Red River Basin
Immediate Drought Response Process

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Acronyms and Short Forms

AOP	Annual Operating Plan
AWHC	Available Water Holding Capacity
CDMC	Crops Drought Management Committee
DCMI	Domestic, Commercial, Municipal, and Industrial water use
ET	Evapotranspiration
FAO	Food and Agricultural Organization
MB	Province of Manitoba
MN	State of Minnesota
MnDNR	Minnesota Department of Natural Resources
ND	State of North Dakota
NDAWN	North Dakota Agricultural Weather Network
NDMC	National (U.S.) Drought Mitigation Center
NEPA	National (U.S.) Environmental Policy Act
NOAA	National (U.S.) Oceanic and Atmospheric Administration
NPDES	National (U.S.) Pollution Discharge Elimination System
NWS	National (U.S.) Weather Service
PDSI	Palmer Drought Severity Index
PVWC	Pembina Valley Water Cooperative
Q90	90% flow exceedance value
RRB	Red River Basin of the North
RRBC	Red River Basin Commission
SD	State of South Dakota
SPI	Standardized Precipitation Index
SWE	Snow Water Equivalent
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USDA NASS	United States Department of Agriculture – National Agricultural Statistics Service
USGS	United States Geological Survey

Executive Summary

The Red River of the North ("Red River") basin is approximately 48,000 square miles (124,000 km^2) and includes the U.S. states of South Dakota, North Dakota, and Minnesota and the Canadian province of Manitoba. The Red River forms the boundary between Minnesota and North Dakota; roughly 20,000 mi^2 (52,000 km^2) of the basin is in North Dakota and 17,000 mi^2 (44,000 km^2) is in Minnesota. The basin is approximately 10,000 mi^2 (30,000 km^2) in Manitoba. The South Dakota portion of the basin is roughly 600 mi^2 (1,500 km^2).

Responding and preparing for drought can take many forms. These include increasing water supplies, reducing water needs by conserving water, and mitigating for drought impacts. The development of additional water supplies, as with the Red River Valley Water Supply Project, may not be possible in the short term. During this time, the risk of drought and hazards from associated impacts will remain and possibly increase as basin population and water needs change. This document discusses options and recommendations to move forward for the immediate future in improving the basin's resiliency to and mitigating the impacts of drought.

Drought is caused by a lack of precipitation over a given amount of time. Drought can be described in several ways as it unfolds:

- Meteorological: Reduction in amount of precipitation over time. This can be accompanied by increased temperatures and evaporation.
- Agricultural: Reduction in soil moisture content, generated by meteorological drought conditions.
- Hydrological: Reduction in stream flow, surface storage, lakes, reservoirs, and aquifers.

At any time during these types of droughts, a "socioeconomic drought" can occur:

- Socioeconomic: Deficits of precipitation, soil moisture, stream flow, groundwater, and reservoir conditions generate a reduction in economic goods and alterations to lifestyles and effects to individual property.

The Table below shows some of the historic droughts which have impacted the basin. Indicators of drought show that the majority of the droughts in the basin last less than 12 months. These drought events tend to be mild to moderate in severity and affect the northern portions of the basin most. The next most frequent drought events last from 12 to 36 months and are severe to extreme in nature. The impacts are throughout the basin during these droughts. Droughts lasting more than 36 months are generally extreme in nature.

All cities in Minnesota with populations over 3,000 have submitted drought management plans in 2006. The Cities of Fargo and Grand Forks have implemented drought management plans. The plans may limit certain water uses depending on the severity of drought. While these drought plans are relatively recent, examining past droughts indicates that there may have been six historic droughts peaking in Drought Warnings (a municipally declared condition requiring mandatory water use reduction for all water uses of 20 to 30%) and Drought Emergencies (requiring additional water rationing, bans on

outdoor water use, and other mandatory reduction measures) for these cities. This would have resulted in mandatory demand reductions. These events include the 1930s drought and the more recent 1987 to 1992 drought. While some of these are more intense events lasting less than 2 years, any drought event over 3 years eventually would result in a Drought Warning. Extended drought can also impact agricultural production. For example, wheat yields in east central North Dakota generally begins to fall when drought events exceed six months in length. Yield declines by roughly 10% for each year the drought lasts.

Table i. Red River Basin Historic Drought Events

Drought Event	**Duration**	**Maximum Severity (PDSI)**	**Areas of greatest drought intensity**
1897-1898	13 to 20 months	Mild to moderate	Southern ND; Southern MB
1909-1911	16 to 26 months	Severe to extreme	Central ND and MN, Winnipeg Area
1917-1918	11 to 20 months	Moderate to severe	Southern MB
1929-1942 (the 1930s drought)	102 to 151 months	Extreme	Southern ND, MN, and Southeast MB
1950-1957	35 to 77 months	Moderate to severe	Central ND and South east MB
1960-1965	21 to 37 months	Moderate to severe	Northern ND, Southeast MB, Winnipeg Area
1967-1968	8 to 15 months	Mild to severe	Northern ND and MN, Southwest MB
1974-1979	20 to 56 months	Extreme	Northern ND, South MN, Southeast MB
1979-1982	11 to 37 months	Extreme	Central and Southern ND, Northern MN
1987-1992	43 to 59 months	Extreme	Southern ND and MN
2006-2007	2 to 19 months	Moderate to severe	Northern MN and ND; Winnipeg Area

Note: See section "2.3 Historic Drought" for additional information.

The waters of a state or province are considered a public resource. Each jurisdiction operates under respective and separate water laws and regulations. Water law in Minnesota follows the riparian doctrine, which is generally used in eastern jurisdictions. North Dakota and Manitoba water law is based on prior appropriation, which is generally used in western jurisdictions. Allocation and use of water requires permits or licenses which regulate amounts, types of uses, and places of use. Minnesota has the largest number of permitted uses, accounting for 46% of all basin permits, followed by North Dakota with 32%, Manitoba with 20%, and South Dakota with less than 2% of basin permits. Based on reported actual use, Manitoba has 52% of basin reported actual use (assuming permits reflect actual water use), followed by Minnesota with 34%, and North Dakota with 14%. The actual water use in South Dakota may be negligible.

The primary uses of water in the basin include power generation, public water supply, and irrigation. Power generation is the highest permitted and reported actual use, accounting for 40% of basin permits and 60% of reported actual use. Power generation water use generally uses “once-through” cooling, where water is diverted for cooling purposes and then returned to the receiving stream. Irrigation makes up 27% of basin permits and 25% of reported actual use. Public water supply constitutes 31% of basin permits and 14% of reported actual use. Other uses constitute the remaining percentages.

Determining which areas and types of water use in the basin are susceptible to drought involves comparing the water needs against the available water resources. The 1930s drought event is the most severe, with widespread public water supply, irrigation, and industrial shortage impacts on both the mainstem of the Red River and its tributaries. Modeled flows on the Red River near the Snake River (a location close to the international border) would have approximately 530 cfs of average flow, and at least 10% of the time there would be no flow. Shortages to Fargo’s water needs might have totaled 22,000 acre-feet over 5 years and for Grand Forks it totaled 4,500 acre-feet over 7 years. In other drought events, potential impacts occur on the tributaries.

Several options were reviewed as possible responses to an immediate drought. These options are:

Conjunctive Uses

Conjunctive uses refer to the ability to use both surface water and groundwater resources as a water supply. Several municipalities have incorporated conjunctive uses into their water supplies or have expressed interest in doing so. Promoting conjunctive water uses is one approach to prepare for drought conditions. This activity may involve:

- Identifying and prioritizing conjunctive use projects.
- Develop groundwater models and studies where information is lacking to estimate sustainable safe yields of aquifers and facilitate project approval from regulators.
- Identifying funding for infrastructure improvements to facilitate conjunctive uses.

Disaster Relief

In a severe and extended drought, there may be critical water uses that cannot be satisfied with other approaches. The complete failure of a water supply could be responded to by shipping in potable water for drinking and cooking needs. The North Dakota Enhanced Hazard Mitigation Plan discusses the need for preparation of disaster relief in response to drought. Minnesota and Manitoba are in various stages of revising or producing jurisdictional drought response plans. A drought event is regional and would require coordination from the federal, state, and local emergency response agencies, both in planning and response.

Drought Forecasting

Several agencies produce reports that forecast various aspects of drought. Outlooks of 90 days are available while extended outlooks, perhaps of a year or more, may be possible by examining the relationship of temperature and precipitation to global climatic indices. Forecasting supply, demand, or anticipated shortages can have benefits in proactive water management.

Drought forecasting activities could include:

- Promote basin specific forecasts, both for short term and long term outlooks
- Select drought indicators to apply in basin-wide forecasts and monitoring applications
- Promote the National Drought Mitigation Center (NDMC) and National Weather Service (NWS) study of drought impacts and modification of the NWS flood forecasting system to include drought events
- Develop a comparison model or tool to evaluate forecasted water supply and demand to provide jurisdictions with information for proactive cooperation or water use restrictions provided under respective water law.

Drought Plan Coordination

Drought plans exist for municipalities and reservoirs in the basin. Many of these plans were developed in response to drought. These drought plans have not been utilized during an extended or severe drought nor has coordination between various plans been established. The drought plan coordination option could include:

- Determine the actual potential for demand reductions for each plan.
- Determine the effectiveness of long term water conservation versus emergency demand reductions.
- Develop a common drought monitoring system within the basin
- Provide coordination between existing drought plans to improve their combined effectiveness.
- Suggest adjustments if needed to trigger levels to improve plan effectiveness and anticipate worsening drought conditions.
- Promote cooperation among basin entities for water crisis management during drought emergencies

Emergency Supplies

During a severe and extended drought, emergency supplies should be examined to supplement shortages. Reservoirs in the basin serve multiple purposes, including habitat, water supply, flood control, water quality enhancement, recreation, and tribal water rights. Operational changes may provide additional water supply during drought, although such changes would require permit and regulatory adjustments. The operational changes include:

- Reactivation of the Lake Orwell conservation pool.
- Conversion of Ashtabula and Orwell flood pool into conservation uses.
- Partial conversion of habitat, recreation, and flood control uses of lakes into water supply.

Water Marketing/Risk Adjustment

In the event of drought, all water users have an increased risk of shortage. This risk and the consequences of water shortage are not evenly distributed. Marketing irrigation water uses to municipal uses might have a significant benefit in a long drought. However, the timing of the groundwater pumping impacts on surface water means that initiation of a water market would need to be done early in the drought and continued for the duration of the drought.

Water Rights Enforcement Coordination

Each jurisdiction has provisions to curtail certain water uses during a drought. While currently no agreement exists on how water is shared between jurisdictions during a drought, coordinating water rights enforcement actions may be beneficial. There would not necessarily be formal water sharing agreements or changes made to respective water law under this arrangement. Each jurisdiction would be operating under its current water law, with benefits of coordination of actions that would be normally taken.

Recommendations for Jurisdictional Consideration

The establishment of a basin-wide Drought Action Committee ("Committee") is recommended. The Committee could be comprised of emergency management and water resources agencies from each jurisdiction. Initial tasks for this Committee will be to develop and refine the definition of drought for the basin as a natural hazard. This includes evaluation of indicators to describe the severity of the drought.

The previously described drought response options would be reviewed by the Committee for refinement. These activities could include:

- Evaluate the feasibility of drought preparedness, reporting, monitoring, and response.
- Evaluate various drought indicators to describe drought severity and recommend a set of indicators for basin-wide drought forecasting and monitoring
- Evaluate the feasibility of drought response options.
- Develop a detailed plan on how the jurisdictions will cooperate and act, and what will trigger such action.

- Work with the national, state and provincial climate offices to develop a basin specific water supply, demand, and shortage forecasting system that is accessible through a public website.
- Start a dialogue on drought reoperation of the three major supply reservoirs of Orwell, Traverse, and Ashtabula. Some operational changes will require state permit changes, Congressional reauthorization of project uses, and/or action under the U.S. National Environmental Policy Act.
- Develop a common drought forecasting, reporting, and monitoring system in the basin.
- Initiate dialogues with emergency management agencies of the basin on coordinating drought related basin-wide disaster relief efforts.
- Initiate consultations with the public and stakeholders for drought response and monitoring.
- Initiate a study program for climate change adaptation to drought.