Goal of Research

The goal of this research is to evaluate the accuracy of five different hydrologic models (HELP, UNSAT-H, Vadose/W, Hydrus-2D, and LEACHM) commonly used for the design of cover systems using high quality field data from large-scale test facilities of alternative covers, with the ultimate aim of developing an improved, easy-to-use, and field-verified model for long-term assessment of alternative covers at a variety of sites and climatic conditions.

Statement of Work (including objectives and tasks)

The research project has four objectives:

- a baseline assessment and comparison of the algorithms in existing hydrologic models when applied to a variety of meteorological conditions,
- an unbiased critical assessment of the predictive capabilities of existing hydrologic models for covers using field data from ALCD, ACAP, and RMA,
- improvement of the hydrologic model (or models) that have the most promise so that predictions made with the model are accurate, and
- incorporation of additional algorithms in the model that can be used to assess the impact of long-term processes such as plant succession, pedogenesis, and climatic change.

A research plan consisting of four tasks has been designed to meet the four objectives mentioned earlier. A brief description of these tasks follows.

Task I: Baseline Assessment of Hydrologic Models (Project Year 1)

A baseline assessment of the five models will be conducted at the onset of the study. This assessment will have two parts: (a) a series of comparative and parametric simulations, and (b) a review and comparison of all basic algorithms used in the models in the context of the simulation results.

Task II: Comparison of Field Data and Model Predictions (Project Years 1 and 2)

Based on the results of Task I, a subset of the five models will be used to make predictions of field performance for each of the test facilities to be evaluated. This subset will include only those models that yield predictions that are consistent with well-known field behavior and physical principles. Water balance models, Richards’ equation models, or both
types of models may be used in this subset. Depending on the outcome of Task I, all five models potentially may be included in Task II.

Task III: Model Improvement (Project Years 2 and 3)  
In Task III, the results of Tasks I and II will be used to (i) identify the model (or models) with the greatest promise to accurately replicate field behavior, and (ii) determine how the model should be modified to make it more accurate. The detailed and comprehensive data collected at the field sites will provide the means for assessing how each of the meteorological, biological, and geotechnical factors influences field performance, and how to develop algorithms that reflect this behavior.

Task IV: Algorithms for Long-Term Performance Assessment (Project Year 3)  
Additional algorithms will be added to the model (or models) in Task IV for simulating long-term effects that may influence the hydrologic behavior of covers. The characteristics of these algorithms will be based on the short-term pedogenetic and vegetative changes observed at the ACAP and ALCD field sites, as well as the knowledge that has been gained from natural analog studies.

Relevance of Research

The key deliverable from this study will be an improved, easy-to-use, and field-verified model for long-term assessment of alternative covers at a variety of sites and climatic conditions. This deliverable is consistent with Focus Areas 1 (e.g., unsaturated flow) and 4 (control technologies) and the Specific Research Needs of the Rocky Mountain Regional HSRC, as stated on the web site for the center (http://www.engr.colostate.edu/hsrc/research.html).

Progress (for each objective/task, provide the following: (1) Progress to date; (2) % completed; (3) Problems encountered and/or unexpected results; and (4) Future activities)

Task I
(1) Progress to date:

The models used for cover analysis (HYDRUS-2D, UNSAT-H, HELP, SOILCOVER, LEACHM, AND VADOSE/W) have been successfully acquired at both the University of Wisconsin (UW) and Colorado State University (CSU), have been uploaded onto PCs, and tested for functionality. A new desktop Dell PC (Intel® Pentium® 4 Processor at 2.40 GHz with 512 K L2 Cache; 1.2 GB memory) has been purchased off of project funds at CSU solely for the project. The algorithms used by the models are being reviewed and compared, and data sets to be used for the comparative analyses are being compiled.

(2) % completed: 25 %

(3) Problems encountered/unexpected results: Due to the semester system employed at both the University of Wisconsin (UW) and Colorado State University (CSU), the project effectively didn't start until the middle of January 2003. As a result, the project has been active for less than three months. In addition, while a qualified graduate student has been hired to work on the
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project at the UW, some difficulty has been encountered in terms of hiring a graduate student to work on the project at CSU. As a result, an existing PhD student at CSU, Jae-Myung Lee, has been hired temporarily to get the project started. As of today (March 31, 2003), this problem has been rectified since a new PhD student, Qing Lin, has just accepted an offer to work on the project beginning Summer 2003. So, although we have been delayed somewhat on the start of the project due to staffing problems, no serious technical problems or unexpected results have been encountered.

(4) Future activities: Assembly of the input files will be continued, and then the comparative simulations will be conducted.

**Task II**

(1) Progress to date:

The field data to be used in Task II have been compiled and organized.

(2) % completed: 10%

(3) Problems encountered/unexpected results: No problems or unexpected results have been encountered.

(4) Future activities: Simulation of the field sites will begin once the remainder of Task I has been completed.

**Task III**

This task has not yet been started.

**Task IV**

This task has not yet been started.

**Summary of Relevant Data (if any)**

**Schedule and Scope (given the work to date, is original timetable and work plan still valid?)**

The original timetable and scope of work are still valid, except the timetable should be shifted about 6 months due to the delay in setting up the contract at UW and getting started on Task I at CSU.

**Appendix (attach a separate appendix listing publications, presentations and relevant web sites)**

Results of this study have not yet been disseminated.