ARCHIVING OF SOURCE CODE FOR THE FINITE-DIFFERENCE FLOW MODEL AND THE POST-PROCESSORS AND INPUT AND OUTPUT FILES FOR THE COLUMBIA PLATEAU REGIONAL AQUIFER SYSTEM, WASHINGTON, OREGON, AND IDAHO

By A. J. Hansen, Jr.

A Contribution of the
Regional Aquifer-System
Analysis Program

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CONTENTS

ILLUSTRATION

TABLE

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ABSTRACT

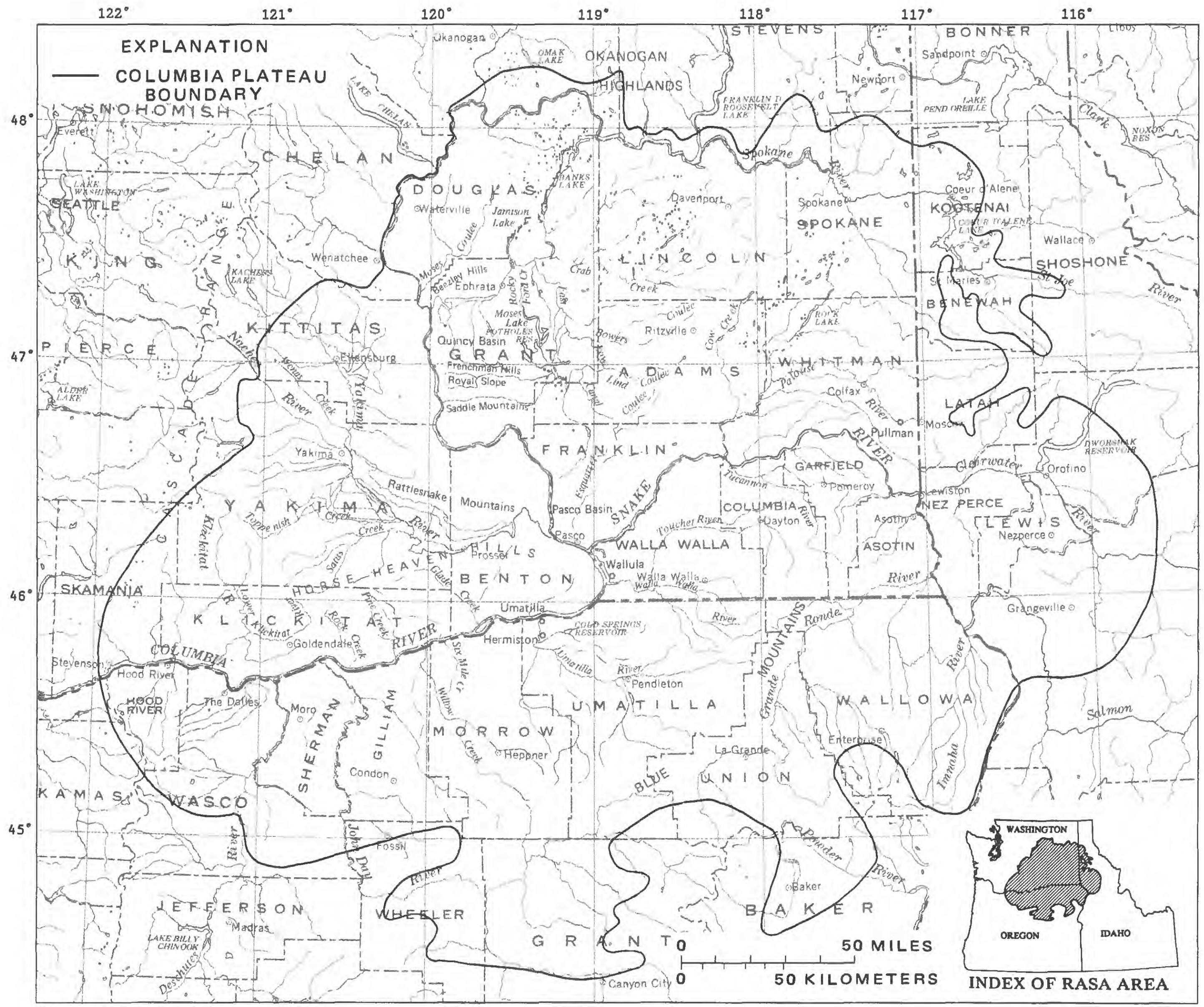
The report documents the archiving of computer files used in the modified modular finite-difference flow model and post-processor programs for the Columbia Plateau regional aquifer system in parts of Washington, Oregon, and Idaho. The files are obtainable on magnetic tape from the U.S. Geological Survey, WRD, Pacific Northwest District Office, 1201 Pacific Avenue, Suite 600, Tacoma, Washington 98402. There are five files containing source codes of the flow model and post-processors. Input for the flow model is stored in 51 files and grouped into 16 categories, one for each of the packages of the model except its utility package. Model output is in 18 files. The post-processors have four files, two with input control and two with output. Five command-input files compile and load the flow model, run it, and run the post-processors.

INTRODUCTION

A study of the Columbia Plateau regional aquifer system was begun in October 1982 as one of the 28 studies in the U.S. Geological Survey's Regional Aquifer-System Analyses Program (RASA). The Columbia Plateau aquifer system underlies the Columbia Plateau (fig. 1) in central and eastern Washington, north-central and eastern Oregon, and a small part of northwestern Idaho. The aquifer system is composed of the Columbia River Basalt Group, all of the intercalated sediments collectively assigned to the Ellensburg Formation, and the unconsolidated sediments overlying the basalts.

The ground-water flow in part of the aquifer system was simulated by a modified version (A.J. Hansen, U.S. Geological Survey, written commun., 1991) of the U.S. Geological Survey's three-dimensional modular finite-difference ground-water flow model (McDonald and Harbaugh, 1988). The construction, calibration, and results of applying the model to the Columbia Plateau aquifer system are described by Hansen and others (U.S. Geological Survey, written commun., 1991). The model was used to simulate both predevelopment (steady-state) and current (time-averaged, spring 1983 to spring 1985) land-use conditions.

The purpose of this report is to describe the archiving of the computer files containing the source code for the finite-difference flow model, four post-processing programs, and the input and output files for both the flow model and the post-processors. There are 83 files for both the flow model and the post-processors (table 1); these files are stored on magnetic tape at the U.S. Geological Survey's Pacific Northwest District office of the Water-Resources Division, Tacoma, Wash. The next section describes the attributes for the magnetic tape. Copies of the tape can be obtained from the State Office Chief, Water Resources Division, U.S. Geological Survey, 1201 Pacific Avenue, Suite 600, Tacoma, Washington 98402.



Base from U.S. Geological Survey
State base maps, 1:500 000

Figure 1.--Location of Columbia Plateau regional aquifer-system study.

Table 1.--File descriptions

File	Filename~	Description of file
1	HDUTOF.F77	Source to separate formatted heads from unformatted-head-output of modular flow model.
2	LYTP.F77	Source for first post-processor.
3	MMDD.F77	Source for modular flow model.
4	MMPST.F77	Source for second post-processor.
5	PSTSMQ.F77	Source for third post-processor.
6	BAS	Input file for basic package.
7	OUT	Output control for flow model.
8	IBOUND1	Boundary array of layer 1.
9	IBOUND2	Boundary array of layer 2.
10	IBOUND3	Boundary array of layer 3.
11	IBOUND4	Boundary array of layer 4.
12	IBOUND5	Boundary array of layer 5.
13	HNEW1	Starting head of layer 1.
14	HNEW2	Starting head of layer 2.
15	HNEW3	Starting head of layer 3.
16	HNEW4	Starting head of layer 4.
17	HNEW5	Starting head of layer 5.
18	BASPRE	Input file for basic package (pre-development conditions).
19	IBOUNDPRE1	Boundary array of layer 1 (pre-development conditions).
20	IBOUNDPRE2	Boundary array of layer 2 (pre-development conditions).
21	BCF	Input file for block-centered-flow package.
22	HY1	Hydraulic-conductivity array for layer 1.
23	BOT1	Bottom array for layer 1.
24	CV1	Vertical-conductance array for layer 1.
25	HY2	Hydraulic-conductivity array for layer 2.
26	BOT2	Bottom array for layer 2.
27	CV2	Vertical-conductance array for layer 2.
28	TOP2	Top array for layer 2.
29	HY3	Hydraulic-conductivity array for layer 3.
30	BOT3	Bottom array for layer 3.
31	CV3	Vertical-conductance array for layer 3.
32	TOP3	Top array for layer 3.
33	HY4	Hydraulic-conductivity array for layer 4.
34	BOT4	Bottom array for layer 4.
35	CV4	Vertical-conductance array for layer 4.
36	TOP4	Top array for layer 4.
37	HY5	Hydraulic-conductivity array for layer 5.
38	BOT5	Bottom array for layer 5.
39	TOP5	Top array for layer 5.
40	CVPRE2	Vertical-conductance array for layer 2 (pre-development conditions).
41	CVPRE3	Vertical-conductance array for layer 3 (pre-development conditions).
42	WEL	Input file for well package.
43	DRN	Input file for drain package.
44	RIV	Input file for river package.
45	RIVPRE	Input file for river package (pre-development conditions).
46	EVT	Input file for evapotranspiration package.
47	SURF	Land-surface array.
48	BAR	Input file for flow-barrier package.

Table 1.--File descriptions--continued

File	Filename~	Description of file
49	CUT	Input file for canyon-cutter package.
50	GHB	Input file for general-head-boundary package.
51	GHBPRE	Input file for general-head-boundary package (pre-development conditions).
52	RCH	Input file for recharge package.
53	RECH	Recharge array.
54	RECHPRE	Recharge array (pre-development conditions).
55	SIP	Input file for strongly implicit procedure package.
56	SIPPRE	Input file for strongly implicit procedure package (pre-development conditions).
57	HCUR1	Output head of modular flow model, for layer 1.
58	HCUR2	Output head of modular flow model, for layer 2.
59	HCUR3	Output head of modular flow model, for layer 3.
60	HCUR4	Output head of modular flow model, for layer 4.
61	HCUR5	Output head of modular flow model, for layer 5.
62	CCUR	List of cancelled cells.
63	KCUR	Output cell-by-cell flow of modular flow model.
64	MCUR	Output boundary arrays of modular flow model.
65	PCUR	General output of modular flow model.
66	HPRE1	Output head of modular flow model, for layer 1 (pre-development conditions).
67	HPRE2	Output head of modular flow model, for layer 2 (pre-development conditions).
68	HPRE3	Output head of modular flow model, for layer 3 (pre-development conditions).
69	HPRE4	Output head of modular flow model, for layer 4 (pre-development conditions).
70	HPRE5	Output head of modular flow model, for layer 5 (pre-development conditions).
71	CPRE	List of cancelled cells (pre-development conditions).
72	KPRE	Output cell-by-cell flow of modular flow model (pre-development conditions).
73	MPRE	Output boundary arrays of modular flow model (pre-development conditions).
74	PPRE	General output of modular flow model (pre-development conditions).
75	XBD	Basins: hydrologic-budget summation by a post-processor.
76	XHDUF	Heads: format & other parameters for a post-processor.
77	YBDCUR	Hydrologic budget of specified basins.
78	YBDPRE	Hydrologic budget of specified basins (pre-development conditions).
79	CUR.COMI	Command-input file to run modular flow model.
80	HDUF.COMI	Command-input file to separate formatted heads from unformatted-head-output of modular flow model.
81	MMDD.COMI	Command-input file to compile and load modular flow model.
82	POST.COMI	Command-input file to calculate flow between layers.
83	PRE.COMI	Command-input file to run modular flow model (pre-development conditions).

~ Filename used during study, some of which are referenced in command-input files (numbers 79-83).

MAGNETIC TAPE ATTRIBUTES

The attributes of the magnetic tape, archiving the files herein described, are:

Tracks : 9 (odd parity)

Density : 1600 bits per inch

Labels : None

Character Code : ASCII, high-order bit set to a 1

Fixed record length (bytes)	Block Size	Files
17	425	46, 81
30	750	80
40	1,000	7, 76
50	1,250	42, 48, 49, 79, 82, 83
60	1,500	55, 56
72	1,800	1-5
76	1,900	8-12, 19, 20, 62, 71
80	2,000	43-45, 50, 51
81	2,025	63, 72
110	2,750	6, 18
120	3,000	13-17, 22-41, 47, 53, 54, 57-61, 64, 66-70, 73
123	3,075	75, 77, 78
130	3,250	21, 52
132	3,300	65, 74

SOURCE CODE FILES

The FORTRAN 77 source code for the modified modular finite-difference flow model and the four post-processor programs is stored on magnetic tape as ASCII files; file 3 is the source for the flow model and files 1, 2, 4, and 5 are for the post-processor programs. The flow-model file consists of the MAIN program and subroutines; the post-processors are small programs. The program in file 1 separates formatted heads from the unformatted-head-output of the flow model. The program in file 2 writes the layer number of the top active layer in each vertical column. The program in file 4 writes the layer-by-layer hydrologic budget. The program in file 5 writes the hydrologic budget for specified basins within the modeled area.

FLOW-MODEL INPUT FILES

The input needed by the modular flow model is stored in 51 magnetic tape files, grouped into 16 categories, one for each package (except the utility package) of the model. These categories and pertinent information for each are described in the following subsections. The formats of the model are stated by A.J. Hansen (U.S. Geological Survey, written commun., 1991). Most of the input presented is applicable for both the predevelopment (steady-state) and current (time-averaged) conditions. The input files for the current conditions are presented first; the few files that must be substituted in them for predevelopment conditions are described at the end of each category.

Basic Package

Files 6 through 17 are the input to the basic package; files 6 and 7 have the parameters, files 8 through 12 are the boundary arrays, and files 13 through 17 are the starting heads. For predevelopment conditions, file 18 (the parameters) is to be substituted for file 6, and files 19 and 20 (the boundary arrays for layers 1 and 2) are to be substituted for files 8 and 9.

Block-Centered-Flow Package

Files 21 through 39 are the input to the block-centered-flow package. File 21 has the parameters. Files 22 through 24 are the arrays for model layer 1: hydraulic conductivity, bottom, and vertical conductance. Files 25 through 36 are the arrays for layers 2 through 4: hydraulic conductivity, bottom, vertical conductance, and top (files 25 through 28 are for layer 2, files 29 through 32 for layer 3, and files 33 through 36 for layer 4). Files 37 through 39 are for layer 5: hydraulic conductivity, bottom, and top. Files 40 and 41 (the vertical conductance arrays for layers 2 and 3, for predevelopment conditions) are to be substituted for files 27 and 31.

Addressed-Stress Packages

The addressed-stress packages are the well, drain, river, and general-head-boundary packages (where the address of each stress is read). File 42 has the input for the well package, file 43 for the drain package, file 44 for the river package, and file 50 for the general-head-boundary package. For predevelopment conditions, file 45 has the input for the river package and file 51 for the general-head-boundary package.

Distributed-Stress Packages

The distributed-stress packages are the recharge and evapotranspiration packages (where the stress is distributed over the upper surface of the system). File 52 has the parameters for the recharge package; file 53 is the recharge-rate array. File 54 is the recharge-rate array for predevelopment conditions. File 46 is an empty file to indicate that the evapotranspiration package is available for use (this package was not used in this regional model); should it be used, file 47 holds the land-surface array.

Cell-Wall Packages

The cell-wall packages are the flow-barrier and canyon-cutter modifications (A.J. Hansen, U.S. Geological Survey, written commun., 1990). These packages operate on the branch conductance of specific cell walls. File 48 has the input for the flow-barrier package; file 49 for the canyon-cutter package.

Solver Package

The solver package is the strongly implicit procedure package. File 55 has the input for the strongly implicit procedure. For predevelopment conditions, file 56 is to be substituted for file 55.

FLOW-MODEL OUTPUT FILES

Files 57 through 65 are the output of the modular flow model; files 57-61 have the output heads; file 62 lists the cancelled cells; file 63, the cell-by-cell flow; file 64, the boundary arrays (set to zero at cancelled cells); and file 65, the general output. Files 66 through 74 are similar (but for predevelopment conditions); these files replace files 57 through 65, respectively.

COMMAND-INPUT FILES

The command-input files are numbers 79 through 83; these are for the U.S. Geological Survey Prime minicomputer using the Primos operating system. File 81 compiles and loads the flow-model source as a segment directory; file 79 runs the model (file 83 is for predevelopment conditions); files 80 and 82 run the post-processors.

REFERENCES

Hansen, A.J., Jr., 1993, Modifications to the modular three-dimensional finite-difference ground-water-flow model used for the Columbia Plateau regional aquifer-system analysis, Washington, Oregon, and Idaho: U.S. Geological Survey Water-Resources Investigations Report 91-532, 162 p.

Hansen, A.J., Jr., Vaccaro, J.J., and Bauer, H.H., 1993, Ground-water flow simulation of the Columbia Plateau regional aquifer system, Washington, Oregon, and Idaho: U.S. Geological Survey Water-Resources Investigations Report 91-4187, 15 plates, 101 p.

McDonald, M.G., and Harbaugh, A. W., 1988, A modular three-dimensional finite-difference ground-water-flow model: U.S. Geological Survey Techniques of Water Resources Investigations, Book 6, Chapter A1, 14 chapters.

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