

### Upper Basin Storage Studies

**Explanation:** The actual amount of wetland storage that is available in the Devils Lake basin has been a matter of some debate in recent years. The following is a brief summary of the studies that have been conducted by various agencies or teams of agencies examining the acreage, and storage potential of wetlands in the Devils Lake basin.

#### 1) Wetland Acreage and Storage Studies

a)

**Author:** Ludden, A.P., D.L. Frink, and D.H. Johnson

**Year:** 1983

**Title:** Water storage capacity of natural wetland depressions in the Devils Lake Basin of North Dakota

**Publisher:** Journal of Soil and Water Conservation 38:1

**Findings:** **Estimate of Wetlands Acreage (Drained and Undrained) in the DL Basin:**  
(Remaining: 412,000 acres)

**Estimate of Wetland Storage in the DL Basin (Drained and Undrained) in the DL Basin:**

2-Year Event: 116,000 acre-feet

100-Year Event: 435,000 acre-feet

**Average Depth of Wetlands:** 19.1 inches (1.59 feet) \*Annotated in article\*

**Maximum Total Storage Remaining (Drained and Undrained):** 657,000 acre-feet

**Average Annual Evapotranspiration (Based on ND PPR):** 29.9 inches

**Limitations:** Did not examine the role of evapotranspiration, climate, and antecedent moisture in storage. Did not consider storage of waterbodies larger than one 1/4 section (160 acres). Assumed uniform volume for wetlands. Limited topographical resolution. Evapotranspiration estimated based upon average for North Dakota prairie pothole region, not specific to Devils Lake. Storage of anthropogenic depressions was eliminated or reduced.

b)

**Author:** W.M. Schuh (NDSWC)

**Year:** 1996

**Title:** Drained and Partially Drained Wetlands in the Devils Lake Basin

**Publisher:** NDSWC Memorandum to Stan Hanson

**Findings:** **Estimate of Drained Wetlands in the Devils Lake basin (207 samples in DL basin):**

Completely Drained Wetlands: 28,869 acres

Partially Drained Wetlands: 40,521 acres

Total Drained Wetlands (95% CI) 69,390 acres

**Limitations:** Did not estimate wetland acreage lost between cessation of NWI sampling and "Swampbuster." Limited topographical resolution.

c)

**Author:** Sprynczynatyk, D.A. (NDSWC)

**Year:** 1996

**Title:** Letter to Steve Blomeke (Natl. Wildlife Federation)

**Publisher:** The North Dakota State Water Commission (Letter)

**Findings:**

**Summary of Storage for Three Different Frequency Rain Events:**

2 Year: 7.9 inches-14,912 acre-feet of storage

10 Year: 11.8 inches-22,143 acre-feet of storage

25 Year: 14.6 inches-27,340 acre-feet of storage

**Limitations:** Storage estimates were based upon wetland being completely dry prior to event. Limited topographical resolution.

d)

**Author:** Sprynczynatyk, D.A. (NDSWC), and A.J. Sapa (USFWS)

**Year:** 1997

**Title:** Untitled NDSWC & USFWS letter

**Publisher:** Letter to Steve Blomeke (Natl wildlife Federation) and Roger Beaver, (DLBJWRB)

**Findings:** **Estimate of Undrained Wetland Acres Remaining as of 1979(NWI):** 252,460 acres

**Minimum Estimate of Altered Wetlands As of 1979(NWI)**

Completely Drained: 25,490 acres

Partially Drained: 34,000 acres

**Assumed Wetland Loss Between 1979 and "Swampbuster" Act:** 41,000 acres

**Total Wetlands Altered as of 1985(Personal Calculation 1):** 100,490 acres

**Total Wetland Area(Personal Calculation 2):** 352,950 acres

**Estimated Drained Wetland Storage:** Based on 60,000 acres (w/out post 1979 additional 41,000 acres) drained wetland acres, utilizing Ludden(1983), Best(1978)Range of 156,000-294,000 acre-feet

**Additional Storage:** Available above current on upper basin lakes: 33,250 acre-feet

**Total Storage(Not Incorporating Wetland Loss 1979-1985):** Range of 189,250-327,250 acre-feet (Personal Calc. of Min. Estimate)

**Limitations:** Did not extrapolate lost storage based upon additional acreage. Relied exclusively upon literature review, with no ground-truthing. Did not examine the role of evapotranspiration, climate, and antecedent moisture in storage. Limited topographical resolution.

e)

**Author:** Sapa, A.J. (USFWS)

**Year:** 1997

**Title:** Letter to Steve Blomeke (Natl. Wildlife Federation)

**Publisher:** United States Fish & Wildlife Service

**Findings:** **Estimate of Original Wetland Acreage in the DL basin:** 400,000 acres

**Estimate of Drained Wetland Acreage in the DL basin:** 189,000 acres

**Estimate of Remaining Wetland Acreage in the DL basin:** 211,000 acres

**Estimated Range of Storage of Drained Wetlands in the DL basin:** 491,400-926,100 acre-feet

**Estimate of Maximum Storage of Remaining Wetlands in the DL basin:** 657,000 acre-feet

**Estimate Maximum Storage of Original Wetland Acreage in the DL basin (personal calculation):** 1,148,400-1,583,100 acre-feet

**Estimate of Drained Hydric-Soil Acreage in the DL basin as of 1980 (NRCS source):** 142,000 acres

**Estimate of Required Wetland Acreage Restoration to Hold 75,000 Acres:** 43,000 acres

**Estimated Evaporation Rate (As from Shjeflo, 1968):** 25.32 inches annually

**Estimated Evapotranspiration Rate (As from Ludden et al. 1983):** 29.9 inches annually

**Estimated Seepage (Groundwater Loss?):** 7.2 inches annually

**Max Wetland Depth (Ludden, 1983, with # number changes to reflect revision):** 19.1 inches

**Estimate of Average Original Wetland Storage/Depth (Personal Calculation: Storage of Original Wetlands/Original Wet Acres):** 47.5 inches

**Estimate of Average Drained Wetland Storage/Depth (Personal Calculation: Min-Max Storage of Drained Wetlands/Drained Wet Acres):** 31.2 inches to 58.8 inches

**Limitations:** Evapotranspiration estimated based upon average for North Dakota prairie pothole region, not specific to Devils Lake. Analysis not based on specific hydrological studies.



f)

**Author:** Gehringer, M. and M. Hove (State Water Commission)

**Year:** 1998

**Title:** Assessment of Drainage in the Devils Lake Basin

**Publisher:** North Dakota State Water Commission

**Findings:**     **Number of Drained Wetlands in the Devils Lake Basin (includes Stump):** 23,000  
                  **Acreage of Drained Wetlands in the Devils Lake Basin (includes Stump):** 41,000 acres  
                  **Volume of Drained Wetlands in the Devils Lake Basin (includes Stump):** 82,000 acre-feet

**Limitations:** Assumed an average wetland depth of two feet. Wetland data is based upon NRCS wetlands maps of almost the entire basin, and GIS delineations of those maps. Study assumes that all drained wetlands do contribute to Devils Lake or Stump Lake.

g)

**Author:** Bell, A., D. Eckhardt, and M. Pucherelli (Bureau of Reclamation)

**Year:** 1999

**Title:** Pilot Project: Wetlands Inventory and Drained Wetlands Water Storage Capacity Estimation for the St. Joe-Calio Coulee Subbasin of the Greater Devils Lake Basin, North Dakota

**Publisher:** U.S. Department of the Interior, Bureau of Reclamation. Technical Service Center. Denver, Colorado. Technical Memorandum No. 8260-99-02

**Findings:**     **Number of Existing Wetlands in St. Joe-Calio Coulee:** 4,309  
                  **Acreage of Existing Wetlands in the St. Joe-Calio Coulee:** 21,505 acres  
                  **Average Maximum Depth of Depressions in the St. Joe-Calio Coulee:** 8.6 inches  
                  **Number of Drained Wetlands in the St. Joe-Calio Coulee:** 1,898  
                  **Acreage of Drained Wetlands in the St. Joe-Calio Coulee:** 4,749 acres  
                  **Storage of Drained Wetlands in the St. Joe-Calio Coulee:** Estimate of 3,400 acre-feet (95% CI)  
                  **Estimate of Drained Wetland Storage for Entire DL Basin based on St. Joe-Calio Coulee Numbers:** 53,408 acre-feet (95% CI)  
                  **Estimate of Total Wetland Storage in the Entire DL Basin based on St. Joe-Calio Coulee Numbers:** 524,000 acre-feet  
                  **Estimate of Drained Wetland Storage (Total Wetland Storage-Drained Wetland Storage) (Personal Calculation):** 470,592 acre-feet

**Limitations:** Estimates of basin-wide wetland storage based upon small, extensively studied data subset. Difficulty in estimating drained wetland area. Limited ground-truthing. Limited topographical resolution. Did not examine the role of evapotranspiration, climate, and antecedent moisture in storage.

h)

**Author:** Doeing, B.J., and S.M. Forman (West Consultants, Inc. on Behalf of USACE)

**Year:** 2001

**Title:** Final Report: Devils Lake Upper Basin storage Evaluation

**Publisher:** West Consultants, Inc. Prepared for United States Army Corps of Engineers

**Findings:**     **Number of Possibly Intact/Undrained Wetlands in the DL Basin:** 63,458  
                  **Possibly Intact/Undrained Wetland Acreage in the DL Basin:** 201,990 acres  
                  **Estimated Storage of Possibly Intact/Undrained Wetlands in the DL Basin:** 481,604 acre-feet  
                  **Number of Possible Drained Wetlands in the DL Basin:** 52,210  
                  **Possibly Drained Wetland Acreage in the DL Basin:** 92,429 acres  
                  **Estimated Storage of Possibly Drained Wetlands in the DL Basin:** 132,729 acre-feet  
                  **Total Number of Wetlands in the DL Basin:** 115,668  
                  **Total Acreage of Wetlands in the DL Basin:** 294,419 acres  
                  **Total Storage of Wetlands in the DL Basin:** 614,333 acre-feet  
                  **Restoration of 25% of Possibly Drained Wetlands (Option B) Acreage:** 19,472 acres  
                  **Restoration of 25% of Possibly Drained Wetlands (Option B) Storage:** 31,431 acre-feet  
                  **Restoration of 50% of Possibly Drained Wetlands (Option C) Acreage:** 39,681 acres

**Restoration of 50% of Possibly Drained Wetlands (Option C) Storage:** 63,608 acre-feet  
**Restoration of 75% of Possibly Drained Wetlands (Option D) Acreage:** 59,872 acres  
**Restoration of 75% of Possibly Drained Wetlands (Option D) Storage:** 94,850 acre-feet  
**Restoration of 100% of Possibly Drained Wetlands (Option D) Acreage:** 79,762 acres  
**Restoration of 100% of Possibly Drained Wetlands (Option D) Storage:** 127,835 acre-feet  
**Average Annual Runoff Reduction (10 Climate Sequences Average)(Option B):** 6,836 acre-feet  
**Average Annual Runoff Reduction (10 Climate Sequences Average)(Option C):** 12,910 acre-feet  
**Average Annual Runoff Reduction (10 Climate Sequences Average)(Option D):** 18,403 acre-feet  
**Average Annual Runoff Reduction (10 Climate Sequences Average)(Option B):** 23,841 acre-feet  
**Average Annual Runoff Reduction (Wet Scenario)(Option B):** 7,959 acre-feet  
**Average Annual Runoff Reduction (Wet Scenario)(Option C):** 15,643 acre-feet  
**Average Annual Runoff Reduction (Wet Scenario)(Option B):** 23,502 acre-feet  
**Average Annual Runoff Reduction (Wet Scenario)(Option B):** 31,193 acre-feet  
**Average Evaporation from a Depression:**  $\geq 20$  inches annually

**Limitations:** Evapotranspiration was likely underestimated. Did not examine the effects of climate completely enough. No ground-truthing of estimates. Wetland restoration could be optimized to increase wetland storage for Options B-D.

i)

**Author:** Vining, K.C. (USGS)

**Year:** 2002

**Title:** Simulation of Streamflow and Wetland Storage, Starkweather Coulee Subbasin, North Dakota, Water Years 1981-98

**Publisher:** USGS, Water-Resources Investigations Report 02-4113

**Findings:** **Average Wetland Depth in Starkweather Coulee:** 2.21 feet  
**Total Maximum Wetland Area in Starkweather Coulee:** 30,890 acres  
**Total Maximum Wetland Volume in Starkweather Coulee:** 68,270 acre-feet  
**Average Reduction in Spillage from Wetlands with Removal of Drains (1981-1998):** 49%  
**1997-Event Reduction in Spillage from Wetlands with Removal of Drains:** 20%  
**Average Wetland Evapotranspiration-Personal Calc. (1981-1998):** Approx 20 inches annually.

**Limitations:** Did not model hydrological effects of frozen soil. Study was limited to hydrological factors being estimated based upon one wetland analyzed per hydrological response unit. Other hydrological modeling limitations, due to an extremely complex system.