

MAHMOUD HUSSEIN, Ph.D.

PRINCIPAL GROUNDWATER MODELER / HYDROGEOLOGIST

**EDUCATION**

Ph.D., Hydrogeology, University of Leeds, UK, 2013
 M.Sc., Groundwater, Zagazig University, Egypt, 2007
 B.Sc., Civil Engineering, Zagazig University, Egypt, 2002

SUMMARY

Mahmoud Hussein has over 13 years of consultancy experience and 5 years of research experience in the field of hydrogeology. Mahmoud specializes in the application of groundwater flow and solute transport modelling techniques to assess seepage and associated groundwater impacts from mine waste facilities. Mahmoud also specializes in the application of these modelling techniques to design and predict the performance of proposed mitigation measures (such as drains, extraction and injection wells and cut-off walls). Mahmoud has applied these techniques to a wide range of mining applications, including seepage from tailings impoundments and tailings dams, open pits, underground mine workings and waste storage facilities for mine sites located in Canada, Chile and Australia.

Mahmoud is also experienced in the field of physical hydrogeology and the application of the following techniques used for a wide range of consultancy and research projects for sites located in the UK, Qatar and Egypt:

- Aquifer storage and recovery testing
- Design, implementation, supervision and interpretation of hydrogeological investigations
- Analysis of aquifer and well performance testing
- Time series analysis applied to borehole water levels response to natural and anthropogenic influences

Mahmoud Hussein has written 5 technical papers on groundwater flow & contaminant transport, time series analysis and groundwater vulnerability.

PROFESSIONAL HISTORY

2018-present:	Principal Groundwater Modeler, Robertson GeoConsultants Inc. (Canada)
2016-2018	Senior Hydrogeologist, Robertson GeoConsultants Inc. (Canada)
2013-2016	Hydrogeologist & Groundwater modeler, AMEC Foster Wheeler, Qatar
2009-2012	Marie Curie Research Fellow in Hydrogeology at University of Leeds, UK
2007-2008	Part Time Groundwater Modeler at SD Consultants, Cairo, Egypt
2003-2008	Hydrogeologist at the Research Institute for Groundwater, Cairo, Egypt
2002-2003	Structural Civil Design Engineer at CID Consultants, Cairo, Egypt

PROJECT EXPERIENCE (SELECTED STUDIES)

GROUNDWATER IMPACT & SEEPAGE CONTROL STUDIES

Las Tortolas Mill Site, Chile (2016 – present) for Anglo American Chile (AACH)

- Development and update of site characterization programs (drilling, hydraulic testing and installation of monitoring wells and seepage interception pumping wells) to delineate seepage plumes and/or update SIS systems downstream of the Muro Principal, Muro Oeste, Muro Este and the El Bosque areas.
- Development and calibration of transient groundwater flow and solute transport models to evaluate future groundwater impacts and seepage interception options for the Muro Principal, Muro Este and the El Bosque areas,
- Completed a draindown study to estimate seepage rates from the Las Tortolas Tailings Impoundment to be collected in the seepage interception systems of the different dam reaches for the post-closure period. Basal seepage rates induced by self-weight consolidation and gravity-driven flow were simulated, during filling and post-closure, to predict upper and lower bound seepage rates post-closure

MINE CLOSURE PLANNING

Myra Falls Mine Site, Vancouver Island (2018 & 2020) for Nyrstar

- Updated the conceptual hydrogeological site model for the Myra Valley Aquifer
- 2018: Developed steady-state (SS) numerical groundwater flow and transport models for high flow and low flow conditions, using MODFLOW NWT and MT3D-USGS, to simulate the movement of groundwater and the transport of Zn in the MVA.
- 2020: converted the SS model to a transient flow and transport model to simulate “current conditions” for groundwater in the MVA from 2012 to 2019, including the representation of the site-wide SIS system (the Old TDF under-drains and the Phases I&2 Lynx SIS wells).
- Calibrated the groundwater models (SS in 2018 & transient in 2020) to observed groundwater levels, SIS wells and underdrains pumping rates, Zn concentrations in groundwater, and estimated Zn loads recovered by the system of under-drains beneath the Old Tailings Disposal Facility (TDF).
- Predict Zn loading to Myra Creek, assess and evaluate options to upgrade the current SIS and to assess the performance of mitigation and closure works in progress and/or proposed at Nyrstar Myra Falls
- Predict groundwater flows and Zn loading to Myra Creek under multiple scenarios of SIS shutdown.

Former Bouchard Hebert Mine Site, Quebec (2020) for Breakwater Resources Ltd.

- Developed a conceptual hydrogeological model of the groundwater flow regime near the flooded pit and downgradient of the Industrial Area. A scoping level numerical flow model was constructed to provide a 3D representation of conceptualized hydrostratigraphic units and to calculate the groundwater budget for low flow and high flow conditions

Former Rum Jungle Mine Site, Australia (2019) for NT Dept. of Mines & Energy (Australia)

- Updated and refined the calibration of the transient groundwater flow and transport model (developed by RGC in 2016) for the Rum Jungle Mine site in support of the Environmental Impact Statement (EIS). The numerical model was updated to reflect additional information from the hydrogeological field investigations and additional monitoring data in 2017/2018
- The updated model was developed to simulate groundwater flows and contaminant transport for historic conditions, current conditions and predict future conditions during the construction phase of rehabilitation and conditions once rehabilitation is completed

- The transport model simulates and predicts concentrations of dissolved sulphate and copper in groundwater and loads to the East Branch of the Finnis River (EBFR) and its tributaries.
- Report is publicly available at:
https://ntepa.nt.gov.au/_data/assets/pdf_file/0004/786892/draft_eis_rum_jungle_rehab_project_robertson_geoConsultants_2019_groundwater_surface_water_modelling_1.pdf

MINE PERMITTING, FEASIBILITY & BASELINE STUDIES

Magino Gold Project, Ontario (2016) for Argonaut Gold Inc

- Updated the transient 3D numerical groundwater flow model to predict the effects of proposed open pit mining, operation of a Tailings Management Facility (TMF) and Mine Rock Management Facility (MRMF) on local groundwater and surface water bodies, at different stages of development of open pit excavation, TMF, MRMF and reflooding of the open pit for mine closure

Aquifer Storage and Recovery (ASR) Feasibility Study, Qatar (2013 - 2016)

- Contributed to the design, implementation, supervision and contractor management of a wide range of site investigations including borehole drilling and installations, surface and downhole geophysics, aquifer and well performance pumping and injection testing
- Analyses, interpretation and reporting of step and constant rate discharge tests at ten sites
- In charge of planning, management and coordination of modelling activities and reports
- Developed a transient regional scale groundwater flow model for North of Qatar
- Contributed to the development of three local scale, axisymmetric 2D, transient flow and solute transport models to simulate injection and re-abstraction trials
- Completed the development, calibration and reporting of a 3D transient flow and solute transport model to simulate a long duration ASR pilot test
- Liaison and coordination with Ministries and governmental entities in Qatar to acquire and renew permits required to conduct site activities

Study on the Effect of Faults on Groundwater Flow, UK (2012) for TOTAL Petroleum

- Carried out a hydrogeology feasibility study to evaluate aquifer anisotropy and presence of faults as flow barriers in the UK Sherwood Sandstone Aquifer
- Completed site reconnaissance, data collection, borehole selection and automatic data logger's installation
- Liaised with YorkshireWater to arrange for conducting constant rate and cyclical pumping tests using one of their pumping stations
- Analysis of borehole water levels in response to pumping tests and other natural and anthropogenic effects

Hydrogeologist, Egypt (2003 - 2008) at The Research Institute for Groundwater (RIGW)

- RIGW is an affiliate of the National Water Research Center (NWRC) - Ministry of Water Resources and Irrigation in Egypt
- Contributed to nation-wide projects involving:
 - Field surveys and data collection
 - Monitoring wells design and drilling supervision
 - Implementation and analysis of aquifer testing
 - Groundwater flow and solute transport modelling
 - Designing and construction supervision of dewatering systems for significant archeological sites suffering water logging issues
 - Liaised with clients and contractors and preparation of technical reports and specification notes

Part Time Groundwater Modeler, Egypt (2007 – 2008) at SD Consultants

- Completed data processing, construction, calibration and report writing of regional and local scale groundwater flow models for projects in Egypt and KSA.

STRUCTURAL ENGINEERING**Structural Civil Design Engineer, Egypt (2002 – 2003) at Consultants for Investigation & Design (CID)**

- Structural design and construction supervision of a wide variety of residential towers and governmental buildings.

SELECTED PUBLICATIONS

Hussein M., P. Ferguson, C. Wels and N. Pesonen, 2019. Numerical Modelling of Groundwater Flow and Contaminant Transport at the Myra Falls Mine Site. Proceedings of Tailings and Mine Waste 2019, 755-768. Published by the University of British Columbia.

Ferguson P., M. Hussein, C. Wels and N. Pesonen, 2019. Current Acid Rock Drainage Impacts and Seepage Interception Strategies at the Myra Falls Mine Site. Proceedings of Tailings and Mine Waste 2019, 729-738. Published by the University of British Columbia.

N.E. Odling, R.P. Serrano, M. E.A. Hussein, M. Riva, A. Guadagnini (2014), Detecting the vulnerability of groundwater in semi-confined aquifers using barometric response functions, Journal of Hydrology, doi.org/10.1016/j.jhydrol.2014.11.016.

Hussein, M. E.A., Odling N. E., and Clark R. A. (2013), Borehole water level response to barometric pressure as an indicator of aquifer vulnerability, Water Resources Research, 49, 7102–7119, doi:10.1002/2013WR014134.

Hussein M. E.A., El Arabi, N., Lefebvre, R. and Mowafy, M. (2008), Modeling Potential Environmental Impact of New Settlements on Groundwater Quality, Quessna City, Nile Delta, Egypt. Groundwater and Development, GeoEdmonton, 61th Canadian Geotechnical Conference & 9th Joint CGS/IAH-CNC Groundwater Conference.