ROBERT J. MITCHELL, ASSOCIATE PROFESSOR

Geology Department
516 High Street
Western Washington University
Bellingham, WA 98225-9080

Voice: (360) 650-3591
FAX: (360) 650-7302
robert.mitchell@geol.wwu.edu
http://kula.geol.wwu.edu/rjmitch/

Education

Ph.D., Environmental Engineering, 1996, Michigan Technological University (MTU), Houghton, MI
Topic: Nonideal Flow and Solute Transport in Unsaturated Porous Media: A Modeling Study *(Advisor: Dr. Alex S. Mayer)*

M.S., Physics, 1990 University of Minnesota (UMD), Duluth, MN
Topic: Numerical Solution of the Nonlinear Maxwell Equations: Application to a Quark Confinement Model

M.S., Geophysics, 1986 Michigan Technological University, Houghton, MI
Topic: Paleomagnetism of the Indian Heaven Volcanic Field, Southern Washington

B.S., Geology (Math minor), 1983 University of Wisconsin-River Falls, River Falls, WI
Senior Academic Honors. Geology field course through Indiana University, Bloomington, IN

Experience

Associate Professor: 09/2002 to present, Geology Department, Western Washington University.
My research includes numerical modeling of fluid flow and solute transport in unsaturated ground-water systems, the impact of agricultural practices on ground-water quality, aquifer characterization, and modeling watershed hydrology. I teach environmental geology, engineering geology, surface water hydrology, ground-water hydrology and ground-water contamination. I have been advising graduate theses in both ground and surface-water hydrology topics in the Puget Sound region.

Assistant Professor: 09/1996 to 09/2002, Geology Department, Western Washington University.

Ph.D. Fellow: 09/1991 to 06/1996, Department of Civil and Environmental Engineering, MTU.
I focused on hydrogeology and contaminant fate and transport in ground-water systems. My research involved the development of a 2-D Eulerian-Lagrangian numerical model to investigate the influence of non-ideal flow processes on solute transport in unsaturated heterogeneous porous media. I had graduate courses in mass transfer, waste water and drinking water treatment, and ground-water remediation technologies.

Instructor (full time): 06/1990 to 06/1991, Department of Chemical Engineering, UMD.
I was a full-time instructor for engineering statics, dynamics, and deformable body mechanics, which included lectures and problem recitations. I also performed E.I.T review sessions.

Graduate Teaching Assistant: 09/1988 to 06/1990, Department of Physics, UMD.
I conducted problem recitations and help sessions for engineering statics, dynamics, and deformable body mechanics and graded homework and exams. My research focused on computational physics.

Instuctor (full time): 1987 to 1988. Dept of Physical Sciences, Ferris State Univ., Big Rapids, MI.
I taught physical geology, historical geology, and technical physics (all with weekly labs).

Graduate Teaching Assistant: 09/1984 to 09/1986, Dept of Geological Engr. and Sciences, MTU.
My course work included topics in geophysics and applied mathematics. My thesis involved a paleomagnetic study of Late Tertiary-Quaternary volcanics.

Publications

Mitchell, R. J., R. S. Babcock, S. Gelinas, L. Nanus, D. E. Stasney, Nitrate Distributions and Source Identification in the Abbotsford-Sumas Aquifer, Northwestern Washington, J. Environ. Qual. 32:789-800, 2003.

Mitchell, R. J. and A. S. Mayer, 1999. The Impacts of Source Size and Horizontal Correlation Scale on Solute Transport during Unsaturated Hysteretic Flow, Proceedings: Characterization and Measurement of Hydraulic Properties of Unsaturated Porous Media, Riverside California, edited by M. TH. van Genuchten, F. J. Leij, and L. Wu, Published by University of California, Riverside, CA.

Mitchell, R. J. and A. S. Mayer, 1998. The Significance of Transient and Hysteretic Flow in Modeling Solute Transport in Unsaturated Porous Media, J. Soil Sci. Soc of Amer. Vol. 62, No. 6:1506-1512.

Mitchell, R. J. and A. S. Mayer, 1998. A Numerical Model for Transient-Hysteretic Flow and Solute Transport in Unsaturated Porous Media, Journal of Contaminant Hydrology, Vol. 30, 243-264.

Mayer, A. S., P.P.E. Carriere, M.L. Green, R. J. Mitchell, K. D. Pennel, A. J. Rabideau, K. T. Russel, T. M. Sandman, T. M. Young, 1996. Groundwater Quality, Water Environ. Res. Vol. 68, No. 4.

Mitchell, R. J. and A. S. Mayer, 1994. A Modified Method of Characteristics Technique for Simulating Contaminant Transport in Variably-Saturated Porous Media. Computational Methods in Water Resources X, edited by A. Peters et al., pp. 505-512, Kluwer Academic Publishers, Dordrecht, The Netherlands.

Mayer, A. S., R. J. Mitchell, P.P.E. Carriere, G. L. Hein, A. J. Rabideau, C. L. Wojick, 1995. Groundwater Quality, Water Environment Research, Vol. 67, No. 4, 629-685.

Mayer, A. S., P. T. Imoff, R. J. Mitchell, A. J. Rabideau, J. F. McBride, C. T. Miller, 1994. Groundwater Quality, Water Environment Research, Vol. 66(4), pp. 486-534, 1994.

Mayer, A. S., A. J. Rabideau, R. J. Mitchell, P. T. Imoff, M. I. Lowry, C. T. Miller, 1993. Groundwater Quality, Water Environment Research, Vol. 65, No. 4, pp. 532-585.

Mitchell, R. J., D. J. Jaeger, J. F. Diehl, P.E. Hammond, 1989. Paleomagnetic Results from the Indian Heaven Volcanic Field, South-Central Washington, Geophysical Journal, Vol. 97, pp. 381-390.

Professional Technical Reports

Matthews, R., M. Hilles, J. Vandersypen, R. Mitchell and G. Matthews, Lake Whatcom Monitoring Report 2005-2006, March 2007.

Matthews, R., M. Hilles, J. Vandersypen, R. Mitchell and G. Matthews, Lake Whatcom Monitoring Report 2004-2005, March 2006.

Mitchell, R. J., R. S. Babcock, H. Hirsch, L. McKee, R. Matthews, and J. Vandersypen, Water Quality: Abbotsford-Sumas Aquifer Final Report, 166 pp., March 2005.

Matthews, R., M. Hilles, J. Vandersypen, R. Mitchell and G. Matthews, Lake Whatcom Monitoring Report 2003-2004, March 2005.

Matthews, R., M. Hilles, J. Vandersypen, R. Mitchell and G. Matthews, Lake Whatcom Monitoring Report 2002-2003, March 2004.

Matthews, R., M. Hilles, J. Vandersypen, R. Mitchell and G. Matthews, Lake Whatcom Monitoring Report 2001-2002, March 2003.

Matthews, R., M. Hilles, J. Vandersypen, R. Mitchell and G. Matthews, Lake Whatcom Monitoring Report 2000-2001, March 2002.

Matthews, R., M. Hilles, J. Vandersypen, R. Mitchell and G. Matthews, Lake Whatcom Monitoring Report 1999-2000, March 2001.

Mitchell, R. J., R.S. Babcock, D. Stasney, L. Nanus, S. Boesser, R. Matthews, and J. Vandersypen, Abbotsford-Sumas Aquifer Monitoring Project, Final Report, 2000.

Matthews, R., M. Hilles, J. Vandersypen, R. Mitchell and G. Matthews, Lake Whatcom Monitoring Report 1998/1999, March 2000.

Published Abstracts/Presentations

Donnell, C., R.J. Mitchell and D. Clark. 2007. Quantifying the glacial meltwater component of streamflow in a North Cascades basin using a distributed hydrology model. The 103rd Annual Meeting of the Cordilleran Section, GSA, Bellingham, WA. May 4-6.

Hirsch, H., R. J. Mitchell, S. Bittman and D. Hunt. 2007. Applicability of the NLOS Model for Predictions of Soil Water Movement and Nitrogen Transport in an Agricultural Soil, Agassiz, BC. The 103rd Annual Meeting of the Cordilleran Section, GSA, Bellingham, WA. May 4-6.

Mitchell, R. J. 2007. A strategy for revealing student preconceptions about geologic topics. The 103rd Annual Meeting of the Cordilleran Section, GSA, Bellingham, WA. May 4-6.

DeBari, S.M., J. Bachman, B. Dougan, B. Fackler-Adams, S. Grupp, S. Linneman, R. Mitchell, and T. Plake. 2007. Development of a new curriculum for a lab-based, introductory earth science course for future elementary teachers: How faculty from a regional university and local community colleges work together to design and implement a common geology course. The 103rd Annual Meeting of the Cordilleran Section, GSA, Bellingham, WA. May 4-6.

DeBari, S.M., J. Bachman, B. Dougan, B. Fackler-Adams. R. Kratz, S. Linneman, R. Mitchell, T. Plake, and B. Smith. 2007. Using "How People Learn" as a blueprint for developing teaching strategies: an example from an introductory geology course for future elementary teachers and non0science majors. The 103rd Annual Meeting of the Cordilleran Section, GSA, Bellingham, WA. May 4-6.

Hanell, C. and R. Mitchell. 2007. Effects of timber harvest on groundwater response to precipitation events near Kalaloch, Olympic Peninsula, WA. 6th Washington Hydrogeology Symposium, May 1-3, Tacoma, WA.

Burton, M. and R. Mitchell. 2007. Application of a nitrate fate and transport model to the Abbotsford-Sumas aquifer, Whatcom County, Washington. 6th Washington Hydrogeology Symposium, May 1-3, Tacoma, WA.

Donnell, C., R.J. Mitchell and D. Clark. 2006. Modeling the glacial meltwater contribution to streamflow in the Middle Fork Nooksack River, Whatcom County, WA using a distributed hydrology model. Rocky Mountain Rendezvous of Geoscience students and employers Oct 1-3 in Laramie, WY.

Mitchell, R.J. 2006. Groundwater nitrate distributions in a portion of the Abbotsford-Sumas aquifer: northwest Washington. June 24. National Association of Gescience Teachers- Northwest Section meeting held in Bellingham, WA.

Donnell, C., R.J. Mitchell and D. Clark. 2006. Modeling the glacial meltwater contribution to the Middle Fork Nooksack River, Whatcom County, WA using a distributed hydrology model. The 102nd Annual Meeting of the Cordilleran Section, GSA, 81st Annual Meeting of the Pacific Section, AAPG, and the Western Regional Meeting of the Alaska Section, SPE (8–10 May).

Mitchell R.J., L. McKee and S. Babcock. 2005. Ground Water Nitrate Distributions and Denitrification in a Portion of the Abbotsford-Sumas Aquifer, Northwest Washington. 5th Washington Hydrogeology Symposium, April 12-14, Tacoma, WA.

Hirsch, H., R. J. Mitchell and S. Bittman. 2005. Applicability of the NLOS Model for Predictions of Soil Water Movement and Nitrogen Transport in an Agricultural Soil, Agassiz, BC. 5th Washington Hydrogeology Symposium, April 12-14, Tacoma, WA.

Kelleher, K. and R. J. Mitchell. 2005. Simulating Runoff in Two Basins in the Lake Whatcom Watershed, Whatcom Count, Washington Using a Distributed Hydrology Model. 5th Washington Hydrogeology Symposium, April 12-14, Tacoma, WA.

Mitchell R.J., L. Braverman and S. Babcock. 2003. Transboundary Transport in the Abbotsford-Sumas Aquifer, British Columbia and Northwest Washington State. GSA Abstracts 35(6).

Chennault, J., R. J. Mitchell and P. Storck. 2003. Contributions of Glacial Meltwater to Streamflow in Thunder Creek, North Cascades National Park, Washington: A Modeling Study. GSA Abstracts 35(6).

Callahan, K., R.J. Mitchell and P. Storck. 2003. Calibration of the Distributed Hydrology-Soils-Vegetation Model to the Lake Whatcom Watershed, Washington. GSA Abstracts 35(6).

Sullivan, W. and R.J. Mitchell. 2003. Hydrogeology and Seawater Intrusion of Lummi Island, Washington State. GSA Abstracts 35(6).

Published Abstracts/Presentations Cont.

Braverman, L. and Mitchell, R. J. 2003. Nitrate Distributions in a Portion of the Abbotsford-Sumas Aquifer, Northwest Washington. 4th Symposium on the Hydrogeology of Washington State.

Sullivan, W. and Mitchell, R. J. 2003. The Hydrogeology of Northern Lummi Island, Washington. 4th Symposium on the Hydrogeology of Washington State.

Mitchell, R. J. and D.E. Stasney. 2000. Hydrogeology in a Nitrate Contaminated Region of the Abbotsford-Sumas Aquifer in Northern Whatcom County, Washington. 3rd Symposium on the Hydrogeology of Washington State.

Babcock, S. , R. Mitchell, S. Gelinas, and L. Nanus, 2000. Nitrate Variations in the Abbotsford-Sumas Aquifer in Northern Whatcom County, Washington, 3rd Symposium on the Hydrogeology of Washington State.

Mitchell, R.J., and A.S. Mayer, 1999. A Numerical Study of Solute Spreading in Heterogeneous Soil with Transient Water Flow, Transactions, American Geophysical Union, Eos Vol. 79, No. 45, Nov.

Mitchell, R. J. and A. S. Mayer, 1997. The Significance of Lateral Flow Components to Solute Transport During Unsaturated Hysteretic Flow Transactions of the American Geophysical Union, Eos, Vol. 78, No. 46, November 18,.

Mitchell, R.J. and Mayer, A.S., 1997. The Impacts of Source Size and Horizontal Correlation Scale on Solute Transport during Unsaturated Hysteretic Flow, International Workshop: Characterization and Measurement of the Hydraulic Properties of Unsaturated Porous Media, Riverside, CA, Oct. 22-24.

Mitchell, R.J. and A. S. Mayer, 1996. A Numerical Study of the Impact of Hysteretic Flow on Solute Transport in Unsaturated, Heterogeneous Porous Media. Transactions of the American Geophysical Union, Eos, Vol. 77, No. 46, November 12.

Mitchell, R.J. and A. S. Mayer, 1995. A Numerical Study of the Effect of Nonideal Flow Processes on Solute Transport in Unsaturated, Heterogeneous Porous Media. Transactions of the American Geophysical Union, Eos, Vol. 76, No. 45, November 7, 1995.

Mitchell, R.J. and A. S. Mayer, A Numerical Study of the Impact of Transient-Hysteretic Flow on Nonreactive Solute Transport in the Vadose Zone, Proceedings of Vadose Hydrology – Cutting Across Disciplines Conference, September 6, UC-Davis.

Mitchell, R.J. and A. S. Mayer, 1994. A Modified Method of Characteristics Technique for Simulating Contaminant Transport in Variably-Saturated Porous Media. Proceedings of the Xth International Conference on Computational Methods in Water Resources X, Heidelberg, Germany.

Mitchell, R.J. and A. S. Mayer, 1993. A Modified Method of Characteristics Technique for Simulating Contaminant Transport in Variably-Saturated Porous Media. Transactions of the American Geophysical Union, Eos, Vol. 74, No. 43, October 26.

Mitchell, R.J. and A. S. Mayer, 1993. Mathematical Modeling of Flow and Transport in a Finger. Transactions of the American Geophysical Union, Eos, Vol. 74, No. 16, April 20.

Mitchell, R.J., A. S. Mayer, J. S. Gierke, and N. J. Hutzler, 1992. Unsaturated Solute Transport in a Fingered Flow System. Transactions of the American Geophysical Union, Eos , Vol. 73, No. 43.

Mitchell, R.J., D. J. Jaeger, J. F. Diehl, and P. E. Hammond, 1986. Paleomagnetic Results from the Indian Heaven Volcanic Field, Southern Washington, Transactions of the AGU, Eos, Vol 67 (44).

External Grants Awarded

PI (with Casey Hannell) Effects of timber harvest on groundwater response to precipitation events near Kalaloch, Olympic Peninsula, WA. January 2007 to July 2007, Washington State Department of Natural Resources. $14,000.

PI with Doug Clark (both of us are equal Co-PIs). Hydrologic Assessment of Ebey's Prairie, Whidbey Island, WA. April 2006 to 2008, North Cascades National Park, $40,000.

Co-PI (with Robin and Geoff Matthews): Lake Whatcom Monitoring Project, October 2006 to September, 2009. City of Bellingham. $645,921 (hydrology portion: $99,074).

Co-PI (with Robin and Geoff Matthews): Lake Whatcom Monitoring Project, October 2004 to September, 2006. City of Bellingham. $471,135 (hydrology portion: $62,090).

Co-PI (with Robin and Geoff Matthews): Lake Whatcom Monitoring Project, October 2003 to September, 2004. City of Bellingham. $168,680 (hydrology portion: $27,508).

Co-PI (with Robin and Geoff Matthews): Lake Whatcom Monitoring Project, October 2002 to September, 2003. City of Bellingham. $168,680 (hydrology portion: $23,470).

PI (with Scott Babcock and Robin Matthews). Water Quality: Abbotsford-Sumas Aquifer, April 2002 to April 2005. Washington State Department of Ecology, Centennial Clean Water Fund. $155,671.

Co-PI (with Robin and Geoff Matthews): Lake Whatcom Monitoring Project, October 2001 to September, 2002. City of Bellingham. $165,407 (hydrology portion: $23,418).

PI (with D. H. Clark) North Fork Nooksack Geology and Hydrology Project, January to June 2001, Washington State Department of Transportation. $12,000.

Co-PI (with Robin and Geoff Matthews): Lake Whatcom Monitoring Project, 2000 to 2001, City of Bellingham, WA. $163,662 (hydrology portion: $39,741).

Co-PI (with Robin and Geoff Matthews): Lake Whatcom Monitoring Project, October 1999 to September, 2000. City of Bellingham. $145,754 (hydrology portion: $36,731)

Co-PI (with Robin and Geoff Matthews): Lake Whatcom Monitoring Project, October 1998 to September, 1999. City of Bellingham. $123,549 (hydrology portion: $20,994).

Co-PI (with Scott Babcock and Robin Matthews): Abbotsford-Sumas Aquifer Monitoring Project, January 1997 to June, 1999. Washington State Department of Ecology, Centennial Clean Water Fund. $162,356.

Internal Grants Awarded

Co-PI with Doug Clark, Scott Linneman and Scott Babcock. 2006. WWU Student Technology Fee program. Improved Stream-Flow Monitoring for Student Training and Research. $38,098.

NCOSP Summer Academy Facilitator and Curriculum Design Team Participant, 2006 (1 month salary).

Co-PI with Michael Medler and Stefan Freeland. 2005. WWU Student Technology Fee program. Spatial Analysis Lab GPS Equipment. $13,700.

Co-PI with Michael Medler, Gene Hoerauf and Stefan Freeland. 2004. Modernizing the Huxley Spatial Analysis Lab, Establish a Second Spatial Analysis Lab, and Enhance Graduate Computing Access Spatial Analysis Lab Computer Upgrade. $41,429.

BFR Summer Research Grant. 2005. Calibration of the Distributed-Hydrologic-Soils-Vegetation-Model to the Anderson Creek basin in the Lake Whatcom Watershed. $5000.

BFR Faculty Development Grant. 2003. Modeling with GMS. $1000.

BFR, Summer Research Grant. 1999. Characterizing the Hydrodynamics of Lake Whatcom: A Modeling Study. $5000.

BFR, Summer Research Grant. 1997 . The Effect of Physical Nonequilibrium on Solute Transport in Unsaturated, Heterogeneous Porous Media. $5000.

Current Graduate Student Research M. S. Thesis Advisees

Erica Martel started in the Fall of 2004 and is characterizing the degree of arsenic and seawater contamination on Lummi Island, Washington .

Casey Hanell started in the fall of 2005 is examining effects of timber harvest on groundwater response to precipitation events near Kalaloch, Olympic Peninsula, WA.

Sarah Harper-Smith (Committee member, Biology 2005) Relative Effects of Riparian Cover and Groundwater Inflow on Stream Temperature in Lowland Whatcom County, Washington.

Completed Graduate Student Research M. S. Thesis Advisees

Heather Hirsch (2007) Applicability of the NLOS Model for Predictions of Soil Water Movement and Nitrogen Transport in an Agricultural Soil, Agassiz, BC.

Carrie Donnel (2007) Quantifying the glacial meltwater component of Streamflow in the Middle fork of the Nooksack River, Whatocm County WA using a distributed hydrology model.

Margo Burton (2007) Application of a nitrate fate and transport model to the Abbbotsford-Sumas aquifer, Whatcom County, Washington.

Katie Kelleher (2006): Streamflow calibration of two sub-basins in the Lake Whatcom Watershed, Washington using a distributed hydrology model.

William Sullivan (2005): The hydrogeology of north Lummi Island, Washington.

Leslie McKee (2004): An investigation of denitrification along Pangborn Creek in the Abbotsford-Sumas Aquifer, Washington.

Jay Chennault (2004): Modeling the contribution of glacial meltwater to streamflow in Thunder Creek, North Cascades National Park, Washington.

Jenny Baker* (2003; Huxley College) The effect of red alder (Alnus rubra) ripari forests on ground water and stream-water chemistry.

Karel Tracy* (2002): Changes in Mirror Lake as a result of diversions of water from the Nooksack Basin, 2002. (Co-advised with Chris Suczek and Doug Clark).

David Stasney (2000): Hydrostratigraphy, Ground-water flow and nitrate transport within the Abbotsford-Sumas Aquifer, Whatcom County, Washington.

Sharon Gelinas (2000): An exploratory statistical analysis of ground-water quality in the Abbotsford-Sumas Aquifer.

Leora Nanus* (2000): Seasonal and temporal variability of nitrate contamination in the Abbotsford-Summas Aquifer (Co-advised with Scott Babcock).

Paul Humphreys (1998): Ground and surface-water interaction near aplywood manufacturing facility on the Lake Roosevelt Shoreline, Kettle Falls, Washington.

* Committee member

Non-Thesis MS Advisement

Tracy Kelley, Hydrostratigraphy and Groundwater Resources of Northern Lummi Island, Project, Geology Department, summer 1998.

Brandie Theisen, Wellhead Protection Plan Isle Aire Beach Water Association Lummi Island Project, Geology Department, summer 1999.

Undergraduate Thesis supervision

Peter Ojala. 2004. Estimating the recharge on Lummi Island using the USGS Deep Percolation Model.

Stephen Bond. 2005. Characterizing the groundwater flow beneath an agricultural field in northern Whatcom County using GMS.

Professional Registration/Memberships

Washington State Licensed Geologist and Hydrogeologist (#2229)
E.I.T. certification, Michigan
American Geophysical Union
Association of Environmental & Engineering Geologists
National Ground Water Association
National Association of Geoscience Teachers

Outside Professional Service

Member of the Joint Scientific Committee of the State of Washington Water Research Center (2005 to present).

Member of the Lake Whatcom Data Management Committee (1998 to present).

Description of Courses I Teach at WWU

Environemtnal Geology – 214: A survey course introduces students to the relationships between man and her/his geologic environment. Environmental geology encompasses geologic hazards (*e.g.* earthquakes, landslides, volcanic hazards, floods), waste management, ground-water supply and pollution, and land-use planning to name a few.

Engineering Geology – 314: Introduction to the engineering properties of Earth materials and the role of geologists in engineering projects. Topics include: stress and strain, strength of earth materials, rock slope processes, soil mechanics, engineering properties of soils, and soil slope stability. Weekly problem sets develop a framework for solving basic engineering-geology problems.

Watershed Hydrology – 372: An introduction to the processes controlling the water budget of a watershed and streamflow, including groundwater. Basins in the Lake Whatcom watershed will be used as a model for teaching hydrological concepts. An overview of current hydrological issues will also be discussed.

Surface-Water Hydrology – 472/572: The objective of the course is to expose students to the factors that contribute to the water balance in a watershed such as, precipitation, interception, infiltration, evaporation, evapotranspiration, runoff, stream discharge. I use the Lake Whatcom watershed (a local watershed) as a model for teaching hydrologic concepts in this course. Each student exercise focuses on a separate hydrologic process in watershed using actual data. The course is Excel intensive.

Ground-Water Hydrology– 473/573: The objective of this course is to introduce students to the principles of ground-water flow. The topics discussed include a review of fluid mechanics along with an introduction to the properties of aquifer materials, Darcy's law, the ground-water flow equations (partial differential equations), unsaturated flow, well hydraulics, regional ground-water flow, and salt-water intrusions. The students are assigned weekly Mathcad exercises and complete a capstone field project that utilizes actual field data from Area 6 on the Whidbey Island Naval Air Station.

Ground-Water Contamination –474/574: This course outlines the physical, chemical, and biological processes governing the fate and transport of pollutants in ground-water systems, including the partial differential equations governing them. Topics include: mass transport in saturated and unsaturated porous media, organic compounds in ground water, transformation processes such as sorption and biodegradation, multiphase fate and transport, and site remediation. The weekly exercises in this course are MathCad intensive and are used examine mathematical models and to perform sensitivity analyses. The course includes a capstone field project that utilizes actual natural attenuation data from Area 6 on the Whidbey Island Naval Air Station.