MICROFICHE ETABLIE A PARTIR DE L'UNITE DOCUMENTAIRE N جديدة منجزة حسب الوثيقة رقم:

93

0 2 6

ROYAUME DU MAROC

المملكة المغربية

CENTRE ZATIONAL DE DOCUMENTATION

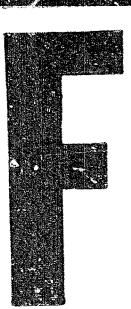
SERVICE DE REPROGRAPHIE ET IMPRIMERIE

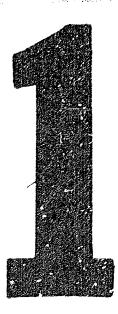
B-P 826

RABAT



مصلحة الطباعة والتصوير ص. ب 828 الرباط





33-0-15

GROUND-WATER FLOW AND TRANSPORT MODELING FOR BASELINE RISK ASSESSMENT IN FRACTURED MEDIA AT ARID AREA

Eddebbarh. A.A., Groundwater Resources CH2M HILL

Introduction. A ground-water flow and transport modeling was used as a tool to assist in estimating concentrations of contaminants at various receptors in the future. The modeling consists of a numerical ground-water flow model used in conjunction with a numerical solute transport model. The flow model utilized is the modular three-dimensional finite-difference (MODFLOW) ground-water flow model developed by Michael McDonald and Arlen Harbaugh (USGS, 1988). The model is publicly available, well documented, and extensively used. The transport modeling was performed using the Modular Three-Dimensional Transport (MT3D) model (Zheng, 1990). The computer code uses a modular three-dimensional structure similar to that implemented in MODFLOW. The modular structure makes it possible to simulate advection, dispersion, sink/source mixing, and sorption.

Modeling Objectives. The major objective of the modeling effort was to estimate the relative concentrations of contaminants at different receptors over time for several future exposure scenarios. The scenarios include domestic and industrial wells. In addition, the models were tested to identify the sensitivity of the relative concentrations to input parameters.

Numerical modeling was chosen as the appropriate analytical tool for this task because it has the capability to represent multidimensional flow in a heterogeneous system with less conceptual idealization than is required by other analytical techniques.

Model Conceptualization

Regional Hydrogeologic Characteristics. The climate of the modeled area is semiarid. The nean annual precipitation is approximately 14 inches with about 70 percent of the precipitation occurring between April and November. Mean monthly temperatures range from approximately 70°F in July and August to

93.4.1 03-92/5

32°F in December and January. Mean annual pan evaporation is estimated to be 55 inches.

The modeled area is located within the Denver Basin. This basin is a north-south trending structural depression extending from Wyoming into southern Colorado. As much as 15,000 feet of Wyoming into southern Colorado. As much as 15,000 feet of sediments have been deposited in some parts of the basin. These sediments have been grouped into a number of geologic formations, sediments have been grouped into a number of geologic formations, and of regional importance as aquifers; the Dawson, the Denver, and of regional importance as aquifers; the Dawson, the Denver, and the Arapahoe Formations. The lateral and vertical extents of and the Arapahoe Formations. The lateral and vertical extents of the formations do not transmit water. aquifers because part of the formations do not transmit water. For this modeling effort, seven model layers were identified and cover the extent of the three formations of interest.

Fractures have been identified within the weathered Dawson but appear to be sufficiently interconnected for the ground-water system to function as an equivalent porous medium. Fracture data from both core and borehole geophysical logs were compiled and analyzed. Core logs from 14 ASC boreholes and 26 pre-ASC boreholes were examined and assessed for fracture occurrence, boreholes were examined and assessed for fracture occurrence, boreholes were interpreted for fracture occurrence and orientation.

A three-dimensional ground-water system exists at the site within the seven identified model layers. The principal flow directions are northward and downward.

Model Domain. The extent of the model domain was determined primarily on the basis of the distribution of receptors and the types of ground-water extraction scenarios.

Grid Delineation and Boundary Conditions. Both the MODFLOW and MT3D models were developed as seven-layer models using the same computational grid with 42 rows and 32 columns in the horizontal plane.) describes how the grid was delineated and the boundary conditions used in the steady-state MODFLOW simulations.

Hydraulic Properties. The parameterization of the ground-water flow model required estimation of the transmissivities and vertical leakage. Transmissivity is defined as the product of horizontal hydraulic conductivity and layer thickness. These hydraulic properties were computed based on site characterization data and concepts. This flux was verified by performing mass balances. For each exposure scenario, MODFLOW was run to simulate the pumping stresses in the Dawson, Denver or Arapahoe Aquifers, thus generating the heads used in MT3D.

Moder Calibration. During calibration, model parameters and boundary conditions are adjusted to minimize the difference between computed and observed hydraulic conditions.

Most of the computed heads were within 10 feet of the values measured in the field. The maximum elevation difference, 35 feet, occurred in Layer 1. With the exception of Layers 1, 4, and 5, the results for the other layers appear to be randomly distributed about the correlation line. No overall systematic bias appears to be present. Most of the calibrated hydraulic parameters have been altered only minimally from the original estimates. The most altered parameters are the vertical leakages for Layers 5 and 6. For the overall model, the mass balance discrepancy is less than 0.01 percent.

Calibration of the transport model was not performed because of the difficulties associated with defining the source, the numerous chemicals detected, and the uncertainty related to the transport parameters.

Transport Model MT3D is designed to work directly with MODFLOW. This means only a few additional parameters must be estimated. The additional input parameters used in the MT3D transport model relate to advection, dispersion, sorption, sources, and sinks.

Advection. The input parameters for advection include hydraulic conductivity, thickness, and effective porosity for each layer.

Dispersion. The input parameters for dispersion are the longitudinal dispersivity, the ratio of the horizontal transverse to the longitudinal dispersivity, the ratio of the vertical transverse to the longitudinal dispersivity, and molecular diffusion.

Scrption. Sorption is implemented in MT3D through the use of a retardation factor (R). The input parameters for sorption are the partition coefficient, the bulk density, and the type of sorption isotherm.

Sources and Sinks. The remaining input parameters deal with sources and sinks. Source and sink input parameters include the type of boundary conditions, stresses, and concentrations associated with the source areas.

Initial Conditions. For the transport model it was necessary to specify initial solute concentrations. An initial solute concentration of zero was specified everywhere in the seven layers, simulating the conditions prior to any disposal at the landfill. The source area for the Site is defined as the area where waste pits have been delineated and along Unnamed Creek. Each model cell in the source area received contaminated water at

a rate calculated by the flow model. This contaminated source water was assigned a constant unitless normalized concentration of 1.

The length of time the source would be present and contributing contaminants to the ground water was estimated using a mixing model approach. Assuming a two order of magnitude reduction in contaminant mass, the source duration was estimated to be 200 years.

Sensitivity Analysis. Sensitivity analysis is the process of studying the sensitivity of parameters by systematically changing one parameter while holding other parameters constant. This is done, even if a model is calibrated, because the calibration may not be unique. Sensitivity analysis of the transport model included systematic variation of dispersivity, effective porosity, and retardation parameters.

Summary of Transport Modeling. The predicted arrival times at a receptor and the relative concentrations are based on conservative assumptions. Therefore, actual arrival times are bikely to be higher and relative concentrations lower. Advective transport was simulated using low effective porosities and sorption terms were not considered.

The scenarios with the greatest relative concentrations are the domestic/industrial Scenarios 2 and 3. These scenarios have receptors located closest to the source area in Layers 1 and 2.

The Denver and Arapahoe Aquifers (Layers 6 and 7) are the only aquifers that can sustain municipal pumping. The relative concentrations simulated from municipal wells pumping in these layers and having receptors in these layers were low. Based on a flowpath analysis using MODPATH, contaminants moving purely by advection would reach these aquifers between 700 to 1,100 years. This indicates the relative concentrations simulated at these receptors are due to pure dispersion. The majority of the dispersion is numeric 1. The effects of retardation would increase the travel times even more.

References. McDonald, M.G. and Harbaugh, A. W. A Modular Three-Dimensional Finite-Difference Ground-Water Flow Model. Techniques of Water Resources Investigation of the USGS. U.S. Government Printing Office. Chapter Al, Book 6. 1988.

Zheng. C. A Modular Three-Dimensional Transport Model for Simulation of Advection, Dispersion, and Chemical Reactions of Contaminants in Ground-Water Systems. S. S. Papel pulos and Associates, Inc. October 17, 1990.

agris	<u>)</u>	 001 [
	>	ſ	TEN Property of Number total Modification State of Stat
		006	T / Styles TRN or relation
08 F.	JJ 6		TIVE SHOOTEN de relation CONTRACTOR STATE OF THE STATE OF
IN	IPALE) CATEGOR	CSECON	
	009	A	Utilitier un borderenn pour chaque nivens bibliographique A, M ou C, cerclé en 000, en partant du nivens le plus spécifique (c'est-à une la gauche) et reporter le code correspondant en 009. Pour le nivens bibliographique S, utiliser la section 2 du borderens. Pour les descripteurs
	计编码	NIVEAU	AGROVOC, les termes d'indexation du vocabulaire local et les résumés utiliser les éctions 3 à 5 au verso;
iner (s) Iffication (s)		<u>課。</u> 1000	Eddelswih, A.A.;
Bestivist(e) and	ew(s)	110	
(¢ anlyst skale)		111	
Tribre prioris	100	200	Ground-water flow and transport modeling for baseline risk assessment in fractined media at
Elément MECON	P.,	201	arida: a
Hom		210	Hypotrogoologie des Hilieux Biscortinus consclinate Arrolles
lieu		211	Marrakech (Maroc)
Dete		213	22-25 Qui 1992
Tillee princh	-	230	Modelization do Perontenical Ada transplacted as the south
ginar randir.)			amy la deles solton du lisque deuis ha milien
EM-mi			treclare da me al rac
aise (N°)	and their comme	250	
grobon pre		300 310	
s, secondairre NV/IPC		320	
Lieu		401	
Acers Educ		402	
Dete pubb		403	
Series		500	
unger (1) de le			
36		610	
		S	
Titre de petino ubili atavo n afric	cipal	230	Rev. de la for des Se de Martin herte Sen Calla (Maroz)
1000	odeire odeire	231	
225		320	
date de publica	ukea	403	
Collistica		500	
iores		610	
	W 14 .	1411	Sections 3 à 5 au verso

BORDEREAU D'ENTREE DES DONNEES

# i 8	9 9	/ EN 009 9 / ES 009 9 / FR
	(+- <u> </u> <u> </u>	
	1 3 4 7 6	EAU SOUTERRAINE, BODELE DE SIMULATION CIRCULATION DE L'EAU; ECOLIEMENT DE FLUIDE;
Acadovoc Acadovoc		
	810	
6 006	9	
	6.50	
3 w:	X	ZFR
Langue de riverado en cado	850	
		la modelisation de é occurle. Les du trouperts de l'ence non les rens en pour enjecte plostimer les concentrations des contaminants dans différents
		receptours, et d'identifier lu sencitairée des concentrations relations sur correntres du dunte d'allèment latine
		Control 25 Least
		25 1.1 92 0215 =,

FIN

النهاية

مشاهد

VUES