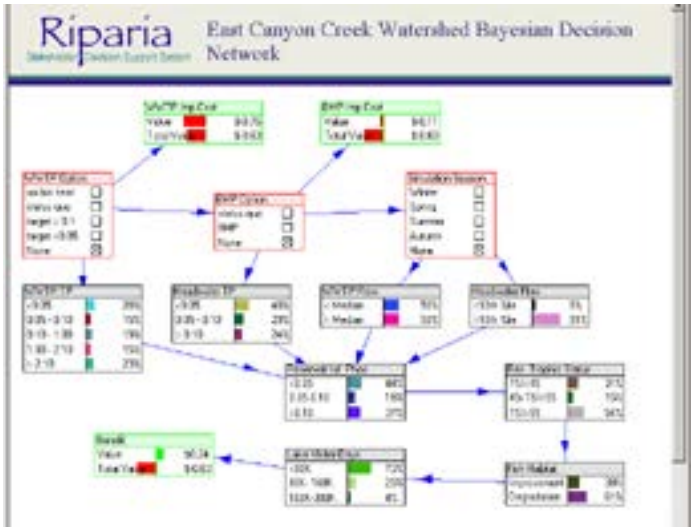
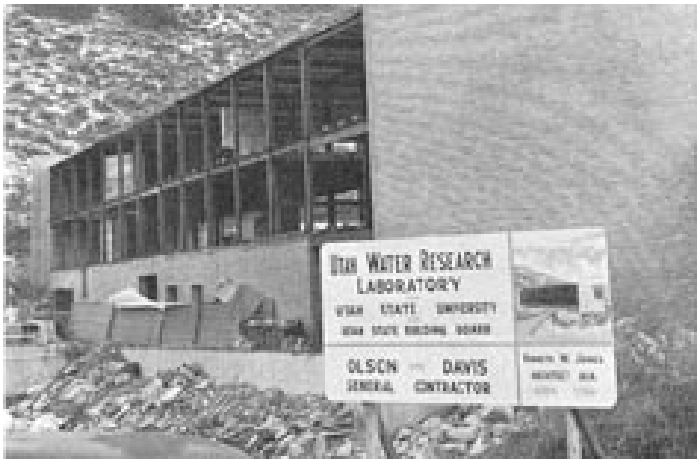
The Utah Water Journal
November 2001

Environmental Management Research Center (EMRC)



Web-based decision models are one application of Bayesian Networks being explored by EMRC



Water research at Utah State University is as old as Utah State University itself

Director's Corner

Graduate Students 1965-1966

Degrees offered by College of Engineering in 1965

Degrees offered by College of Engineering in 1966

Spotlight

Karl Nieman, Ph.D. Candidate

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Director's Corner

Dr. Ronald C. Sims, UWRL Director

In this issue . . .

I am pleased to report the addition to the Utah Water Research Laboratory team of the Environmental Management Research Center (EMRC), focused on the development of advanced methods and tools to support environmental management and decision-making. The EMRC integrates environmental engineering and water resources disciplines, and currently provides support to the State of Utah Department of Environmental Quality and other organizations. A description of the EMRC research and project areas, and research engineers leading the Center are presented in this issue of the Utah Water Journal. Also, we are adding a new section of the UWJ to describe the history and role of the UWRL in water research, education, and outreach over the 35+ year period since it's dedication in 1965, starting with the birth of the UWRL in this issue.

We are also reaching out to identify and locate all of the graduate students who conducted research at the UWRL or in some way were associated with the UWRL as part of their professional education. We have listed those students that graduated with M.S. and Ph.D. degrees in 1965 and 1966 in this issue of the UWJ. If you are on this list or know of someone on the list, we would like to hear from you. We plan to identify graduates for succeeding years in future issues of the UWJ in an effort to locate and communicate with our graduates, to update them about current USU/UWRL programs and initiatives, and to connect our previous graduates with our current students for potential job opportunities and for professional advice.

Our graduate student research "spotlight" in this issue of the UWJ features Karl Nieman, a Ph.D. student in the Department of Civil and Environmental Engineering who is investigating basic mechanisms whereby bacteria may be used to immobilize toxic chemicals in contaminated soil and prevent them from contaminating ground and surface water resources in a collaborative project involving the UWRL and the U.S. Department of Energy Lawrence Berkeley National Laboratory. I hope that you enjoy reading this issue of the Utah Water Journal. Please send your comments, ideas, or feedback to Ivonne Harris, Jan Urroz, or to me.

Utah Water Journal staff

Dr. Ronald C. Sims, UWRL Director (ronsims@cc.usu.edu)

Ms. Ivonne Harris, Information Dissemination Coordinator (iharr@cc.usu.edu)

Ms. Jan Urroz, Features Contributor (janurroz@cc.usu.edu)

Environmental Management Research Center (EMRC)

The Environmental Management Research Center (EMRC) is a collaborative effort between Utah State University researchers and various local, state, and national agencies, including the Idaho and Utah State Departments of Environmental Quality, the Idaho National Engineering and Environmental Laboratory (INEEL) in Idaho Falls, Idaho, and the United States Environmental Protection Agency (USEPA). EMRC is focused on the development of advanced tools and methods to support environmental management and decision-making.

Some of the key research and project areas of EMRC include:

EPA BASINS Training Seminars

BASINS is a surface water quality assessment tool that incorporates Geographical Information Systems (GIS) with mathematical models, and unites spatial and temporal watershed data for the purpose of identifying pollutant sources and quantifying their impacts on streams. Workshops presented quarterly by EMRC personnel integrate BASINS into the process of establishing total maximum daily loads (TMDLs) for meeting stream water quality provisions for the Clean Water Act.

Advanced GIS Tools for Programmers

GIS tools for programmers under development by EMRC include software components for the analysis of spatial data. These components enable the creation of site-specific or project specific GIS applications that can be distributed to users as stand alone applications that do not require any third party software. MapWindow, created by EMRC, is a GIS ActiveX component that allows the display and manipulation of common forms of spatial data and is fully customizable using Microsoft Visual Basic.

Watershed Decision Support Systems

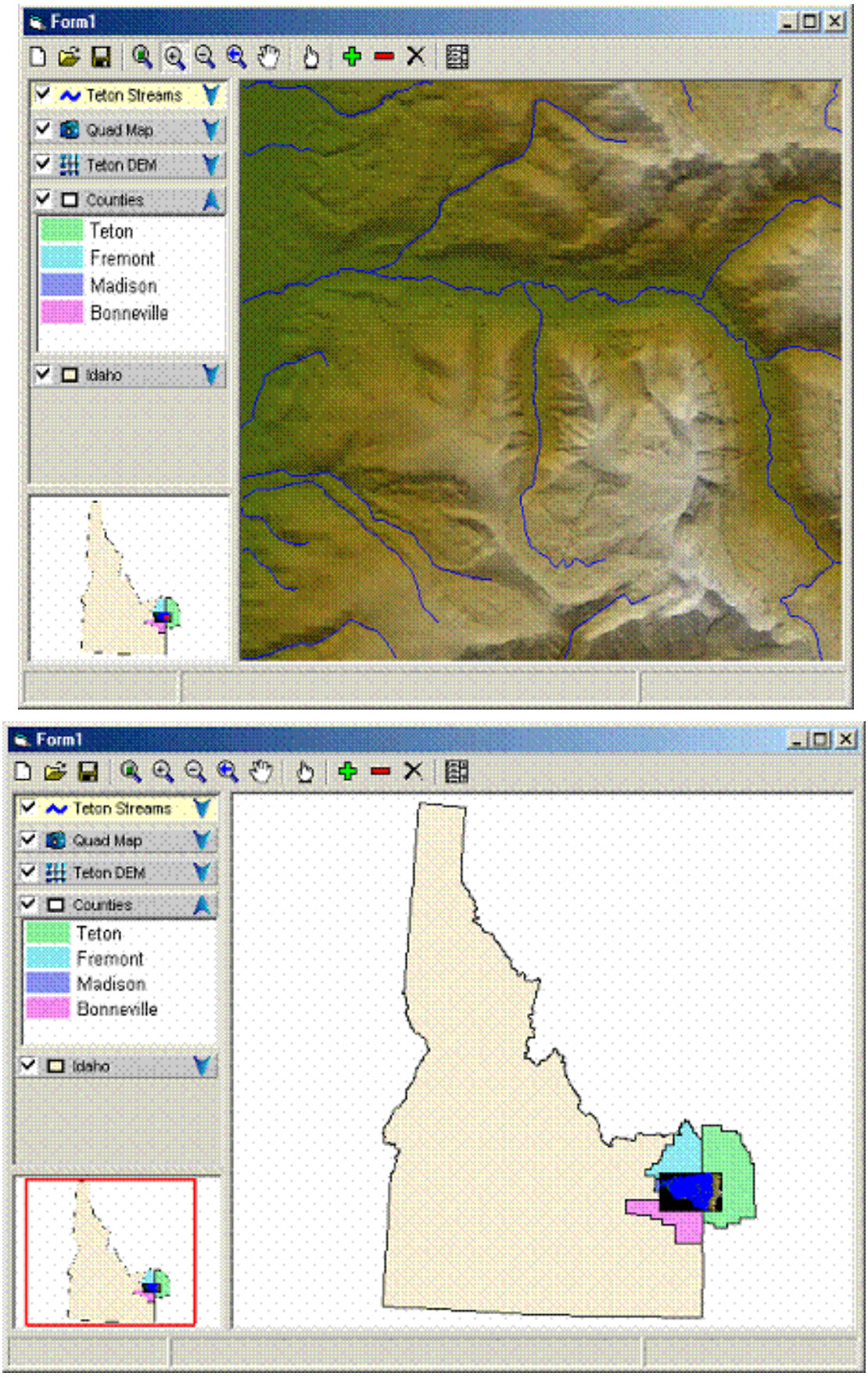
EMRC is working with the INEEL to produce a Watershed Management Toolkit (WMT) that will integrate and leverage water and environmental management information leading to the improvement of watershed management and decision making. The approach integrates data and models into a Bayesian Decision Network (BDN) description of the physical, chemical, biological, and socioeconomic issues in complex watersheds. It will also identify and account for uncertainties associated with the physical systems, water quantity and quality, alternative long-term management options, and socioeconomic impacts of watershed management decisions.

Terrain and DEM Modeling

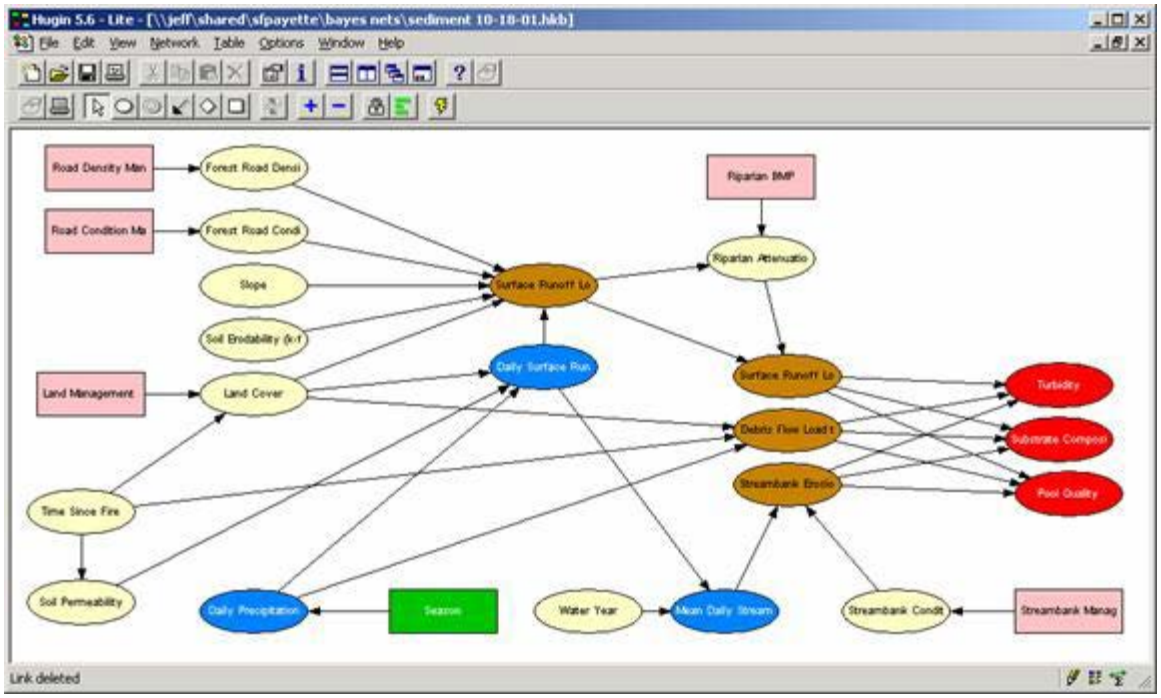
EMRC researchers and programmers have been instrumental in the development of TauDEM (Terrain Analysis Using Digital Elevation Models), a graphical user interface software package for the analysis of digital elevation data and mapping of channel networks and watersheds. This software package, developed in collaboration with Dr. David Tarboton at USU, enables users to delineate watersheds and stream networks from digital elevation data.

3-D Terrain Visualization and Modeling

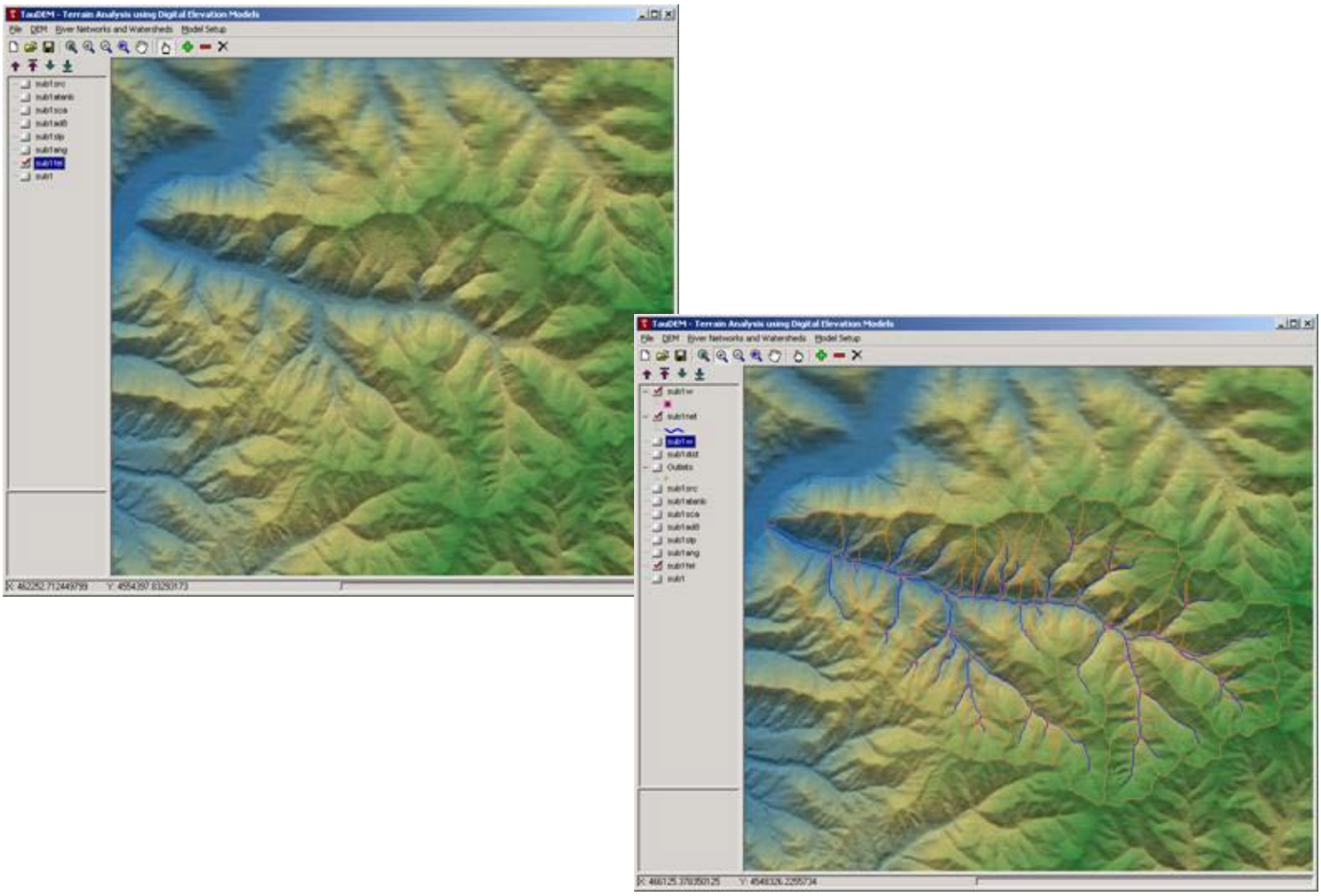
EMRC researchers and programmers have developed a set of programmable ActiveX 3-D visualization components for use in Visual Basic, Visual C++ or other Microsoft operating system programming language that supports ActiveX. Also included is an Internet browser plug-in that can be used to deploy 3-D visualization in either Netscape or Internet Explorer. Support tools used to prepare data sets for the 3-D terrain viewer components include a Grid Wizard for downloading, merging, resampling and converting file formats on digital elevation data and a TIN Wizard for generating triangulated irregular networks (TIN) from digital elevation data.



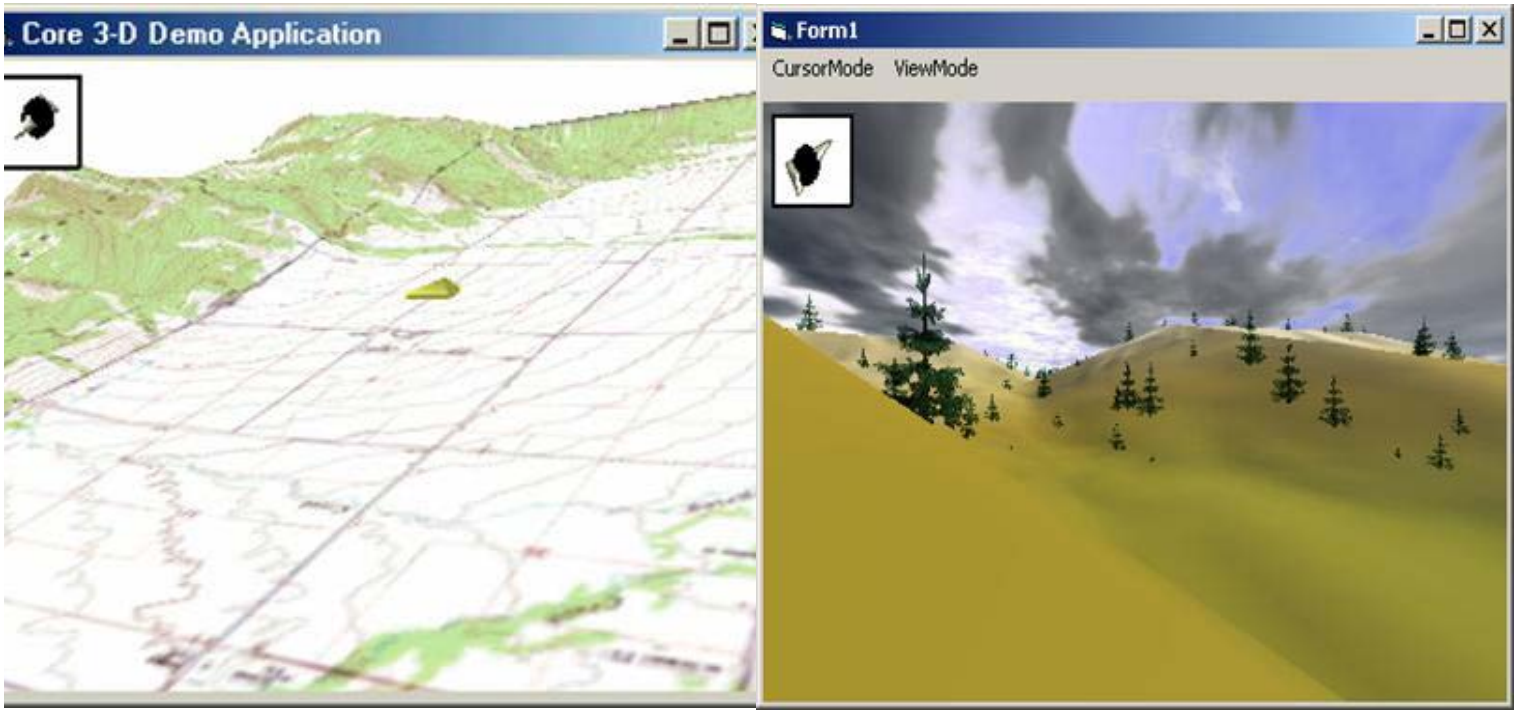
MapWindow provides the capability to display and manipulate most common GIS data types and formats.



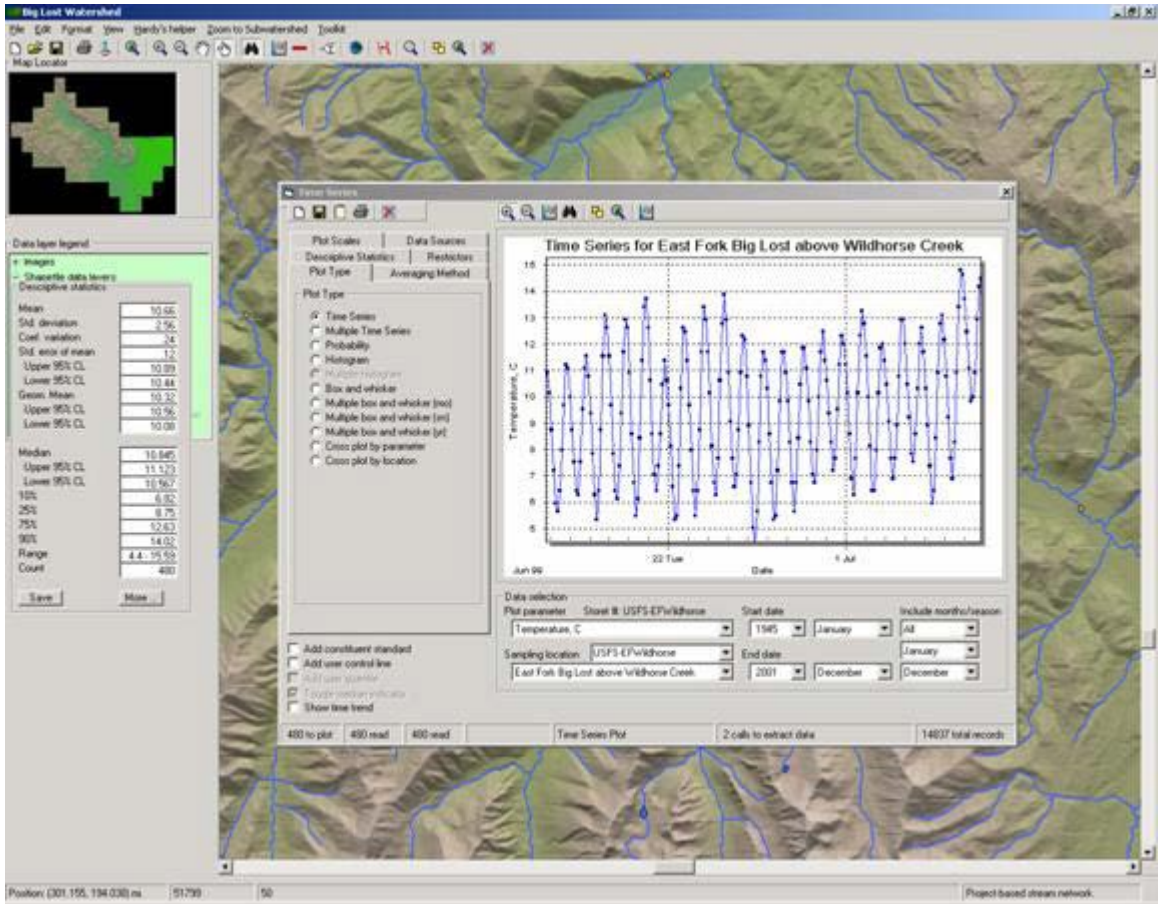
Bayesian Decision Networks (BDNs) are being used to describe the physical, chemical, biological, and sociaoeconomic issues in complex watersheds.



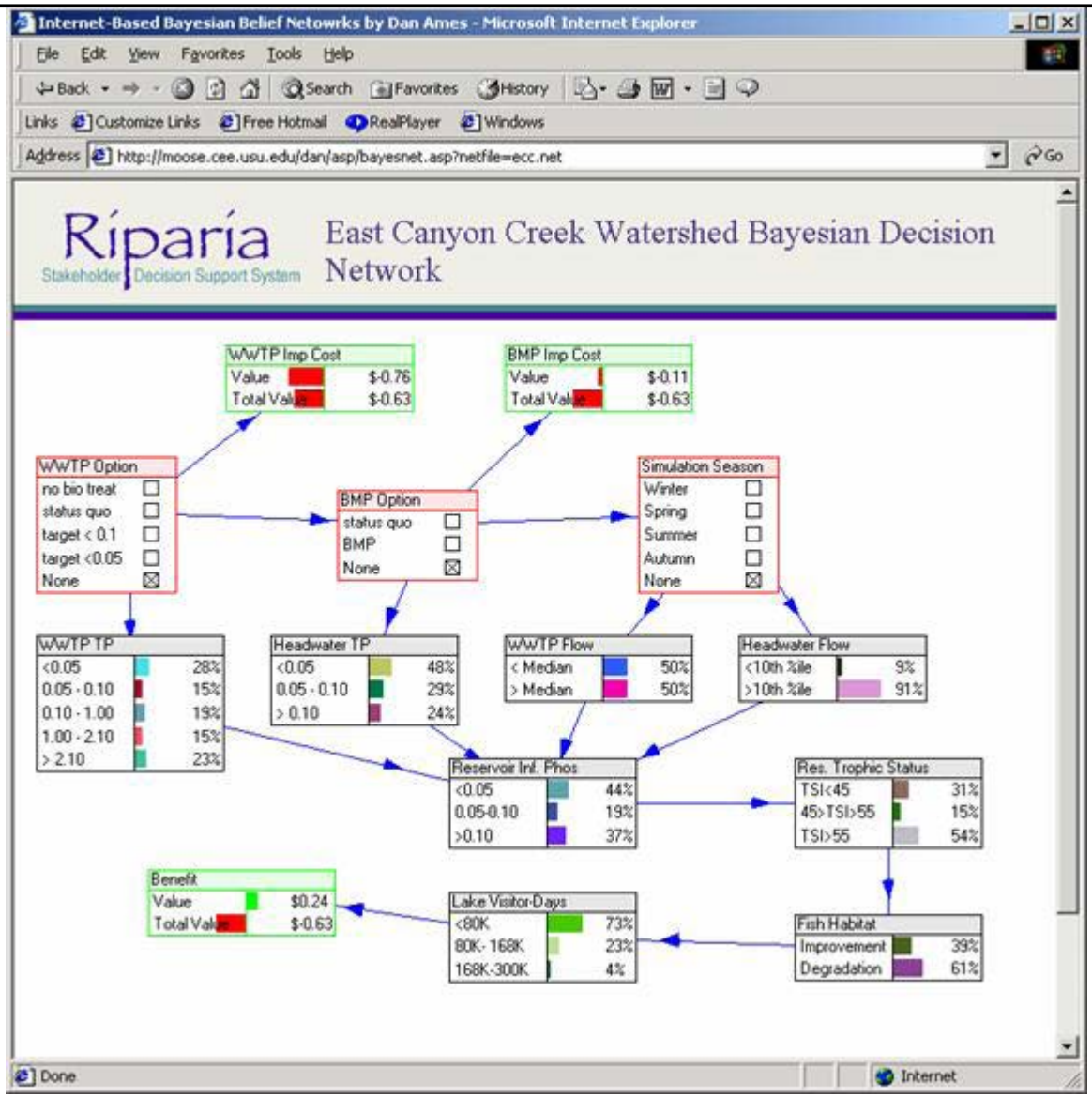
TauDEM allows users to delineate watersheds and stream networks from digital elevation data.



The EMRC 3-D visualization ActiveX tools provide the ability to view and navigate the landscape in 3 dimensions.



Water quality/quantity data viewers developed by Dr. David Stevens and EMRC link databases with Geographic Information Systems (GIS)



Web-based decision models are one application of Bayesian Networks being explored by EMRC

Water Quality/Quantity Data Management

EMRC is working with Dr. David Stevens to develop advanced data viewers for water quality and quantity. These tools are meant to provide decision makers with the latest and most correct data available in a format that is easy to use. Water quality and flow databases have been linked to Geographic Information Systems (GIS) data coverages, enabling both analysis of the data as well as spatial relationships that may exist in the data.

Sourcewater Protection Software

Diffuse sources of contamination present a major challenge to drinking water source protection and management. Nonpoint source pollution is seen as the nation's largest water quality problem, and it is a major focus of water quality management in the State of Utah. EMRC researchers and programmers are collaborating with Dr. Darwin Sorensen and other university researchers from several departments at USU on the development of a source water assessment tool that will provide a systematic approach to applying available, state-of-the-art scientific information, including expert understanding of contaminant transport in natural systems, to the assessment and management of potential drinking water source contamination.

Probabilistic Collaborative Decision Modeling

Probabilistic decision models have been used extensively in medicine and computer science and have,

in recent years, begun to be applied in engineering and natural resource management problems. EMRC researchers are applying Bayesian networks, which are formal statistical modeling frameworks that support analysis of probabilistic relationships between variables in a complex system, to solve complicated watershed management problems. Bayesian networks are formed by building a graphical diagram of nodes representing all significant variables associated with a particular problem and directed links representing the cause and effect relationships between variables. Web-based tools for deploying Bayesian Networks are also being developed.

Connely Baldwin,
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TMDL Case Studies

EMRC researchers are exploring various probabilistic and deterministic water quality modeling techniques, including Bayesian Decision Networks, to support TMDL development activities in the state of Utah and Idaho. EMRC efforts are aimed at addressing uncertainty associated with data and modeling in TMDL development and communication of this uncertainty to stakeholders

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435-797-3581,
dan.ames@usu.edu

EMRC People

EMRC is co-directed by UWRL research engineers Connely Baldwin, Daniel Ames, Bethany Neilson, and Jeffery Horsburgh, and employs a number of undergraduate and graduate students as software engineers, computer programmers, and research assistants. These students gain a broad and practical experience in water quality modeling, data analysis, and the development of engineering software tools. University and Utah Water Research Laboratory (UWRL) professors working with EMRC include David Stevens, David Tarboton, Mariush Kemblowski, Gilberto Urroz, Darwin Sorensen, Terry Glover, and others.

Bethany Neilson,
435-797-7369,
bethany.neilson@usu.edu

Contact information for EMRC is given below:

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Logan, UT 84322-8200
emrc@tmdl.org

Jeffery Horsburgh,
435-797-2946,
jeff.horsburgh@usu.edu

The Birth of the Utah Water Research Laboratory

Water research at Utah State University is as old as Utah State University itself. Established in 1888 as a Federal Land Grant University, Utah State University was given special assignment to study problems connected with water, soil, plant, and animal life. In 1890 the College of Engineering was organized, and departments under this College gave heavy emphasis to teaching and research in the various aspects of water resource development and use. Many of the Civil and Irrigation Engineering Department staff did research in association with the Agricultural Experiment Station. The establishment of an Engineering Experiment Station in 1918 to conduct research on many kinds of engineering and scientific developments gave engineering staff members further opportunity to engage in water research.

First Dam and the UWRL Site

The concept of a Utah Water Research Laboratory evolved after many years of careful thought and study by individuals with a special interest in water research. The establishment of a laboratory was given impetus in 1949 when Dr. Vaughn E. Hansen of the Civil and Irrigation Engineering Department took pictures of the potential site on the Logan River at the mouth of Logan Canyon. Several years of negotiations and planning involving many individuals and agencies of state and federal governments followed. Commitments from the Utah State Legislature, the National Institutes of Health, and the National Science Foundation were finally secured in 1959 and the plans for the facility were drawn up.

Staff members started using the newly completed laboratory building in September 1965

Sufficient State funds were made available to begin construction of the laboratory in the fall of 1962. The first phase of construction consisted of installing an outlet from the reservoir (with gates) together with a four-foot supply pipe extending to the laboratory site. A bridge was constructed to span the river. Sewer and water lines were brought into the area.

Bids were opened October 1963 for the second phase of the laboratory, designed by architect Kenneth W. Jones and estimated to cost in excess of $1,600,000. Olson and Davis Construction Company of Logan was awarded the contract and subsequently completed construction of the facility. Groundbreaking ceremonies for the laboratory were held in November of 1963. Among state dignitaries participating were George D. Clyde, Governor of Utah, and Glenn R. Swenson, Director of Utah State Building Board. Occupancy of the building began in September 1965.

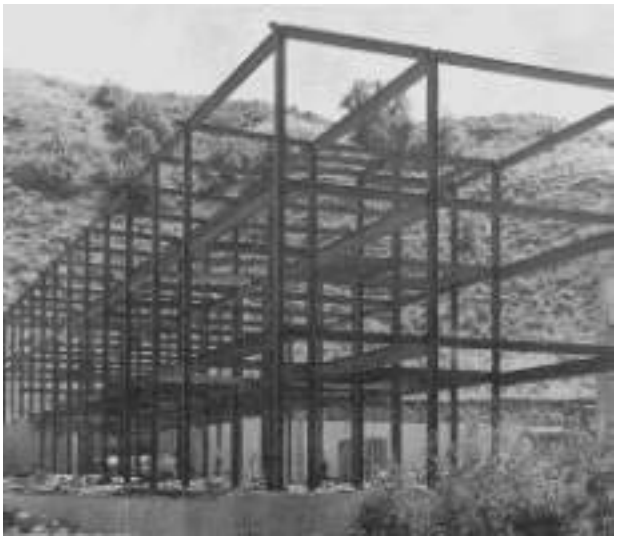
On July 12, 1964, the USU Board of Trustees appointed Dr. Vaughn E. Hansen as Director of the Utah Water Research Laboratory. He served in this capacity until his resignation on June 30, 1966.

The dedication of the building was held on December 6 and 7, 1965. Special guests for the occasion included Calvin L. Rampton, Governor of Utah; George D. Clyde, former Governor of Utah; Dr. John C. Calhoun, Jr., Vice President for Programs, Texas A& M University, and formerly Science Adviser to the Secretary of the Interior; Dr. Hunter Rouse, Director, Iowa Institute of Hydraulic Research, State University of Iowa; and Dr. Daryl Chase, President, Utah State University.

The facility provided approximately 80,000 square feet of space and included a chemical laboratory, bacteriological laboratory, instrumentation laboratory, measurement laboratory, sedimentation laboratory, model laboratories, printing room, publication room, drafting room, instrument shop, machine shop, project rooms, long towing flume, large flume, weighing tanks, volumetric tanks, receiving area, conference rooms, projection room, lecture room, dark room, library, and offices.

We have compiled a list of graduates from the College of Engineering who were associated with the UWRL for the years 1965 and 1966. If you are on this list or know of someone on this list, we would love to hear from you. Please drop us a line and let us know what has been happening during the last 35 years!

First step in the construction of the UWRL was the bridge across the river



A skeleton began forming the laboratory's shape

Front view of laboratory as construction progresses

Rearview of laboratory during construction

Staff members started using the newly completed laboratory building in September 1965

The Utah Water Research Laboratory today

1965 Degrees from the College of Engineering

Doctorate Degrees 1965:

Abdel-Aziz, Mahmoud Hassan
Cairo, Egypt
Major: Irrigation and Drainage Engineering
Major Professor: Dr. A. A. Bishop
Dissertation: The Influence of Exchangeable Ions and Their Concentration in the Pore Fluid on Plastic and Strength Properties of Cohesive Soil.

Abdelsalam, Mohamed Wafaie
Alexandria, Egypt
Major: Civil Engineering
Major Professor: Dr. D. F. Peterson
Dissertation: Flume Study of the Effect of Concentration and Size of Roughness Elements on Flow in High-Gradient Natural Channels.

Mason, Earl Sewell
Grand Fork, North Dakota
Major: Civil Engineering
Major Professor: Gordon H. Flammer
Dissertation: Analysis of Drag Forces on a Hemisphere With Free Surface Effects

Masters Degrees 1965:

Chery, Donald L., Jr.
Tucson, Arizona
Major: Civil Engineering
Major Professor: Dr. J. M. Bagley
Thesis: Construction, Instrumentation, and Verification of a Model Watershed.

Chung, David Shieh-Lin
Taipei, Taiwan, China
Major: Civil Engineering
Major Professor: Dr. Irving Dunn
Thesis: Slope Stability of Open Drain Channels.

Clarke, Stephen Davis
Ogden, Utah
Major: Electrical Engineering
Major Professor: Dr. D. G. Chadwick
Thesis: Telemetry of Hydrologic Data in Mountainous Terrain.

Hsieh, Chi Achu George
Taipei, Taiwan China
Major: Civil Engineering
Major Professor: Dr. J. E. Christiansen
Thesis: Estimation of Evapotranspiration and Water Budget Study in the Bear River Delta, Utah.

Hyatt, Milton Leon
Cedar City, Utah
Major: Civil Engineering
Major Professor: Dr. Calvin G. Clyde
Thesis: Design, Calibration, and Evaluation of a Trapezodial Measuring Flume by Model Study.

Liu, Ernest Y.
Taipei, Taiwan, China
Major: Civil Engineering
Major Professor: Dr. Gordon H. Flammer
Thesis: Application of Ultrasonics to the Measurement of Size Distribution and Concentration of Natural Sediments.

Robinson, Lee
Fillmore, Utah
Major: Irrigation and Drainage Engineering
Major Professor: Dr. A. Alvin Bishop
Thesis: Vertical Flow Toward an Air-Water Interface Under Sprinkling.

Willis, Wayne Storey
Laketown, Utah
Major: Civil Engineering
Major Professor: Prof. Lyman Willardson
Thesis: Use of a Rainfall Simulator in a Laboratory Study of Infiltration Rates of Bare Soils.

1966 Degrees from the College of Engineering

Doctorate Degrees 1966:

Al-Abdulla, Taha I.
Fallujah, Iraq
Major: Civil and Irrigation Engineering
Major Professor: Dr. A. Alvin Bishop
Dissertation: Effect of Some Physical Parameters on Soil intake.

Sallam, Abdel-Wahhab M. Hamza
Cairo, Egypt
Major: Irrigation and Drainage Engineering
Major Professor: Dr. H. B. Peterson
Dissertation: Leaching and Reclamation Equations for Saline Soils.

Tullis, James Paul
Ogden, Utah
Major: Civil Engineering
Major Professor: Dr. Gordon H. Flammer
Dissertation: Free Surface Effects on the Drag of a Hemisphere on a Boundary in Velocity Gradient Flow.

Masters Degrees 1966:

Biggs, Ernest Niel
Provo, Utah
Major: Agriculture and Irrigation Engineering
Major Professor: Prof. Jack N. Keller
Thesis: Predicting the Quality of Reservoir Flow.

Bishop, A. Bruce
Logan, Utah
Major: Civil Engineering
Major Professor: Prof. Norman B. Jones
Thesis: The Development of Roads in Emerging Economics: A Study of Rio Grande do Norte, Brazil.

Channarasappa, Kallubasanna Rudrappa
Bangalore, India
Major: Civil and Irrigation Engineering
Major Professor: Prof. Gerald E. Christiansen
Thesis: Tests of a Suggested Prizometric Method for Determining Hydraulic Conductivity of Saturated Soils.

Chindasngoan, Chamroon
Bangkok, Thailand
Major: Civil Engineering
Major Professor: Prof. Jerald E. Christiansen
Thesis: Estimation of Pan Evaporation in Northeast Region of Thailand by Using Various Formulas Based on Climatological Data.

Clark, Daniel Robert
Belleville, New Jersey
Major: Civil Engineering
Major Professor: Dr. Gary Z. Watters
Thesis: The Effects of Seepage on the Dynamic Forces on Hemispheres at the Surface of a Permeable Bed of a Flowing Channel.

McAllister, Robert Samuel
Kanab, Utah
Major: Civil Engineering
Major Professor: Dr. Gordon H. Flammer
Thesis: Energy Dissipation in Open Channels by Semi-Circular Disk Roughness Elements.

Mehta, Ashwinkumar Dalshukmdas
Baroda, India
Major: Civil Engineering
Major Professor: Prof. Gerald E. Christiansen / Prof. Jack N. Keller
Thesis: Estimation of Pan Evaporation from Climatological Data.

Morrell, Robert Louis
Logan, Utah
Major: Electrical Engineering
Major Professor: Dr. Bruce O. Watkins / Prof. Duane G. Chadwick
Thesis: A Comparison of Optimum and Conventional Control Systems.

Shih, Charles Chia-Chang
Taipei, Taiwan, China
Major: Agricultural Engineering
Major Professor: Dr. Yu-Si Fok
Thesis: The Influence of Intake Function on the Mathematical Model of the Water Advance Function for Surface Irrigation.

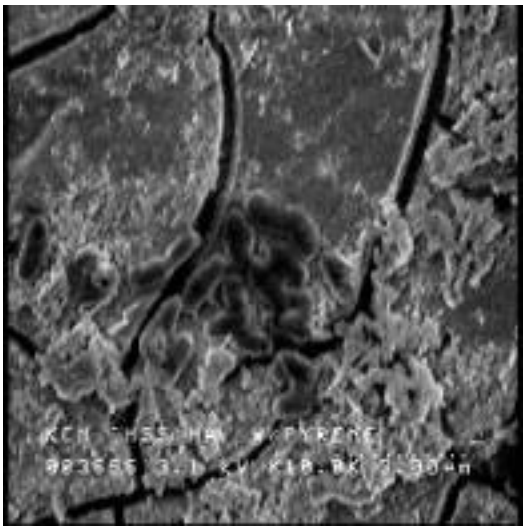
Uzcategui-Briceno, German E.
Merida, Venezuela
Major: Civil Engineering
Major Professor: Dr. Gordon A. Flammer
Thesis: Drag Coefficients and Pressure Distribution for Large Semicircular Roughness Elements for Various Roughness Patterns and Flow Conditions.

Assessment of Bacterially Mediated Pyrene Bound Residue Formation

Karl Nieman
k.nieman@usu.edu
Utah Water Research Laboratory

Since the mid 80's, contaminated soil at the Libby Groundwater Superfund Site in Libby, MT, has been undergoing treatment. The site is a former wood-treatment facility, and was one of the first Superfund sites listed. Operations at the site resulted in the contamination of significant amounts of soil and groundwater with toxic chemicals. Pyrene is one of the organic contaminants present in the Libby soil. Contaminated soil is currently being treated in a landfarming operation in which indigenous soil microbes are encouraged to degrade the contaminants and detoxify the soil. This bioremediation process results in either complete destruction (conversion to carbon dioxide and water) of the contaminants or the production of degradation products that are further degraded or remain sorbed or bound to the soil. Sorbed compounds or degradation products can be extracted and quantified by environmental chemists, but chemicals that are not extractable are considered to be "bound residues" and can only be detected by laboratory studies that involve radiolabeled tracers. Their exact chemical identity and potential for future release is not well characterized.

This project involves the use of two analytical techniques, synchrotron-based FTIR Microspectroscopy and Nuclear Magnetic Resonance (NMR), to further characterize the bound residues produced in the Libby soil. The bioavailability and toxicity of the bound residues will also be assessed. Presently, these bound residues are not believed to pose a significant hazard to human health and the environment, but the presence of these bound compounds and residual sorbed compounds may prevent the soil from being used for anything more than fill material. This research will provide new information about the nature of bound residues that can be used to decide about future soil use, including the potential return of the soil to sustainable agriculture.



Contaminant degrading bacteria on a humic acid surface. The bacteria were isolated from the Libby soil at the Utah Water Research Laboratory

Contaminated soil being placed in a treatment cell at the Libby Superfund Site

Synchrotron-based FTIR microscope at the Lawrence Berkeley National Laboratory Advanced Light Source that is being used to monitor bacterial contaminant degradation