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Abstract

This regional accounts and simulation system is based on interindustry analysis. In other words, the model emphasized the relationships between the economic structure of a region and both/either the recreation component of final demand and/or the water demand implications from changing industry outputs. As is typical of most input-output based systems, the strength of the model is in its capacity for estimating the economic impacts from assumed changes in final demand.

The creation demand is distributed across industries on the basis of recreational activities. Such an approach recognizes the fact that there is no single, identifiable recreation industry. Instead, there exists a collection of recreation demands on several regional specific industries. These industries serve both local and outside demanders.

The water component of the model relates water use to final demand and resulting industry outputs. In addition, aggregate regional water supply as well as water supplies on an industry specific basis are also introduced into the model. Such a program permits the user to adjust water supplies to simulate both the economic impacts from water constraints and the implications of potential water allocation schemes.

A simulation relating water use to recreation demand is presented in the paper to demonstrate the flexibility of the model. In so doing, an analysis of the sensitivity of a regional economy to changes in water supply/recreation use if demonstrated.

Introduction

The purpose of this paper is to address issues in the preparation and use of a decision information systems for evaluating the effects of water allocation schemes in times of relative water shortages. It is argued that a systems approach offers flexibility not found in many other types of water allocation models. An example of such a system will be provided with sample outputs.

Allocation schemes have been found to be necessary throughout the world as water scarcities become more and more evident. No where has this been more evident than in the United State where the appropriation of water was viewed as being a public right. The consequences of such a view are evident in the fact that the United States is a major user of water resources when compared to other countries that have had to be concerned about relative water supplies through a longer historical period (see Peter Rogers).

In addition, when nations have developed laws relating to water resources, these laws often emphasize withdrawal rights as opposed to instream needs. To the extent that these laws view water consumption as an inherent right, most of them require equal sharing of the burden when water supplies are short. If persistent shortages exist, the tendency has been to construct facilities geared towards increasing supply, often resulting in significant instream effects (a case study evaluation of such a "constant percent rule" can be found in G. D. Lynne and C. F. Kiker).

To the extent that there has been little incentive to conserve withdrawal uses of water as attempts are made to increase water supplies to meet demands, to the extent that the issue of instream effects have emerged only in the past few decades, and to the extent that it has been only recently that major aquifers have been found to be approaching depletion or that some of the world's ground water resources are even danger of being made unusable through contamination; water is being overused from an economic efficiency point of view. Because of this overuse, water is becoming increasingly scarce in economic terms, if not in physical terms. In other words, there is ont enough water to meet all of the demands at the current price.

When such scarcity presents itself, allocations must be made in the short run. In order for these allocations to be efficient[1] they need to be made in such a way as to have the resource go to those highest and best uses relative to identified objectives.

If a country insists on continuing with an allocation scheme bases either on everyone reducing their consumption by the same amount, the earliest users of the resource have first claim, withdrawals have priorities over instream uses, or households have first claims while remaining scarcities are allocated according to one of the above schemes (see Kenneth Fredrick and A. K. Biswas) at least it should be done with as much understanding as possible relative to the implications and costs of such allocations.

PREVIOUS RESEARCH APPROACHES

In a previous paper (Lichty and Anderson) we outlined several approaches taken to date to analyze water allocation questions. Most of

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[1] It should be noted that efficiency is but one of many possible allocation goals. While western economists often take the goal of market efficiency as a given, other goals surrounding issues of fairness and equity are equally viable. While this paper will stay with the assumption that efficiency is a worthy criterion, we do not necessarily subscribe to the notion that market efficiency is the only form worthy of implementation. Efficiency can also be expressed as an allocation of resources to meet stated political bases economic objectives, such as maximizing regional income, employment, etc.

these approaches have attempted to estimate the value of water from some point of view. A number of these attempts are summarized in Table 1.

These approaches can be summarized as being of two basic types; approaches that attempt to estimate the value of water form a market efficiency point of view and approaches that attempt to estimate the value of water using objective functions. The former approach needs little explanation as it represents the market orientation of western economic theory.

The latter approach attempts to measure efficient allocations usually relative to some maximizing political/economic objective, such as maximizing regional income, employment, or output. The programming and input/output approaches tend to be of this type. One approach not listed in Table 1 has been suggested by many authors. Such an approach takes a systems point of view in estimating not only the value of water, but also in analyzing the probable effects from alternative value and resulting allocating schemes.

While such an approach has often been suggested, to our knowledge, few attempts at systems design have been made. Such an approach, building on the design of an interactive, policy-oriented simulation model (IPASS) developed by Olson, et al, with the addition of a water module, will be described in the section to follow.

THE IPASS SYSTEM

. One component of this research, sponsored by the Legislative Commission on Minnesota's Resources, involves the building of an economic simulation model for the state and for five sub-regions within the state. This model is built around the U.S. Forest Service IMPLAN (Impact Analysis for Planning System. It includes a core input-output model and a "senes" of recursively-interactive modules.

Table 1
Summary of Attempts to Estimate Water Value

Method Title	Method Description
Market Transaction Observation	Estimate value for non-market by looking market instances that do exist
Estimate Demand Functions	Estimate marginal productivity of water or its marginal utility
Cost of Delivery	Estimate value from the estimated cost of delivering water
Alternative Cost	Estimate the opportunity cost for water by looking at costs of next best alternative to achieving a desired end
Residual Imputation	Allocate the value added from a product's production to resources other than water - the residual is water's contribution to value
Input-Output	Values water according to its contribution to regional income
Linear Programming	Values water through shadow price estimation with water serving as a programming constraint

A water module has also been developed and is attached to the broader system. This module will be used to simulate the state's water demands and supplies under differing assumptions as to the state's economic performance. The characteristics of this module will be discussed as an integral part of the simulation model itself.

There are three basic components of the valuation/impact analysis portion of this project -- IPASS and its "shell", the water module in IPASS, and the linear programming model. Their relationships to one another are illustrated in Figure 1. The linear programming component to this model has been discussed in other papers and will not be presented here (Garcia and Dalton; Anderson, Garcia, and Lichty). This section will describe the IPASS model followed by a discussion on the components of the water module.

IPASS is a dynamic simulation model capable of estimating a number of socioeconomic variables such as population, employment, sector outputs, earnings, and investment in a region over time. It differs from the urdely-used REMI model (Treyzand Stevens) if its limited structural content. It essentially provides a "shell" for drawing the IMPLAN model and managing additional modules like the ivator module. The "shell" itself consists of several algorithms (grouped into eight basic modules-- investment, final demand, production, regional output, employment, labor force, population, and primary input) that are used to calculate and project the central income, demographic and engineering variables used in the water or any other special-purpose module.

A comprehensive description of the IPASS system and its attending algorithms already exists in two publications by Olson et al. No attempt will be made in this report to replicate the discussions in those reports. However, in reference to Figure 1, a general description of the model

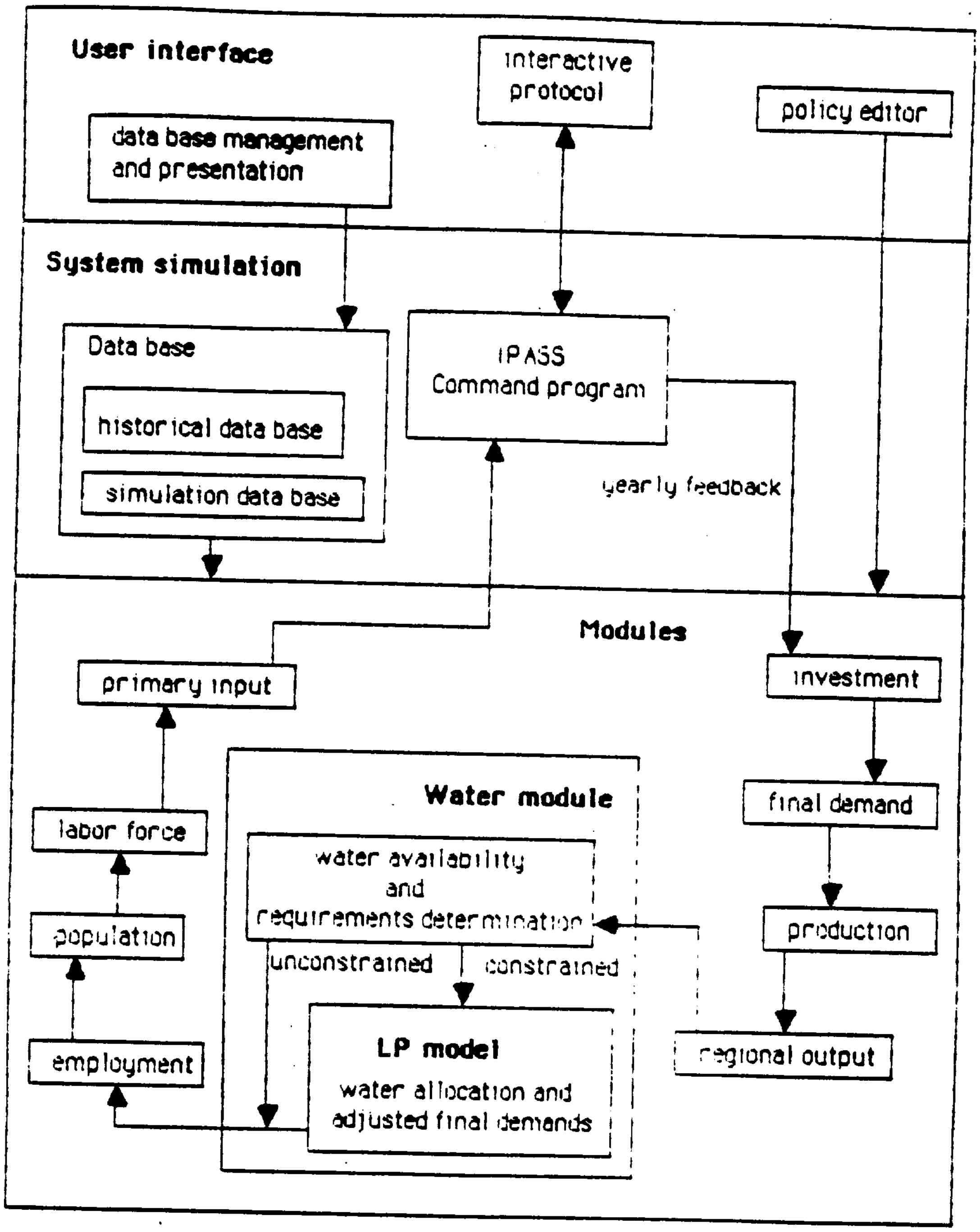

Figure 1. The structure of the modeling system indicating major information flows between and within the user interface, the system simulation, and the data base.

follows for those interested in a cursory review of IPASS's characteristics.

The IPASS "shell" provides for interactive policy analysis, i.e., analysis where the user is allowed to change parameters and to simulate impacts for these parameter modification on regional economic and demographic variables. This user interaction feature of the model is demonstrated in the user interface portion of Figure 1.

There is an initial data system that is provided for the system. The initial data base is extremely large including information on over 100 variables and parameter values within the system. These values come from a bast array of secondary data sources. In developing the Minnesota models major attempts had to be made to reconcile data systems that were not consistent with one another, such as data form the U.S. Census and the U.S. Department of Commerce County Business Patterns information.

The base year for Minnesota's system is 1982. Once the data base is inserted for that base year, the interaction of the command program and the various modules of the system simulate variable values for future years.

The Interactive protocol for the model consists of a series of questions asked out of the command program and responded to by the user. Once again, reference is made to the Olson et al work for the details concerning the questions asked by the program and optional responses. Suffice it to say here that the user if allowed to make changes in parameter and resulting variable values within this interactive protocol. When no such changes are made, the user may ask for yearly summaries of the changing variable values through the simulation run. Such a "no change" scenario represents a baseline against which "modified" runs may be compared for impact analyses.

IPASS is a recursive model, i.e., the variable values calculated during any one year of a simulation run serve as inputs to subsequent years. The simulated forecast through time reflects trends and rates of change that serve as the parameter base of the system. Since any of the parameter values may be altered by the user, the program may be used to measure the sensitivity of the system to "What happens if ..." types of questions.

The modules of the system interact with one another in the following manner:

(1) The first module, the investment module, lists the physical capital stock required for seventy-five identified industrial groupings to produce industrial outputs. This module contains the level of capital required per dollar of output as well as the earnings and capital depreciation rates for each of the seventy-five industries. When output capacity is being approached, say when an increase in national and regional outputs are forecast by the system, the earnings and depreciation allowances provide the funds for further investment. Should that further investment be made, the capital stock for the region will increase or decrease accordingly. If the earnings and depreciation allowances are not sufficient to finance such investment, capital appears as a constraint to output expansion, and the potential output levels consistent with final demand are not allowed to take place. In this latter case, output and attending earnings, employment, etc., are reduced in accordance

with the reduction in output that exists due to the capital constraint.

(2) The final demand module includes the final demand components of the input-output system. These components include local investment (out of the investment module), personal consumption expenditures (out of the population and employment modules), inventory changes, government expenditures (currently linked to population, eventually linked to a separate government module), and exports (out of a market component of the final demand module).

A little more detail concerning this most important module is in order:

a. National economic activity and the region's share of that activity appear in the market component of this final demand module. National output levels for the seventy-five identified industrial groupings along with the rates of growth in national output for each of these industries are projected through the year 2000 (based on U.S. Department of Commerce projections). Also contained in this component of the module is the market share of those outputs that is made up by Minnesota exports along with the rate of change in that market share projected to the year 2000. Thus, when the national activity is being projected, the region's output is also predicted based on the region's industrial market shares and the trends that are present in those market shares.

b. Another source of economic activity comes from the federal, state, and local government spending. This spending is currently forecast on the basis of population changes. However, a government module is currently being developed which would provide much more detail on government expenditures and receipts.

c. Yet another source of economic activity in the state comes from household consumption. Household consumption comes out of household income. Household income results from production. Which brings us full circle back to the economic activity forecast out of the other interacting modules. An income component exists in the primary input module that relates earnings to regional economic activity. As that activity is conditionally forecast out of the various modules of the system, income is also forecast and appropriate ratio estimators are applied to the forecasted income to determine the percentage of income earned that is spent in the state. The result is the consumption component of the demand module.

d. The investment component of the model has already been discussed. The outputs from the investment module serve as inputs to the final demand module in a recursive fashion.

(3) The production module relates of these changes in final demand activities (consumption, investment, government, and export) to the industrial structure of the economy. The production module contains the industrial multipliers that are traditional to input-output analysis against which the demand estimators from the other modules are applied.

(4) The output module adjusts outputs that are consistent

with final demand to actual outputs when constraints to production are present. There are three potential such constraints: a constraint out of the water module when there is not enough water to satisfy production requirements (to be discussed later in this chapter), a constraint out of the investment module when the capital stock is not sufficient to meet production requirements, and a constraint out of the employment and labor force modules when there is not enough labor force in certain occupations to meet production requirements. When any of these constraints are operating, the output module calculate actual output as being less than potential output in accordance with the effects from the constraint being felt.

(5) The employment module relates levels of employment, by skill category, to industrial output. So, when industrial output is forecast out of the other modules, levels of employment by occupation are forecast in this module. These resulting estimated levels of employment are compared to the region's labor force. If the labor force is insufficient to meed final demand requirements, labor serves as a constraint to production.

(6) The population module relates births, deaths, and in- or out-migration to an existing population base to forecast population levels for the state. In and out-migration are related to changing levels of employment relative to the labor force discussed previously.

(7) The primary input module utilizes ratio indicators to relate total value added, employee earnings, business income, and

net business income to projected levels of output.

The Water Module

A special purpose module has been developed for the purposes of this project. The water module takes on a form very much like that of the other modules described earlier. Water demand is estimated on the basis of ratios of water use to output on an industry by industry basis. When the output of the region is conditionally forecast in the earlier modules, water use is also forecast on the basis of these water to output ratios. The water use information was provided by the Department of Natural Resources based on water permit information regularly collected in the state.

The estimated water use is compared to water supplies. Water supply is based on estimates compiled by the U.S. Geological Survey. These estimates represent the availability of runoff for both surface and shallow ground water sources under high, average, and low runoff assumptions.

It should be noted that the total runoff does not represent the total supply for direct use in production. A portion of the water supply is held back for a number of legal and practical purposes. For example, a minimum amount of water is required for the preservation of aquatic life. Another amount of water is required for minimal needs for recreation use or for use by transportation. Finally, there are legal limits on the minimum instream flow that needs to be in place for a variety of purposes. These requirements are applied against the total runoff availabilities estimated by the U.S.G.S. to calculate the remaining water available for direct use. As in the investment and labor force modules, if the water supply is inadequate to meet the estimated water demands, water becomes a constraint against production, income, and employment suffer as a result.

Also, like the other modules of the system, there are a number of parameters in the water module that are capable of being changed by the user to ask what happens if types of questions. Fore example, the amount of water held out of production represents a changeable parameter which has a direct effect on the water constraint component of the system. The amount of water needed by each industry per dollar of output is also a changeable parameter. This latter parameter might allow the analysis of the effects of conservation during low flow periods, for example.

There is also the possibility for allocating water supplies to each of the identified industries. Such allocation of water supplies would be especially important for simulations under conditions of water shortages. The user will be able to simulate the effects on Minnesota's economy when water is allocated to manufacturing vs. agriculture, for example.

Such allocations lead to one other important aspect of this portion of the total research program. There are many possible schemes for allocating resources whose supplies are limited. There is the market allocation system which essentially allocates these resources to those segments of the economy most able willing and able to pay for that particular resource.

Allocations outside of the market (where water often appears) can be made according to all kinds of objectives. The IPASS model would be best able to analyze allocations based on such objectives as maximizing income, maximizing employment, maximizing state output, maximizing population size, etc. Each of these allocations would probably be different depending on the size of the water supply deficiency.

The combinations of possibilities are almost endless in this regard. The strength of the simulation approach to such analyses is the flexibility that such a system provides. The system is neutral with respect to the various objectives that are capable of being analyzed. Rather, the system allows the user to insert his/her own objectives and analyze the implications from those objectives. Such implications may then be compared against other objectives to simulate the impacts from differing objectives as well as the economic impacts from the imposition of one particular objective.

The next section will provide an example of such simulation exercises along with a set of the tables that come out of the water module.

AN EXAMPLE

Table 2 presents the primary summary table for the IPASS water module. This table presents basic information concerning the water coefficients and multipliers used in the system. The system has seventy-five sectors, but only the first forty are

TABLE 2. WATER RESOURCE INDICATORS OF SPECIFIED SECTORS
MINNESOTA , 1982.

SECTOR NO.	SECTOR NAME	DIRECT WATER COEFFICIENT GROUND	DIRECT WATER COEFFICIENT SURFACE	WATER MULTIPLIER GROUND	WATER MULTIPLIER SURFACE	WATER REQUIRED PER THOUSAND OF FINAL DEMAND GROUND	WATER REQUIRED PER THOUSAND OF FINAL DEMAND SURFACE
		(ACRE-FEET/THOU-OUTPUT)		(ACRE-FEET/ACRE-FEET)		(ACRE-FEET/THOU-FD)	
1	DAIRY & PO	.00	.00	752.81	.00	.05	.05
2	MEAT ANIMA	.00	.00	28.79	28.79	.05	.05
3	FOOD & FEE	.10	.10	1.16	1.16	.12	.12
4	OTHER CROP	.00	.00	21.43	21.43	.01	.01
5	FORESTRY,	.04	.04	1.08	1.08	.05	.05
6	AGRICULTUR	.13	.13	1.04	1.04	.13	.13
7	IRON & FER	.83	.83	1.04	1.04	.87	.87
8	NONFERROUS	.44	.44	1.01	1.01	.44	.44
9	COAL & PEA	.00	.00	.00	.00	.00	.00
10	OIL & GAS	.00	.00	.00	.00	.00	.00
11	STONE & CL	1.00	1.00	1.01	1.01	1.01	1.01
12	OTHER MINI	.00	.00	.00	.00	.00	.00
13	NEW CONSTR	.00	.00	184.37	184.37	.03	.03
14	MAINTANANC	.00	.00	201.35	201.35	.02	.02
15	ORDNANCE	.01	.01	1.24	1.24	.01	.01
16	MEAT PRODU	.00	.00	17.00	17.00	.04	.04
17	DAIRY PROD	.01	.01	4.67	4.67	.05	.05
18	CANNED & F	.01	.01	2.74	2.74	.03	.03
19	GRAIN MAIL	.04	.04	1.96	1.96	.07	.07
20	BAKERY PRO	.01	.01	1.92	1.92	.02	.02
21	BEVERAGES	.03	.03	1.55	1.55	.05	.05
22	MISCELLANE	.03	.03	1.39	1.39	.04	.04
23	TEXTILE MI	.02	.02	1.47	1.47	.04	.04
24	KNITTING &	.00	.00	23.59	23.59	.01	.01
25	LOGGING	.00	.00	5.77	5.77	.00	.00
26	SAWMILLS	.00	.00	4.96	4.96	.01	.01
27	OTHER WOOD	.01	.01	2.23	2.23	.02	.02
28	FURNITURE	.01	.01	2.23	2.23	.01	.01
29	PULP & PAP	.05	.05	1.65	1.65	.08	.08
30	PAPERBOARD	.01	.01	2.59	2.59	.04	.04
31	PRINTING &	.02	.02	1.68	1.68	.03	.03
32	CHEMICAL &	.02	.02	1.88	1.88	.03	.03
33	PETROLEUM	.00	.00	4.05	4.05	.02	.02
34	RUBBER PRO	.02	.02	1.95	1.95	.03	.03
35	LEATHER PR	.02	.02	1.20	1.20	.03	.03
36	STONE, CLA	.01	.01	2.67	2.67	.03	.03
37	PRIMARY FE	.46	.46	1.58	1.58	.73	.73
38	IRON & STE	.04	.04	1.75	1.75	.08	.08
39	PRIMARY CO	.11	.11	1.10	1.10	.12	.12
40	OTHER PRIM	.01	.01	2.59	2.59	.03	.03

presented in Table 2 for demonstration purposes.

Table 3 is a summary table related to Table 2. The user has the option to call this table for all years in the simulation to follow aggregate changes in water requirements and availabilities.

Table 4 lists the parameter modification options available to the user. As already mentioned, the program is user interactive. The program asks the user if he/she would like to make modifications. If the user responds in the affirmative, the program responds with questions such as those shown on Table 4.

As can be seen, the use has the option of modifying the water multiplier for ground and surface water, the percentage of total ground and surface water available to the sectors, the percentage of total output produced depending on ground water, the drought index (currently not operative), the total water available, and the total water held out of production for both ground and surface water.

All parameters have values in them that represent the research team's best initial guess as to their levels. The user is always free to make any changes he/she feels to be appropriate for simulation exercises.

Table 5 is a special table that the user may access. The first column (labled X) of Table 5 represents the actual gross output produced by the economy. The second column (XD) shows the level of gross output that would be required to satisfy final demand. The third column (XW) is a list of the potential gross

TABLE 3.

SUMMARY TABLE OF GENERAL WATER RESOURCE INDICATORS, MINNESOTA 1982-1983.

	WATER REQUIRED FOR TOTAL PRODUCTION		WATER AVAILABLE TOTAL		WATER REQUIRED FOR PRODUCTION TO FINAL DEMAND	
	GROUND	SURFACE	GROUND	SURFACE	GROUND	SURFACE
			(IN ACRE-FEET/1000)			
1982	429.24	1962.98	790.79	7062.60	271.97	1827.14

DO YOU WANT TO MODIFY THE 1983 SIMULATION?
[YES OR NO]

TABLE 4.

```
HOW DO YOU WANT TO MODIFY
 121   DIRECT WATER MULTIPLIER (GROUND-SURFACE WATER)
?


HOW DO YOU WANT TO MODIFY
 122   PERCENTAGE OF THE TOTAL GROUND AND SURFACE
          AVAILABLE BY SECTOR
          NOTE: THESE PERCENTAGES MUST ADD TO 1 ACROSS ROWS
?
 0

HOW DO YOU WANT TO MODIFY
 123   PERCENTAGE TOTAL OUTPUT PRODUCED
          USING GROUND WATER
?
 0

HOW DO YOU WANT TO MODIFY
 124   DROUGHT INDEX EFFECT (GROUND&SURFACE)
?
 0

HOW DO YOU WANT TO MODIFY
 125   TOTAL WATER AVAILABLE (GROUND&SURFACE)

HISTORICAL DATA FOR SUPERFICIAL WATER (SURFACE&SHALLOW GROUND WATER)
    ANNUAL MEDIAN 25 PERCENT EXCEEDENCE -- 31.43 MILLION ACRE-FEET
    ANNUAL MEDIAN 75 PERCENT EXCEEDENCE -- 15.51 MILLION ACRE-FEET
    ANNUAL MEDIAN NORMAL                -- 22.28 MILLION ACRE-FEET

HISTORICAL DATA FOR DEEP GROUND WATER
    ANNUAL MEDIAN 25 PERCENT EXCEEDENCE -- 10.48 MILLION ACRE-FEET
    ANNUAL MEDIAN 75 PERCENT EXCEEDENCE --  5.17 MILLION ACRE-FEET
    ANNUAL MEDIAN NORMAL                -- 11.14 MILLION ACRE-FEET

?
 0

HOW DO YOU WANT TO MODIFY
 126   TOTAL WATER HELD OUT OF PRODUCTION
          GROUND AND SURFACE WATER
?
 0

DO YOU WANT TO MAKE ANY OTHER PARAMETER MODIFICATIONS?
[YES OR NO]
```

TABLE 5.

SEC	X	XD	XW	ADJUTMENT	ADJUSTMENT
1	1287908.	1297191.	169630238.	-9282.	168333047.
2	1935563.	1947475.	55594900.	-11912.	53647425.
3	1037383.	1685329.	1038115.	-647947.	-647214.
4	1940143.	1959039.	241755498.	-18896.	239796460.
5	8711.	8757.	2491564.	-46.	2482807.
6	231788.	239144.	824220.	-7356.	585076.
7	127940.	139017.	128069.	-11077.	-10948.
8	9247.	9343.	243700.	-95.	234357.
9	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.
11	66294.	68050.	106208.	-1756.	38158.
12	0.	0.	0.	0.	0.
13	7955990.	7955990.	702852078.	0.	694896088.
14	2312876.	2377977.	930970735.	-65101.	928592758.
15	357595.	358531.	10069323.	-936.	9710792.
16	3725145.	3727102.	46939701.	-1957.	43212599.
17	1304958.	1307255.	9916900.	-2297.	8609645.
18	938968.	940036.	11296505.	-1068.	10356469.
19	863567.	868032.	2835217.	-4465.	1967185.
20	125969.	126178.	8630614.	-209.	8504437.
21	360221.	361301.	3344278.	-1080.	2982977.
22	1322530.	1325101.	3656148.	-2571.	2331047.
23	89216.	91678.	4363925.	-2462.	4272248.
24	131424.	131459.	335856531.	-34.	335725072.
25	106200.	107248.	178071584.	-1048.	177964335.
26	55472.	55845.	74845320.	-372.	74789475.
27	272187.	273023.	12559842.	-836.	12286819.
28	318598.	318808.	18095595.	-210.	17776787.
29	2107724.	2132666.	2109115.	-24942.	-23551.
30	284987.	287025.	7262757.	-2038.	6975732.
31	1882688.	1902552.	6155357.	-19864.	4252805.
32	831577.	870345.	6552489.	-38768.	5682144.
33	2798022.	2897309.	26367867.	-99287.	23470558.
34	793646.	800666.	6918557.	-7020.	6117891.
35	34022.	34092.	4322513.	-70.	4288421.
36	495490.	498631.	10805403.	-3141.	10306772.
37	172089.	173402.	230663.	-1313.	57262.
38	199102.	199998.	2378971.	-896.	2178973.
39	63151.	63726.	969274.	-575.	905548.
40	253482.	255497.	10719186.	-2015.	10463689.
41	1345584.	1355798.	2537979.	-10214.	1182181.
42	1306702.	1307381.	7846419.	-679.	6539038.
43	308288.	313648.	134683584.	-5360.	134369936.
44	2290291.	2302891.	41899196.	-12600.	39596305.
45	3438454.	3440516.	74634785.	-2061.	71194269.
46	480829.	482367.	162777092.	-1538.	162294725.
47	2317306.	2333375.	15468687.	-16070.	13135312.
48	2620411.	2620646.	98910218.	-235.	96289572.
49	608769.	611966.	19434291.	-3197.	18822325.
50	557467.	559979.	6906401.	-2512.	6346422.
51	394357.	396823.	34683223.	-2466.	34286401.
52	385576.	388578.	22105950.	-3002.	21717371.
53	597037.	646388.	212261328.	-49351.	211614940.
54	205494.	207429.	118449402.	-1936.	118241972.
55	1115235.	1129620.	68559860.	-14386.	67430240.

output given the amount of water allocated as supply for that particular industry. The fourth column is the difference between column two and column one. The fifth column is the difference between column three and column one.

The final column (Adjustment) is the most important. A negative entry in that column shows a water constraint to be present in the system. Since output is adjusted downward when such a constraint holds, attending variables such as employment, income, and population will show the effects during a simulation.

The initial program will be designed in such a way that there will be no water constraints operating (contrary to the few negatives showing up in Table 5 at the present time). Such a "no constraint" case is consistent with Minnesota's current position. The user may activate the constraints by building a scenario using the parameter modifications listed in Table 3 for any once sector or for the list of sectors as a whole.

These tables, along with several relating directly to the modules listed earlier in this paper, may be accessed by the user to create baseline and modified runs under various assumptions. The differences between these two types of runs represent impacts from assumed parameter changes. Such analysis permits to user to ask and answer, "What happens if ..." types of questions and to investigate the region's sensitivity to such assumed changes.

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