Willem A. Schreüder, Ph.D

President and Principal Scientist, Principia Mathematica Inc.

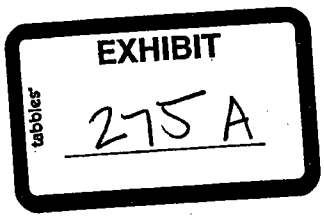
Specialist in Applied Research and Development Activities in Mathematical Modeling and Computational Fluid Dynamics, including Groundwater Modeling.

Expertise: Mathematical Modeling; Advanced Data Analysis; Numerical Analysis; Computational Fluid Dynamics; Ground and Surface Water Hydrology; Contaminant Transport; Turbulence Modeling; Heat and Mass Transport; Software Development for Data Analysis, Mathematical Modeling, Computer Graphics and Geographical Information Systems (GIS); Solution of Differential Equations; Operations Research; Graphical Presentation of Information; Litigation Support and Expert Witness Testimony.

Billing rate: $140/hour

Expert Witness Testimony

1. Rio Grande Silvery Minnow, et al. vs. John W. Keys, III et al. Case No. CIV 99-1320 JP/RLP-ACE
2. Concerning the Application for Water Rights of Park County Sportsmen's Ranch LLP in Park County, Colorado Case No. 96CW014
3. Rules Governing New Withdrawals of Groundwater in Water Division 3 Affecting the Rate or Direction of Movement of Water in the Confined Aquifer, Case No. 04CW024.
4. ECCV Northern Project Case No. 02CW403
5. Republican River Compact Arbitration before Mr. Karl Dreher Pursuant to Section VII, Final Settlement Stipulation (2009)
6. Cherokee Metropolitan District Upper Black Squirrel Creek Designated Basin Alluvial Aquifer Replacement Plan, Case No. 08GW71.
7. Concerning the Office of the State Engineer's Approval of the Plan of Water Management for Special Improvement District No. 1 of the Rio Grande Water Conservation District, Case No. 2007CW52.
8. In the Matter of Rules and Regulations for the Determination of the Nontributary Nature of Ground Water Produces through Wells in Conjunction with the Mining of Minerals, 2 CCR 402-17
9. Colorado Ground Water Commission hearing on amendment of Rule 5.2.5.2 – Closing Hay Gulch subbasin of Lost Creek Designated Groundwater Basin 09-GW-12.



ACADEMIC BACKGROUND

B.Sc (1981), University of Stellenbosch. Physics III, Chemistry III, Mathematics III, Applied Mathematics III and Computer Science III.

Hons. B.Sc (1982), University of Stellenbosch. Applied Mathematics.

M.Sc (cum laude) (1984), University of Stellenbosch. Applied Mathematics.

Ph.D (1986), University of Stellenbosch. Applied Mathematics, Computational Fluid Dynamics.

Visiting Assistant Professor of Mathematical Sciences (1986-1987), Rensselaer Polytechnic Institute.

Assistant Professor of Mathematics (1987-1989), West Virginia University.

MS (1998), University of Colorado at Boulder. Computer Science.

Ph.D (2005), University of Colorado at Boulder. Computer Science, Parallel Systems.

Instructor (2006-2008), University of Colorado at Boulder, Computer Science.

Assistant Professor Adjunct (2008-), University of Colorado at Boulder, Computer Science.

PROFESSIONAL EXPERIENCE

9/2001 - Present: President, Principia Mathematica Inc.
11/1997 – 8/2001: Senior Engineer/Scientist, Principia Mathematica Inc.
Responsible for data analysis and mathematical modeling related to groundwater flow and transport. Projects include:

1. Peer review and development of the Rio Grande Decision Support System (RGDSS) Groundwater Model;
2. Development and maintenance of the Republican River Compact Administration Groundwater Model, resulting from litigation before the U.S. Supreme Court between the States of Colorado, Kansas and Nebraska;
3. Evaluation of the Park County Sportsman's Ranch application which involved groundwater modeling to support an underground storage project;
4. Lockheed-Redlands project which involved basin-scale groundwater fate and transport modeling and data analysis.
5. Peer review and development of the East Snake Plane Hydrologic Model

Responsible for data analysis and mathematical modeling related to surface water. Projects include:

1. Evaluation of the Truckee River Operations Model (TROM) in California and Nevada;
2. Evaluation of the Upper Rio Grande Water Operations Model (URGWOM) as part of the Silvery Minnow litigation.

Responsible for data analysis and mathematical modeling related to atmospheric modeling. Projects include:

1. Evaluation of plume condensation at BASF facility, Port Arthur, TX;
2. Atmospheric dispersion modeling to evaluate the impacts of the Ingram Barge incident, Baton Rouge, LA;
3. Evaluation of hexavalent chromium exposure from cooling towers at the PG&E Kettleman facility.

Responsible for mathematical modeling, model evaluations and data analysis in several projects involving complex soils and ground water contamination. Projects include:

1. Houston Research Tract;
2. Long Beach Terminal.

Responsible for development and maintenance of mathematical model software and software for data

analysis and graphics.

2/1995 – 10/1997: Senior Engineer, Principia Mathematica Division of Terranext.
Responsible for development of advanced methods of site characterization, evaluation of soil and groundwater contamination, design and optimization of remediation options, atmospheric and groundwater modeling and data analysis. Specific issues addressed included interfacing with laboratories, data validation, integration of GIS and GPS technology into the database and field campaigns, interpretation and modeling of free product contamination, and bioremediation.

Responsible for data analysis and modeling in projects related to soil and groundwater contamination. Projects included:
1. Eugene Rail Yard in Eugene, Oregon;
2. Taylor Rail Yard in Los Angeles, California;
3. Los Angeles Transportation Center in Los Angeles, California;
4. Former Northeast Petroleum Terminal in Tiverton, Rhode Island.

Responsible for air quality data analysis and mathematical modeling related to atmospheric transport at several sites. Projects included:
1. Data analysis and modeling of hexavalent chromium releases from the Gas Compressor Station located at Hinkley, California. This project was dramatized in the motion picture *Erin Brockovich*.
2. Data analysis and modeling of formaldehyde and particulate matter releases from the Willamette plant near Gifford, Arkansas
3. Data analysis and mathematical modeling of air quality at an aircraft manufacturing facility located in Burbank, California;
4. Data analysis, modeling and operational analysis of plume condensation at a geothermal power plant in Kakkonda, Japan.

Responsible for development and maintenance of mathematical model software and software for data analysis and graphics.

1/1990 – 2/1995: Project Engineer, Principia Mathematica Inc.
7/1989-12/1989: Staff Engineer, Principia Mathematica Inc.
Responsible for data analysis and mathematical modeling related to groundwater flow and transport. Projects include:
1. Development of a groundwater model of the Lowry Landfill Site. The model included complex three-dimensional flow and transport of ten different compounds, including simultaneous simulation of five reacting compounds.
2. Development of a groundwater model in the Arkansas River Basin resulting from litigation before the U.S. Supreme Court Litigation between Colorado and Kansas.
3. Development of a groundwater model and evaluation of other groundwater models in the San Luis Valley, Colorado for the AWDI litigation, which involved an application for water rights.
4. Evaluation of groundwater flow and transport models in the Honey Lake Valley in California and Nevada as part of an EIS.
5. Development of a groundwater flow and transport model for the Remedial Action Plan at the Anoka Landfill Superfund Site in Minnesota. A Decision Support System (DSS) was developed and successfully defended before State regulatory agencies.
6. Forensic data analyis and modeling of groundwater and water chemistry to evaluate flooding at the IMC Esterhazy Mine.
7. Data analysis, model development and evaluation for a water rights dispute in Nevada.

8. Senior consultant to Waste Management of North America Inc. on data analysis and mathematical modeling. Specific projects included data analysis and model development for at the Cortese Landfill in New York, the WDI Landfill in New Jersey and the Durham Road landfill in California.

Responsible for the development and maintenance of software for mathematical modeling, data analysis and graphics. Specific items include:

1. Enhancement and maintenance of the PM-TARGET series of ground water flow and heat and mass transport model programs for saturated and unsaturated flow flow and transport in one, two and three dimensions;
2. Enhancements to the USGS MODFLOW groundwater flow program;
3. Development and maintenance of the PM-MODTAR program that permits simultaneous multi-compound reactive transport to be simulated;
4. Enhancement and maintenance of PM-DIAMOND, an advanced systems for the analysis of multi-dimensional models and data, and production of device-independent graphics.

Primary responsibility for analysis and evaluations of large volumes of complex precipitation, surface topography, hydrologic and geologic data, and developing new techniques specifically for this purpose.

Presented and led several scientific workshops on advanced data analyses, numerical modeling of ground water flow, contamination transport and remediation using the MODFLOW and PM-TARGET series of programs as well as the complete suite of Principia graphics packages.

8/1987-5/1989: Assistant Professor of Mathematics, West Virginia University.
Teaching undergraduate and graduate courses in Calculus, Differential Equations and Numerical Analysis. Research on the numerical prediction of highly non-linear diffusion processes, and numerical prediction of atmospheric flows. As part of both of the above research projects, fundamental research was conducted on automatic grid refinement in parabolic and elliptic problems.

9/1986-6/1987: Visiting Assistant Professor of Mathematical Sciences, Rensselaer Polytechnic Institute.
Teaching Numerical Analysis. Research in conjunction with Prof. Georges Belfort of Chemical Engineering and Prof. Donald Drew of Mathematical Sciences Department on the numerical prediction of pulsating flow in ultra-filtration membrane systems.

1/1986-7/1986: Scientific Computing Specialist, Bureau of Mechanical Engineering, University of Stellenbosch.
Responsible for development of data acquisition system on towing tank; enhancement of ADINA finite element package, including development of graphical pre- and post-processing packages; development of VT 100/Tektronix 4010 terminal emulation software; supervising operation of VAX minicomputers; development of a routing and scheduling program for a fleet of containerized cargo vehicles; supervising development of software for a 4 axis flight simulator.

1/1985-12/1985: Captain Pilot, Wellington Air Services.
Flying charters in southern Africa. Command pilot on AC 112, PA 28-200R and PA 28-260, co-pilot on BE 54 and BE 58 aircraft.

SELECTED PUBLICATIONS:

Schreüder, W.A. (1984) **Numerical Prediction of Laminar Cross-Stream Jet Flow**. M.Sc. thesis, University of Stellenbosch.

du Plessis, J.P., W.A. Schreüder and M.R. Collins (1985) **Numerical Prediction of Dry Air Flow at Cooling Installations**. Report TW 85-2, Department of Applied Mathematics.

Schreüder, W.A. (1986) **Air Flow About a Directly Air-Cooled Heat Exchanger.** Ph.D. thesis, University of Stellenbosch.

Schreüder, W.A. and Esbeth van Dyk (1988) **Multidimensional Scaling of Qualitative Pair-wise Comparisons.** *Proceedings of 8'th MCDA Conference*, Manchester, pp. 70-77.

J.L. Moseley, H. Yu, W.A. Schreüder and W.Y. Kerr (1989). **Numerical Solutions for Particle Size Distribution in a Fluidized Bed Gasifier.** *Proceedings of the 20'th Conference on modeling*, Pittsburgh.

Schreüder, W.A. and J. Prieur du Plessis (1989). **Simulation of Air Flow About a Directly Air Cooled Heat Exchanger.** *Building and Environment*, **24** 1, pp. 223-235.

Schreüder, W.A. J. Prieur du Plessis and Devraj Sharma (1990). **On the Numerical Treatment of Atmospheric Boundaries.** *Numerical Heat Transfer* **17** 2, pp. 171-196.

Schreüder, W.A. and J. Prieur du Plessis (1990) **On the Numerical Treatment of Interior Boundaries.** *Numerical Heat Transfer* **17** 2, pp. 197-215.

Cole, S.E., D. Sharma and W.A. Schreüder (1994) **A Modern, Refined Application of a Ground Water Flow Model to the Arkansas River basin.** *Proc. 1994 Groundwater Modeling Conference*, Fort Collins, Colorado, August 10-12, pp. 385-393.

Schreüder, W.A. and D. Sharma (1994). **Unsaturated Flows Within layered Materials Used as Liners for landfills and Impoundments -Important Concepts and Predicted Results.** *Proc. 1994 Groundwater Modeling Conference*, Fort Collins, Colorado, August 10-12, pp. 469-477.

Schreüder, W.A., Steven E. Cole and D. Sharma (1996) **Complex Coordinate-System Transformations: Data in South-Central Nevada,** *Proceedings of 6'th Annual Devils Hole Workshop*, Death Valley, California.

Schreüder, W.A. (1997) **On Contouring Surfaces.** Principia Mathematica Technial Note PM-TN-1997-1.

Schreüder, W.A. (1999) **Spatial Interpretation & Analysis of Point Data.** Principia Mathematica Technial Note PM-TN-1999-1.

Schreüder, W.A. and M. Murillo (1999) **rat: A secure archiving program with fast retrieval.** *Proceedings, Large Installation System Administration Conference*, Seattle Washington, November 7-12, pp. 79-86.

Schreüder, W.A. (2001) **Three-Dimensional Spatial Interpretations.** *Engineering Sciences Section, American Academy of Forensic Sciences, Annual Meeting*, Seattle; Washington, February 22-23.

Schreüder, W.A. (2001) **Accessing Files on Unmounted File Systems.** *Proceedings, Large Installation System Administration Conference*, San Diego, CA, December 2-7, pp. 163--167.

Schreüder, W.A. (2002) **Quantitative Uncertainty Analysis.** *Engineering Sciences Section, American Academy of Forensic Sciences, Annual Meeting,* Atlanta, Georgia, February 14-15.

Schreüder, W.A. and Leslie Eng (2003) **Fitting Calibration Data.** *Engineering Sciences Section, American Academy of Forensic Sciences, Annual Meeting*, Chicago, Illinios, February 20-21.

Schreüder, W.A. (2003) **The Five Minute Guide to Perl.** Principia Mathematica Technial Note PM-TN-2003-1.

Schreüder, W.A (2004) **Principal Component Analysis: Mathematics and Voodoo.** *Engineering Sciences Section, American Academy of Forensic Sciences, Annual Meeting*, Dallas, Texas, February 19-20.

Schreüder, W.A. and Jeffrey .W. Short (2005). **A Method to Prioritize Differences between Chromatograms.** *Engineering Sciences Section, American Academy of Forensic Sciences, Annual Meeting*, New Orleans, Louisiana, February 25.

Schreüder, W.A. (2005) **Parallel Numerical Solution of Groundwater Flow Problems.** Ph.D. thesis, University of Colorado, Boulder.

Schreüder, W.A., Walter Goldstein and Tracy Welch (2006) **Presumptive Mathematical Model of Capillary Electrophoresis Processes Involved in STR Analysis Based on Observations at the Biotechnology Center, Shadow Lane Campus, University of Nevada Las Vegas.** *Criminalistics Section, American Academy of Forensic Sciences, Annual Meeting*, Seattle Washington, Feb 20-25, 2006.

Schreüder, W.A. (2006) **Uncertainty Approach to the Johnson and Ettinger Vapor Intrusion Model.** *Proceedings of the National Groundwater Association Ground Water and Environmental Law Conference,* Chicago, Illinois, July 6-7, 2006.

Schreüder, W.A. (2007) **Uncertainty in Plume Delineation.** *Engineering Sciences Section, American Academy of Forensic Sciences, Annual Meeting*, San Antonio, Texas, Feb 22-23, 2007.

Schreüder, W.A. (2007) **Mathematical Principles of Groundwater Modeling.** *Colorado Bar Association Continuing Legal Education*, Denver, Colorado, April 6, 2007.

Crawford, Todd R and W.A. Schreüder (2007) **Models and Uncertainty.** *Proceedings of the National Groundwater Association Ground Water and Environmental Law Conference,* Dublin, Ohio, July 25 2007.

Schreüder, W.A. (2008) **Alternatives to Straight Line Calibration Curves.** *National Ground Water Association Groundwater Summit*, Memphis, Tennessee, March 31, 2008.

Schreüder, W.A. (2009) **Parallel PEST using BeoPEST** *PEST Conference,* Potomac MD, Nov 3, 2009.

Schreüder, W.A. (2010) **Mathematical Principles of Groundwater Modeling.** *Uses and Abuses of Technology in Resolving Disputes American Bar Association 2010 Eastern Water Resources Conference* Orlando, Florida, May 21, 2010.

Goldstein, W.E. and W.A. Schreüder (2010) **Mathematical model of mold propagation and product formation in building materials, inherent transport phenomena and applications.** In *Sick Building and Related Illness: Prevention and Remediation of Mold Contamination.* CRC Press, 240 pp. accepted for publication.

END