.64333,
#   -0.48917,  -0.43854,  -0.30685,  -0.15516,  -0.08371,   0.20397,
#    0.60944,   1.30259,   1.99573,   2.21888,   2.68888,   2.91202,
#    3.60517,   4.29832,   5.21461,   5.90776,   6.60090,   8.21034 /
 DATA V21 /    -0.95234,
#   -0.95215,  -0.95188,  -0.95131,  -0.94945,  -0.94607,  -0.93878,
#   -0.93495,  -0.92295,  -0.91458,  -0.86938,  -0.76482,  -0.64125,
#   -0.49494,  -0.44628,  -0.31872,  -0.17030,  -0.09997,   0.18540,
#    0.59183,   1.29377,   2.00128,   2.22986,   2.71234,   2.94181,
#    3.65600,   4.37186,   5.32014,   6.03865,   6.75798,   8.43064 /
 DATA V22 /    -0.90908,
#   -0.90899,  -0.90885,  -0.90854,  -0.90742,  -0.90521,  -0.90009,
#   -0.89728,  -0.88814,  -0.88156,  -0.84422,  -0.75211,  -0.63833,
#   -0.49991,  -0.45329,  -0.32999,  -0.18504,  -0.11590,   0.16682,
#    0.57383,   1.28412,   2.00570,   2.23967,   2.73451,   2.97028,
#    3.70543,   4.44398,   5.42426,   6.16816,   6.91370,   8.64971 /
 DATA V23 /    -0.86956,
#   -0.86952,  -0.86945,  -0.86929,  -0.86863,  -0.86723,  -0.86371,
#   -0.86169,  -0.85486,  -0.84976,  -0.81929,  -0.73880,  -0.63456,
#   -0.50409,  -0.45953,  -0.34063,  -0.19933,  -0.13148,   0.14827,
#    0.55549,   1.27365,   2.00903,   2.24831,   2.75541,   2.99744,
#    3.75347,   4.51467,   5.52694,   6.29626,   7.06804,   8.86753 /
 DATA V24 /    -0.83333,
#   -0.83331,  -0.83328,  -0.83320,  -0.83283,  -0.83196,  -0.82959,
#   -0.82817,  -0.82315,  -0.81927,  -0.79472,  -0.72495,  -0.62999,
#   -0.50744,  -0.46499,  -0.35062,  -0.21313,  -0.14665,   0.12979,
#    0.53683,   1.26240,   2.01128,   2.25581,   2.77506,   3.02330,
#    3.80013,   4.58393,   5.62818,   6.42292,   7.22098,   9.08403 /
 DATA V25 /    -0.80000,
#   -0.79999,  -0.79998,  -0.79994,  -0.79973,  -0.79921,  -0.79765,
#   -0.79667,  -0.79306,  -0.79015,  -0.77062,  -0.71067,  -0.62463,
#   -0.50999,  -0.46966,  -0.35992,  -0.22642,  -0.16138,   0.11143,
#    0.51789,   1.25039,   2.01247,   2.26217,   2.79345,   3.04787,
#    3.84540,   4.65176,   5.72796,   6.54814,   7.37250,   9.29920 /
 DATA V26 /    -0.76923,
```

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#   -0.76923, -0.76922, -0.76920, -0.76909, -0.76878, -0.76779,
#   -0.76712, -0.76456, -0.76242, -0.74709, -0.69602, -0.61854,
#   -0.51171, -0.47353, -0.36852, -0.23915, -0.17564,  0.09323,
#    0.49872,  1.23766,  2.01263,  2.26743,  2.81062,  3.07116,
#    3.88930,  4.71815,  5.82629,  6.67191,  7.52258,  9.51301 /
 DATA V27 /   -0.74074,
#   -0.74074, -0.74074, -0.74073, -0.74067, -0.74049, -0.73987,
#   -0.73943, -0.73765, -0.73610, -0.72422, -0.68111, -0.61176,
#   -0.51263, -0.47660, -0.37640, -0.25129, -0.18939,  0.07523,
#    0.47934,  1.22422,  2.01177,  2.27160,  2.82658,  3.09320,
#    3.93183,  4.78313,  5.92316,  6.79421,  7.67121,  9.72543 /
 DATA V28 /   -0.71429,
#   -0.71429, -0.71428, -0.71428, -0.71425, -0.71415, -0.71377,
#   -0.71348, -0.71227, -0.71116, -0.70209, -0.66603, -0.60434,
#   -0.51276, -0.47888, -0.38353, -0.26282, -0.20259,  0.05746,
#    0.45980,  1.21013,  2.00992,  2.27470,  2.84134,  3.11399,
#    3.97301,  4.84669,  6.01858,  6.91505,  7.81839,  9.93643 /
 DATA V29 /   -0.68966,
#   -0.68966, -0.68965, -0.68965, -0.68964, -0.68959, -0.68935,
#   -0.68917, -0.68836, -0.68759, -0.68075, -0.65086, -0.59634,
#   -0.51212, -0.48037, -0.38991, -0.27372, -0.21523,  0.03997,
#    0.44015,  1.19539,  2.00710,  2.27676,  2.85492,  3.13356,
#    4.01286,  4.90884,  6.11254,  7.03443,  7.96411, 10.14602 /
 DATA V30 /   -0.66667,
#   -0.66667, -0.66667, -0.66667, -0.66666, -0.66663, -0.66649,
#   -0.66638, -0.66585, -0.66532, -0.66023, -0.63569, -0.58783,
#   -0.51073, -0.48109, -0.39554, -0.28395, -0.22726,  0.02279,
#    0.42040,  1.18006,  2.00335,  2.27780,  2.86735,  3.15193,
#    4.05138,  4.96959,  6.20506,  7.15235,  8.10836, 10.35418 /
 DATA V31 /   -0.64516,
#   -0.64516, -0.64516, -0.64516, -0.64516, -0.64514, -0.64507,
#   -0.64500, -0.64465, -0.64429, -0.64056, -0.62060, -0.57887,
#   -0.50863, -0.48107, -0.40041, -0.29351, -0.23868,  0.00596,
#    0.40061,  1.16416,  1.99869,  2.27785,  2.87865,  3.16911,
#    4.08859,  5.02897,  6.29613,  7.26881,  8.25115, 10.56090 /
 DATA V32 /   -0.62500,
#   -0.62500, -0.62500, -0.62500, -0.62500, -0.62499, -0.62495,
#   -0.62491, -0.62469, -0.62445, -0.62175, -0.60567, -0.56953,
#   -0.50585, -0.48033, -0.40454, -0.30238, -0.24946, -0.01050,
#    0.38081,  1.14772,  1.99314,  2.27693,  2.88884,  3.18512,
#    4.12452,  5.08697,  6.38578,  7.38382,  8.39248, 10.76618 /
 DATA V33 /   -0.60606,
#   -0.60606, -0.60606, -0.60606, -0.60606, -0.60606, -0.60603,
#   -0.60601, -0.60587, -0.60572, -0.60379, -0.59096, -0.55989,
#   -0.50244, -0.47890, -0.40792, -0.31055, -0.25958, -0.02654,
#    0.36104,  1.13078,  1.98674,  2.27506,  2.89795,  3.20000,
#    4.15917,  5.14362,  6.47401,  7.49739,  8.53236, 10.97001 /
 DATA V34 /   -0.58824,
#   -0.58824, -0.58824, -0.58824, -0.58824, -0.58823, -0.58822,
#   -0.58821, -0.58812, -0.58802, -0.58666, -0.57652, -0.55000,
#   -0.49844, -0.47682, -0.41058, -0.31802, -0.26904, -0.04215,
#    0.34133,  1.11337,  1.97951,  2.27229,  2.90599,  3.21375,
#    4.19257,  5.19892,  6.56084,  7.60953,  8.67079, 11.17239 /
 DATA V35 /   -0.57143,
#   -0.57143, -0.57143, -0.57143, -0.57143, -0.57143, -0.57142,
#   -0.57141, -0.57136, -0.57130, -0.57035, -0.56242, -0.53993,
#   -0.49391, -0.47413, -0.41253, -0.32479, -0.27782, -0.05730,
#    0.32171,  1.09552,  1.97147,  2.26862,  2.91299,  3.22641,
#    4.22473,  5.25291,  6.64627,  7.72024,  8.80779, 11.37334 /
 DATA V36 /   -0.55556,
#   -0.55556, -0.55556, -0.55556, -0.55556, -0.55556, -0.55555,
#   -0.55555, -0.55552, -0.55548, -0.55483, -0.54867, -0.52975,
#   -0.48888, -0.47088, -0.41381, -0.33085, -0.28592, -0.07195,
#    0.30223,  1.07726,  1.96266,  2.26409,  2.91898,  3.23800,
#    4.25569,  5.30559,  6.73032,  7.82954,  8.94335, 11.57284 /
 DATA V37 /   -0.54054,
#   -0.54054, -0.54054, -0.54054, -0.54054, -0.54054, -0.54054,
#   -0.54054, -0.54052, -0.54050, -0.54006, -0.53533, -0.51952,
#   -0.48342, -0.46711, -0.41442, -0.33623, -0.29335, -0.08610,
#    0.28290,  1.05863,  1.95311,  2.25872,  2.92397,  3.24853,
#    4.28545,  5.35698,  6.81301,  7.93744,  9.07750, 11.77092 /
 DATA V38 /   -0.52632,
#   -0.52632, -0.52632, -0.52632, -0.52632, -0.52632, -0.52631,
#   -0.52631, -0.52630, -0.52629, -0.52600, -0.52240, -0.50929,
#   -0.47758, -0.46286, -0.41441, -0.34092, -0.30010, -0.09972,
#    0.26376,  1.03965,  1.94283,  2.25254,  2.92799,  3.25803,
#    4.31403,  5.40711,  6.89435,  8.04395,  9.21023, 11.96757 /
 DATA V39 /   -0.51282,
#   -0.51282, -0.51282, -0.51282, -0.51282, -0.51282, -0.51282,
#   -0.51282, -0.51281, -0.51281, -0.51261, -0.50990, -0.49911,
#   -0.47141, -0.45819, -0.41381, -0.34494, -0.30617, -0.11279,
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#    0.24484,   1.02036,   1.93186,   2.24558,   2.93107,   3.26653,
#    4.34147,   5.45598,   6.97435,   8.14910,   9.34158,  12.16280 /
 DATA V40 /    -0.50000,
#   -0.50000,  -0.50000,  -0.50000,  -0.50000,  -0.50000,  -0.50000,
#   -0.50000,  -0.50000,  -0.49999,  -0.49986,  -0.49784,  -0.48902,
#   -0.46496,  -0.45314,  -0.41265,  -0.34831,  -0.31159,  -0.12530,
#    0.22617,   1.00079,   1.92023,   2.23786,   2.93324,   3.27404,
#    4.36777,   5.50362,   7.05304,   8.25289,   9.47154,  12.35663 /
 DATA V41 /    -0.48780,
#   -0.48780,  -0.48780,  -0.48780,  -0.48780,  -0.48780,  -0.48780,
#   -0.48780,  -0.48780,  -0.48780,  -0.48772,  -0.48622,  -0.47906,
#   -0.45828,  -0.44777,  -0.41097,  -0.35105,  -0.31635,  -0.13725,
#    0.20777,   0.98096,   1.90796,   2.22940,   2.93450,   3.28060,
#    4.39296,   5.55005,   7.13043,   8.35534,   9.60013,  12.54906 /
 DATA V42 /    -0.47619,
#   -0.47619,  -0.47619,  -0.47619,  -0.47619,  -0.47619,  -0.47619,
#   -0.47619,  -0.47619,  -0.47619,  -0.47614,  -0.47504,  -0.46927,
#   -0.45142,  -0.44212,  -0.40881,  -0.35318,  -0.32049,  -0.14861,
#    0.18967,   0.96090,   1.89508,   2.22024,   2.93489,   3.28622,
#    4.41706,   5.59528,   7.20654,   8.45646,   9.72737,  12.74010 /
 DATA V43 /    -0.46512,
#   -0.46512,  -0.46512,  -0.46512,  -0.46512,  -0.46512,  -0.46512,
#   -0.46512,  -0.46512,  -0.46511,  -0.46508,  -0.46428,  -0.45967,
#   -0.44442,  -0.43623,  -0.40621,  -0.35473,  -0.32400,  -0.15939,
#    0.17189,   0.94064,   1.88160,   2.21039,   2.93443,   3.29092,
#    4.44009,   5.63934,   7.28138,   8.55627,   9.85326,  12.92977 /
 DATA V44 /    -0.45455,
#   -0.45455,  -0.45455,  -0.45455,  -0.45455,  -0.45455,  -0.45455,
#   -0.45455,  -0.45455,  -0.45454,  -0.45452,  -0.45395,  -0.45029,
#   -0.43734,  -0.43016,  -0.40321,  -0.35572,  -0.32693,  -0.16958,
#    0.15445,   0.92022,   1.86757,   2.19988,   2.93314,   3.29473,
#    4.46207,   5.68224,   7.35497,   8.65479,   9.97784,  13.11808 /
 DATA V45 /    -0.44444,
#   -0.44444,  -0.44444,  -0.44444,  -0.44444,  -0.44444,  -0.44444,
#   -0.44444,  -0.44444,  -0.44444,  -0.44443,  -0.44402,  -0.44114,
#   -0.43020,  -0.42394,  -0.39985,  -0.35619,  -0.32928,  -0.17918,
#    0.13737,   0.89964,   1.85300,   2.18874,   2.93105,   3.29767,
#    4.48303,   5.72400,   7.42733,   8.75202,  10.10110,  13.30504 /
 DATA V46 /    -0.43478,
#   -0.43478,  -0.43478,  -0.43478,  -0.43478,  -0.43478,  -0.43478,
#   -0.43478,  -0.43478,  -0.43478,  -0.43477,  -0.43448,  -0.43223,
#   -0.42304,  -0.41761,  -0.39617,  -0.35616,  -0.33108,  -0.18819,
#    0.12067,   0.87895,   1.83792,   2.17699,   2.92818,   3.29976,
#    4.50297,   5.76464,   7.49847,   8.84800,  10.22307,  13.49066 /
 DATA V47 /    -0.42553,
#   -0.42553,  -0.42553,  -0.42553,  -0.42553,  -0.42553,  -0.42553,
#   -0.42553,  -0.42553,  -0.42553,  -0.42553,  -0.42532,  -0.42357,
#   -0.41590,  -0.41121,  -0.39221,  -0.35567,  -0.33236,  -0.19661,
#    0.10436,   0.85817,   1.82234,   2.16465,   2.92455,   3.30103,
#    4.52192,   5.80418,   7.56842,   8.94273,  10.34375,  13.67495 /
 DATA V48 /    -0.41667,
#   -0.41667,  -0.41667,  -0.41667,  -0.41667,  -0.41667,  -0.41667,
#   -0.41667,  -0.41667,  -0.41667,  -0.41666,  -0.41652,  -0.41517,
#   -0.40880,  -0.40477,  -0.38800,  -0.35475,  -0.33315,  -0.20446,
#    0.08847,   0.83731,   1.80631,   2.15174,   2.92017,   3.30149,
#    4.53990,   5.84265,   7.63718,   9.03623,  10.46318,  13.85794 /
 DATA V50 /    -0.40000,
#   -0.40000,  -0.40000,  -0.40000,  -0.40000,  -0.40000,  -0.40000,
#   -0.40000,  -0.40000,  -0.40000,  -0.40000,  -0.39993,  -0.39914,
#   -0.39482,  -0.39190,  -0.37901,  -0.35174,  -0.33336,  -0.21843,
#    0.05798,   0.79548,   1.77292,   2.12432,   2.90930,   3.30007,
#    4.57304,   5.91639,   7.77124,   9.21961,  10.69829,  14.22004 /
 DATA V52 /    -0.38462,
#   -0.38462,  -0.38462,  -0.38462,  -0.38462,  -0.38462,  -0.38462,
#   -0.38462,  -0.38462,  -0.38462,  -0.38462,  -0.38458,  -0.38414,
#   -0.38127,  -0.37919,  -0.36945,  -0.34740,  -0.33194,  -0.23019,
#    0.02927,   0.75364,   1.73795,   2.09490,   2.89572,   3.29567,
#    4.60252,   5.98602,   7.90078,   9.39827,  10.92853,  14.57706 /
 DATA V54 /    -0.37037,
#   -0.37037,  -0.37037,  -0.37037,  -0.37037,  -0.37037,  -0.37037,
#   -0.37037,  -0.37037,  -0.37037,  -0.37037,  -0.37036,  -0.37011,
#   -0.36825,  -0.36680,  -0.35956,  -0.34198,  -0.32914,  -0.23984,
#    0.00243,   0.71195,   1.70155,   2.06365,   2.87959,   3.28844,
#    4.62850,   6.05169,   8.02594,   9.57232,  11.15402,  14.92912 /
 DATA V56 /    -0.35714,
#   -0.35714,  -0.35714,  -0.35714,  -0.35714,  -0.35714,  -0.35714,
#   -0.35714,  -0.35714,  -0.35714,  -0.35714,  -0.35714,  -0.35700,
#   -0.35583,  -0.35484,  -0.34955,  -0.33573,  -0.32519,  -0.24751,
#   -0.02252,   0.67058,   1.66390,   2.03073,   2.86107,   3.27854,
#    4.65111,   6.11351,   8.14683,   9.74190,  11.37487,  15.27632 /
 DATA V58 /    -0.34483,
```

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#   -0.34483, -0.34483, -0.34483, -0.34483, -0.34483, -0.34483,
#   -0.34483, -0.34483, -0.34483, -0.34483, -0.34483, -0.34476,
#   -0.34402, -0.34336, -0.33957, -0.32886, -0.32031, -0.25334,
#   -0.04553,  0.62966,  1.62513,  1.99629,  2.84030,  3.26610,
#    4.67050,  6.17162,  8.26359,  9.90713, 11.59122, 15.61878 /
  DATA V60 /  -0.33333,
#   -0.33333, -0.33333, -0.33333, -0.33333, -0.33333, -0.33333,
#   -0.33333, -0.33333, -0.33333, -0.33333, -0.33333, -0.33330,
#   -0.33285, -0.33242, -0.32974, -0.32155, -0.31472, -0.25750,
#   -0.06662,  0.58933,  1.58541,  1.96048,  2.81743,  3.25128,
#    4.68680,  6.22616,  8.37634, 10.06812, 11.80316, 15.95660 /
  DATA V62 /  -0.32258,
#   -0.32258, -0.32258, -0.32258, -0.32258, -0.32258, -0.32258,
#   -0.32258, -0.32258, -0.32258, -0.32258, -0.32258, -0.32256,
#   -0.32230, -0.32202, -0.32016, -0.31399, -0.30859, -0.26015,
#   -0.08580,  0.54970,  1.54487,  1.92343,  2.79259,  3.23419,
#    4.70013,  6.27723,  8.48519, 10.22499, 12.01082, 16.28989 /
  DATA V64 /  -0.31250,
#   -0.31250, -0.31250, -0.31250, -0.31250, -0.31250, -0.31250,
#   -0.31250, -0.31250, -0.31250, -0.31250, -0.31250, -0.31249,
#   -0.31234, -0.31216, -0.31090, -0.30631, -0.30209, -0.26146,
#   -0.10311,  0.51089,  1.50365,  1.88528,  2.76591,  3.21497,
#    4.71061,  6.32497,  8.59027, 10.37785, 12.21429, 16.61875 /
  DATA V66 /  -0.30303,
#   -0.30303, -0.30303, -0.30303, -0.30303, -0.30303, -0.30303,
#   -0.30303, -0.30303, -0.30303, -0.30303, -0.30303, -0.30303,
#   -0.30294, -0.30283, -0.30198, -0.29862, -0.29537, -0.26160,
#   -0.11859,  0.47299,  1.46186,  1.84616,  2.73751,  3.19374,
#    4.71836,  6.36948,  8.69167, 10.52681, 12.41370, 16.94329 /
  DATA V68 /  -0.29412,
#   -0.29412, -0.29412, -0.29412, -0.29412, -0.29412, -0.29412,
#   -0.29412, -0.29412, -0.29412, -0.29412, -0.29412, -0.29412,
#   -0.29407, -0.29400, -0.29344, -0.29101, -0.28854, -0.26072,
#   -0.13231,  0.43608,  1.41963,  1.80618,  2.70751,  3.17062,
#    4.72350,  6.41086,  8.78950, 10.67197, 12.60913, 17.26360 /
  DATA V70 /  -0.28571,
#   -0.28571, -0.28571, -0.28571, -0.28571, -0.28571, -0.28571,
#   -0.28571, -0.28571, -0.28571, -0.28571, -0.28571, -0.28571,
#   -0.28569, -0.28565, -0.28528, -0.28355, -0.28169, -0.25899,
#   -0.14434,  0.40026,  1.37708,  1.76547,  2.67603,  3.14572,
#    4.72613,  6.44924,  8.88387, 10.81343, 12.80069, 17.57979 /
  DATA V72 /  -0.27778,
#   -0.27778, -0.27778, -0.27778, -0.27778, -0.27778, -0.27778,
#   -0.27778, -0.27778, -0.27778, -0.27778, -0.27778, -0.27778,
#   -0.27776, -0.27774, -0.27751, -0.27629, -0.27491, -0.25654,
#   -0.15478,  0.36557,  1.33430,  1.72412,  2.64317,  3.11914,
#    4.72635,  6.48470,  8.97488, 10.95129, 12.98848, 17.89193 /
  DATA V74 /  -0.27027,
#   -0.27027, -0.27027, -0.27027, -0.27027, -0.27027, -0.27027,
#   -0.27027, -0.27027, -0.27027, -0.27027, -0.27027, -0.27027,
#   -0.27026, -0.27025, -0.27010, -0.26926, -0.26825, -0.25352,
#   -0.16371,  0.33209,  1.29141,  1.68225,  2.60905,  3.09099,
#    4.72427,  6.51735,  9.06261, 11.08565, 13.17258, 18.20012 /
  DATA V76 /  -0.26316,
#   -0.26316, -0.26316, -0.26316, -0.26316, -0.26316, -0.26316,
#   -0.26316, -0.26316, -0.26316, -0.26316, -0.26316, -0.26316,
#   -0.26315, -0.26315, -0.26306, -0.26248, -0.26175, -0.25005,
#   -0.17123,  0.29986,  1.24850,  1.63995,  2.57375,  3.06137,
#    4.71998,  6.54727,  9.14717, 11.21658, 13.35309, 18.50446 /
  DATA V78 /  -0.25641,
#   -0.25641, -0.25641, -0.25641, -0.25641, -0.25641, -0.25641,
#   -0.25641, -0.25641, -0.25641, -0.25641, -0.25641, -0.25641,
#   -0.25641, -0.25640, -0.25635, -0.25596, -0.25544, -0.24622,
#   -0.17746,  0.26892,  1.20565,  1.59732,  2.53737,  3.03038,
#    4.71358,  6.57456,  9.22863, 11.34419, 13.53009, 18.80504 /
  DATA V80 /  -0.25000,
#   -0.25000, -0.25000, -0.25000, -0.25000, -0.25000, -0.25000,
#   -0.25000, -0.25000, -0.25000, -0.25000, -0.25000, -0.25000,
#   -0.25000, -0.25000, -0.24996, -0.24970, -0.24933, -0.24214,
#   -0.18249,  0.23929,  1.16295,  1.55444,  2.50001,  2.99810,
#    4.70514,  6.59931,  9.30709, 11.46855, 13.70366, 19.10190 /
  DATA V82 /  -0.24390,
#   -0.24390, -0.24390, -0.24390, -0.24390, -0.24390, -0.24390,
#   -0.24390, -0.24390, -0.24390, -0.24390, -0.24390, -0.24390,
#   -0.24390, -0.24390, -0.24388, -0.24371, -0.24345, -0.23788,
#   -0.18643,  0.21101,  1.12048,  1.51141,  2.46175,  2.96462,
#    4.69476,  6.62159,  9.38262, 11.58974, 13.87389, 19.39516 /
  DATA V84 /  -0.23810,
#   -0.23810, -0.23810, -0.23810, -0.23810, -0.23810, -0.23810,
#   -0.23810, -0.23810, -0.23810, -0.23810, -0.23810, -0.23810,
#   -0.23810, -0.23809, -0.23808, -0.23797, -0.23779, -0.23352,
```

```
     #   -0.18939,  0.18408,  1.07832,  1.46829,  2.42268,  2.93002,
     #    4.68252,  6.64148,  9.45530, 11.70785, 14.04086, 19.68488 /
      DATA V86 /    -0.23256,
     #   -0.23256, -0.23256, -0.23256, -0.23256, -0.23256, -0.23256,
     #   -0.23256, -0.23256, -0.23256, -0.23256, -0.23256, -0.23256,
     #   -0.23256, -0.23256, -0.23255, -0.23248, -0.23236, -0.22911,
     #   -0.19147,  0.15851,  1.03654,  1.42518,  2.38288,  2.89440,
     #    4.66850,  6.65907,  9.52521, 11.82294, 14.20463, 19.97115 /
      DATA V88 /    -0.22727,
     #   -0.22727, -0.22727, -0.22727, -0.22727, -0.22727, -0.22727,
     #   -0.22727, -0.22727, -0.22727, -0.22727, -0.22727, -0.22727,
     #   -0.22727, -0.22727, -0.22727, -0.22722, -0.22714, -0.22469,
     #   -0.19277,  0.13431,  0.99519,  1.38213,  2.34242,  2.85782,
     #    4.65277,  6.67443,  9.59243, 11.93509, 14.36528, 20.25402 /
      DATA V90 /    -0.22222,
     #   -0.22222, -0.22222, -0.22222, -0.22222, -0.22222, -0.22222,
     #   -0.22222, -0.22222, -0.22222, -0.22222, -0.22222, -0.22222,
     #   -0.22222, -0.22222, -0.22222, -0.22219, -0.22214, -0.22030,
     #   -0.19338,  0.11146,  0.95435,  1.33922,  2.30138,  2.82035,
     #    4.63541,  6.68763,  9.65701, 12.04437, 14.52288, 20.53356 /
C
C
C
      IORDER=1
      IF(SKU.LT. 0.0)IORDER=-1
      S=ABS(SKU)
      IF(S.GT.9.01)GOTO500
      IF(S.GT.4.75 .AND. S.LT.4.90)GOTO300
      H=0.1
      IF(S.GT.4.75)H=0.2
      KKTV=50+(S-4.8)/H + .5
      IF(KKTV.GT.70)KKTV=70
      SKTV = 4.8 + H*(KKTV-50)
      P = (S - SKTV)/H
      C0=P*(P-1.)*.5 *FLOAT(IORDER)
      C1=(1.-P**2)   *FLOAT(IORDER)
      C2=P*(P+1.)*.5 *FLOAT(IORDER)
      GOTO400
  300 KKTV=50
      P=S-4.8
      Q=S-5.0
      R=S-4.7
      C2=P*R*16.66667*FLOAT(IORDER)
      C1=Q*R*(-50.)  *FLOAT(IORDER)
      C0=P*Q*33.33333*FLOAT(IORDER)
  400 L=16*(1-IORDER)
      DO410I=1,31
      L=L+IORDER
  410 PD(L)=C0*PCT(I,KKTV-1)  + C1*PCT(I,KKTV) + C2*PCT(I,KKTV+1)
      RETURN
  500 DO520I=1,31
  520 PD(I)=0.
      RETURN
      END
C===============================================
C===============================================  HARTK      =======
      FUNCTION HARTK (P,V)
C  G387 - LOOK UP K OR P IN HARTERS TABLES.  WKIRBY 9/76.
C  HARTK  - LOOKUP STDIZED HARTER K AT CUMULATIVE PROB P
C  HARTP  - LOOKUP CUM (NONEXCEED) PROB P AT STDIZED HARTER K
C  V      - VECTOR OF SKEW-INTERPOLATED HARTER K VALUES (FROM HARTIV)
C  6/78 WK -- USING LOCAL NOT HARTAB COPY OF HARTER TAB PROBS/GAUSS DEV.
      DIMENSION V(1)
C  HARTER TABULAR PROBABILITIES OR  GAUSSIAN DEVIATES ------------
      REAL PROB(31)
      DATA PROB     /   0.00010,
     #   0.00050,  0.00100,  0.00200,  0.00500,  0.01000,  0.02000,
     #   0.02500,  0.04000,  0.05000,  0.10000,  0.20000,  0.30000,
     #   0.40000,  0.429624, 0.50000,  0.570376, 0.60000,  0.70000,
     #   0.80000,  0.90000,  0.95000,  0.96000,  0.97500,  0.98000,
     #   0.99000,  0.99500,  0.99800,  0.99900,  0.99950,  0.99990 /
C  -----------------------------------------------------------------
      DATA HUGE / 1E38/
C  ENTRY HARTK -
      IF(P.GT.PROB(31) .OR. P.LT.PROB(1))GOTO90
      IB=2
      IF(P.GE.0.5)IB=17
      IE=IB+13
      DO10I=IB,IE
      IF(P.LT.PROB(I))GOTO20
   10 CONTINUE
```

```
      I=IB+14
   20 HARTK=V(I-1)+(P-PROB(I-1))*(V(I)-V(I-1))/(PROB(I)-PROB(I-1))
      RETURN
C  RETURN + OR - 1E38 IF OUT OF RANGE OF PROB
   90 HARTK=HUGE
      IF(P.LT.PROB(1))HARTK=-HUGE
      RETURN
C
C  ENTRY HARTP -
      ENTRY HARTP(SHK, V)
      IF(SHK.GT.V(31).OR.SHK.LT.V(1))GOTO190
      IB=2
      IF(SHK.GE.V(16))IB=17
      IE=IB+13
      DO110I=IB,IE
      IF(SHK.LT.V(I))GOTO120
  110 CONTINUE
      I=IB+14
  120 DV=V(I)-V(I-1)
      IF(DV.EQ.0.)GOTO180
      HARTP=PROB(I-1)+(SHK-V(I-1))*(PROB(I)-PROB(I-1))/DV
      RETURN
  180 HARTP=PROB(I)
      IF(V(1).NE.V(31))      RETURN
  190 HARTP=1.
      IF(SHK.LT.V(1))HARTP=0.
      RETURN
      END
C==============================================
c ****************************************************************
c ****************************************************************
      subroutine inv3(x,xinv)
      double precision x(3,3), xc(3,3), xinv(3,3), det
      integer*4 i,j
      det=x(1,1)*x(2,2)*x(3,3)+x(1,2)*x(2,3)*x(3,1)
     1 +x(1,3)*x(3,2)*x(2,1) - x(1,1)*x(2,3)*x(3,2)
     1 -x(1,2)*x(2,1)*x(3,3) - x(1,3)*x(2,2)*x(3,1)
      xc(1,1)=x(2,2)*x(3,3) - x(2,3)*x(3,2)
      xc(2,1)=-x(2,1)*x(3,3) + x(2,3)*x(3,1)
      xc(3,1)=x(2,1)*x(3,2) - x(2,2)*x(3,1)
      xc(1,2)=-x(1,2)*x(3,3) + x(1,3)*x(3,2)
      xc(2,2)=x(1,1)*x(3,3) - x(1,3)*x(3,1)
      xc(3,2)=-x(1,1)*x(3,2) + x(1,2)*x(3,1)
      xc(1,3)=x(1,2)*x(2,3) - x(1,3)*x(2,2)
      xc(2,3)=-x(1,1)*x(2,3) + x(1,3)*x(2,1)
      xc(3,3)=x(1,1)*x(2,2) - x(1,2)*x(2,1)
      do 1 i=1,3
      do 1 j=1,3
      xinv(i,j)=xc(i,j)/det
    1 continue
      return
      end
      SUBROUTINE INVERT(N,NDIM,DET,COVINV,COV)
      implicit real*8 (a-h,o-z)
C ------------------------------------------------------------
C    COV IS AN N*N MATRIX
C    SUBROUTINE COMPUTES DETERMINANT OF COV THEN REPLACES COV WITH ITS
C      INVERSE
C    B IS THE LOWER TRIANGULAR DECOMPOSITION OF COV
C ------------------------------------------------------------
      INCLUDE 'DIMENS.CMN'
      INTEGER*4 N,NDIM,I,IM,K,J
      DOUBLE PRECISION COVINV(NDIM,NDIM), COV(NDIM,NDIM), B(MAXS,MAXS)
      DOUBLE PRECISION A(MAXS,MAXS),TEMP,DETL,SUM,DET
C
      IF (N.EQ.2) THEN
          DET = COV(1,1)*COV(2,2) - COV(1,2)**2
          TEMP = COV(1,1)/DET
          COVINV(1,1) = COV(2,2)/DET
          COVINV(2,2) = TEMP
          COVINV(1,2) = - COV(1,2)/DET
          COVINV(2,1) = COVINV(1,2)
      ELSE
C
      CALL DECOMP(N,NDIM,COV,B)
CC    WRITE(6,9)((B(I,J),J=1,N), I=1,N)
    9 FORMAT(10F10.4)
      DETL=B(1,1)
      DO 1 I=2,N
    1 DETL=DETL*B(I,I)
      DET=DETL**2
```

```
      IF(DET.EQ.0.0)THEN
           WRITE(6,1000)
 1000      FORMAT(1X,' PROCESSING STOPPED -- SINGULAR MATRIX')
C          STOP
           END IF
C
      A(1,1)=1./B(1,1)
      A(2,2)=1./B(2,2)
      A(2,1)=-B(2,1)*A(1,1)*A(2,2)
C
      DO 10 I=3,N
      A(I,I)=1./B(I,I)
      IM=I-1
      DO 11 K=1,IM
      SUM=0.
      DO 12 J=K,IM
   12 SUM=SUM+B(I,J)*A(J,K)
   11 A(I,K)=-SUM*A(I,I)
   10 CONTINUE
C
      DO 4 I=1,N
      DO 4 J=1,I
      SUM=0.
      DO 25 K=I,N
   25 SUM=SUM+A(K,I)*A(K,J)
      COVINV(I,J)=SUM
      COVINV(J,I)=SUM
    4 CONTINUE
      END IF
      RETURN
      END
C ******************************************************************
C *******************************************************************
C
      subroutine lever
      include 'dimens.cmn'
      include 'gr.cmn'
      double precision x(maxs,maxp), xt(maxp,maxs), hat(maxs,maxs),
     +                 temp(maxp,maxs)
      double precision xtxinv(maxp,maxp), xtx(maxp,maxp)
      include 'nari.cmn'
      integer*4 i
      DO 1 I=1,50
      X(I,1)=1.0
      X(I,2)=DAOLD(I)
      X(I,3)=PROLD(I)
      XT(1,I)=1.0
      XT(2,I)=DAOLD(I)
      XT(3,I)=PROLD(I)
    1 CONTINUE
C ====================
C COMPUTE LEVERAGE FOR 50 REPRESENTATIVE SITES
C========================
      CALL MULTIPLY(XTX,XT,X,3,50,3,3,3,50)
      CALL INV3(XTX,XTXINV)
      CALL MULTIPLY(TEMP,XTXINV,XT,3,3,50,3,3,3)
      CALL MULTIPLY(HAT,X,TEMP,50,3,50,50,50,3)
      DO 3 I=1,50
    3 H(I)=SNGL(HAT(I,I))
      return
      end
C
C SUBROUTINE LNMOM
C
      SUBROUTINE LNMOM(X,Y,U,V)
      REAL*4 X,Y,U,V,W
      W=(Y**2)/(X**2)
      IF(W.LT.0.000001) GO TO 10
      W=ALOG(1.0+W)
   10 CONTINUE
      V=SQRT(W)
      U=ALOG(X)-0.5*W
      RETURN
      END
C
C SUBROUTINE MELIOR
C
      SUBROUTINE MELIOR(YCUM,YCUMBL,PRIOR,NPHI)
      REAL*4 YCUM(500,14),YCUMBL(12),PRIOR(1000),ALPHA(14),V(500),
     +       YCUMAL(12),ALFA(12),PCT(12),PSTORE,YSTORE,PCUM,VMIN,B,
     +       ALPROX,DELP,SLOPE
```

```
      INTEGER*4 NPHI,IND(500),N,I,I13,IMIN,IP,J,K,KP,JM,NN,MM
      DATA    ALFA/.05,.10,.20,.30,.40,.50,.60,.70,.80,.90,.95,.99/
      DATA     PCT/.05,.10,.20,.30,.40,.50,.60,.70,.80,.90,.95,.99/
      N=1
      ALPHA(1)=1.0
      ALPHA(14)=0.0
      DO 10 I=1,NPHI
         VCUM(I,14)=0.0
         V(I)=VCUM(I,13)
         IND(I)=13
   10 CONTINUE
      DO 20 I=1,12
         IP=I+1
         I13=13-I
         ALPHA(IP)=PCT(I13)
   20 CONTINUE
      IMIN=1
      PSTORE=0.0
      VSTORE=0.0
   30 PCUM=0.0
      VMIN=V(IMIN)
      DO 35 I=1,NPHI
         IF(V(I).GT.VMIN) GO TO 35
         VMIN=V(I)
         IMIN=I
   35 CONTINUE
      J=IND(IMIN)
      DO 40 I=1,NPHI
      K=IND(I)
      KP=K+1
      IF(V(I).GE.1.0E36 ) GO TO 37
      IF(VCUM(I,K).EQ.VCUM(I,KP)) GO TO 37
      B=(ALPHA(K)-ALPHA(KP))/(VCUM(I,K)-VCUM(I,KP))
      ALPROX=ALPHA(KP)+B*(VCUM(IMIN,J)-VCUM(I,KP))
      GO TO 38
   37 ALPROX=1.0
   38 CONTINUE
      PCUM=PCUM+ALPROX*PRIOR(I)
   40 CONTINUE
   45 CONTINUE
      DELP=PCUM-ALFA(N)
      IF(ABS(DELP).LE.0.001) GO TO 60
      IF(DELP.GT.0.0) GO TO 50
      PSTORE=PCUM
      VSTORE=VCUM(IMIN,J)
      IF(IND(IMIN).NE.1) THEN
         JM=J-1
         IND(IMIN)=JM
         V(IMIN)=VCUM(IMIN,JM)
      ELSE
         V(IMIN)=1.0E36
      ENDIF
      GO TO 30
C
   50 CONTINUE
      SLOPE=(VCUM(IMIN,J)-VSTORE)/(PCUM-PSTORE)
      VCUMAL(N)=VSTORE+SLOPE*(ALFA(N)-PSTORE)
      N=N+1
      IF(N.GT.12) GO TO 90
      GO TO 45
C
   60 VCUMAL(N)=VCUM(IMIN,J)
      N=N+1
      IF(N.GT.12) GO TO 90
      GO TO 45
   90 CONTINUE
      DO 100 NN=1,12
      MM=13-NN
      VCUMBL(NN)=VCUMAL(MM)
  100 CONTINUE
      RETURN
      END
C ***********************************************************
C ***********************************************************
C
      SUBROUTINE MODLVALU(ANV,ANB,SEC)
C MODLVALU  VERSION OF 21 FEB,1980 INFORMATIVE PRIOR ON MODEL ERROR IS ALLOWED
C THIS PROGRAM IS BIG BASIN DESIGN PROCEDURE BASED
C ON THE STANDARD ERROR OF A REGIONAL REGRESSION ANALYSIS
C OF MEAN, STANDARD DEVIATION, 2, 10, 50, 100 YEAR EVENTS .
C REQUIRED PROBABILITY DISTRIBUTIONS HAVE BEEN INTERPOLATED
```

```
C OVER ALL PARAMETERS EXCEPT      . CV MUST BE BETWEEN 0.1 AND 5.0 .
C NB AND NY MUST BE BETWEEN 10 AND 50 .
C MODEL ERROR MAY NOT EXCEED 2.0 .
C JOINT PRIORS ON RHOC AND CV MUST BE ENTERED
C
      INTEGER*4 JEVENT,ICARD,IPHI,KFLAG
      REAL*4 ANY,ANB,SEC
C
CC    WRITE(6,1000)
CC1000 FORMAT(///,T10,91(1H*),/,1X,T10,'*',T100,'*',/,1X,T10,'* THIS PROG
CC    1RAM  IS  NARI   DESIGN  PROCEDURE BASED ON THE STANDARD ERROR OF A
CC    2 REGIONAL',T100,'*',/,1X,T10,'* REGRESSION ANALYSIS OF MEAN, STAND
CC    3ARD DEVIATION, 2-YEAR, 10-YEAR, 50-YEAR, OR 100-YEAR',T100,'*',/,
CC    41X,T10,'* EVENTS.  REQUIRED PROBABILITY DISTRIBUTIONS HAVE BEEN IN
CC    5TERPOLATED OVER ALL PARAMETERS',T100,'*',/,1X,T10,'* *** NOTE **.
CC    AJOINT PRIORS ON RHOC AND CV MUST BE ENTERED AS INPUT.'
CC    6 ,T100,'*',/,1X,T10,'*',T100,'*',/,1X,T10,'*       RESTRICTIONS: 1)
CC    6 CV MUST BE BETWEEN 0.1 AND 5.0',T100,'*',/,1X,T10,'*',T31,'2) STD
CC    7. ERROR OF REGRESSION MUST BE IN NATURAL (BASE E) LOG UNITS',
CC    8T100,'*',/,1X,T10,'*',T31,'3) NB & NY MUST BE BETWEEN 10 AND 50 ',
CC    8T100,'*',/,1X,T10,'*',T31,'4) ALLOWABLE VALUES OF RHOC ARE BETWEEN
CC    1  0.0   AND  0.9 .   ',T100,'*',/,1X,T10,'*',T100,'*',/,1X,T10,'*
CC    2DATE: APRIL 6 , 1979',T100,'*',/,1X,T10,'*',T100,'*',/,1X,T10,91(1
CC    3H*))
      CALL DATAIN(ANY,ANB,SEC,JEVENT)
C     CALL PRITAB
      KFLAG=1
      CALL BHIND(IPHI,KFLAG,JEVENT)
c     IF(KFLAG.EQ.2) GO TO 5
      CALL  DZNOUT(IPHI,JEVENT,ICARD)
      END
C ***************************************************************
C ***************************************************************
      SUBROUTINE MULTIPLY(PROD,X,Y,K1,K2,K3,N1,N2,N3)
      IMPLICIT REAL*8 (A-H,O-Z)
C --------------------------------------------------------------
C  X IS K1*K2 MATRIX
C  Y IS K2*K3 MATRIX
C  PROD = X*Y IS A K1*K3 MATRIX
C --------------------------------------------------------------
      DOUBLE PRECISION PROD,X,Y,SUM
      INTEGER*4 K1,K2,K3,N1,N2,N3,I,J,K
      DIMENSION PROD(N1,K3), X(N2,K2),Y(N3,K3)
      DO 1 I=1,K1
      DO 3 K=1,K3
      SUM=0.
      DO 2 J=1,K2
    2 SUM=SUM+X(I,J)*Y(J,K)
    3 PROD(I,K)=SUM
    1 CONTINUE
      RETURN
      END
c *******************************************************************
c *******************************************************************
c Subroutine netgls
c
      subroutine netgls(b0,b1,b2,bias,pmse,tmse,jend,rbar)
      implicit double precision (a-h,o-z)
      include 'dimens.cmn'
      include 'gr.cmn'
      include 'gr1-5.cmn'
      double precision work(3,1), v(1,3), vt(3,1), z(1,1), pred(1,1),
     +                 work1,work2,work3,sum,sumerr,sserr,avep,err,
     +                 ebar,varp
      COMMON /WORKC/ WORK1(3,maxs), WORK2(3,maxs), WORK3(maxs,1)
      common /net1/ noall,daall(150), prall(150), amall(150)
      real*4 daall, prall, amall,b0,b1,b2,bias,pmse,tmse,rbar
      integer*4 jend,i
c
c Compute predicted ave mse of prediction, avep
c
      sum=0.0
      sumerr=0.0
      sserr=0.0
      do 1 i=1,50
      v(1,1)=1.0
      v(1,2)=(daold(i))
      v(1,3)=(prold(i))
      vt(1,1)=v(1,1)
      vt(2,1)=v(1,2)
      vt(3,1)=v(1,3)
```

```
      call multiply(work,xtxinv,vt,3,3,1,3,3,1)
      call multiply(z,v,work,1,3,1,1,1,3)
      sum=sum+z(1,1)
    1 continue
      avep=gamasv+sum/50.
      avep=avep*2.302585**2
c
c regress using data relaized from gls network design
c
      call glsreg(nsites,jend,rbar,2,1)
      do 2 i=1,noall
      v(1,1)=1.0
      v(1,2)=alog10(daall(i))
      v(1,3)=alog10(prall(i))
      vt(1,1)=v(1,1)
      vt(2,1)=v(1,2)
      vt(3,1)=v(1,3)
      call multiply(pred,v,bhat,1,3,1,1,1,3)
      err=pred(1,1)-dble(amall(i))
      err=err*2.302585
      sumerr=sumerr+err
      sserr=sserr+err**2
    2 continue
      ebar=sumerr/noall
c     varp=(sserr-146.0*ebar**2)/145.0
      varp=sserr/noall
c     write(6,1000)avep, varp
 1000 format(' gls pred mse and obs mse =',2f15.4)
      bias=sngl(ebar)
      pmse=sngl(avep)
      tmse=sngl(varp)
      b0=sngl(bhat(1,1))
      b1=sngl(bhat(2,1))
      b2=sngl(bhat(3,1))
      return
      end
      SUBROUTINE OBSEMT(XNB,XNV,CVS,RHOCS,GAMMA,NEV,AM,AS)
      REAL*4 XNB,XNV,CVS,RHOCS,GAMMA,AM,AS,SIGSQ,RX,RNV,BEX,BSD,AHAT
      INTEGER*4 NEV,NEV2,NUP
      NEV2=NEV+2
      SIGSQ=ALOG(1.0+CVS*CVS)
      RX=ALOG(1.0+RHOCS*CVS*CVS)/SIGSQ
      RNV=XNV-1.0
      BEX=.87+.214/(XNV-1.0)+.003*XNB
      BSD=0.4659/(XNB-2.0)
      NUP=NEV
      IF(MOD(NUP,19).EQ.1)
     1AHAT=EXP(0.18  +1.16*ALOG(SIGSQ)+.912*ALOG(1.0-RX)-.901*ALOG(RNV))
      IF(MOD(NUP,19).EQ.5)
     1AHAT=EXP(-.35  +1.08*ALOG(SIGSQ)+.926*ALOG(1.0-RX)-.844*ALOG(RNV))
      IF(MOD(NUP,19).EQ.9)
     1AHAT=EXP( .08  +1.04*ALOG(SIGSQ)+.840*ALOG(1.0-RX)-.801*ALOG(RNV))
      IF(MOD(NUP,19).EQ.13)
     1AHAT=EXP( .35  +1.04*ALOG(SIGSQ)+.770*ALOG(1.0-RX)-.701*ALOG(RNV))
      IF(MOD(NUP,19).EQ.17)
     1AHAT=EXP( .47  +1.04*ALOG(SIGSQ)+.760*ALOG(1.0-RX)-.670*ALOG(RNV))
                                  AM=SQRT(AHAT+BEX*GAMMA*GAMMA)
      NUP=NEV2
      IF(MOD(NUP,19).EQ.3)  AHAT=EXP(-2.264+1.055*ALOG(SIGSQ)+
     *0.548*ALOG(1.0-RX)-0.685*ALOG(RNV)-0.656*ALOG(XNB-2.0))
      IF(MOD(NUP,19).EQ.7)  AHAT=EXP(-2.453+0.917*ALOG(SIGSQ)+
     *0.592*ALOG(1.0-RX)-0.702*ALOG(RNV)-0.729*ALOG(XNB-2.0))
      IF(MOD(NUP,19).EQ.11) AHAT=EXP(-1.494+0.981*ALOG(SIGSQ)+
     *0.643*ALOG(1.0-RX)-0.749*ALOG(RNV)-0.753*ALOG(XNB-2.0))
      IF(MOD(NUP,19).EQ.15) AHAT=EXP(-1.162+1.060*ALOG(SIGSQ)+
     *0.544*ALOG(1.0-RX)-0.625*ALOG(RNV)-0.760*ALOG(XNB-2.0))
      IF(MOD(NUP,19).EQ.0)  AHAT=EXP(-1.055+1.072*ALOG(SIGSQ)+
     *0.525*ALOG(1.0-RX)-0.603*ALOG(RNV)-0.746*ALOG(XNB-2.0))
                                  AS=SQRT(AHAT+BSD*GAMMA*GAMMA)
      RETURN
      END
      SUBROUTINE OBSESD(XB,XV,CV,RC,GAM   ,XMU,XSD)
      REAL*4 XB,XV,CV,RC,GAM,XMU,XSD,XNB,XNV,A04,A14,A24,B4,A06,A16,A26,
     +        B6,A4,A6,PRC4,PRC6
      XNB=XB
      XNV=XV
      XNB=1.0/XNB
      XNV=1.0/XNV
      A04=-2.4283+8.9763*XNV-4.4345*XNB
      A14=0.9555-2.4770*XNV
      A24=0.8165+0.42*XNV
```

```
      B4=0.9745+0.4833*XNY-3.2148*XNB
      A06=-2.3403+8.9734*XNY-2.3211*XNB
      A16=0.9777-2.676*XNY
      A26=0.7977+0.3858*XNY
      B6=0.982+0.6781*XNY-2.1032*XNB
      A4=EXP(A04+ A14*ALOG(CV)+A24*ALOG(1.0-RC))
      A6=EXP(A06+ A16*ALOG(CV)+A26*ALOG(1.0-RC))
      PRC4=A4+B4*GAM**2
      PRC6=A6+B6*GAM**2
      XSD=(ALOG(PRC6)-ALOG(PRC4))*0.5/0.52
      XMU=0.5*ALOG(PRC6)
      RETURN
      END
C ***************************************************************
C ***************************************************************
      SUBROUTINE OLSREG(YIN,X1,X2,N,SE)
      INTEGER*4 N,I,NDF
      REAL*4 YIN(100), X1(100), X2(100), SE, SS, SUM, PRED, RES, VRES,
     +        SEB2, SEB3, T2 ,T3, P2, P3
      DOUBLE PRECISION X(100,3), XT(3,100)
      DOUBLE PRECISION XTXINV(3,3), BHAT(3,1), E(3,1), Y(100,1),XTX(3,3)
      INCLUDE 'DIMENS.CMN'
      INCLUDE 'NARI.CMN'
      DO 1 I=1,N
      X(I,1)=1.0
      X(I,2)=X1(I)
      X(I,3)=X2(I)
      XT(1,I)=1.0
      XT(2,I)=X1(I)
      XT(3,I)=X2(I)
C ====================
C     WRITE(1,702)X1(I), X2(I)
  702 FORMAT(1X,2F12.4)
C ================
      Y(I,1)=YIN(I)
    1 CONTINUE
      CALL MULTIPLY(XTX,XT,X,3,N,3,3,3,100)
C =============
C     DO 701 I=1,3
C     DO 701 J=1,3
C 701 WRITE(1,111)XTX(I,J)
  111 FORMAT(1X,G13.3)
C ===========
C     CALL INVERT(3,3,DET,XTXINV,XTXINV)
      CALL INV3(XTX,XTXINV)
C ==================
C     DO 707 I=1,3
C     DO 707 J=1,3
C     WRITE (1,111)XTXINV(I,J)
C 707 CONTINUE
C =====================
      CALL MULTIPLY(E,XT,Y,3,N,1,3,3,100)
      CALL MULTIPLY(BHAT,XTXINV,E,3,3,1,3,3,3)
C =======================
C     WRITE(6,1000)BHAT(1,1), BHAT(2,1), BHAT(3,1)
 1000 FORMAT(1X,' BHATS ',3F12.4)
C CALCULATE SE
      SS=0.0
      SUM=0.0
      B0=SNGL(BHAT(1,1))
      B1=SNGL(BHAT(2,1))
      B2=SNGL(BHAT(3,1))
      DO 2 I=1,N
      PRED=B0 + X1(I)*B1 + X2(I)*B2
      RES=YIN(I)-PRED
      SUM=SUM+RES
      SS=SS+RES**2
    2 CONTINUE
      VRES=(SS-SUM**2/N)/(N-3)
      SE=SQRT(VRES)
      SEB2=VRES*XTXINV(2,2)
      SEB3=VRES*XTXINV(3,3)
      T2=ABS(B1/SEB2)
      T3=ABS(B2/SEB3)
      NDF=N-3
      P2=2.0*STUTP(-T2,NDF)
      IF(P2.LT..0001)P2=.0001
      P3=2.0*STUTP(-T3,NDF)
      IF(P3.LT..0001)P3=.0001
C =========================
C     WRITE(6,1001)SE, P2, P3
```

```
 1001 FORMAT(1X,' SE, PLEVELS 1 AND 2 ',3F12.5)
C
      RETURN
      END
      SUBROUTINE PRICAL(ZMU,ZSD,PTU,PTL,PRI)
      REAL*4 ZMU,ZSD,PTU,PTL,PRI,XU,XL
      XU=(PTU-ZMU)/ZSD
      XL=(PTL-ZMU)/ZSD
      PRI=GAUSCF(XU)-GAUSCF(XL)
      RETURN
      END
C *******************************************************
C *******************************************************
C
C
      FUNCTION RAN2(IDUM)
c
c Returns a uniform random deviate between 0.0 and 1.0
c (Numerical Recipes, 1986, p 197)
c
      PARAMETER (M=714025,IA=1366,IC=150889,RM=1.4005112E-6)
      DIMENSION IR(97)
      DATA IFF /0/
      DATA IY /0/
      DATA IR /97*0/
      IF(IDUM.LT.0.OR.IFF.EQ.0)THEN
        IFF=1
        IDUM=MOD(IC-IDUM,M)
        DO 11 J=1,97
          IDUM=MOD(IA*IDUM+IC,M)
          IR(J)=IDUM
 11     CONTINUE
        IDUM=MOD(IA*IDUM+IC,M)
        IY=IDUM
      ENDIF
      J=1+(97*IY)/M
      IF(J.GT.97.OR.J.LT.1)PAUSE
      IY=IR(J)
      RAN2=IY*RM
      IDUM=MOD(IA*IDUM+IC,M)
      IR(J)=IDUM
      RETURN
      END
c ******************************************************************
c ******************************************************************
      subroutine rank(jl, irank)
      include 'dimens.cmn'
      integer*4 jl(maxs), irank(maxs), i,k,kmax,isave
      real*4 hsave
      include 'nari.cmn'
      do 1 i=1,50
    1 irank(i)=0
      do 3 k=1,50
      kmax=-1
      hsave=-1.0
      do 2 i=1,50
          if(jl(i).lt.kmax.or.irank(i).gt.0)go to 2
          if(jl(i).eq.kmax.and.h(i).lt.hsave)go to 2
          isave=i
          kmax=jl(i)
          hsave=h(i)
    2 continue
      irank(isave)=k
    3 continue
      return
      end
c ******************************************************************
c ******************************************************************
      subroutine readin(y,ni,nj,da,pr,sta,i,ibeg,kbeg)
      integer*4 ni,nj,i,ibeg,ii,jset,j,kbeg
      real*4 y,da,pr,a,p,q(90)
      dimension y(ni,nj), da(ni), pr(ni)
      double precision sta(ni), stano
          read(5,202)stano
  202     format(t2,a8)
          read(5,203)(q(ii),ii=1,10)
          read(5,203)(q(ii),ii=11,20)
          read(5,203)(q(ii),ii=21,30)
          read(5,203)(q(ii),ii=31,40)
          read(5,203)(q(ii),ii=41,50)
          read(5,203)(q(ii),ii=51,60)
```

```
          read(5,203)(q(ii),ii=61,70)
          read(5,203)(q(ii),ii=71,80)
  203 format(1x,10f7.1)
          read(5,203)(q(ii),ii=81,90)
          read(5,203)a,p
      jset=ibeg-1
      kend=kbeg+nj-1
      do 1 j=1,nj
      jset=jset+1
      if(jset.gt.kend)jset=kbeg
      y(i,j)=alog10(q(jset))
    1 continue
      da(i)=alog10(a)
      pr(i)=alog10(p)
      sta(i)=stano
      return
      end
c ****************************************************************
c ****************************************************************
      subroutine read5(y,da,pr)
      integer*4 i,ii,icnt
      real*4 y,da,pr,q(90)
      double precision  stano
          read(5,202)stano
  202     format(t2,a8)
          read(5,203)(q(ii),ii=1,10)
          read(5,203)(q(ii),ii=11,20)
          read(5,203)(q(ii),ii=21,30)
          read(5,203)(q(ii),ii=31,40)
          read(5,203)(q(ii),ii=41,50)
          read(5,203)(q(ii),ii=51,60)
          read(5,203)(q(ii),ii=61,70)
          read(5,203)(q(ii),ii=71,80)
  203 format(1x,10f7.1)
          read(5,203)(q(ii),ii=81,90)
          read(5,203)da,pr
      icnt=0
      y=0.0
      do 1 i=1,90
      if(q(i).ge.0.0)then
           y=y+(q(i))
           icnt=icnt+1
      end if
    1 continue
      y=y/icnt
      y=alog10(y)
      return
      end
      SUBROUTINE SECANT
      implicit double precision (a-h,o-z)
C -----------------------------------------------------------------
C COMPUTES METHOD OF MOMENTS GAMASQ FOR GLS
C -----------------------------------------------------------------
      include 'dimens.cmn'
      include 'gr1-5.cmn'
      DOUBLE PRECISION X1,X2,X3,F1,F2,F3,FNEW,XNEW
      INTEGER*4 I,J
      X1=0.
      X3=0.
      if(aj.gt..7)then
            X2=YVAR*2.
            F2 =  GLS(X2)
            ELSE
            X2 = 1.0
            F2 = GLS(X2)
            DO 15 I = 1,4
            IF( F2.GT. 0.0) GO TO 16
            X2 = 2.*X2
            F2 =  GLS(X2)
   15 CONTINUE
   16 CONTINUE
      END IF
C
C     CHECK TO SEE IF A ROOT CAN BE FOUND LESS THAN X2---
      IF( F2.LT. 0.D+0) THEN
            WRITE(6,91) aj,X2
   91       FORMAT(' CANNOT FIND ROOT IN SECANT. IVR,X2 = ',f2.1, F10.5)
            GAMASQ = X2
            RETURN
            END IF
C
```

```
      F1 = GLS(X1)
      IF (F1.GE.0.)GO TO 100
C ---------------------------------------------------------------------
C DO MIDPOINT SEARCH TO FIND GOOD STARTING POINT FOR SECANT SEARCH
C---------------------------------------------------------------------
      DO 2 J=1,3
      XNEW = (X1+X2)/2.
      FNEW = GLS(XNEW)
      IF(FNEW.LT.0.) THEN
         X1 = XNEW
         FNEW = FNEW
      ELSE
      X2=XNEW
      F2=FNEW
      END IF
    2 CONTINUE
C ---------------------------------------------------------------------
C SEARCH FOR GAMA SQ USING SECANT SEARCH
C ---------------------------------------------------------------------
      DO 1 I=1,30
      X3 = X1 - F1*(X2-X1)/(F2-F1)
C     WRITE(6,4050)X3
 4050 FORMAT(' X3 =',F10.3)
      IF(X3.LT.0.) THEN
         X3=DMIN1(X2,X1)/2.
         F3 = GLS(X3)
      ELSE
      F3 =  GLS(X3)
      END IF
      IF(ABS(F3).LT..0001)GO TO 100
      IF(ABS(F1).LT.ABS(F2)) THEN
      X2=X3
      F2=F3
      ELSE
      X1=X3
      F1=F3
      END IF
    1 CONTINUE
C ---------------------------------------------------------------------
C IF SEARCH FAILS TO GET CLOSE ENOUGH IN 20 TRIES, WRITE MESSAGE
C ---------------------------------------------------------------------
      WRITE(6,1000)
 1000 FORMAT(1X,' NO CONVERGENCE IN SECANT')
      WRITE(6,92) X1,X2,F1,F2
   92 FORMAT( ' X1,X2 =',2F10.5/' F1,F2 =',2F10.5)
  100 GAMASQ=X3
      RETURN
      END
C ***************************************************************
C ***************************************************************
      subroutine smpsrl(x,eps,n,xint)
      implicit real*8 (a-h,o-z)
      double precision x(100),eps,xint,d
      integer*4 i,i1,i2,n
      d=10.0**16
      d=1.0/d
      xint=0.0
      do 10 i=3,n,2
      i1=i-1
      i2=i-2
      xint=xint+(x(1)+4.0*x(i1)+x(i2))
   10 continue
      if(xint.lt.d)then
         xint=0.0
      else
         xint=eps*xint/3.0
      end if
      return
      end
C ***************************************************************
C ***************************************************************
      SUBROUTINE        SRPOS(NB,Z1,Z2,Z3,Z4,Z5)
      IMPLICIT REAL*8 (A-H,O-Y)
      CHARACTER*4 ZDAT1(30),ZDAT2(30)
      DOUBLE PRECISION NY,PRO(5),X(1100),Y(10),DRHO(5),RHOL(6),P(30,5)
      REAL*4 Z1,Z2,Z3,Z4,Z5,ZD(31),ZL,ZU,ZSRC,ZZ
      DOUBLE PRECISION DD,VARBAR,RHOBAR,R,PZERO,EMPTY,QZERO,CVFRVR,RCFS,
     +                  SUMSUM,HAF,XNB,XNY,XNU,XNUS,SKU,B2,DEL,CVM,
     +                  XPOW1,XPOW2,SIGM,RDUMU,RDUML,XM,AMAX,EPS,RHO,B0,
     +                  B1,UP,SUMOV,XI,CVL,CVU,SIGL,SIGU,TOT,PART,RDUM,
     +                  SHKL,SHKU,PL,PU,XCESS,CVADJ
```

```
      INTEGER*4 NB,NRCV,K,I,J,L,NINTP,NRHOC,JP
      COMMON/N2SET/NRCV
      INCLUDE 'MV.CMN'
      DATA ZDAT1/9*'    ',' U ',' N ',' A ',' D ',' J ',' U ',
     +     ' S ',' T ',' E ',' D ','   ',' C ',' V ',8*'   '/
      DATA ZDAT2/9*'    ','   ','   ','   ',' A ',' D ',' J ',' U ',
     1     ' S ',' T ',' E ',' D ','   ',' C ',' V ',8*'   '/
      DATA RHOL/ 0.00,0.15,0.40,0.60,0.80,0.99/
      DATA DRHO/.00,.30,.50,.70,.90/
      DD=-180.0
      NY=Z5
      VARBAR=Z2
      RHOBAR=Z3
      R=RHOBAR
      IF(R.LT.0.0) R=0.0
      PZERO=Z4
      EMPTY=0.0
      QZERO=1.0-PZERO
CCC   WRITE(6,2) PZERO
CCC 2 FORMAT(     ' PROBABILITY OF ZERO FLOWS = ',F5.2)
      CVFRVR=DSQRT(-1.0+DEXP(VARBAR))
      RCFS=-1.0+ DEXP(     R*VARBAR)
      RCFS=RCFS/CVFRVR**2
CCC   WRITE(6,80)
CCC80 FORMAT('0' , 4X,'STATISTICS OF THE LOGARITHMS OF FLOWS')
CCC   WRITE(6,81) VARBAR,RHOBAR
CCC81 FORMAT(' AVERAGE VARIANCE = ',F7.2,'  WEIGHTED AVERAGE CROSS CORRE
CCC  1LATION = ',F7.2)
CCC   WRITE(6,1)
CCC   WRITE(6,82)
CCC82 FORMAT(5X,'ESTIMATES OF THE FLOW STATISTICS OBTAINED FROM STATISTI
CCC  *CS OF THE LOGARITHMS')
CCC   WRITE(6,83) CVFRVR,RCFS
CCC83 FORMAT(          ' COEFFICIENT OF VARIATION = ',F7.2,'          CROS
CCC  1S CORRELATION = ',F7.2)
      IF(QZERO.GT.EMPTY) GO TO 17
CCC   WRITE(6,16)
CCC16 FORMAT(' PROBABILITY OF NONZERO FLOWS  GIVEN AS ZERO')
      GO TO 999
   17 CONTINUE
       SUMSUM=0.0
      HAF=0.5
      XNB=NB
       XNY=NY
      XNU=XNB*(XNY-1.0)
      XNUS=DSQRT(2.0*XNU)
      SKU=DSQRT(8.0/XNU)
      ZZ=SKU
      CALL HARTIV( ZZ,ZD)
      B2=0.5*(XNY-1.0)*XNB+0.5
      XPOW1=0.5*(XNB-1.0)*(XNY-1.0)+1.0
      XPOW2=0.5*(XNY-1.0)+1.0
      NRHOC=5
      DEL=0.1
      CVM=5.9
       SIGM=DLOG(1.0+CVM**2)
      RDUMU=DLOG(1.0+0.990000*CVM**2)/SIGM
      RDUML=0.0
      XM=-1.0
      K=0
      AMAX=0.0
      EPS=0.001
   74 CONTINUE
      XM=XM+1.0
      RHO=RDUML+XM*EPS
      IF(RHO.GE.RDUMU) GO TO 71
      K=K+1
      B0=XPOW1*DLOG(1.0-RHO)
      B0=B0+XPOW2*DLOG(1.0+(XNB-1.0)*RHO)
      B0=-B0
      B1=    1.0
      B1=B1*(1.0-RHO+(XNB-1.0)*(1.0-R)*RHO)
      B1=B1/(1.0-RHO)
      B1=B1/(1.0+(XNB-1.0)*RHO)
            X(K)=DLOG(HAF)+                         B0 -(B2-0.5)*DLOG(B1)
      IF(X(K).GT.AMAX)AMAX=X(K)
      GO TO 74
   71 CONTINUE
      UP=0.99
      SUMOV=0.0
      I=0
```

```
   10 CONTINUE
      XI=I
      I=I+1
      CVM=DEL+XI*2.0*DEL
      CVL=CVM-DEL
      IF(I.EQ.1) CVL=0.01
      CVU=CVM+DEL
      SIGL=DLOG(1.0+CVL**2)
      SIGM=DLOG(1.0+CVM**2)
      SIGU=DLOG(1.0+CVU**2)
      K=0
      TOT=0.0
      XM=-1.0
      DO 15 J=1,NRHOC
      PRO(J)=0.0
      JP=J+1
      RDUMU=DLOG(1.0+RHOL(JP)*CVM**2)/SIGM
    3 CONTINUE
      DO 4 L=1,3
      XM=XM+1.0
      RHO=RDUML+XM*EPS
      IF(RHO.GE.RDUMU) GO TO 15
      K=K+1
       NINTP=L
      Y(L)=X(K)-AMAX
      IF(       Y(L).LT.DD)GO TO 9
            Y(L)=DEXP(       Y(L))
      GO TO 11
    9 Y(L)=0.0
   11 CONTINUE
    4 CONTINUE
      CALL SMPSRL(  Y   ,EPS,NINTP,PART)
      TOT=TOT+PART
      RDUM=RHO-EPS
      B1=( B2-HAF)*VARBAR*(1.0-RDUM+(XNB-1.0)*(1.0-R)*RDUM)
      B1=B1/(1.0-RDUM)
      B1=B1/(1.0+(XNB-1.0)*RDUM)
      B1=2.0*B1
      SHKL=B1/SIGU
      SHKU=B1/SIGL
      SHKL=(SHKL-XNU)/XNUS
      SHKU=(SHKU-XNU)/XNUS
      ZL=SHKL
      ZU=SHKU
      PL=HARTP(   ZL,ZD)
      PU=HARTP(   ZU,ZD)
      PRO(J)=PRO(J)+PART*(PU-PL)
      GO TO 3
   15 CONTINUE
      DO 60 J=1,NRHOC
      PRO(J)=PRO(J)/TOT
      SUMSUM=SUMSUM+PRO(J)
   60 CONTINUE
      IF(I.GT.30) GO TO 200
      DO 70 J=1,NRHOC
       P(I,J)=PRO(J)
   70 CONTINUE
      XCESS=1.0-SUMSUM
      GO TO 10
  200 CONTINUE
      IF(SUMSUM.GT.UP) GO TO 201
      XCESS=1.0-SUMSUM
      SUMSUM=1.0
  201 CONTINUE
      SUMOV= XCESS
      DO 205 I=1,30
      DO 206 J=1,5
      P(I,J)=P(I,J)/SUMSUM
  206 CONTINUE
  205 continue
CCC   write(6,1)
CCC 1 FORMAT('0')
CCC   WRITE(6,92) NB
CCC   WRITE(6,91) Z1
CCC92 FORMAT(54X,        'NUMBER OF STATIONS = ',I3)
CCC91 FORMAT(45X,'HARMONIC MEAN RECORD LENGTH = ',F6.2)
CCC   WRITE(6,25)
CCC   WRITE(6,23)
CCC   WRITE(6,26) (DRHO(J),J=1,5)
CCC   WRITE(6,20)
CCC25 FORMAT(1X,/   ,43X,' PROBABILITIES OF JOINT OCCURRENCE OF CV AND RH
```

```
CCC   10C')
CCC23 FORMAT('0',50X,'                    RHOC            ')
CCC26 FORMAT(28X          ,5(6X,F3.1,6X),'              ')
CCC20 FORMAT(' ',29X,72('-'))
      ZSRC=0.0
      NRCV=0
      DO 207 I=1,30
      XI=I-1
      CVM=DEL+XI*2.0*DEL
      CVADJ=DSQRT((CVM**2+PZERO)/QZERO)
CCC   WRITE(6,27) ZDAT1(I),CVM,(P(I,J),J=1,5),CVADJ,ZDAT2(I)
CCC27 FORMAT(20X,A4,F5.2,' !',3X,F7.5    ,4(7X,F7.5,1X),'!',4X,F7.5,A4)
      DO 208 J=1,5
         IF(P(I,J).GT..01)THEN
         NRCV=NRCV+1
         RHOC(NRCV)=SNGL(DRHO(J))
         CV(NRCV)=SNGL(CVM)
         PROBRC(NRCV)=SNGL(P(I,J))
         ZSRC=ZSRC+PROBRC(NRCV)
         END IF
  208 CONTINUE
  207 CONTINUE
      DO 209 I=1,NRCV
      PROBRC(I)=PROBRC(I)/ZSRC
CCC   WRITE(6,57) RHOC(I), CV(I), PROBRC(I)
CCC57 FORMAT(1X,' RHO, CV, PROBRC ',3F13.3)
  209 CONTINUE
CCC   WRITE(6,20)
CCC   IF(SUMOV.GT.0.01)  WRITE(6,204) SUMOV
CC204 FORMAT(9X,' PROBABILITY OF CV GREATER THAN 6.0 EQUALS ',F5.2)
CCC   WRITE(6,21)
CCC21 FORMAT(                                  ' RHOC STANDS FOR THE INT
CCC  4ERSTATION CORRELATION AND CV FOR THE COEFFICIENT OF VARIATION AT T
CCC  5HE STATIONS.')
  999 CONTINUE
      RETURN
      END
C===============================================  STUTP       =======
      FUNCTION STUTP(X,N)
C
C   STUDENT T PROBABILITY
C   STUTP = PROB( STUDENT T WITH N DEG FR  .LT.  X )
C
C   NOTE  -  PROB(ABS(T).GT.X) = 2.*STUTP(-X,N) (FOR X .GT. 0.)
C
C   SUBPGM USED - GAUSCF
C
C   REF - G.W. HILL, ACM ALGOR 395, OCTOBER 1970.
C
C     USGS - WK 12/79.
C
C
      DATA RHPI / 0.63661977 /
C
      STUTP  =  .5
      IF(N.LT.1) RETURN
C
      NN = N
      Z = 1.
      T = X**2
      Y = T/NN
      B = 1.0 + Y
C
      IF(NN.GE.20 .AND. T.LT.NN .OR. NN.GT.200) GO TO 200
C               ( OR IF NN NON-INTEGER)
C
      IF(NN.LT.20 .AND. T.LT.4.) GO TO 100
C
C  --  TAIL SERIES FOR LARGE T
      A = SQRT(B)
      Y = A*NN
      J = 0
   30 J = J + 2
      IF(A.EQ.Z) GO TO 40
      Z = A
      Y = Y*(J-1)/(B*J)
      A = A + Y/(NN+J)
      GO TO 30
   40 CONTINUE
      NN = NN + 2
      Z = 0.
```

```
      Y = 0.
      A = -A
      GO TO 110
C
C  --  NESTED SUMMATION OF COSINE SERIES
  100 Y = SQRT(Y)
      A = Y
      IF(NN.EQ. 1) A = 0.
  110 NN = NN - 2
      IF(NN.LE.1) GO TO 120
      A = (NN-1)/(B*NN)*A + Y
      GO TO 110
  120 IF(NN.EQ.0) A = A/SQRT(B)
      IF(NN.NE.0) A = (ATAN(Y)+A/B)*RHPI
      STUTP  = 0.5*(Z-A)
      IF(X.GT.0.) STUTP = 1.-STUTP
      RETURN
C
C  --  ASYMPTOTIC SERIES FOR LARGE OR NONINTEGER N
  200 IF(Y.GT.1E-6) Y = ALOG(B)
      A = NN - 0.5
      B = 48.*A**2
      Y = A*Y
      Y = (((((-0.4*Y-3.3)*Y-24.)*Y-85.5)/
     $      (0.8*Y**2+100.+B)+Y+3.)/B+1.)*SQRT(Y)
      STUTP = GAUSCF(-Y)
      IF(X.GT.0.) STUTP = 1.-STUTP
      RETURN
C
      END
      SUBROUTINE TRSEMT(NBS,NVS,CVS,RHOCS,GAM,IEQ,YHAT)
C   MARCH 29 , 1979  VERSION  EJG  ***********
      REAL*4 NBS,NVS,CVS,RHOCS,GAM,YHAT(12),PCT(12),RC,XNB,XNY,RNY,RNB,
     +       BC,AC,AD,BD,C,D,EAA,BCONE,ACONE,ADONE,BDONE,CONE,DONE,EA5,
     +       EAAONE,EA20,P,Q,BABAR,AB,BB,G,ST,A,B,CHK
      INTEGER*4 IEQ,I
      REAL*4 AC0(5),AC1(5),AC2(5),BC0(5),BC1(5),BC2(5)
      REAL*4 AD0(5),AD1(5),AD2(5),BD0(5),BD1(5),BD2(5)
      REAL*4 P1(5),P2(5),P3(5),Q1(5),Q2(5),Q3(5)
      DATA     PCT/.05,.10,.20,.30,.40,.50,.60,.70,.80,.90,.95,.99/
      DATA    AC0/-.00004768,-.00004627,-.000135,-.00026899,-.00033366/
      DATA    AC1/.00098828,.00095741,.00218582,.00364928,.00434355/
      DATA    AC2/.00228696,.00228433,.00506094,.00989079,.01227075/
      DATA    BC0/.00004756,.0000558,.00008135,.00015733,.00018675/
      DATA   BC1/-.00104333,-.00114918,-.00116913,-.00202905,-.00224835/
      DATA    BC2/.00294110,.00292981,.00421797,.00656359,.00762483/
      DATA    AD0/-.00483009,.04922095,-.0109047,-.00682937,.00136460/
      DATA    AD1/.14990742,.06462133,.16338939,.21607053,.22409377/
      DATA    AD2/.58877368,.21735231,.71078425,1.90346478,2.59422482/
      DATA    BD0/.01501139,-.06598009,.01685218,.02941826,.02694948/
      DATA    BD1/-.12428315,.02139170,-.14327578,-.12743067,-.13453086/
      DATA    BD2/.19042281,.42306749,.47739744,-.06762123,-.31559290/
      DATA    P1/1.4075,1.2884,1.3825,1.2679,1.2337/
      DATA    P2/-1.6088,-1.1602,-1.4826,-0.9747,-0.8280/
      DATA    P3/-0.0463,0.5287,-0.2825,-0.4225,-0.5090/
      DATA    Q1/0.8097,1.1120,0.8690,1.0496,1.0684/
      DATA    Q2/-3.1175,-3.8594,-4.5154,-5.1262,-4.9757/
      DATA    Q3/0.4488,-0.6487,1.3425,1.3592,1.3258/
      RC=RHOCS-0.48
      XNB=NBS
      XNY=NYS
      RNY=1.0/XNY
      RNB=1.0/XNB
      BC=BC0(IEQ)+BC1(IEQ)*RNB+BC2(IEQ)*RNV
      AC=AC0(IEQ)+AC1(IEQ)*RNB+AC2(IEQ)*RNV
      AD=AD0(IEQ)+AD1(IEQ)*RNB+AD2(IEQ)*RNV
      BD=BD0(IEQ)+BD1(IEQ)*RNB+BD2(IEQ)*RNV
      C=AC+BC*RC
      D=AD+BD*RC
      EAA=C+D*(CVS*CVS/(1.0+CVS)-0.01/1.1)
      IF(IEQ.NE.2) GO TO 12
      BCONE=BC0(1)+BC1(1)*RNB   +BC2(1)*RNV
      ACONE=AC0(1)+AC1(1)*RNB   +AC2(1)*RNV
      ADONE=AD0(1)+AD1(1)*RNB   +AD2(1)*RNV
      BDONE=BD0(1)+BD1(1)*RNB   +BD2(1)*RNV
      CONE=ACONE+BCONE*RC
      DONE=ADONE+BDONE*RC
      EAAONE=CONE+DONE*(CVS*CVS/(1.0+CVS)-0.01/1.1)
      IF(CVS.GT.2.0)  GO TO 11
      EAA=EAAONE
      GO TO 12
```

```
   11 CONTINUE
      EA5=C+D*(25.0/6.0-0.01/1.1)
      EA20=CONE+DONE*(4.00/3.0-0.01/1.1)
      EAA=EA20+(CVS-2.0)*(EA5-EA20)/(5.0-2.0)
   12 CONTINUE
      P=P1(IEQ)+P2(IEQ)*RNB+P3(IEQ)*RNV
      Q=Q1(IEQ)+Q2(IEQ)*RNB+Q3(IEQ)*RNV
      BABAR=P+Q*RC
      AB=0.0046+1.4622*RNB+0.01017*RNV
      BB=0.0068+1.0659*RNB-0.02152*RNV
      IF(EAA.LE.0.0) EAA=0.001
      G=GAM
      DO 2999  I=1,12
      ST=ALOG(-ALOG(1.0-PCT(I)))+0.49
      A=BABAR*ST
      A=EAA*EXP(A)
      B=EXP(AB+BB*ST)
      CHK=A+B*G*G
      VHAT(I)=SQRT(CHK)
 2999 CONTINUE
      RETURN
      END
      SUBROUTINE TRSESD(ZNB,ZNV,CV,RC,GAM,FRAC2)
C  APRIL 11, 1979  VERSION   *********
      REAL*4 FRAC2(12),CAWB(12),PCT(12),ZNB,ZNV,CV,RC,GAM,RNB,RNV,P1,P2,
     +       P3,BA,A1,A2,B1,B2,C,D,AA,AB,BB,A,B
      INTEGER*4 I
      DATA      PCT/.05,.10,.20,.30,.40,.50,.60,.70,.80,.90,.95,.99/
      RNB=1.0/ZNB
      RNV=1.0/ZNV
      P1=0.75+2.18*RNB-1.49*RNV
      P2=-0.077
      P3=1.00-5.20*RNB+1.92*RNV
      BA=P1+P2*CV+P3*RC
      A1=-0.013+0.072*RNB+0.372*RNV
      A2=0.004-0.012*RNB-0.017*RNV
      B1=0.02-0.0002*RNB+.753*RNV
      B2=.15*RNV+.01*RNB
      C=A1+A2*RC
      D=B1+B2*RC
      AA=C+D*(CV*CV-0.01)
      IF(AA.LT.0.0) AA=0.001
      AB=0.0046+1.4622*RNB+0.01017*RNV
      BB=0.0068+1.0659*RNB-0.02152*RNV
      DO 100 I=1,12
      CAWB(I)=ALOG(-ALOG(1.0-PCT(I)))+0.49
      A=AA*EXP(BA*CAWB(I))
      B=EXP(AB+BB*CAWB(I))
      FRAC2(I)=(A + B*GAM*GAM)
      FRAC2(I)=SQRT(FRAC2(I))
  100 CONTINUE
      RETURN
      END
C
C SUBROUTINE ZERO
C
      SUBROUTINE ZERO
      INTEGER*4 NRCV,I
      COMMON/N2SET/NRCV
      REAL*4 POGAM,POSJO
      COMMON/PROSET/POGAM(41),POSJO(100)
      DO 10 I=1,NRCV
         POSJO(I)=0.0
   10 CONTINUE
      DO 20 I=1,41
         POGAM(I)=0.0
   20 CONTINUE
      RETURN
      END
```

COMMON FILES

```
c*** begin dimens.cmn
c
c      maxs = maximum number of sites
c      maxp = maximum number of parameters
c      maxyr = maximum number of years
       integer*4 maxs,maxp,maxyr
       parameter(maxs=50,maxp=3,maxyr=30)
c
c*** end dimens.cmn
c*** begin gr.cmn
c
       real*4 yold(maxs,maxyr),amean(maxs),stdev(maxs),daold(maxs),
     +        prold(maxs)
       common /gr/yold,amean,stdev,daold,prold
c
c*** end gr.cmn
C*** BEGIN TAB.CMN
C
       REAL*4 PRIOR,CVARAY,RCARAY,GARAY
       COMMON/TAB1/PRIOR(1000)
       COMMON/TAB2/CVARAY(1000),RCARAY(1000),GARAY(1000)
C
C*** END TAB.CMN
C*** BEGIN MV.CMN
C
       REAL*4 RHOC,CV,PROBRC
       COMMON /MV/ RHOC(150),CV(150),PROBRC(150)
C
C*** END MV.CMN
c*** gr1-5.cmn
c
       double precision sighat(maxs),ys(maxs,maxp),x(maxs,maxp),
     +                  xt(maxp,maxs),xtx(maxp,maxp),xtxinv(maxp,maxp)
       integer*4 mcon(maxs,maxs)
       common /gr1/ sighat,ys,mcon,x,xt,xtx,xtxinv
       double precision sta(maxs,maxs),cov(maxs,maxs),covinv(maxs,maxs),
     +                  bhat(maxp,1)
       common /gr2/ sta,cov,covinv,bhat
       double precision e(maxs,1),et(1,maxs),yvar,aj
       integer*4 nsites,ne,nexp,iys
       common /gr3/ e,et,yvar,aj,nsites,ne,nexp,iys
       double precision bsv(maxp,1),rsv,gamasv,gamasq
       common /gr4/ bsv,rsv,gamasv,gamasq
       integer*4 msv(maxs,maxs)
       common /gr5/ msv
c
c*** end gr1-5.cmn
c*** begin nari.cmn
c
       real*4 b0,b1,b2,semin,anbsv,anysv,h
       common /nari/ b0, b1, b2, semin, anbsv, anysv, h(maxs)
c
c*** end nari.cmn
```

APPENDIX B -- Input data for program. Flow values are in cubic feet per second, drainage area is in square miles, and precipitation is in inches.

```
 03086500  MAHONING R AT ALLIANCE OH
   -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    -1.0    -1.0
   -1.0    59.0    92.7    37.7    71.6    87.8    89.6    68.5    67.9    93.8
  124.0   114.0    61.7    41.5   100.0   136.0    78.4   107.0   106.0    95.7
   69.1    49.7    54.5    66.2    60.3    52.7    78.6    75.5    60.6    86.9
   94.7    87.5   122.0   127.0   158.0   104.0    79.3   138.0   120.0   104.0
  121.0   101.0    96.8   139.0   104.0    -1.0    -1.0    -1.0    -1.0    -1.0
   89.2    37.0
 03092000  KALE C NR PRICETOWN OH
   -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    -1.0    -1.0
   -1.0    18.1    25.9    13.2    16.6    19.2    27.9    15.9    14.2    26.5
   28.4    31.4    12.9    13.8    25.9    36.4    19.7    24.2    29.1    27.8
   15.0    13.2    10.9    20.8    15.6    14.8    18.8    16.2    20.7    22.8
   21.7    28.5    30.2    35.8    43.1    40.7    22.4    37.3    34.0    25.2
   21.3    21.6    22.5    26.6    21.7    -1.0    -1.0    -1.0    -1.0    -1.0
   21.9    38.0
 03093000  EAGLE C AT PHALANX STATION OH
   -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   145.0
  143.0   146.0    95.1    51.4    84.5    71.3    34.4   102.0    87.0   108.0
   69.5   100.0   138.0    68.3    89.8   111.0   140.0    81.0    83.6   132.0
  139.0   149.0    47.5    68.9   121.0   168.0   118.0   107.0   152.0   125.0
   98.1    73.6    69.1    89.8    89.7    94.2    96.1    96.1   126.0    87.7
  113.0   126.0   143.0   145.0   167.0   131.0    89.6   159.0   144.0   138.0
  123.0   146.0   121.0   170.0   125.0    -1.0    -1.0    -1.0    -1.0    -1.0
   97.6    38.0
 03109500  L BEAVER C NR EAST LIVERPOOL OH
   -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   575.0   404.0   400.0   396.0   512.0
  470.0   522.0   318.0   710.0   313.0   563.0   780.0   798.0   630.0   608.0
  207.0   429.0   488.0   216.0   440.0   572.0   899.0   624.0   562.0   493.0
  400.0   434.0   624.0   349.0   576.0   605.0   502.0   423.0   432.0   559.0
  742.0   663.0   451.0   286.0   609.0   809.0   455.0   651.0   565.0   551.0
  418.0   341.0   323.0   387.0   386.0   373.0   410.0   429.0   340.0   428.0
  589.0   570.0   722.0   671.0   815.0   588.0   471.0   678.0   655.0   714.0
  589.0   428.0   494.0   644.0   564.0    -1.0    -1.0    -1.0    -1.0    -1.0
  496.0    37.5
 03110000  YELLOW C NR HAMMONDSVILLE OH
   -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    -1.0    -1.0
   -1.0   128.0   189.0   122.0   214.0   178.0   170.0   145.0   178.0   167.0
  265.0   221.0   114.0    77.6   164.0   240.0   129.0   179.0   143.0   149.0
  161.0   128.0   121.0   112.0   123.0   134.0   148.0   109.0    95.1   144.0
  168.0   142.0   191.0   184.0   243.0   154.0   128.0   200.0   233.0   266.0
  179.0   124.0   164.0   216.0   117.0    -1.0    -1.0    -1.0    -1.0    -1.0
  147.0    40.0
 03111500  SHORT C NR DILLONVALE OH
   -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    -1.0    -1.0
   -1.0   102.0   170.0   103.0   163.0   125.0   110.0   119.0   157.0   159.0
  194.0   160.0    83.4    46.1   119.0   170.0   101.0   102.0   120.0    94.8
  128.0    95.1   113.0    83.2    94.8   111.0   119.0   101.0    74.6   106.0
  143.0   119.0   142.0   149.0   208.0   140.0   107.0   179.0   217.0   225.0
  185.0   115.0   137.0   145.0    92.6    -1.0    -1.0    -1.0    -1.0    -1.0
  123.0    39.0
 03117000  TUSCARAWAS R AT MASSILLON OH
   -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   372.0   463.0
  280.0   319.0   530.0   269.0   359.0   364.0   658.0   370.0   364.0   512.0
  527.0   576.0   268.0   245.0   393.0   591.0   432.0   454.0   573.0   510.0
  393.0   254.0   284.0   326.0   267.0   269.0   386.0   434.0   556.0   426.0
  440.0   420.0   620.0   542.0   661.0   538.0   386.0   629.0   622.0   619.0
  513.0   431.0   459.0   539.0   465.0    -1.0    -1.0    -1.0    -1.0    -1.0
  518.0    37.0
```

```
03117500   SANDY C AT WAYNESBURG OH
  -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    -1.0   237.0
 200.0   219.0   314.0   162.0   276.0   308.0   290.0   221.0   254.0   294.0
 406.0   340.0   182.0   147.0   265.0   371.0   233.0   306.0   301.0   286.0
 226.0   182.0   177.0   191.0   185.0   194.0   260.0   211.0   182.0   293.0
 283.0   228.0   368.0   386.0   429.0   292.0   237.0   391.0   370.0   392.0
 320.0   223.0   294.0   296.0   273.0    -1.0    -1.0    -1.0    -1.0    -1.0
 253.0    37.5
03118000   MIDDLE BRANCH NIMISHILLEN CREEK AT CAN
  -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    -1.0    -1.0
  -1.0    24.1    31.2    17.1    26.3    37.4    47.5    25.7    32.1    47.4
  53.3    49.5    21.2    16.0    27.6    47.1    26.0    37.8    46.4    37.1
  23.6    18.6    16.7    21.0    20.3    20.4    29.0    31.3    30.8    31.8
  34.6    41.7    54.8    48.9    67.3    50.1    33.1    57.0    54.7    52.1
  41.6    31.4    44.3    51.3    41.3    -1.0    -1.0    -1.0    -1.0    -1.0
  43.1    37.0
03118500   NIMISHILLEN C AT NORTH INDUSTRY OH
  -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   178.0   139.0   228.0    98.6   155.0   230.0   202.0   179.0   179.0
  72.4   126.0   126.0    76.4   134.0   174.0   233.0   199.0   166.0   170.0
 117.0   134.0   174.0   103.0   146.0   170.0   218.0   141.0   155.0   204.0
 234.0   210.0   144.0   122.0   160.0   231.0   156.0   204.0   231.0   209.0
 160.0   124.0   130.0   145.0   138.0   143.0   172.0   189.0   187.0   205.0
 211.0   217.0   273.0   262.0   308.0   262.0   211.0   307.0   285.0   284.0
 257.0   202.0   237.0   269.0   238.0   234.0    -1.0    -1.0    -1.0    -1.0
 175.0    37.0
03136500   KOKOSING R AT MOUNT VERNON OH
  -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    -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    78.7   158.0   228.0   223.0   216.0   265.0   180.0
 213.0   149.0   151.0   215.0   140.0   139.0   232.0   208.0   267.0   218.0
 166.0   255.0   325.0   237.0   266.0   194.0   170.0   246.0   289.0   310.0
 230.0   220.0   211.0   280.0   176.0    -1.0    -1.0    -1.0    -1.0    -1.0
 202.0    37.0
03139000   KILLBUCK C AT KILLBUCK OH
  -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
 128.0   330.0   412.0   163.0   405.0   354.0   572.0   463.0   365.0   400.0
 234.0   314.0   534.0   241.0   387.0   431.0   665.0   436.0   344.0   491.0
 517.0   561.0   231.0   170.0   337.0   534.0   417.0   443.0   546.0   400.0
 374.0   224.0   252.0   349.0   263.0   267.0   355.0   374.0   695.0   376.0
 371.0   404.0   672.0   498.0   630.0   442.0   309.0   609.0   638.0   642.0
 519.0   445.0   482.0   569.0   375.0    -1.0    -1.0    -1.0    -1.0    -1.0
 464.0    37.0
03140000   MILL C NR COSHOCTON OH
  -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    29.9    21.8    30.0
  20.0    24.0    29.1    13.2    29.0    38.5    33.7    29.2    24.4    32.7
  38.5    35.9    13.7     7.7    20.5    35.9    31.0    26.5    29.9    28.4
  29.1    20.6    25.2    23.8    20.7    21.5    21.4    29.2    30.1    26.5
  23.9    24.5    36.3    32.9    41.3    26.9    19.8    44.9    54.5    45.2
  37.9    24.3    29.6    33.3    18.0    -1.0    -1.0    -1.0    -1.0    -1.0
  27.2    39.5
03144000   WAKATOMIKA C NR FRAZEYSBURG OH
  -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   247.0   161.0   136.0   172.0
  90.7   113.0   191.0   103.0   165.0   148.0   176.0   152.0   161.0   191.0
 187.0   203.0    68.1    51.9   110.0   170.0   130.0   146.0   154.0   159.0
 152.0   111.0   123.0   124.0   106.0   143.0   137.0   183.0   146.0   171.0
 147.0   105.0   180.0   169.0   193.0   155.0   100.0   204.0   270.0   249.0
 203.0   128.0   167.0   199.0    99.8    -1.0    -1.0    -1.0    -1.0    -1.0
 140.0    39.0
03146500   LICKING R NR NEWARK OH
  -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
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-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	591.0
267.0	407.0	708.0	367.0	686.0	592.0	773.0	587.0	633.0	694.0
797.0	739.0	227.0	156.0	364.0	684.0	459.0	651.0	564.0	490.0
545.0	453.0	511.0	515.0	475.0	499.0	578.0	667.0	621.0	696.0
473.0	505.0	858.0	753.0	756.0	555.0	387.0	803.0	1129.0	818.0
745.0	524.0	624.0	766.0	534.0	-1.0	-1.0	-1.0	-1.0	-1.0
537.0	39.0								
03157000	CLEAR C NR ROCKBRIDGE OH								
-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	-1.0	82.0
69.4	59.7	111.0	62.8	129.0	93.2	105.0	125.0	99.7	89.2
127.0	105.0	44.0	28.8	59.1	77.0	57.6	96.6	76.7	65.4
102.0	66.6	81.3	75.3	65.6	65.9	93.9	121.0	80.6	87.1
80.6	70.6	122.0	107.0	118.0	103.0	63.1	113.0	164.0	116.0
102.0	64.0	94.6	97.7	87.6	-1.0	-1.0	-1.0	-1.0	-1.0
89.0	39.0								
03157500	HOCKING R AT ENTERPRISE OH								
-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	398.0	543.0	205.0	501.0	414.0	637.0	580.0	505.0	461.0
297.0	311.0	554.0	291.0	593.0	457.0	510.0	610.0	540.0	519.0
654.0	521.0	200.0	110.0	321.0	458.0	313.0	572.0	404.0	322.0
490.0	356.0	425.0	406.0	374.0	423.0	517.0	581.0	349.0	428.0
399.0	369.0	659.0	553.0	618.0	570.0	302.0	551.0	860.0	700.0
552.0	342.0	493.0	513.0	421.0	-1.0	-1.0	-1.0	-1.0	-1.0
459.0	39.0								
03202000	RACCOON C AT ADAMSVILLE OH								
-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	1095.0	802.0
552.0	543.0	1086.0	811.0	889.0	548.0	871.0	400.0	748.0	1015.0
729.0	609.0	542.0	341.0	573.0	709.0	283.0	687.0	837.0	491.0
418.0	330.0	846.0	411.0	829.0	712.0	628.0	849.0	673.0	734.0
952.0	638.0	408.0	186.0	617.0	773.0	488.0	797.0	494.0	476.0
700.0	668.0	636.0	459.0	438.0	612.0	662.0	821.0	344.0	581.0
572.0	624.0	764.0	779.0	862.0	685.0	422.0	594.0	1088.0	856.0
591.0	403.0	538.0	552.0	528.0	-1.0	-1.0	-1.0	-1.0	-1.0
585.0	40.0								
03219500	SCIOTO R NR PROSPECT OH								
-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	492.0	833.0	563.0	554.0	667.0	165.0	385.0	367.0
226.0	284.0	462.0	249.0	493.0	390.0	649.0	553.0	582.0	647.0
630.0	595.0	217.0	127.0	293.0	388.0	522.0	552.0	560.0	283.0
400.0	328.0	337.0	425.0	265.0	268.0	540.0	431.0	603.0	486.0
345.0	588.0	815.0	513.0	569.0	399.0	208.0	580.0	454.0	642.0
356.0	568.0	285.0	576.0	301.0	-1.0	-1.0	-1.0	-1.0	-1.0
567.0	35.0								
03220000	MILL C NR BELLEPOINT OH								
-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	-1.0	-1.0
-1.0	-1.0	-1.0	83.3	141.0	132.0	231.0	187.0	188.0	220.0
257.0	198.0	71.6	51.4	109.0	169.0	151.0	214.0	187.0	97.6
144.0	118.0	94.9	145.0	99.0	70.3	175.0	144.0	154.0	144.0
96.5	171.0	239.0	159.0	199.0	109.0	81.0	206.0	199.0	254.0
173.0	166.0	112.0	190.0	120.0	-1.0	-1.0	-1.0	-1.0	-1.0
178.0	37.0								
03223000	OLENTANGY R AT CLARIDON OH								
-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	-1.0	-1.0
-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	237.0	149.0	162.0	205.0
183.0	179.0	84.3	72.7	98.7	157.0	175.0	156.0	185.0	94.8
124.0	102.0	118.0	151.0	111.0	99.5	175.0	137.0	154.0	168.0
119.0	163.0	234.0	148.0	194.0	158.0	100.0	199.0	151.0	206.0
179.0	194.0	123.0	209.0	146.0	-1.0	-1.0	-1.0	-1.0	-1.0
157.0	35.5								
03230500	BIG DARBY C AT DARBYVILLE OH								
-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	629.0	249.0	601.0	127.0	468.0	689.0
537.0	658.0	604.0	123.0	465.0	629.0	79.1	243.0	445.0	361.0
155.0	262.0	489.0	253.0	445.0	381.0	648.0	537.0	577.0	560.0

746.0	652.0	199.0	132.0	288.0	423.0	397.0	710.0	573.0	273.0
463.0	430.0	337.0	405.0	355.0	305.0	488.0	431.0	530.0	479.0
329.0	469.0	812.0	595.0	633.0	372.0	250.0	649.0	705.0	765.0
475.0	431.0	358.0	583.0	398.0	576.0	-1.0	-1.0	-1.0	-1.0
534.0	37.0								
03237500	OHIO BRUSH C NR WEST UNION OH								
-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	650.0	424.0	403.0	350.0	204.0	576.0	663.0	241.0	588.0
183.0	239.0	605.0	235.0	568.0	454.0	507.0	540.0	491.0	666.0
659.0	438.0	265.0	158.0	408.0	516.0	418.0	578.0	378.0	364.0
520.0	408.0	377.0	468.0	483.0	395.0	393.0	546.0	180.0	387.0
440.0	411.0	592.0	509.0	716.0	444.0	245.0	661.0	951.0	634.0
390.0	353.0	387.0	415.0	379.0	-1.0	-1.0	-1.0	-1.0	-1.0
387.0	42.0								
03238500	WHITEOAK C NR GEORGETOWN OH								
-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	117.0	336.0
414.0	268.0	256.0	213.0	101.0	280.0	383.0	120.0	289.0	228.0
92.1	152.0	319.0	120.0	312.0	252.0	290.0	278.0	301.0	380.0
384.0	264.0	160.0	82.4	262.0	310.0	225.0	329.0	190.0	203.0
269.0	185.0	207.0	214.0	245.0	209.0	186.0	294.0	124.0	253.0
264.0	270.0	433.0	366.0	426.0	254.0	142.0	389.0	583.0	322.0
209.0	216.0	198.0	311.0	194.0	-1.0	-1.0	-1.0	-1.0	-1.0
218.0	41.5								
03240000	L MIAMI R NR OLDTOWN OH								
-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	-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	55.3	28.6	76.9	111.0	91.3	168.0	127.0	59.9
96.4	108.0	112.0	107.0	96.1	79.4	130.0	116.0	142.0	106.0
72.1	106.0	199.0	156.0	200.0	104.0	48.8	117.0	192.0	228.0
145.0	147.0	104.0	127.0	114.0	-1.0	-1.0	-1.0	-1.0	-1.0
129.0	38.0								
03241500	MASSIES C AT WILBERFORCE OH								
-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	-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	26.0	8.7	36.7	63.2	57.5	100.0	63.0	34.4
65.0	54.3	61.0	54.9	48.7	46.5	73.4	63.0	73.0	56.3
44.5	66.0	113.0	88.0	102.0	50.4	22.7	63.5	99.3	104.0
77.0	73.7	57.8	66.6	63.7	-1.0	-1.0	-1.0	-1.0	-1.0
63.2	38.5								
03245500	L MIAMI R AT MILFORD OH								
-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	1638.0	1304.0
1608.0	1203.0	478.0	1283.0	1892.0	432.0	893.0	794.0	1379.0	1015.0
330.0	771.0	1536.0	731.0	1742.0	1003.0	1662.0	1277.0	1656.0	1675.0
1873.0	1581.0	655.0	301.0	849.0	1236.0	1110.0	1721.0	1243.0	759.0
1307.0	1038.0	1054.0	1134.0	1016.0	882.0	1187.0	1404.0	1167.0	1086.0
981.0	1320.0	2358.0	1875.0	1840.0	942.0	477.0	1349.0	2187.0	1685.0
1148.0	1260.0	1174.0	1499.0	1454.0	1300.0	-1.0	-1.0	-1.0	-1.0
1203.0	43.5								
03255500	MILL C AT READING OH								
-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	-1.0	44.4
5.3	39.7	84.2	42.0	89.3	50.0	81.4	57.5	82.2	80.5
83.4	67.7	50.2	18.4	53.6	74.4	59.8	90.3	69.0	43.4
85.6	60.9	51.2	57.0	62.9	44.6	56.5	71.4	58.6	72.9
60.0	64.2	126.0	90.0	104.0	57.0	34.8	92.8	139.0	102.0
71.0	86.4	70.0	89.4	95.7	-1.0	-1.0	-1.0	-1.0	-1.0
73.0	39.0								
03261500	G MIAMI R AT SIDNEY OH								
-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	423.0	762.0	338.0	300.0	350.0	553.0
685.0	639.0	370.0	669.0	195.0	606.0	963.0	568.0	627.0	711.0
141.0	376.0	648.0	159.0	223.0	346.0	636.0	564.0	502.0	363.0
169.0	287.0	506.0	314.0	599.0	384.0	593.0	633.0	641.0	734.0
692.0	609.0	297.0	179.0	359.0	471.0	573.0	672.0	528.0	284.0
452.0	349.0	318.0	362.0	296.0	209.0	527.0	528.0	526.0	441.0
279.0	585.0	953.0	545.0	646.0	407.0	196.0	545.0	517.0	608.0

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   386.0   681.0   338.0   636.0   343.0    -1.0    -1.0    -1.0    -1.0    -1.0
   541.0    36.0
03264000   GREENVILLE C NR BRADFORD OH
    -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   131.0   293.0    70.1    54.8   105.0   257.0   278.0   193.0   120.0
    52.8   158.0   163.0   120.0   167.0   156.0   189.0   193.0   260.0   302.0
   287.0   239.0   142.0    57.1   124.0   182.0   183.0   290.0   190.0    90.1
   170.0   175.0   121.0   144.0   110.0    75.9   223.0   201.0   234.0   166.0
   112.0   149.0   295.0   173.0   232.0   131.0    62.3   210.0   293.0   266.0
   141.0   223.0   106.0   189.0   164.0    -1.0    -1.0    -1.0    -1.0    -1.0
   193.0    37.5
03265000   STILLWATER R AT PLEASANT HILL OH
    -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   452.0   333.0   427.0   535.0   513.0   678.0   337.0   612.0
   215.0   633.0   684.0   467.0    -1.0   275.0   655.0   627.0   472.0   301.0
    99.3   365.0   398.0   288.0   425.0   378.0   475.0   479.0   634.0   764.0
   693.0   560.0   326.0   115.0   301.0   452.0   510.0   762.0   478.0   205.0
   426.0   398.0   303.0   364.0   268.0   186.0   534.0   480.0   534.0   380.0
   259.0   405.0   775.0   451.0   545.0   328.0   127.0   541.0   704.0   710.0
   379.0   592.0   268.0   515.0   391.0    -1.0    -1.0    -1.0    -1.0    -1.0
   503.0    37.0
03267000   MAD R NR URBANA OH
    -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   136.0   221.0   162.0   189.0   178.0    75.0   116.0
    68.1    84.2   125.0    91.1   123.0   120.0   186.0   202.0   212.0   236.0
   219.0   197.0    91.9    58.1    99.8   132.0   113.0   189.0   189.0    93.1
   120.0   109.0    97.6   108.0    96.8    75.6   134.0   140.0   160.0   150.0
   101.0   141.0   240.0   200.0   193.0   128.0    79.6   170.0   183.0   234.0
   164.0   187.0   125.0   170.0   140.0    -1.0    -1.0    -1.0    -1.0    -1.0
   162.0    37.0
03272000   TWIN C NR GERMANTOWN OH
    -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   313.0   378.0   250.0   251.0
   254.0   338.0   366.0   412.0   220.0    -1.0    -1.0   288.0   405.0   337.0
    66.5   231.0   427.0    78.3   107.0   188.0   446.0   395.0   286.0   159.0
    72.6   206.0   283.0   138.0   230.0   201.0   328.0   216.0   344.0   460.0
   439.0   364.0   124.0    43.3   168.0   265.0   255.0   409.0   303.0   106.0
   279.0   213.0   172.0   204.0   181.0   132.0   336.0   299.0   315.0   197.0
   169.0   206.0   440.0   295.0   350.0   165.0   121.0   319.0   407.0   410.0
   216.0   355.0   229.0   274.0   283.0    -1.0    -1.0    -1.0    -1.0    -1.0
   275.0    39.0
03275000   WHITEWATER RIVER NEAR ALPINE, IND
    -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   725.0   583.0
   167.0   429.0   897.0   178.0   206.0   462.0   857.0   855.0   543.0   316.0
   117.0   444.0   536.0   407.0   526.0   514.0   657.0   578.0   843.0  1000.0
   887.0   696.0   367.0   178.0   335.0   572.0   468.0   866.0   683.0   318.0
   660.0   521.0   427.0   439.0   402.0   233.0   717.0   663.0   740.0   534.0
   397.0   423.0   858.0   608.0   727.0   402.0   218.0   736.0  1001.0   838.0
   421.0   722.0   400.0   587.0   689.0   656.0    -1.0    -1.0    -1.0    -1.0
   529.0    40.0
03302500   INDIAN CREEK NEAR CORYDON, IND.
    -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    -1.0    -1.0
    -1.0    -1.0    -1.0    70.0   237.0   160.0   170.0   153.0   284.0   345.0
   242.0   203.0   116.0    32.5   148.0   169.0   144.0   212.0   155.0   150.0
   185.0   158.0   104.0   160.0   113.0   159.0   111.0   140.0   127.0   177.0
   158.0   177.0   235.0   186.0   242.0   148.0   119.0   258.0   317.0   173.0
    68.2   158.0   202.0   176.0   166.0   109.0    -1.0    -1.0    -1.0    -1.0
   129.0    43.0
03324000   LITTLE RIVER NEAR HUNTINGTON, IND
    -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    -1.0    -1.0
    -1.0    -1.0    -1.0    -1.0   209.0   141.0   217.0   343.0   258.0   450.0
   330.0   323.0   137.0    67.0   280.0   210.0   226.0   287.0   356.0   199.0
   161.0   176.0    68.0   123.0   164.0    76.4   286.0   288.0   230.0   205.0
   168.0   218.0   299.0   294.0   194.0   209.0   143.0   296.0   162.0   235.0
   206.0   357.0   230.0   286.0   258.0   343.0    -1.0    -1.0    -1.0    -1.0
   263.0    36.0
03325500   MISSISSINEWA RIVER NEAR RIDGEVILLE, IN
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   -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    -1.0    -1.0
   -1.0    -1.0    -1.0    -1.0    -1.0    -1.0   132.0   154.0   179.0   191.0
  161.0   139.0    96.3    29.8   107.0   127.0   177.0   223.0   144.0    64.8
  135.0   123.0    68.0   110.0    80.3    47.4   139.0   116.0   106.0    90.4
   61.8   145.0   200.0   121.0   151.0   101.0    30.4   156.0   209.0   195.0
  109.0   160.0    82.4   126.0   118.0   193.0    -1.0    -1.0    -1.0    -1.0
  133.0    39.0
03328000  EEL RIVER AT NORTH MANCHESTER, IND.
   -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
  103.0   268.0   477.0   172.0   273.0   288.0   477.0   453.0   357.0   186.0
  127.0   324.0   563.0   349.0   317.0   282.0   302.0   361.0   372.0   783.0
  535.0   506.0   227.0   176.0   431.0   359.0   329.0   383.0   472.0   389.0
  323.0   317.0   157.0   189.0   315.0   207.0   468.0   505.0   420.0   290.0
  290.0   310.0   543.0   432.0   414.0   347.0   265.0   457.0   314.0   400.0
  478.0   542.0   433.0   431.0   474.0   505.0    -1.0    -1.0    -1.0    -1.0
  417.0    36.5
03329700  DEER CREEK NEAR DELPHI, IND.
   -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    -1.0    -1.0
   -1.0    -1.0    -1.0    -1.0   188.0   225.0   194.0   206.0   313.0   510.0
  248.0   327.0   187.0    63.7   162.0   240.0   248.0   385.0   310.0   235.0
  226.0   267.0   137.0   132.0   161.0    62.7   235.0   302.0   287.0   287.0
  158.0   228.0   397.0   397.0   233.0   247.0    99.2   298.0   202.0   306.0
  187.0   361.0   251.0   253.0   248.0   293.0    -1.0    -1.0    -1.0    -1.0
  274.0    38.0
03331500  TIPPECANOE RIVER NEAR ORA, IND.
   -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    -1.0    -1.0
   -1.0    -1.0    -1.0   849.0   674.0   750.0   658.0   726.0   754.0  1580.0
 1057.0  1080.0   523.0   493.0   813.0   721.0   531.0   833.0   973.0   946.0
  694.0   763.0   476.0   354.0   649.0   586.0   943.0  1054.0   916.0   708.0
  648.0   828.0  1351.0  1039.0   925.0   868.0   561.0   945.0   717.0   899.0
 1253.0  1143.0   945.0   868.0  1153.0   973.0    -1.0    -1.0    -1.0    -1.0
  856.0    37.0
03339000  VERMILION RIVER NEAR DANVILLE, IL
   -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   532.0   851.0   635.0   678.0   840.0   819.0   446.0  1052.0   876.0
  242.0   596.0  1163.0   158.0  1097.0   666.0  1433.0  1279.0  1331.0   399.0
  349.0  1290.0  1551.0   916.0   822.0  1299.0   885.0   911.0  1092.0  1965.0
 1540.0  1331.0   562.0   139.0   386.0   782.0   933.0  1290.0   938.0   831.0
  804.0  1377.0   482.0   692.0   782.0   535.0   790.0  1434.0   859.0   954.0
  686.0   893.0  2026.0  1935.0  1123.0   827.0   597.0  1293.0  1460.0   823.0
 1216.0  1700.0  1643.0  1630.0  1119.0  1545.0    -1.0    -1.0    -1.0    -1.0
 1290.0    37.0
03339500  SUGAR CREEK AT CRAWFORDSVILLE, IND.
   -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   513.0   153.0
   65.0   301.0   510.0   336.0   380.0   571.0   423.0   565.0   563.0  1086.0
  574.0   625.0   430.0   144.0   350.0   527.0   751.0   806.0   533.0   333.0
  455.0   499.0   335.0   418.0   377.0   159.0   431.0   541.0   525.0   567.0
  369.0   483.0   748.0   972.0   572.0   413.0   148.0   764.0   612.0   516.0
  396.0   692.0   448.0   475.0   582.0   608.0    -1.0    -1.0    -1.0    -1.0
  509.0    39.5
03345500  EMBARRAS RIVER AT STE. MARIE, IL
   -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0
   -1.0   943.0  1173.0  1820.0  1149.0  1311.0   988.0  1091.0  1202.0  1322.0
  686.0  1733.0   802.0  1599.0   801.0  1100.0  2696.0  1845.0  1907.0  1309.0
  181.0  1099.0  1777.0   310.0  1546.0   571.0  1510.0  1564.0  1409.0   413.0
  325.0  1597.0  1658.0   787.0  1432.0  1360.0  1175.0  1060.0  1455.0  2636.0
 1664.0  1381.0   537.0    35.9   432.0   866.0  1846.0  1754.0  1055.0   831.0
  943.0  1464.0   402.0   595.0   561.0   486.0  1224.0  1872.0  1257.0  1238.0
  701.0   683.0  2273.0  2595.0  1819.0   846.0   419.0  1534.0  2039.0   813.0
 1017.0  1928.0  1657.0  1745.0  1615.0  1334.0    -1.0    -1.0    -1.0    -1.0
 1516.0    38.5
03346000  NORTH FORK EMBARRAS RIVER NEAR OBLONG,
   -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
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-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
41.7	374.0	359.0	141.0	367.0	289.0	213.0	206.0	337.0	644.0
308.0	296.0	116.0	3.9	90.8	203.0	330.0	383.0	209.0	160.0
241.0	282.0	121.0	88.4	78.5	86.1	257.0	426.0	337.0	276.0
157.0	116.0	430.0	558.0	460.0	174.0	52.7	300.0	321.0	199.0
183.0	419.0	382.0	386.0	425.0	316.0	-1.0	-1.0	-1.0	-1.0
318.0	39.0								
03347500	BUCK CREEK NEAR MUNCIE, IND								
-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	-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	33.4	37.6	42.1	49.7	41.6	30.5
34.7	30.3	22.8	33.2	21.8	15.4	31.0	37.3	38.3	33.6
28.2	33.6	53.1	42.1	42.4	30.3	18.9	46.5	51.5	51.0
32.2	45.7	28.2	43.1	39.4	46.1	-1.0	-1.0	-1.0	-1.0
35.5	39.0								
03351500	FALL CREEK NEAR FORTVILLE, IND.								
-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	-1.0	-1.0
-1.0	115.0	169.0	122.0	135.0	182.0	153.0	195.0	185.0	298.0
214.0	168.0	120.0	70.1	104.0	180.0	209.0	278.0	187.0	149.0
187.0	134.0	127.0	169.0	123.0	61.4	141.0	184.0	185.0	145.0
117.0	167.0	218.0	220.0	208.0	142.0	72.2	219.0	245.0	213.0
123.0	193.0	105.0	186.0	182.0	225.0	-1.0	-1.0	-1.0	-1.0
169.0	38.0								
03354500	BEANBLOSSOM CREEK AT BEANBLOSSOM, IND.								
-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	-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	29.9	9.0	3.9	9.6	15.7	19.4	26.0	18.7	14.7
17.5	11.9	10.8	9.0	11.0	11.0	22.6	20.7	21.1	13.0
12.0	12.2	24.5	19.7	21.8	11.8	9.2	10.8	21.8	18.5
15.5	16.3	18.7	15.1	24.8	16.8	-1.0	-1.0	-1.0	-1.0
14.6	40.5								
03358000	MILL CREEK NEAR CATARACT, IND.								
-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	-1.0	-1.0
-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	448.0
298.0	399.0	177.0	37.3	135.0	293.0	348.0	294.0	271.0	251.0
263.0	308.0	180.0	176.0	140.0	78.6	212.0	318.0	294.0	234.0
176.0	186.0	441.0	382.0	298.0	165.0	137.0	350.0	528.0	286.0
267.0	307.0	235.0	226.0	335.0	340.0	-1.0	-1.0	-1.0	-1.0
245.0	40.5								
03361500	BIG BLUE RIVER AT SHELBYVILLE, IND								
-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	-1.0	-1.0
-1.0	-1.0	-1.0	316.0	395.0	463.0	551.0	440.0	635.0	908.0
621.0	512.0	278.0	166.0	273.0	502.0	414.0	672.0	506.0	384.0
524.0	356.0	338.0	371.0	365.0	229.0	543.0	552.0	540.0	376.0
373.0	383.0	722.0	516.0	573.0	334.0	196.0	604.0	712.0	639.0
332.0	500.0	305.0	492.0	571.0	557.0	-1.0	-1.0	-1.0	-1.0
421.0	40.5								
03362000	YOUNGS CREEK NEAR EDINBURGH IND								
-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	-1.0	-1.0
-1.0	-1.0	-1.0	78.5	109.0	102.0	120.0	81.5	132.0	165.0
153.0	170.0	65.2	20.3	58.8	133.0	150.0	155.0	118.0	82.5
114.0	100.0	70.3	86.8	81.2	49.7	129.0	133.0	129.0	80.4
68.2	62.7	152.0	121.0	141.0	84.3	45.6	134.0	176.0	112.0
89.9	112.0	76.2	106.0	129.0	136.0	-1.0	-1.0	-1.0	-1.0
107.0	40.0								
03362500	SUGAR CREEK NEAR EDINBURGH IND								
-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	-1.0	-1.0
-1.0	-1.0	-1.0	350.0	423.0	482.0	539.0	422.0	605.0	849.0
627.0	644.0	332.0	160.0	292.0	662.0	555.0	688.0	521.0	365.0

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  558.0   387.0   358.0   383.0   353.0   203.0   525.0   605.0   626.0   404.0
  349.0   363.0   762.0   630.0   626.0   386.0   213.0   660.0   785.0   561.0
  390.0   525.0   320.0   506.0   613.0   654.0    -1.0    -1.0    -1.0    -1.0
  474.0    40.0
03363000   DRIFTWOOD RIVER NEAR EDINBURGH IND
   -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    -1.0    -1.0
   -1.0   849.0  1155.0   814.0   985.0  1182.0  1301.0  1024.0  1533.0  2039.0
 1628.0  1578.0   746.0   411.0   742.0  1591.0  1218.0  1656.0  1294.0   986.0
 1325.0   942.0   845.0   937.0   874.0   536.0  1344.0  1391.0  1450.0   961.0
  884.0   845.0  1784.0  1392.0  1511.0   900.0   523.0  1552.0  1852.0  1489.0
  921.0  1306.0   746.0  1204.0  1437.0  1523.0    -1.0    -1.0    -1.0    -1.0
 1060.0    40.0
03364000   EAST FORK WHITE RIVER AT COLUMBUS, IND
   -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    -1.0    -1.0
   -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0  2585.0  3304.0
 2546.0  2353.0  1121.0   534.0  1125.0  2269.0  1790.0  2677.0  1949.0  1412.0
 2096.0  1494.0  1313.0  1452.0  1312.0   840.0  2021.0  2153.0  2144.0  1440.0
 1315.0  1390.0  2676.0  2161.0  2413.0  1413.0   859.0  2407.0  2893.0  2456.0
 1419.0  1903.0  1237.0  1905.0  2269.0  2061.0    -1.0    -1.0    -1.0    -1.0
 1707.0    40.5
03364500   CLIFTY CREEK AT HARTSVILLE, IND.
   -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    -1.0    -1.0
   -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0   188.0   197.0
  150.0   136.0    64.3     9.0    65.0   115.0    96.2   122.0    90.5    64.4
  101.0    79.8    67.2    74.1    75.6    49.2    89.7   128.0   100.0    76.1
   50.9    77.7   119.0   131.0   111.0    58.2    45.7   152.0   131.0   122.0
   56.6    97.8    72.0   100.0   135.0   112.0    -1.0    -1.0    -1.0    -1.0
   91.4    41.0
03365000   SAND CREEK NEAR BREWERSVILLE, IND.
   -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    -1.0    -1.0
   -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0   269.0   364.0
  247.0   223.0   108.0    18.4   104.0   167.0   180.0   235.0   174.0   135.0
  172.0   138.0   114.0   127.0   108.0    99.0   157.0   193.0   168.0   140.0
  100.0   163.0   244.0   209.0   221.0   121.0   103.0   268.0   273.0   221.0
  132.0   179.0   133.0   186.0   207.0   182.0    -1.0    -1.0    -1.0    -1.0
  155.0    41.0
03366500   MUSCATATUCK RIVER NEAR DEPUTY, IND.
   -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    -1.0    -1.0
   -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0   555.0   636.0
  499.0   347.0   157.0    25.3   331.0   378.0   370.0   406.0   343.0   311.0
  389.0   412.0   234.0   269.0   220.0   262.0   263.0   374.0   307.0   206.0
  265.0   322.0   479.0   410.0   434.0   247.0   269.0   421.0   546.0   452.0
  226.0   391.0   437.0   406.0   440.0   306.0    -1.0    -1.0    -1.0    -1.0
  293.0    43.0
03378000   BONPAS CREEK AT BROWNS, IL
   -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    -1.0    -1.0
    9.7   199.0   201.0   116.0   447.0   280.0   212.0   169.0   350.0   505.0
  283.0   330.0   134.0    16.9   192.0   161.0   211.0   401.0   192.0   202.0
  311.0   226.0   104.0   113.0    82.3    90.1   131.0   215.0   339.0   259.0
  119.0   143.0   342.0   334.0   350.0   105.0   171.0   214.0   379.0   202.0
  131.0   290.0   468.0   366.0   342.0   220.0    -1.0    -1.0    -1.0    -1.0
  228.0    41.3
03379500   LITTLE WABASH RIVER BELOW CLAY CITY, I
   -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  1267.0  1074.0   735.0  1006.0   903.0  1252.0
  483.0  1161.0   689.0   822.0   347.0   748.0  1533.0  1196.0  1501.0  1040.0
  200.0   852.0  1394.0   200.0  1256.0   350.0   939.0   953.0   815.0   298.0
  181.0  1038.0  1283.0   458.0  1418.0  1142.0   850.0   899.0  1375.0  2040.0
 1033.0   912.0   286.0    29.3   392.0   580.0  1538.0  1347.0   762.0   786.0
  990.0  1037.0   420.0   272.0   221.0   379.0   751.0  1374.0  1143.0   982.0
  392.0   309.0  1584.0  1703.0  1097.0   390.0   318.0  1045.0  1480.0   497.0
  414.0  1298.0  1300.0  1794.0  1881.0  1099.0    -1.0    -1.0    -1.0    -1.0
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 1131.0    40.6
03380500   SKILLET FORK AT WAYNE CITY, IL
   -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   314.0   303.0   315.0
  541.0   579.0   449.0   459.0   369.0   396.0   789.0   222.0   397.0   414.0
  149.0   412.0   569.0    35.0   604.0   115.0   498.0   326.0   404.0   151.0
   54.5   401.0   400.0   237.0   577.0   506.0   347.0   376.0   709.0   928.0
  459.0   434.0   182.0    32.1   289.0   148.0   632.0   593.0   377.0   337.0
  579.0   370.0   156.0   340.0   156.0   177.0   276.0   576.0   574.0   433.0
  129.0   200.0   699.0   596.0   523.0   127.0   220.0   391.0   665.0   191.0
   80.6   434.0   710.0   685.0   762.0   529.0    -1.0    -1.0    -1.0    -1.0
  464.0    42.0
03381500   LITTLE WABASH RIVER AT CARMI, IL
   -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    -1.0  1090.0
  335.0  2719.0  2659.0  1398.0  4171.0  3388.0  2512.0  2494.0  4470.0  6094.0
 3121.0  3147.0  1146.0   151.0  1603.0  1399.0  3522.0  3953.0  2373.0  2331.0
 3252.0  2747.0  1214.0  1395.0   893.0  1171.0  1715.0  3319.0  3597.0  3155.0
 1269.0  1180.0  4092.0  4096.0  4062.0  1130.0  1307.0  2722.0  4358.0  1556.0
 1097.0  3004.0  4780.0  4300.0  4786.0  3483.0    -1.0    -1.0    -1.0    -1.0
 3102.0    40.5
03612000   CACHE RIVER AT FORMAN, IL
   -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   111.0   239.0   707.0   501.0   549.0   276.0
   66.6   264.0   489.0    81.0   534.0   108.0   396.0   232.0   271.0   150.0
   37.5   290.0   277.0   152.0   520.0   308.0   202.0   279.0   463.0   779.0
  337.0   397.0   107.0    73.0   196.0   164.0   379.0   567.0   206.0   184.0
  374.0   394.0   129.0   160.0   206.0   233.0   167.0   310.0   414.0   363.0
  171.0   212.0   540.0   361.0   411.0   199.0   193.0   216.0   490.0   181.0
  193.0   293.0   601.0   326.0   584.0   280.0    -1.0    -1.0    -1.0    -1.0
  244.0    46.0
04099000   ST. JOSEPH RIVER AT MOTTVILLE, MICH
   -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   942.0  1728.0  1408.0  1887.0  1670.0  1345.0
  731.0  1242.0  1615.0  1082.0   977.0  1058.0  1762.0  1707.0  1595.0  1232.0
 1127.0  1879.0  2512.0  1668.0  1257.0  1158.0  2015.0  1759.0  1528.0  2856.0
 1994.0  2394.0  1078.0  1297.0  1561.0  1490.0   972.0  1166.0  1443.0  1946.0
 1257.0  1349.0   793.0   580.0  1160.0  1520.0  1571.0  1957.0  2133.0  1583.0
 1506.0  1296.0  2243.0  2236.0  1805.0  2077.0  1176.0  1839.0  1780.0  2057.0
 2174.0  2415.0  2096.0  1627.0  2126.0  2079.0    -1.0    -1.0    -1.0    -1.0
 1866.0    35.0
04102500   PAW PAW RIVER AT RIVERSIDE, MICH
   -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    -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   601.0   344.0   346.0   467.0   412.0   304.0   338.0   315.0   448.0
  328.0   348.0   318.0   273.0   380.0   475.0   453.0   474.0   518.0   470.0
  429.0   440.0   560.0   559.0   550.0   545.0   398.0   453.0   565.0   557.0
  514.0   532.0   496.0   437.0   554.0   532.0    -1.0    -1.0    -1.0    -1.0
  390.0    34.0
04105000   BATTLE CREEK AT BATTLE CREEK, MICH.
   -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   151.0   127.0   226.0   179.0   168.0   125.0
  173.0   290.0   394.0   204.0   156.0   170.0   282.0   259.0   180.0   328.0
  224.0   274.0   141.0   152.0   187.0   202.0   138.0   135.0   151.0   270.0
  132.0   159.0    99.0    64.1   152.0   157.0   184.0   214.0   267.0   191.0
  171.0   188.0   333.0   331.0   276.0   269.0   135.0   183.0   217.0   220.0
  221.0   232.0   237.0   165.0   299.0   300.0    -1.0    -1.0    -1.0    -1.0
  241.0    32.0
04105500   KALAMAZOO RIVER NEAR BATTLE CREEK, MIC
   -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   646.0   545.0   422.0
  498.0   784.0  1081.0   703.0   547.0   532.0   887.0   855.0   638.0  1067.0
  828.0   898.0   494.0   527.0   645.0   648.0   470.0   436.0   497.0   666.0
  486.0   511.0   367.0   250.0   431.0   476.0   552.0   691.0   853.0   625.0
  600.0   578.0   975.0  1039.0   782.0   930.0   531.0   582.0   636.0   679.0
  758.0   860.0   849.0   652.0   876.0   849.0    -1.0    -1.0    -1.0    -1.0
  824.0    34.0
04185000   TIFFIN R AT STRYKER OH
   -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0
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-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	382.0	220.0	330.0	190.0	367.0	294.0	415.0
141.0	241.0	584.0	300.0	256.0	196.0	382.0	319.0	280.0	671.0
561.0	452.0	112.0	180.0	257.0	346.0	172.0	319.0	367.0	407.0
231.0	236.0	94.7	59.6	212.0	259.0	337.0	461.0	411.0	284.0
269.0	214.0	447.0	407.0	349.0	383.0	210.0	437.0	244.0	419.0
446.0	482.0	423.0	401.0	441.0	-1.0	-1.0	-1.0	-1.0	-1.0
410.0	33.0								
04186500	AUGLAIZE R NR FORT JENNINGS OH								
-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	463.0	306.0	335.0	149.0	341.0
471.0	370.0	297.0	422.0	65.3	214.0	358.0	137.0	181.0	-1.0
94.8	211.0	359.0	209.0	319.0	231.0	309.0	314.0	359.0	475.0
476.0	358.0	162.0	99.9	267.0	265.0	376.0	388.0	359.0	207.0
246.0	205.0	159.0	233.0	176.0	124.0	324.0	293.0	278.0	275.0
200.0	338.0	537.0	296.0	290.0	275.0	133.0	398.0	274.0	376.0
230.0	382.0	209.0	450.0	193.0	-1.0	-1.0	-1.0	-1.0	-1.0
332.0	36.0								
04189000	BLANCHARD R NR FINDLAY OH								
-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	299.0	104.0	292.0
424.0	312.0	302.0	386.0	57.5	175.0	284.0	78.1	91.6	-1.0
68.7	183.0	269.0	131.0	246.0	212.0	322.0	296.0	316.0	319.0
397.0	333.0	122.0	72.2	204.0	233.0	286.0	227.0	386.0	212.0
197.0	148.0	171.0	178.0	130.0	182.0	354.0	298.0	271.0	268.0
155.0	258.0	571.0	309.0	284.0	223.0	150.0	397.0	284.0	337.0
341.0	423.0	191.0	480.0	198.0	-1.0	-1.0	-1.0	-1.0	-1.0
346.0	35.0								
04195500	PORTAGE R AT WOODVILLE OH								
-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	360.0	455.0	81.4	202.0	432.0	93.0	98.4	-1.0	228.0
111.0	217.0	480.0	258.0	237.0	276.0	381.0	390.0	330.0	569.0
624.0	498.0	144.0	131.0	330.0	415.0	308.0	357.0	404.0	331.0
258.0	177.0	146.0	177.0	235.0	236.0	458.0	365.0	306.0	304.0
214.0	337.0	628.0	368.0	325.0	364.0	270.0	497.0	370.0	382.0
421.0	581.0	322.0	618.0	318.0	-1.0	-1.0	-1.0	-1.0	-1.0
428.0	33.0								
04198000	SANDUSKY R NR FREMONT OH								
-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	1313.0	566.0	1140.0	1549.0	1184.0
1102.0	1551.0	342.0	861.0	1100.0	275.0	320.0	-1.0	802.0	819.0
358.0	723.0	1218.0	464.0	895.0	768.0	1371.0	1011.0	1065.0	1397.0
1391.0	1314.0	382.0	364.0	782.0	959.0	952.0	940.0	1343.0	738.0
880.0	743.0	712.0	748.0	667.0	710.0	1340.0	1014.0	1219.0	1109.0
918.0	915.0	1908.0	1178.0	1153.0	862.0	704.0	1558.0	1218.0	1375.0
1359.0	1557.0	727.0	2167.0	862.0	1444.0	-1.0	-1.0	-1.0	-1.0
1251.0	35.0								
04200500	BLACK R AT ELYRIA OH								
-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	-1.0	-1.0
-1.0	-1.0	-1.0	-1.0	227.0	217.0	470.0	299.0	283.0	465.0
414.0	418.0	130.0	204.0	288.0	397.0	371.0	247.0	480.0	300.0
322.0	183.0	226.0	236.0	185.0	145.0	303.0	271.0	509.0	295.0
308.0	328.0	534.0	397.0	494.0	276.0	277.0	449.0	335.0	398.0
314.0	385.0	375.0	532.0	295.0	-1.0	-1.0	-1.0	-1.0	-1.0
396.0	35.0								
04201500	ROCKY R NR BEREA OH								
-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	219.0	334.0	365.0	339.0	351.0	291.0	98.5	205.0
234.0	79.5	144.0	165.0	200.0	202.0	360.0	244.0	213.0	348.0
328.0	314.0	118.0	205.0	268.0	323.0	262.0	226.0	418.0	266.0
249.0	142.0	201.0	201.0	155.0	164.0	232.0	258.0	359.0	218.0
263.0	340.0	416.0	332.0	393.0	237.0	213.0	353.0	288.0	303.0
287.0	326.0	370.0	437.0	308.0	353.0	-1.0	-1.0	-1.0	-1.0
267.0	36.5								
04202000	CUYAHOGA R AT HIRAM RAPIDS OH								
-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	249.0	236.0	217.0	122.0	141.0

146.0	106.0	143.0	-1.0	154.0	206.0	241.0	166.0	155.0	252.0
260.0	254.0	112.0	162.0	223.0	270.0	223.0	201.0	266.0	265.0
186.0	131.0	162.0	168.0	172.0	186.0	195.0	175.0	301.0	161.0
225.0	207.0	261.0	224.0	290.0	263.0	203.0	292.0	207.0	249.0
196.0	266.0	236.0	249.0	240.0	276.0	-1.0	-1.0	-1.0	-1.0
151.0	41.0								
04209000	CHAGRIN R AT WILLOUGHBY OH								
-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	403.0
407.0	343.0	360.0	317.0	207.0	251.0	225.0	148.0	205.0	306.0
193.0	299.0	373.0	227.0	294.0	294.0	386.0	294.0	257.0	427.0
399.0	429.0	208.0	288.0	404.0	434.0	355.0	295.0	448.0	395.0
314.0	224.0	268.0	254.0	261.0	248.0	290.0	265.0	440.0	274.0
334.0	408.0	421.0	393.0	465.0	405.0	326.0	432.0	387.0	405.0
356.0	432.0	381.0	457.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
246.0	40.0								
04213000	CONNEAUT C AT CONNEAUT OH								
-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	206.0	274.0	169.0	367.0	306.0
281.0	253.0	237.0	140.0	191.0	156.0	141.0	158.0	-1.0	-1.0
317.0	276.0	199.0	241.0	289.0	355.0	272.0	243.0	281.0	336.0
198.0	170.0	182.0	235.0	244.0	208.0	277.0	301.0	368.0	257.0
309.0	391.0	296.0	303.0	278.0	324.0	352.0	325.0	323.0	337.0
303.0	332.0	260.0	323.0	312.0	-1.0	-1.0	-1.0	-1.0	-1.0
175.0	41.0								
05413500	GRANT RIVER AT BURTON, WI								
-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	106.0	103.0	143.0	187.0	113.0	137.0
121.0	141.0	248.0	210.0	184.0	189.0	243.0	195.0	164.0	216.0
206.0	206.0	175.0	148.0	130.0	86.7	81.8	59.3	178.0	212.0
176.0	310.0	161.0	82.0	168.0	118.0	117.0	92.8	135.0	116.0
153.0	187.0	341.0	270.0	231.0	163.0	113.0	191.0	192.0	142.0
115.0	199.0	230.0	225.0	217.0	170.0	-1.0	-1.0	-1.0	-1.0
269.0	33.6								
05414000	PLATTE RIVER NEAR ROCKVILLE, WI								
-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	62.6	50.5	90.5	104.0	81.8	77.3
81.8	107.0	148.0	116.0	112.0	123.0	140.0	94.7	63.0	114.0
117.0	127.0	87.6	76.8	80.4	48.8	51.7	40.8	105.0	153.0
91.4	184.0	86.8	44.4	85.0	88.7	79.1	65.0	105.0	76.8
95.6	101.0	179.0	164.0	141.0	89.7	63.8	121.0	104.0	81.5
78.0	145.0	143.0	126.0	128.0	113.0	-1.0	-1.0	-1.0	-1.0
142.0	33.6								
05415000	GALENA RIVER AT BUNCOMBE, WI								
-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	-1.0	42.5
49.7	62.8	96.4	86.1	97.0	89.6	98.1	92.3	74.7	89.9
82.5	102.0	70.2	47.6	47.7	34.0	43.7	27.1	94.9	128.0
89.7	144.0	54.4	34.4	69.9	58.6	57.1	54.0	105.0	58.1
61.3	69.1	159.0	137.0	106.0	57.4	44.4	76.4	85.5	66.0
57.7	106.0	113.0	80.5	105.0	127.0	-1.0	-1.0	-1.0	-1.0
125.0	33.7								
05418500	MAQUOKETA RIVER NEAR MAQUOKETA, IOWA								
-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	609.0	1024.0	1145.0	679.0	733.0	1257.0	1391.0
843.0	1194.0	854.0	1012.0	795.0	924.0	1477.0	1125.0	1375.0	598.0
386.0	939.0	679.0	344.0	856.0	554.0	1224.0	898.0	765.0	540.0
1167.0	1251.0	1134.0	1175.0	1120.0	1133.0	1911.0	982.0	748.0	962.0
1395.0	1212.0	890.0	540.0	573.0	431.0	425.0	306.0	951.0	1607.0
1085.0	2218.0	887.0	516.0	984.0	986.0	652.0	889.0	1749.0	975.0
1342.0	1516.0	2320.0	1935.0	1257.0	720.0	431.0	902.0	1250.0	892.0
1202.0	1575.0	1499.0	1128.0	1013.0	1453.0	-1.0	-1.0	-1.0	-1.0
1553.0	33.7								
05419000	APPLE RIVER NEAR HANOVER, IL								
-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	178.0	115.0	214.0	210.0	131.0	39.3
105.0	129.0	219.0	196.0	181.0	154.0	185.0	157.0	145.0	171.0
224.0	270.0	116.0	83.4	121.0	76.6	86.4	71.8	175.0	400.0
162.0	294.0	88.3	64.8	188.0	158.0	100.0	115.0	253.0	101.0

```
  147.0   196.0   441.0   361.0   198.0    91.0    54.5   140.0   220.0   168.0
  223.0   312.0   271.0   152.0   257.0   331.0    -1.0    -1.0    -1.0    -1.0
  247.0    33.0
05422000   WAPSIPINICON RIVER NEAR DE WITT, IOWA
   -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  1325.0   890.0  1358.0  1215.0   982.0   471.0
 1274.0  2022.0  1790.0  1654.0  1444.0  1466.0  2556.0  1193.0  1048.0  1284.0
 2523.0  1751.0  1170.0   612.0   829.0   425.0   459.0   475.0  1372.0  2307.0
 1609.0  2997.0  1029.0   493.0  1539.0  1897.0   895.0  1399.0  2441.0  1309.0
 1832.0  1598.0  3515.0  2646.0  1454.0   753.0   384.0  1818.0  2612.0  1616.0
 1700.0  2807.0  3060.0  2057.0  1311.0  2387.0    -1.0    -1.0    -1.0    -1.0
 2330.0    33.0
05426000   CRAWFISH RIVER AT MILFORD, WI
   -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   248.0   334.0    95.0   338.0   177.0   334.0   491.0   464.0   151.0
  309.0   277.0   516.0   320.0   241.0   476.0   332.0   377.0   186.0   404.0
  515.0   738.0   387.0   222.0   410.0   242.0   219.0   128.0   332.0   640.0
  332.0   469.0   127.0    61.8   283.0   539.0   267.0   255.0   350.0   134.0
  405.0   357.0  1013.0   670.0   534.0   388.0   114.0   463.0   695.0   420.0
  443.0   571.0   593.0   513.0   630.0  1095.0    -1.0    -1.0    -1.0    -1.0
  762.0    30.5
05430500   ROCK RIVER AT AFTON, WI
   -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  2346.0  2949.0  2563.0  2436.0  1063.0  2209.0
 1578.0  2706.0  1796.0  2020.0  1163.0  1285.0  2128.0  2229.0  3081.0  1463.0
  603.0  1323.0  1737.0   593.0  1461.0   930.0  1613.0  2168.0  2060.0   981.0
 1484.0  1392.0  2308.0  1431.0  1169.0  1920.0  1396.0  1673.0  1074.0  1898.0
 2149.0  3110.0  1771.0  1123.0  1904.0  1225.0  1096.0   694.0  1577.0  3083.0
 1886.0  2197.0   874.0   557.0  1393.0  2317.0  1298.0  1286.0  1798.0   931.0
 1701.0  1701.0  3749.0  3100.0  2726.0  1903.0   806.0  2174.0  2937.0  1810.0
 2044.0  2623.0  2568.0  2322.0  2836.0  3692.0    -1.0    -1.0    -1.0    -1.0
 3340.0    30.9
05432500   PECATONICA RIVER AT DARLINGTON, WI
   -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    -1.0    93.0
  136.0   202.0   261.0   221.0   202.0   199.0   220.0   192.0   144.0   236.0
  270.0   273.0   179.0   122.0   142.0    74.9   102.0    66.5   214.0   331.0
  188.0   307.0   153.0    67.8   172.0   126.0   143.0   113.0   233.0   119.0
  155.0   154.0   346.0   254.0   236.0   144.0   109.0   213.0   216.0   170.0
  155.0   267.0   245.0   214.0   254.0   249.0    -1.0    -1.0    -1.0    -1.0
  273.0    33.2
05433000   EAST BR PECATONICA R NR BLANCHARDVILLE
   -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    -1.0    75.2
  109.0   118.0   164.0   161.0   127.0   154.0   150.0   164.0   122.0   170.0
  163.0   193.0   161.0   113.0   127.0    86.2   105.0    70.4   151.0   240.0
  154.0   184.0   117.0    75.1   156.0   118.0   112.0    96.9   160.0    93.2
  117.0   118.0   251.0   208.0   182.0   136.0    89.9   149.0   165.0   135.0
  137.0   193.0   192.0   191.0   209.0   201.0    -1.0    -1.0    -1.0    -1.0
  221.0    31.9
05434500   PECATONICA RIVER AT MARTINTOWN, WI
   -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    -1.0   335.0
  562.0   691.0   880.0   835.0   702.0   706.0   750.0   797.0   580.0   868.0
  928.0  1091.0   687.0   454.0   511.0   342.0   409.0   307.0   774.0  1360.0
  773.0  1128.0   533.0   292.0   778.0   553.0   496.0   463.0   884.0   469.0
  649.0   648.0  1421.0  1173.0   861.0   519.0   372.0   677.0   830.0   654.0
  643.0  1052.0  1003.0   811.0  1019.0  1026.0    -1.0    -1.0    -1.0    -1.0
 1034.0    32.6
05435500   PECATONICA RIVER AT FREEPORT, IL
   -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  1139.0  1347.0   806.0   823.0   781.0  1185.0
  729.0  1175.0   845.0   905.0   745.0   793.0  1286.0  1419.0  1552.0   690.0
  410.0   828.0   891.0   396.0   789.0   494.0  1013.0  1142.0   773.0   402.0
  684.0   840.0  1095.0   954.0   876.0   891.0   861.0  1000.0   753.0  1017.0
 1098.0  1336.0   837.0   531.0   720.0   466.0   460.0   380.0   954.0  1565.0
  874.0  1347.0   635.0   373.0   878.0   770.0   639.0   603.0  1153.0   591.0
  815.0   868.0  1967.0  1535.0  1095.0   646.0   434.0   846.0  1067.0   825.0
  845.0  1366.0  1235.0   978.0  1275.0  1444.0    -1.0    -1.0    -1.0    -1.0
 1326.0    33.0
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05437500   ROCK RIVER AT ROCKTON, IL
   -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 4310.0 4700.0
   -1.0   -1.0   -1.0   -1.0 4938.0 6496.0 4569.0 4756.0 3614.0 2038.0
 3066.0 3245.0 4589.0 3466.0 2781.0 3801.0 3118.0 3800.0 2749.0 3918.0
 4489.0 6086.0 3503.0 2380.0 3548.0 2209.0 2123.0 1568.0 3709.0 6584.0
 4085.0 5169.0 2295.0 1622.0 3471.0 4267.0 2765.0 2814.0 4073.0 2470.0
 3839.0 4167.0 8601.0 7516.0 5309.0 3464.0 1876.0 4291.0 5527.0 3990.0
 4153.0 5920.0 5983.0 4840.0 5626.0 7059.0   -1.0   -1.0   -1.0   -1.0
 6363.0   30.5
05438500   KISHWAUKEE RIVER AT BELVIDERE, IL
   -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   -1.0  115.0
  205.0  370.0  409.0  300.0  192.0  334.0  213.0  285.0  223.0  363.0
  433.0  508.0  225.0  230.0  333.0  114.0  158.0  158.0  240.0  546.0
  202.0  431.0  112.0  116.0  366.0  411.0  309.0  249.0  393.0  377.0
  363.0  585.0  801.0  823.0  381.0  371.0  119.0  469.0  645.0  335.0
  337.0  440.0  660.0  404.0  389.0  593.0   -1.0   -1.0   -1.0   -1.0
  538.0   32.7
05439500   SOUTH BR KISHWAUKEE RIVER NR FAIRDALE,
   -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   -1.0   65.9
  155.0  330.0  277.0  216.0  153.0  264.0  176.0  177.0  140.0  271.0
  325.0  326.0  110.0  113.0  391.0   94.3  129.0  205.0  182.0  416.0
  106.0  353.0   82.2   95.5  254.0  319.0  212.0  169.0  356.0  364.0
  225.0  424.0  558.0  537.0  263.0  244.0   65.7  395.0  583.0  324.0
  265.0  315.0  556.0  269.0  227.0  383.0   -1.0   -1.0   -1.0   -1.0
  387.0   34.0
05440000   KISHWAUKEE RIVER NEAR PERRYVILLE, IL
   -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   -1.0  244.0
  468.0  831.0  805.0  605.0  402.0  717.0  465.0  588.0  452.0  742.0
  903.0 1014.0  415.0  392.0  754.0  250.0  334.0  420.0  479.0 1094.0
  373.0  948.0  253.0  259.0  727.0  821.0  574.0  461.0  960.0  805.0
  719.0 1138.0 1579.0 1585.0  772.0  714.0  227.0  941.0 1371.0  755.0
  698.0  902.0 1417.0  809.0  783.0 1168.0   -1.0   -1.0   -1.0   -1.0
 1099.0   34.0
05444000   ELKHORN CREEK NEAR PENROSE, IL
   -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   -1.0   30.7
   73.3   81.6  113.0   93.5   58.7   85.3   85.2   90.8   86.0   86.7
  140.0  136.0   77.8   47.6  110.0   40.1   40.3   45.5  103.0  116.0
   77.9  124.0   50.5   49.0  109.0   87.9   58.7   53.1  126.0   96.3
   96.4  146.0  275.0  239.0  124.0   63.2   41.3  118.0  131.0   92.8
  110.0  149.0  127.0   90.2  102.0  170.0   -1.0   -1.0   -1.0   -1.0
  146.0   35.0
05446500   ROCK RIVER NEAR JOSLIN, IL
   -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   -1.0 2847.0
 4596.0 5342.0 7338.0 5285.0 4144.0 6173.0 4970.0 5838.0 4533.0 6144.0
 7316.0 9302.0 5112.0 3527.0 5872.0 3104.0 3081.0 2710.0 5066.0 9440.0
 5407.0 8047.0 3145.0 2587.0 5758.0 6879.0 4451.0 4252.0 6761.0 4916.0
 6252.0 6977.013430.012250.0 7827.0 5425.0 2807.0 7033.0 8850.0 6014.0
 6358.0 8608.0 9144.0 6896.0 7899.010340.0   -1.0   -1.0   -1.0   -1.0
 9549.0   33.0
05447500   GREEN RIVER NEAR GENESEO, IL
   -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  813.0  662.0  472.0  159.0
  335.0  847.0  729.0  506.0  422.0  668.0  664.0  417.0  506.0  586.0
  867.0  830.0  254.0  232.0  774.0  190.0  224.0  333.0  435.0  987.0
  400.0  967.0  253.0  252.0  643.0  716.0  409.0  332.0  720.0  868.0
  572.0  704.0 1367.0 1369.0  567.0  468.0  186.0  919.0  977.0  536.0
  743.0  909.0  892.0  654.0  679.0  829.0   -1.0   -1.0   -1.0   -1.0
 1003.0   34.0
05448000   MILL CREEK AT MILAN, IL
   -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
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-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	33.6	59.4	44.9	28.4	41.5	49.3	29.7	40.5	44.4
54.1	43.3	16.9	14.4	57.2	9.0	8.7	18.7	42.6	105.0
25.3	79.3	20.7	16.8	81.0	43.2	33.7	25.0	39.2	66.0
44.6	43.1	79.1	76.2	30.9	26.4	22.7	60.8	43.0	39.7
36.6	73.7	59.7	40.0	50.6	77.2	-1.0	-1.0	-1.0	-1.0
62.4	34.0								
05454000	RAPID CREEK NEAR IOWA CITY, IOWA								
-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	12.2	13.4	4.9
8.4	14.8	21.5	20.8	8.3	11.9	14.8	10.4	11.0	18.5
17.1	16.4	18.3	2.2	7.3	6.0	1.1	3.0	18.5	26.0
16.3	37.9	6.6	3.9	21.2	20.3	11.4	13.5	27.6	25.0
11.4	32.5	32.3	36.9	13.2	3.7	10.6	17.4	21.6	9.8
14.5	27.9	24.0	14.6	20.1	38.6	-1.0	-1.0	-1.0	-1.0
25.3	33.0								
05466000	EDWARDS RIVER NEAR ORION, IL								
-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	-1.0	-1.0
52.6	157.0	135.0	88.2	82.2	89.2	115.0	65.1	107.0	106.0
189.0	142.0	54.8	46.6	141.0	31.1	40.8	92.9	53.7	165.0
49.4	150.0	45.4	38.1	114.0	108.0	114.0	55.3	125.0	181.0
84.1	96.7	213.0	213.0	95.8	95.6	22.0	155.0	125.0	77.0
147.0	179.0	152.0	104.0	120.0	136.0	-1.0	-1.0	-1.0	-1.0
155.0	34.5								
05466500	EDWARDS RIVER NEAR NEW BOSTON, IL								
-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	438.0	191.0	290.0	251.0	215.0	76.6
124.0	323.0	318.0	262.0	232.0	261.0	354.0	188.0	229.0	295.0
427.0	353.0	124.0	111.0	362.0	80.4	83.9	246.0	163.0	483.0
146.0	405.0	103.0	91.2	388.0	306.0	234.0	149.0	346.0	407.0
250.0	298.0	673.0	584.0	252.0	284.0	84.6	395.0	367.0	239.0
398.0	619.0	477.0	280.0	348.0	378.0	-1.0	-1.0	-1.0	-1.0
445.0	34.5								
05467000	POPE CREEK NEAR KEITHSBURG, IL								
-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	189.0	80.7	93.8	98.4	81.0	25.8
40.8	134.0	125.0	99.0	102.0	91.3	152.0	72.0	105.0	122.0
158.0	136.0	44.1	46.4	112.0	35.0	37.5	106.0	69.5	190.0
48.1	148.0	37.8	29.4	151.0	104.0	72.9	57.6	134.0	154.0
93.4	98.8	245.0	251.0	99.8	107.0	46.3	170.0	130.0	128.0
122.0	303.0	184.0	105.0	133.0	155.0	-1.0	-1.0	-1.0	-1.0
174.0	34.6								
05469000	HENDERSON CREEK NEAR OQUAWKA, IL								
-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	471.0	200.0	210.0	293.0	201.0	58.4
101.0	434.0	353.0	291.0	328.0	225.0	353.0	195.0	284.0	400.0
386.0	360.0	137.0	145.0	266.0	128.0	116.0	193.0	163.0	434.0
132.0	441.0	96.9	84.6	441.0	261.0	197.0	182.0	342.0	427.0
236.0	199.0	597.0	632.0	288.0	310.0	147.0	443.0	361.0	236.0
303.0	635.0	410.0	290.0	321.0	308.0	-1.0	-1.0	-1.0	-1.0
432.0	34.7								
05472500	NORTH SKUNK RIVER NEAR SIGOURNEY, IOWA								
-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	-1.0	-1.0
-1.0	-1.0	-1.0	-1.0	-1.0	683.0	861.0	317.0	307.0	265.0
524.0	507.0	295.0	86.2	191.0	27.7	106.0	132.0	523.0	860.0
456.0	737.0	261.0	173.0	582.0	630.0	127.0	82.7	615.0	456.0
435.0	439.0	986.0	1019.0	379.0	421.0	74.6	573.0	700.0	141.0
149.0	709.0	746.0	823.0	312.0	736.0	-1.0	-1.0	-1.0	-1.0
730.0	33.1								
05495000	FOX RIVER AT WAYLAND, MO.								
-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	63.6	180.0	183.0	367.0	377.0	371.0	572.0	135.0
191.0	318.0	244.0	27.0	364.0	123.0	223.0	81.1	162.0	46.0
81.8	279.0	224.0	199.0	312.0	383.0	368.0	241.0	227.0	228.0

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  242.0  231.0  182.0   62.4  161.0   17.6   69.9  261.0  351.0  538.0
  127.0  315.0   93.4   70.0  244.0   82.6  193.0  118.0  332.0  478.0
  168.0  143.0  665.0  393.0  172.0  188.0  129.0  525.0  327.0  302.0
  497.0  677.0  427.0  353.0  395.0  639.0   -1.0   -1.0   -1.0   -1.0
  400.0   36.0
05495500  BEAR CREEK NEAR MARCELLINE, IL
   -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   -1.0   -1.0
   -1.0   -1.0   -1.0   -1.0  376.0  161.0  290.0  225.0  137.0  183.0
  231.0  164.0   67.0   48.6  175.0   28.1  107.0  123.0  110.0  320.0
  325.0  186.0   40.0   82.0  261.0  125.0  176.0  133.0  404.0  482.0
  119.0  120.0  435.0  394.0  211.0   95.2   68.7  377.0  194.0  104.0
  314.0  334.0  322.0  336.0  357.0  496.0   -1.0   -1.0   -1.0   -1.0
  349.0   35.5
05497000  NORTH FABIUS RIVER AT MONTICELLO, MO
   -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  128.0  234.0  155.0  459.0  465.0  334.0  617.0  189.0
  196.0  389.0  327.0   21.9  567.0  159.0  250.0  116.0  218.0   61.7
   64.8  327.0  238.0  238.0  332.0  355.0  481.0  254.0  233.0  208.0
  258.0  228.0  147.0   66.4  183.0   30.6   69.3  273.0  357.0  535.0
  162.0  379.0  115.0   93.4  319.0  129.0  264.0  169.0  329.0  578.0
  192.0  159.0  830.0  613.0  229.0  186.0   68.2  502.0  348.0  252.0
  536.0  713.0  450.0  421.0  429.0  662.0   -1.0   -1.0   -1.0   -1.0
  452.0   36.0
05498000  MIDDLE FABIUS RIVER NEAR MONTICELLO, M
   -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   -1.0   -1.0
   -1.0   -1.0   -1.0   -1.0   -1.0  247.0  421.0  272.0  213.0  221.0
  227.0  222.0  135.0   57.6  174.0   30.2   83.7  266.0  291.0  462.0
  191.0  301.0  101.0  104.0  307.0   98.6  234.0  124.0  472.0  496.0
  182.0  132.0  749.0  500.0  201.0  170.0   45.1  432.0  248.0  185.0
  486.0  575.0  402.0  424.0  440.0  568.0   -1.0   -1.0   -1.0   -1.0
  393.0   36.0
05500000  SOUTH FABIUS RIVER NEAR TAYLOR, MO
   -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  237.0  346.0  241.0  401.0  105.0
  114.0  606.0  483.0  429.0  615.0  435.0  728.0  379.0  288.0  252.0
  297.0  360.0  184.0  112.0  353.0   84.1  235.0  425.0  256.0  533.0
  361.0  461.0   97.5  133.0  486.0  174.0  423.0  279.0  808.0  884.0
  279.0  169.0 1105.0  723.0  381.0  163.0  117.0  682.0  285.0  111.0
  646.0  830.0  606.0  610.0  681.0  794.0   -1.0   -1.0   -1.0   -1.0
  620.0   36.0
05501000  NORTH RIVER AT PALMYRA, MO
   -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  112.0  213.0  164.0  342.0   45.5
   72.0  420.0  285.0  303.0  435.0  234.0  495.0  226.0  294.0  190.0
  178.0  204.0   94.2   56.8  251.0   50.9  164.0  227.0  146.0  176.0
  262.0  241.0   66.6   94.6  261.0  124.0  219.0  193.0  495.0  580.0
  168.0   84.5  748.0  486.0  333.0  126.0  119.0  503.0  231.0   55.1
  336.0  540.0  437.0  394.0  417.0  524.0   -1.0   -1.0   -1.0   -1.0
  373.0   36.0
05512500  BAY CREEK AT PITTSFIELD, IL
   -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   -1.0    2.8
    8.5   52.0   38.1   21.4   49.8   31.6   42.6   16.0   17.7   21.2
   16.7   24.6    5.1    9.9   16.6    4.3   28.5   12.8   20.4   24.8
   38.4   35.1   16.1   13.5   37.1   34.7   27.2   25.5   40.2   84.6
   18.2   16.0   40.5   47.8   37.0   14.4   14.8   32.2   29.0    8.6
   54.6   26.7   29.5   26.1   23.4   32.9   -1.0   -1.0   -1.0   -1.0
   39.4   36.6
05513000  BAY CREEK AT NEBO, IL
   -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   -1.0    8.5
   24.2  217.0  175.0   89.1  172.0  140.0  183.0   79.1   97.6   80.7
   64.4   81.4   17.2   16.8   43.3   19.8   90.3   87.5   57.1   85.5
  134.0  120.0   59.2   32.5   96.5   80.0   80.6  115.0  161.0  256.0
   79.6   39.9  114.0  165.0  105.0   55.3   61.7  164.0  136.0   51.1
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  228.0   148.0   147.0   106.0   144.0   132.0    -1.0    -1.0    -1.0    -1.0
  161.0    36.7
05515000   KANKAKEE RIVER NEAR NORTH LIBERTY, IND
   -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    -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   206.0   108.0   120.0   181.0   149.0   110.0   137.0   134.0   176.0
  116.0   124.0   120.0    95.4   132.0   177.0   174.0   174.0   160.0   146.0
  133.0   149.0   193.0   154.0   152.0   159.0   129.0   159.0   151.0   153.0
  184.0   203.0   183.0   143.0   201.0   174.0    -1.0    -1.0    -1.0    -1.0
  174.0    38.5
05519000   SINGLETON DITCH AT SCHNEIDER, IND.
   -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    -1.0    -1.0
   -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    79.7   160.0
  102.0   127.0    51.6    58.5    89.5    59.5    76.3    86.0   129.0   145.0
   74.3   103.0    48.1    24.0   104.0   119.0   121.0   124.0   104.0   114.0
   82.0   127.0   211.0   132.0   151.0   147.0    48.8   124.0   119.0    84.8
  173.0   148.0   152.0   131.0   113.0   114.0    -1.0    -1.0    -1.0    -1.0
  123.0    36.0
05520500   KANKAKEE RIVER AT MOMENCE, IL
   -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  1885.0  1485.0  1395.0  1819.0  1597.0
 1057.0  2042.0  1206.0  2530.0  1159.0  1806.0  2563.0  2565.0  2626.0  1919.0
 1004.0  1666.0  2040.0   965.0  1794.0  1104.0  1654.0  1962.0  1934.0  1211.0
 1129.0  2103.0  2786.0  1963.0  1416.0  1816.0  1993.0  1935.0  1714.0  3247.0
 2289.0  2844.0  1299.0  1448.0  2368.0  1563.0  1472.0  1893.0  2091.0  2424.0
 1674.0  2077.0  1205.0   857.0  1827.0  2442.0  2557.0  2554.0  2318.0  2091.0
 1803.0  2356.0  3434.0  2422.0  2570.0  2538.0  1516.0  2246.0  2171.0  1879.0
 2889.0  2986.0  2809.0  2177.0  2486.0  2315.0    -1.0    -1.0    -1.0    -1.0
 2294.0    36.5
05523000   BICE DITCH NEAR SOUTH MARION, IND.
   -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    -1.0    -1.0
   -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    36.1
   24.8    24.9    12.4     5.9    17.8    10.6    13.4    27.0    16.7    17.4
   10.1    18.0     7.3     3.5     9.9    12.4    11.8    20.5    16.9    19.8
   12.9    17.5    31.4    23.6    21.9    16.5    10.7    22.5    18.3    18.5
   17.8    25.2    21.2    21.2    22.6    28.7    -1.0    -1.0    -1.0    -1.0
   21.8    37.0
05525000   IROQUOIS RIVER AT IROQUOIS, IL
   -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    -1.0    -1.0
   -1.0    -1.0    -1.0    -1.0   326.0   529.0   398.0   464.0   485.0  1129.0
  749.0   673.0   373.0   199.0   427.0   363.0   518.0   730.0   569.0   602.0
  364.0   616.0   253.0   121.0   406.0   426.0   556.0   747.0   572.0   603.0
  440.0   605.0   983.0   720.0   603.0   619.0   347.0   663.0   586.0   521.0
  601.0   835.0   701.0   709.0   621.0   835.0    -1.0    -1.0    -1.0    -1.0
  686.0    35.2
05525500   SUGAR CREEK AT MILFORD, IL
   -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    -1.0    -1.0
   -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0   351.0   680.0
  517.0   439.0   242.0    87.2   197.0   207.0   405.0   416.0   303.0   322.0
  279.0   427.0   152.0   145.0   299.0   267.0   269.0   451.0   322.0   394.0
  260.0   271.0   655.0   648.0   466.0   308.0   241.0   390.0   479.0   358.0
  373.0   501.0   516.0   615.0   366.0   613.0    -1.0    -1.0    -1.0    -1.0
  446.0    35.4
05526000   IROQUOIS RIVER NEAR CHEBANSE, IL
   -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  2164.0   703.0  1673.0  3445.0  2184.0  2110.0  1390.0
  365.0  1018.0  1961.0   469.0  1669.0   883.0  1721.0  1837.0  1677.0   472.0
  421.0  2011.0  2797.0  1423.0  1017.0  1732.0  1339.0  1618.0  1452.0  3210.0
 2301.0  2023.0  1149.0   538.0  1202.0   978.0  1792.0  1867.0  1628.0  1559.0
 1014.0  1988.0   698.0   423.0  1371.0  1305.0  1443.0  2222.0  1603.0  2036.0
 1233.0  1908.0  3243.0  2449.0  2031.0  1811.0  1100.0  2159.0  2144.0  1498.0
 1968.0  2972.0  2314.0  2368.0  1797.0  2405.0    -1.0    -1.0    -1.0    -1.0
 2091.0    35.1
05527500   KANKAKEE RIVER NEAR WILMINGTON, IL
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```
   -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  3381.0  2339.0  2325.0  3592.0  2986.0
 1647.0  4517.0  2052.0  5170.0  2158.0  3954.0  6851.0  5187.0  5497.0  3509.0
 1493.0  2740.0  4280.0  1582.0  4252.0  2194.0  3809.0  4160.0  3950.0  1817.0
 1795.0  5043.0  6667.0  3990.0  2982.0  3991.0  3999.0  4082.0  3342.0  7232.0
 5096.0  5293.0  2770.0  2356.0  4074.0  2884.0  3875.0  4381.0  4123.0  4493.0
 2871.0  4867.0  2014.0  1407.0  3680.0  4384.0  4425.0  5492.0  4732.0  4543.0
 3154.0  4976.0  7983.0  5879.0  5513.0  4966.0  3039.0  5062.0  5074.0  3954.0
 6024.0  6734.0  6675.0  6179.0  5738.0  6095.0    -1.0    -1.0    -1.0    -1.0
 5150.0    33.5
05537500   LONG RUN NEAR LEMONT, IL
   -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    -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    23.2    13.1    11.9    31.7     9.3    13.7    10.0    11.5    16.0
   11.3    17.9     3.4     3.4    12.8    20.0    15.0    15.6    15.9    18.1
   11.8    14.4    26.8    30.5    20.9    17.2     7.6    20.1    21.6    15.4
   21.2    18.9    33.2    22.0    17.3    15.9    -1.0    -1.0    -1.0    -1.0
   20.9    35.0
05539000   HICKORY CREEK AT JOLIET, IL
   -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    -1.0    -1.0
   -1.0    -1.0    -1.0    -1.0    59.2    76.6   115.0    75.9    57.7   141.0
   86.6   106.0    51.4    61.9   109.0    47.9    90.8    66.5    69.8    78.4
   57.1    90.5    20.8    21.5    71.8   107.0    63.2    81.5    72.9    82.9
   62.8    71.2   159.0   159.0   123.0   104.0    34.1   109.0   120.0    81.9
  129.0    98.5   151.0   101.0    82.4    69.9    -1.0    -1.0    -1.0    -1.0
  107.0    35.0
05540500   DU PAGE RIVER AT SHOREWOOD, IL
   -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    -1.0    -1.0
  140.0   283.0   280.0   136.0   149.0   221.0   225.0   241.0   163.0   308.0
  276.0   277.0   138.0   175.0   391.0   114.0   166.0   191.0   203.0   314.0
  147.0   326.0    94.2   117.0   251.0   321.0   252.0   218.0   296.0   348.0
  192.0   319.0   437.0   428.0   325.0   305.0   137.0   332.0   460.0   300.0
  312.0   343.0   535.0   356.0   312.0   304.0    -1.0    -1.0    -1.0    -1.0
  324.0    33.7
05542000   MAZON RIVER NEAR COAL CITY, IL
   -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    -1.0    20.6
   70.2   623.0   688.0   296.0   254.0   350.0   344.0   251.0   241.0   587.0
  375.0   422.0   158.0   187.0   180.0    41.4   355.0   357.0   215.0   430.0
   98.4   390.0    75.3    41.0   302.0   310.0   284.0   410.0   207.0   411.0
  217.0   469.0   699.0   560.0   372.0   305.0   165.0   452.0   576.0   340.0
  452.0   564.0   573.0   473.0   341.0   475.0    -1.0    -1.0    -1.0    -1.0
  455.0    33.4
05546500   FOX RIVER AT WILMOT, WI
   -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    -1.0   322.0
  435.0   408.0   592.0   335.0   265.0   474.0   393.0   547.0   305.0   461.0
  633.0   851.0   413.0   381.0   491.0   251.0   262.0   174.0   405.0  1049.0
  551.0   647.0   207.0   219.0   501.0   647.0   403.0   394.0   569.0   458.0
  550.0   713.0  1152.0  1082.0   642.0   559.0   229.0   660.0   868.0   516.0
  564.0   740.0   926.0   683.0   733.0   921.0    -1.0    -1.0    -1.0    -1.0
  868.0    31.6
05550500   POPLAR CREEK AT ELGIN, IL
   -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    -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    29.8     9.6    15.9    24.8     7.7    14.6    16.7    14.4    32.9
   11.2    30.7     4.7     8.9    23.6    27.0    26.7    14.9    25.5    33.3
   19.0    34.7    47.6    50.7    34.7    26.4     8.4    26.2    42.0    18.6
   20.3    22.6    41.3    36.5    26.6    33.7    -1.0    -1.0    -1.0    -1.0
   35.2    32.6
05554500   VERMILION RIVER AT PONTIAC, IL
   -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
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-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
-1.0	-1.0	771.0	386.0	257.0	403.0	350.0	333.0	236.0	623.0
599.0	471.0	216.0	167.0	222.0	120.0	435.0	409.0	261.0	364.0
154.0	530.0	104.0	49.7	400.0	296.0	248.0	533.0	213.0	546.0
233.0	439.0	902.0	648.0	422.0	421.0	163.0	461.0	568.0	390.0
500.0	524.0	664.0	537.0	421.0	539.0	-1.0	-1.0	-1.0	-1.0
579.0	33.9								
05556500	BIG BUREAU CREEK AT PRINCETON, IL								
-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	166.0	160.0	126.0	28.9
76.9	178.0	146.0	86.6	104.0	155.0	124.0	75.8	140.0	149.0
185.0	180.0	44.5	75.9	188.0	51.4	72.0	113.0	87.7	219.0
36.5	189.0	34.5	32.9	133.0	190.0	91.9	68.5	154.0	222.0
107.0	192.0	301.0	255.0	145.0	91.4	14.6	185.0	259.0	92.5
171.0	214.0	218.0	126.0	152.0	178.0	-1.0	-1.0	-1.0	-1.0
196.0	33.6								
05567500	MACKINAW RIVER NEAR CONGERVILLE, IL								
-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	-1.0	-1.0
-1.0	-1.0	-1.0	-1.0	393.0	641.0	546.0	449.0	345.0	861.0
806.0	666.0	316.0	319.0	415.0	94.8	406.0	357.0	366.0	459.0
294.0	656.0	97.2	130.0	565.0	396.0	324.0	666.0	327.0	717.0
375.0	445.0	1147.0	911.0	496.0	577.0	299.0	624.0	557.0	393.0
828.0	711.0	958.0	796.0	575.0	675.0	-1.0	-1.0	-1.0	-1.0
767.0	35.0								
05569500	SPOON RIVER AT LONDON MILLS, IL								
-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	-1.0	-1.0
-1.0	-1.0	827.0	557.0	682.0	608.0	661.0	551.0	500.0	858.0
1048.0	880.0	368.0	459.0	883.0	246.0	345.0	511.0	457.0	1117.0
337.0	917.0	201.0	283.0	954.0	659.0	498.0	479.0	630.0	1247.0
564.0	436.0	1393.0	1795.0	669.0	739.0	362.0	1026.0	897.0	513.0
886.0	1058.0	991.0	825.0	901.0	812.0	-1.0	-1.0	-1.0	-1.0
1072.0	34.5								
05570000	SPOON RIVER AT SEVILLE, IL								
-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	812.0	1253.0	916.0	841.0	1056.0	849.0
357.0	820.0	316.0	1299.0	462.0	1585.0	2594.0	1683.0	2213.0	661.0
309.0	731.0	1164.0	193.0	1586.0	693.0	774.0	1019.0	632.0	210.0
501.0	1667.0	1285.0	919.0	1119.0	1026.0	1157.0	881.0	780.0	1360.0
1397.0	1411.0	584.0	708.0	1298.0	329.0	527.0	746.0	669.0	1675.0
665.0	1376.0	328.0	486.0	1400.0	973.0	841.0	821.0	1133.0	1837.0
865.0	625.0	2146.0	2652.0	1017.0	1197.0	643.0	1586.0	1293.0	787.0
1486.0	1769.0	1773.0	1202.0	1361.0	1319.0	-1.0	-1.0	-1.0	-1.0
1636.0	34.5								
05572000	SANGAMON RIVER AT MONTICELLO, IL								
-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
407.0	208.0	207.0	633.0	258.0	368.0	220.0	318.0	369.0	414.0
195.0	619.0	347.0	724.0	269.0	574.0	1105.0	596.0	686.0	387.0
75.3	179.0	429.0	68.0	445.0	260.0	461.0	484.0	481.0	133.0
142.0	633.0	709.0	401.0	239.0	480.0	383.0	334.0	361.0	798.0
522.0	494.0	174.0	69.1	173.0	263.0	405.0	419.0	336.0	310.0
355.0	558.0	158.0	240.0	282.0	245.0	301.0	663.0	312.0	445.0
323.0	488.0	859.0	697.0	439.0	340.0	295.0	461.0	603.0	240.0
607.0	592.0	522.0	587.0	357.0	594.0	-1.0	-1.0	-1.0	-1.0
550.0	36.4								
05576000	SOUTH FORK SANGAMON RIVER NR ROCHESTER								
-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	-1.0	-1.0
-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	895.0
652.0	443.0	129.0	26.3	162.0	223.0	961.0	640.0	425.0	719.0
377.0	674.0	250.0	200.0	284.0	436.0	730.0	1147.0	627.0	936.0
312.0	468.0	1345.0	1320.0	689.0	270.0	195.0	830.0	738.0	214.0
504.0	1098.0	1054.0	859.0	609.0	661.0	-1.0	-1.0	-1.0	-1.0
867.0	36.9								
05577500	SPRING CREEK AT SPRINGFIELD, IL								
-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	-1.0	-1.0
-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	76.1
73.8	60.7	7.2	2.2	18.0	18.8	119.0	47.2	51.0	139.0

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    56.9    84.5    21.9    46.5    50.7    54.5    49.5   121.0    93.1    87.7
    38.8    27.8   140.0   120.0    94.8    45.4    32.9    80.1    67.7    38.3
   108.0    79.1   123.0    87.0    51.7    79.5    -1.0    -1.0    -1.0    -1.0
   107.0    36.2
05579500   LAKE FORK NEAR CORNLAND, IL
    -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    -1.0    -1.0
    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0    -1.0   119.0   278.0
   210.0   160.0    65.3     8.9    42.6    54.6   183.0   152.0   106.0   132.0
   119.0   144.0    26.5    63.4    93.4    95.5   126.0   275.0   111.0   227.0
    78.5   112.0   280.0   329.0   182.0   135.0   121.0   261.0   230.0    52.3
   267.0   212.0   336.0   194.0   142.0   254.0    -1.0    -1.0    -1.0    -1.0
   214.0    37.3
05582000   SALT CREEK NEAR GREENVIEW, IL
    -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    -1.0    -1.0
    -1.0  1941.0  2227.0  1030.0   798.0  1471.0  1662.0   907.0   817.0  1882.0
  1495.0  1307.0   649.0   315.0   486.0   515.0  1132.0  1201.0   879.0  1068.0
   993.0  1491.0   381.0   609.0  1035.0   876.0   880.0  2174.0  1272.0  1873.0
   720.0  1005.0  2483.0  2425.0  1478.0  1158.0   892.0  1548.0  1844.0   582.0
  2286.0  2036.0  2339.0  1595.0  1317.0  1862.0    -1.0    -1.0    -1.0    -1.0
  1804.0    37.3
05583000   SANGAMON RIVER NEAR OAKFORD, IL
    -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  2248.0  2114.0  2837.0  3312.0
  2390.0  1701.0    -1.0  4901.0  5720.0  2321.0   581.0  1471.0  3837.0   723.0
   810.0  5501.0  6213.0  2901.0  3083.0  3879.0  4768.0  2642.0  2615.0  5726.0
  4462.0  3520.0  1367.0   516.0   986.0  1506.0  4058.0  3564.0  2553.0  3625.0
  2784.0  4101.0  1270.0  1755.0  2516.0  2543.0  2892.0  5970.0  3548.0  5069.0
  2160.0  2931.0  7325.0  7081.0  4254.0  2692.0  2117.0  4540.0  4776.0  1594.0
  4910.0  4889.0  5808.0  4810.0  3391.0  4328.0    -1.0    -1.0    -1.0    -1.0
  5093.0    37.0
05584500   LA MOINE RIVER AT COLMAR, IL
    -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    -1.0    -1.0
    -1.0    -1.0    -1.0    -1.0   679.0   448.0   657.0   512.0   373.0   357.0
   408.0   431.0   192.0   192.0   413.0    71.2   210.0   216.0   316.0   804.0
   672.0   556.0    94.5   249.0   533.0   339.0   252.0   263.0   498.0   832.0
   310.0   192.0   976.0  1184.0   519.0   297.0   117.0   616.0   349.0   257.0
   642.0   653.0   694.0   458.0   558.0   734.0    -1.0    -1.0    -1.0    -1.0
   655.0    35.3
05585000   LA MOINE RIVER AT RIPLEY, IL
    -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   816.0   323.0   923.0   545.0  1131.0  1410.0   693.0  1756.0   392.0
   317.0   571.0   804.0    70.9  1264.0   529.0   512.0   943.0   619.0   136.0
   199.0  1124.0  1081.0   960.0  1396.0   837.0  1285.0   839.0   573.0   757.0
   817.0   737.0   300.0   238.0   778.0   187.0   430.0   424.0   601.0  1320.0
  1220.0  1116.0   241.0   395.0  1007.0   617.0   577.0   490.0  1150.0  1473.0
   634.0   451.0  1544.0  1843.0   888.0   576.0   277.0  1394.0   690.0   463.0
  1363.0  1376.0  1325.0  1104.0  1260.0  1385.0    -1.0    -1.0    -1.0    -1.0
  1293.0    35.0
05587000   MACOUPIN CREEK NEAR KANE, IL
    -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   889.0   159.0
   506.0   300.0   675.0  1883.0   882.0  1029.0   339.0    34.9   242.0   591.0
    84.7   922.0   953.0   516.0   938.0   750.0   888.0   301.0   595.0   815.0
   461.0   384.0    98.0    17.0   107.0    96.9   877.0   373.0   159.0   406.0
   461.0   681.0   255.0   139.0   174.0   395.0   450.0   722.0   727.0   756.0
   242.0   329.0  1043.0   843.0   710.0   186.0   283.0   831.0   588.0   139.0
   507.0   769.0   885.0  1039.0   781.0   459.0    -1.0    -1.0    -1.0    -1.0
   868.0    38.2
05588000   INDIAN CREEK AT WANDA, IL
    -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    -1.0    -1.0
     4.3    28.1    44.7    22.4    38.7    45.4    42.0    21.5    31.4    49.3
    25.5    30.7    10.0     1.4     8.7     4.8    36.5    17.6    13.0    20.9
    32.1    35.2    14.0     5.2     4.1     9.1    20.2    39.7    50.7    30.8
    13.0    15.6    45.1    42.3    40.2     7.0    12.8    36.7    29.5     6.4
    11.1    31.4    43.8    48.2    50.4    38.1    -1.0    -1.0    -1.0    -1.0
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    36.7     38.4
05590000     KASKASKIA DITCH AT BONDVILLE, IL
    -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     -1.0     -1.0
    -1.0     -1.0     -1.0     -1.0     -1.0     -1.0     -1.0     -1.0     -1.0     18.3
    13.3     11.5      4.2      1.8      3.5      3.9      7.9     13.6      9.7      9.2
     9.6     12.3      5.4      7.1      7.8      7.1      8.0     15.9      8.4     10.5
     7.7     10.3     23.2     20.7     10.3      8.4      6.5     11.6     15.0      4.5
    15.0     18.2     14.2     16.2      8.8     17.3     -1.0     -1.0     -1.0     -1.0
    12.4     36.5
05594000     SHOAL CREEK NEAR BREESE, IL
    -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     -1.0     -1.0
    -1.0     -1.0     -1.0    423.0    811.0    689.0    749.0    411.0    689.0    955.0
   736.0    463.0    189.0     28.5    160.0    157.0    913.0    479.0    354.0    565.0
   432.0    615.0    276.0    179.0     91.3    308.0    629.0    731.0    692.0    628.0
   224.0    369.0   1067.0   1067.0    731.0    147.0    226.0    703.0    629.0    154.0
   253.0    839.0   1040.0   1003.0    909.0    573.0     -1.0     -1.0     -1.0     -1.0
   735.0     38.5
05597500     CRAB ORCHARD CREEK NEAR MARION, IL
    -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     -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     37.4      6.8      2.4     14.4      8.2     35.6     26.6     14.3     16.6
    32.3     31.4     12.7     11.3     11.8     19.0     10.1     26.3     31.1     39.4
    22.6     16.1     45.5     35.8     39.4     20.2     16.2     27.1     50.3     13.6
    24.2     40.7     66.6     38.1     61.2     36.0     -1.0     -1.0     -1.0     -1.0
    31.7     43.2
07014500     MERAMEC RIVER NEAR SULLIVAN, MO.
    -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   1457.0   1132.0   1166.0    679.0    949.0   2447.0   1939.0   1274.0   1115.0
   522.0    522.0   1061.0    835.0   2414.0   1191.0   1437.0   1091.0   1404.0   2378.0
  1821.0   1413.0    597.0    341.0    675.0    507.0   1844.0   1258.0    724.0    828.0
  1259.0   1057.0    650.0    628.0    609.0   1085.0    897.0   1415.0   1457.0   1057.0
   726.0    835.0   1786.0   1992.0   1567.0    513.0    608.0   1033.0   1462.0    492.0
   877.0   1583.0   2032.0   1720.0   3014.0   1536.0     -1.0     -1.0     -1.0     -1.0
  1475.0     42.0
07016500     BOURBEUSE RIVER AT UNION, MO
    -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    782.0    408.0    752.0    404.0    534.0   1261.0   1080.0    805.0    525.0
   285.0    300.0    652.0    428.0   1198.0    221.0    733.0    831.0    605.0    204.0
   317.0   1018.0    957.0    613.0   1124.0    487.0    784.0    751.0    635.0   1590.0
   893.0    626.0    247.0    106.0    291.0    189.0   1496.0    572.0    326.0    428.0
   600.0    498.0    227.0    380.0    269.0    580.0    354.0    646.0    880.0    799.0
   353.0    428.0   1033.0    762.0   1033.0    189.0    447.0    644.0    809.0    196.0
   745.0    788.0   1192.0   1019.0   1490.0    743.0     -1.0     -1.0     -1.0     -1.0
   808.0     40.0
07018500     BIG RIVER AT BYRNESVILLE MO
    -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    869.0    889.0    409.0    841.0   1564.0   1243.0    901.0    725.0
   265.0    389.0    736.0    375.0   1312.0    364.0    966.0   1168.0    918.0    430.0
   394.0   1122.0    982.0    585.0   1421.0    909.0    990.0    753.0   1088.0   1685.0
  1363.0   1039.0    495.0    227.0    461.0    315.0   1796.0   1039.0    630.0    674.0
  1030.0    773.0    560.0    466.0    363.0    741.0    614.0   1092.0   1112.0    735.0
   494.0    742.0   1537.0   1282.0   1097.0    312.0    479.0    769.0    969.0    311.0
   531.0    997.0   1485.0   1061.0   1934.0   1006.0     -1.0     -1.0     -1.0     -1.0
   917.0     40.0
07019000     MERAMEC RIVER NEAR EUREKA, MO
    -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   3542.0   3237.0
    -1.0   3482.0   2750.0   3309.0   1785.0   2699.0   5975.0   4779.0   3317.0   2650.0
  1168.0   1399.0   2741.0   1608.0   5077.0   1390.0   3131.0   3819.0   3421.0   1537.0
  1601.0   4111.0   4229.0   2355.0   5561.0   2862.0   3657.0   2904.0   3550.0   6667.0
  4558.0   3471.0   1477.0    751.0   1563.0   1135.0   6024.0   3192.0   1917.0   2253.0
  3385.0   2767.0   1609.0   1702.0   1334.0   2662.0   2142.0   3628.0   4103.0   3010.0
  1968.0   2369.0   5237.0   4788.0   4451.0   1230.0   1860.0   3131.0   4209.0   1184.0
  2640.0   4143.0   5612.0   4599.0   7407.0   3768.0     -1.0     -1.0     -1.0     -1.0
  3790.0     40.0
07021000     CASTOR RIVER AT ZALMO, MO
    -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
502.0	547.0	709.0	324.0	233.0	442.0	1076.0	841.0	737.0	378.0
185.0	294.0	693.0	199.0	726.0	178.0	624.0	546.0	461.0	266.0
149.0	496.0	591.0	325.0	1010.0	618.0	362.0	496.0	715.0	1088.0
564.0	660.0	291.0	195.0	377.0	220.0	862.0	788.0	398.0	434.0
513.0	483.0	270.0	382.0	381.0	540.0	261.0	623.0	509.0	351.0
286.0	390.0	1071.0	779.0	686.0	438.0	354.0	319.0	838.0	262.0
315.0	523.0	1004.0	552.0	1063.0	520.0	-1.0	-1.0	-1.0	-1.0
423.0	44.0								

APPENDIX C -- Program HYNET output for seventeen experiments.

EXPERIMENT NUMBER 1
Initial number of stations = 10
Planning horizon = 5
Number of stations to be operated in future = 10
Number of replications = 100
Initial distribution of record lenghts
3 stations with 5 years of record
4 stations with 8 years of record
3 stations with 10 years of record

The following statistics are based on the differences , in percent, between projected and achieved mean square error:
Mean difference NARI = 1.62
Root-Mean-Square difference NARI = 4.07
Mean difference NAUGLS = -0.65
Root-Mean-Square difference NAUGLS = 3.21

Relative information of network output of NAUGLS to that of NARI = 1.61

EXPERIMENT NUMBER 2
Initial number of stations = 10
Planning horizon = 10
Number of stations to be operated in future = 10
Number of replications = 100
Initial distribution of record lenghts
3 stations with 5 years of record
4 stations with 8 years of record
3 stations with 10 years of record

The following statistics are based on the differences , in percent, between projected and achieved mean square error:
Mean difference NARI = 2.15
Root-Mean-Square difference NARI = 4.21
Mean difference NAUGLS = -0.25
Root-Mean-Square difference NAUGLS = 2.75

Relative information of network output of NAUGLS to that of NARI = 2.34

EXPERIMENT NUMBER 3
Initial number of stations = 10
Planning horizon = 5
Number of stations to be operated in future = 40
Number of replications = 100
Initial distribution of record lenghts
3 stations with 5 years of record
4 stations with 8 years of record
3 stations with 10 years of record

The following statistics are based on the differences , in percent, between projected and achieved mean square error:
Mean difference NARI = 0.91
Root-Mean-Square difference NARI = 3.74
Mean difference NAUGLS = -0.82
Root-Mean-Square difference NAUGLS = 2.93

Relative information of network output of NAUGLS to that of NARI = 1.63

EXPERIMENT NUMBER 4
Initial number of stations = 10
Planning horizon = 10
Number of stations to be operated in future = 40
Number of replications = 100
Initial distribution of record lenghts
3 stations with 5 years of record
4 stations with 8 years of record
3 stations with 10 years of record

The following statistics are based on the differences , in percent, between projected and achieved mean square error:
Mean difference NARI = 1.65
Root-Mean-Square difference NARI = 3.83
Mean difference NAUGLS = -0.18
Root-Mean-Square difference NAUGLS = 2.57

Relative information of network output of NAUGLS to that of NARI = 2.23

EXPERIMENT NUMBER 5
Initial number of stations = 10
Planning horizon = 5
Number of stations to be operated in future = 10
Number of replications = 100
Initial distribution of record lenghts
3 stations with 10 years of record
4 stations with 12 years of record
3 stations with 20 years of record

The following statistics are based on the differences , in percent,
between projected and achieved mean square error:
Mean difference NARI = 1.26
Root-Mean-Square difference NARI = 3.03
Mean difference NAUGLS = -0.16
Root-Mean-Square difference NAUGLS = 2.26

Relative information of network output of NAUGLS to that of NARI = 1.80

EXPERIMENT NUMBER 6
Initial number of stations = 10
Planning horizon = 10
Number of stations to be operated in future = 10
Number of replications = 100
Initial distribution of record lenghts
3 stations with 10 years of record
4 stations with 12 years of record
3 stations with 20 years of record

The following statistics are based on the differences , in percent,
between projected and achieved mean square error:
Mean difference NARI = 1.80
Root-Mean-Square difference NARI = 3.06
Mean difference NAUGLS = 0.11
Root-Mean-Square difference NAUGLS = 1.95

Relative information of network output of NAUGLS to that of NARI = 2.46

EXPERIMENT NUMBER 7
Initial number of stations = 10
Planning horizon = 5
Number of stations to be operated in future = 40
Number of replications = 100
Initial distribution of record lenghts
3 stations with 10 years of record
4 stations with 12 years of record
3 stations with 20 years of record

The following statistics are based on the differences , in percent, between projected and achieved mean square error:
Mean difference NARI = 0.44
Root-Mean-Square difference NARI = 3.08
Mean difference NAUGLS = -0.37
Root-Mean-Square difference NAUGLS = 2.24

Relative information of network output of NAUGLS to that of NARI = 1.89

EXPERIMENT NUMBER 8
Initial number of stations = 10
Planning horizon = 10
Number of stations to be operated in future = 40
Number of replications = 100
Initial distribution of record lenghts
3 stations with 10 years of record
4 stations with 12 years of record
3 stations with 20 years of record

The following statistics are based on the differences , in percent, between projected and achieved mean square error:
Mean difference NARI = 1.03
Root-Mean-Square difference NARI = 2.79
Mean difference NAUGLS = -0.02
Root-Mean-Square difference NAUGLS = 1.86

Relative information of network output of NAUGLS to that of NARI = 2.24

EXPERIMENT NUMBER 9
Initial number of stations = 30
Planning horizon = 5
Number of stations to be operated in future = 10
Number of replications = 100
Initial distribution of record lenghts
9 stations with 5 years of record
12 stations with 8 years of record
9 stations with 10 years of record

The following statistics are based on the differences , in percent, between projected and achieved mean square error:
Mean difference NARI = 0.71
Root-Mean-Square difference NARI = 2.24
Mean difference NAUGLS = -0.08
Root-Mean-Square difference NAUGLS = 1.70

Relative information of network output of NAUGLS to that of NARI = 1.74

EXPERIMENT NUMBER 10
Initial number of stations = 30
Planning horizon = 10
Number of stations to be operated in future = 10
Number of replications = 100
Initial distribution of record lenghts
9 stations with 5 years of record
12 stations with 8 years of record
9 stations with 10 years of record

The following statistics are based on the differences , in percent, between projected and achieved mean square error:
Mean difference NARI = 1.12
Root-Mean-Square difference NARI = 2.40
Mean difference NAUGLS = 0.20
Root-Mean-Square difference NAUGLS = 1.75

Relative information of network output of NAUGLS to that of NARI = 1.88

EXPERIMENT NUMBER 11
Initial number of stations = 30
Planning horizon = 5
Number of stations to be operated in future = 40
Number of replications = 100
Initial distribution of record lenghts
9 stations with 5 years of record
12 stations with 8 years of record
9 stations with 10 years of record

The following statistics are based on the differences , in percent, between projected and achieved mean square error:
Mean difference NARI = 0.62
Root-Mean-Square difference NARI = 2.08
Mean difference NAUGLS = -0.18
Root-Mean-Square difference NAUGLS = 1.71

Relative information of network output of NAUGLS to that of NARI = 1.49

EXPERIMENT NUMBER 12
Initial number of stations = 30
Planning horizon = 10
Number of stations to be operated in future = 40
Number of replications = 100
Initial distribution of record lenghts
9 stations with 5 years of record
12 stations with 8 years of record
9 stations with 10 years of record

The following statistics are based on the differences , in percent, between projected and achieved mean square error:
Mean difference NARI = 1.16
Root-Mean-Square difference NARI = 2.33
Mean difference NAUGLS = 0.18
Root-Mean-Square difference NAUGLS = 1.76

Relative information of network output of NAUGLS to that of NARI = 1.75

EXPERIMENT NUMBER 13
Initial number of stations = 30
Planning horizon = 5
Number of stations to be operated in future = 10
Number of replications = 100
Initial distribution of record lenghts
9 stations with 10 years of record
12 stations with 12 years of record
9 stations with 20 years of record

The following statistics are based on the differences , in percent, between projected and achieved mean square error:
Mean difference NARI = 0.74
Root-Mean-Square difference NARI = 1.40
Mean difference NAUGLS = 0.21
Root-Mean-Square difference NAUGLS = 1.03

Relative information of network output of NAUGLS to that of NARI = 1.87

EXPERIMENT NUMBER 14
Initial number of stations = 30
Planning horizon = 10
Number of stations to be operated in future = 10
Number of replications = 100
Initial distribution of record lenghts
9 stations with 10 years of record
12 stations with 12 years of record
9 stations with 20 years of record

The following statistics are based on the differences , in percent, between projected and achieved mean square error:
Mean difference NARI = 0.94
Root-Mean-Square difference NARI = 1.49
Mean difference NAUGLS = 0.34
Root-Mean-Square difference NAUGLS = 1.06

Relative information of network output of NAUGLS to that of NARI = 1.96

EXPERIMENT NUMBER 15
Initial number of stations = 30
Planning horizon = 5
Number of stations to be operated in future = 40
Number of replications = 100
Initial distribution of record lenghts
9 stations with 10 years of record
12 stations with 12 years of record
9 stations with 20 years of record

The following statistics are based on the differences , in percent, between projected and achieved mean square error:
Mean difference NARI = 0.65
Root-Mean-Square difference NARI = 1.39
Mean difference NAUGLS = 0.24
Root-Mean-Square difference NAUGLS = 1.04

Relative information of network output of NAUGLS to that of NARI = 1.78

EXPERIMENT NUMBER 16
Initial number of stations = 30
Planning horizon = 10
Number of stations to be operated in future = 40
Number of replications = 100
Initial distribution of record lenghts
9 stations with 10 years of record
12 stations with 12 years of record
9 stations with 20 years of record

The following statistics are based on the differences , in percent, between projected and achieved mean square error:
Mean difference NARI = 0.97
Root-Mean-Square difference NARI = 1.47
Mean difference NAUGLS = 0.34
Root-Mean-Square difference NAUGLS = 1.04

Relative information of network output of NAUGLS to that of NARI = 2.01

EXPERIMENT NUMBER 17
Initial number of stations = 20
Planning horizon = 10
Number of stations to be operated in future = 25
Number of replications = 100
Initial distribution of record lenghts
6 stations with 10 years of record
8 stations with 12 years of record
6 stations with 15 years of record

The following statistics are based on the differences , in percent, between projected and achieved mean square error:
Mean difference NARI = 1.14
Root-Mean-Square difference NARI = 2.15
Mean difference NAUGLS = 0.39
Root-Mean-Square difference NAUGLS = 1.55

Relative information of network output of NAUGLS to that of NARI = 1.92

FINAL HYNET REPORT FOR THE UNITED STATES OF AMERICA

I. The Homgeneous Region-- This study was limited to the upper central part of the United States (figure 2) because of the region's roughly similar climate and topography. The area is characterized by generally low relief with relief increasing from west to east and from north to south. Average annual precipitation increases from about 100 cm in the north to about 115 cm in the south. In the eastern two-thirds of the area, average precipitation is relatively evenly distributed throughout the year. In the western third of the area, precipitation from November to February is somewhat less than that for the rest of the year.

II. Hydrology of the Region-- Runoff increases from about 23 cm in the northwest part of the area to about 40 cm along the southern boundary and in the eastern part of the area. Average monthly discharge is generally highest in early spring when snowmelt runoff occurs and gradually decreases to a low on August and September when evapotranspiration losses are large. Mean annual flows exhibit some serial correlation -- sample lag-one correlation coefficients average about 0.3 in the region. This persistence in annual flows may be due to persistence in annual precipitation and in groundwater storage.

III. Availability of Data-- The available streamflow data in the region was screened so that only those stations that were operated, at least in part, for the purpose of collecting regional information and had complete record for the period 1955-1984 were considered. The 146 stations that form the potential data base for this example have drainage areas that range between 32 and 24,730 square kilometers and mean annual precipitation ranging between 77 and 117 cm as shown in figure 3.

In order to investigate the regional homogeneity of the potential data base, mean annual discharge was computed for each of the 146 gauging stations for the common period of record, 1955-1984, and a logarithmic regression of these values against the logarithms of the independent variables, drainage area and mean annual precipitation, was performed. The resulting regression had a coefficient of determination of 0.99 and a standard error of estimation of 14 percent. A plot of the data-based estimates of mean annual discharge against those derived from the regression (figure 4) shows no unusual outliers. Figure 5, a map of the residuals (that is, the regression estimates minus the data-based estimates), shows a minor trend from east to west. However, because of the overall goodness of fit of the regression, it was felt that this trend was not a significant violation of the assumption of homogeneity. Thus, the conclusion from this step is that all 146 stations comprise a sufficiently homogeneous region for the purposes of the HYNET study. There are no missing values for any stations during the period 1955-1984.

Drainage areas and mean annual precipitation for each site were retrieved from the basin characteristics files of the U. S. Geological Survey. In general, the values in this file for drainage areas were determined by planimetering the area drawn on 7.5 minute topographic maps available from the U. S. Geological Survey. Values for mean annual precipitation were determined by overlaying an outline of the basin boundary on an isoline map of mean annual precipitation provided by the National Weather Service.

IV. The Experments-- The sixteen basic experiments recommended in the manual and enumerated in Table D-1 were run. In addition as recommended, an experiment in which 20 records are available for the regression --six of which are 10 years long, eight of which are 12 years long, and six of which are 15 years long -- was run. The planning horizon for the experiment was 10 years and the budget provided for 25 gauges during the planning horizon.

Table D-1 -- Basic experiments

Data Availability	Design Constraints	Design Parameters			
		NB	L3	PH	NP
Few, short records	Austere budget, short horizon	10,	10,	5,	10
	Austere budget, modest horizon	10,	10,	10,	10
	Adequate budget, short horizon	10,	10,	5,	40
	Adequate budget, modest horizon	10,	10,	10,	40
Few, long records	Austere budget, short horizon	10,	20,	5,	10
	Austere budget, modest horizon	10,	20,	10,	10
	Adequate budget, short horizon	10,	20,	5,	40
	Adequate budget, modest horizon	10,	20,	10,	40
Many, short records	Austere budget, short horizon	30,	10,	5,	10
	Austere budget, modest horizon	30,	10,	10,	10
	Adequate budget, short horizon	30,	10,	5,	40
	Adequate budget, modest horizon	30,	10,	10,	40
Many, long records	Austere budget, short horizon	30,	20,	5,	10
	Austere budget, modest horizon	30,	20,	10,	10
	Adequate budget, short horizon	30,	20,	5,	40
	Adequate budget, modest horizon	30,	20,	10,	40

Output for the seventeen experiments in the U.S. example are given in Table D-2..

Table D-2. Summary of results for intercomparison on NARI and NAUGLS

EXP NO.	NB	L3	PH	NP	BIAS(in percent) NARI	NAUGLS	RMSE(in percent) NARI	NAUGLS	RELATIVE INFORMATION [mse(NARI)/mse(NAUGLS)]
1	10	10	5	10	1.62	- 0.65	4.07	3.20	1.6
2	10	10	10	10	2.15	- 0.25	4.20	2.75	2.3
3	10	10	5	40	0.91	- 0.82	3.74	2.93	1.6
4	10	10	10	40	1.65	- 0.18	3.83	2.57	2.2
5	10	20	5	10	1.26	- 0.16	3.03	2.26	1.8
6	10	20	10	10	1.80	0.11	3.06	1.95	2.5
7	10	20	5	40	0.44	- 0.37	3.08	2.24	1.9
8	10	20	10	40	1.33	- 0.02	2.79	1.86	2.2
9	30	10	5	10	0.71	- 0.08	2.24	1.70	1.7
10	30	10	10	10	1.12	0.20	2.40	1.75	1.9
11	30	10	5	40	0.62	- 0.18	2.08	1.71	1.5
12	30	10	10	40	1.16	0.18	2.33	1.76	1.8
13	30	20	5	10	0.74	0.21	1.40	1.02	1.9
14	30	20	10	10	0.94	0.39	1.49	1.06	2.0
15	30	20	5	40	0.65	0.24	1.39	1.04	1.8
16	30	20	10	40	0.97	0.34	1.47	1.04	2.0
17	20	15	10	25	1.14	0.39	2.15	1.55	1.9

V. Conclusions-- For the seventeen experiments, the relative information statistic described in the manual ranged from 1.6 to 2.5. Because the relative information was greater than 1 for all experiments, one concludes that the NAUGLS technique conveys more information than does the NARI technique to the network designer interested in maximizing regional information about average flows with a limited budget.