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2.2 Climate

In accordance with:

- Section 38-14.1-14(1)(p), North Dakota Century Code (NDCC).

This section presents the climatological conditions for the area within the Permit Boundary as shown on [Figure 2.2-1](#). Data from existing and historic meteorological (MET) stations and from a MET station installed within the Permit Boundary in 2006 were used to describe these climatological conditions. The MET station locations are also shown on [Figure 2.2-1](#). Data collected from these existing and historic climate stations include average seasonal precipitation, seasonal temperature ranges, average relative humidity records, and average direction and velocity of prevailing winds.

2.2.1 Historic Data

Daily historical data were obtained from the National Climate Data Center (NCDC)/National Oceanic and Atmospheric Administration (NOAA) and the on-line North Dakota State Water Commission (NDSWC) precipitation databases. The criteria used for selecting the existing MET stations were based on the proximity to the Permit Boundary ([Figure 2.2-1](#)), elevation and availability of information. The elevation range within the Permit Boundary is approximately 2,490 feet to 2,541 feet. The elevation range for the MET Stations is approximately 2,451 feet to 2,621 feet. [Table 2.2-1](#) presents the MET station locations, elevation, period of record, and parameters used in this evaluation. Data sets for three of the MET stations (Belfield Station No. 320639, Dickinson Exp. Station No. 322188 and Dickinson Municipal Airport Station No. 322183) are from NCDC (NWS 2007). Data sets for four of the MET stations (759, 3995, 1945, and 4323) are from NDSWC (2007).

2.2.1.1 Precipitation

Monthly mean precipitation values recorded at the NCDC and NDSWC stations are shown on [Figure 2.2-2](#) and summarized in [Table 2.2-2](#). [Table 2.2-3](#) presents mean annual precipitation data at the three NCDC stations. Precipitation data from the NDSWC stations were not included because of their short-period of record and lack of records for the months of October through March. The highest monthly mean precipitation value of 3.78 inches was observed in June at the Belfield

Station ~~and Station 759~~. The lowest value of 0.302 inches was observed in December at the Dickinson Municipal Airport Station. Monthly precipitation values vary substantially by season. Higher precipitation values are observed from April to October, and peak in June at all stations. ~~Figure 2.2-3 shows observed annual precipitation at the three NCDC MET stations.~~

2.2.1.2 *Temperature*

The mean annual temperature within and adjacent to the Permit Boundary is reported as 42.4 °F at the Dickinson Municipal Airport MET Station (NWS 2007). The coldest months are November through March with mean monthly temperature values below 30 °F. The warmest months are June, July and August with mean monthly temperatures above 60 °F. ~~The lowest and highest recorded temperatures at the Dickinson Municipal Airport MET Station for the period of record July 2, 1948 through April 30, 2007 are 35 °F and 109 °F (NWS 2007), respectively.~~ Table 2.2-4 presents monthly temperature values of daily mean maximum, daily mean minimum, and daily mean average temperature between July 2, 1949 to ~~April 30, 2007~~ December 31, 2007.

2.2.1.3 *Relative Humidity*

Relative humidity was not recorded historically within the Permit Boundary. Therefore, data from Bismarck, North Dakota (1931 to 1960) was used to characterize relative humidity. Relative humidity data was obtained from the “Climate of North Dakota” report, prepared by Ray Jensen in 1998 and posted on the USGS website (Jansen 1998). Average relative humidity records at six-hour intervals are presented in [Table 2.2-5](#). Regardless of the month of record, average relative humidity has been higher at the 12:00 AM (midnight) and 6:00 AM periods than at the 12:00 PM (noon) and 6:00 PM periods.

2.2.1.4 *Wind Speed and Direction*

Wind speed and direction were evaluated using data recorded from 1990 to 1994 at the Dickinson Municipal Airport. Data was obtained from the North Dakota Department of Health (NDDH) by TRC Environmental Corporation (TRC 2005). Collected data indicates that prevailing wind directions in the region are west and northwest during most of the year. Average wind speed ranges from 10 to 13 miles per hour. The average wind speed for the five-year period of record is also 10 to 13 miles per hour. A composite frequency distribution of wind direction and wind speed for the

five-year period of record is shown on [Figure 2.2-4](#) [Figure 2.2.3](#). The wind rose diagram indicates prevailing wind directions from the west, northwest approximately 14 percent of the time with secondary wind flow prevalence from the west approximately 11 percent of the time. The lowest frequency of wind directions is from the north northeast, which only occurs 2.5 percent of the time.

2.2.2 On-Site Meteorological Data

The MET station within the Permit Boundary was installed on October 18, 2006. Data collection began on October 25, 2006. Data were recorded on hourly intervals at the station. [Table 2.2-6](#) lists the parameters collected at the station. The daily and monthly ~~averages, minimums and maximums, except for the rain gages and solar radiation,~~[data summaries](#) are presented in [Table 2.2-7](#) and [Table 2.2-8](#) ~~Table 2.2-9, and Table 2.2-10.~~

Precipitation is presented as daily or monthly totals, and solar radiation is presented as average and maximum, since the minimum is always zero (recorded every night). The two rain gages represent different methods of measuring precipitation. The weighing bucket (RNw) is more reliable during the winter months when snow is the major form of precipitation.

Data are reported from October 25, 2006 through ~~September 23, 2007~~[December 31, 2009](#) but had intermittent periods where no data were collected due to ~~a~~ [datalogger or equipment](#) malfunction. ~~Periods in which no data were collected included December 2006, January 2007, and the second half of February until March 13, 2007.~~Data from the Dickinson Exp. Station No. 322188 and Dickinson Municipal Airport Station No. 322183 are available during these periods. ~~After March 13, 2007 the record is continuous.~~ On March 27, 2007, the configuration of the station was changed. Sensors recording high wind speed for the hour (GUST) were removed and a sensor for solar radiation (SR) was added. The value “No Data” was added to the GUST column and the SR columns, to differentiate the time periods when the sensor was added or removed.

TABLES

FIGURES