

Minnesota and Red River CWMS Watershed Modeling



Lake Traverse and Reservation Dam

To establish a flood forecasting system and reduce future flood damage in the Red River of the North basin (4,010 square miles) and Minnesota River basin (1,770 square miles), the U.S. Army Corps of Engineers, St. Paul District (the Corps), is developing a Corps Water Management System (CWMS) model to assist in real time operation of the reservoirs to regulate reservoir outflows.

WEST Consultants, Inc., (WEST) developed snow process, hydrologic, water control, and hydraulic models that will be incorporated by the Corps into CWMS as model components. The modeling work included development, calibration, and verification of the Distributed Snow Process Model (DSPM), HEC-HMS, HEC-ResSim, and HEC-RAS models. The study involved the following major tasks:

Watershed Delineation. Watershed subbasins and stream networks were delineated using HEC-GeoHMS. Basin areas at select locations and stream delineations were confirmed with USGS DLGs, HUC maps, and reported drainage areas.

CWMS Modeling Approach. Modeling sequences were determined for both basins to integrate DSPM, HEC-HMS, HEC-ResSim, and HEC-RAS models. Particular attention was given to node and reach naming convention. Common computation points were also identified to accomplish flow exchange between models.

DSPM Snow Process Modeling. DSPM models were developed and calibrated to calculate the snowmelt for rain-free conditions and rain-on-snow events as gridded precipitation into HEC-HMS models. Gridded precipitation, temperature, and initial snow water equivalent were developed for DSPM using GageInterp and other utility programs.

HEC-HMS Model Development and Calibrations. For both basins, three separate HEC-HMS models were developed and calibrated for simulating spring snowmelt only, spring snowmelt plus rain, and summer rain events. The deficit and constant loss method, the bounded recession baseflow method, and the distributive ModClark transform method were employed in the HEC-HMS models.

HEC-ResSim Model Development and Calibration. HEC-ResSim models were developed to simulate flow routing through reservoirs and reaches. The inflows were calculated in HEC-HMS models.

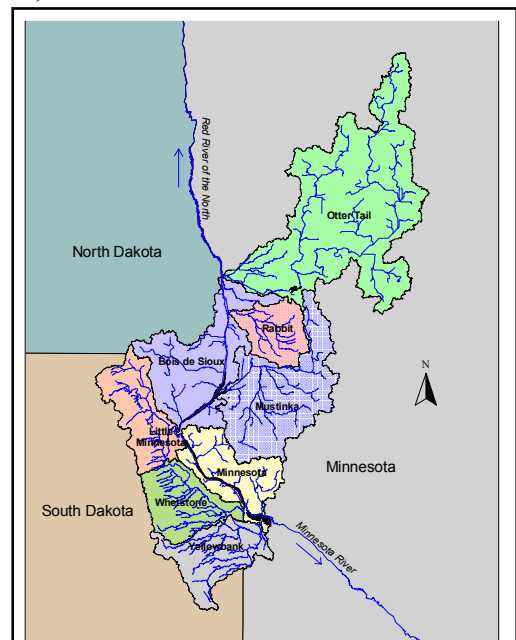
HEC-RAS Model Development and Calibration. Two geo-referenced unsteady flow HEC-RAS models were developed and calibrated to simulate flow routing for spring and summer floods through the Bois de Sioux River with the inflows provided from the HEC-ResSim and HEC-HMS output.

CWMS Model Verification. Four historic events were selected to verify the DSPM and the HEC-HMS and HEC-RAS models. Model verification results indicated that the models developed in this study were appropriate for the CWMS type watershed modeling.

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Red River of the North basin and Minnesota River basin subwatersheds