

## APPENDIX B

### Literature Review and Bibliography

#### 1. Spring Flood 2007, Browns Valley, Minnesota. JOR Engineering, Inc. May 15, 2007

Contents: This report provides a general history of flooding and geology near and within Browns Valley.

It also presents a comprehensive discussion of the causes of the flooding problems, including the effects of ice jams. Great detail of the 2007 flood mechanism, including aerial photographs, is also provided. Bank full river capacity through town is estimated to be about 1600 cfs.

The document discusses how the naturally developed delta formation historically allowed high water to escape and bypass Browns Valley, thereby providing moderation of flows on the Little Minnesota River. However, this natural flood relief system has been blocked by road and dike construction, so that significantly more water is forced through Browns Valley than there would have been previously.

The document recommends that restoration of that bypass as the preferred approach to reducing the current flood hazard.

Relevance: *This document is a source of information used to assist in identifying the range of flood mitigation alternatives.*

#### 2. Background on the March 13-14, 2007 Flooding in Browns Valley (Traverse County), Minnesota. Report to the Governor's Office. Minnesota Department of Natural Resources Waters Division. April 20, 2007

Contents: This report is a summary of the March 13-14, 2007 flooding in Browns Valley. It describes where the ice jamming occurred and its effect on the flow regime of the river, as well as a detailed description of the flow path taken by the breakout flows.

The document also discusses the potential effects of the agricultural dike at the Roger Haanen property and dredging in the Little Minnesota River in the area between Veblen and Claire City, SD.

It also presents a table with measured peak flows at the Peever gage during past flood events and whether or not the peaks were affected by ice.

The report also explains the process by which it is determined whether a damaged structure must be retrofitted to meet the

requirements of the current floodplain ordinance, as well as potential cost-share opportunities.

Relevance: *The information in this report was used to assist in understanding the flooding mechanism under conditions of ice jams in the river, specifically regarding the March, 2007 flood event. The table of historical flooding was used in the selection of flood events to simulate for hydraulic model calibration.*

**3. Browns Valley High Water Mark Survey, Minnesota Department of Natural Resources, Division of Waters. March 26, 2007**

Contents: This document reports the results of an elevation survey to assist in the evaluation of flooding caused by ice jams on March 14, 2007. High water marks and some control features were surveyed in the City of Browns Valley, and at the USGS discontinued stream gage (#05290000). The document includes photographs and a brief review of stream gage data.

Relevance: *The high water marks provided in this document were used to assist in calibrating the hydraulic model.*

**4. Section 22 Study, Minnesota River Main Stem Hydrologic Analyses. U.S. Army Corps of Engineers, St. Paul District, October 2001**

Contents: This report presents the hydrologic analyses for development of a consistent set of frequency distributions for the main stem of the Minnesota River from Ortonville, Minnesota, to its confluence with the Mississippi River at Mendota Heights, Minnesota. These analyses were performed as part of a joint funding effort between the Minnesota Department of Natural Resources and the St. Paul District Corps of Engineers under Section 22 of the Water Resources Development Act of 1974.

Relevance: *The results of the stage-frequency analysis are used as a guide in selecting elevations to be used at the downstream boundary conditions (Big Stone Lake) for hydraulic analysis.*

**5. CEMVP-ED-H Memorandum for Record. Subject: Interbasin Flow, Browns Valley Dike, Browns Valley, Minnesota, 2001 Flood and Historical Information, August 23, 2001**

Contents: This memorandum was written following the Spring 2001 flood in Browns Valley and discusses the Little Minnesota River breakout flow that occurred. It describes the flows measured near the time of

the flood/breakout, as well as the observations and photographs made by two Corps of Engineers flood reconnaissance engineers. There were no ice jam problems in Browns Valley during the 2001 flood.

By observing the locations of breakout flow, the discharge at the Peever gage, and aerial photographs, the document makes its case that breakout flow from the left bank of the river and into Lake Traverse occurs more frequently than a 10-year event.

*Relevance: This report was used in the selection process of hydraulic model calibration events and in understanding the breakout flow mechanism to Lake Traverse.*

## **6. Browns Valley Dike, History and Potential for Interbasin Flow. USACE. 2000**

Contents: This report examines history and current state of interbasin flow between the Minnesota River basin and the Red River of the North watershed in the vicinity of Browns Valley, Minnesota. It provides a detailed description of the infrastructure and the flow regime of the Little Minnesota River, Big Stone Lake, and Lake Traverse, as well as interbasin flow, including a time-line of how the area has changed over time.

The document provides information on the gages in the vicinity of Browns Valley, recorded hydrometeorological data, and results of a literature search on historical flood events.

*Relevance: This document is a valuable reference for the Task Force to use in understanding the history of flooding issues in Browns Valley.*

## **7. Post Ice Jam Flood Field Trip Report, Little Minnesota River at Browns Valley, MN, Richard Pomerleau, P.E., U.S. Army Corps of Engineers, St. Paul District, March 28, 1995**

Contents: This report includes a memorandum, photographs, and maps from the spring flood in 1995, caused by an ice jam.

It also summarizes information on prior flood events and a reference list of prior reports and studies.

Regarding the Toelee Coulee, it states that the 1965 flooding problems on the coulee were a result of debris plugging a bridges and culverts. The coulee has not experienced flooding since 1965, and conditions along the coulee have changed since then. The document notes that the highway has been raised and re-aligned,

and that the city is of the opinion that the actual flood threat on the coulee has been reduced.

Relevance: *This report was used in the selection process of hydraulic model calibration events and in understanding the flood mechanism.*

**8. City of Browns Valley Flood Damage Reduction Project, Study of Alternate Diversion Alignments B&D. Widseth Smith Nolting & Assoc., Inc. December 1991**

Contents: This report considered two alternative diversion/levee alignments. A HEC-2 hydraulic model was used to develop the functional design of each alternative. The existing FIS model was modified and adapted for this purpose.

One alternative was similar to the proposed project in the 1989 report, a combination diversion channel and levee system along the southwest side of the city, except that the project would be completely within the state of Minnesota.

The other alternative shifted the alignment of the diversion much farther upstream to the point where the river enters the valley. It also included an improved overflow channel from the river to Lake Traverse. Obtaining land rights in South Dakota was deemed too difficult.

Relevance: *This document is a source of information used to assist in identifying the range of flood mitigation alternatives.*

**9. Flood Damage Reduction Study for Browns Valley, Minnesota. Widseth Smith Nolting & Assoc., Inc. January 1989**

Contents: This report provides a preliminary analysis of the city's flooding problems and possible solutions. The goal of the study was to reduce the threat of flooding sufficiently to remove most or all of the developed area of Browns Valley from the 100-year flood plain.

The report concludes that it would be possible to remove the City from the 100-year floodplain by installing structural measures. Preliminary proposals included a reservoir on the Unnamed Coulee and a combination diversion channel and levee system along the southwest side of the city.

The proposed plan was abandoned due to difficulties related to obtaining land rights in South Dakota.

Relevance: *This document is a source of information used to assist in identifying the range of flood mitigation alternatives.*

**10. Section 205, Flood Control, Initial Appraisal Report, Little Minnesota River at Browns Valley. U.S. Army Corps of Engineers, St. Paul District, August, 1986**

Contents: Flood control alternatives evaluated included channel improvement, bypass channels, and levees which would protect from Little Minnesota River and coulee flooding.

The preliminary results of this study show that it would not be economically feasible to provide flood protection for Browns Valley against the design flood (100-year) by any of these alternatives.

Relevance: *This document is a source of information used to assist in identifying the range of flood mitigation alternatives.*

**11. Flood Insurance Study, City of Browns Valley, Minnesota, Traverse County, Federal Emergency Management Agency, June 17, 1986**

Contents: This Flood Insurance Study determined the frequency with which breakout flow occurs from the left bank of the Little Minnesota River to Lake Traverse.

The study used the HEC-2 computer model to compute water surface profiles and revealed that the breakout begins between a discharge of approximately 3,000 and 6,000 cfs (between a 10- and 50-year event), under open-water conditions.

The report also investigated flood hazards and prepared floodplain maps.

Relevance: *This document is used a source for checking reasonability of results for the current flood mitigation hydrologic/hydraulic modeling.*

**12. Interim Report: Hydrologic Analysis for Type 15 Flood Insurance Study, Browns Valley, Minnesota. U.S. Army Corps of Engineers, St. Paul District, June 7, 1983**

Contents: This interim report presents the methodology used to develop the hydrology of the Little Minnesota River through Browns Valley.

This report was submitted to FEMA for review before its results (i.e., frequency curves) were used for a hydraulic analysis. Through this hydrologic analysis, it was determined that Little Minnesota River flows would break out from the river just upstream of Browns Valley in South Dakota.

Relevance: *Historical reference.*

**13. Section 205, Flood Control Reconnaissance Report. Little Minnesota River at Browns Valley, Minnesota. U.S. Army Corps of Engineers, St. Paul District, February, 1972**

Contents: This report describes the developments prior to 1972 affecting the flood situation at Browns Valley, including the raising of the Roberts County, South Dakota Highway No. 24 (Dakota Avenue) by local interests to provide a more reliable farm-to-market route for the area. The document states that prior to the raising of this road, a significant portion of the flood discharge on the Little Minnesota River could overtop the roadway and flow southeast to rejoin the river channel downstream of Browns Valley. The document makes a case that the raising of the road prevents flood flows from following this natural bypass and, as a result, increases flooding to agricultural lands both north and west of the raised road and within the city.

The report notes additional structural constraints affecting the natural drainage pattern including private levees constructed by farmers to protect their fields from overland flow.

The report evaluates both structural and nonstructural flood control solutions, including bypass channels, levees, and evacuation. But the preliminary results of this study show that it would not be economically feasible to provide any of these flood projection alternatives. The report recommends that the village adopt strict floodplain management regulations, and that local officials consider applying to the MNDNR for a floodplain information study to aid in defining the true extent of the local flood problem.

Relevance: *This document provides valuable historical information on structural modifications and their hydraulic effects on the Little Minnesota River and flooding in Browns Valley.*

**14. Memo for Record. Flood Emergency in Browns Valley, Minnesota. Thomas Raster, Planning Branch, Engineering Division. U.S. Army Corps of Engineers. 20 March, 1972**

Contents: This memo describes the site visit made to Browns Valley during the March, 1972 flood.

It was found that the apparent cause of the high waters to be the sudden breakup of an ice jam located several miles upstream which caused a temporary surge in runoff at Browns Valley.

County Highway No. 24 (Dakota Street) had recently been raised about 18 inches by the County Highway Department.

They also constructed a levee beside the river just upstream of Browns Valley where the river emerges onto the outwash plain, which was intended to prevent overbank flow from damaging the improved road.

Prior to construction of these improvements, a significant portion of any flood flow could bypass Browns Valley via the natural overland drainage system.

Relevance: *This document provides valuable historical information on structural modifications and their hydraulic effects on the Little Minnesota River and flooding in Browns Valley.*

**15. Section 205, Flood Control Project; Unnamed Coulee at Browns Valley, Minnesota. U.S. Army Corps of Engineers, St. Paul District, June, 1966**

Contents: This document contains a discharge-frequency curve for the Unnamed Coulee based on a drainage area of 3.32 square miles at State Highway No. 28 (Broadway Avenue). Because of limited data available, the annual discharge frequency curve was computed by several synthetic methods.

Rating curves for the culverts under Highway 28 were based on data for the flood of 1 June 1965 when the highwater elevation at the headwater side of Highway 28 was 679.2, and a highwater elevation at the tailwater side was 976.0, as determined from the flood outline and highwater data.

Relevance: *data was recomputed for this study.*

**16. Section 205, Flood Control Reconnaissance Report. Unnamed Coulee at Browns Valley, Minnesota. U.S. Army Corps of Engineers, St. Paul District, January, 1966**

Contents: This document describes in detail the 1965 event which caused flooding from Unnamed (Toelle) Coulee, including the meteorological information, the flow regime, and the flood damages.

Relevance: *The information in this report is used in understanding the 1965 flood event in the northeastern portion of Browns Valley.*



**17. Review of Report . Minnesota River, Minnesota for Diversion of Floodwaters of Little Minnesota River into Lake Traverse. War Department, United States Engineer Office, St. Paul, Minnesota. 17 September 1945**

Contents: This comprehensive document reviews previous flood control studies, completed flood control projects in the region, local hydrology, past floods and resulting damages. It presents several alternative plans for improvement.

It finds that the most feasible plan for flood control between Browns Valley and Marsh Lake is by diversion of the excess floodwaters of the Little Minnesota River into Lake Traverse. In addition to the flood control benefit, this plan would provide pollution abatement benefits along the Red River of the North by the availability of an added supply of water during periods of flow deficiency, and more desirable levels would be obtained in Big Stone Lake.

Relevance: *This document is a valuable reference on the history of the region in terms of water conservation and flood control.*

**18. Lake Traverse – Bois de Sioux River Flood Control and Water Conservation Project, Red River of the North Watershed. War Department, Corps of Engineers, U.S. Army. March 1, 1941**

Contents: The document explains the need for and the details of the flood control and water conservation project, including detailed descriptions of the White Rock Dam, Reservation Dam, Browns Valley Dike and the Bois de Sioux Channel Improvement.

Relevance: *This document provides a historical perspective of hydrology and flooding in the region prior to the major structural modifications affecting the behavior of the Little Minnesota River near Browns Valley.*