

SOFTWARE RELEASE NOTICE

01. SRN Number: PA-SRN-155		
02. Project Title: Revision to ERA & NRC Rule Technical Assistance		Project No. 20-5708-771
03. SRN Title: GFLOW Version 1.1		
04. Originator/Requestor: Randy Fedors		Date: 8/5/97
05. Summary of Actions		
<input checked="" type="checkbox"/> Release of new software <input type="checkbox"/> Release of modified software: <input type="checkbox"/> Enhancements made <input type="checkbox"/> Corrections made <input type="checkbox"/> Change of access software <input checked="" type="checkbox"/> Software Retirement		
<i>AW 12/5/2009</i>		
06. Persons Authorized Access		
Name	RO/RW	A/C/D
Randy Fedors	RO	A
Amit Armstrong	RO	A
Gordon Wittmeyer	RO	A
Jim Winterle	RO	A
Bob Baca	RO	A
07. Element Manager Approval: <i>Bob Baca</i>		Date: <i>8/5/97</i>
08. Remarks:		

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SOFTWARE SUMMARY FORM

01. Summary Date: 08/05/97		02. Summary prepared by (Name and phone) Randy Fedors (210) 522-6818		03. Summary Action: New	
04. Software Date: 06/16/97		05. Short Title: GFLOW			
06. Software Title: GFLOW, Version 1.1; Basic Version				07. Internal Software ID:	
08. Software Type: <input type="checkbox"/> Automated Data System <input checked="" type="checkbox"/> Computer Program <input type="checkbox"/> Subroutine/Module		09. Processing Mode: <input checked="" type="checkbox"/> Interactive <input type="checkbox"/> Batch <input type="checkbox"/> Combination		10. APPLICATION AREA a. General: <input checked="" type="checkbox"/> Scientific/Engineering <input type="checkbox"/> Auxiliary Analyses <input type="checkbox"/> Total System PA <input type="checkbox"/> Subsystem PA <input type="checkbox"/> Other b. Specific:	
11. Submitting Organization and Address: CNWRA/SwRI 6220 Culebra Road San Antonio, TX 78228			12. Technical Contact(s) and Phone: Henk Kaitjema (812) 336-2464 Haitjema Software, Inc. 2738 Brig's Bend Wilmington, Indiana 47401		
13. Narrative: Two- and three-dimensional groundwater flow modeling and particle tracing software based on the analytic element method.					
14. Computer Platform IBM Compatible		15. Computer Operating System: Windows 3.1		16. Programming Language(s): N/A	
17. Number of Source Program Statements: N/A		18. Computer Memory Requirements: 4 MB		19. Tape Drives: N/A	
20. Disk/Drum Units: 2 MB Hard disk		21. Graphics: DOS			
22. Other Operational Requirements: Mouse driver and ansi.sys must be loaded under DOS window (full screen)					
23. Software Availability: <input checked="" type="checkbox"/> Available <input type="checkbox"/> Limited <input type="checkbox"/> In-House ONLY			24. Documentation Availability: <input checked="" type="checkbox"/> Available <input type="checkbox"/> Inadequate <input type="checkbox"/> In-House ONLY		
Software Custodian: <i>Dunn Malin</i>			Date: <i>8/5/97</i>		

# CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

## SOFTWARE CONTROL CHECKLIST

Name of Software: GFLOW  
Primary User: Randy Fedors

Version: 1.1

- SOFTWARE REQUIREMENTS DESCRIPTION  
Documentation
- DESIGN AND DEVELOPMENT  
Documentation (Scientific Notebook)
- DESIGN VERIFICATION  
Computer runs uniquely identified   
Software analysis tools have been applied and discrepancies resolved   
Design Verification Report
- INSTALLATION TESTING   
Installation test documentation   
Discrepancy resolution
- CONFIGURATION CONTROL   
Software Summary Form   
User's Manual   
Technical Description ON DISKETTE   
Source Code   
Version Control   
Software Release Notice
- SOFTWARE PROBLEM REPORTING AND RESOLUTION   
Software Problem and Change Request
- SOFTWARE VALIDATION   
Software Validation Test Plan   
Software Validation Test Report   
Software Validation Review
- SOFTWARE RETIREMENT   
Software Release Notice

TO Mail List:#DIRS-MGRS  
To: Larry McKague at CNWRA  
To: English Percy at CNWRA  
To: Randall Fedors at CNWRA-SUN  
To: Amit Armstrong at CNWRA-SUN  
To: Gordon Wittmeyer at CNWRA-SUN  
To: Jim Winterle at CNWRA-SUN  
CC: Linda Hearon  
CC: RBrient@swri.edu at Internet  
BCC: Bruce Mabrito  
From: Bruce Mabrito  
Subject: Control of Software - GFLOW Version 1.1  
08-05-97 08:16 PM

The following scientific and engineering code has been put under control in the CNWRA QA Records Room: GFLOW Version 1.1 ("Basic Version").

This code was acquired by the CNWRA as an executable only; installation testing has been performed and adequately documented in a scientific notebook and those pages have been copied and are in the GFLOW Version 1.1 QA Folder; there is a technical description provided in the book "Analytic Element Modeling of Groundwater Flow" in the CNWRA Library (and a copy of the first chapter is included in the GFLOW folder); a GFLOW user's manual is provided in diskette form (also included in the GFLOW folder); the Software Release Notice has been signed by Bob Baca; and the electronic copy of the GFLOW Version 1.1 software is in the GFLOW folder in the QA Records Room. A copy of this email message will be printed and filed in the GFLOW folder.

GFLOW is described as a "two- and three-dimensional groundwater flow modeling and particle tracing software based on the analytic element method." Appreciation to Randy Fedors for his work to put this S&E software under CNWRA control. Bruce Mabrito

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GFLOW analytic element model from Henk Haitjema

documentation includes:

(1) postscript file sent with disks & tutorial  
 chapters 1-7, appendix B, C

(2) book  $\Rightarrow$  Analytic Element Modeling of Groundwater Flow  
 Henk Haitjema (1995)  
 Academic Press, New York  
 ISBN 0-12-316550-4  
 purchased for CNWRA library

The story of the diskettes:

An educational version comes with the book. However,  
 Henk Haitjema sent me the "basic" version 1.10

(Henk Haitjema (Indiana University))  
 Haitjema Software (812) 336-2464  
 2738 Briggs Rd  
 Bloomington IN 47401

The educational version has some of the capabilities turned off.

Installation testing

To install this windows 3.x executable on "c" drive in directory "GFlow":

(1) add following lines to autoexec.bat

c:\path...\mouse.com

set GFLOW = c:\GFLOW

set PATH = %\* ; c:\GFLOW

(2) add to config.sys

DEVICE = c:\ANSI.SYS

(assuming ansi.sys is in root directory)

(3) Use install.exe which comes with package (on diskettes)

For the IBM's running OS/2, just make sure that the mouse  
 and the ansi.sys are installed for DOS overlay so that this  
 program will run in a full DOS window.

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It is anticipated that most of the simulations will be done on the IBM running a DOS overlay on OS/2 (machine is PS/2 95). This machine has the 32 bit extensions installed.

The installation test will be done using data extracted from a solution file (demo.sol) which comes with the package and a solution created on my installed program version using the input file "demo.dat". This is a complicated groundwater problem which includes many of GFLOW's capabilities (43 line sinks without resistance, 19 line sinks with resistance, and 16 line doublets for inhomogeneities). The domain coverage for the plot is:

$$\begin{aligned} x_1 &= -21522. \\ y_1 &= -34509. \\ x_2 &= 71832. \\ y_2 &= 73526. \end{aligned}$$

The plot of solutions appear to be identical; Using the "sol 5" command to create a solution, the same max error 0.4416% for line sinks w/ resistance results as was stated in demo/tutorial text.

Direct comparison between my solution & Henk's (distributed) solution for location  $x=0, y=0$  (middle of lower left quadrant)

	$x$	$y$	$z$		Henk's	My Solution
head	0	0	-	$\Rightarrow$	275.1672	275.2815
potential	0	0	-	$\Rightarrow$	56501.03	56685.03
discharge	0	0	-		$Q_x = 5.333770$	5.383546
					$Q_y = 0.3924446$	0.4011707
specific discharge	0	0	-		$q_x = 0.7095877E-1$	0.7150465E-1
					$q_y = 0.5220957E-2$	0.5328378E-2
					$q_z = 0.125312E-2$	-0.1257065E-2
velocity	0	0	-		$V_x = 0.3547938$	0.3575293
					$V_y = 0.2610478E-1$	0.2664189
					$V_z = -0.626560E-2$	-0.6285327E-2

2 locations automatically taken as water table; note that there is a slight difference in heads at location (0,0). The differences in the results are probably due to the 32 bit extension (prior to pentiums, IBM-compatibles ran a 16 bit operating system & hardware). The differences are not considered significant.

Information on Pages 7 through 15 contains Analytic Element Modeling of Groundwater Flow copyright information and is therefore not included in this file.