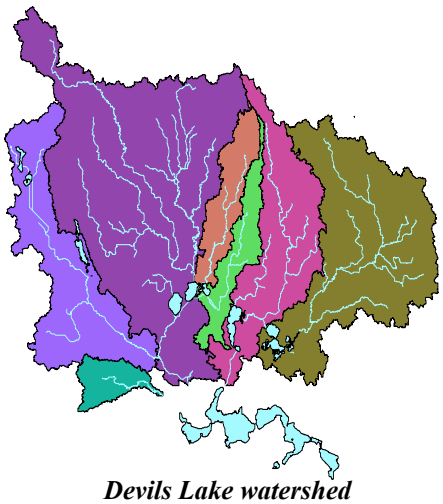
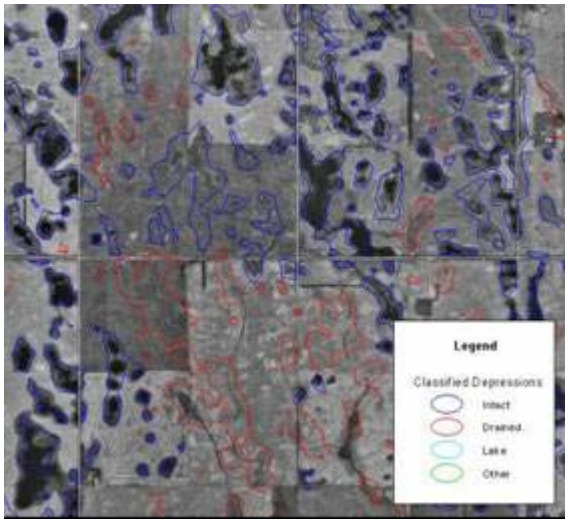
Devils Lake Upper Basin Storage Evaluation

Devils Lake is a terminal lake located within a 3,858 square mile drainage area in the prairie pothole region of northeastern North Dakota. This region is characterized by numerous shallow wetland depressions, some of which have been drained for farming or other purposes. Since 1993, the water surface elevation of the lake has risen rapidly, causing significant flooding in nearby communities. The restoration of drained depressions is being considered as a potential option for reducing future flood damages.

WEST Consultants, Inc., (WEST) conducted a hydrologic study to evaluate the impacts of depression restoration on the volume of runoff flowing into Devils Lake. The first phase of the analysis was a familiarization study to obtain and review previous studies and to obtain input from local agency representatives. During the second phase of the study, a custom physically-based hydrologic model, the Pothole-River Network Model (PRINET), was developed to simulate the hydrologic functions of the depressions and to evaluate the effects of depression restoration on runoff volumes.



Devils Lake watershed



Classified depressions

Using ArcView GIS, over 115,000 depressions were delineated and classified for the entire watershed. A digital elevation model (DEM) was used to determine the location, area, and volume of the depressions. Depressions not captured by the DEM were added based on aerial photographs and National Wetlands Inventory (NWI) data. Depressions were classified as intact, drained, lake, or "other". The depression delineation and classification process was extensive, physically-based (with minimal extrapolation), and reproducible, yielding reasonable estimates of depression area and volume.

Using ArcView GIS, the watershed was divided into over 9,000 subbasins, and the corresponding stream network was delineated. The pour point and contributing drainage area for each depression was also computed. Each depression was assigned to a subbasin and categorized as either on-river or off-river. The PRINET model applies precipitation (rainfall plus snowmelt) to a subbasin, performs soil moisture accounting calculations, computes runoff into the on- and off-river intact depressions, and routes the excess runoff to on-river intact depressions in the downstream subbasins.

To analyze the impacts on the watershed runoff from depression restoration, drained depressions were reclassified as intact depressions. Various climatic scenarios (wet, dry, average etc.) were simulated to analyze the effectiveness of depression restoration under different conditions.

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