# An Agroclimatic Risk Assessment of Southern Manitoba and Southeastern Saskatchewan

by

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# Abstract

A quantitative spatial assessment of Southern Manitoba's and Southeastern Saskatchewan's agroclimatic resource base was undertaken to investigate agricultural risk and/or potentials. The research objectives were threefold in nature: 1) to choose the appropriate climatic and agroclimatic events relevant to agriculture production on the Eastern Prairies, 2) to establish a climatic data base that would permit the highest spatial density to sufficiently analyze the agroclimatic resources and potentials of the regions, and to apply this knowledge in agricultural planning - sustainability, 3) to statistically analyze the data base in order to describe the agroclimatic risks and/or potentials as they apply to the various agroecological regions within the two provinces. This was accomplished through the establishment of a mean, 10%, and 25% statistical risk assessment.

A number of thermal and moisture conditions were investigated using specially developed computer programs. The analysis of soil moisture conditions within each of the two provinces involved a soil moisture model, which simulated a number of physical processes: 1) snowmelt and snowpack storage, 2) infiltration, and 3) evapotranspiration and phenological stage. These modelled processes were incorporated into a computer program and used to develop a number of agroclimatic parameters, e.g. available moisture status, which subsequently were used to mimic plant growth and development of a wheat, corn, and alfalfa crop on a daily and annual basis. The input for all thermal and moisture conditions was supplied by past records of daily data from climatological and synoptic stations within the study area. The derived thermal and moisture

conditions focused on three essential agroclimatic parameters: 1) the occurrence of spring and fall frosts and the subsequent lengths of the frost-free periods, 2) the accumulation of heat above a base threshold during a growing season, 3) the analysis of moisture conditions in the soil - plant - atmosphere continuum of a wheat, corn, and alfalfa crop.

The probability analysis (mean, 10%, 25%) carried out on each of the agroclimatic parameters indicated that some general conclusions can be surmised about the suitability and production potential of the Eastern Prairies for agriculture. When considering moisture and precipitation limitations, the broad region in central Saskatchewan (i.e. Humboldt, Nokomis, Lumsden, and Cardrose) experienced the highest rates of plant moisture stress and the lowest levels of available soil moisture and growing season precipitation. The production potential of any crop is therefore limited within this region. On the other hand, the Red River Valley demonstrates some of the best soil moisture conditions and precipitation rates in the Eastern Prairies. This is coupled with some of the best soil type/texture conditions, highest accumulations of heat, and longest frost-free periods. This consequently indicates that the Red River Valley region is highly flexible for crop production. Severe thermal limitations are encountered within four general areas of the two provinces, i.e. Pelly -Prairie River, Wasagaming, Hodgson, and Sprague. Overall, both provinces are generally thermally suited for cereal and forage production but the production of grain corn is limited to specific regions of Southern Manitoba.

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# Chapter I

## Introduction

### 1.1 Overview

Adversity and risk are not uncommon on the Eastern Prairies with regards to the grain and forage sectors. The recent successive droughts of the 1980's have re-emphasized the dependency of agriculture and/or agricultural production upon the soil - plant - atmosphere continuum. Within Saskatchewan and Manitoba, grain and oilseeds account for 70% and 50% respectively of farm cash receipts received annually (Dumanski 1988). The values of these commodities escalate substantially (50 - 100%) if one includes the on-farm value as livestock feed (Dumanski 1988).

The 1980's was a decade of high financial stress and debt. Generally, this financial stress was a result of falling returns, falling commodity prices, rising operating costs, and rising debt loads (Dumanski 1988). In addition to financial stress, the Eastern Prairies have experienced severe environmental and meteorological conditions of unprecedented magnitude of the recent past.

Canadian Prairie agriculture is known as dryland production and thus is highly dependent upon moisture from annual precipitation. The decade of the 80's experienced a general decline in winter snowfall amounts (McNaughton 1989). The consequences of this are twofold in nature since less snowfall means, 1) less moisture available for soil moisture recharge in the spring, 2) a higher incidence of wind erosion. In addition to these two factors, the overall water balance of the area becomes more debit laden. If timely spring or early summer rains fail, the consequences are devastating to both agricultural sectors. An example is the year of 1988, when poor snowfall conditions were exacerbated by diminutive amounts of growing season precipitation. This led to widespread crop failure and/or yield reduction, which further aggravated the problem of financial stress, and consequently resulted in more farm foreclosures. The growing season of 1990 was an interesting year with respect to growing season rainfall. As mentioned, the timing and amount of rainfall within a growing season is critical for a good harvest to be obtained. In 1990 the soil conditions were dry at the start of growing season (i.e. May) within Southern Manitoba. The prospect of obtaining a good quality and/or quantity yield was speculative. Early in June, most of the areas received 100 - 200 mm of rain within a weekend. In most cases, the soil was recharged up to it's water-holding capacity, and therefore plenty of moisture was available for crop development throughout the growing season. Consequently, in some cases, the rainfall and resulting soil moisture conditions resulted in bumper crops; even though the rest of the growing season received little rainfall, and by the end of 1990 some of the driest conditions in recent years were experienced. This shows the importance of the amount and timing of growing season rainfall and the dependency of Prairie agriculture upon it. Therefore as Bootsma and DeJong (1988b) state, " In the short term it is the year to year fluctuations in weather that contribute to changing production levels, aggravate price and market stabilization problems, increase economic disparity for farmers, and influence the need for government assistance to farmers in financial distress ".

Of all the factors influencing Prairie agriculture, soil and climate resources still control the production potential of crops. Therefore, soils and climate have had a major influence on farm configuration and crop distribution. Consequently, many farmers have made considerable adjustments in land management practices and farming patterns, in relation to soil, heat, and moisture availability patterns, existing in the different agro-ecological zones within Southern Manitoba and Southeastern Saskatchewan (Dumanski 1988). Many producers, as a result, have made investments (in land management, conservation, crop type, and machinery) that optimize the production potential of their land.

Today a new problem lingers on the horizon - environmental degradation. Agriculture must expand in such a way that it does not destroy the natural environment. For this to happen a steady stream of new technologies must be developed that emphasize land management and conservation practices which minimize erosion, salinization, and desertification (Crosson and Rosenberg 1989). Therefore, a knowledge of the past soil-climate resource base under which agriculture functions in Southern Manitoba and Southeastern Saskatchewan is essential to the development of appropriate agricultural infrastructures and support policies, and, most importantly, to the definition and implementation of solutions (Bootsma and DeJong 1988b). This leads to the fundamental objectives of this research.

## 1.2 Objectives of the Study

Along with the major concerns stated above, the best forecast of agricultural weather for an entire growing season is obtained through a knowledge of the past agro-climate. To accomplish this, the research undertaken here was an historical investigation of agricultural risks and/or potentials as they apply to the thermal and moisture conditions encountered within Southern Manitoba and Southeastern Saskatchewan. Therefore, this study was undertaken with the ultimate aim of providing a precise evaluation of the agroclimatic resources and potentials of the Eastern Prairies, to be used to make the necessary recommendations for future agriculture infrastructures and support policies. As a result, three major research objectives can be outlined.

1) To choose the climatic and agroclimatic events relevant to agricultural production on the Eastern Prairies. Within a thesis of limited length and scope, it is impossible to quantify all aspects of the soil - plant - atmosphere continuum. For example, high temperature stress is a relatively minor problem on the Eastern Prairies. For the most part, it is the lower thresholds of heating and lethal minimum temperatures that limit production of certain crop species to specific agroecological regions on the Eastern Prairies. Along the same lines, there are very few regions that consistently experience excessive moisture conditions (i.e. above or at field capacity). For the most part, prairie soils are below field capacity for long periods of time (DeJong 1984). These factors led the researcher to choose a number of thermal conditions (i.e. spring and fall frosts, and frost-free periods, degree-days base 5°, 10°, 15°C, and corn heat units) and moisture conditions (i.e. available soil moisture, growing season precipitation and actual evapotranspiration, and plant moisture stress at different phenological stages under a continuous cropped land of wheat, corn, and alfalfa). All of these conditions are of paramount importance to successful agricultural production on the Eastern Prairies.

2) To establish a climatic data base that would permit the highest spatial density to sufficiently analysis the agroclimatic resources and potentials of the regions, and to apply this knowledge in agricultural planning.

3) To statistically analyze the data base in order to describe the agroclimatic risks and/or potentials as they apply to the various agroecological regions within the two provinces. This was accomplished through the establishment of mean, 10%, and 25% risk values for the various agroclimatic characteristics. The final product is a series of risk and/or potential maps and tables for each of the agroclimatic parameters established for Southern Manitoba and Southeastern Saskatchewan.

1.3 Organization of the Thesis

The first chapter provides a brief introduction and overview of some of the current trends and concerns affecting agriculture today and outlines the research objectives. The second chapter, the literature review, is essentially an overview of the agroclimatic relationships relevant to this research. Within this, five major categories can be defined: 1) non-meteorological factors involving the relationships of soil water-holding capacities, and estimated seeding dates, 2) meteorological factors, examined in terms of their spatial, temporal, and missing data representativeness, 3) thermal considerations, dealing with temperature measurements, frosts (spring, fall, and frost-free periods), growing degree-days, and corn heat units, 4) soil moisture considerations, such as general soil moisture models, the phenological development of a wheat crop and its application to soil moisture analyses, critical stages of wheat development, choice of a thermal index for the corn moisture analysis, critical stages for moisture in corn and their effects on yield, the critical stages of moisture in alfalfa and their effects on yield, and finally 5) probability theory in agroclimatic relationships.

The third chapter details the methodology and theoretical considerations employed in the analysis of each of the non-meteorological, meteorological, thermal, and soil moisture parameters used to establish the data base. First, the non-meteorological inputs of planting dates, soil water-holding capacities, daily photo-periods, and solar energy (Qo) at the top of the atmosphere will be considered. The second topic of discussion deals with daily meteorological data in terms of their spatial and temporal distributions and the incidences of missing data within the data base. Following the discussion on the creation of the data base, the methods used in the establishment of the thermal and moisture parameters are discussed. The three thermal parameters are: 1) temperatures at the time of seeding (i.e. spring frosts), 2) the accumulation of heat over the growing season (i.e. growing degree-days, corn heat units), 3) the length of the growing season and the critical temperatures that end it (i.e. frost-free periods, and fall frosts). In order for the soil - plant - atmosphere continuum to be accurately represented under an actively growing wheat, corn, and alfalfa crop, a number of modelled physical processes must be examined. In fact, three physical processes can be considered in the general soil moisture model; 1) snowmelt and snowpack storage, 2) infiltration, 3) evapotranspiration, phenological stage, and stress. These modelled processes attempt to mimic the daily development and growth of wheat, corn, and alfalfa crops. As a result, three sections deal with the methods used in tracking the development of each crop and the critical stages of phenological growth as they pertain to moisture conditions under a wheat, corn, and alfalfa crop. Two final sections discuss the mapping techniques employed and the procedures utilized in the probability analysis.

The fourth chapter presents the major findings of the research and discusses the results of the various agroclimatological parameters derived. This includes the estimation of seeding dates, the presentation of the results on the tests for normality, and the results of the thermal and moisture analyses. This was accomplished through a series of figures and illustrations derived by computer mapping and plotting techniques or, through the use of tables. The results are discussed on a regional basis with regards to their applicability to producers and/or organizations/institutions involved in the various fields of agroclimatology.

The final chapter of thesis presents an overview of the pertinent information derived from the analyses carried out in this research. This includes such information as the variations that can be expected in the thermal and moisture conditions encountered on the Eastern Prairies, along with the statistical levels used to assess each agroclimatic parameter (i.e. mean, 10%, and 25% risk). Finally, a concluding sub-section will offer recommendations and directions for future research in the broad field of agroclimatology. Three natural resources - land/soil management, water conservation, and multiple cropping - are discussed with regards to sustainable agriculture on the Eastern Prairies.

Chapter II

# Literature Review of Agroclimatic Relationships

## 2.1 Non-Meteorological Inputs

### 2.1.1. Estimation of Seeding Date

The derivation of many agroclimatic parameters (e.g. growing season precipitation and actual evapotranspiration) requires knowledge of seeding dates. It is essential that seeding dates are established in order to depict an accurate representation of crop growth and development at specific phenological stages within each year. Since, seeding dates fluctuate from one year to the next, especially for annual crops, crops will react to various climatic conditions in their environment in a somewhat different way for each year.

In most studies the assessment of soil moisture reserves and stress levels at various phenological stages has assumed a constant seeding date. For example, DeJong (1985), assumed that spring wheat was seeded on May 1. Shields and Sly (1984) used exactly the same criteria in their establishment of aridity indices derived from soil and climatic parameters. Stewart (1988) modelled calculations of soil moisture status beginning on May 1 for any given year.

In recent years, a number of researchers have studied the problem of field tractability, which controls seeding dates, and solved it in a variety of theoretical ways. A review of some of the methods seems a worthwhile approach to synthesis the methods to date.

Some of the first research done on the estimation of seeding dates was accomplished by Rutledge and McHardy (1968) of the University of

Alberta. In this study a budget for soil moisture was estimated using the "Versatile Soil Moisture Budget" developed by Baier and Robertson (1965). The estimates of tractability were performed in two ways: 1) if the soil moisture content in all upper three zones was above 99.5% of capacity, field operations ceased, 2) likewise, operations were not possible if soil moisture conditions were above 95% in the upper two zones. In both cases, it was demonstrated that tillage operations may be performed at moisture contents near field capacity.

Selirio (1969), and Selirio and Brown (1972) conducted similar studies into the estimates of spring workdays based on the use of climatological data. It has been widely believed that the early seeding of annual grain crops in temperate climates tends to promote higher yields. Based on this, they developed a soil moisture budgeting technique that estimated days when the soil was tractable (i.e. suitable for planting). The criteria used were: 1) soil moisture was at or below 90% of field capacity in the top 12 cm of the soil, 2) daily precipitation was less than 2.5 millimetres, 3) maximum air temperature was above 0°C. Before soil moisture budgeting commenced in the spring, a period of 10 consecutive days with the daily maximum temperature above 5°C had to accumulate. Following this event, soil moisture budgeting began and was based on the assumption that the soil was initially at field capacity.

Baier (1973) used a climatological technique called the Versatile Soil Moisture Budget to estimate field workdays during the various months of a year, as well as during the various phenological stages of a wheat crop's development. A field workday in this study was defined as a day with no snow cover and various estimated soil moisture conditions in the upper three soil zones. The various soil moisture conditions were chosen to represent different field operations and various sizes of machinery. This soil moisture budgeting procedure assumed an average planting date for each station. Baier, concluded that research and application should include the development and perfection of a planting date estimator for various crops and soils.

Hassan and Broughton (1975) reviewed other studies which use soil moisture levels as criteria for tractability. A number of interesting conclusions were drawn. 1) Limiting soil moisture conditions can be specified on a basis of either percent field capacity or percent of available water capacity. The choice of either one should be clearly stated at the outset of research. 2) The limiting condition of soil tractability may be more closely related to physical characteristics of the soil than to absolute soil moisture content or available soil water capacity. Nevertheless, the use of soil moisture contents to predict soil tractability is a useful tool. Finally, 3) the moisture content of the top 3 cm of a clay soil was the only limiting factor for tractability.

Dyer and Baier (1979) proposed a revised weather-based model to estimate field workdays in the fall. In this model, they considered evaporation and drainage as the physical processes that reduce soil moisture content. Their basic assumption was that fall tractability was more dependent upon rates of drainage of excess water (above field capacity) through the top layers of the soil than upon evaporation.

Finally, in 1988 Bootsma and DeJong proposed a means of estimating seeding dates of spring wheat on the Canadian Prairies based on climate data. A number of seeding date criteria was developed and tested on 17 climate stations representing 13 crop districts. The final criteria selected to define a seeding date were: 1) 3/4 Tmax + 1/4 Tmin (daily maximum and minimum temperatures) above 7°C, 2) daily precipitation less than 2mm, 3) less than 10mm of snow on the ground, 4) soil moisture levels less than 90% of available water holding capacity in zone 1 and less than 95% in zone 2 of the versatile soil moisture budget. Once the estimated seeding dates were established based on the above criteria, they were compared with observed seeding dates for each of the crop districts in which a climate station fell. The observed seeding dates were available from Statistics Canada, Agricultural Statistics Division. The comparison was accomplished by using linear regression and correlation analysis. The correlation coefficients (r) obtained, ranged from +0.11 to +0.76. Bootsma and DeJong (1988a) stressed that additional research was needed to improve the accuracy of seeding date estimates for use in crop modelling application and especially for real time crop information systems such as that described by Raddatz (1989b).

In the spring in Manitoba and Saskatchewan early seeding operations are occasionally delayed by three factors: frozen ground, snow, and high soil moisture conditions. In recent years (1980-1988), high soil moisture conditions at the time of seeding seems to be less pronounced. McNaughton (1989) documented that the first nine years of the 1980's had the lowest winter precipitation ever recorded at Edmonton. Less snowfall results in reduced ponding of melt water, higher aeration and higher soil temperatures (Chanasyk et al 1983). The problem of soil tractability then becomes reduced, and one of the main restrictions on seeding now becomes soil temperature. Consequently, an accurate year to year representation of seeding dates is required if any reasonable estimation is to be made about climatic change and its implications on agricultural production.

2.1.2. Available Water-Holding Capacities (AWC) of Soils

The soil occupied by plant roots is the primary storage reservoir of water for crops. Precipitation in the form of rain or snowmelt is stored in the soil, and is used by the plants for growth and development. The total amount of water present in the soil at any one time is not all available for plant development. Part of this water is held too tightly in the soil to be removed by the plants. When soil moisture is reduced to this level plants wilt, and the soil is said to be at the wilting point. On the other hand, soil cannot always hold all the water that comes in the form of precipitation or irrigation. The excess of this water drains away through deep percolation or runoff. The term used to describe this upper limit is called field capacity. The amount of water held between field capacity and the wilting point is known as plant available water.

As the available water is used by a crop, increasing suction is required to extract it. At field capacity, the amount of suction required to extract soil moisture is minimal. But as the soil is dried to its wilting point, the amount of suction required to extract the soil moisture is greatly increased. The wilting point is said to be the practical limit beyond which plants cannot extract moisture. If the soil moisture suction is less than the suction that tends to move water into the roots, through the plant, and into the atmosphere, the crop can remove moisture from the soil. When the soil moisture suction is greater than that exerted by roots, the plant stops removing water from the soil and growth ceases.

In reality, only about half the water held between field capacity and the wilting point is said to be readily available (Brun et al 1985). The remaining half becomes increasingly difficult for the plants to remove. To represent this physical process, a root zone drying function was adopted. This was an attempt to simulate the difficulty that plants have in extracting moisture as the soil became drier.

Soils vary in their plant available water holding capacities. The amount of water retained by the soil and available for plant use is primarily determined by soil type. This is dependent upon a number of principle factors such as soil texture, structure, and organic matter. A considerable amount of work has been accomplished to determine what individual soil components have the most influence on available water. In general, the silt content has the most influence, while organic matter has the least influence on available water capacity (Shaykewich and Zwarich 1968). However, soil texture in general is the primary factor in controlling available water. It can be defined as the size of the soil particles (clay, silt, sand), and indicates the degree of coarseness of the mineral material. The coarser soils such as fine gravels and sands, have mostly large pores. This allows most of the annual precipitation to percolate to very deep soil depths, leaving little water in the plant root zone. On the other hand, finer textured soils such as clay and loam have mostly smaller pores, allowing for much of the water to remain in the root zone. The consequences of soil texture in general, are that soils with a high percentage of sand have a low available water holding capacity in comparison of soils with a loam and clay texture. In fact, approximately one half as much available water is held in coarse textured soils as in medium and fine textured soils (Shaykewich 1990). Thus, coarse textured soils (sands, fine gravels) require rain or irrigation to maintain soil moisture levels optimum for plant growth far more often than those of medium to fine textured soils (clay, loam).

In Southern Manitoba and Southeastern Saskatchewan soil textures range from very coarse sands to fine clays and, consequently, there exists a high degree of variation in the water holding capacities of these soils. To accurately portray the variations in soil moisture conditions yearly, and for each crop (wheat, corn, and alfalfa), varying soil textures and resulting water holding capacities must be taken into consideration. A number of studies have come to this conclusion, and have used the soils water holding capacities based on the textural group for analyses of soil moisture conditions in their research (Raddatz 1989b, DeJong and Sly 1985, Bootsma and DeJong 1988b, DeJong and Bootsma 1988, DeJong 1985, Shields and Sly 1984, Dunlop 1981).

Recently, DeJong and Shields (1988) produced Available Water-Holding Capacity Maps of Alberta, Saskatchewan, and Manitoba. In their research, available water-holding capacity maps (AWC) were derived from generalized soil landscape maps, by equating AWC classes to textural groups (Table 1), and they also assumed that there were no lithological discontinuities. This was possible because data presented by Shields and Sly 1984, DeJong et al 1984, showed that textural groups could be equated with AWC.

DeJong and Shields (1988) state in concluding remarks that even though soil texture is a good indicator of AWC, further refinement is needed to define the relationship of other soil properties and AWC. Nevertheless, the maps produced are very useful for the geographic interpretation of soil moisture through crop modelling analyses.

Table 1. Relationship between available water-holding capacity and soil texture for a 120 cm profile (DeJong and Shields 1988).

| Class | Available Water-Holding Capacity (mm) | Textural Group |
|---|---|---|
| 1 | 50 | Sand; loamy sand |
| 2 | 100 | Sandy loam |
| 3 | 150 | Very fine Sandy loam; loam |
| 4 | 200 | Silt loam; sandy clay loam; clay loam |
| 5 | 250 | Silty clay loam; sandy clay; silty clay; clay; heavy clay |

## 2.2. Meteorological Inputs

### 2.2.1. Spatial, Temporal, and Missing Data Representation

#### 2.2.1.1. Spatial and Temporal

The first question that should be asked is - what spatial density and frequency of climatic measurements are required to obtain a reasonable agroclimatic analysis for Southern Manitoba and Southeastern Saskatchewan? For each variable or weather element, a measurement is a sample of the atmosphere at a particular time and location. When the atmosphere is sampled at many locations, this is collectively known as the observing and/or data network (Raddatz 1987c). The Canadian federal agency responsible for the collection and dissemination of meteorological and climatological data is known as Atmospheric Environment Services (AES), Environment Canada.

The AES data collection network within Canada is arranged into a hierarchy of recording station importance, consisting of three major groups of stations. The first order or synoptic and aeronautical weather stations record most surface meteorological conditions. The data are transmitted in "real time" intervals of one, three, or six hour intervals. In Manitoba and Saskatchewan there are about 15 and 20 first order stations respectively. The stations are generally separated by about 150 km, with only a small number of them falling within the agricultural regions of the two provinces. Second order or upper air stations, which in general are separated by 300-500 km, deal with the analysis of the upper atmosphere (Raddatz 1987c). These stations consequently have little use in agroclimatic analyses. Both the first and second order stations are maintained by professional trained personnel. Budgetary constraints limit the number of first and second order stations, thereby limiting their spatial distribution in Canada.

By far, the most common component of the observing network is the climatological station. Climatological stations are operated, in the main, by volunteers. While the use of a volunteer network is not ideal, it does allow for many areas of Canada to have a higher spatial representation of meteorological conditions. The observers at climatological stations are required to record daily maximum and minimum temperatures and daily precipitation amounts.

The question posed earlier, asked what spatial density of stations is sufficiently dense to analyze the agroclimatic resources of a region? There are a number of assessment criteria that should be examined. The first is point-to-point representativeness. Is an observation taken at one point applicable to another? The second criteria is point-to-area representativeness. What size of an area can be represented by a point measurement? Finally, how well does the data base represent the continuous field, i.e. how truthfully can the field be mapped with the available data density (Raddatz 1987c)?

To answer these questions, the type of data network and its application must be considered. As mentioned above, there are about 35 synoptic stations in Manitoba and Saskatchewan and only a few are located in the agricultural regions. If this number of stations were used in a agroclimatic data base to analyze the resources of the region, large areas of generalizations would have to be assumed. For example, if this size of data base is used to assess soil moisture conditions through the growing season, erroneous regional results would occur because of the high spatial variability of growing season precipitation. This, in turn, can cause highly variable soil moisture values over short spatial distances (Longley 1972).

To achieve a high degree of point-to-point representativeness of growing season precipitation and/or soil moisture would require a much higher spatial density than can be afforded with synoptic stations. The area that can be represented by one point observing precipitation and/or soil moisture, is likewise, spatially diminutive. From this it follows, that the densest spatial data base created using synoptic stations to analyze growing season soil moisture would still leave the continuous field representation in question (Raddatz and Kern 1984, Raddatz 1987b). Generally, a more reliable representation of thermal conditions as they relate to agriculture is possible using a synoptic network of this size, but extreme generalizations would have to be assumed. This is possible due to the fact that temperature has a relatively high spatial homogeneity over a large region. From the above conclusions, it can clearly be seen that an agroclimatic data base with a considerably more extensive spatial density than can be achieved using only synoptic stations was needed for research objectives to be fulfilled, especially for the soil moisture aspect of the research.

The densest agroclimatic data base that could feasibly be established with thermal and, more importantly, soil moisture conditions in mind, was the one derived from the climatological network plus synoptic stations. When these two types of stations were combined a total of 158 stations using a daily time-step were available to represent the thermal and moisture conditions on the Eastern Prairies. The real-time network of stations used by Raddatz (1989b) has a average station spacing of 100 Km. This means that Raddatz (1989b) was able to interpolate point values of precipitation or map precipitation fields for synoptic fronts and organized frontal lines, but not local convective activity. In this research the average station spacing is about 48 km, which is substantially better than the real-time network (Raddatz 1989b). Along with this denser station spacing, a longer sampling period was also used (i.e. up to 60 years for the moisture analysis), thus the spatial representativeness of this network is higher than regional and is in fact approaching local (i.e. local convective activity or microscale). The need for this denser network dictated the use of the first regression equation of Baier and Robertson (1965) which only requires daily maximum and minimum temperatures, total daily precipitation and solar energy at the top of the atmosphere, for the more exacting soil moisture conditions to be derived. Since all of these meteorological parameters could be obtained from climatological and synoptic stations, the equation allowed for a dense network of stations to be established and a more reliable estimate of field soil moisture and thermal conditions (i.e. approaching microscale or local activity).

2.2.1.2 Missing Data

In this research two types of data can be missing; 1) daily maximum and minimum temperature, and 2) daily precipitation. The ability to estimate missing daily precipitation is the more arduous of the two because of its non-homogenous nature over a spatial area, especially for summer precipitation. Therefore, a review of the relevant literature on the estimation of missing daily precipitation will be dealt with in more detail than that of the temperature extremes.

When considering precipitation for the growing season, three atmospheric disturbances must be considered - synoptic cyclones, organized frontal lines, and localized random showers (Raddatz 1989b). Using the Barnes (1964) technique, Raddatz (1989b) estimated missing daily precipitation for synoptic cyclones and organised fronts, but not for localized showers. Since, much of the growing season precipitation in Southern Manitoba and in Southeastern Saskatchewan consists of localized showers, the estimation of daily precipitation amounts for ungauged points from gauge locations is subject to large errors. The entire question of interpolating missing precipitation over a geographic area was investigated by Raddatz and Kern (1984) for the Near Real-Time Rainfall Network on Canada's Eastern Prairies. They determined the probable magnitude of errors, associated with using the near-real-time network (average station spacing = 100 km.) to estimate ungauged precipitation amounts and also, to address the question of how well the discrete network portrayed the continues field. Three temporal periods were considered - a growing season, one month, one day. The use of gauged values for estimating ungauged precipitation amounts can be approximated to within 20% for a growing season, 45% for a month, and the error rate is likely over 100% for daily estimates. The estimated precipitation amounts should therefore, be used in site specific estimates and further to this, the data network cannot be used to accurately portray the continuous field of daily or monthly precipitation amounts. The seasonal fields and accumulative fields, such as soil moisture, can, at best represent the agroclimatological conditions on a regional basis.

Further studies by Raddatz (1987b) investigated the mesoscale representativeness of rainfall measurements for Winnipeg. In this research, rainfall measurements from the AES weather observing site in Winnipeg were extrapolated to ungauged locations and also used as the area-average estimate for the city of Winnipeg. The analysis was carried out on two temporal periods - one day, and one month. It was concluded that using data with a density of 1 site per 54 $km^2$ and 1 per 707 $km^2$, to approximate Winnipeg's monthly area-average rainfall would provide estimates that were within tolerable errors ($\pm$ 6-24%). When attempting to base daily area-averages rainfall estimates on data from one observation site per 54 and 707 $km^2$ areas, the error rates were large ($\pm$ 21-85%). The second part of the research, looked at the problem of extrapolating gauged precipitation values to ungauged locations over a distance of 10 to 32 km (point-to-point representativeness). There were large errors for monthly ($\pm$ 36-48%) values, and even larger errors for daily ($\pm$ 126-165%) estimated values. The conclusion from both studies was that any attempt to use a gauged point to represent an ungauged daily precipitation value would result in large errors. Also, the area that can be represented by a point value of precipitation is diminutive.

2.3. Thermal Considerations

Heat effects all living organisms. The rate of every chemical and physical process within plants is affected by temperature. The physiological processes of transpiration, respiration, photosynthesis, and nutrient uptake all have optimum temperatures that depend upon the crop species and stage of development. Consequently, air temperature has a profound effect on the rate of development of crops, and the final yields that can be expected (Treidl 1978). For example, there are optimum temperatures for the development of cereal crops, 20°-25°C, whereas the optimum temperature for a crop such as corn is 30°C. Forage crops such as alfalfa can be grown successfully in a range of temperatures between 15° - 30°C (Dube 1981). It must be remembered, that in addition to optimum temperatures, each crop has specific upper and lower temperature threshold limits.

Similarly, pest insects can function over a wide range of ambient temperatures. In most cases, these temperatures correspond to the conditions found on the host (crop). If the crop or insect encounters temperatures outside of its optimal range, growth may be hampered, stopped completely or the effect may be lethal. Therefore, temperature fluctuation is one of the primary factors in controlling growth and development of plants and insects, as well as influencing their distribution over the earth. The following is a discussion of the derivation of the different types of thermal indices and their importance to specific crops and insects.

2.3.1. Temperature Measurement

Temperature is measured at about 1.2 metres above the ground in a louvered screened wooden shelter which contains maximum and minimum alcohol thermometers. This is usually on a level grassy surface away from the nearest obstacle by a distance of at least four times its height (Environment Canada 1982b). Problems may arise when temperatures recorded in the wooden shelter are used to represent those of the crop interface temperatures. For example, in most cases the index of frost limitation on agricultural production is defined by a screen temperature of 0° or -2.2°C. A temperature of -2.2°C is generally defined as a killing frost, and therefore ending the growing season. However, at night the ground or crop interface is normally much cooler than temperatures recorded in the screen (Hayter 1978). Also day time leaf temperatures would be higher than those recorded in the wooden shelter. Thus temperatures measured in the screen are not a ideal estimate of those experienced by a crop.

Numerous studies have documented the differences between grass and screen temperatures (Sakai 1987, Environment Canada 1982b, Rosenberg 1983, Hayter 1978). In most cases the differences seem to be about 5° to 10°C (Hayter 1978), with the latter occurring under extreme conditions. In research conducted by Bootsma (1976), regression constants and coefficients were used for estimating frost near the ground from screen and grass minimum temperatures. In most cases, grass minimum temperatures are available in only a few locations in Canada. When attempting to interpolate these temperatures over broad areas, extreme generalizations would be encountered, and therefore an unrepresentativeness of the field would be encountered. Therefore in this research screen temperatures were considered to be the best available measure of thermal conditions experienced on the Eastern Prairies.

2.3.2. Frost

The occurrence of frost is one of the most important concerns for agricultural production on the Canadian Prairies. In an area such as Southern Manitoba and Southeastern Saskatchewan, crop production is practiced close to its northern limits. Therefore, any aberration in the incidence of spring or fall frosts and the duration of the frost-free periods would have serious economic consequences in agricultural production.

The extent of damage imposed on the crops depends upon a variety of factors: 1) the type of crop, 2) the stage of development, 3) the type of frost (or minimum temperatures), and 4) the duration of the frost. When considering the type of crop, there is an extremely wide range of sensitivities to freezing temperatures. Tomatoes, beans, and potatoes would be consider as tender growing crops. Only a very light frost is necessary to incite damage on these crops. At the other end of the scale, lettuce and cabbage are much hardier and therefore resistant to lower temperatures. In addition to the type of crop, the stage of development has an important influence on susceptibility to frost. With spring wheat, temperatures of minus 9° to minus 10°C are possible without damage at germination. At flowering, temperatures can only drop to minus 1° to minus 2°C before impairment sets in. By the time the fruiting stage (heading - soft dough) is reached, spring wheat is only slightly more resistant to frost injury (minus 2° to minus 4°C). On the other hand, corn has generally a lower resistance to frost throughout these three phenological stages (minus 2° to minus 3°C at germination, minus 1° to minus 2°C at flowering, minus 2° to minus 3°C at fruiting) (Rosenberg 1983, Paulsen et al 1982). As a result, the specific degree and type of damage depends upon the type of crop and also the stage of development.

Two other factors that work in conjunction are the type (i.e. how cold it gets) and duration of the frost. It is generally recognized that there are two main types of frost; 1) radiation, and 2) advection. Radiation frost occurs on calm, clear nights when terrestrial radiation to space is relatively unimpeded because of the absence of clouds and heavy concentrations of water vapour. The severity of radiation frost varies greatly with the state of the atmospheric conditions, as well as with local differences in topography, and the type of vegetative surface. Generally speaking however, radiation frosts occur on a nocturnal basis and, therefore, are of a short duration. On the other hand, advection frosts result from large scale atmospheric disturbances being transported into a region. Generally, advective frosts occur with the movement of a cold front into a region at the very beginning or end of the growing season. Consequently, the duration of advective frosts can be several days of critically low temperatures, which in turn has severe implications on agricultural crops. Hence advective frost have often been termed a hard or killing frost (Rosenberg 1983). The terms radiative and advective frosts are somewhat subjective. In many cases, frosts are actually the result of both conditions, cold/dry air being advected over an area followed by a clear calm night (Shaykewich 1988).

The ability to react and take protective action against forecasts of adverse weather is dependent upon the size of farm operation. With orchards and small garden market operations it is possible to take deterrent measures, but at considerable economic expense. Obviously, the ability of the grain farmer to protect against the adverse condition of frost is impossible when the size of the area to be protected is considered. Even with small garden and orchard operations, the type of frost protection must be weighed for practical and effective measures to be considered. For the most part, most measures of frost protection are designed to ward against radiative and combination frosts. Perhaps the best method of frost protection is simply the avoidance of it, i.e. grow crops in the frost-free period. Therefore, when examining the three frost conditions within the two provinces, a number of environmental and human factors may cause significant temporal and spatial variations to occur:

1) Topography (local relief) - which includes differences in elevation, aspect and slope. These three factors may explain why stations only a few kilometres apart have significantly different frost-free periods. Local differences in elevation have a profound effect on frost conditions, where valley bottoms are highly susceptible to frost because of cold air drainage downwards into "frost hollows". The aspect and slope of the surface are also important factors. South and west facing slopes obviously receive more solar radiation than a north or east slope and as a consequence are slightly warmer.

2) Water bodies - the presences of lakes or larger rivers can have three significant effects on spring, fall, and frost-free periods. Firstly, in the spring a large body of water tends to be thermally resistant to quick

heating. Consequently, the dates of the last spring frosts around large bodies of water are usually later. Secondly, the opposite case holds true for the fall condition, where the body of water acts as a thermal heat source forestalling the occurrence of fall frosts. This results in the beneficial effect of prolonging the frost-free period. Thirdly, on a temporal microscale the water body has the additional ability to release some of its stored radiant energy from the day, during the night, thereby reducing the occurrence of frost in nearby areas during the growing season.

3) General temperature - in general, the variation in the spring, fall and frost-free periods can be partly, but not solely explained by differences in latitude. (e.g. climate zones). For example, as one proceeds northeastward from the U.S. border in south central Saskatchewan, the length of the frost-free period will become consistently shorter. It is also important to note that the date of each parameter is not constant. It is necessary to reassess each of the frost conditions since trends in temperature have been recognized and, therefore, normals should be established for a certain period of time.

4) Moisture of the soil - poorly drained soils are cold. For example, cold, damp, peaty soils result in frost prone areas in the spring. Like open water bodies, water in the soil has the ability to store heat during the day and release it at night. Therefore as a growing season progresses, the likelihood of a frost is reduced over moist soil.

5) Altitude - areas of higher elevation are prone to more frost days in both the spring and fall. When elevation increases, air is forced to rise and cool at the adiabatic lapse rate. Consequently, later spring and

earlier fall frosts result in a shorter frost-free period.

6) Human Modification - Farm management itself may have a slight effect on frost conditions. The management of stubble and trash to retain snow may reduce surface soil temperatures in the spring. In the spring, energy is used to melt snow and heat the protective trash layer. This results in cooler and wetter conditions than those encountered on a well drained tilled soil in the spring. The value of added moisture for crop production and the reduction of wind and water erosion will usually offset the slight disadvantage of cooler spring soil temperatures. The second major human modifier occurs in built up areas and has been termed the "heat island effect". The ability of asphalt and concrete to store and release heat more effectively than natural vegetative surfaces results in later fall frost and subsequently longer frost-free periods. In the spring these man-made surfaces result in the rapid removal of snow and precipitation. This will result in more energy being used for heating the air as opposed to evaporating on natural surfaces, which in turn will ensue earlier last spring frosts. Nevertheless, this effect can only be expected at a few synoptic sites on the Eastern Prairies (Dunlop 1981, Longley 1967, Hayter 1978, Dzikowski and Heywood 1990, Environment Canada 1982b).

When attempting to define the last spring, first fall, and frost-free periods, the four factors on page 24 were considered. Research by Dzikowski and Heywood (1990) preferred to use 0°C as the critical temperature at which frost generally resulted in extensive damage to plants. This value was chosen because the temperatures in the Stevenson Screen were much higher than canopy surfaces at night (lower during the day). Work done by Hayter (1978) recognized that the temperature of -2.2°C was considered lethal for plant development. It was also recognized that ground surfaces are normally colder than screen temperatures, and therefore, there was a good reason for accepting the commonly used definition of a killing frost as a screen temperature of 0°C. Sakai et al. (1987) concluded that the temperature recorded in weather stations are about 5°C warmer than the ground surface or in dense vegetation on nights of radiative cooling. Hence the occurrence of frost events are more frequent and the frost-free periods shorter than indicated by temperatures recorded in screens. They suggested that it is necessary to find a means for estimating grass temperatures from weather station data. Dunlop (1981) characterized the occurrence of the last spring, first fall frosts and the subsequent frost-free periods in Southern Manitoba by defining a normal frost as a temperature of 0°C and a killing frost by a value of -2.2°C.

Clearly, the incidence of frost is especially critical at specific times throughout the year. The date of the last spring frost at 0° and -2.2°C can help in determining the appropriate seeding dates. The occurrence of the first fall frost at the two base temperatures marks the end of the productive growth season. The frost-free periods of the two base temperatures are marked by the last spring and first fall frosts. Consequently, the frost-free period is perhaps the most important thermal consideration, since it represents the time available for crop production. The calculated mean and risk values for each of these thermal parameters, along with a knowledge of different crop requirements, determines what crops can be grown in the various agricultural regions of Southern

Manitoba and Southeastern Saskatchewan (Table 2).

Table 2. Number of Days Required for Various Crops to Reach Maturity in Manitoba and Saskatchewan (Dunlop and Shaykewich 1984).

| Crop | Number of Days |
|---|---|
| Wheat | 90 - 100 |
| Oats | 85 - 88 |
| Buckwheat | 80 - 90 |
| Barley | 60 - 90 |
| Flax | 85 - 100 |
| Brown or Oriental Mustard | 85 - 95 |
| Yellow Mustard | 80 - 90 |
| Corn (grain) | 110 - 120 |
| Canola-late Argentine | 92 - 102 |
| Canola-early Polish | 73 - 83 |
| Lentils | 85 - 100 |
| Field Peas | 90 - 100 |
| Canary Grass Seed | 95 - 105 |
| Sunflowers | 120 - 130 |
| Coriander | 90 - 100 |
| Black Beans | 95 - 105 |
| Navy Beans | 90 - 100 |
| Sugar Beets | 120 - 140 |
| Fababeans | 105 - 115 |

## 2.4. Heat Units

### 2.4.1. Growing Degree-Days above base 5°, 10°, 15°C

Plants require a great deal of energy to grow and develop. Most of this energy can be expressed in the form of heat. The heat that is required by the plant or crop is usually expressed in degrees of temperature above a base value. It is then very useful to have some means of assessing the heat that has accumulated over the growing season to predict the degree of maturity or yield expected. As a result of this, and the fact that information on air temperature is readily available, many attempts have been made to link the response of crops to some function of temperature (Jones and Lang 1989, Dzihowski and Heywood 1990, Morrison et al 1990, Selirio and Brown 1979, Dunlop 1981).

To account for this link, the concept of simple degree-days or heat units has evolved, and it is now widely accepted as a means to relate plant development, maturity, and yield to temperature. The first concept of the degree-day system assumes that each plant has its own specific base temperature, below which growth does not occur (Table 3).

Table 3. Average Base Temperature Values for Selected Crops and Insects (Shaykewich 1988).

| Crop or Insect | Base Temperature (°C) |
|---|---|
| Spinach | 2.2 |
| Lettuce | 4.4 |
| General Plant Growth | 5.0 |
| Peas and Asparagus | 5.5 |
| Corn and Beans | 10.0 |
| Grasshoppers | 10.0 |
| Corn Borers | 10.0 |
| Pumpkins and Tomatoes | 13.0 |
| General Insect Development | 15.0 |

The amount of heat that is accumulated during each day is determined by adding the daily maximum and minimum temperatures together and dividing the total by 2, to obtain a mean value. The mean is then subtracted from one of the crop or insect specific base temperatures to determine the daily degree-day accumulations. This value represents the daily effective heat growth for each crop or insect and can be further summed to determine the weekly, monthly or yearly accumulated heat values. For example, if the daily maximum temperature was 30°C and the minimum temperature was 15°C, the mean would be 22.5°C. When the mean is subtracted from the base temperature of 10°C (e.g. corn), a value of 12.5°C above base 10°C has been accumulated for that particular day. If the daily G.D.D's is below zero, the value for that particular day is set to zero. In other words, there is no additional development.

The growing degree-day theory assumes that there is, 1) only one base temperature through the life of a plant or insect, 2) day and night temperatures are of equal importance, and finally 3) that plant and insect response is linear over the entire temperature range. These assumptions are rough approximations for both plant or pest insect development. The heat unit approach does seem, however, to work reasonably well. This is possibly related to the fact that growth is virtually linear for many agricultural crops and pest insects over temperature ranges existing in the temperate regions of the Prairies (Shaykewich 1988).

Not only are there specific thermal requirements for each crop, but it has also been determined that heat requirements for each specific crop can depend upon the planting date and more importantly several environmental factors. The environmental factors that may cause fluctuations in the heat requirements of crops are as follows: 1) Soil fertility, low fertility causes slow growth, high nitrogen delays maturity while high phosphorous accomplishes the opposite. 2) Plant population, lowering plant population accelerates maturity on average. 3) Soil temperature, during the spring warm up, soil temperature lags appreciably behind air temperature, hence soil temperature is often more important than air temperature for determining heat units from planting to emergence (Edey 1977). 4) Soil type, sandy soils warm up earlier than clay soils in the spring. Other factors such as fertility and moisture characteristics are affiliated with soil type also. 5) Soil moisture, poorly drained soils are cold and cause a variety of nutritional problems. If moisture is lacking at the time of seeding or during early growth, maturity will be delayed even though heat units have been accumulating. Drought during the later stages of plant development accelerates maturity and causes a reduction in yield. 6) Photoperiods, longer periods of daylight reduce the heat requirements for a number of crops, particularly those that thrive in a cool environment (Edey 1977, Shaykewich 1988). Consequently, when considering the location for a specific crop not only is it important to have a knowledge of the heat units that are normally available, but more significantly, the environmental factors that can hasten or delay the number of heat units required to reach maturity for each specific crop. Therefore, these factors should be kept in mind when using the growing degree-day maps.

Despite the various limitations, the growing degree-day system is an effective measure used by growers and processors to schedule planting and harvesting of many cash crops. Perhaps the most important application of the degree-day system is its use in identifying the limits of geographic areas suitable for production of various crops. For example, the two types of canola available have quite different heat requirements. The late variety (Argentine) requires 1040 to 1100 heat units above base 5°C to reach maturity. The early variety (Polish) on the other hand, only requires 860 to 920 heat units above base 5°C (Dzikowski and Heywood 1990). Therefore, establishing geographic areas of risk and/or potentials in terms of degree-days, will aid in selecting the type of crop most suited to that area and consequently reduce the risk to the producer.

In this research the growing degree-day system (G.D.D.) was specifically used for tracking the development of alfalfa and corn in the soil moisture estimation. For corn, G.D.D's base 10°C was used instead of the traditional corn heat unit system. Several problems have been identified with the corn heat unit system and will be discussed in the literature review under the section titled "Corn Growth and Development, Choice of a Thermal Index for Moisture Analysis". Numerous studies have used G.D.D.'s base 5°C for estimating the development of alfalfa (Shields and Sly 1984, Bootsma and DeJong 1988b, Dzikowski and Heywood 1990, Bootsma 1984a, 1984c, Dunlop 1981, Selirio and Brown 1979) and for obvious reasons was used in the estimation of soil moisture consumption by this crop.

Another application of the degree-day system is the prediction of insect pest activity as it relates to agriculture production. It has long been recognized that temperature and humidity directly affect insect habitats. The ability of an insect to seek out a specific environment may be viewed as a behaviourial means of controlling its energy balance. If the insect moves from or to a sunny, shady, moist or dry environment, it is selecting a range of ideal environmental levels and dissipative fluxes. The correct combination of the environmental factors of temperature and humidity is essential for the insect to maintain a proper internal water balance, which is critical for the functioning and survival of the insect. The comprehension and integrated working of these environmental factors and a host of other multi-disciplinary factors (e.g. biological, chemical) led researchers to use the term integrated pest management (I.P.M) in the 1970's. The major goals of a (I.P.M.) program depends upon the individual. However, the I.P.M. system's major goal is the maintenance of pest populations below economic thresholds, while utilizing suitable techniques to protect the environment and non-targeted groups (Hatfield and Thomason 1981).

The I.P.M. model involves not only management of insect pests, but may include a host of other pests (nematodes, pathogens, vertebrates, and weeds). The model (I.P.M.) incorporates the well-know disease-triangle which consists of the initial population, the host, and the environment, which are all required for a pest outbreak to occur. The comprehension of insect pest population dynamics involves the critical aspect of weather, which in turn is made up of a number of important meteorological factors such as relative humidity, temperature, light, and wind. It is not possible to quantify all of these meteorological factors in this research. Since temperature is perhaps the most critical meteorological variable for insect development and survival on the Canadian Prairies, it will be dealt with briefly.

Temperature can affect the biochemistry or the physiology of insects. If the temperature increases, the breakage of weak bonds or the cuticle can occur. At the other end of the scale, decreases in temperature cause slower reactions and eventually freezing takes place. Physiologically, as the temperature proceeds out of the optimum range, efficiency of the metabolism decreases. The response of the insect to temperature change can be accomplished behaviorily or biochemically. A behaviourial response would be basking in the sun or seeking shade. In a biochemical cold response, the insect may change its enzyme amount, structure or reaction condition. In others words, the insect may produce enzymes that act as a antifreeze (glycerol), therefore making the insect freezing tolerant or resistant. The biochemical and physiological responses are also very dependent upon the life stage of insect, which in turn plays a significant role in the rate of development. It then becomes necessary to establish some means of tracking the rate of development of pest insects based on a thermal index.

The degree-day system is once again a time-held method of accomplishing this. Degree-days above base 10°C have been used to estimate the development of European corn borers from the capture of the first spring moth in traps. G.D.D.'s base 10°C has also been used to assess grasshopper lifestage cycles for any given year (Gage and Mukerji 1976, Technical Committee on European Corn Borers Studies 1983). Growing degree-days above 15°C is also a useful means for assessing general insect development. The producer is then able to use current year G.D.D. accumulations to estimate the time of application of insecticides or pesticides to reduce the pest insect problem and consequently, reduce the unnecessary use of pesticides. This provides economic and environmental benefits.

2.4.2. Corn Heat Units

Corn is an important economic crop in Manitoba (some what less important in Saskatchewan). As a result, heat available for this crop has been studied in some detail. The various inadequacies of the degree-day system lead Brown (1963) to develop an alternative technique called corn heat units (C.H.U.).

The selection of hybrids suited to the climatic conditions encountered in Southern Manitoba and Southeastern Saskatchewan is essential for successful production in any year. This is accomplished by the characterization of the normal thermal and moisture conditions within each of the two provinces. Perhaps the thermal condition is the most critical climatic factor in limiting corn production in Southern Manitoba and Southeastern Saskatchewan. In areas such as Southern Ontario it is quite possible to obtain 3000 to 3600 C.H.U.'s in any year. In Manitoba and Saskatchewan the average accumulated C.H.U.'s are 2000 to 2600. In recent years the introduction of hybrids that only require 2200 to 2400 C.H.U.'s to reach grain maturity has lead to the spatial dispersion of corn within the two provinces. This illustrates that grain corn production on the Eastern Prairies is at or close to its northern limit. Therefore, sound management and the choice of a suitable hybrid is essential for survival of the corn crop in any given year on the Eastern Prairies. In summary, C.H.U.'s have been used for estimating the amount of accumulated heat for any year, and more importantly to describe the agro-climatic potential of an area for corn production.

The corn heat unit system is similar to the degree-day method, in that it assumes growth and development increase with increasing temperature. In attempting to overcome some of the disadvantages with the degree-day system, the corn heat unit procedure applied two restrictions on diurnal and nocturnal growth. First, it assumed that no growth was possible below a daytime temperature of 10°C and a nighttime temperature of 4.4°C. Secondly, the C.H.U. system assumed a curvilinear relationship, where the rate of plant growth increased up to 30°C and subsequently decreased with higher temperatures. The algebraic form of the relationship for calculating corn heat units was:

$$C.H.U. = \frac{1.8(Tmin - 4.4) + 3.33(Tmax - 10) - .084(Tmax - 10)^2}{2.0}$$

Tmin and Tmax are the daily low and high temperatures (°C). The corn heat units were accumulated over the growing season from May 15 to the first autumn day when the temperature drops to -2.2°C or lower.

The C.H.U. equation considers the response of day and night temperatures individually. During the day phenological development of corn occurs only if the base temperatures is above 10°C, while the optimum development occurs at 30°C. Ideally, daytime temperatures should range from 24-29°C. Considering nocturnal temperatures, development ceases if the temperature falls below 4.4°C. Again, the ideal night temperatures range from 14-16°C (Dube 1981). The geographic area in Canada with the highest potential, i.e. the best agro-climate, for corn production is in Southern Ontario. Except for the Algonquin Park zone of Southern Ontario (which receives 2100 C.H.U.'s or lower), all other regions have almost ideal thermal conditions for corn production, with the Windsor area receiving up to 3600 C.H.U.'s on average (Brown 1979, Bhartendu 1984). Consequently, long season varieties with high corn heat unit ratings are grown there. For a regional assessment of corn potential in Southern Ontario, the research done by Bhartendu (1984), " A Climatology of Corn Heat Units in Ontario ", is an excellent example of research to date.

In Southern Manitoba and Southeastern Saskatchewan, most of the hybrids grown have been specifically rated for this region. In other words, the required corn heat units for a hybrid on the Eastern Prairies is substantially different than that of Southern Ontario. Producers should use hybrids that are approved for this region and can be subsequently found in field and crop recommendation files for each of the two provinces. For example, on the Eastern Prairies, corn requires a yearly accumulation of 2000-2100 C.H.U.'s for high quality silage to be obtained. On the other hand, grain corn hybrids require 2200-2400

C.H.U.'s to reach physiological maturity. Some hybrids require as much as 2600 C.H.U.'s to produce grain corn (Baron et al. 1975). Corn has the ability to escape serious frost injury in the spring because of its higher temperature requirements at the time of germination. Consequently, corn leaves can be frozen without serious long term effects to the plant provided the growing point is below the ground at the time of frost injury. The opposite is true for the fall condition, where a light frost will easily freeze the plant (Treidl 1978). Therefore a knowledge of: 1) a hybrid's C.H.U. rating, and 2) corn heat unit accumulation from planting to the first fall frost, is essential for successful production of corn in any given year on the Eastern Prairies.

## 2.5. Soil Moisture Considerations

### 2.5.1. General Soil Moisture Models

Plants require an amazingly large amount of water. Each day of active growth, a plant requires five to ten times as much water as it can hold at any one time. Over the entire growing season about 1000 Kg. of water are required to produce 1 Kg. of wheat (Hobbs and Krogman 1983).

The question may be asked, where does all this water end up? Water is used to transport nutrients from the soil to the green plant, where they are used in the photosynthetic processes. The products of photosynthesis are carbohydrates, which in turn are moved in the water solution to various organs of the plant. Once the water solution has finished it's function of transporting various chemicals to their destinations within the plant, the water is simply evaporated through tiny pores on the leaves called stomata. The evaporative process, called transpiration, also serves as a heat regulator system of the plant. As the water is transpired, it absorbs heat and cools the plant, preventing heat stress.

Plants have the ability to regulate the rate at which transpiration occurs. For example, when their water uptake cannot meet the rate of water loss, they simple close their stomata (Hobbs and Krogman 1983). The side effect is that the plants reduce their ability to photosynthesize correctly and as a consequence plant growth is restricted. Generally, as soil moisture is restricted, the rate of transpiration decreases and consequently crop yields are usually lowered. This has led many researchers to develop a number of soil - water - plant continuum models for the assessment of soil moisture and stress conditions which ultimately determine plant development and growth.

The characterization of rainfed crop production is of course dependent upon precipitation. However, as with the thermal aspect of the research, an analyses based solely on one single climatic element is too simplistic an approach when considering the interactions between plants and their moisture needs. The seasonal distribution of water within the soil profile is then of paramount importance to crop production since it represents a complex interaction between meteorological and non-meteorological factors. The meteorological factors affecting the soil water regime consist mainly of wind, relative humidity, temperature, precipitation, pressure, and evaporation; while the non-meteorological components deal with the influence of available soil water holding capacity, type of crop, phenological stage of development, and finally the effects of agricultural management practices on soil water regimes.

The advent of the high speed computer has led to the development of a number of simulation and mathematical models to provide a comprehensive quantitative description of the fate of moisture in the soil - plant - atmosphere continuum. For the most part, three types of models (physically-, budgetary-, and combination-based) have been developed to describe the seasonal distribution of moisture within the soil as it relates to plant development (DeJong 1984).

The first, physically-based models, describe the fate of moisture in the soil - water regime by principles of continuity and Darcy's law (DeJong and Cameron 1979, Stewart and Dwyer 1990, and Hayhoe and DeJong 1982, 1987). These, in turn, use the soil water flow equations, which consequently have water flowing through the soil as a result of a response to water potential gradients (DeJong 1984, DeJong and Tugwood 1987). These models are process oriented, distinguishing between, 1) transpiration, 2) soil evaporation and free water evaporation, and finally 3) water use parameters which can be assigned physical meaning (Bootsma and DeJong 1988b). There are, however, several drawbacks. First, a complete physical characterization of the soil profile in terms of water retention and hydraulic conductivity is required. Further, these models require a small time step which consequently requires large amounts of computer time (Bootsma and DeJong 1988b).

Since long term climate data are available for a number of weather stations in agricultural regions, an abundance of empirically derived soil moisture budgets have been proposed. Generally, climate water balances are used to simulate some or all of the processes of the hydrologic cycle. Since the research undertaken in this thesis can be categorized into one of these models, a detailed examination of this modelling approach over time will be addressed.

These climatic water balances were first described by Thornthwaite and Mather (1954), and Thornthwaite (1953), in which evapotranspiration played a key role in plant growth and development. The first water budget models operated by solving simple water balance equations, which in turn are similar to rudimentary accounting procedures. Starting with a known soil water content, the daily value of potential evapotranspiration is subtracted from daily rainfall amount. This, in turn, is subtracted from the water present in the soil to obtain a new daily water balance. In the case when daily rainfall exceeded potential evapotranspiration, soil moisture recharge occurred. When the water content of the soil profile reached field capacity, in the case of heavy rains, the excess water was assumed to be lost from the profile by deep percolation, or runoff. When moisture in the profile decreased to the permanent wilting point, no further water was extracted from the profile.

The next major development in crop modelling investigated the effects of crop type and stage of phenological development on water use (Dunlop 1981, Hobbs and Krogman 1983, Shields and Sly 1984). Potential evapotranspiration (P.E.) is the water required by a vigorously growing crop that is adequately supplied with water and completely shades the ground. The rate of potential evapotranspiration is totally dependent upon meteorological factors. On the other hand, actual evapotranspiration (A.E.) represents the amount of water the crop removes from soil plus the amount that is directly evaporated from the soil surface. As a result, A.E. is dependent upon three major factors described below.

The first, already described, is a result of meteorological determinants. The second major factor causing A.E. fluctuations is the type crop and stage of crop development. For example, the rate of growing season A.E. is higher for perennial forages than that of annual cereals, because forages have complete ground cover in the spring and continue to grow longer in the fall. Row crops such as corn have lower A.E. values in the spring because ground cover is not completely established until later in the growing season (i.e. July, August).

The final major determinant in A.E./P.E. ratios depends primarily upon the soil type/texture. Plants have little difficulty in removing moisture near field capacity. For all practical purposes the rate of A.E. is at or close to the rate of P.E.. As the soil is dried, the plants begin to experience difficulty in extracting moisture from the soil, and consequently the ratio of A.E. to P.E. begins to decrease. In this research the term crop evapotranspiration is synonymous with actual evapotranspiration in other researchers work. As a result, considerable work has gone into defining the soil water content at which the ability of plant roots to extract water is affected and as a consequence, crop evapotranspiration and yields are reduced (see methods on evapotranspiration). The root zone drying function is an attempt to reflect the increasing difficulty that plants have in extracting moisture from the root zone soils as they became drier. This topic requires consideration of a number of factors: soil physical and chemical characteristics, plant physiological factors and atmospheric demand (DeJong and Bootsma 1988). While the direct result of these factors is not yet precisely understood, considerable progress has been made. Meyer and Green (1981) believe that this restricted availability occurs at 30%

of available water holding capacity, while Johnston and Louie (1984) assume the reduction occurs at 60%. In a recent study done by DeJong and Bootsma (1988) the 50% level of available water holding capacity was chosen as the point at which crop evapotranspiration was affected by the root zone soil moisture level. This level was established in research done by Brun et al. (1985) on spring wheat in the North Dakota. They confirmed that crop evapotranspiration decreased when root zone soil moisture dropped to below 50% of available water holding capacity. These models (Hobbs and Krogman 1983, Dunlop 1981, Shields and Sly 1984) are also seen as one dimensional layered models. They usually deal with a single layered soil moisture budget and do not account for soil water deficits and recharge changes by zones or an expanding root system.

In contrast the modulated water balances divide the soil into zones or an expanding root zone (Baier and Robertson 1966, Baier et al. 1979, DeJong and Shaykewich 1981, Dyer and Mack 1984, Street et al. 1986, DeJong et al 1984, DeJong 1985, DeJong and Bootsma 1988, Boisvert et al. 1990). These modulated methods make use of some of the basic concepts established in the earlier models. For example, A.E. is a fraction of P.E. and is accordingly dependent upon crop type and stage as well as the soil type/texture. However, the daily inputs (precipitation) and outputs (A.E.) vary in accordance to each soil zone's importance at each particular stage of development. Therefore, the moisture is not recharged or depleted within one single layer, but on the basis that moisture is unevenly distributed within layers of the soil. Consequently, an expanding root zone makes use of this multi layered approach.

A few drawbacks have been established with climatic water balance models. First, except for the period after which rain has fallen, the movement of soil water is ignored. Although this is acceptable for studies involving irrigation scheduling, it is very limiting in studies which track the movement of various constituents in the soil system, e.g. soluble salt distributions. Secondly, unsaturated flow of water could be important since soils on the Prairies are usually below field capacity for long periods of time. Further to this, the effects of topography are ignored, i.e. horizontal movement of water (DeJong 1984). DeJong and Shaykewich (1981) recognized that most climatic water balances do not account for the upward transfer of water from layers underlying the modelled soil, and therefore are inappropriate for use in modelling water in soils above shallow water tables. This led the authors to propose and develop a soil water budget model for a nearly impermeable or impermeable soil profile associated with shallow water tables or imperfectly drained soils.

The main advantage of climatic water balance models are that they have a time step of one day, and thus are relatively inexpensive to run on computers. Some climatic water balance models, involving the estimation of growing season soil moisture levels, have attempted to estimate snowpack storage, snowmelt, and infiltration processes throughout the fall, winter and freshet periods (Baier et al. 1979, Raddatz 1989b, DeJong and Bootsma 1988). This provides a good estimate of soil water reserves each spring, whereas growing season models have to assume some initial start up level of moisture each spring, e.g. 75% of field capacity. This procedure of continuous year round modelling, using a high speed computer for a number of climatological stations, also allows calculations to be made continuously for a number of years for which the data were available. Thus, estimated soil moisture reserves will represent the actual conditions more truthfully.

The final and most recent development in simulation modelling has led to the combination model (DeJong 1988, DeJong and Zentner 1985, Hayhoe and DeJong 1987). The shortcomings of both the climatic water budget models and physically based models has led to this development. In summary, physical based models require considerable knowledge about the processes that govern water storage and movement; while budget models are largely based on soil characteristics which have been questioned seriously over time. Many of the empirical methods used in these budget models make it difficult to transfer their processes to different climates and soil conditions. Combination approaches simply model soil - water - atmospheric regimes by incorporating several aspects of the climate budget models into the physical based models or vice versa. One such combination approach, called the Soil-Plant-Air-Water (SPAW) model, recharges the soil by precipitation with a dynamic time distribution of hours (Hayoe and DeJong 1987). Soil water is depleted at a much slower rate by surface evaporation, plant transpiration and percolation and finally, is redistributed within the soil profile through a continual state of flux caused by hydraulic head gradients (Hayoe and DeJong 1987).

## 2.6. Phenological Development - Application to Soil Moisture Analysis Under a Wheat Crop

In 1968 Robertson introduced the conceptual idea of a biometeorological time scale for the development of a cereal crop involving daily temperatures and photoperiod. For each phase of plant development, optimum and threshold values associated with temperature and photoperiod were determined. The equation established by Robertson (1968) considered: 1) the response of crop development to temperature and photoperiod as a non-linear relationship related to a lower and upper critical limit as well as an optimum value, 2) the response of plants to day and night temperatures separately, 3) it tried to integrate the influence of these three climatological factors over short phenological processes that are relatively uniform, i.e separate equations for each development stage, 4) it considers daily temperature so that actual meteorological conditions are experienced by the plant and not long-term average value that might mask extreme events (please see methods on soil moisture analysis of a wheat crop).

## 2.7. Critical Stages of Wheat Development and their Effects on Yields

Many studies have investigated the consequences of temperature, moisture stress and nitrogen fertility either singly or in combination on yield and protein contents of cereals. Most studies have come to the conclusion that, during the development of a wheat crop, water shortfall or stress is detrimental to the plant's growth at all biometeorological stages, but however, it is most critical within certain phenological phases just before crop maturation.

Desjardins and Ouellet (1980) investigated for each of the phenological phases in the development of wheat, the environmental factors which were influential in determining the final yield. The basic hypothesis was that the importance of a phase was proportional to the number of environmental variables showing a significant difference between years of high and low yields. The results suggest, that the phases found to be most important were essentially the same for regions that had similar climates. It was established that the phenological phases most influential on yield were virtually the same regardless of the environmental factors. The phases most instrumental were the jointing to heading stages for three out of four of the case studies done on the development of a wheat crop. Seeding date had a somewhat minor role in the final determination of yield in one of the case studies.

Dejong and Bootsma (1988) chose the phenological stages of planting and heading as the critical interval at which soil moisture stress caused reduced grain yields. In another study, Campbell et al. (1981) found that yield was generally reduced to the greatest extent when moisture stress was applied at the boot stage of development. It was also the view that the direct effect of stress on yields can be less detrimental if the moisture deficiency was imposed early in the development of the plant. In other words, the plants seem to be able to adapt to adverse moisture conditions if they are given a long enough adjustment period. Consequently, stress and soil moisture conditions at planting may be relevant to crop yield.

Two studies (Johnson and Kanemasu 1982, French and Schultz 1984) have recently investigated the impact of pre/postanthesis soil moisture and stress levels as they affect wheat yields. The stages of pre/postanthesis can be placed within the reference frame of the Robertson (1968) biometeorological time scale, where preanthesis occurs slightly after the heading phase; likewise, postanthesis ensues slightly after the soft dough stage. In both of these studies, at a given stress level, preanthesis stress reduced yields relatively more than postanthesis stress. Also, different yield components were affected by water deficits differently, depending upon the growth stage at which water stress develops. Nevertheless, the most important component of yields in this analysis was related to the number kernels per square metre. When soil moisture was low at the preanthesis stage the number of kernels per square metre was reduced and this resulted in decreased yields. These two case studies amplify the importance of the level of available moisture at the phenological stages of heading and soft dough on yields obtained from the Canadian Prairies.

In a study done by Mack and Ferguson (1968) it was concluded that 69 - 76% of the variability in yield was a result of moisture stress mainly during the period from 5th-leaf to soft dough and that only 3 -4% of the variability was due to moisture stress following the stage of soft dough.

### 2.8. Corn Growth and Development - Choice of a Thermal Index for Moisture Analysis

Previous studies have used the corn heat unit system (C.H.U.) to trace the development of corn through the assorted phenological phases. Research in Manitoba by Baron et al. (1975) indicates that certain problems exist with the application of the C.H.U. system. They revealed that assuming physiological maturity of a corn crop occurs at 40% moisture, the number of corn heat units required to reach maturity for a hybrid varies from one location to the next. For example, the hybrid of Stewart's 2300 required 1900 C.H.U. at Lyleton (49.05 degrees N), 2300 C.H.U. at Hamiota (50.16 degrees N), 2100 C.H.U. at Brandon (49.50 degrees N). This indicates that the use of the C.H.U. as an indicator of corn maturity must be questioned.

In another study done by Major et al (1983), the evaluation of the corn heat unit system for the short-season growing regions across Canada was investigated. They compared the C.H.U. system with calender days and a variety of growing degree days with base temperatures ranging from 5 to 15°C. In their study, the thermal unit with the lowest coefficient of variability (C.V.) temporally and spatially was deemed to be the most suitable. From planting to emergence the C.H.U. system had a lower C.V. than degree days base 10°C, but from emergence to anthesis the two had the same C.V. and finally, the degree day 10°C had a lower C.V. than the C.H.U. system for the period from anthesis to 45% ear moisture. They concluded that there was no advantage to switch from the C.H.U. system to degree days base 5-15°C for the period from planting to emergence. From the observation of the C.V. for the periods emergence-anthesis and anthesis-45% ear moisture there seems to be slight advantage in favour of the degree day system.

Cutforth and Shaykewich (1990) investigated a temperature response function to estimate the phenological development for field-grown corn. The iterative temperature (IT) model was compared to the C.H.U. and G.D.D. base 10°C models for the periods of emergence to stem elongation and stem elongation to silking on three hybrids of corn at eight different stations (Cutforth and Shaykewich 1990). The coefficients of variance for the emergence to stem elongation period were lowest in the IT model, with G.D.D base 10°C having the next best C.V's, and C.H.U's having the highest C.V's. The C.H.U had a lower C.V. than G.D.D. base 10°C for stem elongation to silking period. A further relationship revealed that C.H.U, and to a somewhat lesser extent, G.D.D. base 10°C accumulated requirements were dependent upon the duration of the emergence to stem elongation period. On the other hand, the IT's development units were totally independent of the duration in days of the emergence to stem elongation phase. Ideally, it would be beneficial to use the IT model in computer simulation of corn growth, but further refinement and testing is needed before it can be applied to the Prairies. Based on the two alternatives remaining, the G.D.D. base 10°C seemed to be as accurate as the C.H.U. model, and it was not as a highly dependent upon the duration of the emergence to stem elongation period.

Further studies by Cutforth and Shaykewich (1989) revealed that as the duration of a phase increases, so does the number of C.H.U. required. By comparison, the G.D.D. base 10°C and modified corn heat unit model (M.C.H.U) are significantly independent of the phase of duration (Cutforth and Shaykewich 1989). The practical implications of this result can be demonstrated by an example. Assume that a particular hybrid required on average 2100 C.H.U. to reach maturity in an region that received on average 2400 C.H.U. If an attempt is made to grow this hybrid in a area that receives 2100 C.H.U. on average, problems arise. Because the area is cooler, the number of days to reach maturity is also longer than in the 2400 C.H.U. region. Therefore it follows that the number of C.H.U. required is also greater, (2200 C.H.U.) since C.H.U. are correlated to the number of days in a phase of development. It is unlikely that this hybrid rated for 2100 C.H.U. in a 2400 C.H.U. region would mature in a 2100 C.H.U. region on average, since it would need 2200 C.H.U. on average to mature. Therefore, the use of the C.H.U. model to estimate hybrid suitability in one region for application in another region is dependent upon the duration of the phase and not only upon the thermal aspects of the equation. When G.D.D. above base 10°C and the M.C.H.U. model were used to estimate the heat requirements, it was found that they were much more independent of the phase of duration in days, and therefore are a more reliable thermal indices (see methods on soil moisture analysis under a corn crop).

2.9. <u>Critical Stages for Moisture in Corn and Effects on Yields</u>

Shaw (1977) concluded that, at about the tasselling-silking stage, there is a sharp increase in the yield reduction per day of moisture stress. In controlled experiments yield reductions were as high as 13% per day of stress, but a figure of 6-7% was more common. It was also noted that if stress stopped pollination, a crop failure could occur.

In other research, Kamemasu and Rosenthal (1977), demonstrated on three controlled soil treatments with 40, 60 and 80% depletion of water, with relatively the same evapotranspiration rate and irrigated water applied, that yields were significantly different because of the timing of irrigations. The soil treatment with 40% reduction in water had the highest yield and water efficiency. The differences in yields were attributed to the amount of water in the profile at the tasselling period which is a critical stage for development.

Hamilton et al. (1977) observed that yield at final harvest was highly significantly correlated with C.H.U. and soil water deficit immediately following silking, but somewhat less with soil water deficit at the end of the growing season. The highest correlation was obtained with soil water deficit immediately after silking, followed by C.H.U. and growing season deficit. These three variables accounted for 98% of the variation in yield.

Dwyer and Stewart (1985) observed that the influence of two watering schedules had a profound effect on plant growth. At the tasselling stage (day 60) the leaf area of water-stressed plants was lower than that of the well-watered plants. It was also noted that the leaf area of the water-stressed plants decrease rapidly after tasselling. The above ground biomass showed a similar pattern to leaf area, with both watering treatments peaking at about day 70 (silking), but the well-watered treatment was 14g/plant heavier at the time and declined at a more gradual rate. The detrimental effect of moisture stress on leaf area and above ground biomass, applied at the tasselling-silking stages, would no doubt effect the quantity and quality of the yield obtained.

Gardner et al. (1981) found that reductions in yields were greatest when stress occurred during pollination (tasselling - silking) or grain filling periods (silking to physiological maturity). It was also noted that moisture stress applied during the grain filling stage causes plants to have a higher canopy temperature, resulting in the reduced yields (see methods on soil moisture analysis under a corn crop).

2.10. Critical Stages for Water in Alfalfa and Effects on Yields

In Ontario, the ability to cut three crops of alfalfa has been documented (Selirio and Brown 1979), but on the Eastern Prairies it is very unlikely that this is possible. If harvesting of a third crop was attempted, alfalfa would be vulnerable to over winterkill. In order for alfalfa to survive the winters on the Eastern Prairies, it must not be cut so late in the fall so that hardening does not take place. A second limitation deals with moisture considerations. In all likelihood, the amount of available moisture left after the second cut of alfalfa is too small to ensure a third harvestable crop of any quality and/or quantity. Furthermore, the reserves of soil moisture would be further depleted and leave the soil extremely dry for the next year of production.

Some work (Bootsma, 1984b, Bootsma and Suzuki 1985, Fulkerson, 1970) has centred on obtaining a reliable method for predicting the critical fall period during which alfalfa should not be harvested. Two methods have been derived from the two researchers; 1) avoid cutting when only 450 G.D.D. above 5°C remain in the average growing season (Bootsma, 1984b, Bootsma and Suzuki 1985), and 2) the harvest date which resulted in the greatest decline in alfalfa yields in future years coincided closely with the 25% risk date of frost (0°C) in Southern Ontario (Fulkerson, 1970). Therefore, recommendations drawn by the Ontario Field Crops Research Committee 1981 state that cutting should be avoided for a six week period centred around this 25% (0°C) risk of fall frost. Based on the conclusions drawn from the second method, a critical fall harvest period can be determined and should be used to make recommendation on the management of alfalfa crops in Southern Manitoba and Southeastern Saskatchewan (see methods on soil moisture analysis under a alfalfa crop).

2.11. Probability Theory in Agroclimatic Relationships

When attempting to characterize the agro-climatology of a region, it is not always beneficial to talk in terms of averages, i.e. 1 in 2 year risks. Therefore, mean values of agroclimatic parameters only provide a first hand look at the climatic capabilities of different agroecological regions on the Eastern Prairies for the purpose of agricultural production. More important are the probabilities or risks associated with the occurrence of each agro-climatic parameter, that is, the climatic variability associated with all aspects of agricultural production on the Eastern Prairies. Knowledge of these risks and/or potentials is essential, since it is the extremes in climate which generally play the key role in limiting specific crops to certain agroecological regions, e.g. grain corn production in the Red River and Pembina Valleys of Southern Manitoba. As stated by Bootsma and DeJong (1988), "While the extremes in climate influence the limits of agriculture production, the probabilities of various climatic events provide a sound basis for the development of viable strategies for risk management. Determination of these probabilities can directly aid farmers and other decision makers with regard to various aspects of agriculture".

Murphy and Katz (1985) stress that methods derived from the fields of probability, statistics, and decision making play an ever increasing role in the atmospheric sciences. They continue by stressing that, the application of such methods can be found in almost every phase of the discipline, from the most theoretical and global (e.g. atmospheric predictability, global climate modelling) to the most practical and local (e.g. crop-weather modelling, forecast evaluation). In a final statement, the WMO (1983) expresses that, "it is not possible to become involved in climatology without using probability analysis".

Probability analysis was thus undertaken in this research to provide an estimate of the degree of risk and/or potential associated with each particular agro-climatic event, in order to provide a sound basis for the development of viable strategies for risk management in agriculture.

The empirical concept of probability can be defined as the relative frequency with which an event occurs over the long run, that is, the ratio of the total number of occurrences of a situation to the total number of times the experiment is repeated. When the number of trials is large, the relative frequency provides a satisfactory measure of the probability associated with a situation of interest. This is one of the so-called laws of large numbers in probability theory.

The basis of all statistical analysis is that the data series must be composed of random variables selected from a single population usually infinite in extent (WMO 1983). Therefore, the specification of a valid climatological series is essential before any further analysis is carried out. Variables within a climatological series may either be discrete or continuous. Discrete variables usually refer to the frequency with which an event occurred during a given period of time. On the other hand, continuous variables are usually measured so that they may have any value on a complete scale of numbers (WMO 1983). Within this research, the agroclimatic parameters of choice can be classed as continuous random variables since precipitation, temperature or any other element measured on continuous scale is a continuous random variable (WMO 1983, Dunlop 1981, Thom 1958).

Before attempting any probability analysis of the various agroclimatological series, one must get a "feel for the data", and ask such questions as: 1) what are the largest and smallest values?, 2) what might be a good single representative number for the data set?, 3) what is the amount of variations or spread?, 4) are the data clustered around one or more values or are they spread uniformly over some interval?, 5) can the data be considered symmetric? (Murphy and Katz 1985). This kind of questioning has often been termed exploratory data analysis (EDA). The basic intent of EDA is to search for interesting relationships and structure within a body of data (e.g. agro-climatological series) and to exhibit the results in such a way as to make it recognizable (Murphy and Katz 1985). This process usually involves a few simple statistics (e.g. mean and variance of the agro-climatological series) or the presentation of the data in the form of simple plots (e.g. stem-leaf plots, boxplots, and normal probability plots).

When working with a agro-climatological series for the first time, one must determine the frequency distribution of the data in question. Each agro-climatological series is made up of random agro-climatological statistics which form the population and hence the frequency of the distribution. The distribution of the climatological series can then be described by the frequency of the curve. The general form of the frequency curve in most cases can be determined by histograms or stem-and-leaf plots. The area that is contained under the curve and between the two values on the horizontal scale represents the probability that a variable will assume some value lying within this interval, and is called the probability density function. These distribution curves for continuous random variables are specified by a number of mathematical formulas or models, i.e., models in which probabilities are assigned to the various values which an observed variable may assume. A number of probability models and tables have been established for a number of frequency curves. Therefore, once the data or agro-climatological series is known to fit a particular frequency distribution curve, the probability of occurrence of a specific agro-climatic event can be easily determined using the appropriate probability tables.

Some of the agroclimatic parameters under investigation in this research have been proven to fit a known frequency distribution, while others have not. Therefore, the first step in the analysis was to identify the agroclimatological parameters in the first case. It should be mentioned that the data or agro-climatological series which do not fit a known frequency distribution were investigated using a Univariate Procedure within SAS (1985). The methodology employed is outlined in the methods section under probability analysis.

Some of the agro-climatic parameters mentioned above have been proven to fit a known frequency distribution. Thom and Shaw (1958) determined that the last spring and first fall frost-dates are randomly and normally distributed so that the mean and the standard deviation are valid statistics. They were also able to show that the dates of the two events are independent of one another, and thus the probability distribution of the frost-free period can be determined. Rosenburg and Myers (1962) further quantified the results of Thom and Shaw (1958), and demonstrated that the dates of occurrence of last spring and first fall radiation and advective frosts were random and normally distributed. These results have been further proven in recent research by the WMO (1983) that suggest the dates of the last spring and first fall frosts are normally distributed and can be utilized to calculate the probability of occurrence of each event at different risk levels.

Dunlop (1981) and WMO (1983) have also proven that degree days above many base temperatures are randomly and normally distributed. Therefore, these two studies provide the basis for the use of the mean and standard deviation in probability analysis, assuming a normal distribution. Dunlop (1981) was also able to show quantitatively that corn heat units follow a normal frequency distribution, and thus the mean and standard deviation are useful characteristics in probability analysis.

# Chapter III

## Methodology

### 3.1. Non - Meteorological Inputs

#### 3.1.1. Estimation of Seeding Dates using Climatological Data

To facilitate an accurate representation of crop growth and development during a specific year, the knowledge of seeding dates (soil tractability) is essential. Seeding date variations have a significant influence on the development of crop growth stages, e.g. heading and soft dough, achieved on a given calendar date. Yield and quality are greatly influenced by available soil moisture and resulting stress levels at critical stages. In most studies, the assessment of soil moisture reserves and stress levels at various phenological stages have assumed a constant seeding date, such as May 1 or May 20 for all years and crop districts. In some applications the use of fixed seeding dates may be preferred. However, the use of estimated seeding dates that closely mimic reality provides a means of more accurately assessing long term soil moisture and stress variability levels at different phenological stages. Since, seeding dates fluctuate from one year to the next, crops and especially annual crops, will react to various climatic conditions in their environment in a distinct way for each year.

As mentioned in the literature review, many researchers (Shields and Sly 1984, Stewart 1988, DeJong 1985) have chosen a fixed date, usually May 1 or May 20, to mark the beginning of the growing season. Crop reporting files store information on estimated dates of seeding (Statistics Canada 1989). However, the temporal coverage of these files does not usually correspond to the climatic data time frame. Hence it becomes necessary to estimate planting dates for part of the record of climatic coverage.

For annual crops, seeding dates were available from crop reporting files for the years of 1952-1988 for both Manitoba and Saskatchewan (Statistics Canada, 1989). The crop reporting file handbook is compiled according to provinces and crop districts. Each date of seeding presented in the handbook for each crop district is the one most frequently reported (the mode). This general date of seeding was applied to each of the reporting crop districts. In Manitoba there were a total of 14 crop districts prior to 1977. After 1977, the number was reduced to 12. For Saskatchewan only 11 of the reporting crop districts were used. These included all crop districts east of 106 degrees longitude (Figure 1).

A total of 37 years of observed seeding dates is available from the crop reporting handbook. In the analysis carried out in this thesis, it was deemed necessary to extend the planting dates back to 1929. This would provide a temporal period of 60 years, which was seen as a requirement to obtain a more reliable statistical distribution, including the "dirty thirties" and the agroclimatic variability of the 80's. To accomplish this, a fortran 77 program using only climatological data was written to estimate planting dates for the period of 1929 to 1951.

Soil moisture budgeting techniques were used in this research to estimate planting dates based on climatological data for each crop district. The approach used, was very similar to that used by Selirio (1969), Selirio and Brown (1972), Dunlop (1981), and partially analogous to that of Bootsma and DeJong (1988a). For each crop district, the predominant soil available water holding capacity was extracted from DeJong and Shields (1988) maps. This procedure was identical to that used

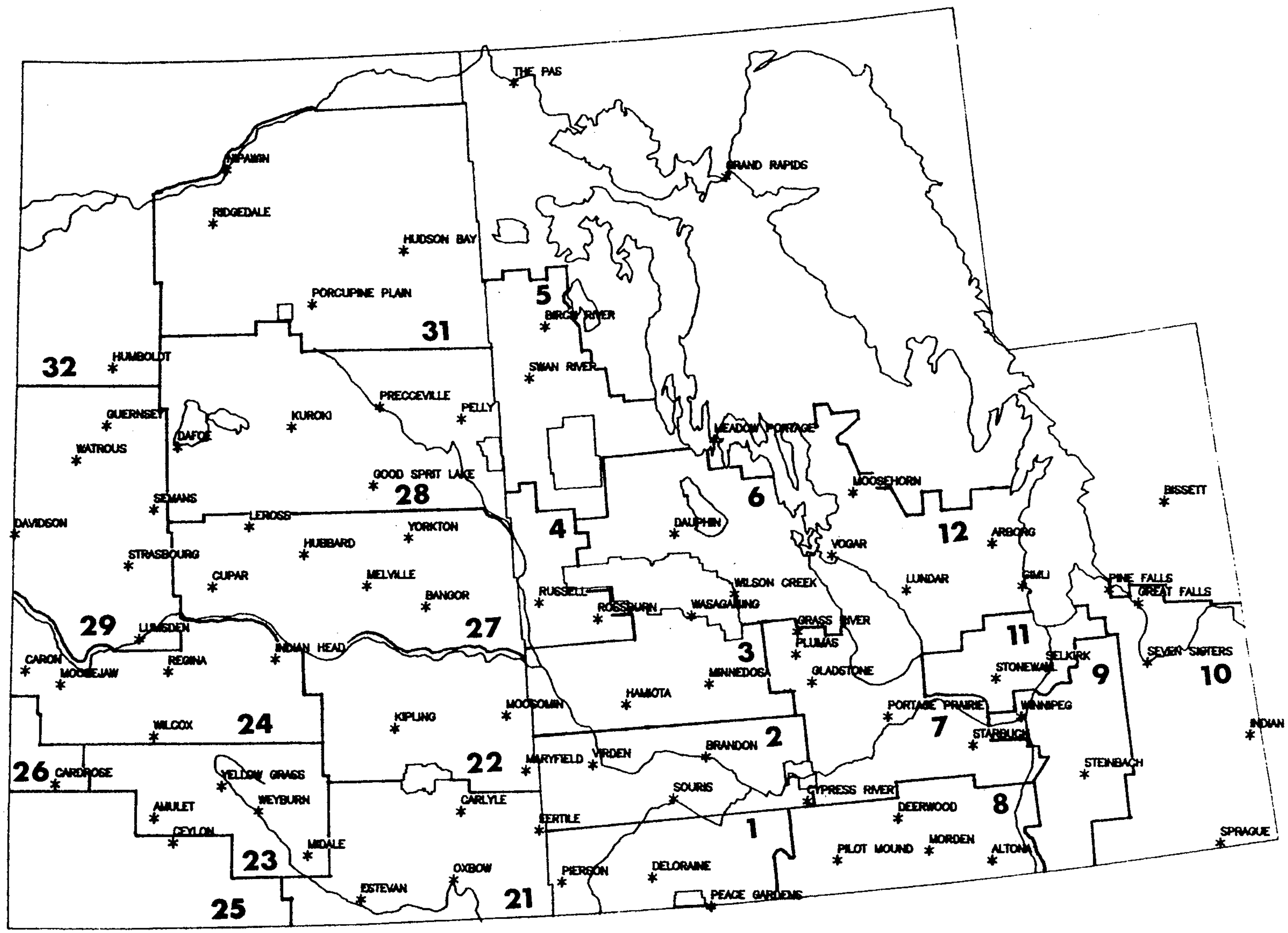


Figure 1: Crop Reporting Districts Utilized in this Research

by Bootsma and DeJong (1988b). Prior to implementing soil moisture budgeting procedures two conditions had to be met: 1) soil moisture levels were assumed to be at field capacity for the top 12 cm profile of the soil, 2) ten consecutive days with a maximum daily air temperature above 5°C after March 15 had to occur. The estimate of soil moisture for a 12 cm profile was accomplished by the following procedure:

Soil moisture (dayi) = Soil moisture (dayi-1) + precipitation (dayi)
- actual evapotranspiration (dayi) (Dunlop 1981)

Actual evapotranspiration was calculated as a portion of the potential evapotranspiration (P.E.) rate estimated by Baier and Robertson (1965) and Baier (1971). The daily rate of actual evapotranspiration (A.E.) depends upon a consumptive use factor (C.U.), which was determined in work by Selirio (1969). When the soil moisture was equal to or greater than 95% of field capacity for the 12 cm profile, the rate of A.E. was equal to P.E.. If the soil moisture level was below 95% of field capacity, then the rate of actual evapotranspiration was determined by P.E. * C.U., where C.U. was equal to:

$$C.U. = (0.01) * (127.42)^{(@/100)}$$

where @ was equal to the percentage of available soil moisture in the 12 cm profile.

The soil on a particular day was considered tractable if, 1) the soil moisture level was less than 90% in the 12 cm profile, and 2) daily precipitation was less than 2.5 mm. If both conditions occurred on 5 consecutive days, the fifth day was then considered as the estimated planting date. If one of the days did not meet both conditions above, the whole procedure was re-initiated back to day one, and run again until both conditions were satisfied. Regression analysis was then run on the estimated planting dates derived from soil moisture budgeting procedures, and the observed planting dates supplied by Statistics Canada, from 1952 - 1988, to establish regression lines to facilitate the estimation of planting dates for each crop district prior to the 1952 actual planting dates.

3.1.2. Available Water-Holding Capacities (AWC) of Soils

Since, the research accomplished in this thesis involves the analysis of soil moisture fluctuations in Southern Manitoba and Southeastern Saskatchewan, water holding capacities for each of the climatological stations within these two provinces were needed, and extracted from maps provided by DeJong and Shields (1988). Each climatological station was assigned a water holding capacity according to the location of the station within one of the textural polygon groups of DeJong and Shields (1988) maps. A list of each of the climatological station's location and resulting water holding capacity can be found in Appendix A. Based on the 158 climatological stations, a map of soil water holding capacities to 120 cm in millimetres was generated (Figure 2). This figure illustrates the spatial variability in the water holding capacities of the soils throughout the two provinces, with Saskatchewan having a lower water holding capacity on average, than Manitoba.

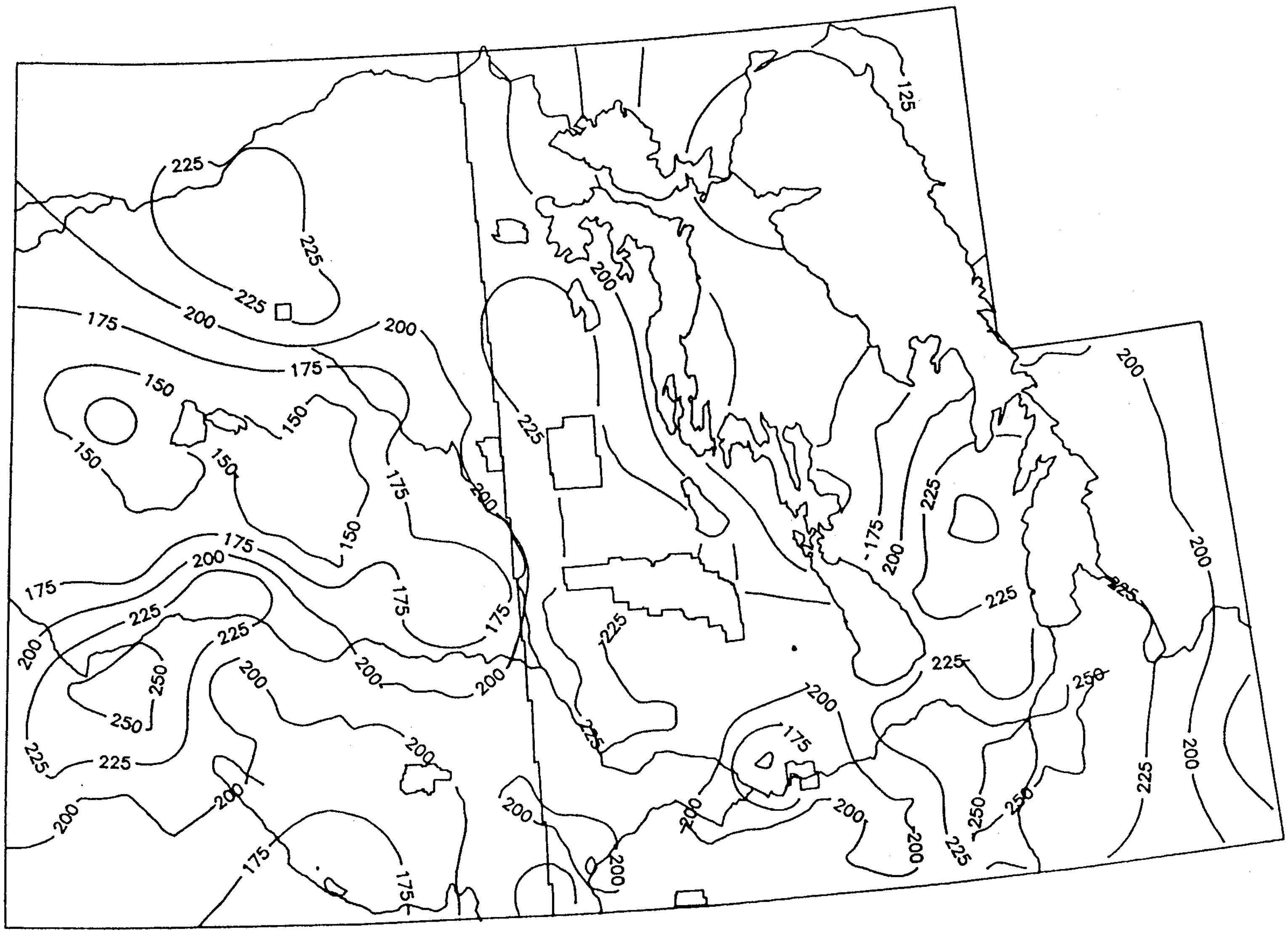


Figure 2: Soil Water Holding Capacity to 120 cm (mm)

### 3.1.3 <u>Daily Photo-Period and Solar Energy (Qo) at the top of the Atmosphere</u>

The total solar energy at the earth's surface in the absence of the atmosphere, Qo and daily photo-period were calculated using a procedure developed by Robertson and Russelo (1968). The daily photo-period was calculated by the following equation:

Daylen = arcos(( -.01454 - sin(Phi) * sin(Delta)) /(cos(Phi) * cos(Delta)))

Where:

Daylen = day length from sunrise to sunset

Phi = latitude of the observer in radians

Delta = declination of the sun

The equation used to calculate solar energy (Qo) at the top of the atmosphere was:

Rad = F * Sc * (Cosoz + Cosz) / (2 * Radius * Radius)

Where:

Rad = hourly solar radiation

F = 60

Sc = Solar Constant (2) cal $cm^{-2}$ $min^{-1}$

Cosoz = angular elevation of the sun at the beginning of an hour for any day of the year and for any latitude.

Cosz = same as above, but end of the given hour.

Radius = radius vector of the earth's orbit around the sun (expressed as a fraction of the mean radius)

The hourly values were summed to obtain a daily total of solar energy (Qo). These equations were applied daily for each of the 158 climatological stations. They provided input variables for calculating the biometeorological time scale for wheat (daily photo-period), and in the calculation of daily potential evapotranspiration (solar energy Qo).

## 3.2. Meteorological Inputs

### 3.2.1. Spatial, Temporal, and Missing Data Representation

#### 3.2.1.1. Spatial

The study area for the present research consists of the southern portion of Manitoba and the southeastern portion of Saskatchewan. Within Manitoba, all 12 crop reporting districts were utilized, while in Saskatchewan 11 of a possible 20 were used (Figure 1). The northern limit of the data base consisted of all areas up to and including 54° north latitude, while the southern limit was the U.S. border (49° latitude). On an east-west basis, the data base extended from the Ontario-Manitoba border to 106° longitude within Saskatchewan.

The use of the climatological station network plus synoptic stations maximized the spatial representativeness of the thermal and, more importantly, the soil moisture requirements of this research. This was feasible because the estimate of potential evapotranspiration in this soil moisture research was based on the first regression equation of Baier and Robertson (1965). This equation used daily maximum and minimum temperatures and solar energy at the top of the atmosphere. Although, this equation is inferior to the seven other equations, it allowed for a high spatial density of climatological observations to be subsequently used in this soil moisture analysis. A full explanation of the potential evapotranspiration equation can be found in the soil moisture section of the literature review of this thesis. For a complete review of thermal and soil moisture spatial requirements the reader is referred to the relevant section in the literature review.

In all, about 158 climatological and synoptic stations were used at any one time for both of the provinces. This number varied with the agroclimatic parameter in question (i.e. frost, soil moisture, degree days), e.g. temperature data could still be used even if precipitation data were missing.

The list of all stations used in this analysis can be found in Appendix A. Table A1 provides a listing of the stations numbers, years of recording, name, elevation, and spatial location, i.e. latitude and longitude, along with a number of other elements. A complete list of all stations within the two provinces can be found in the AES climatological station data catalogue. Figure 3 illustrates the distribution of climatic and synoptic stations used in Southern Manitoba and Southeastern Saskatchewan. Visually one can see that the agricultural regions of the two provinces are well represented (Figure 3), while regions outside the agricultural belt are sparsely represented. The stations used on the extreme northern fringes of the two provinces and in Eastern Manitoba are used strictly for the purpose of computer mapping.

The area of the present study is roughly 358,530 $km^2$. This area along with the number of stations (158) provided an average station spacing of 48 km. This value is slightly better than the regional assessment by Raddatz (1989b), of 100 km. Therefore, the present climatic data base can be used to supply site - specific information and to represent agroclimatological conditions on the mesoscale (regional), and in fact, in some cases (i.e. the long sampling period 1929-1988) it can be used to represent conditions on the microscale (i.e. local).

All climatological and agroclimatological analyses carried out in this research were accomplished by specially developed computer programs written in Fortran 77 for the IBM 360/370 system. The raw input data for each of the programs developed, consisted of daily meteorological observations of maximum and minimum temperature and precipitation amounts recorded at climatological and synoptic stations within the study area.

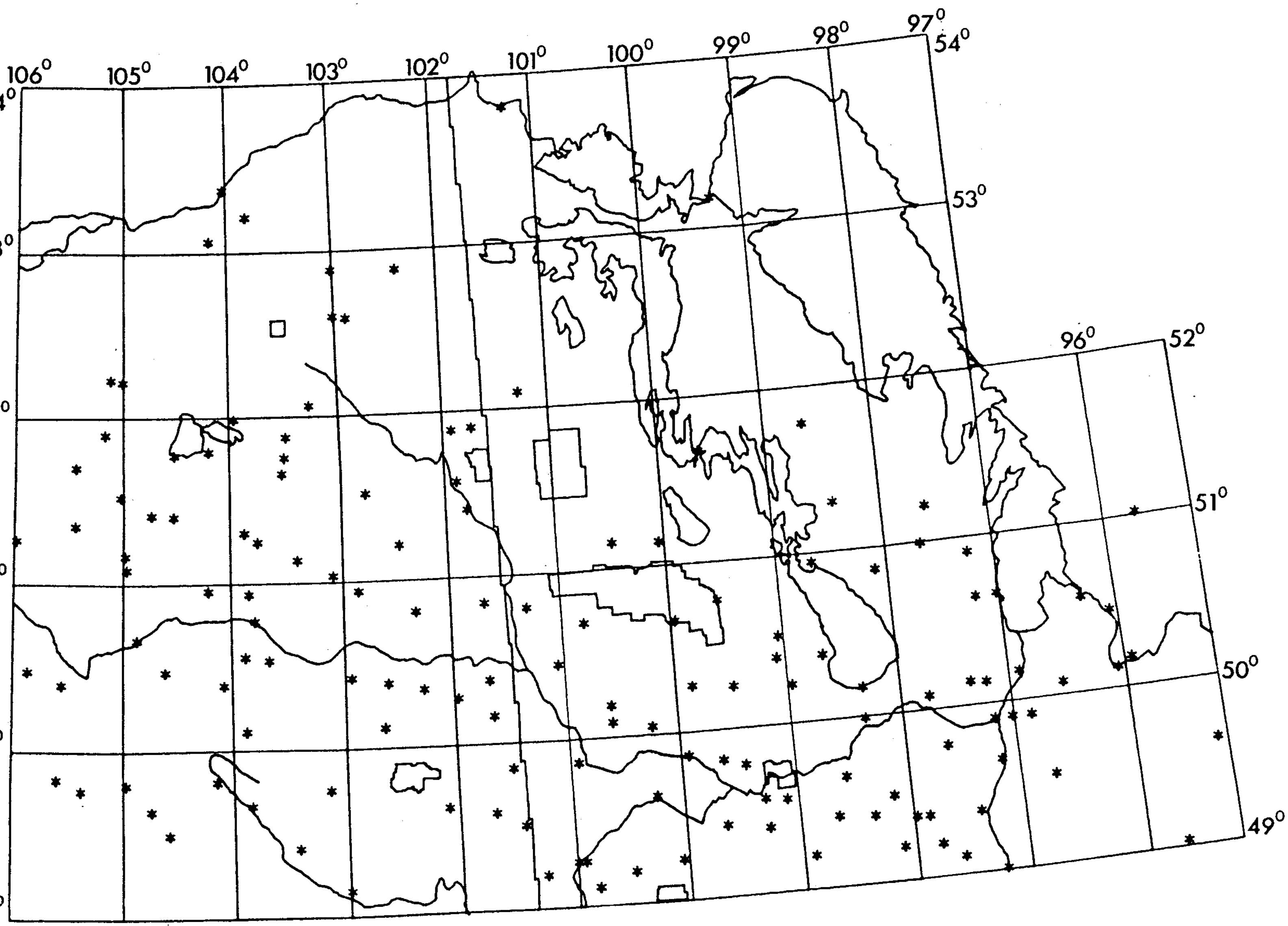


Figure 3: Distribution of Climatological and Synoptic Stations within Southern Manitoba and Southeastern Saskatchewan

3.2.1.2. Temporal

The temporal coverage of the climatological stations varies enormously throughout the two provinces. The large urban centres, such as Winnipeg, have long and extensive records, with multiple climatological stations. This allows for a comparison of the agroclimatological information obtained, but finally only one station for the town or urban centre was used. Thus, if there were three stations in Winnipeg for example, the three would be combined to supply a mean value for the agroclimatic variable in question. It would be greatly beneficial for the analysis if all towns and urban centres were this well represented, but in most cases, the small towns have only one station and the record is of a short duration. At the outset of this research many of the stations in the AES Climatological Station Data Catalogue were discarded due to their insufficient length of record and discontinuous nature of recording.

This brings to question the length of record necessary for use in this analysis. The minimum number of years necessary to represent the area's agroclimatic resources was judged to be 15 years. This was a standard used by previous researchers (Rosini 1963, Jagannathan et al 1967, Dunlop 1981, WMO 1983). The maximum length of available record was 60 years, i.e. no analysis was carried out on climatic data before 1929. Other requirements of the temporal distribution were that the record for each of the stations had to be homogeneous and continuous. Stations with frequent gaps in the record were eliminated. A further requirement was that stations with records that extended from 1929 until only 1945 for example, were not used in the analysis, in that the results obtained may be unrepresentative of contemporary climate conditions. It was also noted that in many instances, towns or urban centres had a record too short at one station alone (i.e. less than 15 years). All of these temporal obstacles made it incumbent on the researcher to establish a temporal data base in an objective and systematic manner.

In some cases these problems were overcome by combining multiple station records (Street et al. 1986). In other words, stations that lasted only a few years were combined with other nearby stations to produce a record of substantial length to be used in the analysis for that town. In most cases, when stations were combined an overlap existed, but in some cases this was not possible. To further clarify the point, an example of combining one such station record with that of another, can be found in Appendix A, Table A1. Using the city of Dauphin as an example, one see's that the city has two climatological stations. One of these stations was operated from 1890 to 1941, while the other extended from 1942 to 1988. Since, the analysis started in 1929, all information before this was truncated. If only the first station were used, the station would have been discarded. The use of the second station would have only permitted analysis from 1947 to 1988. When both of these stations were combined, a record of 60 years was possible, the maximum temporal coverage afforded in this analysis.

These combinations, can obviously create erroneous results due to the variation in microclimate for each specific site. This scenario occurred on limited occasions, so where possible the record was extended through the combination of stations to achieve the highest possible spatial and temporal density. Consequently, one of the main research objectives was fulfilled. With the combination of climatological and synoptic stations around or in each of the towns or urban centres, a total of 158 villages or metropolitan centres with varying temporal periods (15 - 60 years) were used in the analysis of the agroclimatic parameters in this research.

Once the problems of spatial and temporal distributions were solved, the next step in establishing the data base was to attack the problem of missing data in a station record.

3.2.1.3. Missing Data

Within each of the climatological and synoptic station records, two types of data can be missing; 1) daily maximum and minimum temperature, and 2) daily precipitation. Raddatz (1989b) used the Barnes' (1964) interpolation technique to estimate missing daily temperature and precipitation data. The spatial variation of summer precipitation over a geographic area is very great in comparison to thermal variations. Therefore, the estimation of missing daily precipitation will be discussed in more detail than that of the thermal aspect of the research.

In this thesis, daily values of precipitation are needed to estimate soil moisture status. The average station spacing of precipitation sites was comparable to the interpolation distances (10-32 km) study by Raddatz (1987b). He concluded that any attempt to use a gauged point to represent an ungauged daily precipitation value would result in a large error; consequently this was not endeavoured in this study. When attempting to quantify the area-average that can be represented by a point observation of precipitation in this research, the conclusions drawn by Raddatz and Kern 1984, Raddatz 1987b, and Raddatz 1989b indicated that even with a fairly high density of stations, the representativeness of the continuous field still only provides a regional perspective of soil moisture status (see relevant literature review).

While there appears to be no practical means of estimating daily precipitation amounts, temperature is readily extrapolated from gauged to ungauged points (Barnes 1964, Kemp et al 1983, Raddatz 1989b). This is feasible because temperature is more homogenous over a spatial area. An attempt could have been made to estimate missing daily temperature, but it was judged to be too large a task considering the number to stations, years involved, and limited time available to undertake this research.

The number of missing daily temperature values were recorded by a counter. This counter recorded the number of missing temperature days and replaced the missing value with that of the previous days. For each portion of the year, a certain number of missing days of data were allowed to accumulate before that year's data were discarded. In the winter period (Nov.1 - April 1) this was 70 days. Although this is a substantial period of time, the results of missing temperature data has little effect on the overall estimation of soil moisture status since near zero rates of potential evapotranspiration and infiltration occur in this period. During the growing season and fall (planting - Oct. 31), only 25 days of missing data were allowed to accumulate before a year's data were discarded. This shorter period was chosen because highly variant temperatures would result in large errors in growing degree days and, more importantly, in the estimate of potential evapotranspiration. This in turn would affect the assessment of soil moisture recharge and withdrawal in this period.

### 3.2.2. Thermal Considerations

Temperature is one of the main environmental factors that determines which crop species can be grown in a climatic region. The thermal regime of the Eastern Prairies is given paramount importance in this research due to the fact that Southern Manitoba and Southeastern Saskatchewan are at the northern fringe of agricultural production.

On the Eastern Prairies crop distribution is, in general, not limited by the upper or maximum levels of temperature, as most areas rarely experience heat stress for prolonged periods of time (Canada Committee on Ecological Land Classification 1989). For the most part, it is the lower thresholds of heat and lethal minimum temperatures that limit production of certain crop species to specific regions within Southeastern Saskatchewan and Southern Manitoba. There are a number of thermal considerations that delineate the areas for specific crop production within the two provinces: 1) temperatures at the time of seeding, 2) the accumulation of heat over the growing season, and finally, 3) the length of the growing season and the critical temperatures that end it in the fall (Treidl 1978, Dunlop and Shaykewich 1984).

#### 3.2.2.1. Spring Frosts

The dates of occurrence of the last spring frost at 0° and -2.2°C are valuable for defining areas of early plant growth. Most of the crops normally grown in Southern Manitoba and Southeastern Saskatchewan can withstand temperatures of 0°C at germination without significant damage. For most crops the date of the last occurrence of a daily minimum temperature of -2.2°C serves as a better indicator of the areas suitable for early plant growth, because a temperature of this magnitude or lower is generally referred to as a killing frost. The last occurrence of either a 0° or -2.2°C spring frost can control the dates of planting for specific crops. Knowledge of the average dates and frequencies or risks of occurrence of the last spring frost, at various spring frost thresholds can be used to schedule seeding to correspond to times when the risk of damage by frost is minimal to young plants.

In this research, the last spring frost dates at thresholds of 0° and -2.2°C were determined for each year and every climatic station for the period defined as the days between May 1 and June 30, during which the temperature fell below the two base temperatures.

3.2.2.2. Growing Degree-Days Base 5°, 10°, 15°C

A second major thermal consideration for defining conditions that seriously effect the rate of crop development and geographical areas where specific crops can be grown, is the accumulation of heat. This is usually tabulated as the summation of temperatures above a growth threshold. These are often called 'heat-units' or 'growing degree-days'. Growing degree-days are simply the accumulation of temperature above a base temperature throughout the growing season. This simple approach assumes that there is only one base temperature throughout the life of the plant, that day and night temperatures are of equal importance to plant growth, and that plant growth is linear over the entire growing degree-day range. These assumptions are generally true, because growth is virtually linear for many agricultural crops over the temperature ranges existing in temperate regions and, under average circumstances, temperatures are not high enough to cause heat stress damage to plants in temperate regions (Shaykewich 1988).

Three base temperatures (5°, 10°, 15°C) have been used to estimate the growth-stages of a variety of crops and the life-stages of various insects. Growing degree-days base 5°C are used to estimate the various phenological stages of alfalfa, while base 10°C can be used to track the development of corn through its ripening stages. Base 10°C can also be used to assess the life-stages of grasshoppers and corn borers (Gage and Mukerji 1976, Technical Committee on European Corn Borers Studies 1983). Base 15°C has been used to estimate the phenological stages of a number of insect pests. For these applications, simple degree-days were calculated for each day and location. This calculation used the average daily temperature determined from daily maximum and minimum temperatures. The base temperature (5, 10 or 15°C) was then subtracted from the average daily temperature. The accumulation of growing degree-days, calculated for each year, was executed for the period of May 1 to October 1. The empirical formula used to calculate growing degree-days for each year and at each climatological and synoptic station was then:

$$S.G.G.D.{}^{\circ}C = \Sigma[(Tmax(Nday)+Tmin(Nday)) / 2 - \text{Base Temperature}]$$

Where:

S.G.G.D.°C = Sum of the Growing Degree-Days Base 5°,10°,15° for each growing season

Tmax(Nday) = Maximum Daily Temperature for each day between May 1 and October 1

Tmin(Nday) = Minimum Daily Temperature for each day between May 1 and October 1

Base Temperature = 5°, 10°, 15°C

The mapping of critical values of growing degree-days can aid in delineating areas that are suitable for cultivation of specific crops and for predicting the life stages of a number of pest insects. This is important because it determines when spraying should take place, and consequently, is one of the aims of the integrated pest management system.

3.2.2.3. Corn Heat Units

Another thermal unit used as an indicator of heat accumulations over the growing season for the specific crop of corn is the corn heat unit system. The corn heat unit system was introduced by Brown (1963) to improve the simple growing degree-day calculations.

The basic concept of the corn heat unit calculation is the same as the degree-day system, i.e., the rate of growth is assumed to increase with increasing temperatures. However, with the corn heat unit system, no growth is assumed to occur with night temperatures below 4.4°C or day temperatures below 10°C. In addition, growth is assumed to be a curvilinear function of temperature in which maximum growth occurs at 30°C and decreases with higher temperatures. Thus, the relationship accounts for the detrimental affects of very high temperatures. Corn heat units for each day were calculated by the empirical formula of:

$$C.H.U. = \frac{1.8(Tmin - 4.4) + 3.33(Tmax - 10) - .084(Tmax - 10)^2}{2.0}$$

Where:

C.H.U. = Daily Corn Heat Units

Tmax = Daily Maximum Temperatures (°C)

Tmin = Daily Minimum Temperatures (°C)

Corn heat unit calculation began on May 15 and accumulated over the growing season to the first date of occurrence of a fall frost at -2.2°C or lower (Dunlop and Shaykewich 1984).

3.2.2.4. Fall Frosts, and Frost-Free Periods

The length of the growing season for any specific crop is fixed by the occurrence in the spring and fall of frosts with sufficiently low temperatures to kill the crops. The dates of the last 0° and -2.2°C temperatures in the spring and the first such event in the fall were used in this research to define the length of the frost-free season for each year. Fall frosts were defined on an annual basis as those days between July 1 and October 1 during which the temperatures fell below the two frost thresholds. The subsequent frost-free periods are perhaps the most critical determinant in delineating areas suitable for various crop varieties as they determine the time available for plant growth and development.

3.3 Soil Moisture Considerations

3.3.1. Soil Moisture Model

The Model used to estimate soil moisture status was similar in concept to the Versatile Soil Moisture Budget developed by Baier et al. (1979). The modelling approach of Dunlop (1981) as improved by Raddatz (1989b) was used as the starting point of this simulation.

A generalized flow chart of the model's operation for a wheat, alfalfa, or corn crop for any given year can be seen in Figure 4. This flow chart is the same for the three crops, with two main exceptions: 1) the rate at which crop evapotranspiration takes place in the growing season, and 2) the type of root zone growth and resulting root zone soil moisture.

There are four phases to the flow chart for any given year. The first phase begins on January 1 and continues till April 1 or until the snowpack has melted. In this period, any precipitation that falls is considered as snowfall and is added to snowpack storage unless the mean temperature for the day is above -1.0°C; in which case it is considered as rainfall. Within this period, the snowpack was treated as a freely evaporating surface and is reduced by 1/3 of the potential evapotranspiration rate (Baier et al 1979, Raddatz 1989b). The second phase commences after the first is completed and continues until the planting date. In this period any precipitation that falls was considered to be rainfall. The rate of actual evapotranspiration within this period is equal to 1/3 of the potential evapotranspiration rate since the land is fallow a this point in time. The third phase of the model, the most important, runs from planting through maturity to October 31. In this phase, agroclimatic parameters including soil moisture are tracked through the growing season. It is within this section that crop evapotranspiration and root zone growth varies with the type of crop. The final section of the model begins on November 1 and runs till December 31. In this section, like the first, any precipitation that falls is considered to be snowfall, unless the mean temperature of the given day is above -1.0°C, and is added to snowpack storage.

In each of these four phases the model was run on a daily time-step with soil moisture and other agroclimatic parameters being calculated daily.

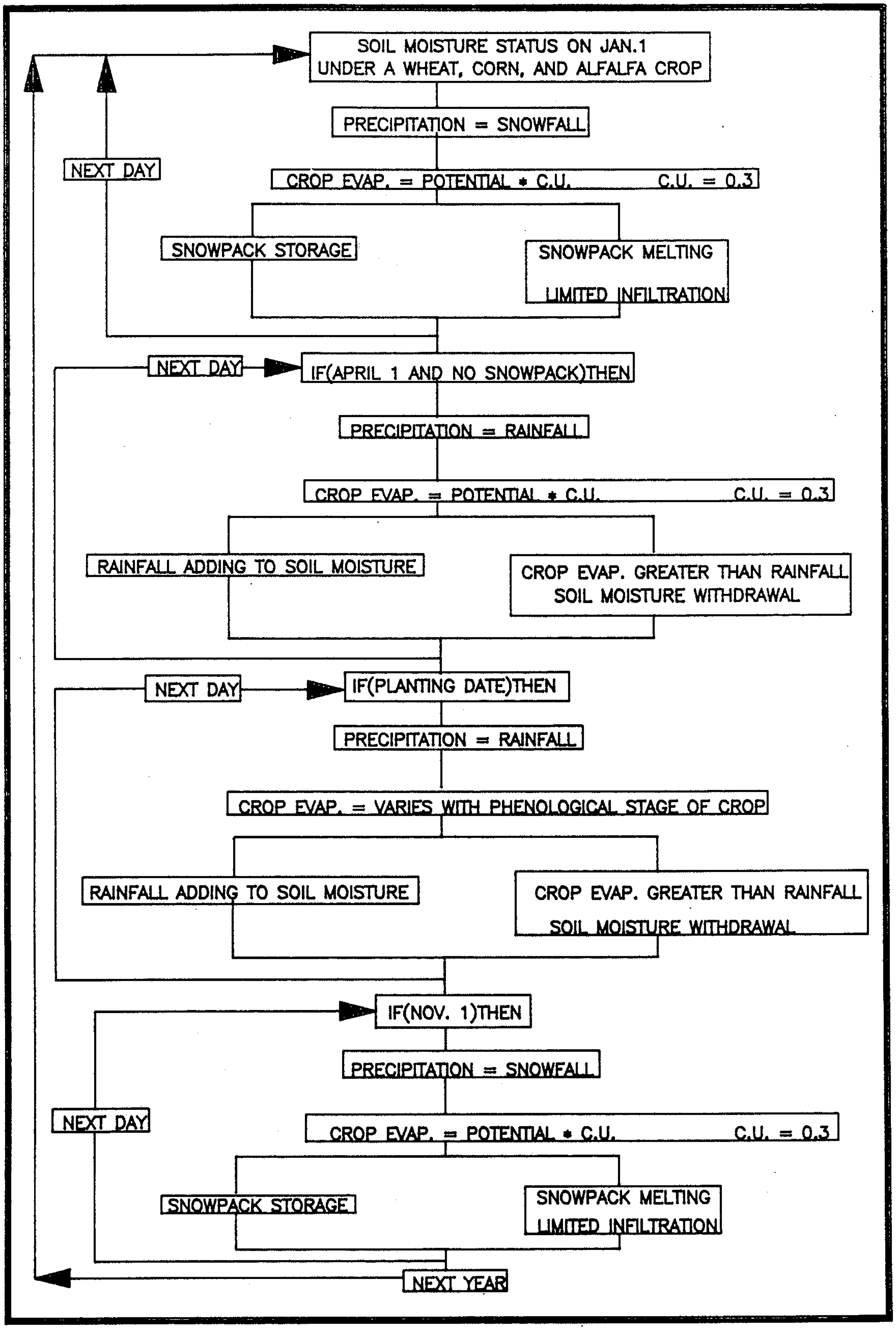


Figure 4: Flow Chart of Model's Operation for any Year and Crop Type

### 3.3.2. Three Modelled Processes

#### 3.3.2.1. Snowmelt and Snowpack Storage

In the first (Jan. 1 to either April 1 or the date of no snowpack) and the last (Nov. 1 to Dec. 31) phases of the flow chart (Figure 4, 5) the modelled physical processes of snowmelt and storage must be considered. As mentioned earlier, the precipitation falling during this period is considered to be snowfall unless the mean temperature of the given day is above -1.0°C, in which case, it was considered to be rainfall. Before the effects of rainfall on snowpack can be discussed, it must be mentioned that the first operation performed was to reduce the snowpack by 1/3 of the potential evaporation rate. This was dependent upon the air temperature, since snowpack can be treated as a freely evaporating surface (Baier et al 1979, Raddatz 1989b).

Rainfall can have two effects on soil moisture: 1) in Phase 1 there may or may not be a snowpack. With no snowpack the rainfall may be directly added to the soil moisture. However, infiltration is limited by the frozen soil (Raddatz 1989b). Soil temperature was estimated from the mean maximum temperature over the ten previous days. Since infiltration is a very complex and dynamically changing process with the seasons, the whole conceptual idea of infiltration will be dealt with in its own subsection. 2) The other possibility is that there is still a snowpack present. In this case, the rainfall would contribute to the melting of the snowpack (Figure 5). The daily snowmelt on days with rain was then calculated by an equation that estimated the melt rate from daily rainfall and mean temperature. This equation was developed by the U.S. Corps of Engineers (1956) and was later used in an Operational Water Budget for

Climate Monitoring (Johnston and Louie 1984).

The equation used to estimate snowmelt on days with rain was:

snwmlt = (1.88 + (0.007*dpre(nday)) * (9.0*(mean/5.0)+ 1.25

Where:

snwmlt = Daily Snowmelt (mm)

dpre(nday) = Daily precipitation (mm)

mean = Daily Mean Temperature °C

The water equivalent of the daily snowmelt was added to the daily rainfall, which was assumed to be the total available for soil moisture recharge. This process is once again restricted by frozen soil, with infiltration greatly reduced at temperatures below 0°C. In the model minor melting did not reach the soil for recharge. It was assumed that the snowpack was capable of reabsorbing 10% of the daily melt (Baier et al 1979, Raddatz 1989b).

The second scenario that can occur in the winter modelling period consists of three possibilities (Figure 5): 1) the mean temperature is below -1.0°C with precipitation; 2) the mean is below -1.0°C and no precipitation; 3) mean is above -1.0°C and no precipitation. The first operation executed upon entering the second scenario is to check if any snowfall occurred (i.e. mean temperature < -1.0°C and precipitation), if so it is added to the snowpack. If snowfall did occur, not all of it remains on the fields to add to the overall winter snowpack storage. Wind redistribution and sublimation result in losses; these limit the water available for soil moisture recharge each spring and fall (Steppuhn 1981, Raddatz 1989b). To account for these losses, a "blow-off" factor, which is determined by ground cover over the winter, is applied. In the case of

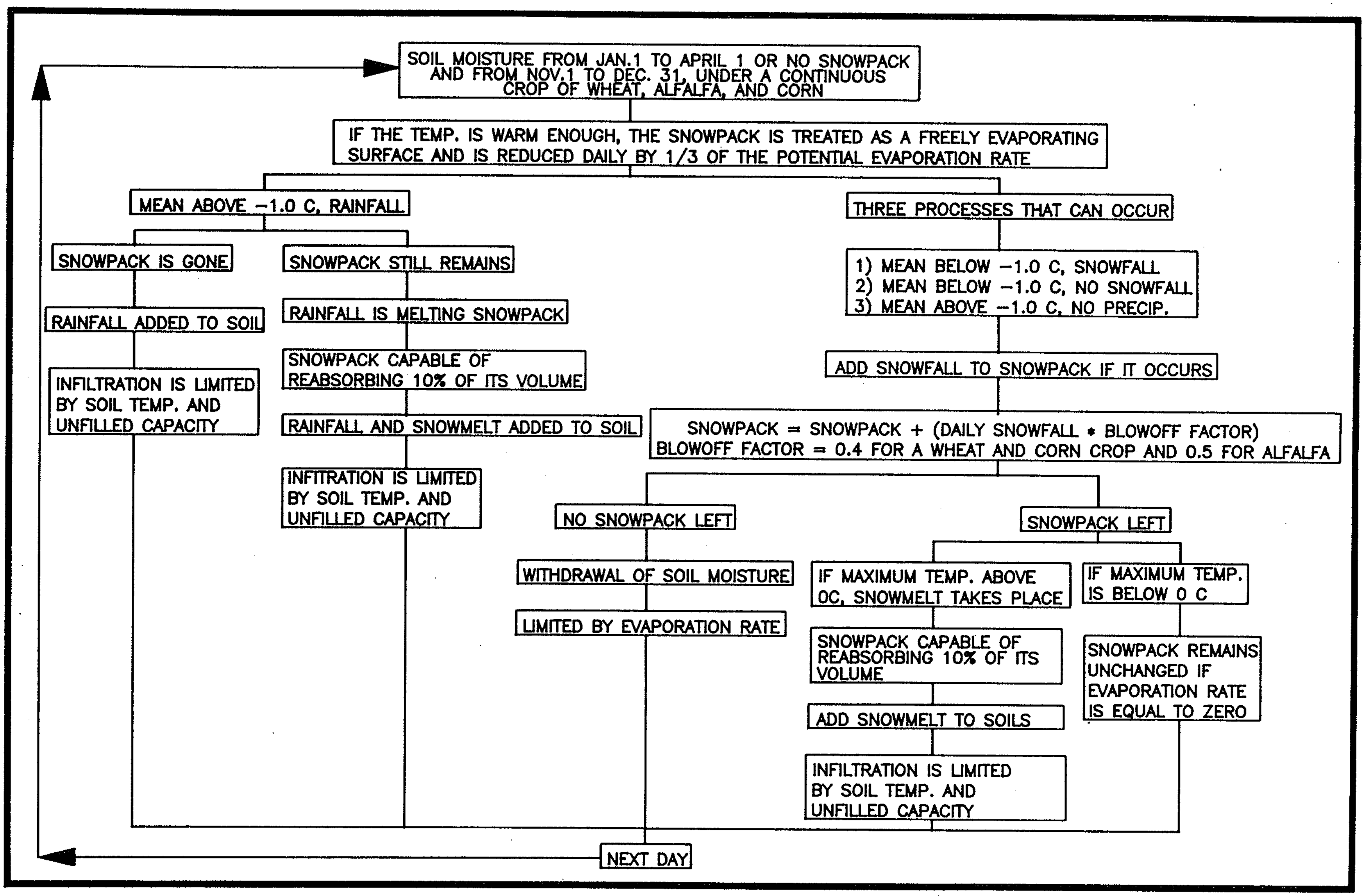


Figure 5: Modelling of Winter Snowmelt and Snowpack Storage

a wheat and corn stubble field, it was assumed that only 40% of the daily snowfall would remain, while a more substantial stand of alfalfa would retain 50% (Raddatz 1989b). As in the first scenario, the snowpack is reduced by 1/3 of the potential evaporation rate (Baier et al 1979, Raddatz 1989b).

The second operation in the second scenario was to check if the snowpack still remained. When the snowpack is not present and no precipitation occurs in the early spring or fall, evaporative demand must be met by soil moisture withdrawal. The rate of withdrawal is fairly minimal due to the low temperature and, as a consequence, the evapotranspiration rate in this period is low. In the case when snowpack remains, there are two possibilities: 1) no melting takes place, 2) melting takes place. For obvious reasons, the second option is the only one of interest. A relationship using julian day and maximum temperature was used to estimate the daily rate of snowmelt (Mckay 1964). The julian day is a proxy for the intensity of solar radiation received on any given day. Four of Mckay's snowmelt curves, for maximum temperature ranges 0-2.8, 2.9-5.6, 5.7-8.3 and above 8.3°C, were used in this model to predict snowmelt on days without rain (Baier et al 1979, Raddatz 1989b).

The equation used to estimate snowmelt on days without rain was:

snwmlt = (a*cos(jday*const)) + (b*sin(jday*const)) + c

snwmlt = snwmlt * 25.4

This equation is based on four temperature curves, where:

a =7.29*(cf(M+1,T)-cf(M,T))-3.91*(cf(M+2,T)-cf(M,T))

b =1.95*(cf(M+1,T)-cf(M,T))

c =cf(M,T)-6.47*(cf(M+1,T)-cf(M,T))+3.47*(cf(M+2,T)-cf(M,T))

If(dmax .ge. 0.0°C and dmax .lt. 2.8°C) T=1

If(dmax .ge. 2.8°C and dmax .lt. 5.6°C) T=2

If(dmax .ge. 5.6°C and dmax .lt. 8.3°C) T=3

If(dmax .ge. 8.3°C) T=4

dmax = daily maximum temperature °C

cf T = coefficients for one of the four temperature curves

cf M = coefficients for one of the months

jday = julian day

const = 0.0174533

snwmlt = daily snow melt (mm)

Table 4. Coefficients Used In Snowmelt Curves: (cf)

| cf | M1 | M2 | M3 | M4 | M5 | M6 | M7 | M8 | M9 | M10 | M11 | M12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T1 | .07 | .00 | .00 | .00 | .00 | .07 | .42 | .77 | .00 | .00 | .00 | .25 |
| T2 | .28 | .10 | .01 | .00 | .13 | .47 | .84 | 1.20 | .00 | .00 | .00 | .46 |
| T3 | .43 | .27 | .16 | .15 | .36 | .87 | 1.38 | 1.89 | .00 | .00 | .00 | .59 |
| T4 | .67 | .42 | .28 | .28 | .58 | 1.23 | 1.88 | 2.53 | .00 | .00 | .00 | .92 |

Minor melting that takes place as a result of Mckay's snowmelt curves is assumed to be reabsorbed by the snowpack. In fact, the snowpack is capable of reabsorbing 10% of the daily melt. This prevents minor melting from reaching the soil (Baier et al 1979, Raddatz 1989b).

3.3.2.2. Infiltration

The modelled physical process of infiltration is much more important for soil moisture recharge in the growing season and fall than it is in the winter period. This is a consequence of two factors: 1) the relative magnitude of precipitation in the warm versus the cold season, and 2) the rate at which water can infiltrate the soil, where generally most soils are considered frozen in the winter. Nevertheless, both cases of recharge will be discussed.

During the growing season and through the fall period, rainfall can be added directly to the soil. There are, however, limits on the amount of rainfall that can enter the soil on any given day. Before the limits on infiltration can be discussed, the dispersion of water within the soil must be examined. The model for wheat and corn used what is called a "dynamic root zone". As the plants begin to develop through their respective phenological stages, their roots tap deeper within the 120 cm profile of the soil. Therefore, the term "dynamic root zone" describes the expanding root zone along with a shrinking subzone for each day's growth. The root zone for wheat and corn begins at 5 cm (assumed planting depth) and increases to the full 120 cm profile by a predetermined stage of phenological development. This rooting depth was estimated daily from planting to maturity, from an equation used by Onofrei (1986), established by Rasmussen et al (1978). This equation estimates daily growth which, in turn, determines the depth of the root zone and finally, the resulting available root zone moisture and capacity. Based on the root zone growth equation, the subzone's soil moisture content and holding capacity can be tracked as it shrinks throughout the growing season as a consequence of the dynamically expanding root zone.

The equation to estimate root zone growth was:

```
rz = 5.0 + ((120.0 - 5.0) /(1.0 + exp(5.0 - (8.0 *(smbts / 3.5)))
                                                    or
                                              (deg10 / 700)))
```

Where:

rz = daily root zone growth (mm)

smbts = sum of the biometeorological time scale for wheat and rooting depth reaches its maximum of 120 cm at biometeorological time of 3.5.

deg10 = sum of the growing degree days above 10°C for corn and rooting depth reaches its maximum of 120 cm when 700 deg10 have accumulated.

For the case of alfalfa, a dynamic root zone was not considered, since alfalfa is a perennial and its roots penetrate the whole 120 cm profile throughout the entire growing season (Shields and Sly 1984).

Case 1 : Rainfall Less Than 25.4 mm (Figure 6)

The limits on rainfall that can enter the soil on any given day, are also dynamically changing within the root zone. Rainfall amounts less than or equal to 25.4 mm may completely infiltrate the soil, but are added to the root zone and subzone in different amounts. For example, when the period immediately after planting is considered for a wheat or corn crop, the root zone would be substantially less than that of the larger subzone. Therefore, any rainfall slightly less than 25.4 mm may fill the root zone to its water holding capacity. Once the root zone is at its water holding capacity, the remaining rainfall is assumed to percolate downward and is added to the subzone. Again, the subzone is restricted to its water holding capacity, and is dynamically shrinking with each day's growth. If an alfalfa crop is considered, then the root zone is the full 120 cm profile and, therefore, the rainfall is added to the whole profile and not to zones within. In all cases (wheat, corn) when the dynamic root zone and subzone or the alfalfa root zone, were filled to their respective field capacities, the rainfall was designated as runoff.

Case 2 : Rainfall Greater Than 25.4 mm (Figure 6)

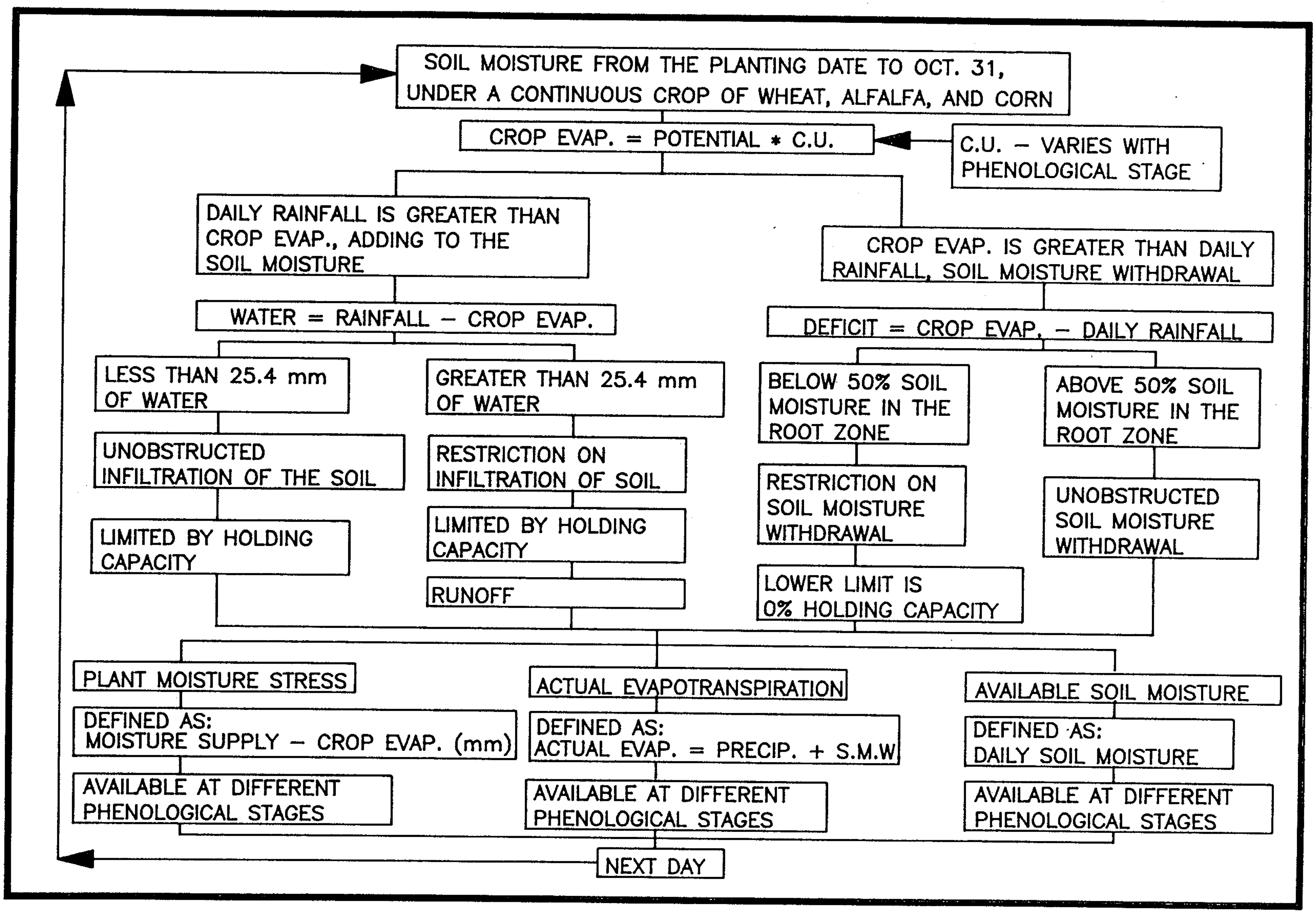


Figure 6: Modelling of Spring, Summer, and Fall Soil Moisture Conditions

Infiltration is estimated as a function of daily rainfall and the percent of soil moisture in the root zone of each of the respective crops. This conceptual idea was established in an equation by Baier et al (1979) and later used by Raddatz (1989b) (see equation below). This attempts to model heavy rainfall events in which the rate of rainfall exceeds the capacity of the soil to absorb water. In this case, the runoff becomes the excess water left after maximum infiltration of the root zone according to the Baier et al (1979) equation or the water left over after field capacity is reached in the dynamic subzone. In the case of alfalfa, runoff is also the excess water left after maximum infiltration according to the Baier et al (1979) equation or the water left over after field capacity is reached within the root zone.

The infiltration formula (Baier et al 1979) applied in this research was:

inf = 0.9177+(1.811*log(exin))-(0.0097*perc*log(exin))

Where:

inf = daily infiltration (mm)

exin = excess water above 25.4 mm or 1 inch   exin=(ex/25.4)

perc = zone's percentage of water holding capacity

In the winter months the model does not consider a dynamic root or subzone, it assumes that moisture can be added to the whole 120 cm profile evenly. The rates of infiltration and permeability of frozen soils are dependent upon the porosity and moisture content at the time of freezing, as well as the type of frost (Street et al 1986). In this model, the soil temperature was estimated from a ten day running mean of daily maximum temperatures. This mimics the well-known soil-to-air temperature lag. It may be expected that under most soil temperature regimes, some infiltration can occur. In a study done by Meghan and Satterlund (1962), used by Street et al (1986), the influence of cover type on infiltration through frozen soils during the winter was investigated. The results on an abandoned farm field showed that infiltration declined slightly and irregularly throughout the winter. To adopt a strategy that could account for this process, the modelling approach for frozen soils proposed by Raddatz (1989b) was used. In this approach the soil was considered frozen when its temperature was less than or equal to 0°C. The infiltration rate in this case was equal to the portion of soil available for moisture recharge multiplied by the infiltration formula, which was dependent upon the amount of snowmelt and rainfall (< 25.4 mm no restrictions, > 25.4 mm restrictions based on Baier et al (1979)).

The formula adopted for frozen soils was:

if(soiltp less than 0°C) dinf = inf*(1.-(perc)/100.)

Where:

soiltp = ten day mean of maximum soil temperature (°C)

dinf = daily infiltration (mm)

inf = infiltration (mm) (if above 25.4 mm then determined from above equation, Baier et al 1979)

perc = percentage of water holding capacity in each soil zone.

1-(perc/100.) = portion of the soil zone available for moisture recharge.

3.3.2.3. Evapotranspiration, Phenological Stage and Stress

These three modelled processes are relevant only to the growing season and will only be dealt with in that specific time period.

The concept of potential evapotranspiration (PE) has been widely accepted and therefore only a short discussion is warranted. Rosenberg et al (1983) defines PE as the "evaporation from an extended surface of a short green crop which fully shades the ground, exerts little or negligible resistance to the flow of water, and is always well supplied with water. Potential evapotranspiration cannot exceed free water evaporation under the same weather conditions." The physical process of evapotranspiration consists of two different processes. The first, evaporation, is the process by which a liquid or a solid is transferred to the gaseous state. The evaporation of water to the atmosphere takes place from many surfaces, soil being one of them. Most of the moisture evaporated at the plant interface is water that has passed through the plant. The water enters from the roots, passing through the vascular tissue to the leaves or other organs, and exiting into the surrounding air primarily through the stomata, but also partly through the cuticle (Rosenberg et al. 1983). This second process is then called transpiration. It is very difficult to separate these processes in nature, since evaporation and transpiration occur simultaneously. Therefore, the term evapotranspiration is used to describe the total water loss from any vegetative and land surface (Rosenberg et al 1983).

A variety of methods have been developed to calculate PE (Baier and Robertson 1965, Thornthwaite 1948, Penman 1956, Tanner and Pelton 1960, Priestley and Taylor 1972). In this research the first regression equation developed by Baier and Robertson (1965) was used to estimate latent evapotranspiration, which was subsequently converted to potential evapotranspiration by work established by Baier (1971). Although this equation results in larger errors in the estimate of daily PE than the other seven equations developed in their research, it is the only one that can be used with the limited data available from climatological stations. Climatological stations provide daily maximum and minimum temperatures, and daily precipitation amounts. The first regression equation of Baier and Robertson (1965) requires daily maximum and minimum temperatures along with Qo, solar energy at the top of the atmosphere. Although, the seven other equations are superior as a result of the inclusion of one or more meteorological and astronomical variables, they did not permit the high spatial density afforded with the first regression equation. Therefore, the use of climatological - Synoptic stations and their simple weather observations maximized the spatial density.

The formula used to calculate potential evapotranspiration in this study was:

poteva=25.4*.0034*(.928*dmax(nday)+.933*(dmax(nday)-dmin(nday)+.0486
    *solar-87.03)

Where:

poteva = daily potential evapotranspiration (mm)

nday = day number from January 1

dmax(nday) = maximum temperature (°F) for (nday)

dmin(nday) = minimum temperature (°F) for (nday)

solar = daily radiation received at the top of the
    atmosphere (Ly).

In a recent study (Street et al 1986) a comparison of PE equations was undertaken. Their results revealed that the Baier and Robertson (1965) technique best suited their study area, which was mainly the

Canadian Prairies. This was expected since the equation established by Baier and Robertson (1965) was developed from data acquired at Agriculture Canada Research Stations, most of which were on the Canadian Prairies. However, the equations have also been tested world-wide. In 1987 DeJong and Tugwood undertook a comparison of potential evapotranspiration models and some applications in soil water modelling. Three physically based combination models and several empirical models (Baier and Robertson 1965, Baier 1971) were compared for computed potential evapotranspiration rates across Canada. Their results indicated the empirical Baier-Robertson model appears to require regional calibration for improved P.E. estimates. This can be accomplished by the derivation of regional coefficients instead of country-wide coefficients. This approach was not applied in this research because of the limited time involved. Once the P.E. equations were incorporated into a soil water budgeting model, the estimation of actual evapotranspiration (A.E.) fluctuated very little among the models. The imposed soil and crop characteristics played a much larger role in determining A.E. than did the P.E. equations. Therefore, the use of the Baier and Robertson (1965) equation in soil moisture budgeting models had little effect on the overall estimation of soil moisture status and as a consequence, is an adequate estimator of potential evapotranspiration (DeJong and Tugwood 1987).

As mentioned earlier, potential evapotranspiration represents the maximum water loss from an extended surface of a short green crop which fully shades the ground, which has little resistance to the flow of water and which is well supplied with water. Crop evapotranspiration is defined as the water used by the crop under ideal moisture conditions and is a fraction (0.3 to 1.0) of the potential evapotranspiration rate. The ratio of crop evapotranspiration to potential evapotranspiration is a function of leaf area index (ratio of leaf area to ground area) (Dunlop 1981). This ratio is often expressed as a consumptive use factor, CU. The value of CU depends upon the amount of actively growing leaf area. In early spring, the evaporative loss from the bare soil is the dominant factor and the consumptive use factor has a low value, i.e. 0.3. As the crop matures, the leaf area increases. When ground cover is complete, CU=1, i.e. water is being used at the potential rate. For each of the crops (wheat, corn, alfalfa) in this study the CU factor was assumed to be determined by the biometeorological stage of the crop. The concept of biometeorological development and the resulting CU factor will be discussed when each specific crop modelling procedure is addressed.

Actual evapotranspiration (AE) was assumed to depend upon the available moisture content of the rooting zone. If the rooting zone had a moisture content below 50% capacity then the rate of soil moisture withdrawal (smw) was less than crop evapotranspiration (demand), i.e. a restriction on soil moisture withdrawal (Figure 6). The ratio of actual evapotranspiration to crop evapotranspiration (demand) is assumed to decrease from unity at 50% available moisture capacity to zero at 0% capacity. This reduced level was termed the root zone drying function. This was an attempt to reflect the increasing difficulty that plants were having in extracting moisture from the root zone soils as they became drier.

Considerable work has gone into establishing the soil water content at which the root zone drying function should be used and as a consequence, reduced crop evapotranspiration can be expected. As indicated in the literature review, DeJong and Bootsma (1988) concluded that crop evapotranspiration decreased when the root zone soil moisture dropped below 50% of its available water holding capacity. Therefore, the initiation of the root zone drying function at this level (50%) can be justified.

Water for actual evapotranspiration (A.E.) was supplied by that day's precipitation (only if daily precipitation < crop evapotranspiration) and soil moisture withdrawal:

actevp = dpre(nday) + smw

Where:

actevp = daily actual evapotranspiration (mm)

dpre(nday) = daily precipitation (mm)

smw = daily soil moisture withdrawal (no restriction if > 50% root zone capacity, <50% root zone capacity, root zone drying function restriction applies)

The equation assumes that daily precipitation was less than the daily crop evapotranspirative demand, and therefore is readily available for the day's evaporative demand.

The final topic of discussion in this section is plant moisture stress. To understand the concept of plant moisture stress, the dynamic root zone equation described in the infiltration section becomes important. As stated previously, the root zones of the wheat and corn crops expand as the plants proceed through their phenological stages. The subzone below the root zone shrinks as a result of the root zone growth. These two dynamically changing zones result in moisture conditions that are dynamic. By contrast for alfalfa, the root zone remained constant at 120 cm. For the purpose of plant moisture stress calculations, the root zone is the only zone of interest, since it is this zone from which plants meet their moisture requirements. The modelling procedure which was used calculated plant moisture stress (mm of water) on a daily basis. Plant moisture stress is defined as daily precipitation plus soil moisture withdrawal minus crop evapotranspirative demand (i.e. supply - demand):

dystr = (dpre(nday) + smw) - crpevp

Where:

dystr = daily stress (mm)

dpre(nday) = daily precipitation (mm)

smw = soil moisture withdrawal (mm)

crpevp = crop evapotranspiration, i.e. crop demand

If the root zone soil moisture withdrawal is not restricted, then the demand is completely met and the daily plant moisture stress is zero. The concept of restricted in this context reflects the increasing difficulty with which plants extract moisture from the soil as it becomes drier. Using the dynamic root zone equation described in the infiltration section, the daily soil moisture of the rooting zone was estimated. If the daily root zone soil moisture was above 50% capacity, the demand not supplied by daily precipitation was fully met. Below 50% capacity, the rate of soil moisture withdrawal decreased linearly to zero at 0% capacity (Figure 6). This mimics the difficulty plants have in obtaining root zone soil moisture through their respective phenological stages. Therefore, from the above equation, when the root zone moisture was below 50% capacity, soil moisture withdrawal was less than crop demand. The difference was defined as the plant moisture stress factor (mm).

## 3.4. Soil Moisture Analysis Under a Wheat Crop

The above sections provided the basis for the basic soil moisture budgeting procedure using the physically modelled processes of: 1) snowmelt and storage, 2) infiltration, and 3) evapotranspiration, phenological stage and stress. For each of the crops the consumptive water use by the plants varied with the different phenological stages of development. The determination of crop evapotranspiration (demand) under an actively growing wheat crop was accomplished by incorporating a meteorological soil moisture budgeting procedure within Robertson's (1968) biometeorological time scale (Dunlop 1981).

The triquadratic equation derived by Robertson (1968) took the form of:

$$dm/dt = [\{a_1(L-a_0)+a_2(L-a_0)^2\}\{b_1(t1-b_0)+b_2(t1-b_0)^2+b_3(t2-b_0)+b_4(t2-b_0)^2\}]$$

Where:

L = daily photoperiod

t1 = daily maximum temperature (°F)

t2 = daily minimum temperature (°F)

$a_0, a_1, a_2, b_0, b_1, b_2, b_3, b_4$ = coefficients

dm/dt = daily rate of development

The biometeorological time scale was calculated on a daily basis from climatological records and planting dates. Each day's biometeorological contribution to growth of the plant was summed from planting to the estimated date of maturity. As the plant proceeds from planting to maturity, the thermal and photoperiod requirements change, and as a consequence the coefficients within the equation must change accordingly. The resulting equation recognized five developmental stages of growth from planting to maturity: planting (P), crop emergence (E), jointing (J), heading (H), soft dough (SD), and finally maturity (M). These were given numerical values of 0 to 5, respectively. The coefficients used for each of the phenological stages are shown in Table 5 (Robertson 1968).

Table 5. Coefficients used to Estimate Phenological Stages of Development in the Biometeorological Time Scale (Robertson 1968:211).

| | P - E | E - J | J - H | H - S | S - M |
|---|---|---|---|---|---|
| a0 | 0.0E0 | 8.413E0 | 10.93E0 | 10.94E0 | 24.38E0 |
| a1 | 0.0E0 | 1.005E0 | 6.256E-1 | 1.389E0 | -1.140E0 |
| a2 | 0.0E0 | 0.0E0 | -6.025E-1 | -8.191E-2 | 0.0E0 |
| b0 | 44.37E0 | 23.64E0 | 42.65E0 | 42.16E0 | 37.67E0 |
| b1 | 1.086E-2 | -3.512E-3 | 2.958E-4 | 2.458E-4 | 6.733E-5 |
| b2 | -2.23E-4 | 5.026e-5 | 0.0E0 | 0.0E0 | 0.0E0 |
| b3 | 9.732E-2 | 3.666E-4 | 3.943E-4 | 3.109E-5 | 3.442E-4 |
| b4 | -2.267E-4 | -4.282E-6 | 0.0E0 | 0.0E0 | 0.0E0 |

Since the consumptive water use by plants varies with the different stages of development, the determination of crop evapotranspiration amounts under an actively growing wheat crop was accomplished by establishing a linearly changing consumptive use factor within Robertson's (1968) biometeorological time scale. This linearly fluctuating consumptive use factor was a function of the amount of actively growing leaf area. The estimation of crop evapotranspiration (or demand) was then determined by P.E. * C.U., where C.U. is linearly changing for each of the five phenological stages of plant development recognized by Robertson (1968). The five phases of development for a wheat plant recognized by Robertson were; P-E, E-J, J-H, H-S, S-M. Since, there are five biometeorological stages, the resulting consumptive use factors were determined as in Table 6 after Dunlop (1981). Figure 7 illustrates the variation of the C.U. factor through each of the five phenological stages of actively changing leaf area.

The shortage of water on the Canadian Prairies is perhaps the single most important factor for limiting the production of cereal yields. The temporal distribution of rainfall is highly variable on the Canadian Prairies, with the bulk of it falling during the growing season (100 - 250mm) from localized showers (Longley 1972, Fraser 1980). This consequently results in a high spatial variability of soil moisture contents at the various biometeorological stages of crop growth; which in turn produces highly variant (highly variable from one year to the next) stress levels at a given plant growth stage.

Soil moisture amounts and stress values were calculated for every phenological stage, but only moisture amounts at the stages of planting (P), heading (H), soft dough (SD), maturity (M), and on October 31 were examined in detail; while plant moisture stress was calculated at heading (H), and soft dough (SD). The first three phenological stages were chosen because the literature indicates that moisture stress at these stages has an important influence on final yield (see literature review). Since the crop has been using water at a high rate throughout the growing season, the water reserves are normally at their lowest levels at physiological maturity. Therefore, the last development stage (maturity) was chosen to illustrate, potentially, the lowest soil moisture reserves for any given growing season. Moisture levels on October 31 were also examined in detail because they represent the soil moisture levels at freeze up. Growing season actual evapotranspiration and precipitation was also

Table 6: Consumptive Use Factors for the Various Stages of Wheat Development

| Stage | | Consumptive Use Factors |
|---|---|---|
| P – E | 0 < BMTS < 1 | C.U. = 0.3 |
| E – J | 1 < BMTS < 2 | C.U. = 0.3+0.5*(BMTS–1) |
| J – H | 2 < BMTS < 3 | C.U. = 0.8+0.2*(BMTS–2) |
| H – S.D. | 3 < BMTS < 4 | C.U. = 1.0–0.2*(BMTS–3) |
| S.D. – M | 4 < BMTS < 5 | C.U. = 0.8–0.3*(BMTS–4) |
| A.M. | BMTS > 5 | C.U. = 0.3 |

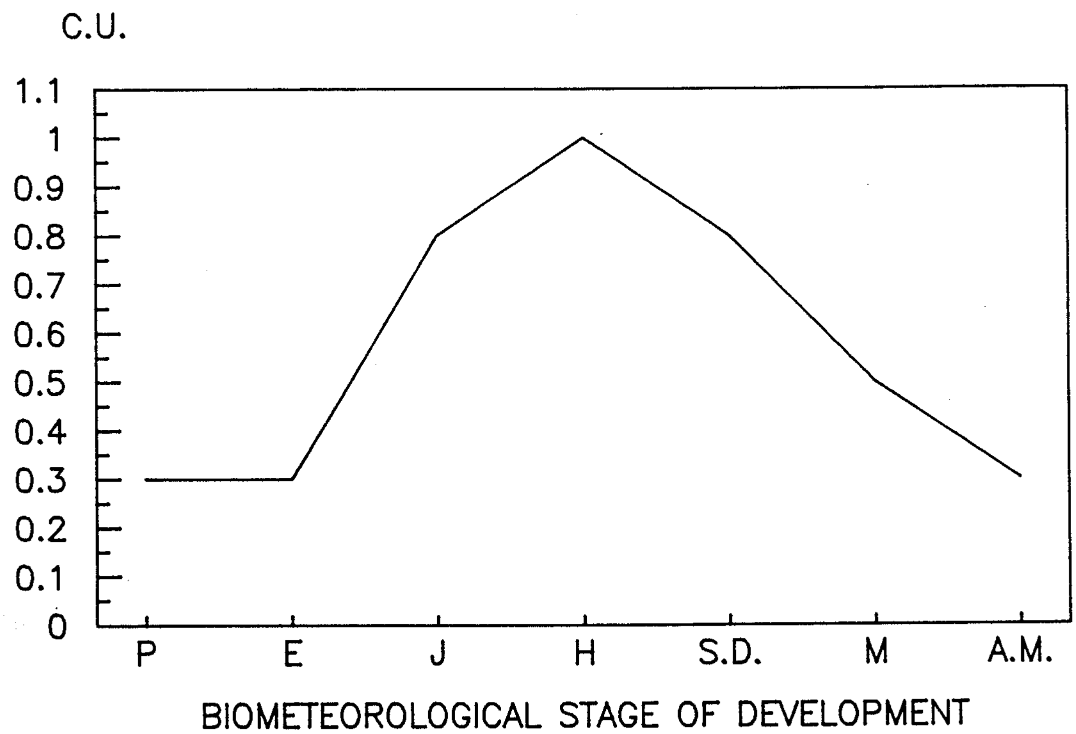


Figure 7: Response of the Consumptive Use Factor for a Wheat Crop

examined in detail, since these are related to the overall water balance for the Prairies.

3.5. Soil Moisture Analysis Under a Corn Crop

Corn growth and development through the various phenological stages were estimated from accumulation of growing degree days above base 10°C. The basis for this choice has been established in the literature review.

As with a wheat crop, a soil moisture budgeting procedure was incorporated within the degree-day base 10°C system to estimate the actively changing leaf area, or the fluctuations in the consumptive use factor for the various phenological stages. These consumptive use factors were assumed to increase or decrease linearly from one phenological stage to the next. Soil moisture amounts were calculated at several stages in the crop's development: at 480 GDD10 (silking), 795 GDD10 (green silage), and 900 GDD10 (maturity for grain corn). The consumptive use factors resulting from changes in actively growing leaf area for the developmental stages of corn were calculated as shown in Table 7.

Table 7. Calculation of the Consumptive Use Factor for a Corn Crop

| Stage | Consumptive Use |
|---|---|
| Silking 0<GDD10<480 | C.U.= .3+(.7*GDD10)/480 |
| Silage 480<GDD10<795 | C.U.= 1.0 |
| Grain 795<GDD10<900 | C.U.= 1.0 -.001*(GDD10-795) |

As with wheat, moisture stress at certain phenological stages can result in reduced yields and increased protein content at maturity. Therefore, the phenological stage or stages that are most critical in the development of corn were determined. The results of the studies discussed in the literature review indicate that soil moisture stress from tasselling-silking to physiological maturity will result in reduced quantity and quality of yields. From this it was decided to analyze soil moisture status and stress at the silking, green silage, and physiological maturity (40% kernel moisture) stages. The growing season precipitation and actual evapotranspiration were also characterized, but only at physiological maturity of corn.

### 3.6. Soil Moisture Analysis Under a Alfalfa Crop

Alfalfa, like silage corn, is an important economic crop in Manitoba and Saskatchewan for the cattle and dairy industry. In order to facilitate the estimation of risks and/or potentials to forage production in Manitoba and Saskatchewan, a model that incorporated thermal and moisture considerations was essential. In work done by Selirio and Brown (1979), it was established that a suitable thermal unit necessary to mature alfalfa was the accumulation of 550 degree days above 5°C. Growing degree days above 5°C have also been used in other studies to determine the maturity date of forage crops in the Atlantic region of Canada (Bootsma, 1984a, 1984b). The only difference of any consequence between Selirio et al (1979) and Bootsma (1984a) were the number of accumulated heat units above 5°C required to mature alfalfa. In the Atlantic region, 450 G.D.D. above base 5°C were used (Bootsma 1984a), whereas, Selirio's work in Southern Ontario indicates that 550 G.D.D above base 5°C are necessary to reach maturity for the first cut alfalfa. On the basis of work by Dyer et al (1981, 1988), it was decided that 550 G.D.D above base 5°C would be used to predict the dates of first cut and 1100 G.D.D. would be used to predict the second cut.

The active growth of the alfalfa crop was assumed to begin sometime after April 1 when the maximum daily temperature exceeded 5°C for five consecutive days (Dunlop 1981, Raddatz 1989b). Prior to active growth the crop evapotranspiration rate was assumed to be 30% of the potential evapotranspiration rate. The estimation of daily soil moisture was calculated by a soil moisture budgeting procedure, very similar to that for the two previous crops. The major difference was that the C U factor remained equal to 1.0 throughout the growing season, i.e. crop evapotranspiration or demand (C.E.) equalled potential evapotranspiration (P.E.). In the case of an alfalfa crop, the leaf area or ground cover is complete throughout the growing season. A number of previous researchers have also assumed these conditions for the active growth of alfalfa to maturity (Shields and Sly 1984, Dyer 1988, Bootsma and DeJong 1988b, Raddatz 1989b). One further note, it was assumed that the root zone did not vary with time, i.e. the whole 120 cm profile was available for water extraction throughout the growing season (Shields and Sly 1984). The only restriction on soil moisture withdrawal occurred when field moisture dropped below 50% of field capacity (Shields and Sly 1984, Bootsma and DeJong 1988b, Dyer 1988). In that case the rate of depletion was assumed to be governed by the root zone drying function as described previously (Figure 6).

The degree days above a base temperature of 5°C and soil moisture amounts were accumulated from the date of active plant growth, to one-tenth bloom stage, i.e. 550 degree days, and then cutting was assumed to have commenced. From this point, a second crop of alfalfa was assumed to have initiated growth and is considered to be ready for harvest when another 550 G.D.D. were accumulated. In other parts of Canada, the ability to grow three crops of alfalfa has been documented (Selirio and Brown 1979), but in Southern Manitoba and Southeastern Saskatchewan it is very unlikely that this is possible because of moisture limitations. Likewise, the harvesting of a third crop of alfalfa would leave the crop vulnerable to over winterkill (thermal limitations). Alfalfa must not be cut during the fall period to allow for food reserves to be replenished and for hardening to take place in order to aid in winter survival (Bootsma and Suzuki, 1985). Therefore, only two cuts of alfalfa were considered in this modelling procedure.

Soil moisture and stress amounts at the end of each cutting period were selected as the parameters that would be examined at different risk levels. The actual evapotranspiration (A.E.) and precipitation amounts at each of the cuttings was also examined at the mean, 10%, and 25% risk level. This was done to provide some indication of the A.E. and precipitation risks experienced throughout the growing season for alfalfa.

### 3.7. Mapping of Agroclimatic Relationships

It was necessary to display the agroclimatic information in some graphical form once the thermal and soil moisture conditions were determined within each of the two provinces. The statistical nature of the thesis resulted in a large amount of quantitative numeric results. The presentation of these results was best accomplished through some form of geographical representation, which illustrates the spatial fluctuation of each of the agroclimatic parameters across the two provinces. In other words, a quantitative assessment of the spatial distribution of Southern Manitoba's and Southeastern Saskatchewan's agroclimatic resource base was undertaken. To spatially display the agroclimatic parameters within each of the two provinces, a computer mapping technique was utilized. The computer mapping technique is called surfer and is an I.B.M. software based package (Surfer 1987). Surfer is a powerful and flexible tool for creating high resolution two and three dimensional graphics. This research utilized the two dimensional aspect of surfer, to produce contour maps. Before contour maps can be addressed, the 'grid option' within surfer must be explained.

The grid option within the surfer package creates a regularly spaced grid from irregularly spaced data located along X, Y, and Z axes which were supplied by the derived agroclimatic relationships (Appendix B). The X and Y values represent the longitudinal and latitudinal locations of each of the climatological station listed in Appendix A. The geographic location of each of the climatological stations was derived by creating a digitized base map of Southern Manitoba and Southeastern Saskatchewan. The base map was a standard Department of Energy, Mines, and Resources map of the Prairie Provinces, with a scale of 1:2 000 000 and a Lambert Conformal Conic projection. Figure 3 is a map representing the latitudinal and longitudinal location of each climatological station utilized in this research (Page 71). The Z value used in the gridding process represents the derived agroclimatic parameters (e.g. thermal or moisture) (Appendix B). For each parameter to be gridded, a file of X - longitudinal, Y - latitudinal, and Z - agro-parameter must be established.

The purpose of gridding in this thesis was to use the established agroclimatic parameters to calculate a value at each predetermined spatial location within the digitized base map. In fact, the whole process can be thought of as lying a transparent grid over Figure 3. The number of rows and columns dictates the grid size, and therefore the grid density. At each intersection of two grid lines, a data point (Z-value) was calculated. For example, if a grid size was 20 by 20, four hundred values would be calculated for the final grid. Each one of the values derived for this hypothetical 400 point grid would stem from the original X, Y, Z file of 150 data points (weather stations). Then, in fact, the 400 point grid is attempting to fill up any "holes" in the existing data base (150 points). Can creating a grid of this density from so few original data points cause spatial irregularities to arise in the representativeness of the agroclimatic relationships? To answer this question please refer to the literature review on spatial, temporal, and missing data representativeness.

Not only is the size of the grid important but also, the type of gridding method. Within the grid option of surfer there is a choice of griding methods, either inverse distance or kriging. In this research the kriging option was chosen because this algorithm will produce more accurate contours. The kriging algorithm assumes an underlying linear variogram. The main problem with the kriging method is that it is numerically intensive and many calculations are done repeatedly to obtain the gridded value for each X and Y coordinate, therefore it is a time consuming process. Once the data was gridded, a data base was available for the creation of surface representation plots (contours).

The next option to be used within surfer was 'topo', which is a program that creates contour maps. A contour map is simply a map consisting of lines which connect all locations (Z-value) having equal values. The area that is contained between two adjacent contours represents points having only values which lie within the range defined by the enclosing lines. For each agroclimatic parameter (i.e. thermal, moisture) a grid file was generated. This grid file was then incorporated into the topo option of surfer. Once inside this option, a number of cosmetic adjustments can be made to the gridded map. A few of the options that were used in this research are: 1) setting the scale, 2) choosing the contour interval, 3) title, and finally 4) blanking areas where lakes and parks occur. The blanking option requires some explanation since this is where the rivers, lakes, parks and boundaries were established. One file containing the X and Y values for each lake, park, river and boundary was created when the original base map was digitized. This file was then called into the topo program of surfer and used either to blank the areas where parks and lakes occurred or simply to draw the rivers and boundaries. The resulting maps for each of the agroclimatic parameters utilized the procedures outlined above.

3.8. <u>Probability Analysis</u>

For a large number of phenomena a smooth bell-shaped curve serves as a mathematical model to describe their probability distribution. This bell-shaped curve is often referred to as the normal curve, and the probability distribution is called a normal distribution. Before probability analysis was applied to the agroclimatic parameters, it was necessary to determine whether a normal curve could be fitted to the data, so as to give the probability of occurrence of the parameters in a continuous distribution (Dunlop 1981).

A sample group of climatological and synoptic stations was chosen on the basis that they represent the different water-holding capacities of the various soils within the two provinces, i.e. Winnipeg, Morden, Brandon, Midale, Regina, Davidson, and Indian Head. For each of these stations, the chosen agroclimatic parameters (i.e. soil moisture, plant moisture stress, growing season precipitation and actual evapotranspiration) were investigated at a number of phenological stages of the three crops, i.e. wheat, corn, and alfalfa. Before the agroclimatological parameters were quantitatively tested to see if they assume a normal distribution, some simplistic plots for normality were drawn. Within the univariate procedure of SAS (1985), a plot option can be specified. When this option is chosen, three data plots are generated, i.e. stem-and-leaf plots, box plots, and normal probability plots or quantile-quantile plots.

Stem-and-leaf plots are an adaptation of the histogram, where information on the data itself is retained while grouped information is simultaneously displayed. This results in a number of bars whose lengths are dependent upon the number of points in each class. The resulting distribution allows the researcher to determine if the data fits a normal distribution. The second plot, a box plot is an attempt to summarize a set of data in terms of a few easily obtained and understood numbers, i.e. the range, location, scale, and skewness of the data. These are usually expressed by the upper and lower extremes and quartiles, and by the median and mode. The last plot drawn, the normal probability or quantile-quantile plot, is a plot of the empirical quantiles against the quantiles of a standard normal distribution. A reference straight line is drawn through the data using the sample mean and standard deviation. If the data assumes a normal distribution, then the data points in question should fall along this reference line. Therefore, this indicates how well an empirical distribution fits a given distribution, but also how the distributions differ.

The second step in the analysis was to quantitatively test whether the agroclimatic parameters were arranged in a continuous distribution described by the bell shaped curve. To accomplish this, a test for normality was chosen. The test chosen can be found in the univariate procedure of SAS (1985). The test of normality in the univariate procedure uses two different test statistics in the rejection or acceptance of the null hypothesis. The choice of the test statistic is dependent upon the sample size. If the sample size is less than 51 then the Shapiro-Wilk statistic, W, is computed (Shapiro and Wilk 1965). In all cases, the sample size was greater than 51; consequently the second test statistic or the Kolomogorov D statistic was computed (Stephens 1974). In this test, the data was tested against a normal distribution with the mean and variance equal to the sample mean and variance. To make a test using this statistic, the value of:

$$(\sqrt{n} - .01 + (.85 / \sqrt{n}) * D$$

| | | Percentage Points | | |
|---|---|---|---|---|
| 15.0% | 10.0% | 5.0% | 2.5% | 1.0% |
| 0.775 | 0.819 | 0.895 | 0.995 | 1.035 |

must be calculated, where n represents the number of nonmissing years and D equal to the computed Kolomogorov D statistic. If the value of the test statistic exceeds one of the percentage points chosen (5.0 or less in this case) then Ho or the null hypothesis is rejected and therefore the data does not assume a continuous normal distribution. This informs the researcher that a curve other than the normal curve should be investigated and identified before probability analysis is applied. The results of the analysis can be found in the results and discussion section under the heading of Results of the Test for Normality.

# Chapter IV

## Results and Discussion

### 4.1. Results of the Estimation of Seeding Dates

The correlation coefficients (r) for the regression analysis of estimated seeding versus actual dates ranged from about 0.4 to 0.8. This compares to the values (0.11-0.76) obtained by Bootsma and DeJong (1988a). Although the correlation coefficients are somewhat lower than those obtained by Selirio (1969), it should be stressed that the circumstances surrounding the two studies are quite different. In this research, a few climate stations within large crop districts were used to mimic seeding dates, which usually occur over several weeks. On the other hand, Selirio's (1969) work was restricted to one specific area. Selirio (1969) used actual planting dates in the regression analysis, whereas in this study, the dates of when seeding was general were used. This would have required some judgement on the part of the observer and this would subjectively contribute to the variation in the regression analyses results. Finally, Selirio's work was concerned with one basic soil type, whereas this research was concerned with six soil types.

### 4.2. Results of the Tests for Normality

The objective of this section is to present the results of the tests for normality, i.e., stem-and-leaf plots, box plots, probability plots, and the computed Kolomogorov D statistic, described in the probability analysis section of the methodology.

For each of the three crops, i.e wheat, corn, and alfalfa, a number of agroclimatic parameters were investigated at different phenological stages. In the case of a wheat crop, soil moisture amounts at planting, heading, soft dough, maturity, and on October 31 or freeze up were investigated for normality. However, plant moisture stress was only scrutinized at the phenological stages of heading and soft dough. Growing season precipitation and actual evapotranspiration were also studied for normality. For a corn crop, soil moisture and plant moisture stress amounts at the phenological stages of silking, silage, and maturity (grain) were investigated for their frequency distribution. As with a wheat crop, growing season precipitation and actual evapotranspiration were investigated. The last crop, alfalfa, had soil moisture, plant moisture stress, actual evapotranspiration and precipitation amounts scrutinized at both the first and second cuts. The only agroclimatic parameter scrutinized on October 31 for normality was soil moisture amounts.

As is the case with most data sets, there was usually one station that had an agroclimatic parameter that did not assume the same distribution as the others. In every data set there are inevitably outliers which creep into every moderate to large data set, no matter how carefully it is collected. Consequently, if the majority of stations assumed a normal distribution for the agroclimatic parameter in question, then a normal curve was chosen for the probability analysis. In the case when a agroclimatic parameter did not assume a normal distribution for the majority of sample stations, probability analysis assuming normality was not carried out.

The three plots drawn from the univarite procedure of SAS (1985) were a simplistic means of identifying the general shape of the curve and the spatial range-distribution of each agroclimatic parameter. These subjective results tended to confirm that many of the agroclimatic parameters followed a normal distribution.

To systematically and quantitatively test the hypothesis that the data were normally distributed, the distribution of the data was tested against the theoretical normal distribution using the Kolomogorov D statistic (SAS 1985). The computed value of the Kolomogorov D statistic was consequently used to determine if the normal distribution curve could be fitted to the data so as to give the probability of occurrence of the agroclimatic parameters in a continuous normal distribution. The null hypothesis was rejected if the computed value of the D statistic was <.05 percentage points. The results tended to confirm the initial assumptions that many of the agroclimatic parameters follow a normal distribution, though inevitably outliers creep into every data set and result in a distribution other than normal.

The results of the Kolomogorov D Statistic for normality under a wheat crop (Table 8) indicated that all agroclimatic parameters, except plant moisture stress at heading and soft dough, followed a normal distribution. As a consequence, probability analysis was carried out on all agroclimatic parameters, except the two mentioned above, assuming a continuous normal distribution. In the case of a corn and alfalfa crop (Table 9,10), the majority of stations for each agroclimatic variable followed the normal distribution. As a result, probability analysis was also carried using the mean and standard deviation for each parameter assuming a continuous normal distribution.

Table 8. Results of the Kolomogorov D Statistic Test for Normality Under a Wheat Crop.

| Station | Wheat F(1) | F(2) | F(3) | F(4) | F(5) | F(6) | F(7) | F(8) | F(9) |
|---|---|---|---|---|---|---|---|---|---|
| Davidson | >.05 | <.01 | >.15 | <.01 | >.065 | <.01 | >.05 | >.15 | >.15 |
| Midale | >.15 | >.15 | <.01 | <.01 | <.01 | >.15 | <.01 | >.02 | >.15 |
| Indian Head | >.15 | >.15 | >.05 | >.05 | <.01 | >.15 | >.15 | >.15 | >.04 |
| Regina | >.04 | >.05 | >.062 | <.01 | <.01 | >.05 | >.15 | >.15 | >.037 |
| Morden | >.15 | >.15 | >.15 | >.10 | <.01 | >.079 | >.05 | >.15 | >.05 |
| Brandon | >.15 | >.15 | >.15 | <.01 | <.01 | >.15 | >.05 | >.10 | >.05 |
| Winnipeg | >.06 | >.10 | >.15 | <.01 | <.01 | >.15 | <.01 | >.15 | >.078 |

Note: Any value of <.05 represent a rejection in the null hypothesis, in other words the data is not normally distributed.

F(1) - Soil moisture amounts at planting.
F(2) - Soil moisture amounts at heading.
F(3) - Soil moisture amounts at soft dough.
F(4) - Plant moisture stress amounts at heading.
F(5) - Plant moisture stress amounts at soft dough.
F(6) - Soil moisture amounts at maturity.
F(7) - Soil moisture amounts on October 31 or freeze up.
F(8) - Accumulated growing season precipitation.
F(9) - Accumulated growing season actual evapotranspiration.

Table 9. Results of the Kolomogorov D Statistic Test for Normality Under a Corn Crop.

| Station | Corn F(1) | F(2) | F(3) | F(4) | F(5) | F(6) | F(7) | F(8) |
|---|---|---|---|---|---|---|---|---|
| Davidson | >.05 | >.15 | <.01 | >.05 | >.05 | >.07 | >.109 | >.05 |
| Midale | >.05 | >.071 | >.056 | >.15 | <.01 | >.15 | >.15 | <.01 |
| Indian Head | >.15 | >.15 | >.05 | >.126 | >.05 | >.082 | >.05 | >.15 |
| Regina | >.15 | >.14 | >.15 | >.15 | >.029 | >.15 | >.15 | >.15 |
| Morden | >.15 | <.01 | >.05 | <.01 | >.05 | >.05 | >.105 | >.15 |
| Brandon | <.01 | >.065 | <.01 | >.065 | <.01 | <.01 | >.02 | >.15 |
| Winnipeg | <.01 | <.01 | >.05 | >.05 | >.061 | >.05 | >.116 | >.15 |

F(1) - Soil moisture amounts at silking.
F(2) - Plant moisture stress amounts at silking.
F(3) - Soil moisture amounts at green silage.
F(4) - Plant moisture stress amounts at green silage.
F(5) - Soil moisture amounts at maturity (grain).
F(6) - Plant moisture stress amounts at maturity (grain).
F(7) - Accumulated growing season actual evapotranspiration.
F(8) - Accumulated growing season precipitation.

Table 10. Results of the Kolomogorov D Statistic Test for Normality Under a Alfalfa Crop.

| | Alfalfa | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Station | F(1) | F(2) | F(3) | F(4) | F(5) | F(6) | F(7) | F(8) | F(9) |
| Davidson | >.05 | >.15 | >.05 | >.15 | >.15 | >.15 | >.15 | <.01 | >.07 |
| Midale | >.15 | >.05 | <.01 | >.15 | >.15 | <.01 | >.15 | >.08 | >.05 |
| Indian Head | >.063 | <.01 | <.01 | >.15 | >.15 | >.15 | >.15 | >.15 | >.15 |
| Regina | >.15 | >.15 | >.15 | >.15 | >.15 | >.15 | >.15 | <.01 | <.01 |
| Morden | <.01 | >.112 | >.15 | <.01 | >.025 | >.15 | >.09 | >.05 | >.15 |
| Brandon | >.05 | <.01 | >.05 | <.01 | >.15 | >.15 | >.15 | >.05 | <.01 |
| Winnipeg | <.01 | >.15 | >.15 | >.05 | >.145 | >.15 | >.092 | >.05 | >.086 |

F(1) - Actual evapotranspiration to the first cut of alfalfa.
F(2) - Accumulated precipitation to the first cut of alfalfa.
F(3) - Soil moisture amounts at the first cut of alfalfa.
F(4) - Plant moisture stress amounts at the first cut of alfalfa.
F(5) - Actual evapotranspiration to the second cut of alfalfa.
F(6) - Accumulated precipitation to the second cut of alfalfa.
F(7) - Plant moisture stress amounts at the second cut of alfalfa.
F(8) - Soil moisture amounts at the second cut of alfalfa.
F(9) - Soil moisture amounts on October 31.

## 4.3. Analysis and Results of the Agroclimatic Relationships

This section presents the results of the third major research objective, that is, a statistical analysis of the data base in order to describe the agro-climatic risks and/or potentials as they apply to the various thermal and moisture conditions within the agricultural regions of the two provinces (Figure 8). This will be accomplished by presenting a series of risk and/or potential maps for each agro-climatic parameter. Included is a brief discussion and interpretation of the results with respect to their usage in agricultural planning.


Figure 8: Names of Climatological and Synoptic Stations Utilized in this Research

### 4.3.1. Thermal Conditions

#### 4.3.1.1. Frost Analyses

The effects of lethally low temperatures and their occurrence at different times within any given year can have serious economic implications on agricultural production in Southern Manitoba and Southeastern Saskatchewan. There are two conditions of lethally low temperatures of particular importance in ascertaining the time available for agricultural production. These are the occurrences of the last spring and first fall frosts at 0°, and -2.2°C. The choices of these two base temperatures were established from of a number of research conclusions illustrated in the literature review. The date of the last spring frost is particularly important because it can dictate the date of planting. The choice of a optimal seeding date is critical in that, a risk to a late spring frost can have serious consequences on young plant development. This depends upon the type of frost and crop grown. The occurrence of the first fall frost at both base temperatures is important since it determines the last day on which growth can take place - again it is dependent upon the type of frost and crop grown. The third and perhaps the most important frost characteristic is the frost-free period. The frost-free period can be defined as the period between the last spring and first fall frosts at both base temperatures. It is particularly important since this was the time available for crop production.

A series of risk and/or potential maps was generated for the three frost characteristics at the two base temperatures (0°, and -2.2°C). The first risk map to be described for any of the three frost events depicts the average conditions. In other words, there is 1 in 2 year chance of the condition occurring. A 25% risk is equivalent to a 1 in 4 year risk of the particular condition occurring. Likewise, a 10% risk is a 1 in 10 year chance of the desirable or undesirable event occurring. In terms of the spring frosts, the maps represent the chance of the last spring frost occurring after the specified date. For the first fall frosts, the maps show the date before which the probability of frost has been reduced to the selected level (mean, 10% or 25%). In a similar manner, the maps of the frost-free period at different probability levels (10% and 25%) represented the chance of receiving a shorter frost-free period than indicated by the average circumstance. In all cases, the more extreme the event is, the lower is the risk or probability of its occurrence.

4.3.1.1.1. Last Spring Frosts

Before the last spring frost characteristics are discussed, it must be mentioned that the maps were generated on a Julian time scale (Table 11).

The first frost parameter is the average date of occurrence of the last spring frost at 0.0°C (Figure 9). When the last spring frost is considered, the earlier the event the more desirable is the condition; thus seeding operation can take place earlier in the spring. In general there was little spatial variation in the occurrence of the last spring frosts throughout the two provinces. As a broad overview two conclusions can be drawn: 1) frost occurs later as one proceeds northward, and 2) on the higher elevations of the Manitoba and Saskatchewan escarpments the last spring frost occurs at a later date.

Table 11. Conversion of Julian Days to the Gregorian Calendar for Spring Frosts

| Julian Day | Gregorian Calendar | |
|---|---|---|
| 1 | January | 1 |
| 15 | | 15 |
| 31 | | 31 |
| 32 | February | 1 |
| 46 | | 15 |
| 59 | | 28 |
| 60 | March | 1 |
| 74 | | 15 |
| 90 | | 31 |
| 91 | April | 1 |
| 105 | | 15 |
| 120 | | 30 |
| 121 | May | 1 |
| 135 | | 15 |
| 151 | | 31 |
| 152 | June | 1 |
| 166 | | 15 |
| 181 | | 30 |

Note: If leap year then J.D.=60 => Feb. 29

The earliest occurrence of the average last spring frost in Southern Manitoba occurs in the Portage La Prairie, Vogar, Morden, Pilot Mound, and Somerset regions (Figure 9). In these regions the last spring frost was encountered on Day 140 (May 20) on average. The latest occurrence of the average last spring frost (Day 155 or June 4) manifests itself in the Wasagaming and Hodgson regions of Southern Manitoba. The Estevan, Ceylon, and Ormiston regions within Saskatchewan have the most desirable location for the event of the last spring frost (Day 140 or May 20). On the other hand, the northerly locations of Pelly, Arran, Prairie River, and Hudson Bay experience the most undesirable last spring frost events on average (Day 160 or June 9) (Figure 9).

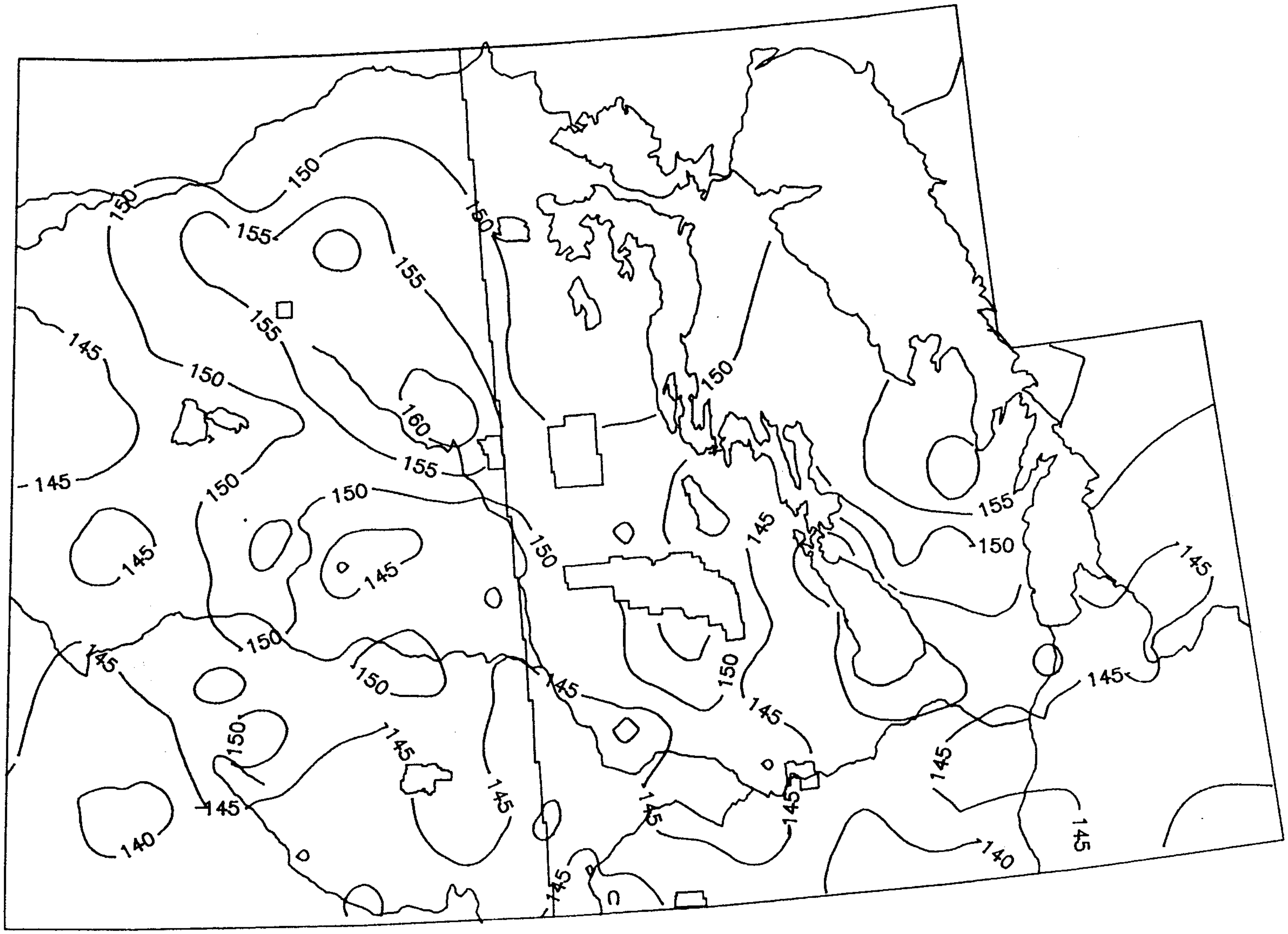


Figure 9: Average Date of Occurrence of the Last Spring Frost (0°C)

A similar spatial pattern as illustrated in the average condition is reflected in the dates of occurrence of the last spring frosts at a 10% risk (Figure 10). In the case of the last spring frosts, all risk events occur later than the average condition. The most desirable localities for early seeding are the same as those identified in the average situation, but occur at a later date (Day 155 or June 4). The areas that experience the latest occurrence of the last spring frosts at a 10% risk are also spatially similar to the average condition. The dates at which this occurs was Day 175 or June 24 (Figure 10).

Throughout the two provinces there is a relatively small fluctuation (10-15 days) in the dates of the last spring frost of -2.2°C. Many of the same spatial patterns are reflected in the maps of the -2.2°C frosts as were apparent in the maps of 0°C frosts. The region east of the Manitoba escarpment, Vogar, Portage la Prairie, Pilot Mound, Morden, and most of the Red River Valley enjoy the earliest average date of last spring frost within Southern Manitoba (Day 130-135 or May 10-15) (Figure 11). There is, however, a small region around Virden and Oakner that also possesses a early spring frost of -2.2°C (Day 130 or May 10). The regions most susceptible to a late spring frost are: 1) Wasagaming, 2) Hodgson, and 3) Sprague (Day 140-145 or May 20-25). Within Saskatchewan most regions in the south enjoy early last spring frosts when compared to the rest of the province (Day 130-135 or May 10-15). The area most vulnerable to spring frost is again the Pelly, Arran, Prairie River and Hudson Bay regions (Day 145 or May 25) (Figure 11).

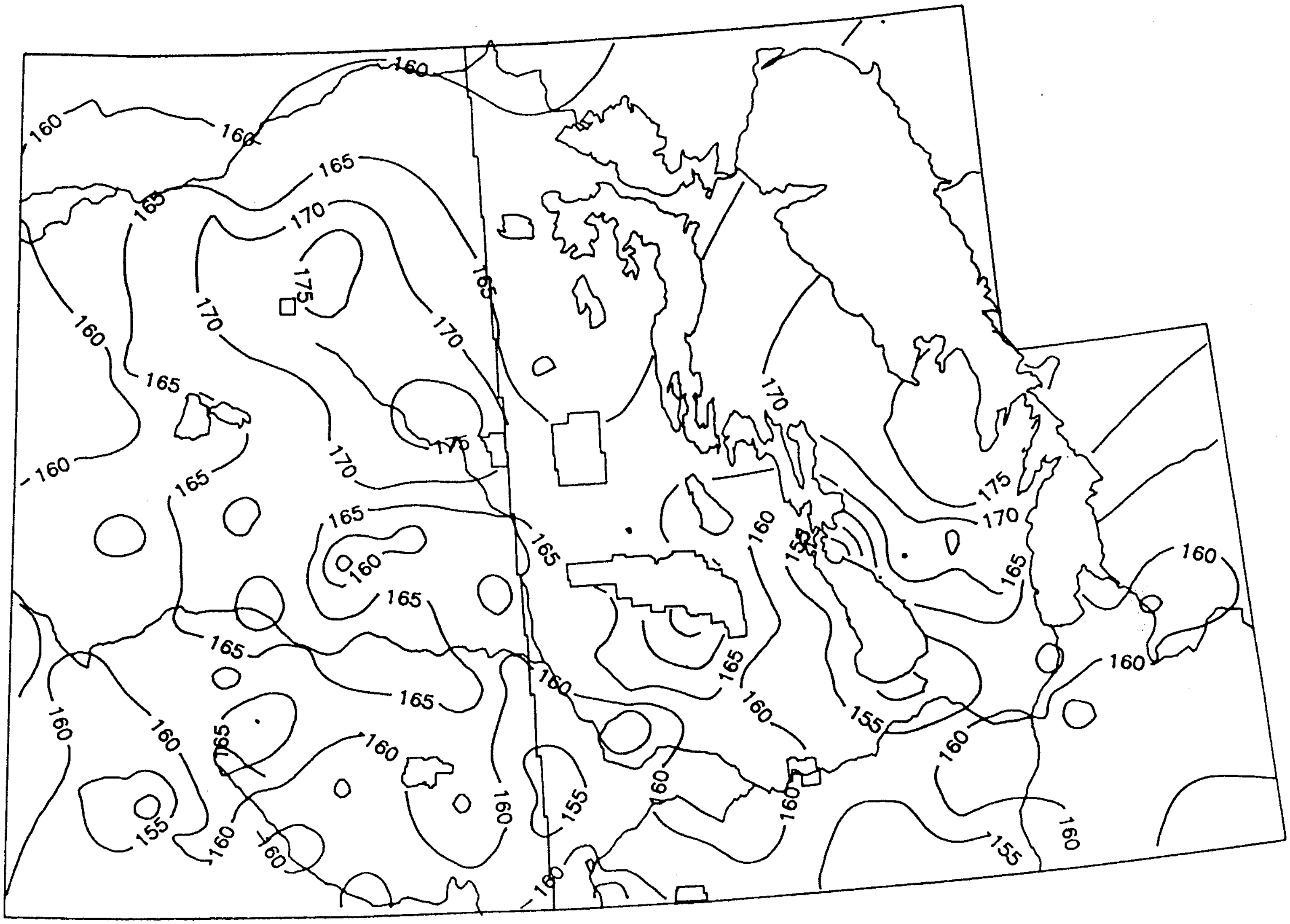

Figure 10: Dates after which the Risk of Occurrence of the Last Spring Frost of 0°C has been reduced to 10%

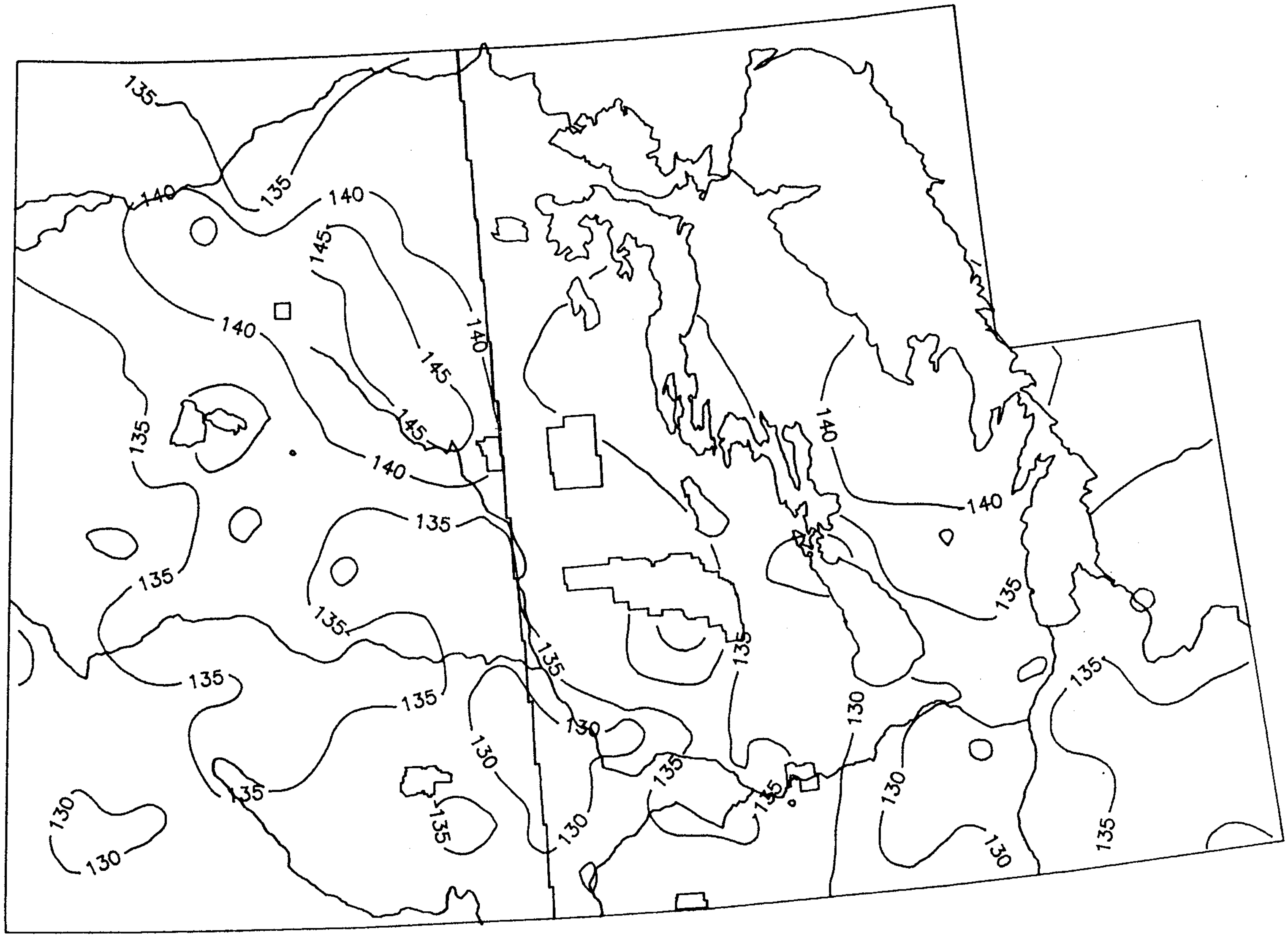


Figure 11: Average Date of Occurrence of the Last Spring Frost (−2.2°C)

4.3.1.1.2. First Fall Frosts

In establishing the dates of the first fall frost it was first necessary to convert the Julian day calendar to the conventional Gregorian one (Table 12).

Table 12. Conversion of Julian Days to the Gregorian Calendar for Fall Frosts

| Julian Day | Gregorian Calendar | |
|---|---|---|
| 196 | July | 15 |
| 212 | | 31 |
| 213 | August | 1 |
| 227 | | 15 |
| 243 | | 31 |
| 244 | September | 1 |
| 258 | | 15 |
| 273 | | 30 |
| 274 | October | 1 |
| 288 | | 15 |
| 304 | | 31 |

Note: If leap year then add one day to Julian scale

The date of occurrence of the first autumn frost has the detrimental effect of ending the growth period. When considering the first fall frost, the later its occurrence the more beneficial this is to agricultural production. Areas that were susceptible to a late spring frost were also at risk of having a early fall frost. The map of the average date of occurrence of the first fall frost of 0.0°C illustrates this point (Figure 12). Thus, the earliest occurrences of the average first fall frost of 0.0°C will ensue in the Wasagaming, Hodgson, and Sprague regions of Southern Manitoba (Day 235-240 or Aug. 23-28). Likewise, areas that have the latest occurrence of the first fall frosts are spatially similar to last spring frosts at the same base temperature. These regions were the Portage La Prairie, Vogar, Morden, Pilot Mound, Morris, and Winnipeg areas, along with a new area centred around, Great

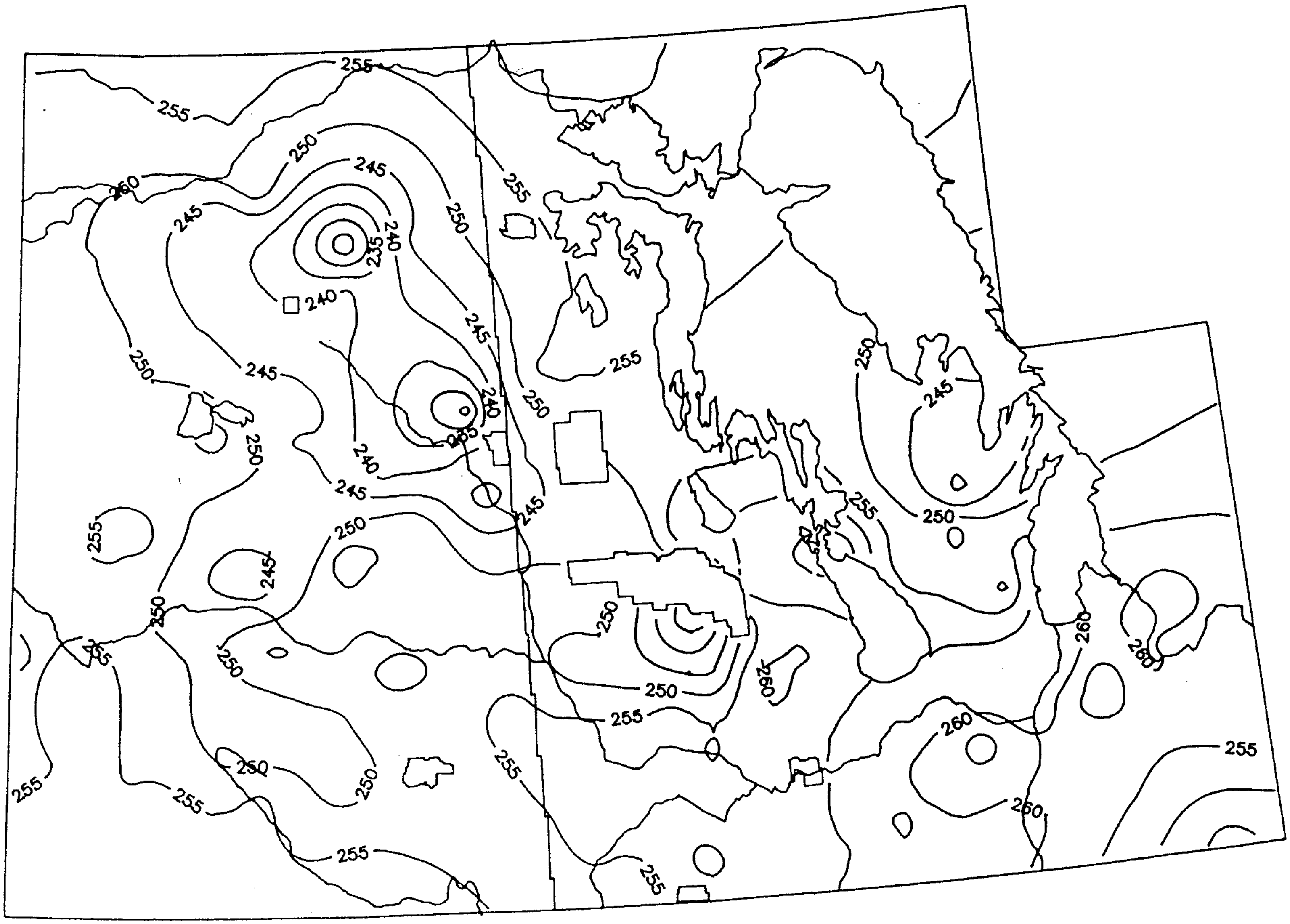


Figure 12: Average Date of Occurrence of the First Fall Frost (0°C)

Falls, and Seven Sisters Falls, which is a result of the influence of the lake (Day 260-265 or Sept. 17-22). Within Saskatchewan similarities are also found between the spatial patterns in spring and fall frosts. The southern portion of the province enjoys a late average date of the first fall frost (Day 250-255 or Sept. 7-15). The northern region of Pelly, Arran, Prairie River, and Hudson Bay experiences a short growth period, because the first average fall frost occurs earlier, Day 225-240 or Aug. 13-28 (Figure 12).

When examining Figure 13, the occurrence of the first fall frost (0°C) reduced to a 25% risk, similar spatial patterns arise to those revealed by the average dates. The only main difference is that a 1 in 4 year risk of a shorter first fall frost event has been chosen. The most suitable region within Manitoba now has the occurrence of the first fall frost on Day 250-255 or Sept. 7-15 (Figure 13). The less desirable areas within the province now have the first fall frost occurring on Day 220-235 or Aug. 8-23 (Figure 13). The latest incidence of a first fall frost at a 25% risk in Saskatchewan occurs in the Estevan, Ceylon, and Ormiston regions (Day 250 or Sept. 7). The earliest incidence of the first fall frost (25% risk) occurs in the same region as that associated with the earliest average date, where Day 210-225 or July 29 to Aug. 13 characterizes this risk. The examination of a 10% risk map at the base temperature of 0°C would identify an even earlier first fall frost event. When the first fall frosts (average, 10%, 25%) at -2.2°C are examined the corresponding spatial patterns will again emerge, except that the gradient of change may be different with each of the regions. These maps are available in Appendix B.

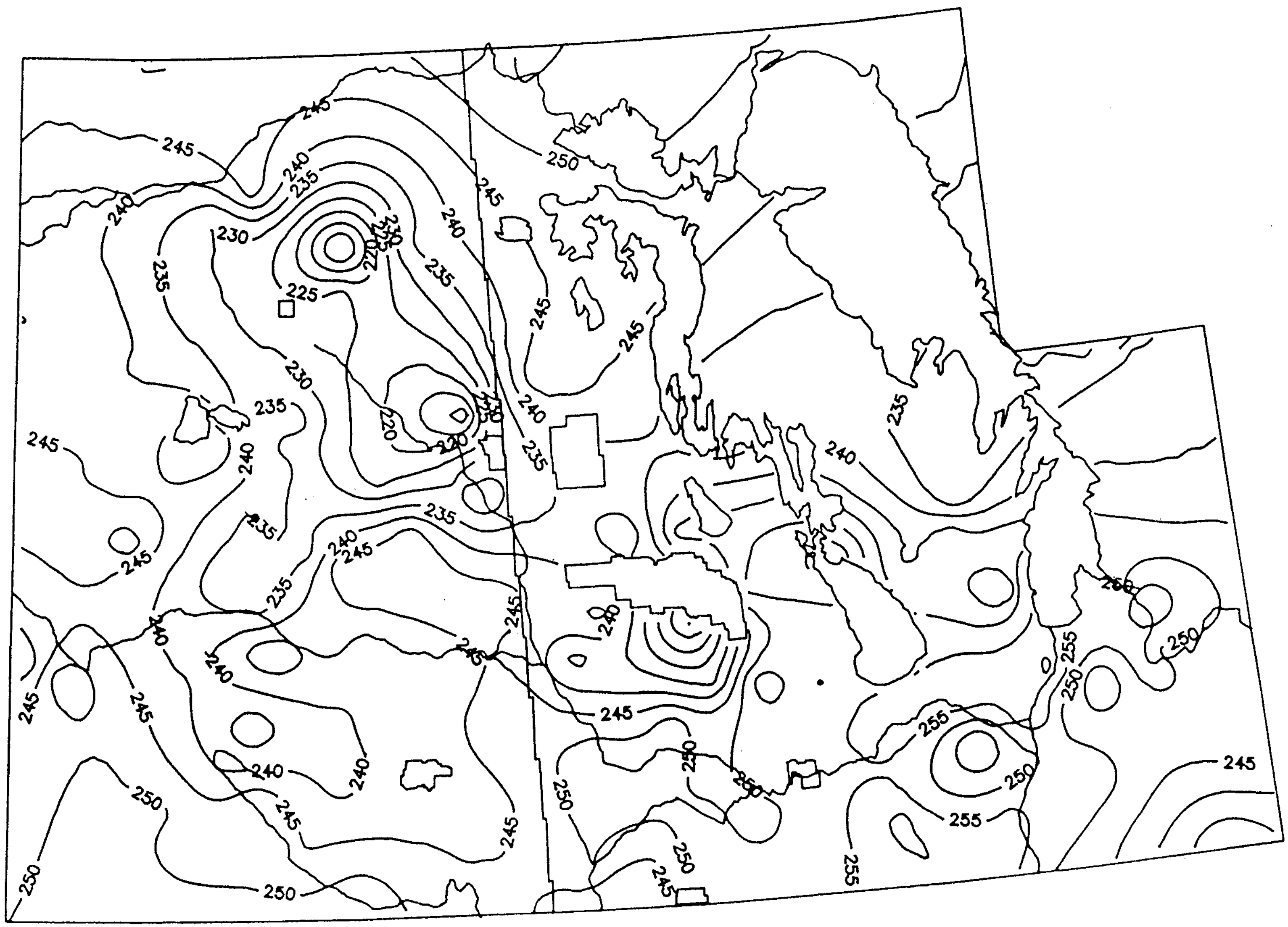


Figure 13: Dates before which the occurrence of the First Fall Frost (0°C) is at a 25% risk

4.3.1.1.3 Frost-Free Periods

The length of the frost-free period is perhaps the most important frost parameter because it dictates the time available for crop production. The spatial variability reflected in maps of the frost-free periods at each base temperature (0°, -2.2°C) is the combined result of the occurrence of the last spring and first fall frosts. Areas that exhibit an early last spring frost and a late first fall frost will consequently have a longer frost-free period.

The average length of the frost-free period above 0°C ranged from low values of 75-80-90 days in the Wasagaming, Hodgson, and Sprague regions respectively, to high average lengths of 125 to 130 days in the Morden, Altona, Portage La Prairie, Delta Beach, Selkirk, Vogar, and Great Falls regions (Figure 14). In Saskatchewan, the length of the frost-free period is considerably shorter than in Manitoba. The longest growing seasons occurred in such areas as Estevan, Ceylon, Ormiston, and Moose Jaw, with 115 to 120 frost-free days. Opposed to this, Pelly, Prairie River, and Arran regions only experience 60-80 frost-free days above 0°C (Figure 14).

It is particularly interesting to examine the length of the frost-free period above 0°C at a 10% risk (Figure 15). In most cases, wheat and other cereals require 90 to 100 days above this base temperature to reach successful maturity. In Southern Manitoba there are only five general areas where this requirement was met: 1) Morden, Pilot Mound, Altona, 2) Portage La Prairie, Marquette, 3) Gimli, Selkirk, 4) Vogar, 5) Brandon, Virden. Therefore, most other regions of the province will experience a 1 in 10 year risk of cereals not reaching maturity. All districts in

Saskatchewan, except for the Amulet - Ormiston area (105 frost-free days), experience less than 90 - 100 days above 0°C one year out of ten. The shortest frost-free periods for both provinces are encountered in the Prairie River, Hudson Bay, Pelly, Arran, and Wasagaming regions (25-35 frost-free days).

It is beneficial to characterize the average length of the frost-free period above -2.2°C because some crops are resistant to temperatures that low (Figure 16). Spatially, the map is nearly identical to the average conditions at 0°C, where the longest frost-free periods approach 140 to 145 days in Manitoba and 130 to 135 in Southeastern Saskatchewan. It is interesting to note that the station of Vogar, Manitoba enjoys one of the longest frost-free periods. This was a direct consequence of the station benefiting from the moderating effect of Lake Manitoba (presence of a large water body), as outlined in the section on thermal conditions in the literature review. The shortest average frost-free periods above -2.2°C in both provinces are approximately 110 to 120 days.

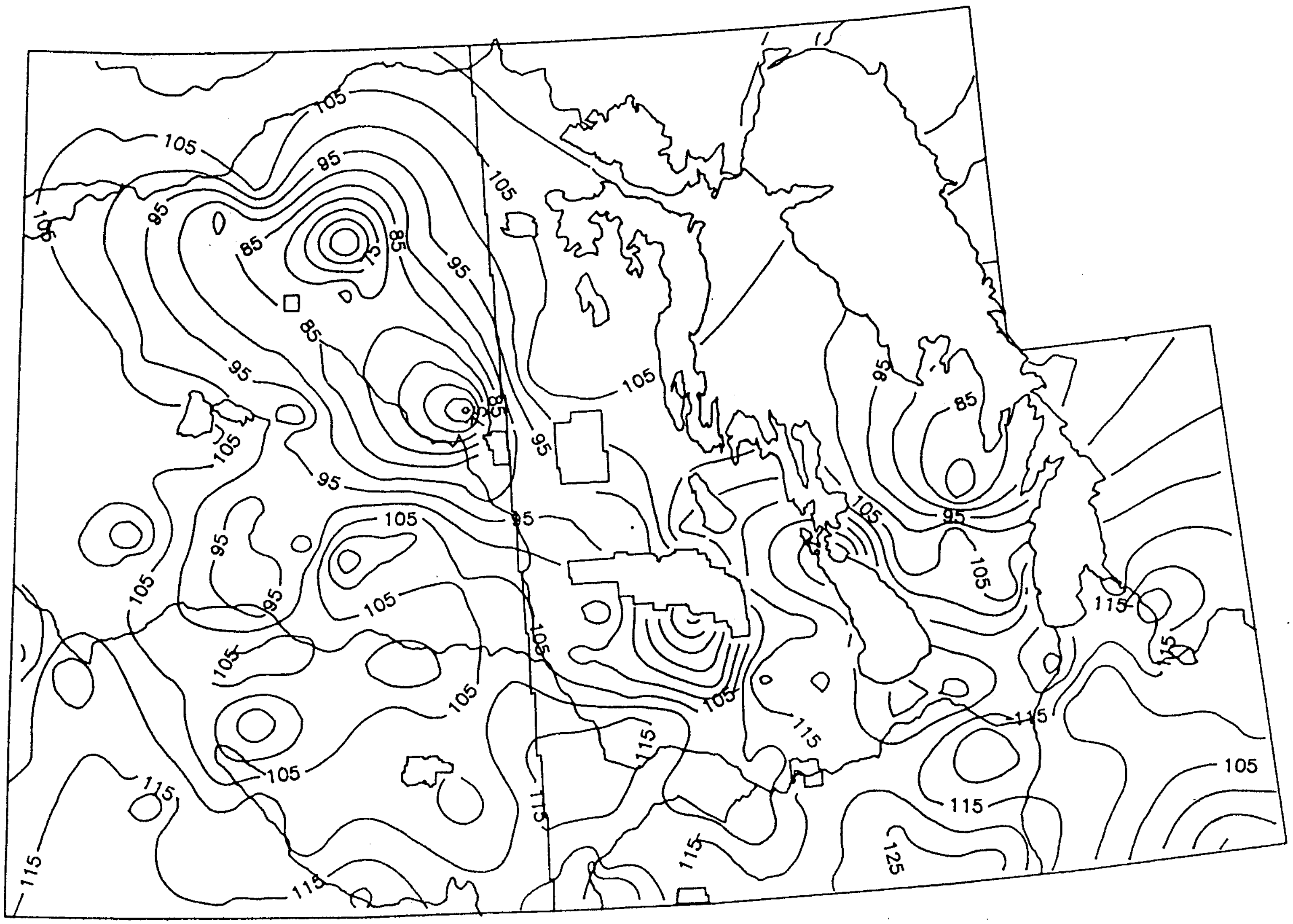


Figure 14: Average Length of the Frost-Free Period above 0°C

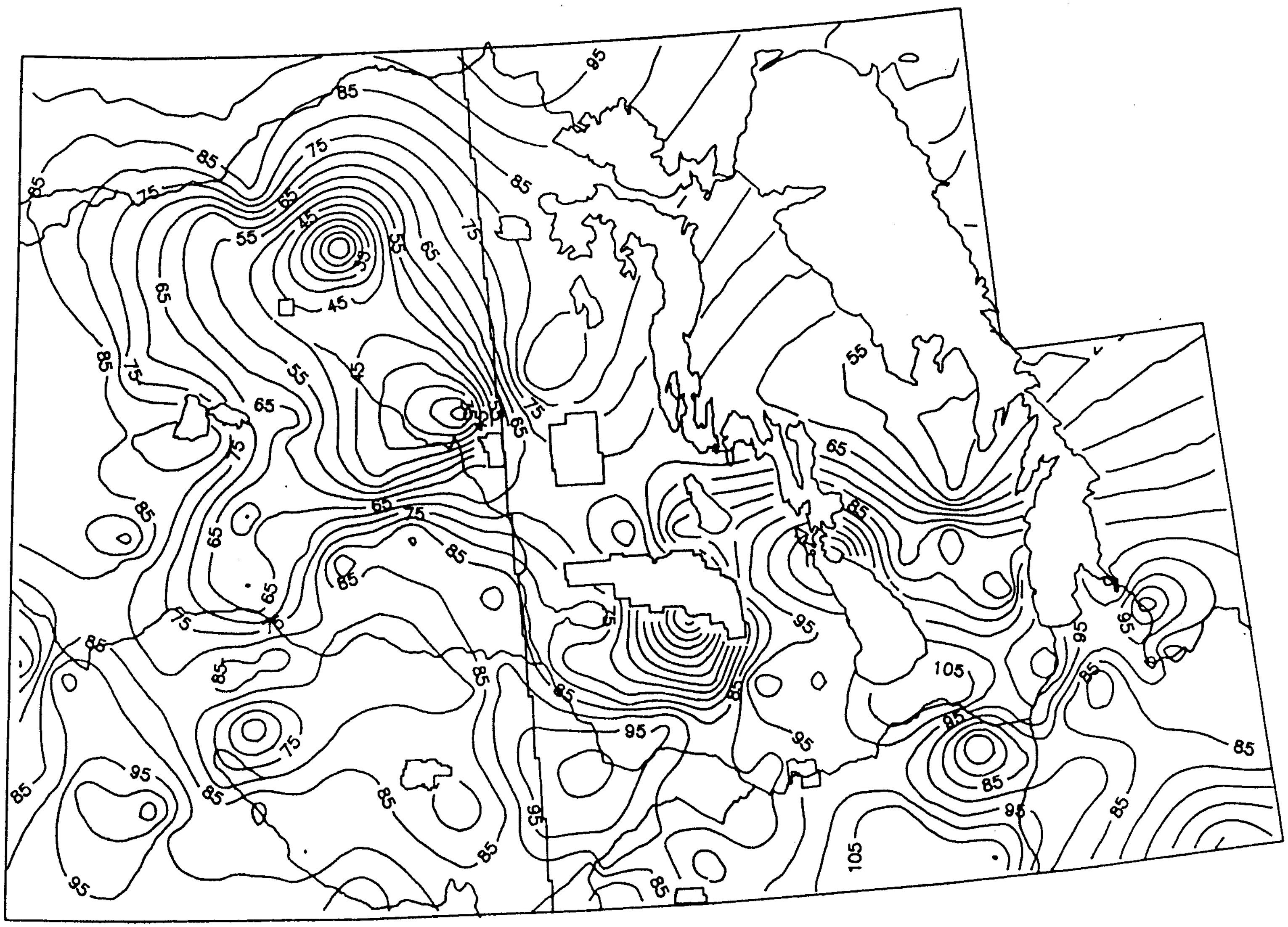


Figure 15: Length of the Frost-Free Period above 0°C at a 10% risk

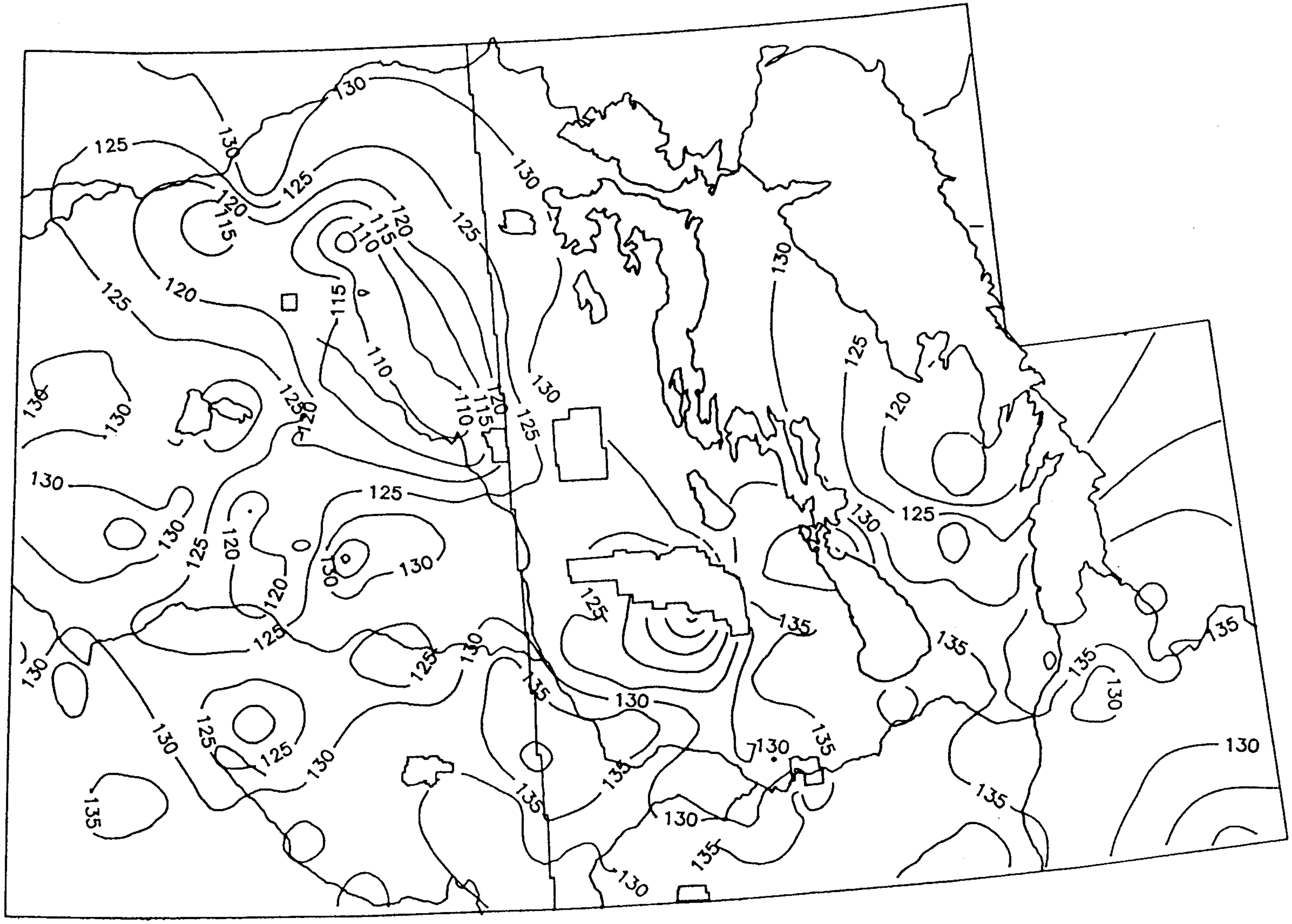

Figure 16: Average Length of the Frost-Free Period above -2.2°C

4.3.1.2. Heat Accumulations

4.3.1.2.1. Corn Heat Units

On the Eastern Prairies it has been recognized that 2300 C.H.U.'s are required to successfully mature grain corn, while 2100 units are necessary for effective corn silage production.

The maps of corn heat units and growing degree-days above 5°, 10°, and 15°C were all similar in geographic spatial patterns. The map of the average accumulation of corn heat units (Figure 17) illustrates that the areas best suited for grain corn production include Pilot Mound, Morden, Altona, Emerson, Portage La Prairie, and Great Falls (2600-2700 C.H.U.). In general, most of the Red River valley enjoys a large accumulation of corn heat units on average (2500-2600 C.H.U.). The Interlake regions as far north as Ashern and the south western part of the province are all viable locations for successful grain corn production on average. The only locality in Manitoba where corn silage production is in jeopardy occurs around the Wasagaming district, which accumulates less than 1900 C.H.U.'s on average.

Within Saskatchewan the required 2300 C.H.U.'s for successful grain corn production are only encountered in the very southern regions of the province; with a small region centred around Estevan, Amulet, and Moose Jaw approaching 2400 C.H.U.'s. In all district of the province, except for the area around Pelly, Arran, Prairie River, and Hudson Bay (1900-2000 C.H.U.), silage corn could be successfully produced given the average condition.

Assessing the minimum accumulation of corn heat units at a 10% risk (Figure 18) indicates that all areas within the two provinces, with the exception of the Morden, Morris, Altona, Emerson, Portage La Prairie, Great Falls, and Vogar regions (2300-2400 C.H.U.), run a risk of receiving less than the required (2300) corn heat units for successful grain corn production. The spatial limits of corn silage production are restricted to most areas of Southern Manitoba, i.e. the Interlake, Southwestern, and Southeastern regions. In Saskatchewan, two regions, one centred around Estevan and the other around Moose Jaw and Amulet are the only localities where successful corn silage can be produced in a 1 in 10 year risk scenario.

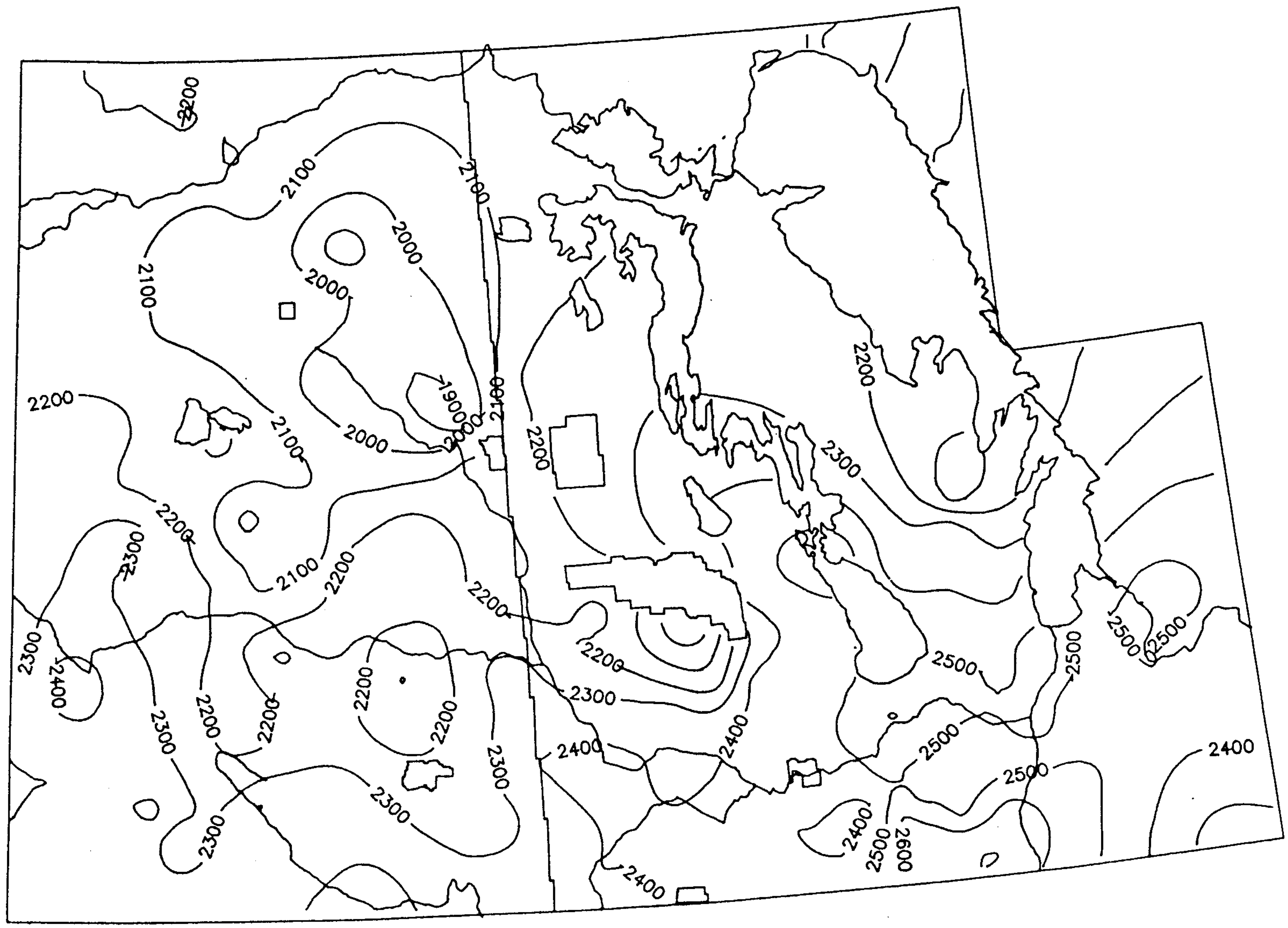


Figure 17: Average Accumulated Number of Corn Heat Units

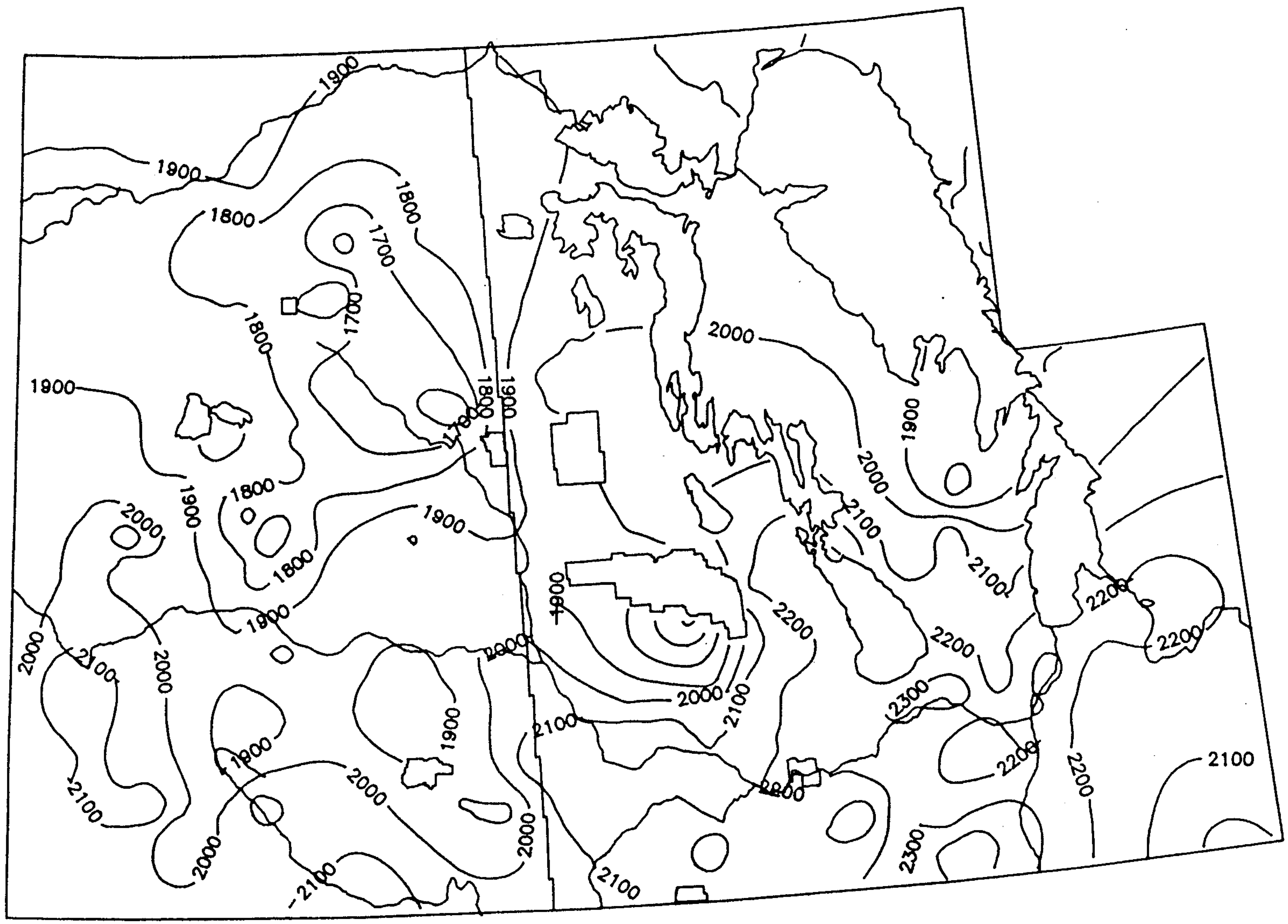


Figure 18: Minimum Accumulation of Corn Heat Units at a 10% Risk

4.3.1.2.2. Growing Degree days

It is important to have some means of assessing the amount of useful heat that has been accumulated over the growing season to predict events such as the date of crop maturity, and the rate of insect development. Many localities within the two provinces normally experience sufficient frost-free periods to ensure successful crop production. However, the amount or intensity of heat received during the growing season may be insufficient to mature the crop even though the prescribed frost-free days have been met. In general, growing degree-days above 5°, 10°, and 15°C have been used to: 1) assess the suitability of a region for crop production, 2) estimate the stages of a variety of pest insects, 3) predict maturity and cutting dates of a forage crop, 4) analyze heat stress in crops such as canola, 5) estimate the yield and protein content of cereals and canola, as well the oil content of canola, and finally, 6) as a planning tool to insure harvest dates are not too close to each other, so as to provide a steady supply of products.

The three base temperatures (5°, 10°, and 15°C) shown at the mean, 10%, and 25% risk levels all illustrate similar spatial patterns, with the only two differences being the gradient of change and the amount of accumulated heat. Cereal grains such as spring wheat, barley, oats, and buckwheat and oilseeds such as canola all require a minimum accumulation of about 1200 degree days above base 5°C to reach successful maturity. The map of the average accumulated number of growing degree days above base 5°C (Figure 19) illustrates that all regions within the two provinces are climatically suited to cereal and oilseed production.

Perhaps the only areas that run a slight risk of crop damage or failure

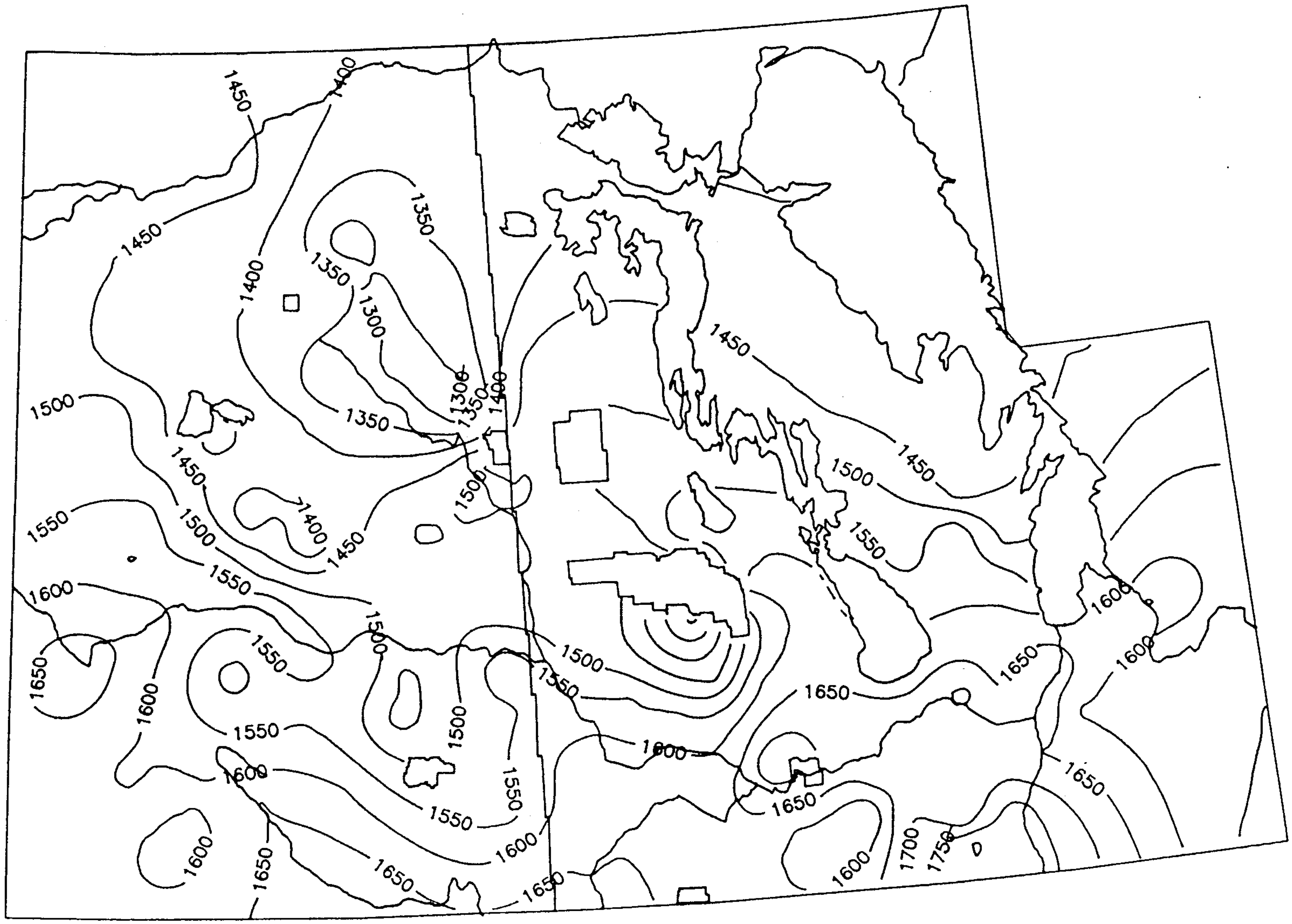


Figure 19: Average Accumulated Number of Growing Degree Days above 5°C

are the regions of Wasagaming, Pelly, Arran, Prairie River, and Hudson Bay. Within Manitoba, Wasagaming has the lowest average accumulated degree days above base 5°C, at 1250, while Plum Coulee in south central Manitoba experiences the highest at 1810. Saskatchewan on the other hand, has on average a lower accumulation of degree days above base 5°C. Where the high values range from 1689 at Estevan to 1695 at Moose Jaw, and the low values range from 1265 to 1243 at Prairie River and Pelly. Applying a 1 in 10 year risk to this parameter (Figure 20), illustrates that most regions within the two provinces are still suited to the production of cereals and oilseeds. The areas that are at risk in the average conditions are now highly susceptible to crop damage and/or failure; since the low values range from 1110 at Wasagaming, to 1112 at Pelly and 1133 at Prairie River.

It must be mentioned that growing degree days above base 5°, 10°, and 15°C were accumulated over the entire period extending from May 1 to October 30. However, before the end of this period is reached, sporadic killing frosts may occur and prevent the crop from reaching maturity. But the amount of degree days accumulated before spring and after fall frosts is usually a very small percentage of the total annual accumulation. Please refer to Appendix B for maps of degree days above base 10°, and 15°C at any risk level.

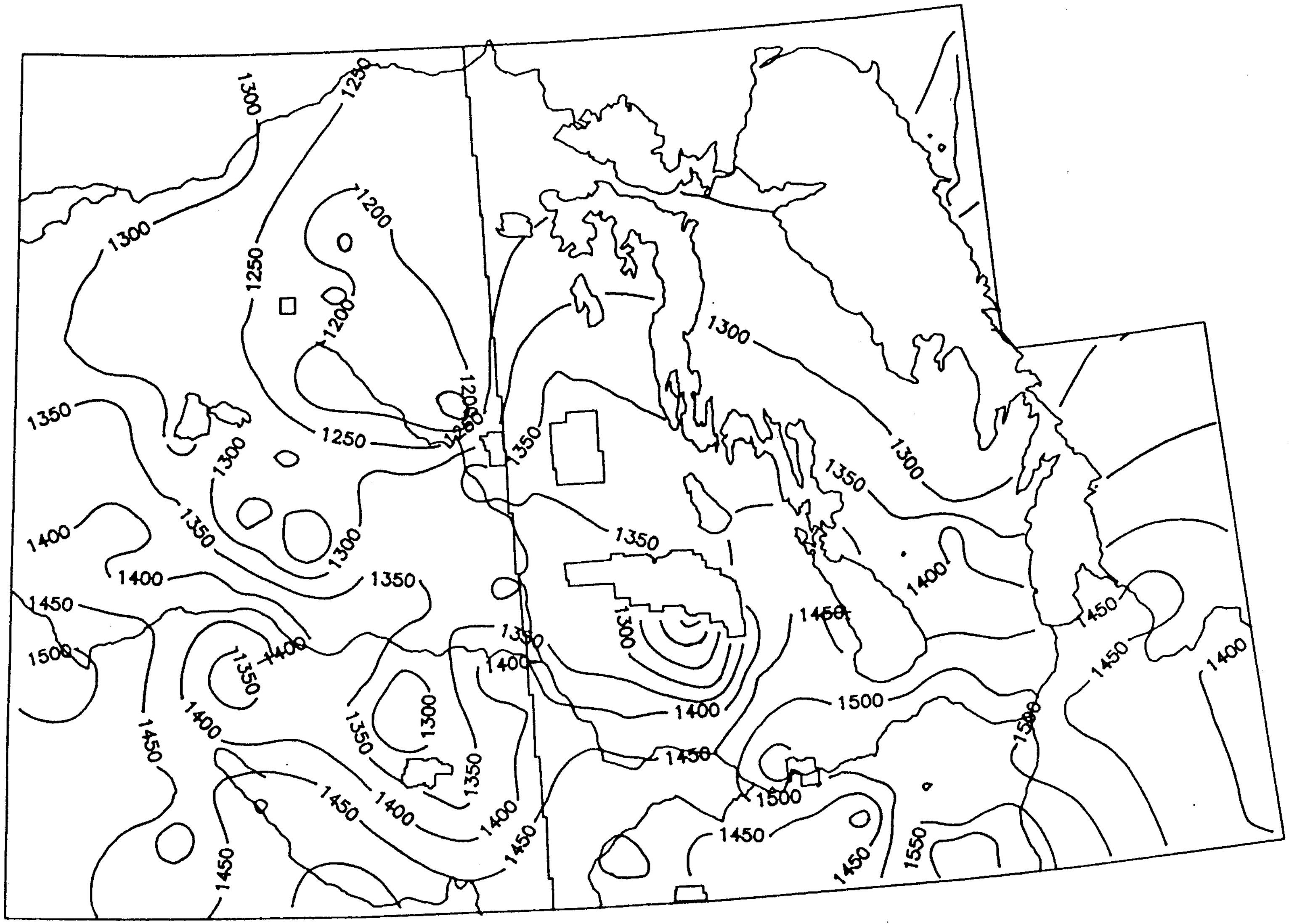


Figure 20: Minimum Accumulation of Growing Degree Days above 5°C at a 10% Risk

4.3.2. Moisture Analysis

In Southern Manitoba and Southeastern Saskatchewan it is not realistic to characterize the agriculture suitability of a region on the basis of the thermal conditions alone. Consideration must also be given to the important agro-climatic characteristic of available soil moisture. In a sense, it is possible to grow a crop without any soil moisture if the rain is perfectly timed within the growing season. The seasonal distribution of water within a soil profile is a complex interaction of many variables related to current and antecedent weather parameters such as wind, relative humidity, temperature, precipitation, evaporation, and the physical factors of available soil water holding capacities, type of crop and stage of development, and finally, agricultural management practices (Bootsma and DeJong 1988b, Dunlop 1981).

For each climatic station the available water holding capacities for the top 120 cm (in mm) of the soil were extracted from DeJong and Shields (1988) maps (Figure 2). The resulting map provided the maximum water holding capacities of the soil for each of the three (wheat, alfalfa, and corn) crop types. This map is the basis for determining soil moisture status or stress levels at any phenological stage of the three crops. It must be kept in mind, that the spatial variability in soil moisture and/or stress levels at each phenological stage is primarily the result of two factors: 1) precipitation received over the growing season, and 2) the ability of the soil type/texture to hold water. It then becomes evident from examining the map of soil water holding capacities (mm) to 120 cm (Figure 2), that great spatial variability exists within the two provinces. The Red River Valley Region exhibits some of the highest available water holding capacity soils, and therefore moisture stress is normally low. On the other hand, regions around Foam Lake and Humboldt Saskatchewan consists mainly of low water holding capacity soils, which contribute to seasonal stress or moisture deficits.

4.3.2.1. Moisture Conditions Under a Wheat Crop

The first map illustrates the amount of estimated soil moisture (mm) in a 120 cm profile at the time of planting for wheat (Figure 21). To fully understand the significance of this map it must be used in conjunction with Figure 2, soil water holding capacity to 120 cm (in mm). In general, areas that have high soil moisture values at the time of planting (e.g. Red River Valley 200-225 mm) also have high water holding capacities. Soils with low water holding capacity have low moisture values at the time of planting (e.g. Watrous and Guernsey 100-125 mm). In Figure 21, the east to west trend in lower soil moisture values is clearly evident. This gradient toward a moisture deficit will become even more prevalent as one proceeds through the average growing season. In fact the soil moisture values seen in Figure 21 represent the most favourable condition within an average growing season.

By the heading stage (Figure 22), the average amount of readily available soil moisture has been severely reduced in all regions. The Red River Valley now has between 150-175 mm of soil moisture available, while regions around Watrous, Guernsey, and Estevan have only 75 mm of available water left in the profile. Examination of the different risk levels of soil moisture amounts at the heading stage will illustrate essentially the same spatial pattern. The only major difference is the magnitude of change that can be expected to occur.

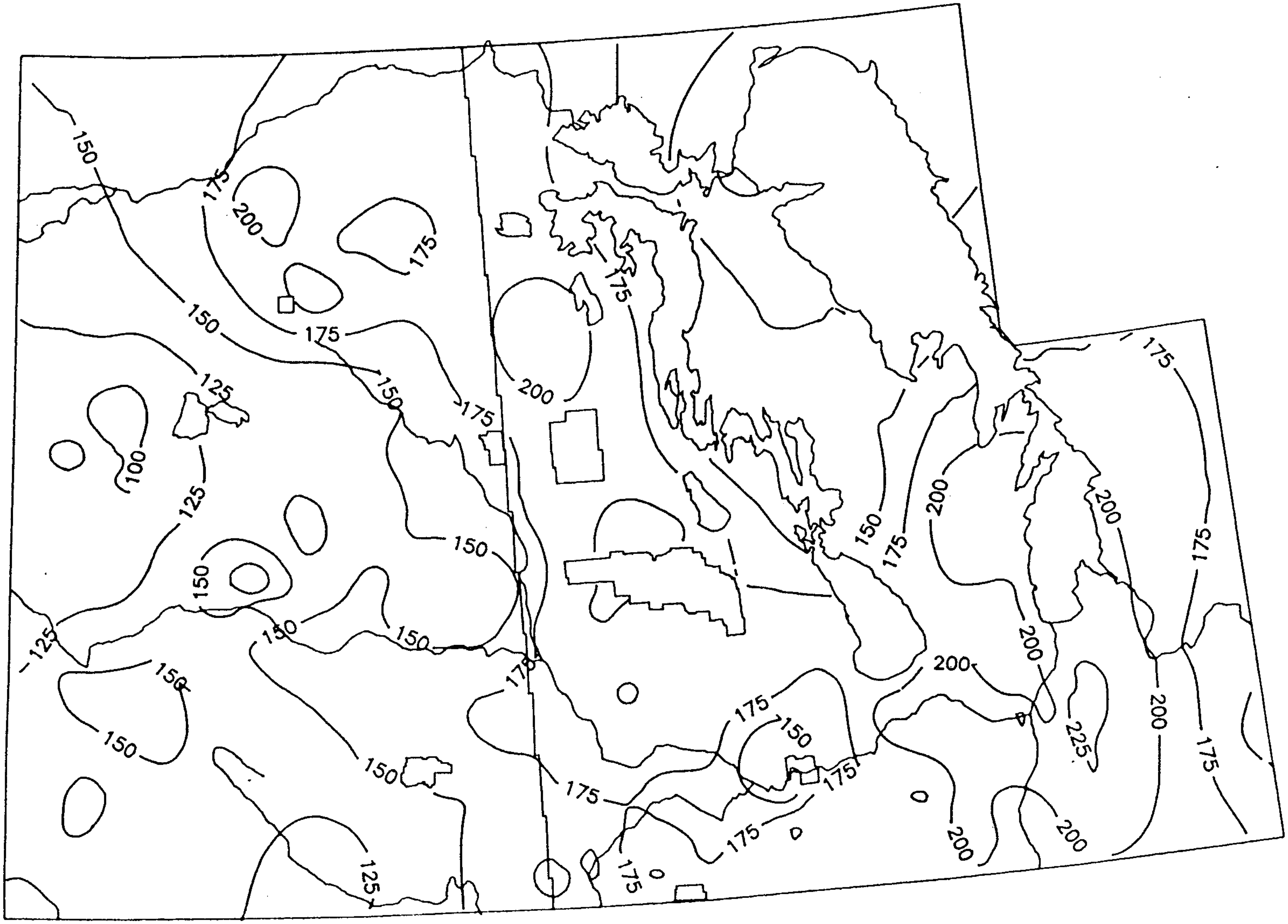


Figure 21: Average Soil Moisture Amounts at Planting of Wheat (mm)

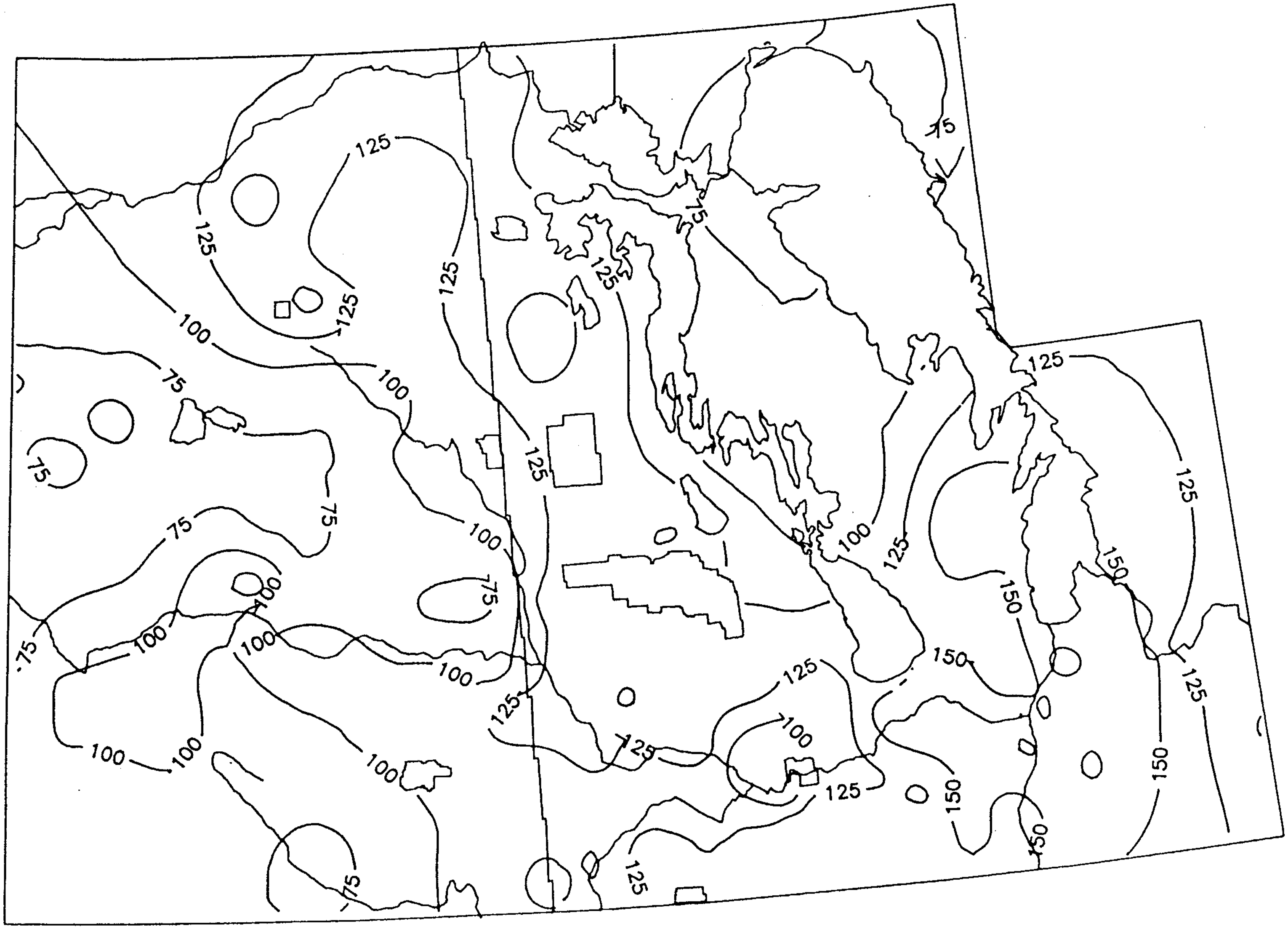


Figure 22: Average Soil Moisture Amounts at the Heading Stage of Wheat (mm)

As outlined in the literature review, not all moisture in the 120 cm profile is equally available for plant uptake. A crop has the ability to easily extract moisture down to 50% of the available water in the root zone. Below 50%, a root zone drying function has been used in an attempt to reflect the increasing difficulty with which plants extract moisture. This difficulty in extraction of moisture is illustrated in a map of average plant moisture stress amounts at heading for wheat (mm) (Figure 23). Within Manitoba there is on average very little moisture stress (-5 to -15 mm) at this stage of wheat development. Saskatchewan on the other hand, has stress amounts from -15 mm in the Southeast to -45 mm in central regions of the province. It is interesting to note, that on average, regions with poorer water holding capacities displayed higher growing season stress rates. This was the case around the regions of Guernsey, Watrous, and Imperial.

As the wheat crop passes through the phenological stage of soft dough, the daily demand for water by the plants begins to decrease. However it is at this stage that some of the greatest average water deficits are encountered because of high crop demand earlier in the growing season. Throughout the two provinces there has generally been another 25 mm of moisture required by the crop since the heading stage (Figure 24). Within the most favourable regions of the Red River Valley about 100-125 mm of available soil moisture remained; while regions in Southern and Central Saskatchewan had only in the order of 50 mm left in the profile (Figure 24).

At this phenological stage of development most soils have been reduced to below 50% capacity of the root zone moisture. As might be

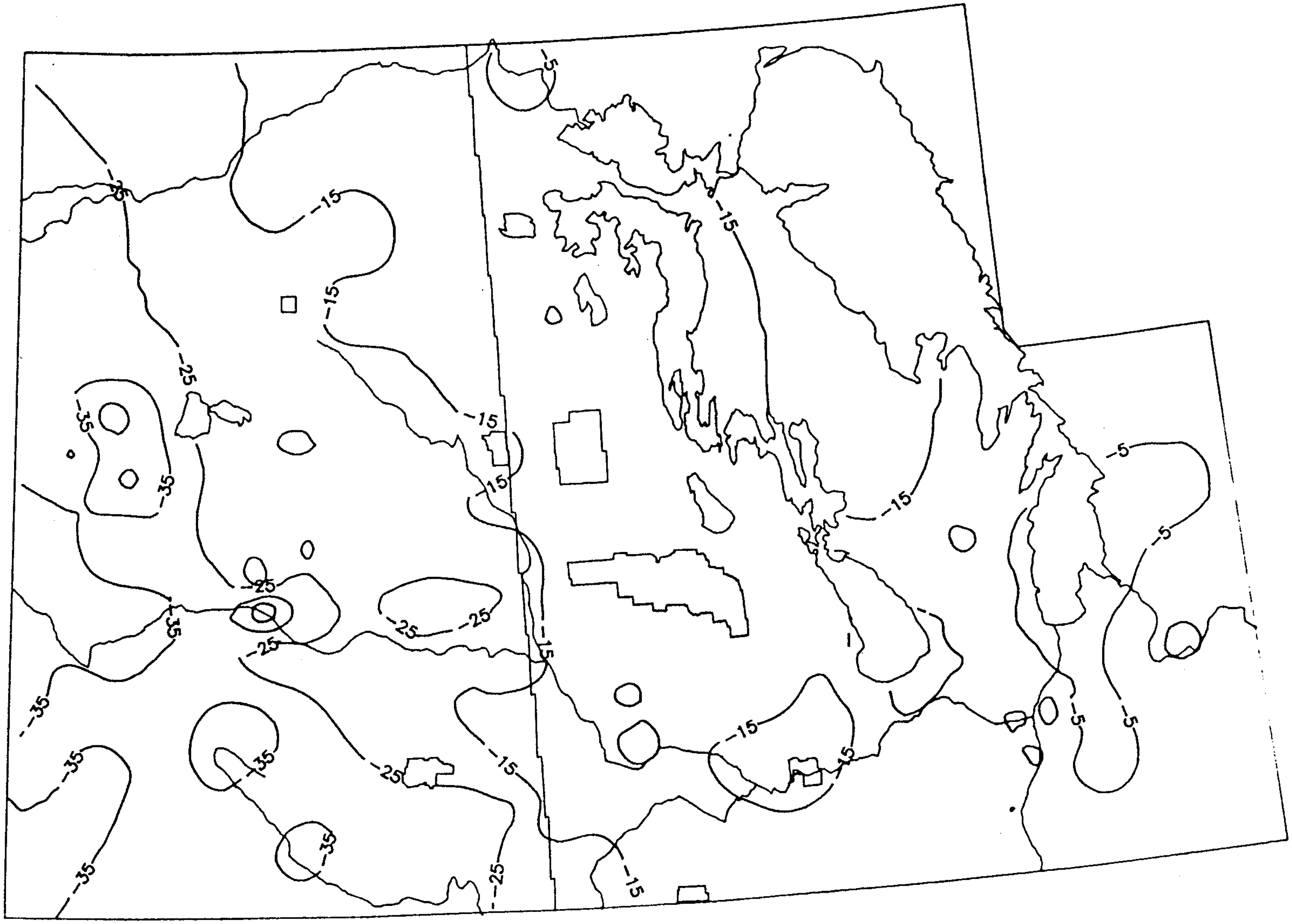


Figure 23: Average Plant Moisture Stress Amounts at the Heading Stage of Wheat (mm)

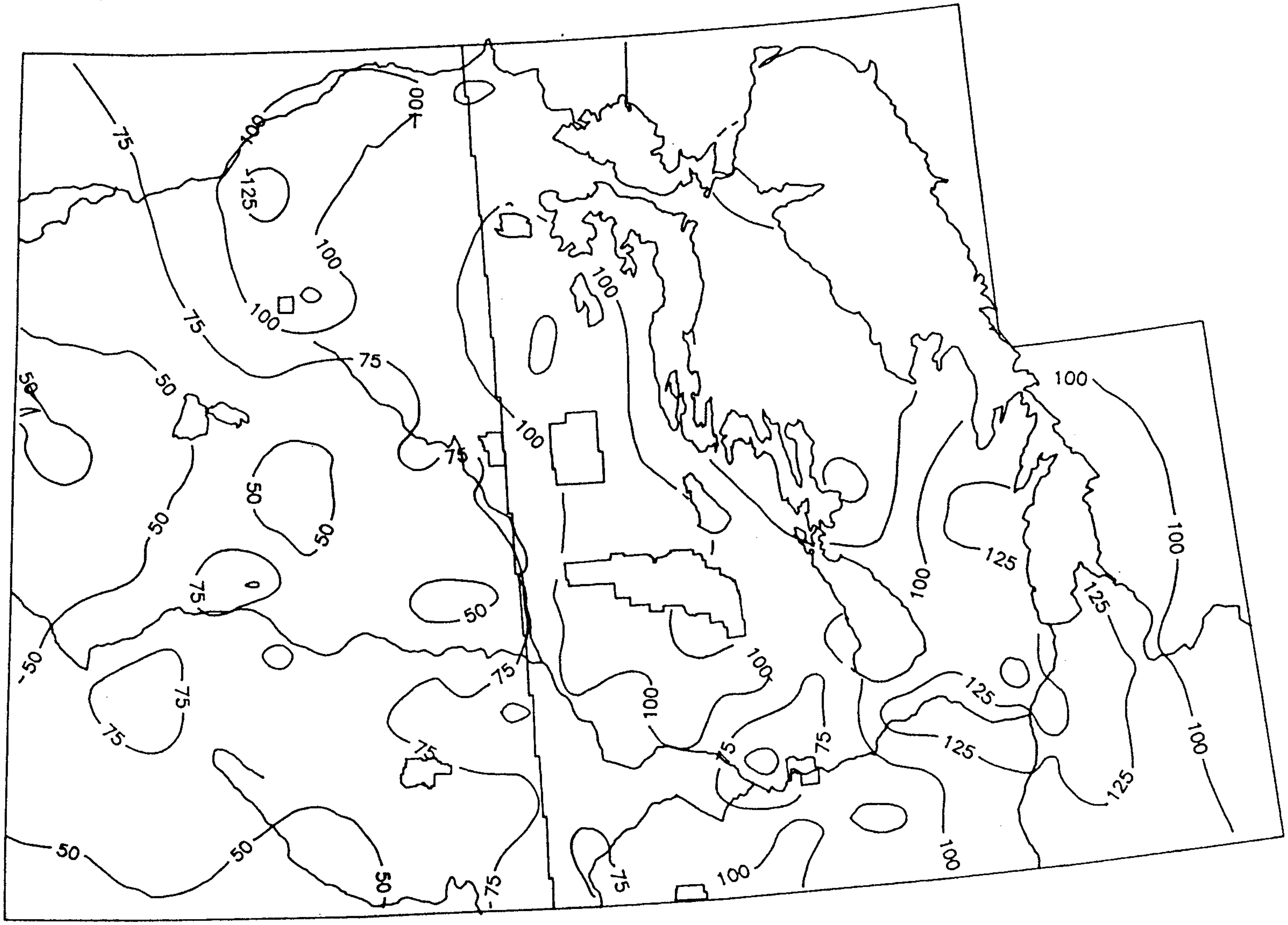


Figure 24: Average Soil Moisture Amounts at the Soft Dough Stage of Wheat (mm)

expected, the level of plant moisture stress since heading has substantially increased in all regions (Figure 25). In Southern Manitoba most of areas east and north of a line running through Pilot Mound and Gladstone experience on average less than -25 mm of stress. The southwestern portion of the province (Carberry, Brandon, Souris, Melita, and Pierson) encounters plant moisture stress amounts in the order of -25 to -40 mm. Proceeding in a southwesterly direction through Saskatchewan, plant moisture stress amounts increase from -25 to -80 mm (Figure 25). The regions with greatest stress on average are again centred around Guernsey, Watrous, and Imperial.

The map of soil moisture amounts at maturity for wheat (Figure 26) represents the lowest moisture values within an average growing season. This is a consequence of high crop demand throughout the growing season. When Figure 26 is compare to Figure 24 (soil moisture amounts at soft dough), there is very little quantitative difference in the spatial representation of moisture values. This is a result of the root zone drying function inhibiting moisture withdrawal. The final map of soil moisture amounts under a continuous crop of wheat, represented the average conditions on October 31 (Figure 27). October 31 in this research depicts the moisture conditions at freeze up. As might be expected, all regions of the two provinces experienced moisture recharge, since crop demand has been negligible from maturity. The Red River Valley Region has in the order of 175-225 mm of moisture in the soil, while this amount decreased in a westerly direction to a low of 75-100 mm in east central Saskatchewan.

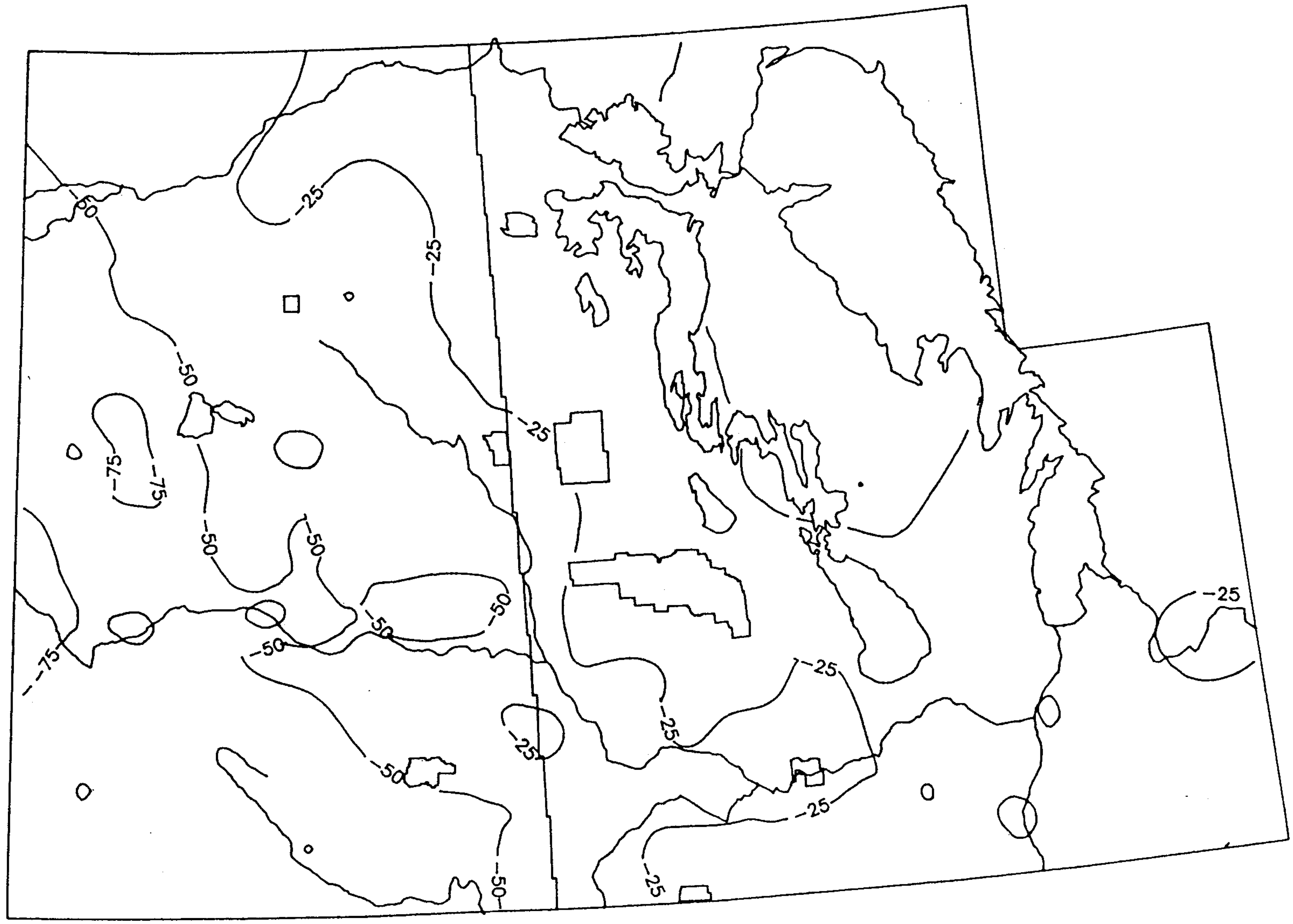


Figure 25: Average Plant Moisture Stress Amounts at the Soft Dough Stage of Wheat (mm)

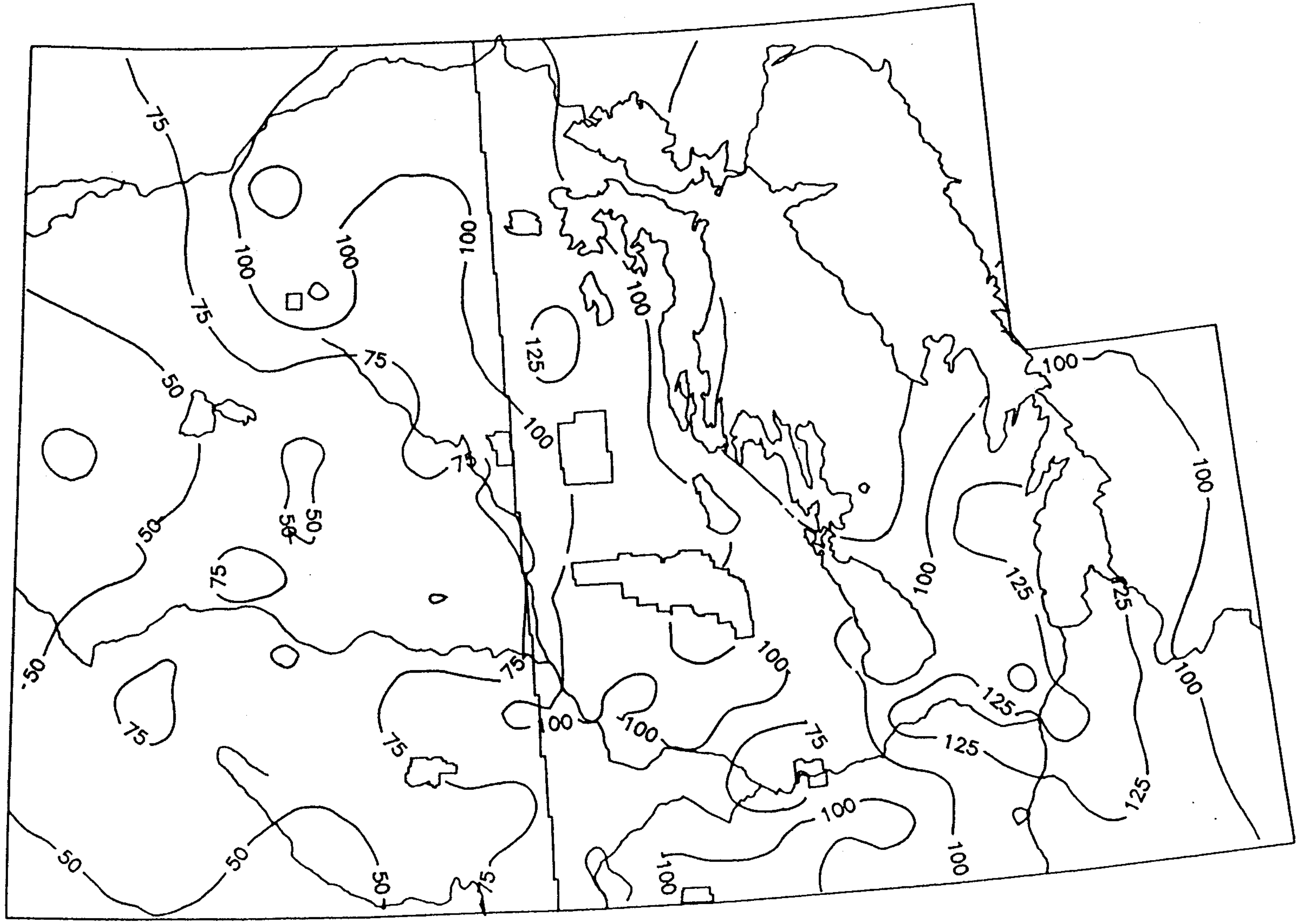


Figure 26: Average Soil Moisture Amounts at Maturity of Wheat (mm)

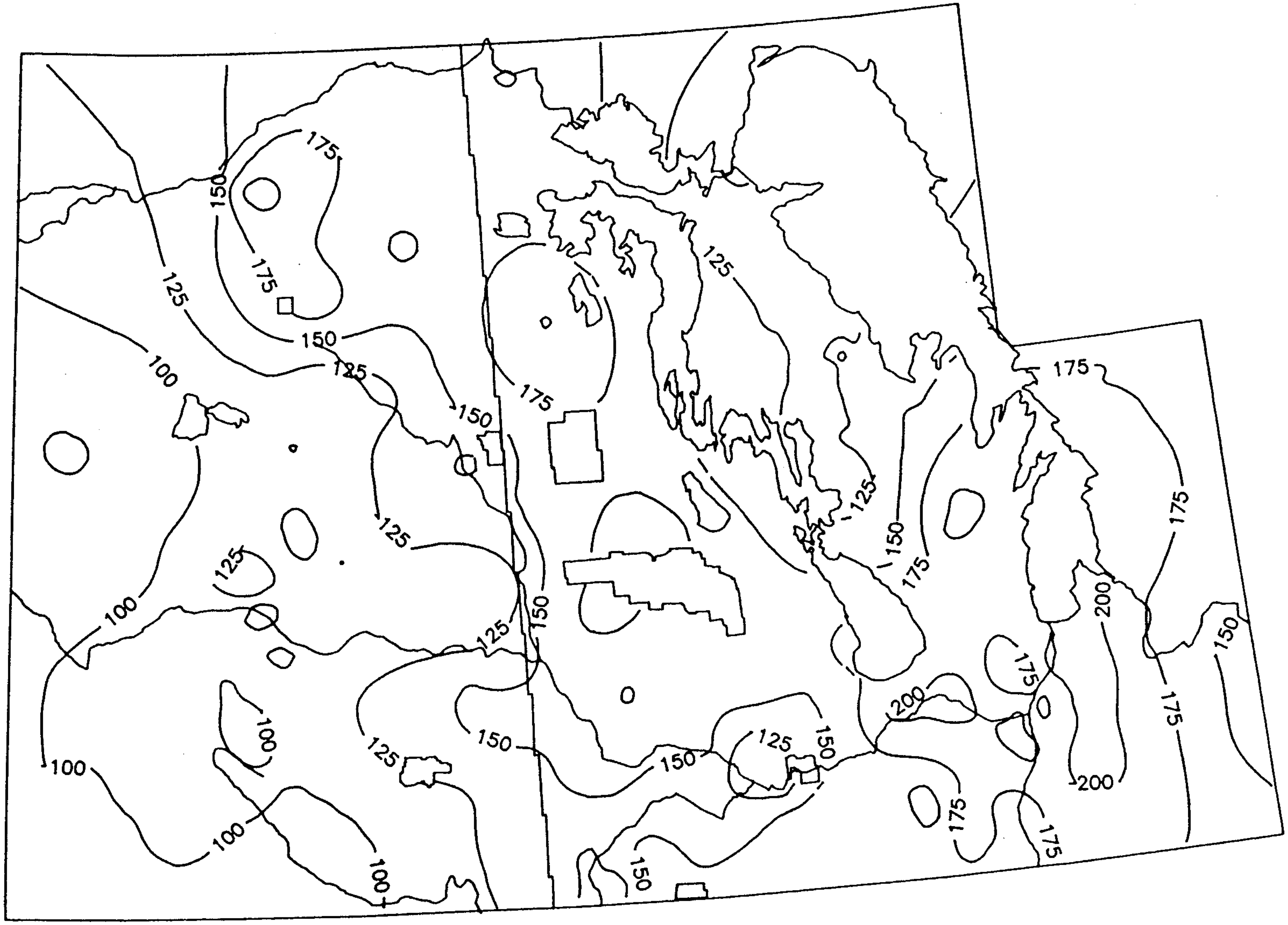


Figure 27: Average Soil Moisture Amounts on October 31 for Wheat (mm)

A component of the research was the determination of growing season actual evapotranspiration and precipitation for each crop. The growing season in the case of wheat was defined as the period extending from the planting date to maturity estimated by the biometeorological timescale. Along with stored soil moisture in the spring, precipitation is one of the most important factors affecting wheat yields. The highest accumulation of precipitation occurs in the Indian Bay - Sprague regions, and a area centred around Hodgson - Arborg (225-250 mm) (Figure 28). The rest of the province receives on average 200 - 225 mm of precipitation, with regions west of Virden accumulating slightly less than 200 mm. The northern agricultural reaches of Saskatchewan (Prairie River, Tisdale, Preeceville, Pelly) all receive 200 mm of precipitation or greater. The south central regions of the province received on average 150 - 175 mm of growing season rain.

In comparison, the average growing season actual evapotranspiration (A.E.) rates are much higher (Figure 29). The rate of actual evapotranspiration depends in part upon soil type and texture. Soils with high available water holding capacities (AWC) are able to free up more of the moisture for crop growth. For example, a soil with a 250 AWC can extract 125 mm before root zone restrictions are applied to limit moisture withdrawal. On the other hand, a soil with 150 AWC can only allow 75 mm of unobstructed soil moisture withdrawal. Consequently, greater average A.E. values can be experienced on high AWC soils (Figure 29). Within Manitoba average A.E. values range from 230 - 290 mm, with the greatest estimated values on the highest AWC soils (i.e. Red River Valley). A.E. values in Saskatchewan range from 210 mm in the Watrous - Humboldt area, to 270 - 280 mm in the Prairie River - Hudson Bay, Pelly - Arran, Cupar - Lipton districts. In conclusion, areas with low average A.E. rates and growing season precipitation amounts experience higher rates of plant moisture stress on average.

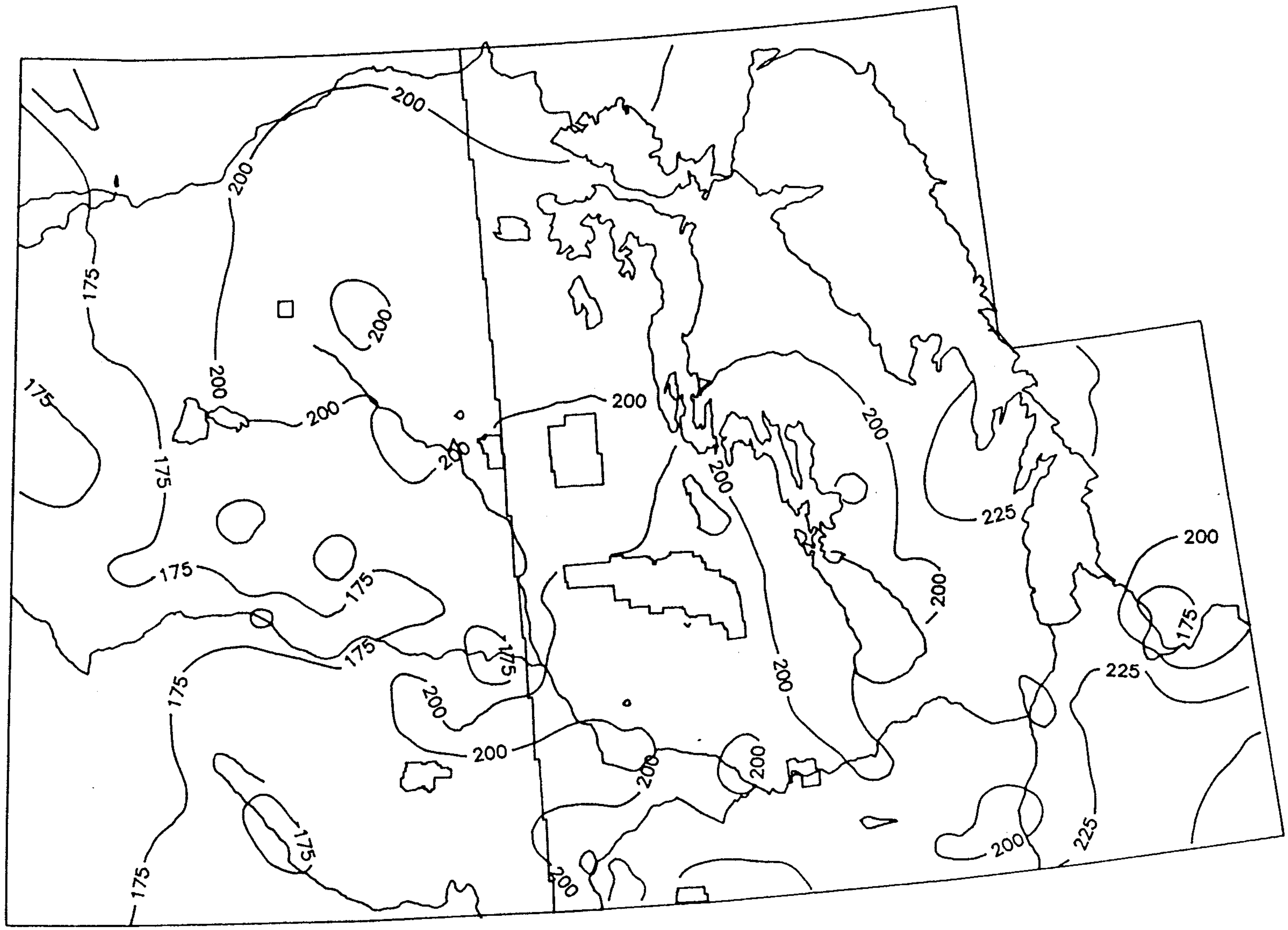


Figure 28: Average Accumulated Growing Season Precipitation for Wheat (mm)

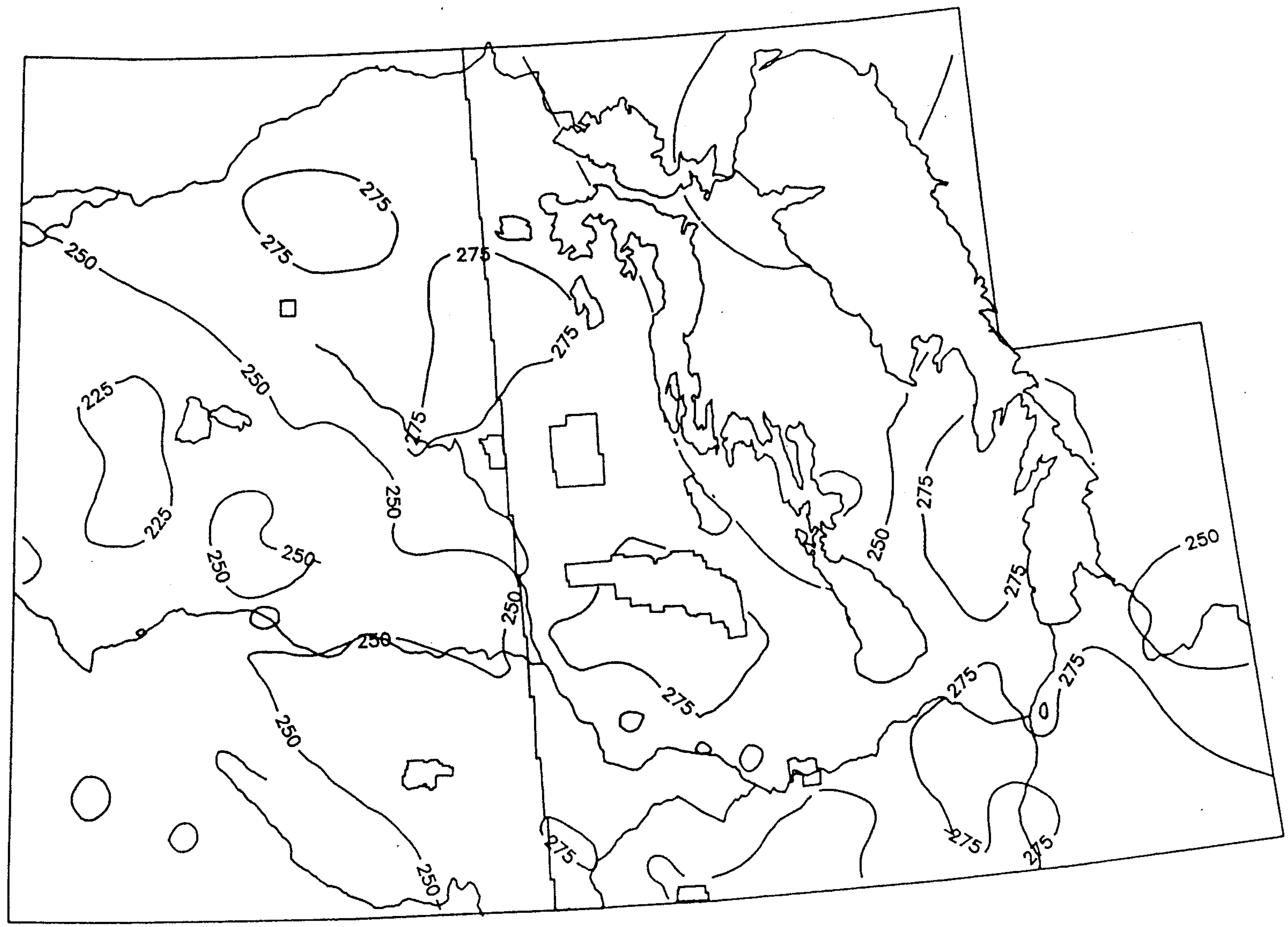


Figure 29: Average Accumulated Growing Season Actual Evapotranspiration for Wheat (mm)

4.3.2.2. Moisture Status Under a Corn Crop

Soil moisture and stress levels under an actively growing corn crop were examined at the silking (480 G.D.D. above base 10°C), silage (795 G.D.D. above base 10°C), and grain stages (900 G.D.D. above base 10°C). As with a wheat crop, certain phenological stages of corn are sensitive to moisture stress. Indicated in the literature review, yields are affected most by a lack of water when harvestable fruit is being set, i.e. the silking stage of corn.

The average soil moisture amounts at the silking stage (Figure 30), reflect spatial patterns similar to those encountered under a wheat crop. The Red River Valley and the Hodgson - Arborg regions has the highest soil moisture amounts (175 - 200mm) at silking. While regions around Watrous, Guernsey and Imperial, have only 75 - 100 mm of available moisture. It is also apparent from Figure 30, that moisture values became lower as one moved west. This east to west gradient is also illustrated in Figure 31, average plant moisture stress amounts at the silking stage of corn. Generally, all regions east of Portage la Prairie experience -25 to -50 mm of stress on average. Regions west of Portage la Prairie have on average -50 to -75 mm of stress. Within Saskatchewan stress levels east of line running through Oxbow to Wynyard average about -75 to -50 mm. West of this line, stress values are in excess of -75 mm and approached -100 mm in a few locations (Figure 31). The examination of either one of the two previous maps at the 10% or 25% risk levels will illustrate the same spatial patterns, with the only major difference being the magnitude of moisture deficits or stress levels (please see Appendix B).

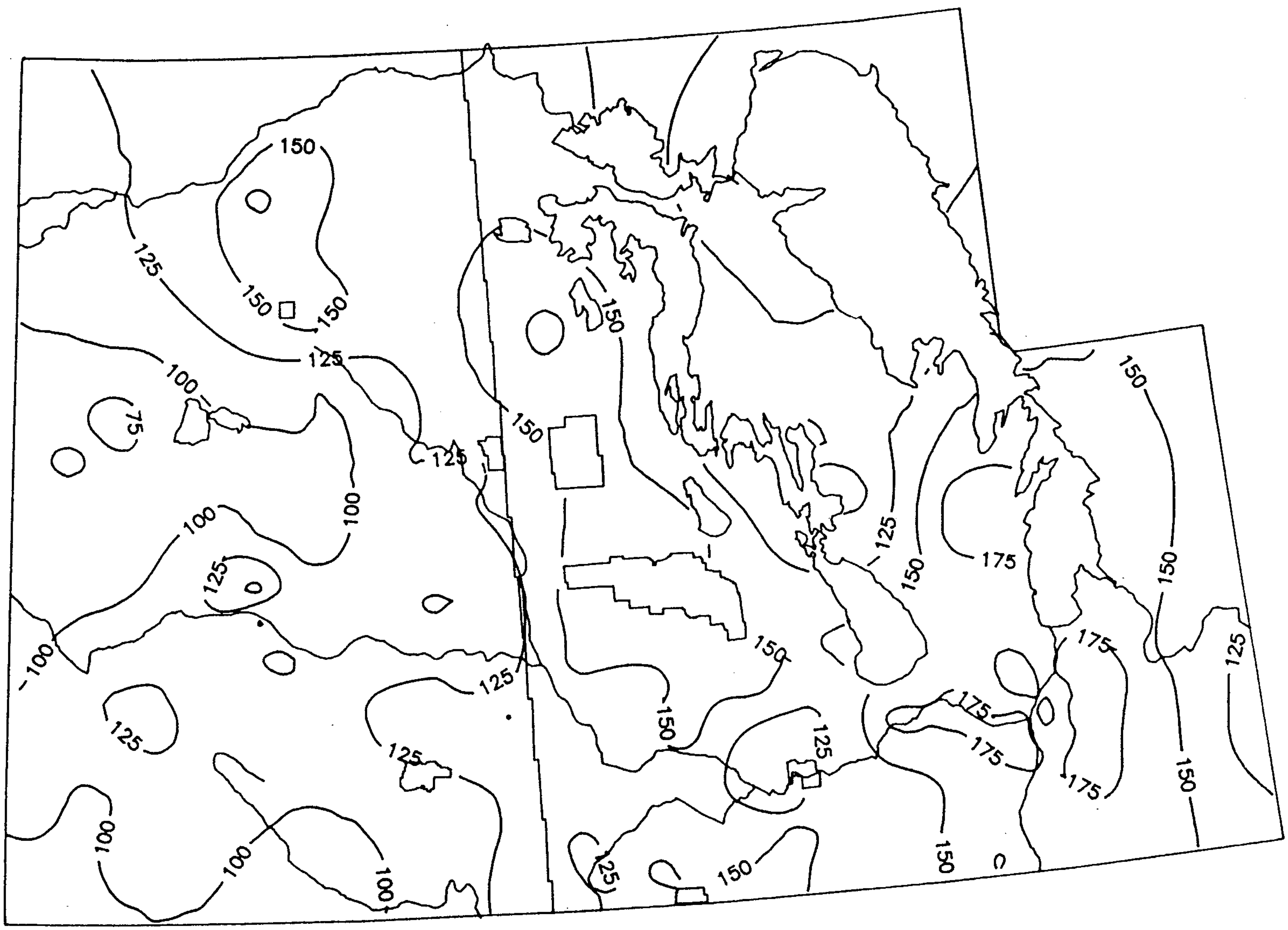


Figure 30: Average Soil Moisture Amounts at the Silking Stage of Corn (mm)

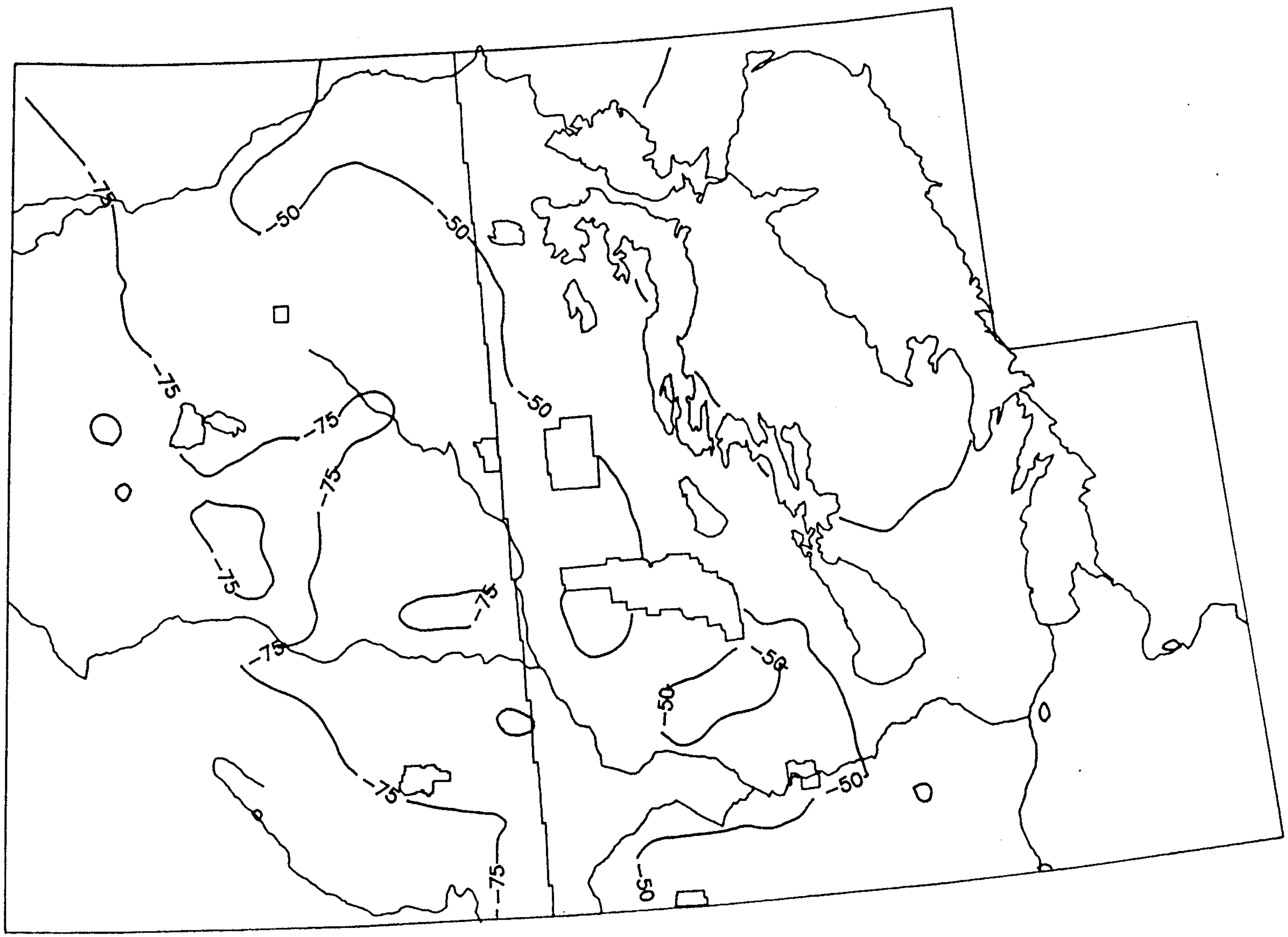


Figure 31: Average Plant Moisture Stress Amounts at the Silking Stage of Corn (mm)

By the silage stage of corn (795 G.D.D. base 10°C) the average amount of soil moisture is substantially lower within all regions of the two provinces (50 - 75 mm lower) (Figure 32). The Red River Valley and regions around Morden, Portage la Prairie, Great Falls, Steinbach, and Arborg average moisture values in the range of 100 - 125 mm. The western part of the province is slightly drier with areas centred around Melita - Bede - Pierson, Virden, Souris having 75 to 100 mm of soil moisture left. Available soil moisture continues to decrease in a westerly direction, and reaches values as low as 25 mm in the Guernsey, Davidson, Nokomis districts. As might be expected, the average level of plant moisture stress at the silage stage (Figure 33) is critically high in all regions of Saskatchewan. Values range from -100 mm in eastern regions of the province, with stress levels as high as -200 mm in areas that have the highest levels of stress at the silking stage. The southwest corner of Manitoba (e.g. Pierson) encounters stress values in excess of -100 mm. Proceeding in a easterly direction, stress values dwindle to -50 mm in most areas east of the Red River Valley (Figure 33). Figure 33 illustrates that most areas within the two provinces experience excessive stress levels which would limit corn silage production in many regions.

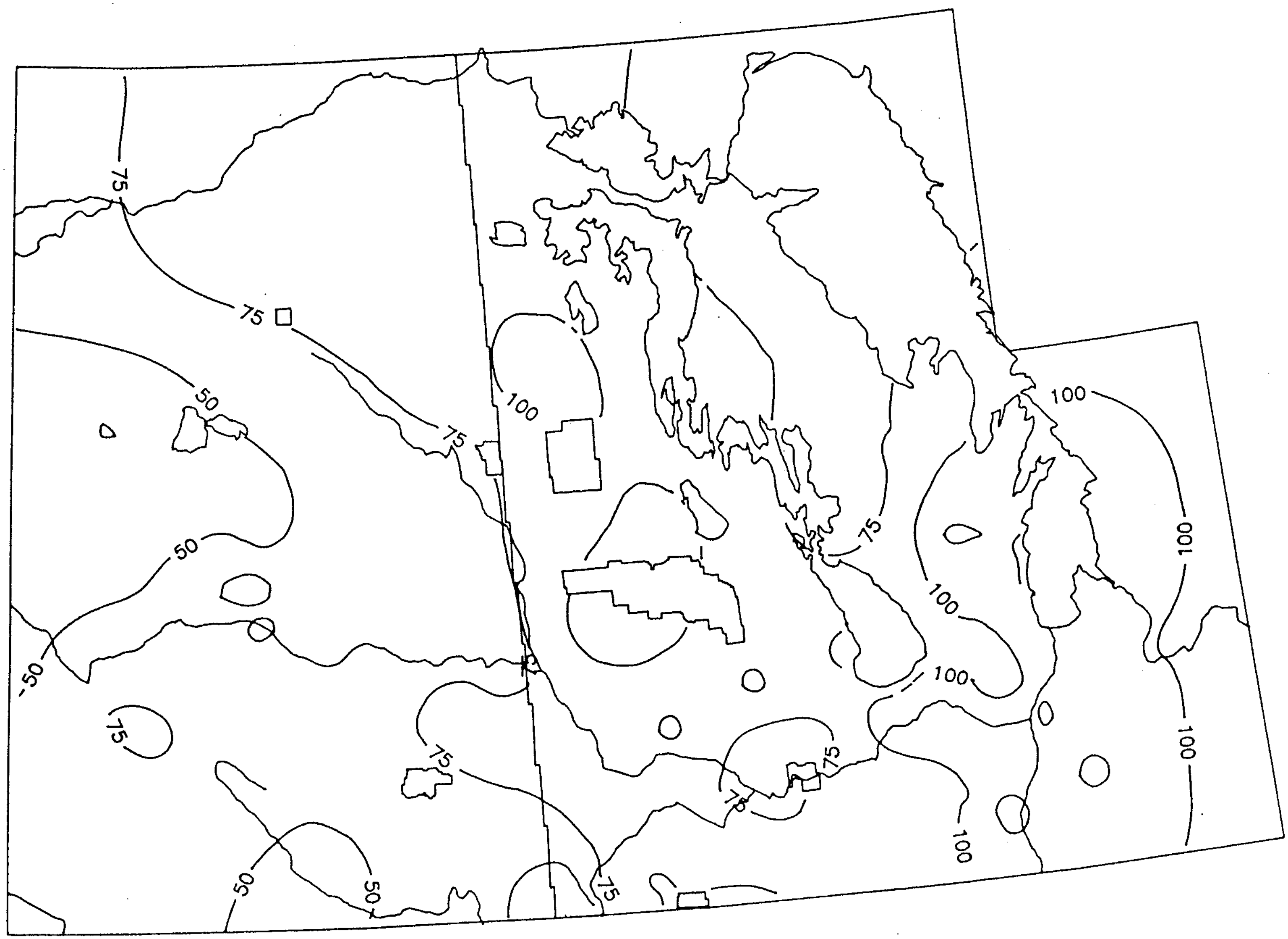


Figure 32: Average Soil Moisture Amounts at the Silage Stage of Corn (mm)

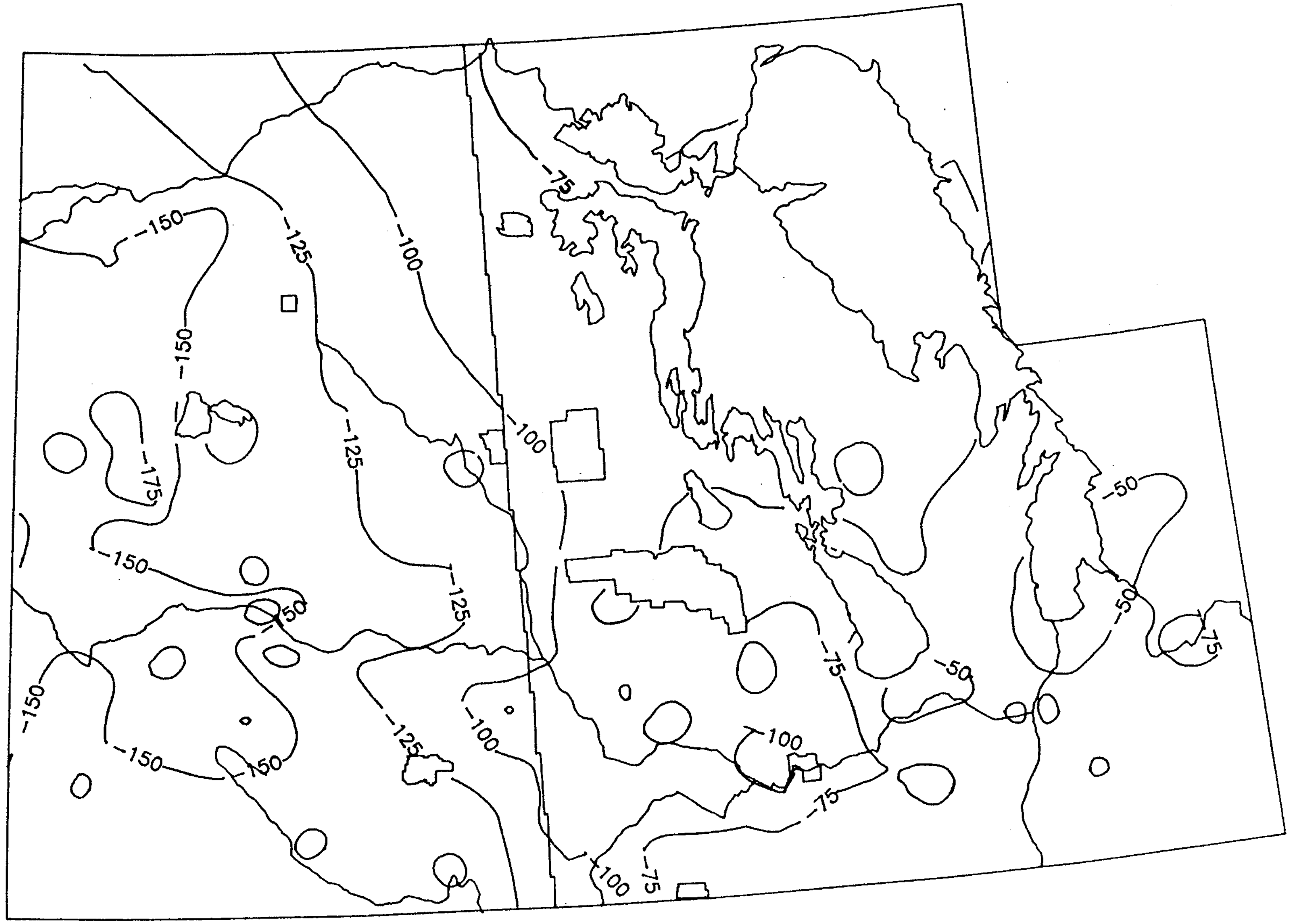


Figure 33: Average Plant Moisture Stress Amounts at the Silage Stage of Corn (mm)

By the grain stage of corn (900 G.D.D. above base 10°C), the average soil moisture amounts are about 5 to 15 mm lower than those at the silage stage in all regions (Figure 34). Areas east of Portage la Prairie have on average 75 - 100 mm of moisture left in the soil, while regions west of Portage to the Manitoba - Saskatchewan border have 50 - 75 mm of water left in the soil. Saskatchewan on the other hand, has on average 25 to 75 mm of moisture left in the soil profile. The highest values occur in the Moose Jaw - Regina regions, which incidently, also have the highest available water holding capacities. At the same time the lowest average moisture values are associated with the lowest available water holding capacity soils (i.e. Davidson - Guernsey districts). Consequently, the highest average plant moisture stress values at maturity (-200 to -225 mm) are in the east central region of the Saskatchewan (Davidson, Nokomis, Semans, and Fort Qu'Applle) (Figure 35). In Manitoba average stress levels range from -50 mm in the Winnipeg, Gimli, Selkirk, Steinbach, and Marquette districts, to -100 to -125 mm in western areas of the province (i.e. Pierson, Melita, and Brandon). In the western regions of Manitoba and in almost all areas of Saskatchewan, stress levels of that magnitude make it virtually impossible to obtain high quality and/or quantity of grain corn.

The last two maps under a corn crop illustrate the growing season accumulation of precipitation and actual evapotranspiration (A.E.) (Figure 36, 37). The growing season is defined as the period extending from the planting date to maturity according to the number of accumulated growing degree days above base 10°C. It is quite evident from both maps that there exists a west to east trend in both parameters. Generally speaking

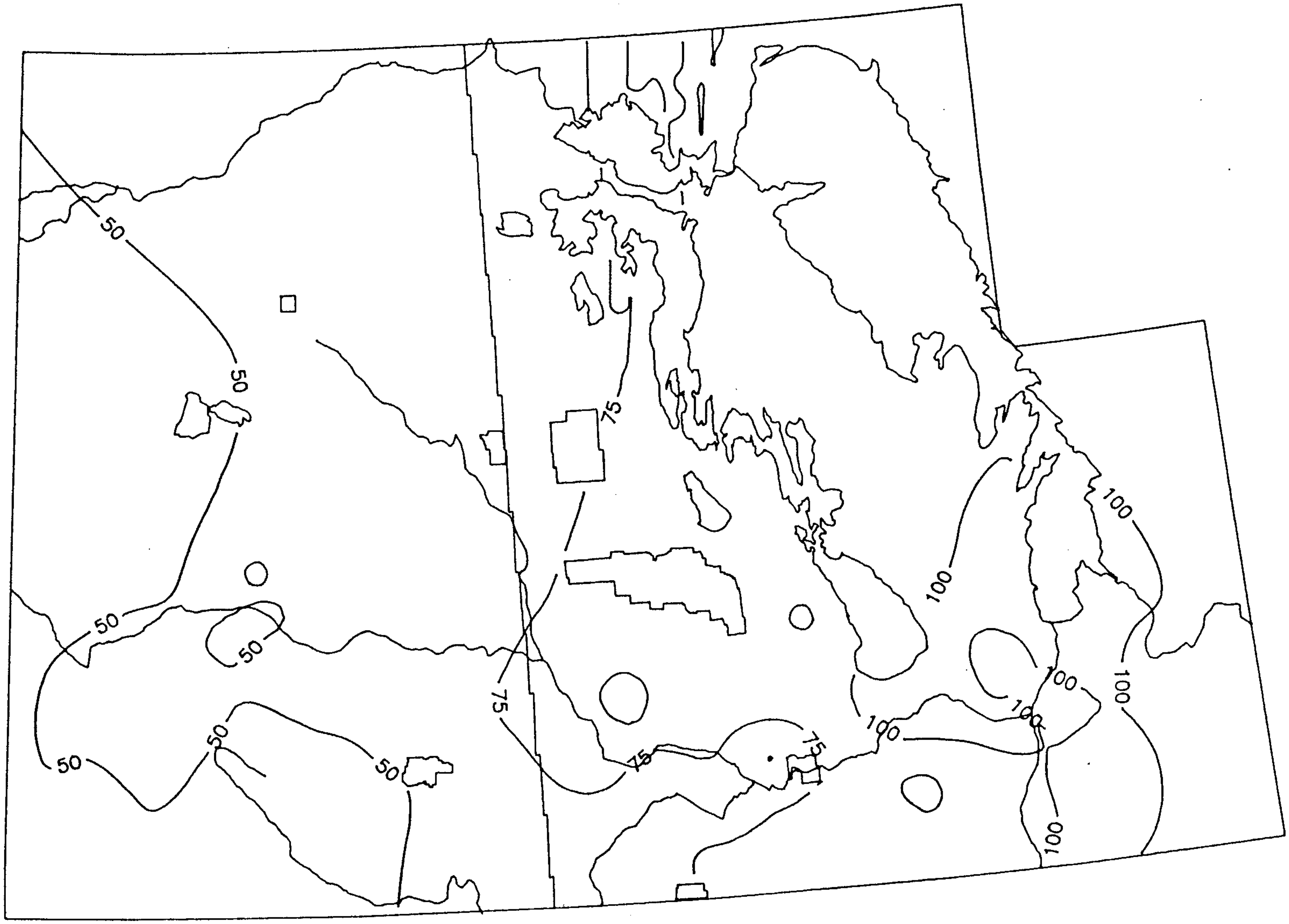


Figure 34: Average Soil Moisture Amounts at the Grain Stage of Corn (mm)

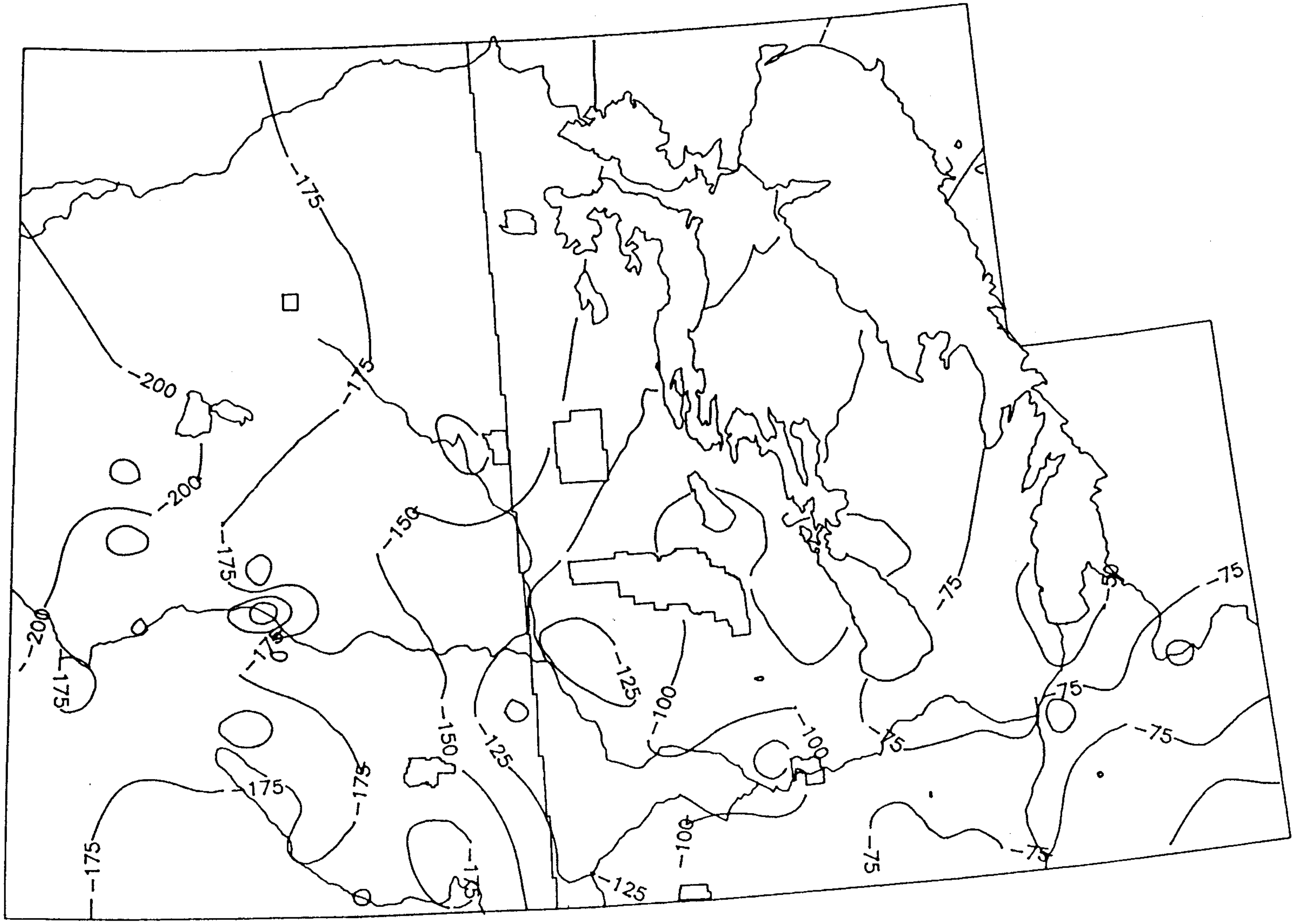


Figure 35: Average Plant Moisture Stress Amounts at the Grain Stage of Corn (mm)

the average accumulated A.E. rates are lower in Saskatchewan (210 - 310 mm) than in Manitoba (250 - 350 mm) (Figure 37). This is directly related to the soil type/texture, with high available water holding capacities enabling large estimated actual evapotranspiration rates (e.g. Red River Valley). The highest average accumulated growing season precipitation occurs in the Sprague - Indian Bay region (300 - 325 mm) (Figure 36). Most other areas of the province on average experience 200 - 300 mm of growing season precipitation, with this amount decreasing in a westerly direction. The decline of average growing season precipitation continues in a westerly direction through Saskatchewan, where 150 - 250 mm fall on average.

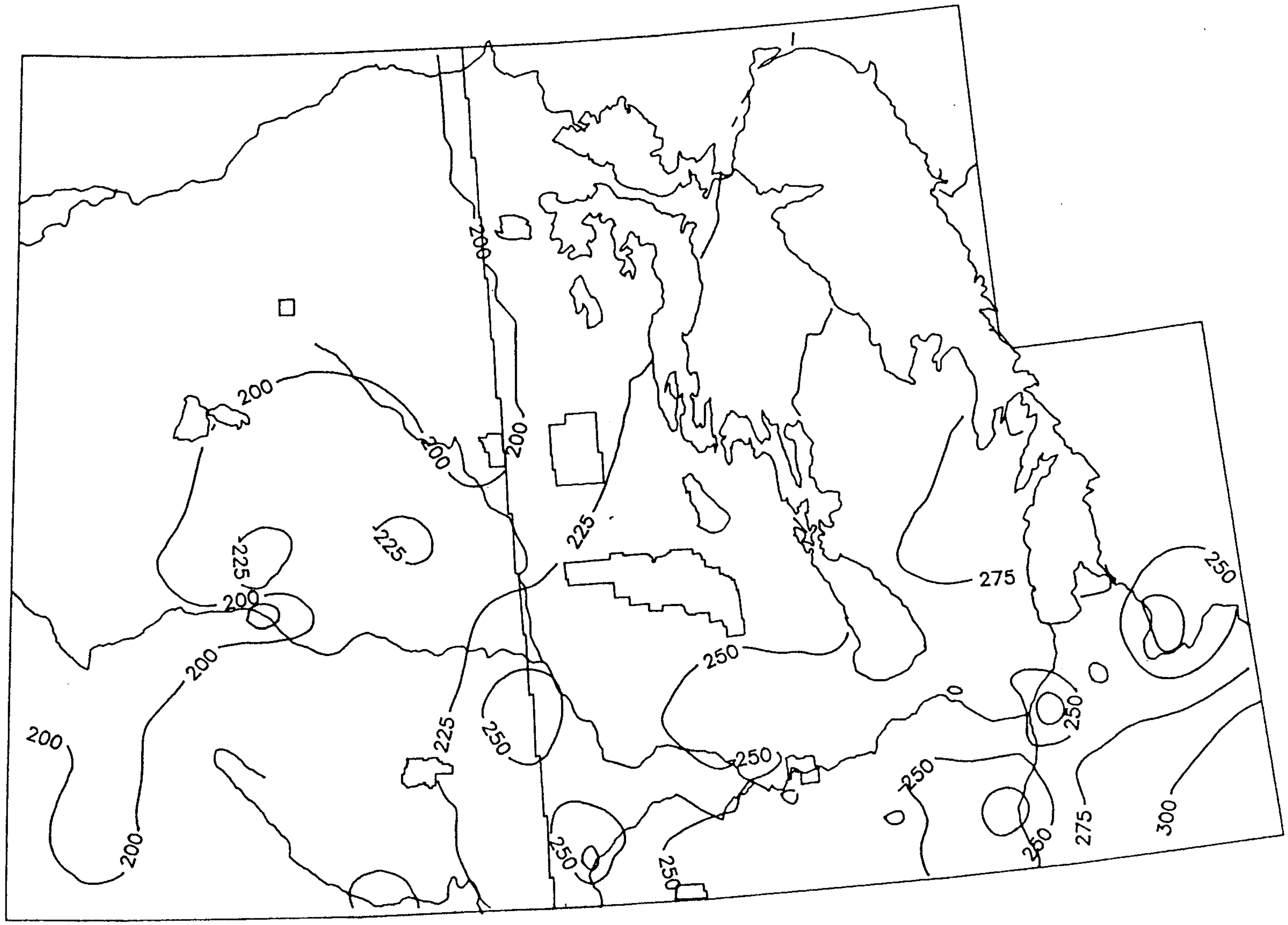


Figure 36: Average Accumulated Growing Season Precipitation for Corn (mm)

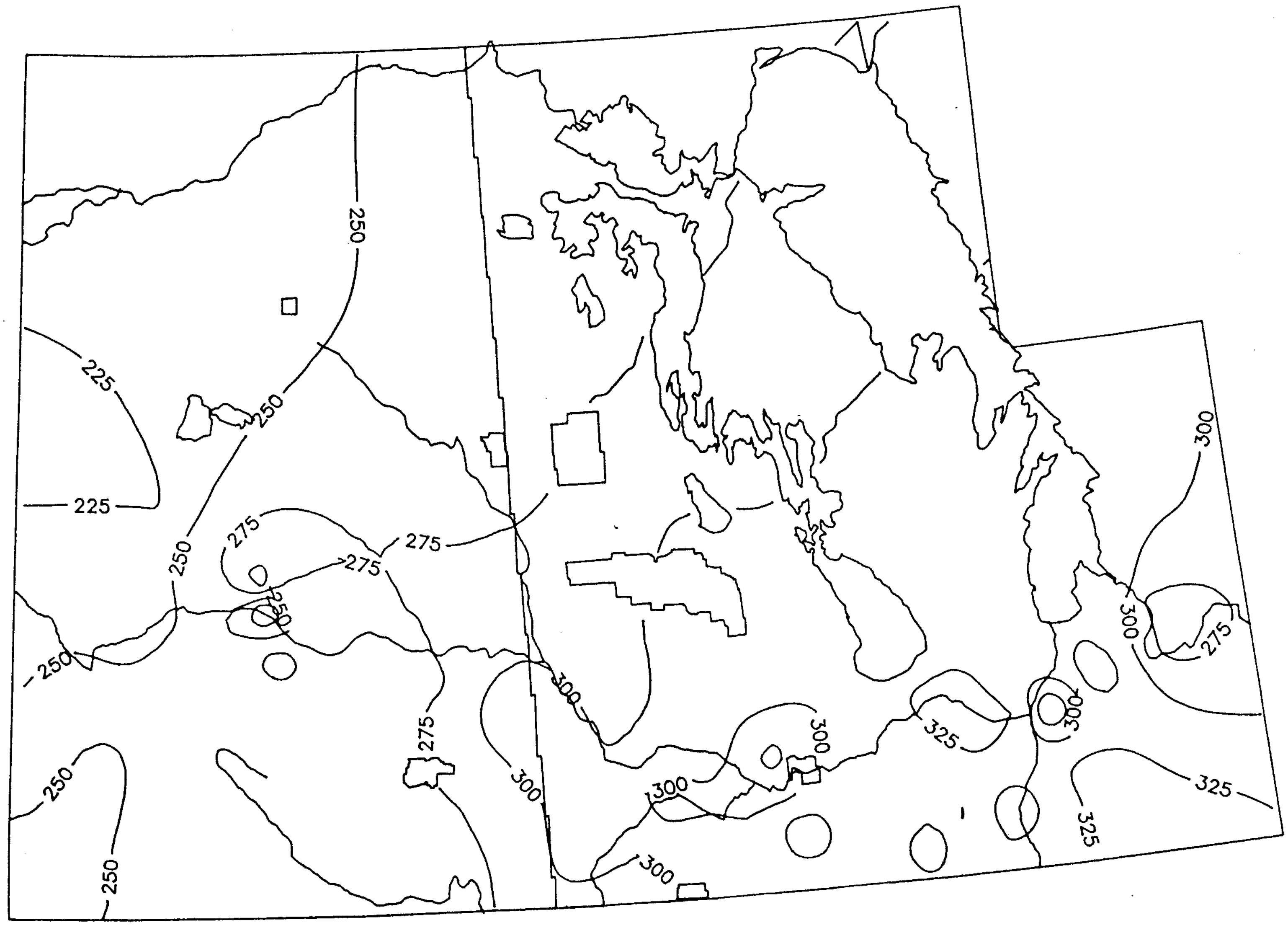


Figure 37: Average Accumulated Growing Season Actual Evapotranspiration for Corn (mm)

4.3.2.3. Moisture Results Under a Alfalfa Crop

Soil moisture analyses and results under a forage crop are spatially similar to that of wheat and corn crops. The driest regions are east central Saskatchewan (Davidson, Humboldt), with the most favourable regions occurring in the Red River Valley. Since perennial forage crops essentially assume complete ground cover throughout the entire growing season, the water used by these crops was much higher than that of annual grains (i.e. wheat, corn). In fact, the water used by perennial forages was approximately equal to the potential evapotranspiration rate for the entire growing season. Therefore an adequate supply of moisture throughout the entire growth phase is critical for successful production.

At the first cut of alfalfa (550 G.D.D. above 5°C) (Figure 38), the average soil moisture reserves are at critically low levels in all regions of the two provinces. Saskatchewan is substantially drier with only 50 mm of soil moisture on average. The amount of soil moisture increases slightly in a easterly direction and reaches levels of 100 mm in the Steinbach, Seven Sisters, and Selkirk areas. The average plant moisture stress at the first cut of alfalfa (Figure 39) varies between -25 mm in eastern Manitoba to over -100 mm in central regions of Saskatchewan. Within Manitoba the average plant moisture stress increases from -25 mm in the Great Falls, Winnipeg districts, to over -75 mm in the Pierson - Melita areas. This implies that on average, 25 to 100 mm of irrigation are necessary to sustain maximum alfalfa production.

After the second cut of alfalfa (1100 G.D.D. above 5°C), the average soil moisture amounts are considerably lower than at the first cut (Figure 40). On a provincial basis, soil water reserves have been further

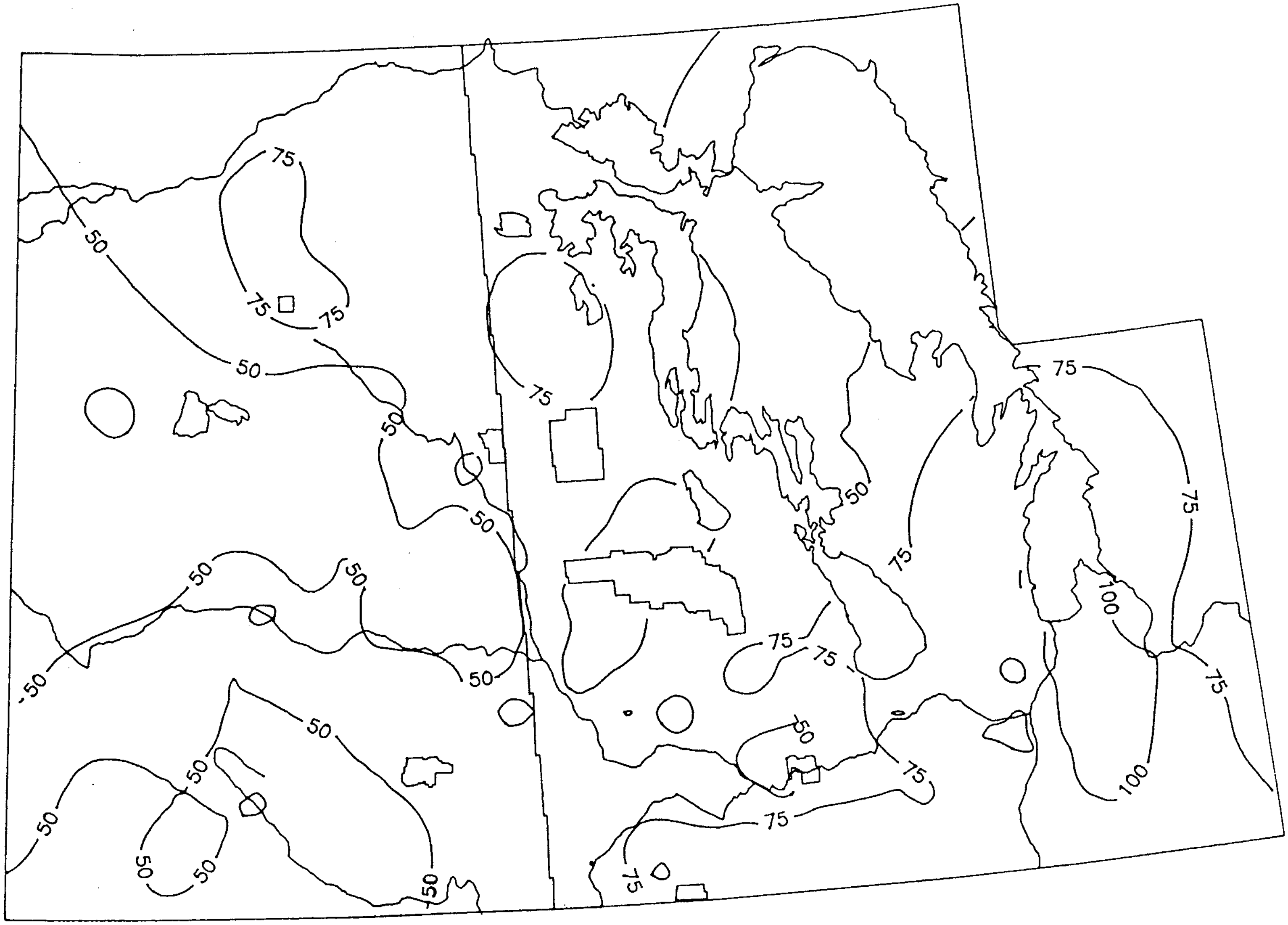


Figure 38: Average Soil Moisture Amounts at the First Cut of Alfalfa (mm)

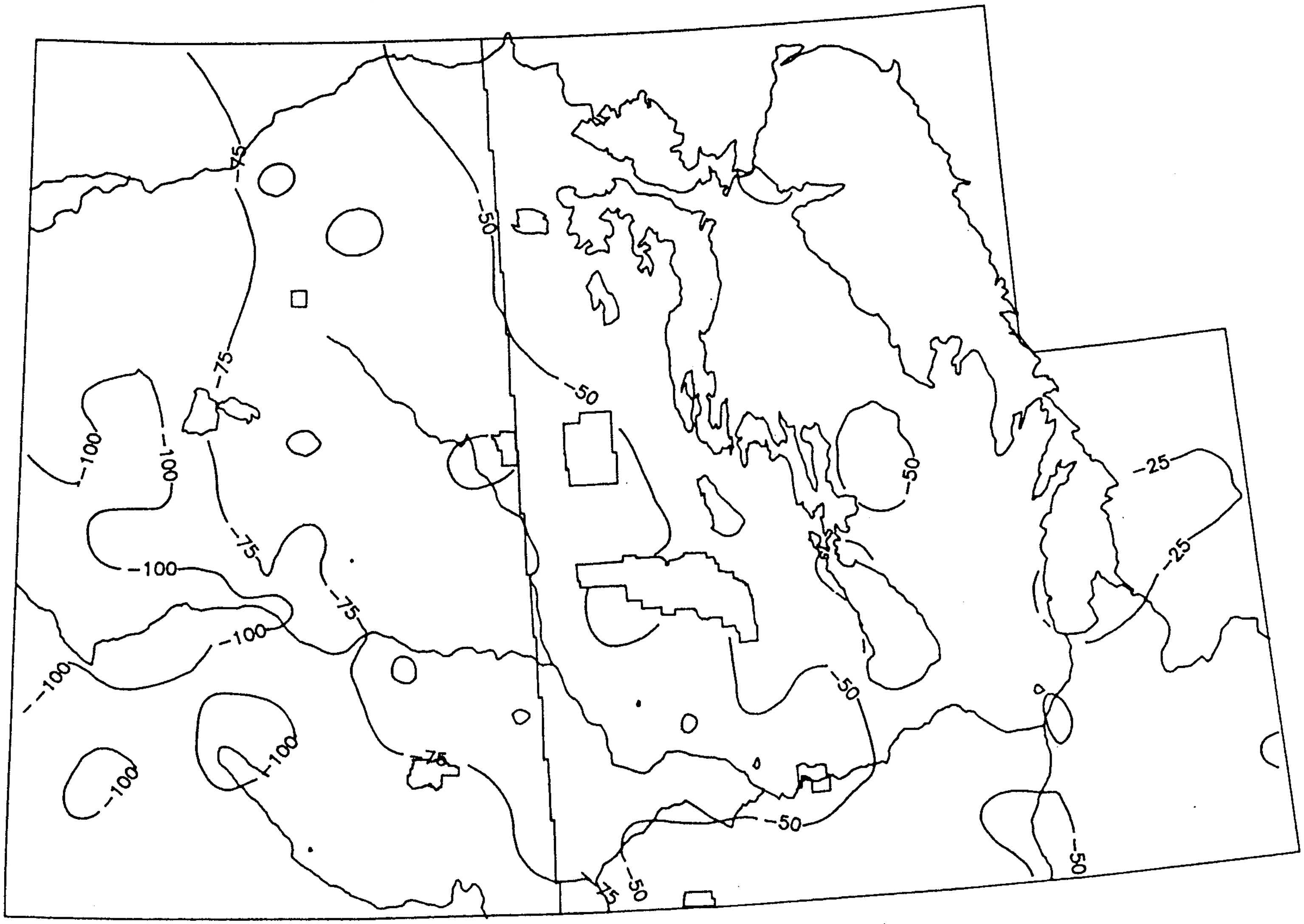


Figure 39: Average Plant Moisture Stress Amounts at the First Cut of Alfalfa (mm)

depleted by an average of 25 mm in Saskatchewan. In Manitoba soil moisture reserves are further reduced by 25 to 75 mm in some cases. Since this map (Figure 40) represents maturity, it illustrates the lowest reserves of soil moisture that are encountered within an average growing season; where all regions of the two provinces have only 25 to 75 mm of soil moisture remaining.

By the second cut of alfalfa, the average plant moisture stress levels (Figure 41) have substantially increased in all regions. The map demonstrates that in most regions of Saskatchewan and south western Manitoba, a harvest of a second crop of alfalfa would be very small unless substantial moisture could be supplied. A total of 150 to 275 mm of water is required to eliminate average plant moisture stress within these regions. The rest of Manitoba on the other hand, requires an average of 75 to 150 mm of additional water. Even with plant moisture stress levels at these values, severe limitations on production would occur. Therefore the probability of obtaining a yield of quality and quantity after the second cut of alfalfa is very low for most regions on the Eastern Prairies.

The final map of soil moisture conditions depicts the average conditions under a perennial forage on October 31 (Figure 42). After the second cut of alfalfa, crop water use was reduced substantially from the potential evapotranspiration rate (i.e. 70%). Consequently, the soils have had a chance to recharge some of moisture lost during thegrowing season. There is on average, an increase in soil moisture reserves across the two provinces (25 to 75 mm increase). However, the central and southern regions of Saskatchewan and southwest Manitoba still remain at

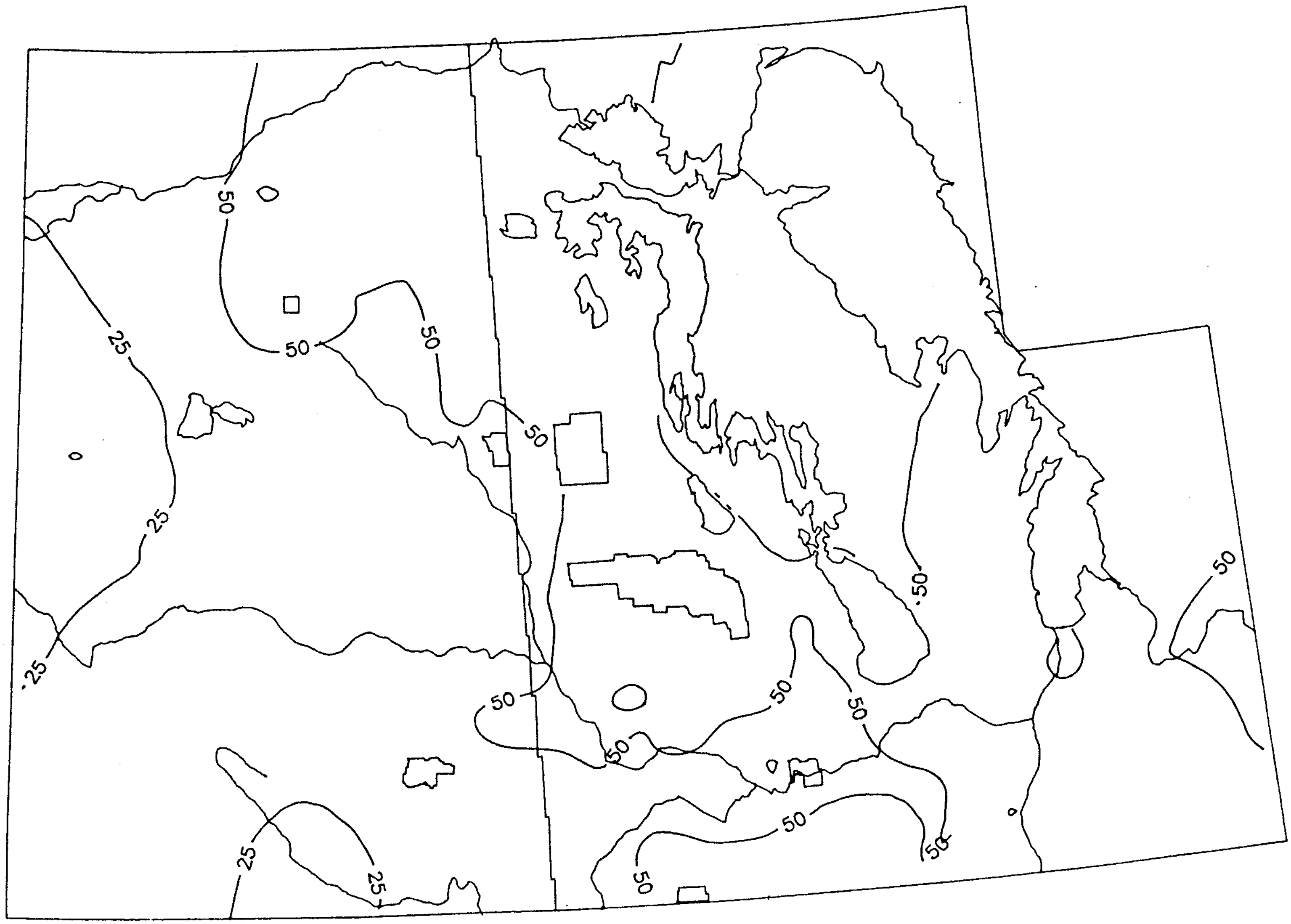


Figure 40: Average Soil Moisture Amounts at the Second Cut of Alfalfa (mm)

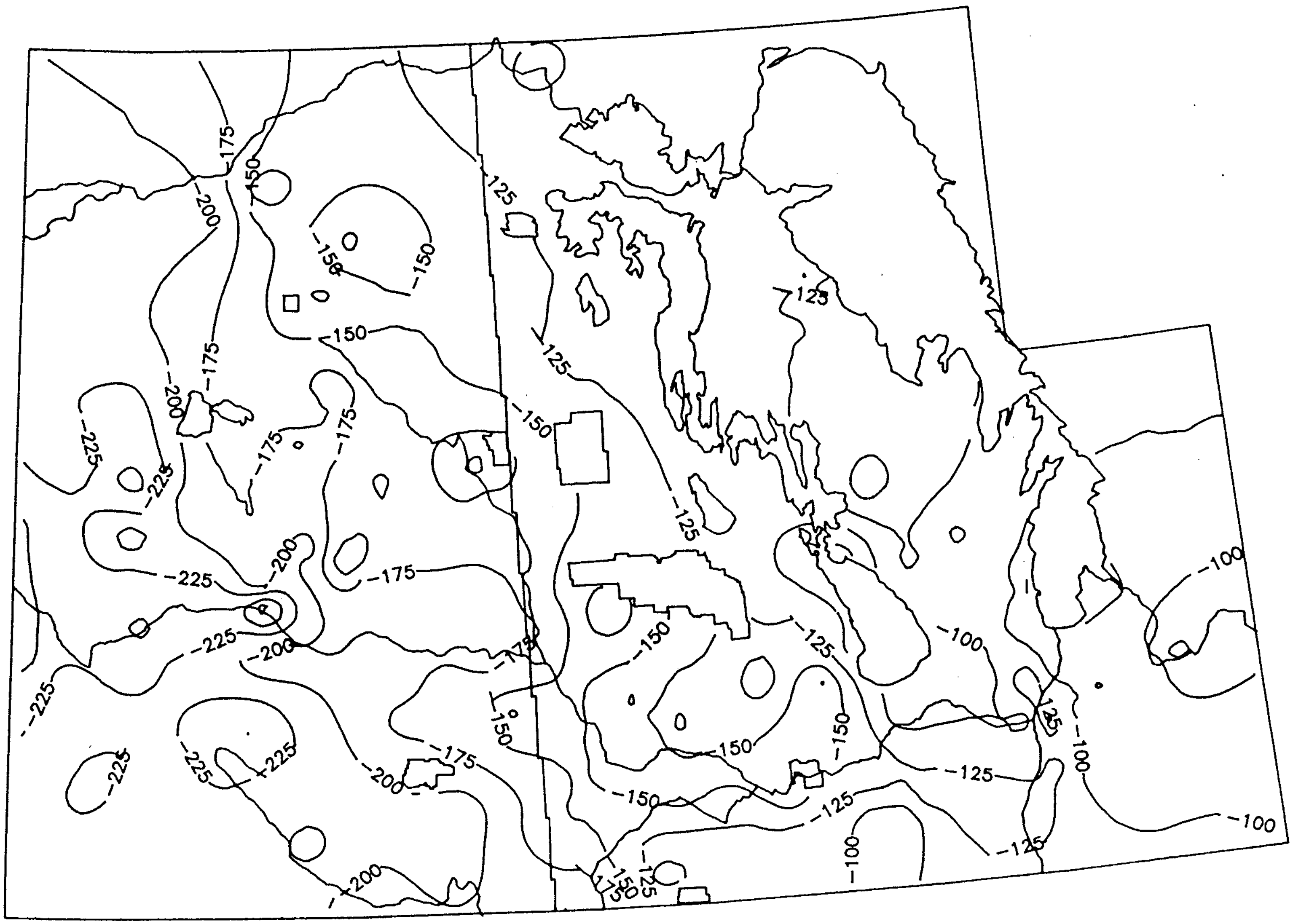


Figure 41: Average Plant Moisture Stress Amounts at the Second Cut of Alfalfa (mm)

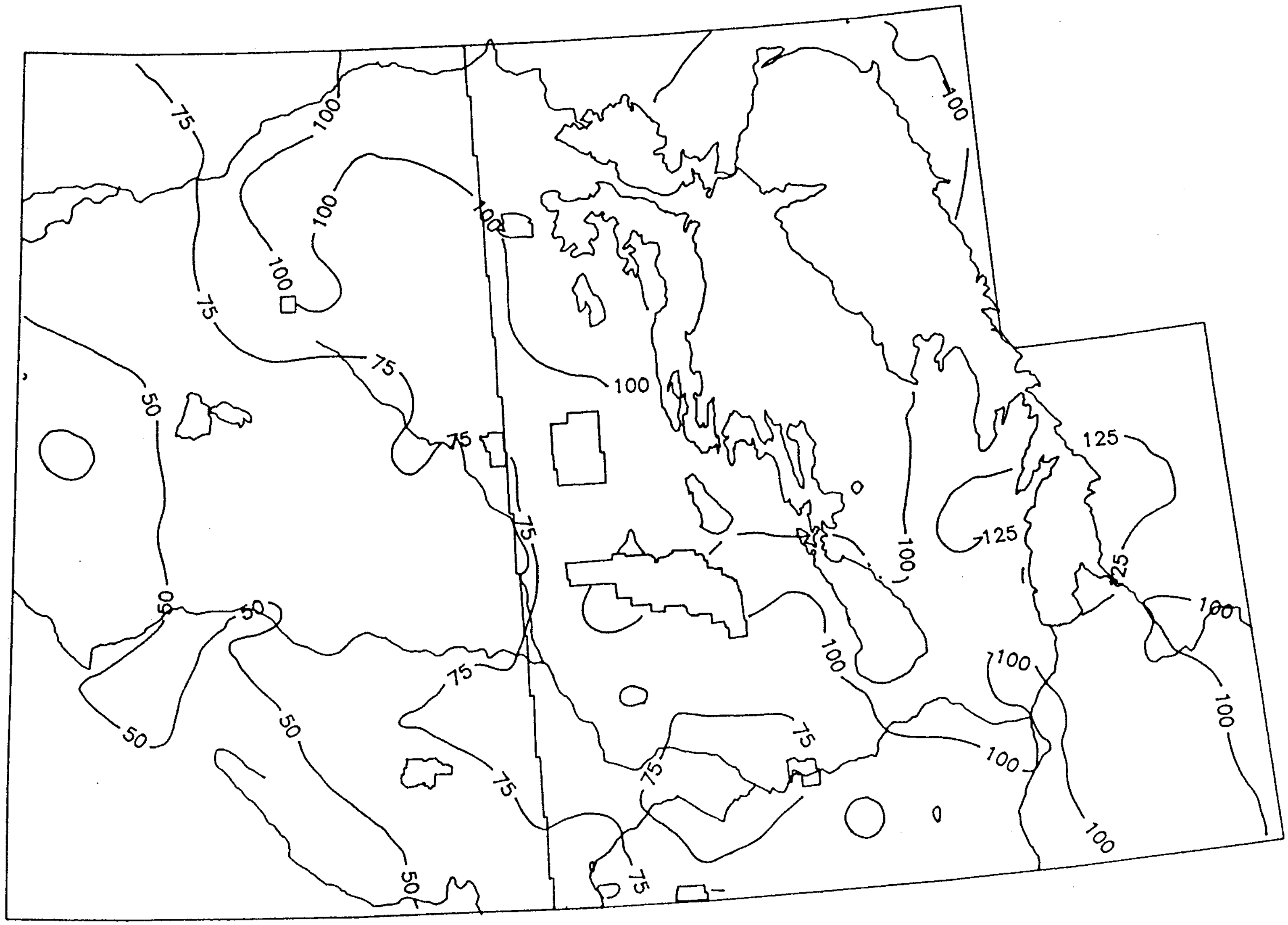


Figure 42: Average Soil Moisture Amounts on October 31 for Alfalfa (mm)

low moisture levels. This in turn, implies limitations on forage production in the next average growing season.

The last two maps to be examined are average actual evapotranspiration and precipitation accumulated to the second cut of alfalfa (Figure 43, 44). The average actual evapotranspiration (A.E.) rates for the growing season demonstrate that 225 to 350 mm of water are required by the crop across the two provinces (Figure 43). The rate of A.E. is of course dependent upon a number of meteorological factors, but primarily upon the soil type/texture characteristics. The higher available water holding capacity soils are able to free up more of the moisture for crop demand, and as a result these soils have larger average A.E. rates. In conjunction with this map, average growing season precipitation for alfalfa must be considered (Figure 44). As might be expected, the lower precipitation rates (150-175 mm) occur in central and southern regions of Saskatchewan. The average values for Manitoba range from 175 to 250 mm in the Sprague, and Hodgson - Arborg districts. Simple subtraction demonstrates (350 A.E. - 250 precip.=125 mm) that an average of 75 to 125 mm of water were derived from the soil's moisture reserve. Applying a risk (10%, 25%) to these values (precipitation and A.E.), results in even lower soil moisture reserves for any year. The probability of obtaining a yield of quality and quantity then becomes even more dismal at the two risk levels (please see Appendix B).

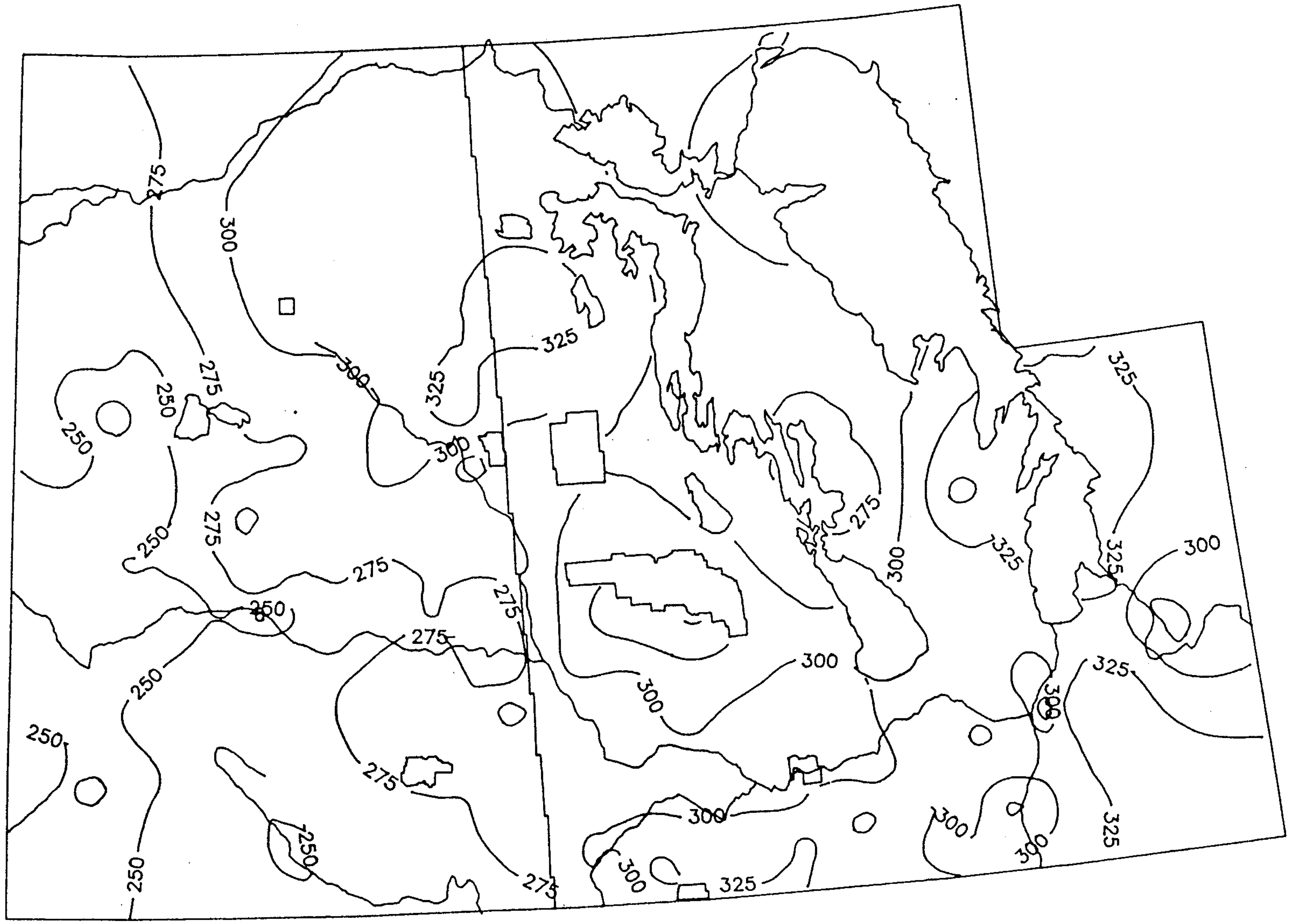


Figure 43: Average Accumulated Actual Evapotranspiration to the Second Cut of Alfalfa (mm)

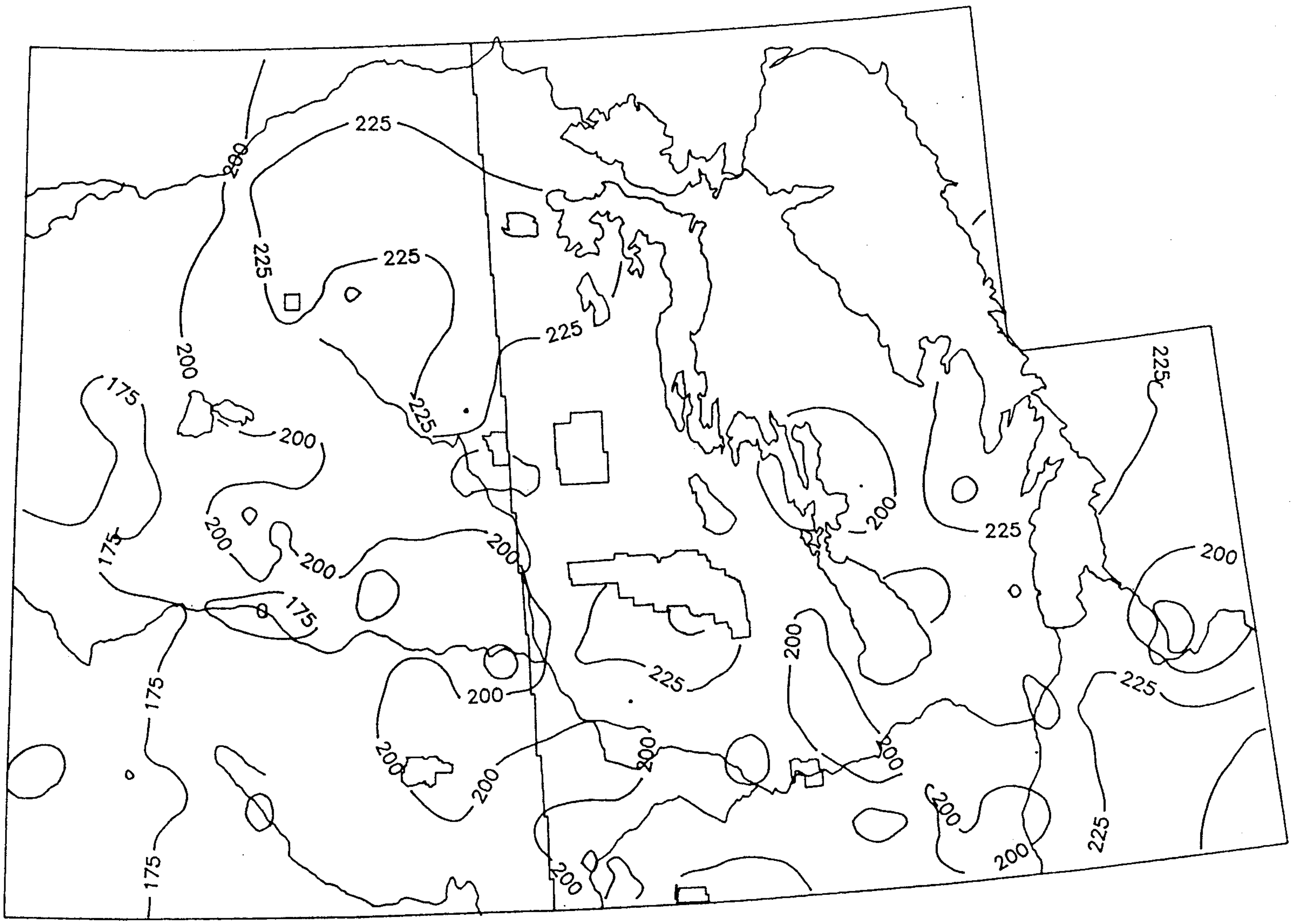


Figure 44: Average Accumulated Precipitation to the Second Cut of Alfalfa (mm)

# Chapter V

## Summary and Conclusions

### 5.1. Summary

The current research represents a continual step in the quantitative assessment of the spatial distribution of Southern Manitoba's and Southeastern Saskatchewan's agroclimatic resource base. To accomplish this, the research undertaken was an historical investigation of agricultural risks and/or potentials as they apply to the thermal and moisture conditions encountered on the Eastern Prairies. The current trends in agrometeorological events has re-emphasized the dependency of agriculture upon the soil - plant - atmosphere continuum. It is still the soil and climate resources of the Eastern Prairies that control; 1) the year to year production potential of crops, and 2) the land management and conservation practices that maximize production. Therefore, as was stated in the introduction, " In the short term it is the year to year fluctuation in weather that contribute to changing production levels, aggravate price and market stabilization problems, increase economic disparity of farmers, and influence the need for government assistance to farmers in financial distress " (Bootsma and DeJong 1988b). Consequently, a study of this nature renders important information that has a practical significance to reviewers of risks associated with agricultural systems on the Eastern Prairies.

Based on the agroclimatological analyses in this research, a number of general conclusions can be drawn about the Eastern Prairies and their potential for agricultural production. The discussion will centre around identifying broad agroecological areas and the magnitudinal differences from region to region as they pertain to the thermal and moisture conditions found on the Eastern Prairies.

The first of the thermal conditions, occurrence of the last spring frost of 0°, and -2.2°C, demonstrates a large spatial and temporal variation in the Eastern Prairies; where Days 140 to 160 (May 20 - June 9) and Days 130 to 145 (May 10 - May 25) characterize the average occurrence of the last spring frost at each base temperature, respectively. The southern end of the Red River Valley and a small local area around Vogar within Southern Manitoba, and another region in south central Saskatchewan enjoy the earliest occurrence of the last spring frost at each base temperature (Day 140 - 145 at 0°C, Day 130 - 135 at -2.2°C). Within Saskatchewan a northeast trend in a later occurrence of the last spring frosts is evident, where an area in east central Saskatchewan has the latest occurrence of the last spring frost at any risk level. In Southern Manitoba it is difficult to identify any north - south or east - west trend in the latest occurrence of the last spring frost at any risk level. Generally, three broad regions can be identified. The first, is in the southeast corner of the province, while another region is in the western part of the province around Riding Mountain National Park, and finally, the last district is located in the central Interlake region.

The average date of occurrence of the first fall frost at both base thresholds (0°, -2.2°C) ranged from Day 225 to 265 (Aug. 23 to Sept. 22) or Day 255 to 275 (Sept. 12 to Oct. 2) respectively. While the occurrence of the first fall frost follows closely the same spatial patterns as the spring frost, there are however, a few differences. Most of the Red River Valley enjoys a late occurrence of the first fall frost, along with three small areas in western, eastern, and the Interlake regions of the province (Day 260 - 265 at 0°C or Day 270 - 275 at -2.2°C). Within Saskatchewan all areas in the Southcentral region enjoy the latest occurrence of the first fall frosts (Day 250 - 255 at 0°C or Day 260 - 265 at -2.2°C). The earliest occurrence of the first fall frost at both thresholds or at any risk level is spatially similar to the latest occurrence or the last spring frost.

Resulting from early spring and late fall frosts in the aforementioned areas, the subsequent frost-free period at both base temperatures is longest in these general regions. The average length of the frost-free period above 0°C ranges from 115 to 125 days, where for the frost-free period above -2.2°C the average length ranged from 135 to 140 days. The shortest length of the frost-free period at both base thresholds (0°, -2.2°C) is 65 - 75 days and 105 - 110 days respectively. Generally, the length of the frost-free period at both base temperatures and at any associated risk level decreases as one proceeds in a northeasterly direction through the two provinces.

The average accumulation of heat over a growing season, in this research, was expressed by growing degree-days and corn heat units. On the Eastern Prairies, 2300 to 2500 corn heat units (C.H.U.'s) are required for successful grain corn production, while 2100 - 2200 are desirable for silage corn. Across the two provinces the average accumulated C.H.U.'s varies from 1900 to 2700, while at a 10% risk these values vary from 1600 to 2400 C.H.U.'s. From the results of a 1 in 10 year risk, it is obvious that silage and grain corn production are seriously hampered in many regions of the Eastern Prairies. Generally, at a 10% risk there are two small areas within Southern Manitoba (2300 to 2400 C.H.U.'s) and for that matter on all of the Eastern Prairies, that are adequate for grain corn production. These are the southern end of the Red River and Pembina Valleys. All areas south of Lake Winnipeg, Manitoba and Riding Mountain National Park exhibit adequate average thermal conditions for the growth and development of corn. Within Saskatchewan the south central regions of the province exhibit adequate average thermal conditions for the growth of corn (2300 - 2400 C.H.U.'s). The number of corn heat units generally decreases in a northeasterly direction, with the lowest accumulations occurring in east central Saskatchewan (1900 C.H.U.'s on average). Within Southern Manitoba the poorest thermal conditions for the growth of corn occurred in the same areas as the shortest frost-free periods (i.e. southeast, western, and central Interlake regions). All three of the regions received 1900 to 2200 C.H.U.'s on average.

Growing degree-days above base 5°C demonstrate similar spatial patterns as those indicative of corn heat units, where most regions receive sufficient heat for the successful growth of cereals and oilseeds at any risk level. On average, the accumulated number of growing degree-days above 5°C in the aforementioned areas ranges from 1300 to 1800, while at a 1 in 10 year risk the values varied from 1150 to 1600.

It was also demonstrated that large variability levels exist in readily available soil moisture and plant moisture stress amounts at any phenological stage of the three crops. This is directly related to soil type/texture and the amount of growing season precipitation. Generally as one proceeds in a westerly direction, the average growing season precipitation decreases. The highest amount of precipitation is found in

Eastern Manitoba, where 225 - 250 mm fall over the average growing season for a wheat crop. Through the rest of the province 200 - 225 mm fall on average over the growing season. Proceeding in a westerly direction through Saskatchewan, growing season precipitation becomes further reduced to 170 - 200 mm on average. This reduction in precipitation is also coupled with the fact that most of Saskatchewan has a lower soil water holding capacity than that of Manitoba. The results are twofold in nature where most regions of Saskatchewan are subject to: 1) higher levels of plant moisture stress, and 2) lower levels of available soil moisture, at any phenological stage of the three crops. Depending on the type of crop and the stage of phenological development, average plant moisture stress values can range from -25 to -225 mm of water. In other words, 25 to 225 mm of water are required to eliminate plant moisture stress which results in yield reductions on the Eastern Prairies. Available soil moisture levels also demonstrate similar fluctuations (25 - 250mm) in readily available moisture, depending on the phenological stage and type of crop. Overall, the Red River Valley once again exhibits the highest potential for cereal and forage production on the bases of moisture indices. The driest soil and highest plant moisture stress levels are found in west central Saskatchewan for any of the three crop types.

Another component of the research was the characterization of growing season actual evapotranspiration for a wheat, corn, and alfalfa crop. Depending on the crop type and soil type/texture condition, an average of 225 - 325 mm of moisture are used yearly. The higher values (275 - 325mm) are found in regions with higher growing season precipitation rates and favourable soil type/texture conditions (i.e.

Eastern Manitoba). Lower rates of actual evapotranspiration, 225 - 250 mm, were found in regions with the opposing conditions, i.e. west central Saskatchewan.

From the above discussion, some general comments can be surmised about the suitability and production potential of the Eastern Prairies for agriculture. When considering moisture limitations, the regions centred around Humboldt, Nokomis, Lumsden, and Cardrose experience the highest amount of plant moisture stress and the lowest available soil moisture. The production potential of any crop is therefore limited within these regions. On the other hand, the Red River Valley is endowed with some of the best soil moisture conditions on the Eastern Prairies. For this reason and for soil type/texture conditions, the Red River Valley has a high flexibility for crop production. Not only is it well suited for production based on soil moisture conditions, it also enjoys some of the highest accumulations of heat, and longest frost-free periods to be found anywhere on the Eastern Prairies. In general, four areas (i.e. Pelly - Prairie River, Wasagaming, Hodgson, and Sprague) within the two provinces have severe thermal limitations, and therefore are limited in crop flexibility and production potential. To fully assess the agroclimatic suitability/potential of the region, the area should be evaluated on the specific thermal and moisture requirements of the crop in question, i.e. the use of appropriate figures and tables in this research.

## 5.2. Recommendations and Directions for Future Research

Within the general field of agroclimatology/meteorology, continual and new research is required to meet the demands placed on agriculture production today. Along with achieving higher levels of production, the development of agriculture must also strive to achieve less environmental damage than is apparent today. This twofold goal has often been discussed under the heading of 'Sustainable Agriculture' (Crosson and Rosenberg 1989). To achieve sustainable development in agriculture, a number of infrastructures and support policies must be implemented and ongoing, in a number of institutions, organizations, and industries. As stated by Clark (1989:4), " In a millennia since our species emerged, it has colonized the planet exuberantly. Can we summon the intelligence to understand the biological and physical systems of which we are a part, so that we can pursue economic growth and development in ecologically sustainable ways? "

Agroclimatology/meteorology is an integral component of all the natural resource and environmental strategies, i.e. land/soil management, water conservation, and cropping systems. The first of these, land management, is closely related to agroclimatology since the value of a piece of land is closely related to its climate. In addition, strategies adopted for land conservation (protection from water and wind erosion) are highly dependent upon soil - climate relationships. Presently on the Eastern Prairies there are a number of regions which are under utilized, while others are over utilized with respect to soil - climate regimes (Dumanski 1988). On the Eastern Prairies it has been documented that production on the Black Chernozemic soil has yet to reach its full potential. With regards to this research, these soils are mainly found in Southern Manitoba and in Eastern Saskatchewan. On the other hand some soils, i.e. Brown and Dark Brown Chernozemic soils of central Saskatchewan, have been over utilized, and therefore should be used at a lower intensity with respect to their soil - climate potential (Dumanski 1988).

Closely related to, and highly dependent upon land/soil management, is water conservation. Soil and climate relationships also dictate the crop's moisture needs as well as the rate of fertilization and trash management strategies of moisture conservation. As a result, water conservation through land management practices, developed in part by agroclimatic analyses, are critical for sustainable agriculture on the Eastern Prairies. Dumanski (1988) concludes that, " In all regions of the prairies, there is considerable potential for more balanced soil water management in relation to crop needs, improved crop husbandry, and improved fertilizer and crop residue management." These areas of improvement offer the field of agroclimatology/meteorology many areas of new and continual research, i.e. research into the effects of moisture stress on crop yield and development, as well as the effects of excess moisture on spring and fall field workdays.

The final major area of research in agroclimatology/meteorology deals with cropping systems. Cropping systems are an integral part of research in the field of agroclimatology since climatic limitations restrict which crops can be grown in a specific region. Defining crop systems based on thermal and moisture restrictions will allow a suitable crop rotation system to be established for each particular region. This creates spin-off benefits for integrated pest management systems. When growing different crops within the same field or rotating them regularly, pests such as weeds, insects, and pathogens have a difficult time in adapting themselves to the changing environmental conditions of the host (crop). Therefore, the population dynamics of the pests are naturally kept in check without the use of pesticides or herbicides. This has a number of environmental benefits (i.e. less ground water contamination) and is one of the major aims of the integrated pest management systems. In summary, agroclimatology is becoming a more vital part of all natural resource and environmental strategies.

These new and old land management strategies and environmental concerns offer the field of agroclimatology many directions for future research. Systematic and quantitative analyses into the relationships of crop growth, development, yield, and environmental degradation against selected thermal and moisture thresholds are needed for sustainable agriculture on the Eastern Prairies. Regional climatic studies are continuously needed since the fluctuating nature of the atmosphere dictates current re-evaluations of the agro-climatic potential and/or resources of a region (Dunlop 1981). The research presented in this thesis represents a continual step in the quantitative and systematic analysis of the climatic suitability of Southern Manitoba and Southeastern Saskatchewan for the purpose of agriculture production and sustainability.

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Appendix A
Climatological and Synoptic Stations Utilized.

Table A1. Climatological and Synoptic Stations: Years of Recording, Elevation, Latitude, Longitude, Crop District, and Soil Water Holding Capacity.

| Station: Number | Years of Record | Name | Prov. | Elev. (ft.) | Lat. | Long. | Crop District <77 >77 | Soil Water Holding Capacity (mm) |
|---|---|---|---|---|---|---|---|---|
| 4010150 | 1970-1988 | AMULET | SASK | 2338 | 49,37 | 104,44 | 23,23 | 200 |
| 4080262 | 1970-1988 | ARRAN 23N | SASK | 1450 | 52,12 | 101,38 | 28,28 | 200 |
| 4080260 | 1957-1971 | ARRAN | SASK | 1476 | 51,58 | 101,44 | 28,28 | 200 |
| 4070365 | 1968-1988 | AYLSHAM | SASK | 1188 | 53,12 | 103,48 | 31,31 | 250 |
| 4010400 | 1953-1988 | BANGOR | SASK | 1745 | 50,51 | 102,14 | 27,27 | 150 |
| 4010880 | 1938-1965 | BROADVIEW | SASK | 2034 | 50,15 | 102,32 | 22,22 | 200 |
| 4010879 | 1965-1988 | BROADVIEW | SASK | 1972 | 50,23 | 102,35 | 22,22 | 200 |
| 4011095 | 1965-1984 | CANORA | SASK | 1604 | 51,38 | 102,24 | 28,28 | 200 |
| 4011120 | 1953-1982 | CARDROSS | SASK | 3000 | 49,49 | 105,39 | 26,26 | 225 |
| 4011280 | 1915-1984 | CARON | SASK | 1841 | 50,27 | 105,53 | 24,24 | 200 |
| 4011160 | 1922-1988 | CARYLE | SASK | 2077 | 49,38 | 102,17 | 21,21 | 200 |
| 4011440 | 1922-1978 | CEYLON | SASK | 2339 | 49,28 | 104,36 | 25,25 | 200 |
| 4011441 | 1978-1988 | CEYLON | SASK | 2480 | 49,24 | 104,39 | 25,25 | 200 |
| 4011846 | 1970-1988 | COTE | SASK | 1526 | 51,31 | 101,48 | 28,28 | 200 |
| 4011980 | 1955-1988 | CUPAR | SASK | 1608 | 50,47 | 104,18 | 27,27 | 250 |
| 4012040 | 1944-1964 | DAFOE | SASK | 1772 | 51,56 | 104,34 | 28,28 | 150 |
| 4012050 | 1973-1988 | DAHINDA | SASK | 2395 | 49,45 | 105,00 | 23,23 | 200 |
| 4012120 | 1922-1988 | DAVIDSON | SASK | 2031 | 51,16 | 105,59 | 29,29 | 150 |
| 4012166 | 1951-1980 | DAVIN | SASK | 2126 | 50,23 | 104,10 | 24,24 | 175 |
| 4012160 | 1951-1969 | DAVIN | SASK | 2172 | 50,23 | 104,06 | 24,24 | 175 |
| 4012300 | 1963-1988 | DUVAL | SASK | 1939 | 51,10 | 104,51 | 29,29 | 150 |
| 4012400 | 1944-1988 | ESTEVAN | SASK | 1857 | 49,04 | 103,00 | 21,21 | 150 |
| 4012483 | 1973-1988 | FENWOOD | SASK | 2051 | 51,09 | 103,04 | 27,27 | 150 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 4012485 | 1969-1988 | FERTILE | SASK | 1676 | 49,20 | 101,27 | 21,21 | 200 |
| 4012560 | 1923-1974 | FOAMLAKE | SASK | 1830 | 51,38 | 103,32 | 28,28 | 150 |
| 4012561 | 1975-1988 | FOAMLAKE | SASK | 1749 | 51,42 | 103,33 | 28,28 | 150 |
| 4012600 | 1911-1973 | FORT QU'APPELLE | SASK | 1594 | 50,47 | 103,48 | 27,27 | 225 |
| 4012720 | 1922-1982 | FRANCIS | SASK | 1978 | 50,07 | 103,50 | 24,24 | 200 |
| 4013040 | 1951-1964 | GEURNSEY | SASK | 1775 | 51,49 | 105,14 | 29,29 | 100 |
| 4013038 | 1973-1988 | GEURNSEY | SASK | 1739 | 51,48 | 105,17 | 29,29 | 100 |
| 4012943 | 1965-1988 | GOOD SPIRIT LAKE | SASK | 1601 | 51,30 | 102,38 | 28,28 | 150 |
| 4013030 | 1883-1982 | GRENFELL | SASK | 1955 | 50,23 | 102,53 | 22,22 | 200 |
| 4013280 | 1908-1971 | HUBBARD | SASK | 2175 | 51,05 | 103,22 | 27,27 | 150 |
| 4083321 | 1978-1988 | HUDSON BAY | SASK | 1175 | 52,49 | 102,19 | 31,31 | 200 |
| 4083320 | 1943-1978 | HUDSON BAY | SASK | 1220 | 52,52 | 102,24 | 31,31 | 200 |
| 4013401 | 1974-1988 | HUMBOLDT | SASK | 1801 | 52,16 | 105,08 | 32,32 | 150 |
| 4013400 | 1879-1974 | HUMBOLDT | SASK | 1864 | 52,12 | 105,07 | 32,32 | 150 |
| 4013480 | 1885-1988 | INDIAN HEAD | SASK | 1922 | 50,22 | 103,40 | 24,24 | 225 |
| 4013490 | 1960-1988 | INDIAN HEAD | SASK | 1919 | 50,31 | 103,41 | 24,24 | 225 |
| 4013640 | 1907-1969 | KAMSACK | SASK | 1444 | 51,34 | 101,54 | 28,28 | 200 |
| 4013660 | 1957-1988 | KELLIHER | SASK | 2218 | 51,15 | 103,44 | 27,27 | 150 |
| 4014040 | 1949-1988 | KIPLING | SASK | 2162 | 50,12 | 102,44 | 22,22 | 200 |
| 4014100 | 1956-1975 | KRISTNES | SASK | 1745 | 51,44 | 103,38 | 28,28 | 150 |
| 4014115 | 1961-1988 | KUROKI | SASK | 1919 | 52,00 | 103,27 | 28,28 | 150 |
| 4014145 | 1959-1988 | LANGENBURG | SASK | 1686 | 50,46 | 101,41 | 27,27 | 150 |
| 4014320 | 1940-1961 | LEROSS | SASK | 2218 | 51,18 | 103,52 | 27,27 | 150 |
| 4084440 | 1926-1968 | LINTLAW | SASK | 2005 | 52,05 | 103,16 | 28,28 | 150 |
| 4014480 | 1947-1988 | LIPTON | SASK | 1988 | 50,55 | 103,50 | 27,27 | 250 |
| 4014481 | 1979-1988 | LIPTON | SASK | 2119 | 51,05 | 103,54 | 27,27 | 250 |
| 4014720 | 1922-1988 | LUMSDEN | SASK | 1631 | 50,39 | 104 52 | 29,29 | 250 |
| 4015045 | 1970-1988 | MARYFIELD | SASK | 1903 | 49,50 | 101,32 | 22,22 | 200 |
| 4015100 | 1956-1980 | MELVILLE | SASK | 1818 | 50,55 | 102,48 | 27,27 | 200 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 4015160 | 1923-1988 | MIDALE | SASK | 1910 | 49,24 | 103,25 | 23,23 | 150 |
| 4015325 | 1929-1954 | MOOSEJAW | SASK | 1965 | 50,23 | 105,42 | 24,24 | 250 |
| 4015320 | 1943-1988 | MOOSEJAW | SASK | 1893 | 50,20 | 105,33 | 24,24 | 250 |
| 4015360 | 1900-1988 | MOOSOMIN | SASK | 1893 | 50,09 | 101,40 | 22,22 | 225 |
| 4015440 | 1904-1988 | MUENSTER | SASK | 1886 | 52,12 | 105,00 | 32,32 | 150 |
| 4075518 | 1973-1988 | NIPAWIN | SASK | 1227 | 53,20 | 104,00 | 31,31 | 225 |
| 4075520 | 1927-1975 | NIPAWIN | SASK | 1175 | 53,21 | 104,01 | 31,31 | 225 |
| 4015560 | 1923-1988 | NOKOMIS | SASK | 1726 | 51,31 | 105,00 | 29,29 | 150 |
| 4015680 | 1951-1988 | ORMISTON | SASK | 2251 | 49,43 | 105,22 | 25,25 | 200 |
| 4015800 | 1949-1988 | OXBOW | SASK | 1877 | 49,19 | 102,07 | 21,21 | 200 |
| 4015960 | 1921-1988 | PASWEGIN | SASK | 1739 | 51,59 | 103,57 | 28,28 | 150 |
| 4086000 | 1951-1988 | PELLY | SASK | 1575 | 52,04 | 101,53 | 28,28 | 200 |
| 4086160 | 1953-1988 | PORCUPINE PLAIN | SASK | 1519 | 52,39 | 103,12 | 31,31 | 250 |
| 4086180 | 1956-1982 | PRAIRIE RIVER | SASK | 1549 | 52,52 | 102,59 | 31,31 | 200 |
| 4016185 | 1970-1988 | PREECEVILLE | SASK | 1686 | 51,58 | 102,37 | 28,28 | 150 |
| 4016322 | 1976-1988 | QU'APPELLE | SASK | 2175 | 50,33 | 103,58 | 24,24 | 200 |
| 4016320 | 1883-1986 | QU'APPELLE | SASK | 2133 | 50,31 | 103,53 | 24,24 | 200 |
| 4016450 | 1966-1988 | RAYMORE | SASK | 1850 | 51,34 | 104,35 | 28,28 | 150 |
| 4016520 | 1950-1973 | REDVERS | SASK | 1949 | 49,35 | 101,42 | 21,21 | 200 |
| 4016522 | 1978-1982 | REDVERS | SASK | 1926 | 49,32 | 101,42 | 21,21 | 200 |
| 4016560 | 1883-1988 | REGINA | SASK | 1893 | 50,27 | 104,37 | 24,24 | 250 |
| 4016640 | 1932-1988 | REGINA | SASK | 1880 | 50,25 | 104,37 | 24,24 | 250 |
| 401FFDB | 1969-1988 | REGINA | SASK | 1880 | 50,25 | 104,35 | 24,24 | 250 |
| 4076790 | 1929-1966 | RIDGEDALE | SASK | 1355 | 53,03 | 104,15 | 31,31 | 250 |
| 4016842 | 1968-1988 | ROCANVILLE | SASK | 1572 | 50,28 | 101,33 | 22,22 | 200 |
| 4017320 | 1923-1988 | SEMANS | SASK | 1850 | 51,24 | 104,44 | 29,29 | 150 |
| 4087640 | 1960-1983 | SOMME EXP. ST. | SASK | 1483 | 52,36 | 103,00 | 31,31 | 225 |
| 4017800 | 1923-1988 | STRASBOURG | SASK | 1798 | 51,05 | 104,57 | 29,29 | 150 |
| 4018508 | 1979-1988 | WAPELLA | SASK | 1873 | 50,27 | 101,56 | 22,22 | 200 |
| 4018506 | 1971-1982 | WAPELLA | SASK | 2001 | 50,10 | 102,08 | 22,22 | 200 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 4018640 | 1953-1988 | WATROS | SASK | 1775 | 51,40 | 105,28 | 29,29 | 175 |
| 4018760 | 1943-1988 | WEYBURN | SASK | 1870 | 49,40 | 103,51 | 23,23 | 200 |
| 4018880 | 1914-1988 | WHITEWOOD | SASK | 1968 | 50,20 | 102,15 | 22,22 | 200 |
| 4018920 | 1952-1988 | WILCOX | SASK | 1896 | 50,06 | 104,43 | 24,24 | 250 |
| 4019007 | 1966-1988 | WISHART | SASK | 2100 | 51,35 | 104,07 | 28,28 | 150 |
| 4019035 | 1939-1988 | WYNYARD | SASK | 1837 | 51,46 | 104,10 | 28,28 | 150 |
| 4019040 | 1911-1988 | YELLOW GRASS | SASK | 1900 | 49,48 | 104,10 | 23,23 | 200 |
| 4019080 | 1941-1988 | YORKTON | SASK | 1634 | 51,16 | 102,28 | 27,27 | 175 |
| 5020040 | 1948-1988 | ALTONA | MAN | 0813 | 49,06 | 097,33 | 05,08 | 225 |
| 5030080 | 1951-1988 | ARBORG EXP ST | MAN | 0746 | 50,54 | 097,13 | 05,12 | 250 |
| 5010140 | 1962-1988 | BALDUR | MAN | 1400 | 49,19 | 099,20 | 02,08 | 225 |
| 5030160 | 1953-1988 | BEAUSEJOUR EXPST | MAN | 0781 | 50,07 | 096,30 | 06,10 | 250 |
| 5010180 | 1956-1977 | BEDE | MAN | 1450 | 49,22 | 100,56 | 01,01 | 200 |
| 5010216 | 1973-1988 | BINSCRATH | MAN | 1725 | 50,35 | 101,16 | 10,03 | 225 |
| 5040218 | 1970-1988 | BIRCH RIVER | MAN | 1000 | 52,27 | 100,59 | 14,06 | 250 |
| 5010240 | 1883-1988 | BIRTLE | MAN | 1707 | 50,26 | 101,01 | 10,03 | 225 |
| 5030282 | 1968-1988 | BISSETT | MAN | 0846 | 51,02 | 095,40 | 06,10 | 200 |
| 5030280 | 1933-1952 | BISSETT | MAN | 0846 | 50,58 | 095,38 | 06,10 | 200 |
| 5020320 | 1912-1981 | BOISSEVAIN | MAN | 1680 | 49,14 | 100,03 | 01,01 | 200 |
| 5010480 | 1941-1988 | BRANDON A | MAN | 1337 | 49,55 | 099,57 | 08,02 | 225 |
| 5010485 | 1890-1988 | BRANDON EXP ST | MAN | 1200 | 49,52 | 099,59 | 08,02 | 225 |
| 5030510 | 1970-1988 | BROAD VALLEY | MAN | 0850 | 50,59 | 097,28 | 05,12 | 250 |
| 5010548 | 1962-1987 | CARBERRY | MAN | 1263 | 49,52 | 099,21 | 08,02 | 150 |
| 5010640 | 1904-1988 | CYPRESS RIVER | MAN | 1232 | 49,33 | 099,05 | 08,07 | 200 |
| 5040675 | 1890-1941 | DAUPHIN | MAN | 0957 | 51,09 | 100,02 | 11,06 | 250 |
| 5040680 | 1942-1988 | DAUPHIN A | MAN | 0999 | 51,06 | 100,03 | 11,06 | 250 |
| 5020720 | 1951-1988 | DEERWOOD | MAN | 1110 | 49,24 | 098,19 | 03,08 | 200 |
| 5010761 | 1953-1976 | DELORAINE 2 | MAN | 1750 | 49,10 | 100,24 | 01,01 | 225 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 5040764 | 1967-1988 | DELTA UNIVERSITY | MAN | 0815 | 50,11 | 098,23 | 03,07 | 200 |
| 5020810 | 1962-1988 | DUGALD BRIARWOOD | MAN | 0843 | 49,53 | 096,39 | 05,09 | 250 |
| 5020880 | 1877-1988 | EMERSON | MAN | 0792 | 49,00 | 097,12 | 05,09 | 225 |
| 5040896 | 1978-1988 | ERIKSDALE 1 | MAN | 0897 | 50,52 | 098,08 | 12,12 | 200 |
| 5040895 | 1959-1978 | ERIKSDALE | MAN | 0877 | 50,52 | 098,10 | 12,12 | 200 |
| 5030982 | 1969-1988 | FRASERWOOD | MAN | 0840 | 50,38 | 097,13 | 05,11 | 225 |
| 5040985 | 1934-1988 | GILBERT PLAINS | MAN | 1317 | 51,09 | 100,30 | 11,06 | 250 |
| 5031040 | 1944-1971 | GIMLI A | MAN | 0725 | 50,38 | 097,03 | 12,12 | 225 |
| 5031038 | 1971-1988 | GIMLI | MAN | 0730 | 50,37 | 096,59 | 12,12 | 225 |
| 50410N0 | 1973-1988 | GLADSTONE | MAN | 1237 | 50,11 | 099,18 | 09,07 | 200 |
| 5011051 | 1970-1988 | GLENBORO | MAN | 1225 | 49,34 | 099,22 | 02,08 | 150 |
| 5021054 | 1967-1988 | GLENLEA U RES | MAN | 0769 | 49,39 | 097,07 | 05,09 | 250 |
| 5011080 | 1951-1976 | GOODLANDS EXP ST | MAN | 1654 | 49,11 | 100,35 | 01,01 | 200 |
| 5031111 | 1966-1988 | GRAND RAPIDS | MAN | 0730 | 53,09 | 099,17 | 13,05 | 100 |
| 5031110 | 1960-1979 | GRAND RAPIDS | MAN | 0765 | 53,10 | 099,17 | 13,05 | 100 |
| 5041140 | 1958-1988 | GRASS RIVER | MAN | 0885 | 50,31 | 098,58 | 14,07 | 225 |
| 5021160 | 1925-1988 | GRAYSVILLE | MAN | 0930 | 49,31 | 098,11 | 03,08 | 200 |
| 5031200 | 1922-1988 | GREAT FALLS | MAN | 0816 | 50,28 | 096,00 | 06,10 | 225 |
| 5011240 | 1914-1988 | HAMIOTA | MAN | 1700 | 50,11 | 100,37 | 10,03 | 225 |
| 5011275 | 1966-1983 | HARDING | MAN | 1550 | 50,02 | 100,30 | 10,03 | 225 |
| 5031300 | 1960-1988 | HODGSON | MAN | 0758 | 51,12 | 097,35 | 12,12 | 250 |
| 5031320 | 1915-1988 | INDIAN BAY | MAN | 1072 | 49,37 | 095,12 | 06,10 | 150 |
| 5041530 | 1970-1988 | LANGRUTH | MAN | 0825 | 50,24 | 098,34 | 03,07 | 225 |
| 5041588 | 1970-1988 | LUNDAR 4 SW | MAN | 0825 | 50,40 | 098,07 | 12,12 | 225 |
| 5041684 | 1973-1988 | MACGREGOR | MAN | 0987 | 49,54 | 098,42 | 03,07 | 200 |
| 5021695 | 1969-1988 | MARQUETTE | MAN | 0800 | 50,01 | 097,48 | 04,11 | 250 |
| 5041711 | 1970-1988 | MEADOW PORTAGE | MAN | 0830 | 51,44 | 099,34 | 14,06 | 150 |
| 5011720 | 1936-1960 | MELITA | MAN | 1450 | 49,20 | 101 00 | 01,01 | 150 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5011760 | 1880-1988 | MINNEDOSA | MAN | 1926 | 50,15 | 099,50 | 09,03 | 225 |
| 5041800 | 1910-1966 | MOOSEHORN | MAN | 0820 | 51,18 | 098,37 | 12,12 | 150 |
| 5021840 | 1885-1971 | MORDEN | MAN | 0991 | 49,11 | 098,06 | 03,08 | 200 |
| 5021848 | 1885-1988 | MORDEN | MAN | 1110 | 49,24 | 098,19 | 03,08 | 200 |
| 5021920 | 1883-1987 | MORRIS | MAN | 0778 | 49,21 | 097,22 | 05,08 | 250 |
| 5021975 | 1966-1988 | MYRTLE | MAN | 0825 | 49,24 | 097,50 | 05,08 | 250 |
| 5042000 | 1945-1962 | NEEPAWA A | MAN | 1273 | 50,14 | 099,30 | 09,03 | 225 |
| 5042003 | 1962-1969 | NEEPAWA CSC | MAN | 1210 | 50,14 | 099,28 | 09,03 | 225 |
| 5042005 | 1969-1988 | NEEPAWA WATER | MAN | 1210 | 50,13 | 099,28 | 09.03 | 225 |
| 5022040 | 1885-1978 | NINETTE | MAN | 1363 | 49,23 | 099,37 | 02,01 | 200 |
| 5022043 | 1961-1988 | NIVERVILLE | MAN | 0777 | 49,36 | 097,03 | 06,09 | 250 |
| 5012054 | 1962-1988 | OAKNER | MAN | 1650 | 50,06 | 100,38 | 10,03 | 225 |
| 5022065 | 1961-1988 | PEACE GARDENS | MAN | 2275 | 49,00 | 100,03 | 01,01 | 225 |
| 5012080 | 1904-1988 | PIERSON | MAN | 1538 | 49,11 | 101,14 | 01,01 | 250 |
| 5022125 | 1957-1986 | PILOT MOUND PO | MAN | 1557 | 49,12 | 098,53 | 02,08 | 200 |
| 5032162 | 1963-1988 | PINAWA WNRE | MAN | 0875 | 50,11 | 096,03 | 06,10 | 225 |
| 5032160 | 1915-1951 | PINAWA | MAN | 0850 | 50,13 | 095,55 | 06,10 | 225 |
| 5032164 | 1959-1988 | PINE FALLS PAPER | MAN | 0750 | 50,34 | 096,15 | 06,10 | 225 |
| 5022245 | 1961-1988 | PLUM COULEE | MAN | 0870 | 49,03 | 097,48 | 05,08 | 250 |
| 5042241 | 1970-1988 | PLUMAS | MAN | 0900 | 50,27 | 099,00 | 09,07 | 225 |
| 5042240 | 1951-1970 | PLUMAS | MAN | 0928 | 50,23 | 099,05 | 09,07 | 225 |
| 5012280 | 1904-1971 | PORTAGELAPRAIRIE | MAN | 0857 | 49,58 | 098,18 | 03,07 | 250 |
| 5012322 | 1962-1988 | PORTAGELAPRAIRIE | MAN | 0851 | 49,59 | 098,18 | 03,07 | 250 |
| 5012320 | 1941-1988 | PORTAGELAPRAIRIE | MAN | 0867 | 49,54 | 098,16 | 03,07 | 250 |
| 5022335 | 1967-1988 | RATHWELL | MAN | 1070 | 49,41 | 098,33 | 03,08 | 200 |
| 5012440 | 1938-1970 | RIVERS A | MAN | 1553 | 50,01 | 100,19 | 10,02 | 225 |
| 5022480 | 1951-1980 | ROLAND | MAN | 0875 | 49,25 | 098,00 | 03,08 | 225 |
| 5012500 | 1955-1988 | ROSSBURN | MAN | 1936 | 50,40 | 100,48 | 10,04 | 225 |
| 5012520 | 1883-1988 | RUSSELL | MAN | 1837 | 50,47 | 101,16 | 10,04 | 225 |
| 5022630 | 1963-1988 | SELKIRK | MAN | 0739 | 50,09 | 096,53 | 05,11 | 250 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5032640 | 1950-1970 | SEVEN SISTERS | MAN | 0875 | 50,07 | 096,01 | 06,10 | 225 |
| 5012672 | 1954-1970 | SHILO | MAN | 1253 | 49,49 | 099,39 | 08,02 | 150 |
| 5012710 | 1970-1988 | SOMERSET | MAN | 1626 | 49,27 | 098,37 | 02,08 | 200 |
| 5012720 | 1921-1972 | SOURIS | MAN | 1350 | 49,37 | 100,15 | 07,02 | 200 |
| 5022760 | 1915-1988 | SPRAGUE | MAN | 1072 | 49,02 | 095,38 | 06,10 | 200 |
| 5012540 | 1885-1960 | ST ALBANS | MAN | 1180 | 49,42 | 099,33 | 02,08 | 150 |
| 5022770 | 1962-1988 | STARBUCK | MAN | 0800 | 49,43 | 097,38 | 05,08 | 250 |
| 5022780 | 1956-1988 | STEINBACH | MAN | 0880 | 49,32 | 096,41 | 05,09 | 250 |
| 5022788 | 1959-1988 | STONEWALL | MAN | 0825 | 50,07 | 097,20 | 05,11 | 200 |
| 5022791 | 1972-1988 | STONY MOUNTAIN | MAN | 0775 | 50,07 | 097 09 | 05,11 | 200 |
| 5042800 | 1904-1988 | SWAN RIVER | MAN | 1115 | 52,06 | 101,16 | 13,05 | 250 |
| 5052864 | 1910-1968 | THE PAS | MAN | 0890 | 53,49 | 101,15 | 13,05 | 200 |
| 5052880 | 1943-1988 | THE PAS A | MAN | 0894 | 53,58 | 101,06 | 13,05 | 200 |
| 5012960 | 1890-1988 | VIRDEN | MAN | 1451 | 49,51 | 100,56 | 07,02 | 225 |
| 5043020 | 1966-1988 | VOGAR | MAN | 0819 | 50,55 | 098,45 | 14,07 | 150 |
| 5013117 | 1966-1988 | WASAGAMING | MAN | 2040 | 50,39 | 099,58 | 09,03 | 200 |
| 5013120 | 1924-1985 | WASKADA | MAN | 1540 | 49,02 | 100,45 | 01,01 | 200 |
| 5043158 | 1971-1988 | WILSON CREEK WR | MAN | 1200 | 50,43 | 099,33 | 09,03 | 200 |
| 5023261 | 1960-1988 | WINNIPEG STP | MAN | 0763 | 49,57 | 097,06 | 05,09 | 250 |
| 5023243 | 1872-1939 | WINNIPEG STJOHNS | MAN | 0760 | 49,53 | 097,07 | 05,09 | 250 |
| 5023222 | 1938-1988 | WINNIPEG INTERNL | MAN | 0789 | 49,54 | 097,14 | 05,07 | 250 |

Appendix B
Results of the Agro-Climatic Analyses.

Table B1: Last Spring Frost (0°c)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 134.28 | 9.12 | 146.44 | 140.56 |
| ARRAN | Sask. | 157.57 | 11.87 | 173.13 | 165.67 |
| AYLSHAM | Sask. | 145.60 | 10.71 | 159.82 | 152.97 |
| BANGOR | Sask. | 149.10 | 12.17 | 165.26 | 157.48 |
| BROADVIEW | Sask. | 152.06 | 12.71 | 168.39 | 160.64 |
| CARDROSS | Sask. | 143.96 | 14.73 | 163.40 | 154.05 |
| CARLYLE | Sask. | 149.72 | 12.73 | 166.09 | 158.32 |
| CARON | Sask. | 149.60 | 15.49 | 169.50 | 160.05 |
| CEYLON | Sask. | 144.76 | 12.02 | 160.20 | 152.87 |
| COTE | Sask. | 149.50 | 12.98 | 166.81 | 158.44 |
| CUPAR | Sask. | 150.08 | 12.19 | 166.13 | 158.42 |
| DAFOE | Sask. | 147.42 | 10.55 | 161.46 | 154.68 |
| DAHINDA | Sask. | 140.00 | 11.03 | 154.89 | 147.66 |
| DAVIDSON | Sask. | 145.65 | 11.41 | 160.32 | 153.36 |
| DAVIN | Sask. | 141.00 | 12.15 | 157.13 | 149.36 |
| DUVAL | Sask. | 138.92 | 12.57 | 155.51 | 147.53 |
| ESTEVAN | Sask. | 138.82 | 11.07 | 153.04 | 146.29 |
| FENWOOD | Sask. | 138.27 | 9.92 | 151.61 | 145.13 |
| FERTILE | Sask. | 138.18 | 10.68 | 152.45 | 145.54 |
| FOAM LAKE | Sask. | 151.54 | 11.82 | 166.73 | 159.52 |
| FORT QUAPPELLE | Sask. | 155.62 | 14.40 | 174.57 | 165.47 |
| FRANCIS | Sask. | 155.06 | 12.75 | 171.44 | 163.67 |
| GOOD SPIRIT LAKE | Sask. | 150.74 | 16.47 | 172.50 | 162.04 |
| GRENFELL | Sask. | 150.47 | 13.08 | 167.28 | 159.30 |
| GUERNSEY | Sask. | 141.12 | 11.02 | 155.85 | 148.72 |
| HEWARD | Sask. | 139.71 | 10.46 | 153.84 | 146.97 |
| HUBBARD | Sask. | 152.48 | 12.48 | 168.97 | 161.04 |
| HUDSON BAY | Sask. | 153.09 | 11.59 | 167.98 | 160.91 |
| HUMBOLDT | Sask. | 144.42 | 11.29 | 158.93 | 152.04 |
| IMPERIAL | Sask. | 146.36 | 11.74 | 162.21 | 154.50 |
| INDIAN HEAD | Sask. | 146.17 | 13.01 | 162.89 | 154.95 |
| KAMSACK | Sask. | 156.30 | 12.88 | 172.85 | 164.99 |
| KELLIHER | Sask. | 146.50 | 13.98 | 164.47 | 155.94 |
| KIPLING | Sask. | 144.44 | 11.97 | 160.48 | 152.71 |
| KRISTNES | Sask. | 153.17 | 12.43 | 169.73 | 161.73 |
| KUROKI | Sask. | 146.50 | 13.60 | 164.40 | 155.80 |
| LANGENBURG | Sask. | 144.25 | 10.36 | 158.14 | 151.41 |
| LEROSS | Sask. | 155.70 | 13.32 | 173.39 | 164.87 |
| LINTLAW | Sask. | 157.54 | 10.26 | 170.73 | 164.47 |
| LIPTON | Sask. | 150.41 | 15.39 | 170.64 | 160.93 |
| LUMSDEN | Sask. | 147.44 | 12.70 | 163.76 | 156.02 |
| MARYFIELD | Sask. | 140.14 | 10.16 | 153.86 | 147.19 |
| MELVILLE | Sask. | 145.77 | 14.08 | 164.40 | 155.43 |
| MIDALE | Sask. | 145.47 | 13.35 | 162.62 | 154.47 |
| MOOSE JAW | Sask. | 141.20 | 11.80 | 156.37 | 149.17 |
| MOOSOMIN | Sask. | 143.33 | 12.00 | 158.76 | 151.43 |
| MUENSTER | Sask. | 149.24 | 14.04 | 167.28 | 158.71 |
| NIPAWIN | Sask. | 146.26 | 11.23 | 160.68 | 153.84 |

| | | | | | |
|---|---|---|---|---|---|
| PASWEGIN | Sask. | 148.92 | 14.07 | 167.47 | 158.56 |
| PELLY | Sask. | 165.27 | 10.82 | 179.45 | 172.66 |
| PRAIRIE RIVER | Sask. | 163.86 | 10.85 | 178.24 | 171.31 |
| QUAPPELLE | Sask. | 150.30 | 13.24 | 167.31 | 159.24 |
| RAYMORE | Sask. | 148.33 | 13.49 | 166.21 | 157.60 |
| REDVERS | Sask. | 145.65 | 11.34 | 160.81 | 153.47 |
| REGINA | Sask. | 147.66 | 13.31 | 164.77 | 156.65 |
| RIDGEDALE | Sask. | 157.28 | 10.22 | 170.41 | 164.18 |
| ROCANVILLE | Sask. | 143.58 | 11.39 | 158.74 | 151.42 |
| SEMANS | Sask. | 147.89 | 12.25 | 163.63 | 156.16 |
| SOMME | Sask. | 154.94 | 16.36 | 176.81 | 166.23 |
| STRASBOURG | Sask. | 144.56 | 13.79 | 162.28 | 153.86 |
| WAPELLA | Sask. | 148.19 | 14.81 | 168.04 | 158.42 |
| WATROUS | Sask. | 144.00 | 12.20 | 159.67 | 152.23 |
| WEEKS | Sask. | 158.33 | 10.55 | 172.52 | 165.63 |
| WEYBURN | Sask. | 143.69 | 11.05 | 157.90 | 151.16 |
| WHITEWOOD | Sask. | 150.71 | 11.50 | 165.48 | 158.47 |
| WYNYARD | Sask. | 144.50 | 12.21 | 160.61 | 152.86 |
| YELLOW GRASS | Sask. | 148.38 | 13.08 | 165.19 | 157.21 |
| YORKTON | Sask. | 144.18 | 11.07 | 158.40 | 151.65 |
| ALTONA | Man. | 137.63 | 9.98 | 150.45 | 144.36 |
| ARBORG | Man. | 151.70 | 12.34 | 167.93 | 160.14 |
| BALDUR | Man. | 145.00 | 10.71 | 159.10 | 152.33 |
| BEAUSEJOUR | Man. | 146.62 | 12.11 | 162.61 | 154.92 |
| BEDE | Man. | 141.11 | 10.06 | 154.49 | 148.03 |
| BIRTLE | Man. | 148.16 | 13.08 | 164.98 | 157.00 |
| BISSETT | Man. | 146.35 | 12.59 | 162.52 | 154.85 |
| BOISSEVAIN | Man. | 141.08 | 12.91 | 157.67 | 149.79 |
| BRANDON | Man. | 148.91 | 11.56 | 163.77 | 156.71 |
| BROAD VALLEY | Man. | 147.33 | 12.22 | 163.63 | 155.75 |
| CYPRESS RIVER | Man. | 143.98 | 11.47 | 158.72 | 151.72 |
| DAUPHIN | Man. | 147.66 | 10.65 | 161.34 | 154.84 |
| DEERWOOD | Man. | 141.27 | 8.88 | 153.02 | 147.37 |
| DELORAINE | Man. | 143.73 | 10.52 | 157.25 | 150.83 |
| DELTA BEACH | Man. | 134.80 | 9.64 | 147.60 | 141.43 |
| DUGALD | Man. | 149.12 | 13.75 | 167.50 | 158.60 |
| EMERSON | Man. | 142.40 | 12.11 | 157.96 | 150.58 |
| ERIKSDALE | Man. | 151.52 | 14.76 | 170.97 | 161.63 |
| FRASERWOOD | Man. | 148.95 | 13.09 | 166.36 | 157.95 |
| GILBERT PLAINS | Man. | 156.11 | 10.79 | 170.30 | 163.49 |
| GIMLI | Man. | 143.11 | 10.25 | 156.28 | 150.03 |
| GLADSTONE | Man. | 142.94 | 10.54 | 157.06 | 150.22 |
| GLENBORO | Man. | 142.82 | 11.83 | 158.64 | 150.99 |
| GLENLEA | Man. | 146.36 | 12.17 | 162.46 | 154.71 |
| GRAND RAPIDS | Man. | 148.52 | 12.14 | 164.42 | 156.81 |
| GRASS RIVER | Man. | 144.38 | 11.57 | 159.56 | 152.28 |
| GRAYSVILLE | Man. | 144.32 | 10.92 | 158.35 | 151.69 |
| GREAT FALLS | Man. | 139.75 | 10.21 | 152.87 | 146.64 |
| GYPSUMVILLE | Man. | 151.07 | 15.71 | 172.28 | 161.97 |
| HAMIOTA | Man. | 147.37 | 13.25 | 164.39 | 156.31 |
| HODGESON | Man. | 162.32 | 13.60 | 180.41 | 171.67 |
| INDIAN BAY | Man. | 146.35 | 12.08 | 161.87 | 154.50 |

| | | | | | |
|---|---|---|---|---|---|
| LANGRUTH | Man. | 139.00 | 10.34 | 152.79 | 146.13 |
| MARQUETTE | Man. | 138.16 | 8.55 | 149.54 | 144.04 |
| MEADOW PORTAGE | Man. | 150.79 | 13.88 | 169.53 | 160.42 |
| MELITA | Man. | 151.96 | 11.58 | 167.26 | 159.90 |
| MINNEDOSA | Man. | 154.76 | 10.92 | 168.79 | 162.13 |
| MOOSEHORN | Man. | 153.77 | 10.55 | 167.66 | 160.99 |
| MORDEN | Man. | 140.10 | 10.44 | 153.52 | 147.15 |
| MORRIS | Man. | 143.33 | 11.85 | 158.55 | 151.33 |
| MYRTLE | Man. | 144.93 | 11.70 | 160.66 | 153.03 |
| NEEPAWA | Man. | 140.78 | 11.18 | 155.14 | 148.32 |
| NINETTE | Man. | 150.38 | 11.29 | 164.90 | 158.01 |
| OAKNER | Man. | 137.76 | 9.59 | 150.58 | 144.38 |
| PIERSON | Man. | 143.92 | 12.11 | 159.48 | 152.09 |
| PILOT MOUND | Man. | 139.14 | 11.11 | 153.74 | 146.74 |
| PINAWA | Man. | 149.15 | 10.78 | 163.00 | 156.42 |
| PINE FALLS | Man. | 147.93 | 11.97 | 163.67 | 156.12 |
| PLUMAS | Man. | 142.09 | 10.52 | 155.98 | 149.30 |
| PLUM COULEE | Man. | 139.35 | 11.08 | 154.05 | 146.97 |
| PORTAGE LA PRAIRIE | Man. | 139.55 | 9.50 | 151.76 | 145.96 |
| RATHWELL | Man. | 143.11 | 12.24 | 159.39 | 151.53 |
| RIVERS | Man. | 144.94 | 10.33 | 158.21 | 151.91 |
| ROLAND | Man. | 142.55 | 12.33 | 158.86 | 151.00 |
| ROSSBURN | Man. | 145.85 | 12.16 | 161.86 | 154.17 |
| RUSSELL | Man. | 149.64 | 11.59 | 164.53 | 157.46 |
| SELKIRK | Man. | 137.58 | 11.45 | 152.81 | 145.46 |
| SEVEN SISTERS | Man. | 143.17 | 12.31 | 159.58 | 151.65 |
| SHILO | Man. | 146.93 | 11.44 | 162.31 | 154.85 |
| SOMSERSET | Man. | 138.79 | 10.26 | 152.64 | 145.91 |
| SOURIS | Man. | 149.67 | 11.69 | 164.69 | 157.56 |
| SPRAGUE | Man. | 154.41 | 11.95 | 169.77 | 162.48 |
| STARBUCK | Man. | 149.06 | 11.81 | 164.84 | 157.21 |
| STEINBACH | Man. | 145.04 | 11.61 | 160.34 | 153.00 |
| STONEWALL | Man. | 144.37 | 11.10 | 159.02 | 151.98 |
| STONY MNT | Man. | 143.00 | 10.94 | 157.72 | 150.57 |
| ST ALBANS | Man. | 151.16 | 10.25 | 164.59 | 158.16 |
| ST BONIFACE | Man. | 144.00 | 11.00 | 158.61 | 151.57 |
| SWAN RIVER | Man. | 146.07 | 10.21 | 159.18 | 152.96 |
| THE PAS | Man. | 147.03 | 9.14 | 158.77 | 153.19 |
| VIRDEN | Man. | 141.94 | 11.02 | 156.10 | 149.38 |
| VOGAR | Man. | 134.38 | 8.08 | 145.09 | 139.93 |
| WASAGAMING | Man. | 159.29 | 15.46 | 179.77 | 169.90 |
| WASKADA | Man. | 150.81 | 12.38 | 167.02 | 159.26 |
| WILSON CREEK | Man. | 147.24 | 12.57 | 164.04 | 155.91 |
| WINNIPEG | Man. | 145.81 | 11.19 | 160.20 | 153.37 |

Table B2: First Fall Frost (0°c)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 258.06 | 8.25 | 247.05 | 252.37 |
| ARRAN | Sask. | 239.93 | 19.71 | 214.08 | 226.47 |
| AYLSHAM | Sask. | 253.05 | 8.60 | 241.64 | 247.14 |
| BANGOR | Sask. | 252.45 | 9.07 | 240.41 | 246.21 |
| BROADVIEW | Sask. | 248.65 | 12.05 | 233.17 | 240.52 |
| CARDROSS | Sask. | 254.83 | 11.49 | 239.67 | 246.96 |
| CARLYLE | Sask. | 251.90 | 14.42 | 233.37 | 242.16 |
| CARON | Sask. | 248.27 | 17.54 | 225.72 | 236.43 |
| CEYLON | Sask. | 256.08 | 12.05 | 240.60 | 247.95 |
| COTE | Sask. | 237.00 | 16.57 | 214.90 | 225.58 |
| CUPAR | Sask. | 243.96 | 16.20 | 222.63 | 232.88 |
| DAFOE | Sask. | 254.11 | 10.79 | 239.75 | 246.68 |
| DAHINDA | Sask. | 254.36 | 6.83 | 245.13 | 249.61 |
| DAVIDSON | Sask. | 253.85 | 12.00 | 238.44 | 245.76 |
| DAVIN | Sask. | 249.60 | 13.45 | 231.75 | 240.35 |
| DUVAL | Sask. | 260.50 | 9.55 | 247.90 | 253.96 |
| ESTEVAN | Sask. | 259.98 | 10.45 | 246.55 | 252.92 |
| FENWOOD | Sask. | 259.00 | 14.17 | 239.94 | 249.19 |
| FERTILE | Sask. | 254.24 | 10.43 | 240.29 | 247.04 |
| FOAM LAKE | Sask. | 248.17 | 18.61 | 224.25 | 235.61 |
| FORT QUAPPELLE | Sask. | 246.77 | 17.76 | 223.39 | 234.62 |
| FRANCIS | Sask. | 244.83 | 19.96 | 219.18 | 231.36 |
| GOOD SPIRIT LAKE | Sask. | 239.35 | 23.27 | 208.60 | 223.38 |
| GRENFELL | Sask. | 250.50 | 15.53 | 230.54 | 240.01 |
| GUERNSEY | Sask. | 250.71 | 13.63 | 232.48 | 241.30 |
| HEWARD | Sask. | 247.79 | 12.78 | 230.53 | 238.91 |
| HUBBARD | Sask. | 245.22 | 18.14 | 221.25 | 232.77 |
| HUDSON BAY | Sask. | 246.07 | 17.15 | 224.02 | 234.49 |
| HUMBOLDT | Sask. | 252.56 | 11.66 | 237.58 | 244.69 |
| IMPERIAL | Sask. | 253.36 | 10.98 | 238.53 | 245.74 |
| INDIAN HEAD | Sask. | 255.99 | 10.60 | 242.37 | 248.84 |
| KAMSACK | Sask. | 244.95 | 17.67 | 222.25 | 233.02 |
| KELLIHER | Sask. | 248.47 | 16.28 | 227.55 | 237.48 |
| KIPLING | Sask. | 252.56 | 14.94 | 232.53 | 242.24 |
| KRISTNES | Sask. | 242.61 | 17.74 | 218.95 | 230.39 |
| KUROKI | Sask. | 251.15 | 17.29 | 228.40 | 239.33 |
| LANGENBURG | Sask. | 251.12 | 5.93 | 243.17 | 247.03 |
| LEROSS | Sask. | 246.15 | 18.43 | 221.68 | 233.47 |
| LINTLAW | Sask. | 243.00 | 20.98 | 216.04 | 228.84 |
| LIPTON | Sask. | 242.52 | 18.35 | 218.39 | 229.97 |
| LUMSDEN | Sask. | 250.46 | 14.14 | 232.29 | 240.92 |
| MARYFIELD | Sask. | 255.79 | 12.40 | 239.04 | 247.18 |
| MELVILLE | Sask. | 253.68 | 11.73 | 238.16 | 245.64 |
| MIDALE | Sask. | 253.38 | 12.82 | 236.91 | 244.73 |
| MOOSE JAW | Sask. | 260.73 | 10.03 | 247.85 | 253.96 |
| MOOSOMIN | Sask. | 256.93 | 10.24 | 243.78 | 250.02 |
| MUENSTER | Sask. | 249.55 | 15.01 | 230.26 | 239.42 |
| NIPAWIN | Sask. | 254.17 | 12.13 | 238.58 | 245.98 |

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|---|---|---|---|---|---|
| NOKOMIS | Sask. | 251.69 | 11.97 | 236.31 | 243.61 |
| ORMISTON | Sask. | 258.61 | 8.42 | 247.79 | 252.93 |
| PASWEGIN | Sask. | 245.36 | 17.61 | 222.15 | 233.30 |
| PELLY | Sask. | 222.83 | 24.28 | 190.99 | 206.25 |
| PRAIRIE RIVER | Sask. | 220.43 | 26.50 | 185.30 | 202.22 |
| QUAPPELLE | Sask. | 254.33 | 11.87 | 239.08 | 246.32 |
| RAYMORE | Sask. | 250.95 | 10.27 | 237.35 | 243.90 |
| REDVERS | Sask. | 253.59 | 13.11 | 236.06 | 244.54 |
| REGINA | Sask. | 250.54 | 15.46 | 230.67 | 240.10 |
| RIDGEDALE | Sask. | 241.09 | 16.72 | 219.61 | 229.81 |
| ROCANVILLE | Sask. | 252.63 | 10.40 | 238.79 | 245.48 |
| SEMANS | Sask. | 252.83 | 11.91 | 237.52 | 244.79 |
| SOMME | Sask. | 242.12 | 19.19 | 216.47 | 228.88 |
| STRASBOURG | Sask. | 253.85 | 13.99 | 235.87 | 244.41 |
| WAPELLA | Sask. | 252.44 | 11.38 | 237.18 | 244.57 |
| WATROUS | Sask. | 252.56 | 10.92 | 238.53 | 245.19 |
| WEEKS | Sask. | 237.87 | 22.55 | 207.53 | 222.26 |
| WEYBURN | Sask. | 256.17 | 9.78 | 243.60 | 249.57 |
| WHITEWOOD | Sask. | 250.59 | 13.54 | 233.19 | 241.45 |
| WYNYARD | Sask. | 257.21 | 11.09 | 242.58 | 249.61 |
| YELLOW GRASS | Sask. | 250.78 | 14.41 | 232.26 | 241.05 |
| YORKTON | Sask. | 255.00 | 10.51 | 241.50 | 247.91 |
| ALTONA | Man. | 264.49 | 7.30 | 255.10 | 259.56 |
| ARBORG | Man. | 254.37 | 9.23 | 242.24 | 248.06 |
| BALDUR | Man. | 258.38 | 10.75 | 244.24 | 251.03 |
| BEAUSEJOUR | Man. | 251.62 | 17.17 | 228.97 | 239.86 |
| BEDE | Man. | 255.26 | 9.63 | 242.46 | 248.64 |
| BIRTLE | Man. | 246.13 | 19.41 | 221.19 | 233.03 |
| BISSETT | Man. | 253.41 | 16.22 | 232.57 | 242.46 |
| BOISSEVAIN | Man. | 261.69 | 9.64 | 249.30 | 255.18 |
| BRANDON | Man. | 254.14 | 10.05 | 241.23 | 247.36 |
| BROAD VALLEY | Man. | 256.50 | 11.53 | 241.12 | 248.55 |
| CYPRESS RIVER | Man. | 259.27 | 9.99 | 246.44 | 252.53 |
| DAUPHIN | Man. | 259.36 | 10.65 | 245.67 | 252.17 |
| DEERWOOD | Man. | 265.95 | 6.42 | 257.46 | 261.55 |
| DELORAINE | Man. | 255.00 | 18.87 | 230.76 | 242.26 |
| DELTA BEACH | Man. | 260.15 | 9.27 | 247.84 | 253.77 |
| DUGALD | Man. | 255.47 | 11.16 | 240.56 | 247.77 |
| EMERSON | Man. | 258.47 | 11.13 | 244.16 | 250.95 |
| ERIKSDALE | Man. | 250.92 | 9.72 | 238.11 | 244.26 |
| FRASERWOOD | Man. | 248.00 | 13.17 | 230.47 | 238.94 |
| GILBERT PLAINS | Man. | 245.70 | 19.65 | 219.87 | 232.26 |
| GIMLI | Man. | 265.20 | 7.47 | 255.60 | 260.16 |
| GLADSTONE | Man. | 256.19 | 9.75 | 243.12 | 249.45 |
| GLENBORO | Man. | 258.29 | 11.47 | 242.96 | 250.38 |
| GLENLEA | Man. | 257.14 | 11.36 | 242.11 | 249.34 |
| GRAND RAPIDS | Man. | 257.84 | 15.81 | 237.12 | 247.04 |
| GRASS RIVER | Man. | 256.21 | 10.31 | 242.68 | 249.17 |
| GRAYSVILLE | Man. | 258.43 | 9.55 | 246.16 | 251.98 |
| GREAT FALLS | Man. | 265.67 | 7.37 | 256.20 | 260.69 |
| GYPSUMVILLE | Man. | 251.79 | 21.21 | 223.15 | 237.07 |
| HAMIOTA | Man. | 251.44 | 14.43 | 232.90 | 241.70 |

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|---|---|---|---|---|---|
| HODGESON | Man. | 238.68 | 11.86 | 222.91 | 230.53 |
| INDIAN BAY | Man. | 257.27 | 10.80 | 243.39 | 249.98 |
| LANGRUTH | Man. | 259.56 | 10.15 | 246.02 | 252.56 |
| MARQUETTE | Man. | 265.05 | 6.79 | 256.01 | 260.38 |
| MEADOW PORTAGE | Man. | 251.50 | 22.69 | 220.86 | 235.75 |
| MELITA | Man. | 255.43 | 7.12 | 246.03 | 250.55 |
| MINNEDOSA | Man. | 245.58 | 17.30 | 223.34 | 233.90 |
| MOOSEHORN | Man. | 252.04 | 12.40 | 235.72 | 243.56 |
| MORDEN | Man. | 265.00 | 7.32 | 255.59 | 260.06 |
| MORRIS | Man. | 261.52 | 8.41 | 250.71 | 255.84 |
| MYRTLE | Man. | 259.40 | 8.67 | 247.74 | 253.40 |
| NEEPAWA | Man. | 262.27 | 7.28 | 252.92 | 257.35 |
| NINETTE | Man. | 255.08 | 10.06 | 242.14 | 248.28 |
| OAKNER | Man. | 253.88 | 11.54 | 238.45 | 245.92 |
| PIERSON | Man. | 253.92 | 12.40 | 237.98 | 245.55 |
| PILOT MOUND | Man. | 259.18 | 8.30 | 248.28 | 253.50 |
| PINAWA | Man. | 256.71 | 14.82 | 237.67 | 246.71 |
| PINE FALLS | Man. | 255.15 | 11.16 | 240.47 | 247.51 |
| PLUMAS | Man. | 261.26 | 9.67 | 248.48 | 254.62 |
| PLUM COULEE | Man. | 263.75 | 8.92 | 251.90 | 257.61 |
| PORTAGE LA PRAIRIE | Man. | 265.27 | 7.71 | 255.36 | 260.07 |
| RATHWELL | Man. | 260.89 | 8.96 | 248.97 | 254.73 |
| RIVERS | Man. | 259.03 | 9.06 | 247.39 | 252.92 |
| ROLAND | Man. | 260.09 | 7.96 | 249.55 | 254.63 |
| ROSSBURN | Man. | 253.92 | 9.77 | 241.07 | 247.24 |
| RUSSELL | Man. | 253.42 | 13.75 | 235.75 | 244.13 |
| SELKIRK | Man. | 266.00 | 5.76 | 258.34 | 262.04 |
| SEVEN SISTERS | Man. | 261.94 | 9.60 | 249.15 | 255.33 |
| SHILO | Man. | 258.13 | 8.94 | 246.10 | 251.94 |
| SOMSERSET | Man. | 263.00 | 8.78 | 251.15 | 256.91 |
| SOURIS | Man. | 256.64 | 9.54 | 244.38 | 250.20 |
| SPRAGUE | Man. | 242.83 | 18.85 | 218.61 | 230.11 |
| STARBUCK | Man. | 252.76 | 20.58 | 225.26 | 238.57 |
| STEINBACH | Man. | 260.00 | 9.07 | 248.05 | 253.79 |
| STONEWALL | Man. | 263.50 | 8.39 | 252.43 | 257.75 |
| STONY MNT | Man. | 261.47 | 8.87 | 249.53 | 255.33 |
| ST ALBANS | Man. | 257.94 | 7.85 | 247.65 | 252.57 |
| ST BONIFACE | Man. | 262.90 | 8.58 | 251.51 | 257.00 |
| SWAN RIVER | Man. | 255.66 | 10.61 | 242.02 | 248.49 |
| THE PAS | Man. | 260.67 | 8.12 | 250.23 | 255.19 |
| VIRDEN | Man. | 260.29 | 8.57 | 249.28 | 254.50 |
| VOGAR | Man. | 269.00 | 7.89 | 258.54 | 263.58 |
| WASAGAMING | Man. | 228.24 | 26.75 | 192.78 | 209.86 |
| WASKADA | Man. | 251.03 | 15.20 | 231.12 | 240.65 |
| WILSON CREEK | Man. | 261.41 | 9.28 | 249.00 | 255.01 |
| WINNIPEG | Man. | 263.73 | 6.91 | 254.85 | 259.06 |

Table B3: Frost-Free Period (0°c)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 123.78 | 11.01 | 109.10 | 116.19 |
| ARRAN | Sask. | 82.37 | 27.64 | 46.12 | 63.49 |
| AYLSHAM | Sask. | 107.45 | 15.93 | 86.30 | 96.49 |
| BANGOR | Sask. | 103.35 | 15.82 | 82.35 | 92.47 |
| BROADVIEW | Sask. | 96.58 | 16.40 | 75.51 | 85.51 |
| CARDROSS | Sask. | 110.88 | 19.11 | 85.66 | 97.78 |
| CARLYLE | Sask. | 102.17 | 20.63 | 75.67 | 88.25 |
| CARON | Sask. | 98.67 | 27.30 | 63.58 | 80.24 |
| CEYLON | Sask. | 111.32 | 18.65 | 87.36 | 98.74 |
| COTE | Sask. | 87.50 | 19.14 | 61.98 | 74.31 |
| CUPAR | Sask. | 93.88 | 22.84 | 63.83 | 78.27 |
| DAFOE | Sask. | 106.68 | 13.36 | 88.91 | 97.49 |
| DAHINDA | Sask. | 114.36 | 13.67 | 95.90 | 104.87 |
| DAVIDSON | Sask. | 108.20 | 16.47 | 87.04 | 97.08 |
| DAVIN | Sask. | 108.60 | 13.06 | 91.26 | 99.61 |
| DUVAL | Sask. | 121.58 | 17.48 | 98.52 | 109.61 |
| ESTEVAN | Sask. | 121.16 | 17.45 | 98.74 | 109.39 |
| FENWOOD | Sask. | 120.73 | 18.29 | 96.13 | 108.07 |
| FERTILE | Sask. | 116.06 | 13.74 | 97.70 | 106.58 |
| FOAM LAKE | Sask. | 96.63 | 27.45 | 61.36 | 78.10 |
| FORT QUAPPELLE | Sask. | 91.15 | 20.48 | 64.20 | 77.15 |
| FRANCIS | Sask. | 89.77 | 23.53 | 59.53 | 73.89 |
| GOOD SPIRIT LAKE | Sask. | 88.61 | 33.51 | 44.34 | 65.62 |
| GRENFELL | Sask. | 100.03 | 19.05 | 75.54 | 87.16 |
| GUERNSEY | Sask. | 109.59 | 17.65 | 85.99 | 97.41 |
| HEWARD | Sask. | 108.07 | 14.83 | 88.04 | 97.78 |
| HUBBARD | Sask. | 92.74 | 18.86 | 67.82 | 79.80 |
| HUDSON BAY | Sask. | 92.98 | 24.04 | 62.09 | 76.75 |
| HUMBOLDT | Sask. | 108.15 | 15.64 | 88.05 | 97.59 |
| IMPERIAL | Sask. | 107.00 | 13.71 | 88.49 | 97.49 |
| INDIAN HEAD | Sask. | 109.82 | 16.56 | 88.54 | 98.64 |
| KAMSACK | Sask. | 88.65 | 20.54 | 62.26 | 74.79 |
| KELLIHER | Sask. | 101.97 | 23.36 | 71.95 | 86.20 |
| KIPLING | Sask. | 108.13 | 18.22 | 83.70 | 95.53 |
| KRISTNES | Sask. | 89.44 | 24.73 | 56.47 | 72.41 |
| KUROKI | Sask. | 104.65 | 27.41 | 68.57 | 85.90 |
| LANGENBURG | Sask. | 106.88 | 11.04 | 92.08 | 99.25 |
| LEROSS | Sask. | 90.45 | 28.59 | 52.49 | 70.78 |
| LINTLAW | Sask. | 85.46 | 25.14 | 53.15 | 68.49 |
| LIPTON | Sask. | 92.11 | 25.05 | 59.17 | 74.98 |
| LUMSDEN | Sask. | 103.01 | 18.68 | 79.01 | 90.40 |
| MARYFIELD | Sask. | 115.64 | 13.53 | 97.37 | 106.25 |
| MELVILLE | Sask. | 107.91 | 20.52 | 80.76 | 93.83 |
| MIDALE | Sask. | 107.91 | 18.32 | 84.38 | 95.55 |
| MOOSE JAW | Sask. | 119.53 | 17.14 | 97.51 | 107.97 |
| MOOSOMIN | Sask. | 113.60 | 14.88 | 94.48 | 103.55 |
| MUENSTER | Sask. | 100.31 | 23.21 | 70.48 | 84.64 |
| NIPAWIN | Sask. | 107.91 | 16.40 | 86.84 | 96.84 |

| | | | | | |
|---|---|---|---|---|---|
| NOKOMIS | Sask. | 105.33 | 18.08 | 82.10 | 93.13 |
| ORMISTON | Sask. | 118.67 | 12.46 | 102.66 | 110.26 |
| PASWEGIN | Sask. | 96.44 | 24.15 | 64.62 | 79.90 |
| PELLY | Sask. | 57.57 | 28.78 | 19.83 | 37.91 |
| PRAIRIE RIVER | Sask. | 56.57 | 34.11 | 11.37 | 33.14 |
| QUAPPELLE | Sask. | 104.02 | 17.22 | 81.89 | 92.40 |
| RAYMORE | Sask. | 102.62 | 16.11 | 81.27 | 91.55 |
| REDVERS | Sask. | 107.94 | 16.83 | 85.45 | 96.33 |
| REGINA | Sask. | 102.87 | 19.47 | 77.86 | 89.73 |
| RIDGEDALE | Sask. | 83.81 | 22.36 | 55.08 | 68.72 |
| ROCANVILLE | Sask. | 109.05 | 12.68 | 92.18 | 100.33 |
| SEMANS | Sask. | 104.93 | 16.90 | 83.22 | 93.53 |
| SOMME | Sask. | 87.18 | 30.97 | 45.78 | 65.81 |
| STRASBOURG | Sask. | 109.30 | 20.20 | 83.34 | 95.66 |
| WAPELLA | Sask. | 104.25 | 19.44 | 78.18 | 90.81 |
| WATROUS | Sask. | 108.56 | 17.38 | 86.23 | 96.83 |
| WEEKS | Sask. | 79.53 | 26.11 | 44.42 | 61.47 |
| WEYBURN | Sask. | 112.47 | 16.43 | 91.36 | 101.38 |
| WHITEWOOD | Sask. | 99.88 | 17.19 | 77.80 | 88.28 |
| WYNYARD | Sask. | 112.71 | 17.53 | 89.58 | 100.70 |
| YELLOW GRASS | Sask. | 102.40 | 19.50 | 77.34 | 89.24 |
| YORKTON | Sask. | 110.82 | 15.14 | 91.37 | 100.60 |
| ALTONA | Man. | 126.86 | 12.49 | 110.81 | 118.43 |
| ARBORG | Man. | 102.67 | 15.68 | 82.04 | 91.94 |
| BALDUR | Man. | 113.38 | 15.74 | 92.66 | 102.62 |
| BEAUSEJOUR | Man. | 105.00 | 23.26 | 74.31 | 89.07 |
| BEDE | Man. | 114.16 | 15.24 | 93.89 | 103.68 |
| BIRTLE | Man. | 97.96 | 21.51 | 70.32 | 83.45 |
| BISSETT | Man. | 107.05 | 23.59 | 76.74 | 91.13 |
| BOISSEVAIN | Man. | 120.62 | 17.35 | 98.32 | 108.90 |
| BRANDON | Man. | 105.23 | 16.33 | 84.25 | 94.21 |
| BROAD VALLEY | Man. | 109.17 | 15.22 | 88.88 | 98.68 |
| CYPRESS RIVER | Man. | 115.29 | 14.82 | 96.25 | 105.29 |
| DAUPHIN | Man. | 111.71 | 17.63 | 89.05 | 99.81 |
| DEERWOOD | Man. | 124.68 | 11.15 | 109.93 | 117.04 |
| DELORAINE | Man. | 111.27 | 21.01 | 84.27 | 97.09 |
| DELTA BEACH | Man. | 125.35 | 12.63 | 108.58 | 116.66 |
| DUGALD | Man. | 106.35 | 17.94 | 82.37 | 93.98 |
| EMERSON | Man. | 116.06 | 19.32 | 91.24 | 103.02 |
| ERIKSDALE | Man. | 99.40 | 17.01 | 76.99 | 87.75 |
| FRASERWOOD | Man. | 99.05 | 19.14 | 73.59 | 85.89 |
| GILBERT PLAINS | Man. | 89.59 | 25.13 | 56.55 | 72.41 |
| GIMLI | Man. | 122.09 | 12.97 | 105.42 | 113.33 |
| GLADSTONE | Man. | 113.25 | 14.80 | 93.41 | 103.02 |
| GLENBORO | Man. | 115.47 | 16.28 | 93.71 | 104.24 |
| GLENLEA | Man. | 110.77 | 19.12 | 85.47 | 97.65 |
| GRAND RAPIDS | Man. | 109.32 | 24.45 | 77.28 | 92.62 |
| GRASS RIVER | Man. | 111.83 | 15.72 | 91.19 | 101.09 |
| GRAYSVILLE | Man. | 114.11 | 15.75 | 93.88 | 103.48 |
| GREAT FALLS | Man. | 125.91 | 12.11 | 110.35 | 117.73 |
| GYPSUMVILLE | Man. | 100.71 | 33.13 | 55.99 | 77.73 |
| HAMIOTA | Man. | 104.08 | 21.50 | 76.45 | 89.56 |

| | | | | | |
|---|---|---|---|---|---|
| HODGESON | Man. | 76.37 | 20.99 | 48.45 | 61.93 |
| INDIAN BAY | Man. | 110.93 | 16.75 | 89.41 | 99.62 |
| LANGRUTH | Man. | 120.56 | 17.58 | 97.11 | 108.44 |
| MARQUETTE | Man. | 126.89 | 11.21 | 111.97 | 119.18 |
| MEADOW PORTAGE | Man. | 100.71 | 30.92 | 58.97 | 79.26 |
| MELITA | Man. | 103.48 | 15.11 | 83.52 | 93.12 |
| MINNEDOSA | Man. | 90.82 | 22.27 | 62.20 | 75.79 |
| MOOSEHORN | Man. | 98.27 | 17.18 | 75.66 | 86.52 |
| MORDEN | Man. | 124.90 | 12.91 | 108.30 | 116.18 |
| MORRIS | Man. | 118.20 | 15.87 | 97.80 | 107.48 |
| MYRTLE | Man. | 114.47 | 14.33 | 95.19 | 104.55 |
| NEEPAWA | Man. | 121.49 | 14.09 | 103.38 | 111.98 |
| NINETTE | Man. | 104.69 | 15.36 | 84.96 | 94.33 |
| OAKNER | Man. | 116.12 | 17.48 | 92.75 | 104.06 |
| PIERSON | Man. | 110.00 | 18.16 | 86.66 | 97.74 |
| PILOT MOUND | Man. | 120.04 | 13.03 | 102.92 | 111.12 |
| PINAWA | Man. | 107.56 | 20.46 | 81.28 | 93.76 |
| PINE FALLS | Man. | 107.22 | 18.80 | 82.50 | 94.36 |
| PLUMAS | Man. | 119.17 | 15.69 | 98.45 | 108.41 |
| PLUM COULEE | Man. | 124.40 | 13.20 | 106.88 | 115.32 |
| PORTAGE LA PRAIRIE | Man. | 125.73 | 13.10 | 108.89 | 116.88 |
| RATHWELL | Man. | 117.79 | 16.18 | 96.27 | 106.66 |
| RIVERS | Man. | 114.09 | 14.01 | 96.09 | 104.64 |
| ROLAND | Man. | 117.55 | 14.04 | 98.97 | 107.92 |
| ROSSBURN | Man. | 108.08 | 17.14 | 85.52 | 96.35 |
| RUSSELL | Man. | 103.77 | 18.94 | 79.43 | 90.99 |
| SELKIRK | Man. | 128.42 | 13.46 | 110.51 | 119.16 |
| SEVEN SISTERS | Man. | 118.78 | 15.71 | 97.83 | 107.95 |
| SHILO | Man. | 111.20 | 12.95 | 93.79 | 102.24 |
| SOMSERSET | Man. | 124.21 | 13.33 | 106.22 | 114.97 |
| SOURIS | Man. | 106.97 | 16.89 | 85.26 | 95.57 |
| SPRAGUE | Man. | 88.41 | 23.88 | 57.73 | 72.30 |
| STARBUCK | Man. | 103.71 | 27.98 | 66.30 | 84.40 |
| STEINBACH | Man. | 114.96 | 15.82 | 94.11 | 104.12 |
| STONEWALL | Man. | 119.12 | 15.57 | 98.59 | 108.46 |
| STONY MNT | Man. | 118.47 | 13.26 | 100.64 | 109.29 |
| ST ALBANS | Man. | 106.77 | 14.99 | 87.13 | 96.53 |
| ST BONIFACE | Man. | 118.90 | 15.59 | 98.20 | 108.17 |
| SWAN RIVER | Man. | 109.59 | 14.36 | 91.14 | 99.90 |
| THE PAS | Man. | 113.64 | 11.35 | 99.06 | 105.98 |
| VIRDEN | Man. | 118.35 | 12.37 | 102.46 | 110.00 |
| VOGAR | Man. | 134.62 | 11.08 | 119.94 | 127.01 |
| WASAGAMING | Man. | 68.95 | 36.99 | 19.93 | 43.54 |
| WASKADA | Man. | 100.23 | 18.90 | 75.46 | 87.32 |
| WILSON CREEK | Man. | 114.18 | 17.07 | 91.36 | 102.40 |
| WINNIPEG | Man. | 117.92 | 14.48 | 99.30 | 108.14 |

Table B4: Last Spring Frost (-2.2°c)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 127.78 | 6.11 | 135.93 | 131.99 |
| ARRAN | Sask. | 141.50 | 12.70 | 158.16 | 150.17 |
| AYLSHAM | Sask. | 130.60 | 8.60 | 142.02 | 136.52 |
| BANGOR | Sask. | 134.75 | 12.24 | 151.00 | 143.17 |
| BROADVIEW | Sask. | 138.46 | 12.99 | 155.15 | 147.23 |
| CARDROSS | Sask. | 130.58 | 10.29 | 144.16 | 137.63 |
| CARLYLE | Sask. | 136.97 | 11.96 | 152.34 | 145.04 |
| CARON | Sask. | 135.98 | 11.03 | 150.15 | 143.42 |
| CEYLON | Sask. | 133.19 | 10.60 | 146.81 | 140.34 |
| COTE | Sask. | 135.39 | 9.99 | 148.71 | 142.27 |
| CUPAR | Sask. | 136.08 | 11.05 | 150.62 | 143.63 |
| DAFOE | Sask. | 138.37 | 12.39 | 154.86 | 146.89 |
| DAHINDA | Sask. | 131.79 | 9.58 | 144.72 | 138.43 |
| DAVIDSON | Sask. | 134.15 | 11.11 | 148.42 | 141.65 |
| DAVIN | Sask. | 133.30 | 11.68 | 148.81 | 141.34 |
| DUVAL | Sask. | 127.33 | 8.39 | 138.41 | 133.08 |
| ESTEVAN | Sask. | 130.39 | 10.76 | 144.21 | 137.65 |
| FENWOOD | Sask. | 126.87 | 8.61 | 138.45 | 132.82 |
| FERTILE | Sask. | 126.94 | 5.55 | 134.36 | 130.77 |
| FOAM LAKE | Sask. | 136.74 | 11.21 | 151.15 | 144.31 |
| FORT QUAPPELLE | Sask. | 139.73 | 13.79 | 157.88 | 149.16 |
| FRANCIS | Sask. | 140.53 | 13.30 | 157.63 | 149.51 |
| GOOD SPIRIT LAKE | Sask. | 136.65 | 14.86 | 156.29 | 146.85 |
| GRENFELL | Sask. | 136.68 | 12.33 | 152.53 | 145.01 |
| GUERNSEY | Sask. | 131.76 | 9.65 | 144.67 | 138.43 |
| HEWARD | Sask. | 133.36 | 11.17 | 148.44 | 141.11 |
| HUBBARD | Sask. | 139.83 | 13.07 | 157.09 | 148.79 |
| HUDSON BAY | Sask. | 139.76 | 11.11 | 154.03 | 147.26 |
| HUMBOLDT | Sask. | 131.98 | 9.39 | 144.05 | 138.32 |
| IMPERIAL | Sask. | 130.00 | 9.70 | 143.09 | 136.73 |
| INDIAN HEAD | Sask. | 135.08 | 11.79 | 150.23 | 143.04 |
| KAMSACK | Sask. | 143.20 | 12.66 | 159.47 | 151.75 |
| KELLIHER | Sask. | 136.56 | 14.70 | 155.45 | 146.49 |
| KIPLING | Sask. | 130.87 | 13.12 | 148.46 | 139.94 |
| KRISTNES | Sask. | 141.50 | 11.68 | 157.08 | 149.55 |
| KUROKI | Sask. | 134.77 | 11.95 | 150.50 | 142.94 |
| LANGENBURG | Sask. | 133.00 | 13.41 | 150.98 | 142.27 |
| LEROSS | Sask. | 143.30 | 13.75 | 161.55 | 152.76 |
| LINTLAW | Sask. | 142.57 | 12.96 | 159.22 | 151.32 |
| LIPTON | Sask. | 137.78 | 13.72 | 155.82 | 147.16 |
| LUMSDEN | Sask. | 137.41 | 12.29 | 153.21 | 145.71 |
| MARYFIELD | Sask. | 125.64 | 7.13 | 135.27 | 130.59 |
| MELVILLE | Sask. | 133.27 | 9.73 | 146.15 | 139.95 |
| MIDALE | Sask. | 134.45 | 11.05 | 148.65 | 141.91 |
| MOOSE JAW | Sask. | 130.75 | 10.16 | 143.80 | 137.61 |
| MOOSOMIN | Sask. | 128.29 | 7.21 | 137.56 | 133.16 |
| MUENSTER | Sask. | 135.28 | 11.70 | 150.32 | 143.18 |
| NIPAWIN | Sask. | 134.51 | 10.48 | 147.98 | 141.58 |

| | | | | | |
|---|---|---|---|---|---|
| NOKOMIS | Sask. | 133.73 | 11.20 | 148.12 | 141.29 |
| ORMISTON | Sask. | 129.47 | 9.98 | 142.30 | 136.21 |
| PASWEGIN | Sask. | 132.96 | 11.38 | 147.96 | 140.76 |
| PELLY | Sask. | 148.50 | 11.89 | 164.09 | 156.62 |
| PRAIRIE RIVER | Sask. | 150.14 | 15.00 | 170.02 | 160.45 |
| QUAPPELLE | Sask. | 138.07 | 11.50 | 152.85 | 145.84 |
| RAYMORE | Sask. | 131.67 | 10.55 | 145.64 | 138.91 |
| REDVERS | Sask. | 134.69 | 12.37 | 151.27 | 143.24 |
| REGINA | Sask. | 135.37 | 11.31 | 149.91 | 143.01 |
| RIDGEDALE | Sask. | 146.84 | 11.17 | 161.19 | 154.38 |
| ROCANVILLE | Sask. | 128.00 | 11.97 | 143.92 | 136.23 |
| SEMANS | Sask. | 134.80 | 11.98 | 150.20 | 142.89 |
| SOMME | Sask. | 141.24 | 13.16 | 158.82 | 150.31 |
| STRASBOURG | Sask. | 134.17 | 12.09 | 149.70 | 142.33 |
| WAPELLA | Sask. | 129.56 | 8.41 | 140.83 | 135.37 |
| WATROUS | Sask. | 134.69 | 10.23 | 147.84 | 141.60 |
| WEEKS | Sask. | 148.87 | 13.13 | 166.53 | 157.95 |
| WEYBURN | Sask. | 132.81 | 11.40 | 147.46 | 140.50 |
| WHITEWOOD | Sask. | 137.00 | 11.42 | 151.67 | 144.71 |
| WYNYARD | Sask. | 132.08 | 9.69 | 144.87 | 138.72 |
| YELLOW GRASS | Sask. | 135.64 | 10.79 | 149.50 | 142.92 |
| YORKTON | Sask. | 133.56 | 9.39 | 145.63 | 139.90 |
| ALTONA | Man. | 128.59 | 8.36 | 139.33 | 134.23 |
| ARBORG | Man. | 140.11 | 9.19 | 152.19 | 146.40 |
| BALDUR | Man. | 132.08 | 8.15 | 142.80 | 137.65 |
| BEAUSEJOUR | Man. | 138.71 | 10.53 | 152.60 | 145.92 |
| BEDE | Man. | 130.32 | 8.82 | 142.05 | 136.38 |
| BIRTLE | Man. | 138.38 | 12.04 | 153.85 | 146.51 |
| BISSETT | Man. | 133.42 | 9.67 | 145.84 | 139.94 |
| BOISSEVAIN | Man. | 130.77 | 8.55 | 141.75 | 136.54 |
| BRANDON | Man. | 136.26 | 10.79 | 150.13 | 143.55 |
| BROAD VALLEY | Man. | 133.78 | 9.07 | 145.87 | 140.02 |
| CYPRESS RIVER | Man. | 132.37 | 9.60 | 144.70 | 138.85 |
| DAUPHIN | Man. | 136.60 | 10.63 | 150.26 | 143.78 |
| DEERWOOD | Man. | 132.45 | 8.54 | 143.75 | 138.31 |
| DELORAINE | Man. | 132.54 | 11.21 | 146.95 | 140.11 |
| DELTA BEACH | Man. | 129.00 | 6.13 | 137.14 | 133.22 |
| DUGALD | Man. | 137.53 | 11.19 | 152.48 | 145.25 |
| EMERSON | Man. | 132.47 | 9.76 | 145.01 | 139.06 |
| ERIKSDALE | Man. | 138.46 | 10.98 | 152.94 | 145.98 |
| FRASERWOOD | Man. | 138.74 | 11.52 | 154.06 | 146.66 |
| GILBERT PLAINS | Man. | 138.93 | 13.68 | 156.91 | 148.28 |
| GIMLI | Man. | 131.67 | 9.70 | 144.13 | 138.21 |
| GLADSTONE | Man. | 131.94 | 7.96 | 142.61 | 137.44 |
| GLENBORO | Man. | 128.65 | 6.83 | 137.77 | 133.36 |
| GLENLEA | Man. | 133.77 | 11.83 | 149.42 | 141.89 |
| GRAND RAPIDS | Man. | 136.42 | 10.22 | 149.81 | 143.40 |
| GRASS RIVER | Man. | 134.93 | 11.43 | 149.93 | 142.74 |
| GRAYSVILLE | Man. | 131.42 | 8.95 | 142.92 | 137.46 |
| GREAT FALLS | Man. | 129.07 | 9.00 | 140.64 | 135.15 |
| GYPSUMVILLE | Man. | 140.29 | 14.96 | 160.49 | 150.67 |
| HAMIOTA | Man. | 136.86 | 11.34 | 151.43 | 144.52 |

| | | | | | |
|---|---|---|---|---|---|
| HODGESON | Man. | 142.47 | 8.74 | 154.10 | 148.49 |
| INDIAN BAY | Man. | 136.07 | 9.27 | 147.99 | 142.33 |
| LANGRUTH | Man. | 130.39 | 8.02 | 141.08 | 135.91 |
| MARQUETTE | Man. | 129.37 | 7.48 | 139.32 | 134.51 |
| MEADOW PORTAGE | Man. | 132.29 | 9.60 | 145.25 | 138.95 |
| MELITA | Man. | 137.91 | 10.70 | 152.05 | 145.25 |
| MINNEDOSA | Man. | 139.36 | 10.41 | 152.73 | 146.38 |
| MOOSEHORN | Man. | 141.31 | 11.05 | 155.86 | 148.87 |
| MORDEN | Man. | 130.02 | 7.88 | 140.15 | 135.34 |
| MORRIS | Man. | 133.22 | 10.28 | 146.43 | 140.16 |
| MYRTLE | Man. | 130.47 | 11.69 | 146.19 | 138.56 |
| NEEPAWA | Man. | 130.46 | 8.44 | 141.30 | 136.16 |
| NINETTE | Man. | 136.44 | 10.33 | 149.71 | 143.41 |
| OAKNER | Man. | 127.18 | 7.10 | 136.67 | 132.08 |
| PIERSON | Man. | 132.48 | 10.26 | 145.67 | 139.41 |
| PILOT MOUND | Man. | 129.79 | 8.19 | 140.55 | 135.39 |
| PINAWA | Man. | 135.17 | 9.54 | 147.43 | 141.61 |
| PINE FALLS | Man. | 131.30 | 9.49 | 143.77 | 137.78 |
| PLUMAS | Man. | 130.18 | 7.65 | 140.31 | 135.43 |
| PLUM COULEE | Man. | 127.20 | 6.64 | 136.01 | 131.77 |
| PORTAGE LA PRAIRIE | Man. | 129.50 | 7.78 | 139.50 | 134.76 |
| RATHWELL | Man. | 127.84 | 6.85 | 136.96 | 132.55 |
| RIVERS | Man. | 133.34 | 8.50 | 144.27 | 139.08 |
| ROLAND | Man. | 132.14 | 7.65 | 142.26 | 137.38 |
| ROSSBURN | Man. | 134.50 | 10.53 | 148.37 | 141.71 |
| RUSSELL | Man. | 137.09 | 13.53 | 154.48 | 146.23 |
| SELKIRK | Man. | 129.68 | 7.19 | 139.25 | 134.63 |
| SEVEN SISTERS | Man. | 131.17 | 8.31 | 142.25 | 136.89 |
| SHILO | Man. | 134.20 | 9.02 | 146.33 | 140.44 |
| SOMSERSET | Man. | 128.43 | 6.66 | 137.43 | 133.05 |
| SOURIS | Man. | 139.06 | 11.81 | 154.23 | 147.03 |
| SPRAGUE | Man. | 141.02 | 11.85 | 156.25 | 149.02 |
| STARBUCK | Man. | 135.82 | 9.72 | 148.82 | 142.53 |
| STEINBACH | Man. | 133.64 | 8.64 | 145.02 | 139.56 |
| STONEWALL | Man. | 133.46 | 9.73 | 146.30 | 140.12 |
| STONY MNT | Man. | 129.40 | 6.99 | 138.80 | 134.24 |
| ST ALBANS | Man. | 139.23 | 10.60 | 153.11 | 146.46 |
| ST BONIFACE | Man. | 133.25 | 7.93 | 143.78 | 138.71 |
| SWAN RIVER | Man. | 134.02 | 11.41 | 148.69 | 141.73 |
| THE PAS | Man. | 135.21 | 8.59 | 146.25 | 141.01 |
| VIRDEN | Man. | 130.39 | 8.03 | 140.70 | 135.81 |
| VOGAR | Man. | 125.95 | 6.28 | 134.31 | 130.27 |
| WASAGAMING | Man. | 151.67 | 13.67 | 169.79 | 161.06 |
| WASKADA | Man. | 134.67 | 8.26 | 145.49 | 140.31 |
| WILSON CREEK | Man. | 130.71 | 7.98 | 141.38 | 136.21 |
| WINNIPEG | Man. | 133.27 | 8.40 | 144.07 | 138.94 |

Table B5: First Fall Frost (-2.2°c)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 265.94 | 6.68 | 257.04 | 261.34 |
| ARRAN | Sask. | 259.93 | 7.78 | 249.73 | 254.62 |
| AYLSHAM | Sask. | 265.45 | 7.17 | 255.92 | 260.51 |
| BANGOR | Sask. | 261.75 | 7.61 | 251.65 | 256.52 |
| BROADVIEW | Sask. | 259.19 | 10.74 | 245.38 | 251.93 |
| CARDROSS | Sask. | 265.17 | 7.64 | 255.08 | 259.93 |
| CARLYLE | Sask. | 262.28 | 9.68 | 249.84 | 255.74 |
| CARON | Sask. | 259.80 | 14.04 | 241.75 | 250.32 |
| CEYLON | Sask. | 263.46 | 9.51 | 251.24 | 257.04 |
| COTE | Sask. | 260.50 | 10.82 | 246.08 | 253.05 |
| CUPAR | Sask. | 258.88 | 11.51 | 243.74 | 251.01 |
| DAFOE | Sask. | 261.95 | 10.73 | 247.67 | 254.56 |
| DAHINDA | Sask. | 267.00 | 7.83 | 256.43 | 261.57 |
| DAVIDSON | Sask. | 264.44 | 9.37 | 252.39 | 258.11 |
| DAVIN | Sask. | 260.35 | 11.46 | 245.13 | 252.46 |
| DUVAL | Sask. | 268.08 | 7.08 | 258.74 | 263.23 |
| ESTEVAN | Sask. | 267.35 | 6.90 | 258.49 | 262.69 |
| FENWOOD | Sask. | 269.40 | 4.63 | 263.17 | 266.20 |
| FERTILE | Sask. | 262.35 | 10.08 | 248.88 | 255.40 |
| FOAM LAKE | Sask. | 261.09 | 12.47 | 245.06 | 252.67 |
| FORT QUAPPELLE | Sask. | 257.23 | 16.07 | 236.08 | 246.24 |
| FRANCIS | Sask. | 256.13 | 11.56 | 241.27 | 248.32 |
| GOOD SPIRIT LAKE | Sask. | 258.30 | 14.20 | 239.54 | 248.56 |
| GRENFELL | Sask. | 260.79 | 10.14 | 247.76 | 253.94 |
| GUERNSEY | Sask. | 264.71 | 11.17 | 249.77 | 257.00 |
| HEWARD | Sask. | 266.71 | 8.28 | 255.54 | 260.97 |
| HUBBARD | Sask. | 258.17 | 10.15 | 244.76 | 251.21 |
| HUDSON BAY | Sask. | 261.27 | 8.58 | 250.24 | 255.47 |
| HUMBOLDT | Sask. | 262.33 | 11.55 | 247.49 | 254.54 |
| IMPERIAL | Sask. | 261.00 | 9.02 | 248.82 | 254.74 |
| INDIAN HEAD | Sask. | 265.07 | 8.00 | 254.79 | 259.67 |
| KAMSACK | Sask. | 256.45 | 15.10 | 237.05 | 246.26 |
| KELLIHER | Sask. | 263.00 | 9.61 | 250.65 | 256.51 |
| KIPLING | Sask. | 266.19 | 6.90 | 256.93 | 261.42 |
| KRISTNES | Sask. | 258.11 | 10.24 | 244.45 | 251.05 |
| KUROKI | Sask. | 263.50 | 9.39 | 251.14 | 257.08 |
| LANGENBURG | Sask. | 262.19 | 7.91 | 251.58 | 256.72 |
| LEROSS | Sask. | 256.35 | 12.71 | 239.48 | 247.61 |
| LINTLAW | Sask. | 257.00 | 13.41 | 239.77 | 247.95 |
| LIPTON | Sask. | 253.81 | 13.62 | 235.90 | 244.50 |
| LUMSDEN | Sask. | 260.81 | 10.16 | 247.76 | 253.96 |
| MARYFIELD | Sask. | 267.71 | 6.43 | 259.04 | 263.25 |
| MELVILLE | Sask. | 262.86 | 8.49 | 251.63 | 257.04 |
| MIDALE | Sask. | 262.57 | 9.20 | 250.75 | 256.36 |
| MOOSE JAW | Sask. | 268.58 | 5.21 | 261.88 | 265.06 |
| MOOSOMIN | Sask. | 265.24 | 9.03 | 253.64 | 259.15 |
| MUENSTER | Sask. | 261.56 | 10.71 | 247.80 | 254.33 |
| NIPAWIN | Sask. | 264.30 | 7.17 | 255.09 | 259.46 |

| | | | | | |
|---|---|---|---|---|---|
| NOKOMIS | Sask. | 261.46 | 10.72 | 247.68 | 254.22 |
| ORMISTON | Sask. | 264.03 | 8.55 | 253.04 | 258.26 |
| PASWEGIN | Sask. | 265.12 | 9.00 | 253.26 | 258.96 |
| PELLY | Sask. | 254.03 | 12.36 | 237.82 | 245.59 |
| PRAIRIE RIVER | Sask. | 251.48 | 13.99 | 232.94 | 241.87 |
| QUAPPELLE | Sask. | 262.60 | 9.55 | 250.34 | 256.16 |
| RAYMORE | Sask. | 264.71 | 10.31 | 251.05 | 257.63 |
| REDVERS | Sask. | 261.12 | 11.87 | 245.22 | 252.93 |
| REGINA | Sask. | 261.02 | 12.82 | 244.54 | 252.37 |
| RIDGEDALE | Sask. | 256.91 | 10.46 | 243.46 | 249.84 |
| ROCANVILLE | Sask. | 265.84 | 8.92 | 253.97 | 259.70 |
| SEMANS | Sask. | 260.65 | 10.64 | 246.98 | 253.47 |
| SOMME | Sask. | 261.88 | 8.28 | 250.81 | 256.17 |
| STRASBOURG | Sask. | 265.33 | 9.01 | 253.75 | 259.25 |
| WAPELLA | Sask. | 262.50 | 12.94 | 245.15 | 253.56 |
| WATROUS | Sask. | 263.36 | 8.66 | 252.24 | 257.52 |
| WEEKS | Sask. | 252.60 | 18.25 | 228.05 | 239.97 |
| WEYBURN | Sask. | 265.17 | 7.99 | 254.90 | 259.78 |
| WHITEWOOD | Sask. | 262.78 | 9.97 | 249.98 | 256.06 |
| WYNYARD | Sask. | 266.83 | 9.45 | 254.37 | 260.36 |
| YELLOW GRASS | Sask. | 261.42 | 11.98 | 246.03 | 253.34 |
| YORKTON | Sask. | 266.23 | 7.68 | 256.36 | 261.04 |
| ALTONA | Man. | 270.29 | 4.97 | 263.90 | 266.94 |
| ARBORG | Man. | 264.56 | 7.70 | 254.43 | 259.29 |
| BALDUR | Man. | 266.77 | 8.19 | 255.99 | 261.17 |
| BEAUSEJOUR | Man. | 265.50 | 8.50 | 254.29 | 259.68 |
| BEDE | Man. | 263.95 | 6.83 | 254.86 | 259.25 |
| BIRTLE | Man. | 259.95 | 12.76 | 243.55 | 251.33 |
| BISSETT | Man. | 267.69 | 7.29 | 258.33 | 262.77 |
| BOISSEVAIN | Man. | 268.90 | 5.73 | 261.54 | 265.03 |
| BRANDON | Man. | 263.60 | 7.97 | 253.35 | 258.21 |
| BROAD VALLEY | Man. | 267.89 | 6.51 | 259.21 | 263.40 |
| CYPRESS RIVER | Man. | 266.24 | 7.00 | 257.24 | 261.51 |
| DAUPHIN | Man. | 267.43 | 6.58 | 258.97 | 262.99 |
| DEERWOOD | Man. | 270.32 | 5.35 | 263.25 | 266.65 |
| DELORAINE | Man. | 263.32 | 9.71 | 250.85 | 256.77 |
| DELTA BEACH | Man. | 268.85 | 5.92 | 260.98 | 264.77 |
| DUGALD | Man. | 267.06 | 6.26 | 258.69 | 262.74 |
| EMERSON | Man. | 267.57 | 6.70 | 258.97 | 263.06 |
| ERIKSDALE | Man. | 263.42 | 6.85 | 254.37 | 258.72 |
| FRASERWOOD | Man. | 264.58 | 8.49 | 253.29 | 258.74 |
| GILBERT PLAINS | Man. | 264.41 | 8.67 | 253.01 | 258.48 |
| GIMLI | Man. | 270.13 | 4.90 | 263.83 | 266.82 |
| GLADSTONE | Man. | 268.56 | 5.74 | 260.87 | 264.60 |
| GLENBORO | Man. | 264.88 | 9.11 | 252.70 | 258.60 |
| GLENLEA | Man. | 266.50 | 8.87 | 254.76 | 260.41 |
| GRAND RAPIDS | Man. | 268.87 | 6.70 | 260.09 | 264.29 |
| GRASS RIVER | Man. | 267.55 | 6.76 | 258.68 | 262.94 |
| GRAYSVILLE | Man. | 268.14 | 6.70 | 259.52 | 263.61 |
| GREAT FALLS | Man. | 270.89 | 5.22 | 264.18 | 267.37 |
| GYPSUMVILLE | Man. | 266.57 | 5.46 | 259.20 | 262.78 |
| HAMIOTA | Man. | 263.10 | 9.23 | 251.24 | 256.87 |

| | | | | | |
|---|---|---|---|---|---|
| HODGESON | Man. | 254.21 | 10.96 | 239.62 | 246.67 |
| INDIAN BAY | Man. | 267.71 | 6.39 | 259.50 | 263.40 |
| LANGRUTH | Man. | 269.00 | 5.34 | 261.88 | 265.32 |
| MARQUETTE | Man. | 268.84 | 5.68 | 261.28 | 264.93 |
| MEADOW PORTAGE | Man. | 265.57 | 9.10 | 253.28 | 259.25 |
| MELITA | Man. | 262.43 | 8.01 | 251.85 | 256.94 |
| MINNEDOSA | Man. | 261.53 | 8.73 | 250.31 | 255.64 |
| MOOSEHORN | Man. | 263.88 | 9.62 | 251.22 | 257.30 |
| MORDEN | Man. | 270.28 | 4.42 | 264.60 | 267.29 |
| MORRIS | Man. | 267.91 | 5.93 | 260.29 | 263.91 |
| MYRTLE | Man. | 269.60 | 4.99 | 262.89 | 266.15 |
| NEEPAWA | Man. | 268.54 | 6.04 | 260.78 | 264.46 |
| NINETTE | Man. | 265.51 | 7.39 | 256.02 | 260.53 |
| OAKNER | Man. | 265.88 | 6.61 | 257.04 | 261.32 |
| PIERSON | Man. | 261.73 | 11.25 | 247.28 | 254.14 |
| PILOT MOUND | Man. | 268.11 | 6.37 | 259.74 | 263.75 |
| PINAWA | Man. | 268.98 | 5.44 | 261.99 | 265.31 |
| PINE FALLS | Man. | 269.19 | 6.20 | 261.03 | 264.95 |
| PLUMAS | Man. | 268.64 | 5.08 | 261.91 | 265.15 |
| PLUM COULEE | Man. | 270.30 | 4.99 | 263.68 | 266.87 |
| PORTAGE LA PRAIRIE | Man. | 270.56 | 4.25 | 265.10 | 267.70 |
| RATHWELL | Man. | 266.63 | 8.85 | 254.85 | 260.54 |
| RIVERS | Man. | 267.19 | 6.64 | 258.65 | 262.71 |
| ROLAND | Man. | 267.82 | 6.60 | 259.09 | 263.29 |
| ROSSBURN | Man. | 260.77 | 10.12 | 247.45 | 253.85 |
| RUSSELL | Man. | 262.21 | 9.56 | 249.92 | 255.76 |
| SELKIRK | Man. | 270.89 | 3.81 | 265.83 | 268.27 |
| SEVEN SISTERS | Man. | 270.50 | 3.93 | 265.26 | 267.79 |
| SHILO | Man. | 265.73 | 7.76 | 255.30 | 260.36 |
| SOMSERSET | Man. | 265.50 | 9.65 | 252.47 | 258.80 |
| SOURIS | Man. | 263.83 | 7.96 | 253.61 | 258.46 |
| SPRAGUE | Man. | 259.07 | 11.14 | 244.75 | 251.55 |
| STARBUCK | Man. | 266.47 | 8.71 | 254.82 | 260.46 |
| STEINBACH | Man. | 268.16 | 5.12 | 261.41 | 264.65 |
| STONEWALL | Man. | 266.58 | 8.20 | 255.77 | 260.97 |
| STONY MNT | Man. | 267.87 | 5.77 | 260.11 | 263.87 |
| ST ALBANS | Man. | 263.13 | 7.98 | 252.67 | 257.68 |
| ST BONIFACE | Man. | 268.90 | 5.34 | 261.81 | 265.23 |
| SWAN RIVER | Man. | 266.05 | 7.46 | 256.46 | 261.01 |
| THE PAS | Man. | 267.71 | 6.05 | 259.94 | 263.63 |
| VIRDEN | Man. | 267.04 | 6.28 | 258.97 | 262.80 |
| VOGAR | Man. | 272.11 | 2.65 | 268.59 | 270.28 |
| WASAGAMING | Man. | 251.81 | 18.22 | 227.66 | 239.29 |
| WASKADA | Man. | 261.47 | 7.27 | 251.93 | 256.50 |
| WILSON CREEK | Man. | 269.88 | 3.95 | 264.60 | 267.15 |
| WINNIPEG | Man. | 268.37 | 5.36 | 261.49 | 264.76 |

Table B6: Frost-Free Period (-2.2°c)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 138.17 | 9.97 | 124.88 | 131.30 |
| ARRAN | Sask. | 118.43 | 13.73 | 100.43 | 109.06 |
| AYLSHAM | Sask. | 134.85 | 10.29 | 121.19 | 127.77 |
| BANGOR | Sask. | 127.00 | 11.72 | 111.44 | 118.94 |
| BROADVIEW | Sask. | 120.73 | 17.97 | 97.64 | 108.60 |
| CARDROSS | Sask. | 134.58 | 13.92 | 116.22 | 125.05 |
| CARLYLE | Sask. | 125.31 | 17.36 | 103.00 | 113.59 |
| CARON | Sask. | 123.82 | 19.35 | 98.96 | 110.76 |
| CEYLON | Sask. | 130.27 | 15.59 | 110.24 | 119.75 |
| COTE | Sask. | 125.11 | 14.57 | 105.68 | 115.07 |
| CUPAR | Sask. | 122.81 | 14.31 | 103.97 | 113.02 |
| DAFOE | Sask. | 123.58 | 15.01 | 103.61 | 113.25 |
| DAHINDA | Sask. | 135.21 | 14.74 | 115.31 | 124.98 |
| DAVIDSON | Sask. | 130.29 | 14.06 | 112.23 | 120.80 |
| DAVIN | Sask. | 127.05 | 16.50 | 105.14 | 115.70 |
| DUVAL | Sask. | 140.75 | 12.42 | 124.36 | 132.24 |
| ESTEVAN | Sask. | 136.96 | 12.77 | 120.56 | 128.34 |
| FENWOOD | Sask. | 142.53 | 9.74 | 129.43 | 135.79 |
| FERTILE | Sask. | 135.41 | 10.84 | 120.92 | 127.93 |
| FOAM LAKE | Sask. | 124.34 | 16.57 | 103.05 | 113.16 |
| FORT QUAPPELLE | Sask. | 117.50 | 21.62 | 89.04 | 102.71 |
| FRANCIS | Sask. | 115.60 | 17.16 | 93.54 | 104.01 |
| GOOD SPIRIT LAKE | Sask. | 121.65 | 21.85 | 92.79 | 106.66 |
| GRENFELL | Sask. | 124.11 | 16.42 | 103.00 | 113.02 |
| GUERNSEY | Sask. | 132.94 | 13.90 | 114.36 | 123.35 |
| HEWARD | Sask. | 133.36 | 14.64 | 113.59 | 123.20 |
| HUBBARD | Sask. | 118.35 | 15.39 | 98.01 | 107.79 |
| HUDSON BAY | Sask. | 121.51 | 12.99 | 104.82 | 112.74 |
| HUMBOLDT | Sask. | 130.35 | 15.60 | 110.31 | 119.82 |
| IMPERIAL | Sask. | 131.00 | 13.82 | 112.34 | 121.41 |
| INDIAN HEAD | Sask. | 129.99 | 14.11 | 111.86 | 120.46 |
| KAMSACK | Sask. | 113.25 | 18.14 | 89.94 | 101.01 |
| KELLIHER | Sask. | 126.44 | 18.54 | 102.61 | 113.92 |
| KIPLING | Sask. | 135.31 | 16.80 | 112.79 | 123.70 |
| KRISTNES | Sask. | 116.61 | 14.65 | 97.07 | 106.51 |
| KUROKI | Sask. | 128.73 | 16.37 | 107.19 | 117.54 |
| LANGENBURG | Sask. | 129.19 | 15.18 | 108.83 | 118.70 |
| LEROSS | Sask. | 113.05 | 18.48 | 88.51 | 100.34 |
| LINTLAW | Sask. | 114.43 | 21.30 | 87.06 | 100.05 |
| LIPTON | Sask. | 116.04 | 20.01 | 89.72 | 102.35 |
| LUMSDEN | Sask. | 123.40 | 16.30 | 102.45 | 112.39 |
| MARYFIELD | Sask. | 142.07 | 9.54 | 129.19 | 135.45 |
| MELVILLE | Sask. | 129.59 | 14.54 | 110.35 | 119.61 |
| MIDALE | Sask. | 128.12 | 15.25 | 108.52 | 117.82 |
| MOOSE JAW | Sask. | 137.83 | 12.48 | 121.79 | 129.40 |
| MOOSOMIN | Sask. | 136.96 | 11.51 | 122.16 | 129.19 |
| MUENSTER | Sask. | 126.28 | 17.23 | 104.13 | 114.65 |
| NIPAWIN | Sask. | 129.79 | 12.90 | 113.21 | 121.08 |

| | | | | | |
|---|---|---|---|---|---|
| NOKOMIS | Sask. | 127.73 | 14.60 | 108.97 | 117.87 |
| ORMISTON | Sask. | 134.56 | 12.42 | 118.60 | 126.17 |
| PASWEGIN | Sask. | 132.16 | 14.74 | 112.74 | 122.07 |
| PELLY | Sask. | 105.53 | 18.57 | 81.19 | 92.85 |
| PRAIRIE RIVER | Sask. | 101.33 | 22.21 | 71.89 | 86.07 |
| QUAPPELLE | Sask. | 124.53 | 15.31 | 104.86 | 114.20 |
| RAYMORE | Sask. | 133.05 | 14.26 | 114.15 | 123.25 |
| REDVERS | Sask. | 126.44 | 18.61 | 101.49 | 113.58 |
| REGINA | Sask. | 125.65 | 17.45 | 103.23 | 113.87 |
| RIDGEDALE | Sask. | 110.06 | 14.64 | 91.25 | 100.18 |
| ROCANVILLE | Sask. | 137.84 | 15.71 | 116.94 | 127.03 |
| SEMANS | Sask. | 125.85 | 13.49 | 108.52 | 116.74 |
| SOMME | Sask. | 120.65 | 17.35 | 97.45 | 108.68 |
| STRASBOURG | Sask. | 131.17 | 15.00 | 111.90 | 121.04 |
| WAPELLA | Sask. | 132.94 | 15.47 | 112.20 | 122.25 |
| WATROUS | Sask. | 128.67 | 13.93 | 110.77 | 119.26 |
| WEEKS | Sask. | 103.73 | 21.99 | 74.16 | 88.52 |
| WEYBURN | Sask. | 132.36 | 14.69 | 113.48 | 122.44 |
| WHITEWOOD | Sask. | 125.78 | 15.46 | 105.91 | 115.35 |
| WYNYARD | Sask. | 134.75 | 13.50 | 116.94 | 125.50 |
| YELLOW GRASS | Sask. | 125.78 | 16.55 | 104.51 | 114.61 |
| YORKTON | Sask. | 132.66 | 11.92 | 117.34 | 124.61 |
| ALTONA | Man. | 141.71 | 11.09 | 127.46 | 134.22 |
| ARBORG | Man. | 124.44 | 10.85 | 110.17 | 117.02 |
| BALDUR | Man. | 134.69 | 11.59 | 119.43 | 126.76 |
| BEAUSEJOUR | Man. | 126.79 | 15.72 | 106.05 | 116.02 |
| BEDE | Man. | 133.63 | 10.25 | 119.99 | 126.58 |
| BIRTLE | Man. | 121.56 | 17.22 | 99.43 | 109.94 |
| BISSETT | Man. | 134.28 | 12.37 | 118.39 | 125.93 |
| BOISSEVAIN | Man. | 138.13 | 10.30 | 124.89 | 131.18 |
| BRANDON | Man. | 127.33 | 12.75 | 110.95 | 118.72 |
| BROAD VALLEY | Man. | 134.11 | 11.73 | 118.47 | 126.03 |
| CYPRESS RIVER | Man. | 133.86 | 11.73 | 118.79 | 125.94 |
| DAUPHIN | Man. | 130.83 | 12.76 | 114.43 | 122.21 |
| DEERWOOD | Man. | 137.86 | 8.46 | 126.67 | 132.06 |
| DELORAINE | Man. | 130.78 | 12.80 | 114.34 | 122.15 |
| DELTA BEACH | Man. | 139.85 | 7.48 | 129.92 | 134.70 |
| DUGALD | Man. | 129.53 | 12.72 | 112.53 | 120.75 |
| EMERSON | Man. | 135.11 | 13.37 | 117.92 | 126.08 |
| ERIKSDALE | Man. | 124.96 | 13.56 | 107.06 | 115.67 |
| FRASERWOOD | Man. | 125.84 | 13.62 | 107.72 | 116.47 |
| GILBERT PLAINS | Man. | 125.48 | 19.32 | 100.07 | 112.26 |
| GIMLI | Man. | 138.47 | 10.89 | 124.47 | 131.11 |
| GLADSTONE | Man. | 136.62 | 8.64 | 125.04 | 130.65 |
| GLENBORO | Man. | 136.24 | 11.82 | 120.43 | 128.08 |
| GLENLEA | Man. | 132.73 | 15.13 | 112.71 | 122.35 |
| GRAND RAPIDS | Man. | 132.45 | 12.61 | 115.92 | 123.84 |
| GRASS RIVER | Man. | 132.62 | 12.79 | 115.84 | 123.89 |
| GRAYSVILLE | Man. | 136.72 | 12.30 | 120.92 | 128.42 |
| GREAT FALLS | Man. | 141.82 | 10.57 | 128.25 | 134.69 |
| GYPSUMVILLE | Man. | 126.29 | 16.39 | 104.15 | 114.91 |
| HAMIOTA | Man. | 126.24 | 14.33 | 107.82 | 116.56 |

| | | | | | |
|---|---|---|---|---|---|
| HODGESON | Man. | 111.74 | 12.64 | 94.92 | 103.04 |
| INDIAN BAY | Man. | 131.64 | 11.82 | 116.45 | 123.66 |
| LANGRUTH | Man. | 138.61 | 7.64 | 128.42 | 133.35 |
| MARQUETTE | Man. | 139.47 | 9.12 | 127.33 | 133.20 |
| MEADOW PORTAGE | Man. | 133.29 | 12.00 | 117.09 | 124.96 |
| MELITA | Man. | 124.52 | 14.63 | 105.19 | 114.48 |
| MINNEDOSA | Man. | 122.18 | 13.82 | 104.42 | 112.85 |
| MOOSEHORN | Man. | 122.58 | 17.77 | 99.19 | 110.42 |
| MORDEN | Man. | 140.26 | 9.75 | 127.73 | 133.68 |
| MORRIS | Man. | 134.70 | 12.57 | 118.54 | 126.21 |
| MYRTLE | Man. | 139.13 | 12.58 | 122.21 | 130.43 |
| NEEPAWA | Man. | 138.07 | 11.17 | 123.72 | 130.53 |
| NINETTE | Man. | 129.08 | 13.67 | 111.51 | 119.85 |
| OAKNER | Man. | 138.71 | 8.67 | 127.12 | 132.73 |
| PIERSON | Man. | 129.25 | 15.60 | 109.20 | 118.72 |
| PILOT MOUND | Man. | 138.32 | 11.51 | 123.20 | 130.45 |
| PINAWA | Man. | 133.81 | 11.59 | 118.91 | 125.99 |
| PINE FALLS | Man. | 137.89 | 12.33 | 121.68 | 129.46 |
| PLUMAS | Man. | 138.45 | 9.53 | 125.84 | 131.92 |
| PLUM COULEE | Man. | 143.10 | 8.28 | 132.10 | 137.40 |
| PORTAGE LA PRAIRIE | Man. | 141.06 | 9.59 | 128.73 | 134.58 |
| RATHWELL | Man. | 138.79 | 9.52 | 126.12 | 132.24 |
| RIVERS | Man. | 133.84 | 11.43 | 119.16 | 126.13 |
| ROLAND | Man. | 135.68 | 11.00 | 121.13 | 128.14 |
| ROSSBURN | Man. | 126.27 | 13.96 | 107.89 | 116.72 |
| RUSSELL | Man. | 125.11 | 17.23 | 102.97 | 113.48 |
| SELKIRK | Man. | 141.21 | 7.68 | 131.00 | 135.93 |
| SEVEN SISTERS | Man. | 139.33 | 9.09 | 127.21 | 133.07 |
| SHILO | Man. | 131.53 | 13.10 | 113.92 | 122.47 |
| SOMSERSET | Man. | 137.07 | 11.29 | 121.83 | 129.24 |
| SOURIS | Man. | 124.78 | 14.98 | 105.53 | 114.66 |
| SPRAGUE | Man. | 118.05 | 18.28 | 94.56 | 105.71 |
| STARBUCK | Man. | 130.65 | 14.90 | 110.73 | 120.37 |
| STEINBACH | Man. | 134.52 | 10.29 | 120.96 | 127.47 |
| STONEWALL | Man. | 133.12 | 14.23 | 114.35 | 123.38 |
| STONY MNT | Man. | 138.47 | 9.76 | 125.34 | 131.71 |
| ST ALBANS | Man. | 123.90 | 14.30 | 105.16 | 114.13 |
| ST BONIFACE | Man. | 135.65 | 7.58 | 125.58 | 130.43 |
| SWAN RIVER | Man. | 132.02 | 14.78 | 113.03 | 122.04 |
| THE PAS | Man. | 132.51 | 10.91 | 118.48 | 125.14 |
| VIRDEN | Man. | 136.65 | 11.00 | 122.51 | 129.22 |
| VOGAR | Man. | 146.16 | 6.60 | 137.37 | 141.62 |
| WASAGAMING | Man. | 100.14 | 26.54 | 64.96 | 81.91 |
| WASKADA | Man. | 126.80 | 10.98 | 112.40 | 119.30 |
| WILSON CREEK | Man. | 139.18 | 9.40 | 126.62 | 132.69 |
| WINNIPEG | Man. | 135.10 | 10.12 | 122.10 | 128.27 |

Table B7: Growing Degree Days Above 5°c

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 1660.17 | 130.36 | 1486.35 | 1570.35 |
| ARRAN | Sask. | 1382.67 | 89.92 | 1264.76 | 1321.26 |
| AYLSHAM | Sask. | 1447.41 | 125.38 | 1280.95 | 1361.15 |
| BANGOR | Sask. | 1487.20 | 101.90 | 1351.90 | 1417.09 |
| BROADVIEW | Sask. | 1441.08 | 117.42 | 1290.20 | 1361.83 |
| CARDROSS | Sask. | 1610.49 | 111.40 | 1463.50 | 1534.18 |
| CARLYLE | Sask. | 1523.46 | 139.89 | 1343.69 | 1429.03 |
| CARON | Sask. | 1634.56 | 101.86 | 1503.67 | 1565.80 |
| CEYLON | Sask. | 1552.19 | 147.50 | 1362.65 | 1452.63 |
| COTE | Sask. | 1509.53 | 118.31 | 1351.77 | 1428.01 |
| CUPAR | Sask. | 1571.67 | 120.43 | 1413.15 | 1489.30 |
| DAFOE | Sask. | 1426.63 | 113.06 | 1276.21 | 1348.84 |
| DAHINDA | Sask. | 1584.75 | 98.63 | 1451.58 | 1516.30 |
| DAVIDSON | Sask. | 1528.96 | 118.79 | 1376.31 | 1448.77 |
| DAVIN | Sask. | 1478.61 | 126.77 | 1310.29 | 1391.39 |
| DUVAL | Sask. | 1606.26 | 115.32 | 1454.09 | 1527.27 |
| ESTEVAN | Sask. | 1689.11 | 126.86 | 1526.10 | 1603.48 |
| FENWOOD | Sask. | 1459.64 | 115.33 | 1304.52 | 1379.83 |
| FERTILE | Sask. | 1598.82 | 99.31 | 1466.07 | 1530.30 |
| FOAM LAKE | Sask. | 1453.25 | 108.94 | 1313.26 | 1379.72 |
| FORT QUAPPELLE | Sask. | 1597.89 | 118.15 | 1442.37 | 1517.07 |
| FRANCIS | Sask. | 1527.96 | 127.49 | 1364.14 | 1441.91 |
| GOOD SPIRIT LAKE | Sask. | 1431.53 | 87.83 | 1315.48 | 1371.28 |
| GRENFELL | Sask. | 1540.20 | 123.02 | 1382.12 | 1457.16 |
| GUERNSEY | Sask. | 1533.74 | 113.23 | 1382.38 | 1455.61 |
| HEWARD | Sask. | 1600.06 | 115.36 | 1444.30 | 1520.00 |
| HUBBARD | Sask. | 1359.43 | 125.89 | 1193.10 | 1273.07 |
| HUDSON BAY | Sask. | 1347.70 | 97.77 | 1222.06 | 1281.70 |
| HUMBOLDT | Sask. | 1434.23 | 128.97 | 1268.49 | 1347.17 |
| IMPERIAL | Sask. | 1551.95 | 120.01 | 1389.92 | 1468.67 |
| INDIAN HEAD | Sask. | 1579.43 | 126.67 | 1416.65 | 1493.92 |
| KAMSACK | Sask. | 1502.21 | 108.80 | 1362.40 | 1428.77 |
| KELLIHER | Sask. | 1423.93 | 109.92 | 1282.69 | 1349.74 |
| KIPLING | Sask. | 1433.77 | 143.16 | 1241.85 | 1334.85 |
| KRISTNES | Sask. | 1408.43 | 94.96 | 1281.81 | 1343.00 |
| KUROKI | Sask. | 1402.17 | 116.10 | 1249.35 | 1322.75 |
| LANGENBURG | Sask. | 1454.67 | 122.23 | 1290.81 | 1370.21 |
| LEROSS | Sask. | 1350.66 | 104.70 | 1211.65 | 1278.62 |
| LINTLAW | Sask. | 1315.48 | 124.76 | 1155.16 | 1231.26 |
| LIPTON | Sask. | 1509.32 | 107.57 | 1367.87 | 1435.74 |
| LUMSDEN | Sask. | 1642.55 | 135.01 | 1469.06 | 1551.42 |
| MARYFIELD | Sask. | 1580.04 | 119.76 | 1418.33 | 1496.92 |
| MELVILLE | Sask. | 1485.42 | 94.25 | 1360.70 | 1420.76 |
| MIDALE | Sask. | 1661.77 | 133.35 | 1490.42 | 1571.76 |
| MOOSE JAW | Sask. | 1695.43 | 126.58 | 1532.77 | 1609.99 |
| MOOSOMIN | Sask. | 1545.01 | 121.33 | 1389.11 | 1463.12 |
| MUENSTER | Sask. | 1426.05 | 109.11 | 1285.85 | 1352.40 |
| NIPAWIN | Sask. | 1469.78 | 108.30 | 1330.61 | 1396.67 |

| | | | | | |
|---|---|---|---|---|---|
| NOKOMIS | Sask. | 1518.89 | 104.97 | 1384.00 | 1448.03 |
| ORMISTON | Sask. | 1633.55 | 105.36 | 1498.17 | 1562.43 |
| PASWEGIN | Sask. | 1419.16 | 104.79 | 1281.07 | 1347.38 |
| PELLY | Sask. | 1243.64 | 99.78 | 1112.79 | 1175.49 |
| PRAIRIE RIVER | Sask. | 1265.04 | 99.11 | 1133.69 | 1196.95 |
| QUAPPELLE | Sask. | 1515.44 | 130.04 | 1348.35 | 1427.67 |
| RAYMORE | Sask. | 1487.84 | 101.67 | 1353.09 | 1417.99 |
| REDVERS | Sask. | 1531.92 | 110.81 | 1383.80 | 1455.47 |
| REGINA | Sask. | 1579.84 | 120.89 | 1424.49 | 1498.23 |
| RIDGEDALE | Sask. | 1440.74 | 120.86 | 1285.43 | 1359.15 |
| ROCANVILLE | Sask. | 1595.61 | 103.21 | 1458.30 | 1524.60 |
| SEMANS | Sask. | 1542.21 | 145.33 | 1355.47 | 1444.12 |
| SOMME | Sask. | 1405.57 | 95.18 | 1278.33 | 1339.89 |
| STRASBOURG | Sask. | 1540.66 | 148.28 | 1350.12 | 1440.57 |
| WAPELLA | Sask. | 1524.07 | 103.64 | 1385.14 | 1452.46 |
| WATROUS | Sask. | 1505.26 | 110.91 | 1362.75 | 1430.40 |
| WEEKS | Sask. | 1292.17 | 93.78 | 1166.03 | 1227.27 |
| WEYBURN | Sask. | 1651.34 | 112.22 | 1507.14 | 1575.59 |
| WHITEWOOD | Sask. | 1471.56 | 121.93 | 1314.89 | 1389.26 |
| WYNYARD | Sask. | 1468.80 | 108.68 | 1325.39 | 1394.35 |
| YELLOW GRASS | Sask. | 1600.38 | 118.25 | 1448.43 | 1520.56 |
| YORKTON | Sask. | 1502.27 | 128.85 | 1336.71 | 1415.30 |
| ALTONA | Man. | 1761.07 | 125.45 | 1599.88 | 1676.40 |
| ARBORG | Man. | 1495.42 | 108.48 | 1352.77 | 1421.22 |
| BALDUR | Man. | 1601.75 | 128.04 | 1433.22 | 1514.18 |
| BEAUSEJOUR | Man. | 1603.50 | 118.62 | 1446.98 | 1522.24 |
| BEDE | Man. | 1647.83 | 97.69 | 1517.87 | 1580.62 |
| BIRTLE | Man. | 1483.93 | 123.66 | 1325.03 | 1400.46 |
| BISSETT | Man. | 1568.56 | 142.68 | 1385.23 | 1472.26 |
| BOISSEVAIN | Man. | 1602.87 | 137.30 | 1426.45 | 1510.20 |
| BRANDON | Man. | 1595.45 | 120.29 | 1440.88 | 1514.26 |
| BROAD VALLEY | Man. | 1588.19 | 125.70 | 1420.58 | 1501.58 |
| CYPRESS RIVER | Man. | 1658.46 | 129.47 | 1492.10 | 1571.07 |
| DAUPHIN | Man. | 1580.03 | 141.16 | 1398.64 | 1484.75 |
| DEERWOOD | Man. | 1697.99 | 117.39 | 1542.66 | 1617.46 |
| DELORAINE | Man. | 1627.83 | 99.19 | 1500.37 | 1560.88 |
| DELTA BEACH | Man. | 1600.77 | 112.35 | 1451.60 | 1523.48 |
| DUGALD | Man. | 1597.29 | 119.40 | 1437.67 | 1514.90 |
| EMERSON | Man. | 1767.23 | 158.18 | 1563.97 | 1660.46 |
| ERIKSDALE | Man. | 1531.14 | 141.57 | 1344.58 | 1434.17 |
| FRASERWOOD | Man. | 1581.32 | 130.81 | 1407.29 | 1491.32 |
| GILBERT PLAINS | Man. | 1491.07 | 100.06 | 1359.49 | 1422.63 |
| GIMLI | Man. | 1542.72 | 115.31 | 1394.55 | 1464.89 |
| GLADSTONE | Man. | 1647.58 | 126.47 | 1478.04 | 1560.19 |
| GLENBORO | Man. | 1665.98 | 101.48 | 1530.31 | 1595.95 |
| GLENLEA | Man. | 1646.55 | 135.04 | 1467.86 | 1553.91 |
| GRAND RAPIDS | Man. | 1395.19 | 121.22 | 1236.34 | 1312.40 |
| GRASS RIVER | Man. | 1610.08 | 114.98 | 1459.18 | 1531.56 |
| GRAYSVILLE | Man. | 1659.77 | 127.88 | 1495.45 | 1573.45 |
| GREAT FALLS | Man. | 1662.05 | 123.97 | 1502.74 | 1578.37 |
| GYPSUMVILLE | Man. | 1442.97 | 96.33 | 1312.91 | 1376.12 |
| HAMIOTA | Man. | 1552.49 | 124.80 | 1392.13 | 1468.25 |

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|---|---|---|---|---|---|
| HODGESON | Man. | 1425.66 | 118.89 | 1267.49 | 1343.87 |
| INDIAN BAY | Man. | 1550.27 | 123.38 | 1391.73 | 1466.99 |
| LANGRUTH | Man. | 1608.72 | 124.45 | 1442.78 | 1522.98 |
| MARQUETTE | Man. | 1711.79 | 122.64 | 1548.63 | 1627.41 |
| MEADOW PORTAGE | Man. | 1490.34 | 113.68 | 1336.85 | 1411.45 |
| MELITA | Man. | 1626.63 | 123.37 | 1463.63 | 1541.99 |
| MINNEDOSA | Man. | 1441.53 | 136.77 | 1265.79 | 1349.21 |
| MOOSEHORN | Man. | 1515.13 | 120.80 | 1356.12 | 1432.50 |
| MORDEN | Man. | 1783.14 | 135.01 | 1609.65 | 1692.01 |
| MORRIS | Man. | 1777.68 | 168.70 | 1560.91 | 1663.81 |
| MYRTLE | Man. | 1648.84 | 107.75 | 1503.92 | 1574.28 |
| NEEPAWA | Man. | 1590.98 | 110.79 | 1448.62 | 1516.20 |
| NINETTE | Man. | 1642.78 | 133.11 | 1471.74 | 1552.93 |
| OAKNER | Man. | 1561.04 | 126.26 | 1392.25 | 1473.91 |
| PIERSON | Man. | 1656.32 | 134.65 | 1483.30 | 1565.44 |
| PILOT MOUND | Man. | 1565.07 | 106.11 | 1425.67 | 1492.48 |
| PINAWA | Man. | 1553.82 | 119.40 | 1400.39 | 1473.22 |
| PINE FALLS | Man. | 1578.97 | 111.80 | 1431.95 | 1502.50 |
| PLUMAS | Man. | 1623.70 | 121.31 | 1463.42 | 1540.48 |
| PLUM COULEE | Man. | 1810.51 | 126.51 | 1642.55 | 1723.47 |
| PORTAGE LA PRAIRIE | Man. | 1692.63 | 126.66 | 1529.88 | 1607.14 |
| RATHWELL | Man. | 1681.51 | 122.72 | 1518.24 | 1597.08 |
| RIVERS | Man. | 1571.40 | 115.17 | 1423.41 | 1493.66 |
| ROLAND | Man. | 1672.75 | 112.29 | 1524.17 | 1595.72 |
| ROSSBURN | Man. | 1485.00 | 111.35 | 1338.44 | 1408.84 |
| RUSSELL | Man. | 1450.33 | 114.96 | 1302.60 | 1372.73 |
| SELKIRK | Man. | 1685.42 | 144.48 | 1493.20 | 1586.02 |
| SEVEN SISTERS | Man. | 1580.16 | 120.55 | 1419.42 | 1497.10 |
| SHILO | Man. | 1653.72 | 111.39 | 1503.90 | 1576.64 |
| SOMSERSET | Man. | 1543.58 | 125.45 | 1374.21 | 1456.52 |
| SOURIS | Man. | 1627.62 | 127.57 | 1463.70 | 1541.52 |
| SPRAGUE | Man. | 1551.45 | 113.51 | 1405.59 | 1474.83 |
| STARBUCK | Man. | 1669.17 | 111.71 | 1519.83 | 1592.09 |
| STEINBACH | Man. | 1644.09 | 126.01 | 1478.03 | 1557.77 |
| STONEWALL | Man. | 1623.22 | 127.34 | 1455.20 | 1535.99 |
| STONY MNT | Man. | 1678.67 | 147.97 | 1479.65 | 1576.27 |
| ST ALBANS | Man. | 1751.33 | 132.41 | 1577.82 | 1660.89 |
| ST BONIFACE | Man. | 1693.32 | 143.39 | 1502.94 | 1594.67 |
| SWAN RIVER | Man. | 1485.50 | 109.99 | 1344.16 | 1411.26 |
| THE PAS | Man. | 1367.60 | 113.94 | 1221.19 | 1290.69 |
| VIRDEN | Man. | 1632.30 | 130.74 | 1464.30 | 1544.05 |
| VOGAR | Man. | 1582.96 | 114.68 | 1430.98 | 1504.18 |
| WASAGAMING | Man. | 1256.89 | 118.04 | 1100.45 | 1175.79 |
| WASKADA | Man. | 1692.75 | 154.69 | 1490.04 | 1587.10 |
| WILSON CREEK | Man. | 1604.96 | 128.75 | 1432.85 | 1516.12 |
| WINNIPEG | Man. | 1696.82 | 130.17 | 1529.55 | 1608.95 |

Table B8: Growing Degree Days Above 10°c

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 1008.28 | 117.25 | 851.93 | 927.49 |
| ARRAN | Sask. | 782.44 | 77.20 | 681.20 | 729.71 |
| AYLSHAM | Sask. | 819.70 | 105.47 | 679.67 | 747.13 |
| BANGOR | Sask. | 867.88 | 91.79 | 746.01 | 804.73 |
| BROADVIEW | Sask. | 830.98 | 98.70 | 704.15 | 764.35 |
| CARDROSS | Sask. | 975.33 | 97.22 | 847.04 | 908.73 |
| CARLYLE | Sask. | 898.56 | 117.74 | 747.26 | 819.08 |
| CARON | Sask. | 1002.92 | 87.44 | 890.56 | 943.90 |
| CEYLON | Sask. | 923.52 | 122.35 | 766.30 | 840.93 |
| COTE | Sask. | 888.26 | 96.90 | 759.05 | 821.50 |
| CUPAR | Sask. | 943.79 | 107.72 | 801.99 | 870.10 |
| DAFOE | Sask. | 811.17 | 100.63 | 677.29 | 741.94 |
| DAHINDA | Sask. | 942.77 | 80.81 | 833.66 | 886.69 |
| DAVIDSON | Sask. | 902.92 | 98.15 | 776.80 | 836.67 |
| DAVIN | Sask. | 856.18 | 113.02 | 706.13 | 778.43 |
| DUVAL | Sask. | 948.31 | 99.65 | 816.82 | 880.05 |
| ESTEVAN | Sask. | 1033.02 | 110.30 | 891.29 | 958.57 |
| FENWOOD | Sask. | 822.86 | 97.63 | 691.56 | 755.31 |
| FERTILE | Sask. | 954.09 | 85.65 | 839.59 | 894.99 |
| FOAM LAKE | Sask. | 835.81 | 89.73 | 720.51 | 775.24 |
| FORT QUAPPELLE | Sask. | 978.33 | 107.55 | 836.76 | 904.76 |
| FRANCIS | Sask. | 915.53 | 106.37 | 778.84 | 843.73 |
| GOOD SPIRIT LAKE | Sask. | 813.31 | 74.43 | 714.98 | 762.25 |
| GRENFELL | Sask. | 920.56 | 103.07 | 788.11 | 850.98 |
| GUERNSEY | Sask. | 899.40 | 99.21 | 766.78 | 830.95 |
| HEWARD | Sask. | 964.74 | 101.33 | 827.93 | 894.42 |
| HUBBARD | Sask. | 770.38 | 97.76 | 641.22 | 703.32 |
| HUDSON BAY | Sask. | 754.52 | 78.68 | 653.42 | 701.42 |
| HUMBOLDT | Sask. | 819.52 | 102.54 | 687.76 | 750.30 |
| IMPERIAL | Sask. | 916.88 | 109.46 | 769.08 | 840.91 |
| INDIAN HEAD | Sask. | 941.19 | 109.16 | 800.91 | 867.50 |
| KAMSACK | Sask. | 883.75 | 92.63 | 764.72 | 821.22 |
| KELLIHER | Sask. | 810.04 | 94.06 | 689.18 | 746.55 |
| KIPLING | Sask. | 826.50 | 118.52 | 667.61 | 744.60 |
| KRISTNES | Sask. | 804.29 | 85.92 | 689.72 | 745.09 |
| KUROKI | Sask. | 788.30 | 93.20 | 665.63 | 724.56 |
| LANGENBURG | Sask. | 839.25 | 107.89 | 694.62 | 764.70 |
| LEROSS | Sask. | 756.26 | 86.78 | 641.05 | 696.56 |
| LINTLAW | Sask. | 726.60 | 100.53 | 597.42 | 658.74 |
| LIPTON | Sask. | 890.82 | 91.46 | 770.55 | 828.26 |
| LUMSDEN | Sask. | 1004.29 | 117.81 | 852.90 | 924.77 |
| MARYFIELD | Sask. | 929.73 | 105.51 | 787.28 | 856.51 |
| MELVILLE | Sask. | 859.74 | 77.56 | 757.11 | 806.54 |
| MIDALE | Sask. | 1020.26 | 116.17 | 870.97 | 941.84 |
| MOOSE JAW | Sask. | 1040.11 | 110.06 | 898.68 | 965.81 |
| MOOSOMIN | Sask. | 908.00 | 105.14 | 772.90 | 837.03 |
| MUENSTER | Sask. | 811.17 | 92.84 | 691.87 | 748.50 |
| NIPAWIN | Sask. | 847.19 | 89.68 | 731.95 | 786.65 |

| | | | | | |
|---|---|---|---|---|---|
| NOKOMIS | Sask. | 892.93 | 89.16 | 778.36 | 832.75 |
| ORMISTON | Sask. | 984.45 | 93.11 | 864.81 | 921.60 |
| PASWEGIN | Sask. | 798.66 | 89.63 | 680.54 | 737.26 |
| PELLY | Sask. | 678.15 | 82.02 | 570.59 | 622.13 |
| PRAIRIE RIVER | Sask. | 700.70 | 76.45 | 599.38 | 648.18 |
| QUAPPELLE | Sask. | 891.00 | 110.80 | 748.62 | 816.21 |
| RAYMORE | Sask. | 860.73 | 89.32 | 742.35 | 799.36 |
| REDVERS | Sask. | 904.79 | 95.79 | 776.74 | 838.70 |
| REGINA | Sask. | 947.63 | 103.96 | 814.04 | 877.46 |
| RIDGEDALE | Sask. | 844.47 | 99.48 | 716.64 | 777.32 |
| ROCANVILLE | Sask. | 954.23 | 90.50 | 833.83 | 891.96 |
| SEMANS | Sask. | 916.62 | 128.78 | 751.14 | 829.70 |
| SOMME | Sask. | 794.98 | 78.77 | 689.68 | 740.63 |
| STRASBOURG | Sask. | 909.99 | 126.69 | 747.18 | 824.47 |
| WAPELLA | Sask. | 888.24 | 88.83 | 769.15 | 826.86 |
| WATROUS | Sask. | 875.94 | 96.35 | 752.13 | 810.90 |
| WEEKS | Sask. | 720.73 | 85.05 | 606.34 | 661.88 |
| WEYBURN | Sask. | 1002.17 | 101.81 | 871.35 | 933.45 |
| WHITEWOOD | Sask. | 853.12 | 100.75 | 723.66 | 785.11 |
| WYNYARD | Sask. | 838.34 | 92.20 | 716.67 | 775.18 |
| YELLOW GRASS | Sask. | 972.08 | 100.94 | 842.37 | 903.94 |
| YORKTON | Sask. | 874.36 | 108.94 | 734.38 | 800.83 |
| ALTONA | Man. | 1090.46 | 113.65 | 944.42 | 1013.75 |
| ARBORG | Man. | 871.66 | 93.97 | 748.09 | 807.39 |
| BALDUR | Man. | 962.32 | 111.81 | 815.15 | 885.85 |
| BEAUSEJOUR | Man. | 965.04 | 104.12 | 827.66 | 893.72 |
| BEDE | Man. | 1004.96 | 85.81 | 890.80 | 945.93 |
| BIRTLE | Man. | 863.67 | 103.99 | 730.04 | 793.48 |
| BISSETT | Man. | 931.72 | 117.94 | 780.16 | 852.11 |
| BOISSEVAIN | Man. | 954.13 | 112.55 | 809.50 | 878.16 |
| BRANDON | Man. | 958.73 | 103.65 | 825.54 | 888.77 |
| BROAD VALLEY | Man. | 942.90 | 107.38 | 799.71 | 868.91 |
| CYPRESS RIVER | Man. | 1008.16 | 112.24 | 863.93 | 932.40 |
| DAUPHIN | Man. | 941.79 | 119.66 | 788.02 | 861.02 |
| DEERWOOD | Man. | 1042.10 | 108.93 | 897.96 | 967.37 |
| DELORAINE | Man. | 987.78 | 84.31 | 879.44 | 930.87 |
| DELTA BEACH | Man. | 946.90 | 96.45 | 818.84 | 880.54 |
| DUGALD | Man. | 958.20 | 97.77 | 827.50 | 890.74 |
| EMERSON | Man. | 1103.00 | 138.24 | 925.37 | 1009.69 |
| ERIKSDALE | Man. | 903.89 | 118.87 | 747.25 | 822.47 |
| FRASERWOOD | Man. | 941.25 | 113.02 | 790.89 | 863.49 |
| GILBERT PLAINS | Man. | 873.32 | 86.65 | 759.37 | 814.05 |
| GIMLI | Man. | 898.49 | 99.59 | 770.53 | 831.27 |
| GLADSTONE | Man. | 999.11 | 110.22 | 851.35 | 922.95 |
| GLENBORO | Man. | 1011.49 | 90.45 | 890.58 | 949.08 |
| GLENLEA | Man. | 998.06 | 120.96 | 838.00 | 915.08 |
| GRAND RAPIDS | Man. | 784.79 | 96.78 | 657.97 | 718.69 |
| GRASS RIVER | Man. | 969.01 | 102.34 | 834.69 | 899.12 |
| GRAYSVILLE | Man. | 1016.12 | 111.84 | 872.41 | 940.63 |
| GREAT FALLS | Man. | 997.02 | 107.87 | 858.40 | 924.20 |
| GYPSUMVILLE | Man. | 822.57 | 76.13 | 719.79 | 769.74 |
| HAMIOTA | Man. | 919.82 | 103.84 | 786.39 | 849.73 |

| | | | | | |
|---|---|---|---|---|---|
| HODGESON | Man. | 828.29 | 96.22 | 700.28 | 762.09 |
| INDIAN BAY | Man. | 909.20 | 105.34 | 773.83 | 838.09 |
| LANGRUTH | Man. | 949.54 | 108.00 | 805.54 | 875.13 |
| MARQUETTE | Man. | 1044.77 | 109.86 | 898.62 | 969.19 |
| MEADOW PORTAGE | Man. | 849.24 | 84.61 | 734.99 | 790.51 |
| MELITA | Man. | 989.62 | 101.26 | 855.84 | 920.16 |
| MINNEDOSA | Man. | 832.56 | 111.84 | 688.85 | 757.07 |
| MOOSEHORN | Man. | 887.90 | 100.29 | 755.88 | 819.30 |
| MORDEN | Man. | 1111.49 | 119.20 | 958.32 | 1031.03 |
| MORRIS | Man. | 1115.35 | 149.53 | 923.20 | 1014.42 |
| MYRTLE | Man. | 1003.57 | 102.47 | 865.74 | 932.66 |
| NEEPAWA | Man. | 941.09 | 96.82 | 816.68 | 875.74 |
| NINETTE | Man. | 998.20 | 119.83 | 844.21 | 917.31 |
| OAKNER | Man. | 920.14 | 109.06 | 774.35 | 844.89 |
| PIERSON | Man. | 1011.13 | 115.54 | 862.66 | 933.14 |
| PILOT MOUND | Man. | 925.31 | 96.40 | 798.67 | 859.37 |
| PINAWA | Man. | 913.57 | 100.39 | 784.57 | 845.81 |
| PINE FALLS | Man. | 936.63 | 100.32 | 804.71 | 868.01 |
| PLUMAS | Man. | 974.24 | 106.34 | 833.74 | 901.29 |
| PLUM COULEE | Man. | 1135.65 | 114.76 | 983.29 | 1056.70 |
| PORTAGE LA PRAIRIE | Man. | 1030.50 | 112.22 | 886.30 | 954.75 |
| RATHWELL | Man. | 1022.48 | 109.73 | 876.50 | 946.99 |
| RIVERS | Man. | 929.57 | 99.38 | 801.86 | 862.48 |
| ROLAND | Man. | 1015.73 | 100.24 | 883.10 | 946.97 |
| ROSSBURN | Man. | 860.98 | 91.93 | 739.97 | 798.10 |
| RUSSELL | Man. | 833.33 | 94.97 | 711.30 | 769.23 |
| SELKIRK | Man. | 1024.43 | 123.91 | 859.58 | 939.18 |
| SEVEN SISTERS | Man. | 927.98 | 109.34 | 782.18 | 852.64 |
| SHILO | Man. | 1006.04 | 101.71 | 869.24 | 935.66 |
| SOMSERSET | Man. | 899.92 | 101.11 | 763.40 | 829.75 |
| SOURIS | Man. | 987.26 | 110.84 | 844.83 | 912.44 |
| SPRAGUE | Man. | 924.12 | 95.31 | 801.66 | 859.79 |
| STARBUCK | Man. | 1021.33 | 100.23 | 887.34 | 952.17 |
| STEINBACH | Man. | 991.92 | 110.19 | 846.71 | 916.44 |
| STONEWALL | Man. | 976.94 | 112.80 | 828.11 | 899.68 |
| STONY MNT | Man. | 1022.11 | 127.33 | 850.85 | 934.00 |
| ST ALBANS | Man. | 1100.63 | 113.76 | 951.55 | 1022.93 |
| ST BONIFACE | Man. | 1038.10 | 127.27 | 869.13 | 950.54 |
| SWAN RIVER | Man. | 861.46 | 90.69 | 744.92 | 800.24 |
| THE PAS | Man. | 757.75 | 95.28 | 635.31 | 693.43 |
| VIRDEN | Man. | 984.04 | 112.91 | 838.95 | 907.82 |
| VOGAR | Man. | 918.68 | 99.94 | 786.22 | 850.02 |
| WASAGAMING | Man. | 695.10 | 93.04 | 571.79 | 631.18 |
| WASKADA | Man. | 1054.96 | 130.82 | 883.53 | 965.61 |
| WILSON CREEK | Man. | 958.89 | 110.55 | 811.10 | 882.61 |
| WINNIPEG | Man. | 1038.41 | 113.17 | 892.99 | 962.02 |

Table B9: Growing Degree Days Above 15°c

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 516.49 | 91.10 | 395.01 | 453.72 |
| ARRAN | Sask. | 359.07 | 55.86 | 285.82 | 320.92 |
| AYLSHAM | Sask. | 372.79 | 71.19 | 278.26 | 323.81 |
| BANGOR | Sask. | 419.33 | 71.79 | 324.01 | 369.93 |
| BROADVIEW | Sask. | 396.42 | 71.43 | 304.63 | 348.21 |
| CARDROSS | Sask. | 503.46 | 72.88 | 407.30 | 453.54 |
| CARLYLE | Sask. | 442.29 | 85.39 | 332.56 | 384.65 |
| CARON | Sask. | 527.78 | 66.06 | 442.90 | 483.19 |
| CEYLON | Sask. | 462.65 | 85.49 | 352.79 | 404.94 |
| COTE | Sask. | 432.87 | 66.92 | 343.64 | 386.76 |
| CUPAR | Sask. | 478.95 | 82.96 | 369.74 | 422.20 |
| DAFOE | Sask. | 375.81 | 74.96 | 276.09 | 324.24 |
| DAHINDA | Sask. | 468.01 | 56.03 | 392.35 | 429.12 |
| DAVIDSON | Sask. | 449.16 | 69.75 | 359.52 | 402.07 |
| DAVIN | Sask. | 407.67 | 87.95 | 290.90 | 347.17 |
| DUVAL | Sask. | 456.40 | 71.64 | 361.87 | 407.33 |
| ESTEVAN | Sask. | 533.24 | 83.43 | 426.03 | 476.92 |
| FENWOOD | Sask. | 369.74 | 67.73 | 278.65 | 322.87 |
| FERTILE | Sask. | 471.44 | 62.71 | 387.61 | 428.17 |
| FOAM LAKE | Sask. | 393.66 | 61.84 | 314.20 | 351.92 |
| FORT QUAPPELLE | Sask. | 515.54 | 94.04 | 391.75 | 451.22 |
| FRANCIS | Sask. | 466.48 | 77.06 | 367.46 | 414.47 |
| GOOD SPIRIT LAKE | Sask. | 371.55 | 52.18 | 302.60 | 335.75 |
| GRENFELL | Sask. | 464.02 | 75.63 | 366.83 | 412.97 |
| GUERNSEY | Sask. | 437.99 | 71.65 | 342.21 | 388.55 |
| HEWARD | Sask. | 493.17 | 74.19 | 392.99 | 441.68 |
| HUBBARD | Sask. | 360.95 | 66.79 | 272.71 | 315.13 |
| HUDSON BAY | Sask. | 343.05 | 53.12 | 274.79 | 307.20 |
| HUMBOLDT | Sask. | 382.98 | 66.83 | 297.11 | 337.87 |
| IMPERIAL | Sask. | 451.64 | 83.37 | 339.07 | 393.78 |
| INDIAN HEAD | Sask. | 468.04 | 80.19 | 365.00 | 413.92 |
| KAMSACK | Sask. | 431.25 | 69.18 | 342.36 | 384.56 |
| KELLIHER | Sask. | 377.73 | 68.79 | 289.34 | 331.30 |
| KIPLING | Sask. | 393.66 | 80.55 | 285.68 | 338.00 |
| KRISTNES | Sask. | 376.82 | 66.27 | 288.45 | 331.16 |
| KUROKI | Sask. | 358.63 | 61.50 | 277.67 | 316.56 |
| LANGENBURG | Sask. | 397.05 | 81.63 | 287.63 | 340.65 |
| LEROSS | Sask. | 346.42 | 60.73 | 265.79 | 304.64 |
| LINTLAW | Sask. | 323.65 | 68.39 | 235.76 | 277.48 |
| LIPTON | Sask. | 439.85 | 66.93 | 351.84 | 394.07 |
| LUMSDEN | Sask. | 523.87 | 88.80 | 409.76 | 463.93 |
| MARYFIELD | Sask. | 447.11 | 78.07 | 341.70 | 392.93 |
| MELVILLE | Sask. | 408.52 | 56.19 | 334.17 | 369.97 |
| MIDALE | Sask. | 534.86 | 89.66 | 419.65 | 474.34 |
| MOOSE JAW | Sask. | 541.61 | 81.95 | 436.30 | 486.30 |
| MOOSOMIN | Sask. | 435.98 | 78.11 | 335.60 | 383.25 |
| MUENSTER | Sask. | 376.14 | 67.06 | 289.96 | 330.87 |
| NIPAWIN | Sask. | 399.30 | 62.11 | 319.49 | 357.38 |

| | | | | | |
|---|---|---|---|---|---|
| NOKOMIS | Sask. | 438.65 | 66.82 | 352.79 | 393.55 |
| ORMISTON | Sask. | 496.83 | 70.07 | 406.80 | 449.54 |
| PASWEGIN | Sask. | 360.67 | 61.77 | 279.27 | 318.36 |
| PELLY | Sask. | 295.21 | 55.38 | 222.58 | 257.38 |
| PRAIRIE RIVER | Sask. | 313.58 | 47.94 | 250.05 | 280.65 |
| QUAPPELLE | Sask. | 435.50 | 81.21 | 331.15 | 380.69 |
| RAYMORE | Sask. | 407.69 | 64.31 | 322.45 | 363.50 |
| REDVERS | Sask. | 443.50 | 74.36 | 344.09 | 392.19 |
| REGINA | Sask. | 477.98 | 76.84 | 379.24 | 426.12 |
| RIDGEDALE | Sask. | 417.76 | 73.81 | 322.91 | 367.94 |
| ROCANVILLE | Sask. | 472.92 | 67.05 | 383.72 | 426.79 |
| SEMANS | Sask. | 458.04 | 98.69 | 331.22 | 391.42 |
| SOMME | Sask. | 362.81 | 55.06 | 289.20 | 324.82 |
| STRASBOURG | Sask. | 449.03 | 89.72 | 333.74 | 388.47 |
| WAPELLA | Sask. | 424.31 | 65.23 | 336.86 | 379.23 |
| WATROUS | Sask. | 420.72 | 71.30 | 329.09 | 372.59 |
| WEEKS | Sask. | 326.32 | 67.49 | 235.55 | 279.62 |
| WEYBURN | Sask. | 512.02 | 78.10 | 411.66 | 459.30 |
| WHITEWOOD | Sask. | 407.96 | 71.86 | 315.62 | 359.46 |
| WYNYARD | Sask. | 386.59 | 64.57 | 301.39 | 342.36 |
| YELLOW GRASS | Sask. | 505.29 | 76.58 | 406.89 | 453.60 |
| YORKTON | Sask. | 418.28 | 80.41 | 314.95 | 364.00 |
| ALTONA | Man. | 559.04 | 89.77 | 443.69 | 498.45 |
| ARBORG | Man. | 409.43 | 69.38 | 318.20 | 361.97 |
| BALDUR | Man. | 480.76 | 84.68 | 369.30 | 422.84 |
| BEAUSEJOUR | Man. | 480.12 | 80.48 | 373.93 | 424.99 |
| BEDE | Man. | 513.23 | 66.12 | 425.27 | 467.74 |
| BIRTLE | Man. | 411.99 | 77.11 | 312.90 | 359.94 |
| BISSETT | Man. | 449.09 | 85.43 | 339.31 | 391.42 |
| BOISSEVAIN | Man. | 462.73 | 79.54 | 360.52 | 409.04 |
| BRANDON | Man. | 480.31 | 78.40 | 379.56 | 427.39 |
| BROAD VALLEY | Man. | 454.29 | 80.16 | 347.41 | 399.06 |
| CYPRESS RIVER | Man. | 509.96 | 86.96 | 398.22 | 451.26 |
| DAUPHIN | Man. | 463.74 | 87.31 | 351.55 | 404.81 |
| DEERWOOD | Man. | 529.65 | 84.58 | 417.73 | 471.63 |
| DELORAINE | Man. | 498.92 | 62.74 | 418.29 | 456.56 |
| DELTA BEACH | Man. | 444.82 | 72.41 | 348.69 | 395.01 |
| DUGALD | Man. | 471.91 | 67.80 | 381.27 | 425.12 |
| EMERSON | Man. | 577.00 | 107.51 | 438.84 | 504.43 |
| ERIKSDALE | Man. | 435.87 | 85.99 | 322.56 | 376.97 |
| FRASERWOOD | Man. | 455.15 | 84.95 | 342.14 | 396.71 |
| GILBERT PLAINS | Man. | 420.90 | 65.26 | 335.09 | 376.26 |
| GIMLI | Man. | 414.59 | 72.24 | 321.77 | 365.83 |
| GLADSTONE | Man. | 504.96 | 85.43 | 390.43 | 445.92 |
| GLENBORO | Man. | 509.90 | 73.22 | 412.02 | 459.38 |
| GLENLEA | Man. | 498.57 | 96.37 | 371.05 | 432.46 |
| GRAND RAPIDS | Man. | 343.02 | 61.01 | 263.07 | 301.34 |
| GRASS RIVER | Man. | 482.79 | 81.12 | 376.32 | 427.39 |
| GRAYSVILLE | Man. | 521.63 | 83.83 | 413.90 | 465.04 |
| GREAT FALLS | Man. | 479.95 | 79.96 | 377.20 | 425.98 |
| GYPSUMVILLE | Man. | 370.60 | 50.95 | 301.81 | 335.24 |
| HAMIOTA | Man. | 450.63 | 76.04 | 352.92 | 399.30 |

| | | | | | |
|---|---|---|---|---|---|
| HODGESON | Man. | 393.76 | 67.61 | 303.82 | 347.25 |
| INDIAN BAY | Man. | 425.89 | 74.28 | 330.44 | 375.75 |
| LANGRUTH | Man. | 445.24 | 81.13 | 337.05 | 389.33 |
| MARQUETTE | Man. | 522.22 | 85.00 | 409.13 | 463.74 |
| MEADOW PORTAGE | Man. | 371.56 | 48.10 | 306.61 | 338.17 |
| MELITA | Man. | 507.89 | 71.02 | 414.06 | 459.17 |
| MINNEDOSA | Man. | 393.57 | 78.68 | 292.46 | 340.46 |
| MOOSEHORN | Man. | 412.38 | 68.33 | 322.44 | 365.65 |
| MORDEN | Man. | 577.55 | 93.79 | 457.03 | 514.24 |
| MORRIS | Man. | 588.42 | 113.82 | 442.16 | 511.59 |
| MYRTLE | Man. | 508.27 | 83.40 | 396.09 | 450.55 |
| NEEPAWA | Man. | 450.75 | 72.01 | 358.22 | 402.15 |
| NINETTE | Man. | 502.75 | 95.08 | 380.57 | 438.57 |
| OAKNER | Man. | 445.87 | 81.16 | 337.38 | 389.87 |
| PIERSON | Man. | 521.79 | 86.73 | 410.35 | 463.25 |
| PILOT MOUND | Man. | 448.21 | 74.38 | 350.49 | 397.33 |
| PINAWA | Man. | 431.67 | 72.68 | 338.29 | 382.62 |
| PINE FALLS | Man. | 448.91 | 77.97 | 346.38 | 395.58 |
| PLUMAS | Man. | 481.68 | 83.00 | 372.02 | 424.74 |
| PLUM COULEE | Man. | 596.54 | 92.77 | 473.37 | 532.72 |
| PORTAGE LA PRAIRIE | Man. | 515.39 | 85.79 | 405.15 | 457.48 |
| RATHWELL | Man. | 514.29 | 87.66 | 397.67 | 453.98 |
| RIVERS | Man. | 449.47 | 72.01 | 356.94 | 400.87 |
| ROLAND | Man. | 508.52 | 77.44 | 406.05 | 455.40 |
| ROSSBURN | Man. | 404.32 | 65.44 | 318.18 | 359.56 |
| RUSSELL | Man. | 389.93 | 67.95 | 302.60 | 344.06 |
| SELKIRK | Man. | 507.03 | 94.23 | 381.67 | 442.20 |
| SEVEN SISTERS | Man. | 435.36 | 80.81 | 327.61 | 379.68 |
| SHILO | Man. | 509.17 | 79.18 | 402.66 | 454.37 |
| SOMSERSET | Man. | 423.30 | 69.37 | 329.63 | 375.15 |
| SOURIS | Man. | 499.33 | 85.11 | 389.97 | 441.88 |
| SPRAGUE | Man. | 453.70 | 69.26 | 364.70 | 406.95 |
| STARBUCK | Man. | 521.84 | 79.44 | 415.65 | 467.03 |
| STEINBACH | Man. | 488.05 | 83.91 | 377.48 | 430.58 |
| STONEWALL | Man. | 483.54 | 85.49 | 370.74 | 424.98 |
| STONY MNT | Man. | 514.16 | 96.30 | 384.64 | 447.52 |
| ST ALBANS | Man. | 591.70 | 88.77 | 475.38 | 531.07 |
| ST BONIFACE | Man. | 523.84 | 98.71 | 392.77 | 455.92 |
| SWAN RIVER | Man. | 407.98 | 62.56 | 327.59 | 365.75 |
| THE PAS | Man. | 329.12 | 64.83 | 245.82 | 285.36 |
| VIRDEN | Man. | 493.77 | 85.50 | 383.90 | 436.06 |
| VOGAR | Man. | 404.43 | 72.60 | 308.22 | 354.55 |
| WASAGAMING | Man. | 312.78 | 59.82 | 233.50 | 271.68 |
| WASKADA | Man. | 562.86 | 97.49 | 435.11 | 496.28 |
| WILSON CREEK | Man. | 468.65 | 81.49 | 359.72 | 412.42 |
| WINNIPEG | Man. | 524.78 | 85.20 | 415.30 | 467.27 |

Table B10: Corn Heat Units

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 2426.97 | 182.45 | 2183.68 | 2301.26 |
| ARRAN | Sask. | 2060.84 | 172.35 | 1834.81 | 1943.12 |
| AYLSHAM | Sask. | 2181.58 | 213.92 | 1897.56 | 2034.40 |
| BANGOR | Sask. | 2215.36 | 196.85 | 1954.01 | 2079.93 |
| BROADVIEW | Sask. | 2091.38 | 213.53 | 1816.99 | 1947.24 |
| CARDROSS | Sask. | 2296.84 | 180.46 | 2058.73 | 2173.23 |
| CARLYLE | Sask. | 2225.37 | 255.95 | 1896.48 | 2052.60 |
| CARON | Sask. | 2268.99 | 252.07 | 1945.08 | 2098.84 |
| CEYLON | Sask. | 2254.15 | 266.15 | 1912.15 | 2074.50 |
| COTE | Sask. | 2128.49 | 237.21 | 1812.19 | 1965.05 |
| CUPAR | Sask. | 2194.78 | 231.11 | 1890.57 | 2036.70 |
| DAFOE | Sask. | 2121.68 | 225.42 | 1821.78 | 1966.59 |
| DAHINDA | Sask. | 2377.82 | 218.71 | 2082.52 | 2226.03 |
| DAVIDSON | Sask. | 2238.20 | 224.41 | 1949.83 | 2086.72 |
| DAVIN | Sask. | 2147.70 | 180.50 | 1908.05 | 2023.52 |
| DUVAL | Sask. | 2427.29 | 176.71 | 2194.12 | 2306.24 |
| ESTEVAN | Sask. | 2461.97 | 209.30 | 2193.02 | 2320.69 |
| FENWOOD | Sask. | 2263.42 | 189.98 | 2007.90 | 2131.95 |
| FERTILE | Sask. | 2326.29 | 203.00 | 2054.91 | 2186.21 |
| FOAM LAKE | Sask. | 2147.88 | 247.75 | 1829.52 | 1980.65 |
| FORT QUAPPELLE | Sask. | 2147.62 | 211.23 | 1869.59 | 2003.15 |
| FRANCIS | Sask. | 2134.74 | 246.21 | 1818.36 | 1968.55 |
| GOOD SPIRIT LAKE | Sask. | 2081.03 | 251.46 | 1748.80 | 1908.53 |
| GRENFELL | Sask. | 2211.84 | 227.87 | 1919.02 | 2058.02 |
| GUERNSEY | Sask. | 2252.10 | 214.11 | 1965.88 | 2104.37 |
| HEWARD | Sask. | 2357.08 | 214.44 | 2067.55 | 2208.26 |
| HUBBARD | Sask. | 1988.56 | 188.31 | 1739.76 | 1859.38 |
| HUDSON BAY | Sask. | 2017.32 | 171.47 | 1796.98 | 1901.58 |
| HUMBOLDT | Sask. | 2131.37 | 259.06 | 1798.48 | 1956.50 |
| IMPERIAL | Sask. | 2265.23 | 211.15 | 1980.14 | 2118.69 |
| INDIAN HEAD | Sask. | 2326.78 | 230.00 | 2031.24 | 2171.54 |
| KAMSACK | Sask. | 2157.00 | 217.39 | 1877.66 | 2010.26 |
| KELLIHER | Sask. | 2124.96 | 194.54 | 1874.97 | 1993.64 |
| KIPLING | Sask. | 2134.83 | 242.36 | 1809.92 | 1967.36 |
| KRISTNES | Sask. | 2072.39 | 219.55 | 1779.64 | 1921.12 |
| KUROKI | Sask. | 2104.45 | 220.34 | 1814.41 | 1953.73 |
| LANGENBURG | Sask. | 2174.02 | 168.62 | 1947.97 | 2057.51 |
| LEROSS | Sask. | 1933.77 | 220.71 | 1640.73 | 1781.92 |
| LINTLAW | Sask. | 1946.69 | 224.44 | 1658.29 | 1795.20 |
| LIPTON | Sask. | 2091.34 | 242.58 | 1772.35 | 1925.41 |
| LUMSDEN | Sask. | 2284.76 | 204.69 | 2021.73 | 2146.60 |
| MARYFIELD | Sask. | 2397.91 | 186.22 | 2146.48 | 2268.68 |
| MELVILLE | Sask. | 2224.98 | 198.82 | 1961.91 | 2088.59 |
| MIDALE | Sask. | 2327.23 | 226.39 | 2036.32 | 2174.42 |
| MOOSE JAW | Sask. | 2482.44 | 216.23 | 2204.58 | 2336.48 |
| MOOSOMIN | Sask. | 2326.86 | 215.30 | 2050.20 | 2181.53 |
| MUENSTER | Sask. | 2113.20 | 203.33 | 1851.92 | 1975.95 |
| NIPAWIN | Sask. | 2202.87 | 186.16 | 1963.65 | 2077.21 |

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|---|---|---|---|---|---|
| NOKOMIS | Sask. | 2195.56 | 201.94 | 1936.07 | 2059.25 |
| ORMISTON | Sask. | 2383.47 | 201.44 | 2124.62 | 2247.50 |
| PASWEGIN | Sask. | 2120.54 | 182.70 | 1879.78 | 1995.39 |
| PELLY | Sask. | 1808.51 | 219.90 | 1520.14 | 1658.32 |
| PRAIRIE RIVER | Sask. | 1831.04 | 211.28 | 1551.03 | 1685.89 |
| QUAPPELLE | Sask. | 2214.78 | 231.80 | 1916.92 | 2058.31 |
| RAYMORE | Sask. | 2218.72 | 186.65 | 1971.35 | 2090.49 |
| REDVERS | Sask. | 2289.23 | 309.08 | 1876.06 | 2075.97 |
| REGINA | Sask. | 2265.95 | 210.00 | 1996.10 | 2124.20 |
| RIDGEDALE | Sask. | 2053.81 | 221.05 | 1769.76 | 1904.60 |
| ROCANVILLE | Sask. | 2367.88 | 195.15 | 2108.25 | 2233.62 |
| SEMANS | Sask. | 2200.73 | 214.87 | 1924.62 | 2055.69 |
| SOMME | Sask. | 2109.66 | 155.75 | 1901.45 | 2002.19 |
| STRASBOURG | Sask. | 2279.16 | 252.44 | 1954.77 | 2108.76 |
| WAPELLA | Sask. | 2236.05 | 233.88 | 1922.52 | 2074.45 |
| WATROUS | Sask. | 2219.11 | 174.25 | 1995.20 | 2101.49 |
| WEEKS | Sask. | 1903.32 | 189.11 | 1648.96 | 1772.45 |
| WEYBURN | Sask. | 2405.63 | 203.22 | 2144.49 | 2268.46 |
| WHITEWOOD | Sask. | 2165.80 | 212.89 | 1892.24 | 2022.10 |
| WYNYARD | Sask. | 2248.40 | 205.80 | 1976.84 | 2107.42 |
| YELLOW GRASS | Sask. | 2226.73 | 259.01 | 1893.89 | 2051.89 |
| YORKTON | Sask. | 2268.79 | 201.36 | 2010.05 | 2132.88 |
| ALTONA | Man. | 2705.09 | 236.58 | 2401.09 | 2545.40 |
| ARBORG | Man. | 2283.42 | 201.03 | 2019.07 | 2145.92 |
| BALDUR | Man. | 2399.92 | 224.76 | 2104.07 | 2246.19 |
| BEAUSEJOUR | Man. | 2395.97 | 210.17 | 2118.66 | 2252.01 |
| BEDE | Man. | 2425.44 | 190.47 | 2172.04 | 2294.40 |
| BIRTLE | Man. | 2194.81 | 190.25 | 1950.33 | 2066.39 |
| BISSETT | Man. | 2421.93 | 240.62 | 2112.74 | 2259.52 |
| BOISSEVAIN | Man. | 2476.42 | 201.35 | 2217.69 | 2340.51 |
| BRANDON | Man. | 2333.48 | 181.41 | 2100.37 | 2211.02 |
| BROAD VALLEY | Man. | 2405.92 | 188.77 | 2154.21 | 2275.86 |
| CYPRESS RIVER | Man. | 2455.10 | 197.81 | 2200.92 | 2321.58 |
| DAUPHIN | Man. | 2390.74 | 236.45 | 2086.91 | 2231.14 |
| DEERWOOD | Man. | 2618.73 | 244.10 | 2295.74 | 2451.28 |
| DELORAINE | Man. | 2404.33 | 212.28 | 2131.54 | 2261.04 |
| DELTA BEACH | Man. | 2495.61 | 176.36 | 2261.46 | 2374.28 |
| DUGALD | Man. | 2437.81 | 170.59 | 2209.77 | 2320.11 |
| EMERSON | Man. | 2602.11 | 241.27 | 2292.08 | 2439.26 |
| ERIKSDALE | Man. | 2313.73 | 219.86 | 2024.00 | 2163.13 |
| FRASERWOOD | Man. | 2359.43 | 213.01 | 2076.04 | 2212.88 |
| GILBERT PLAINS | Man. | 2239.52 | 178.18 | 2005.22 | 2117.65 |
| GIMLI | Man. | 2450.84 | 215.87 | 2173.46 | 2305.14 |
| GLADSTONE | Man. | 2448.94 | 165.37 | 2227.24 | 2334.67 |
| GLENBORO | Man. | 2456.14 | 168.37 | 2231.07 | 2339.97 |
| GLENLEA | Man. | 2460.57 | 203.10 | 2191.83 | 2321.25 |
| GRAND RAPIDS | Man. | 2208.83 | 230.43 | 1906.87 | 2051.45 |
| GRASS RIVER | Man. | 2412.10 | 171.02 | 2187.63 | 2295.29 |
| GRAYSVILLE | Man. | 2462.64 | 184.74 | 2225.24 | 2337.94 |
| GREAT FALLS | Man. | 2620.43 | 231.34 | 2323.16 | 2464.27 |
| GYPSUMVILLE | Man. | 2254.61 | 152.01 | 2049.37 | 2149.11 |
| HAMIOTA | Man. | 2304.90 | 252.23 | 1980.78 | 2134.64 |

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|---|---|---|---|---|---|
| HODGESON | Man. | 2041.27 | 208.83 | 1763.44 | 1897.60 |
| INDIAN BAY | Man. | 2422.29 | 218.23 | 2141.86 | 2274.99 |
| LANGRUTH | Man. | 2503.48 | 193.23 | 2245.82 | 2370.34 |
| MARQUETTE | Man. | 2602.76 | 178.84 | 2364.83 | 2479.72 |
| MEADOW PORTAGE | Man. | 2327.48 | 220.09 | 2030.32 | 2174.74 |
| MELITA | Man. | 2339.13 | 188.11 | 2090.59 | 2210.08 |
| MINNEDOSA | Man. | 2129.58 | 202.99 | 1868.74 | 1992.56 |
| MOOSEHORN | Man. | 2334.79 | 225.65 | 2037.77 | 2180.45 |
| MORDEN | Man. | 2685.79 | 226.90 | 2394.23 | 2532.63 |
| MORRIS | Man. | 2650.89 | 240.52 | 2341.82 | 2488.53 |
| MYRTLE | Man. | 2470.26 | 141.02 | 2280.58 | 2372.67 |
| NEEPAWA | Man. | 2449.67 | 216.82 | 2171.05 | 2303.31 |
| NINETTE | Man. | 2450.33 | 197.31 | 2196.79 | 2317.15 |
| OAKNER | Man. | 2331.88 | 178.62 | 2093.10 | 2208.63 |
| PIERSON | Man. | 2336.82 | 229.77 | 2041.57 | 2181.72 |
| PILOT MOUND | Man. | 2398.37 | 208.30 | 2124.72 | 2255.89 |
| PINAWA | Man. | 2418.42 | 193.51 | 2169.76 | 2287.80 |
| PINE FALLS | Man. | 2438.59 | 207.64 | 2165.54 | 2296.56 |
| PLUMAS | Man. | 2443.62 | 208.60 | 2168.02 | 2300.52 |
| PLUM COULEE | Man. | 2680.47 | 154.31 | 2475.59 | 2574.30 |
| PORTAGE LA PRAIRIE | Man. | 2615.02 | 235.89 | 2311.91 | 2455.80 |
| RATHWELL | Man. | 2502.42 | 212.00 | 2220.38 | 2356.56 |
| RIVERS | Man. | 2401.20 | 215.12 | 2124.77 | 2255.99 |
| ROLAND | Man. | 2541.69 | 236.33 | 2228.98 | 2379.57 |
| ROSSBURN | Man. | 2222.31 | 265.36 | 1873.02 | 2040.80 |
| RUSSELL | Man. | 2166.13 | 211.21 | 1894.73 | 2023.56 |
| SELKIRK | Man. | 2611.79 | 196.58 | 2350.26 | 2476.54 |
| SEVEN SISTERS | Man. | 2518.84 | 257.54 | 2175.43 | 2341.39 |
| SHILO | Man. | 2512.63 | 266.34 | 2154.40 | 2328.32 |
| SOMSERSET | Man. | 2337.98 | 234.30 | 2021.62 | 2175.37 |
| SOURIS | Man. | 2383.44 | 182.79 | 2148.56 | 2260.06 |
| SPRAGUE | Man. | 2233.52 | 213.69 | 1958.94 | 2089.28 |
| STARBUCK | Man. | 2406.36 | 235.70 | 2091.28 | 2243.73 |
| STEINBACH | Man. | 2516.93 | 242.47 | 2197.40 | 2350.84 |
| STONEWALL | Man. | 2445.98 | 246.33 | 2120.95 | 2277.24 |
| STONY MNT | Man. | 2515.56 | 189.64 | 2260.50 | 2384.33 |
| ST ALBANS | Man. | 2412.06 | 165.38 | 2195.35 | 2299.11 |
| ST BONIFACE | Man. | 2560.76 | 191.41 | 2306.62 | 2429.07 |
| SWAN RIVER | Man. | 2241.68 | 184.56 | 2004.53 | 2117.10 |
| THE PAS | Man. | 2152.99 | 196.83 | 1900.06 | 2020.13 |
| VIRDEN | Man. | 2439.19 | 203.10 | 2178.22 | 2302.10 |
| VOGAR | Man. | 2572.94 | 188.50 | 2323.13 | 2443.44 |
| WASAGAMING | Man. | 1841.87 | 239.79 | 1524.07 | 1677.13 |
| WASKADA | Man. | 2339.83 | 200.71 | 2076.81 | 2202.74 |
| WILSON CREEK | Man. | 2436.21 | 190.22 | 2181.93 | 2304.96 |
| WINNIPEG | Man. | 2575.14 | 212.64 | 2301.90 | 2431.61 |

Table B11: Soil Moisture Amounts at Planting for Wheat (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 143.00 | 46.21 | 81.38 | 111.16 |
| ARRAN | Sask. | 172.07 | 28.46 | 135.51 | 152.87 |
| AYLSHAM | Sask. | 222.54 | 27.78 | 185.58 | 203.43 |
| BANGOR | Sask. | 134.54 | 15.53 | 114.02 | 123.88 |
| BROADVIEW | Sask. | 156.43 | 37.20 | 108.62 | 131.32 |
| CANORA | Sask. | 167.20 | 35.15 | 120.43 | 143.02 |
| CARDROSE | Sask. | 143.71 | 61.98 | 61.42 | 101.07 |
| CARLYLE | Sask. | 148.55 | 41.99 | 94.59 | 120.21 |
| CARON | Sask. | 120.85 | 46.07 | 61.65 | 89.76 |
| CEYLON | Sask. | 145.64 | 44.31 | 88.70 | 115.73 |
| COTE | Sask. | 170.29 | 38.01 | 119.60 | 144.10 |
| CUPAR | Sask. | 163.04 | 44.11 | 106.36 | 133.26 |
| DAFOE | Sask. | 118.44 | 23.76 | 86.89 | 102.09 |
| DAHINDA | Sask. | 132.98 | 47.42 | 69.21 | 100.17 |
| DAVIDSON | Sask. | 101.72 | 32.20 | 60.34 | 79.98 |
| DAVIN | Sask. | 123.65 | 41.09 | 69.56 | 95.54 |
| DUVAL | Sask. | 120.79 | 28.99 | 82.58 | 100.93 |
| ESTEVAN | Sask. | 121.46 | 29.37 | 83.71 | 101.63 |
| FENWOOD | Sask. | 137.69 | 19.69 | 111.21 | 124.07 |
| FERTILE | Sask. | 169.75 | 36.04 | 121.80 | 144.95 |
| FOAMLAKE | Sask. | 127.84 | 23.13 | 98.13 | 112.23 |
| FORT QU'APPELLE | Sask. | 118.55 | 58.32 | 43.61 | 79.18 |
| FRANCIS | Sask. | 127.87 | 45.54 | 69.35 | 97.13 |
| GOOD SPRIT LAKE | Sask. | 137.55 | 12.86 | 120.56 | 128.73 |
| GRENFELL | Sask. | 158.68 | 37.47 | 110.53 | 133.39 |
| GUERNSEY | Sask. | 81.04 | 21.53 | 52.51 | 66.25 |
| HUBBARD | Sask. | 118.83 | 28.90 | 81.69 | 99.32 |
| HUDSON BAY | Sask. | 167.65 | 33.55 | 124.54 | 145.00 |
| HUMBOLT | Sask. | 120.79 | 24.30 | 89.57 | 104.39 |
| INDIAN HEAD | Sask. | 168.64 | 44.21 | 111.83 | 138.80 |
| KAMSACK | Sask. | 148.19 | 35.90 | 102.05 | 123.95 |
| KELLIHER | Sask. | 131.09 | 20.81 | 104.35 | 117.04 |
| KIPLING | Sask. | 168.40 | 32.84 | 126.20 | 146.23 |
| KRISTNES | Sask. | 126.23 | 19.52 | 100.20 | 112.78 |
| KUROKI | Sask. | 136.68 | 17.08 | 114.22 | 125.00 |
| LANGENBURG | Sask. | 129.57 | 22.86 | 99.31 | 113.88 |
| LEROSS | Sask. | 135.18 | 20.24 | 108.40 | 121.30 |
| LINTLAW | Sask. | 128.29 | 20.28 | 102.22 | 114.60 |
| LIPTON | Sask. | 203.56 | 42.37 | 149.11 | 174.96 |
| LUMSDEN | Sask. | 133.30 | 57.99 | 58.79 | 94.16 |
| MARYFIELD | Sask. | 171.30 | 34.19 | 125.71 | 147.74 |
| MELVILLE | Sask. | 155.82 | 36.19 | 108.07 | 131.03 |
| MIDALE | Sask. | 110.61 | 32.90 | 68.33 | 88.40 |
| MOOSEJAW | Sask. | 152.42 | 49.99 | 88.18 | 118.67 |
| MOOSOMIN | Sask. | 191.03 | 39.87 | 139.80 | 164.12 |
| MUENSTER | Sask. | 106.70 | 31.15 | 66.67 | 85.67 |
| NIPAWIN | Sask. | 170.74 | 46.47 | 111.02 | 139.37 |
| NOKOMIS | Sask. | 95.95 | 36.08 | 49.58 | 71.59 |

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|---|---|---|---|---|---|
| ORMISTON | Sask. | 115.78 | 44.36 | 58.78 | 85.84 |
| OXBOW | Sask. | 147.88 | 45.74 | 89.10 | 117.00 |
| PASWEGIN | Sask. | 124.37 | 34.61 | 78.94 | 100.73 |
| PELLY | Sask. | 175.84 | 30.69 | 136.40 | 155.12 |
| PORCUPINE PLAIN | Sask. | 215.32 | 44.64 | 157.97 | 185.19 |
| PRAIRIE RIVER | Sask. | 170.75 | 33.69 | 126.40 | 147.70 |
| PRECCEVILLE | Sask. | 136.47 | 17.27 | 113.44 | 124.57 |
| QU'APPELLE | Sask. | 152.56 | 43.46 | 96.71 | 123.22 |
| RAYMORE | Sask. | 116.53 | 25.50 | 82.79 | 99.04 |
| REDVERS | Sask. | 168.78 | 31.98 | 126.53 | 146.84 |
| REGINA | Sask. | 153.92 | 50.71 | 88.75 | 119.69 |
| RIDGEDALE | Sask. | 179.53 | 45.61 | 120.91 | 148.74 |
| ROCANVILLE | Sask. | 158.12 | 39.01 | 106.33 | 131.29 |
| SEMANS | Sask. | 107.32 | 37.46 | 59.19 | 82.04 |
| SOMME | Sask. | 200.47 | 24.82 | 167.67 | 183.44 |
| STRASBOURG | Sask. | 113.54 | 29.19 | 76.03 | 93.83 |
| WAPELLA | Sask. | 171.70 | 27.84 | 134.66 | 152.54 |
| WATROUS | Sask. | 134.21 | 34.40 | 90.00 | 110.99 |
| WEYBURN | Sask. | 140.29 | 46.05 | 81.12 | 109.21 |
| WHITEWOOD | Sask. | 165.17 | 37.79 | 116.61 | 139.66 |
| WILCOX | Sask. | 168.00 | 56.77 | 95.04 | 129.67 |
| WISHART | Sask. | 131.78 | 20.03 | 105.23 | 118.02 |
| WYNYARD | Sask. | 129.34 | 19.42 | 103.78 | 116.06 |
| YELLOW GRASS | Sask. | 137.58 | 45.94 | 78.54 | 106.57 |
| YORKTON | Sask. | 151.22 | 28.68 | 114.37 | 131.86 |
| ALTONA | Man. | 195.83 | 36.60 | 147.80 | 170.84 |
| ARORG | Man. | 221.58 | 34.10 | 176.78 | 198.25 |
| BALDUR | Man. | 203.18 | 30.95 | 162.45 | 182.01 |
| BEAUSEJOUR | Man. | 226.83 | 27.62 | 190.52 | 207.94 |
| BEDE | Man. | 168.00 | 39.46 | 115.70 | 140.89 |
| BINSCARTH | Man. | 186.18 | 38.70 | 134.13 | 159.40 |
| BIRCH RIVER | Man. | 219.10 | 40.15 | 165.57 | 191.44 |
| BIRTLE | Man. | 188.32 | 40.21 | 136.66 | 161.18 |
| BISSETT | Man. | 182.09 | 23.28 | 152.18 | 166.38 |
| BOISEVAIN | Man. | 171.66 | 33.71 | 127.41 | 148.63 |
| BRANDON | Man. | 184.97 | 41.58 | 131.54 | 156.90 |
| BROADVALLEY | Man. | 217.13 | 38.60 | 165.66 | 190.53 |
| CARBERRY | Man. | 125.67 | 29.76 | 86.40 | 105.28 |
| CYPRESS RIVER | Man. | 178.65 | 24.94 | 146.61 | 161.82 |
| DAUPHIN | Man. | 204.63 | 48.68 | 142.07 | 171.77 |
| DEERWOOD | Man. | 184.76 | 21.46 | 157.18 | 170.27 |
| DELORAINE | Man. | 206.96 | 23.91 | 175.27 | 190.54 |
| DELTA BEACH | Man. | 179.60 | 28.58 | 141.73 | 159.97 |
| DUGALD | Man. | 228.92 | 26.71 | 193.67 | 210.62 |
| EMERSON | Man. | 197.94 | 35.57 | 152.24 | 173.93 |
| ERIKSDALE | Man. | 175.95 | 29.52 | 137.20 | 155.78 |
| FRASERWOOD | Man. | 194.76 | 34.47 | 148.90 | 171.04 |
| GILBERT PLAIN | Man. | 211.56 | 44.75 | 152.78 | 180.96 |
| GIMLI | Man. | 213.87 | 17.82 | 190.96 | 201.83 |
| GLADSTONE | Man. | 165.93 | 43.98 | 106.77 | 135.49 |
| GLENBORO | Man. | 132.71 | 21.15 | 104.51 | 118.14 |
| GLENLEA | Man. | 223.89 | 30.69 | 183.22 | 202.80 |

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|---|---|---|---|---|---|
| GRAND RAPIDS | Man. | 92.29 | 6.40 | 84.07 | 87.97 |
| GRASS RIVER | Man. | 193.00 | 34.73 | 147.49 | 169.28 |
| GRAYSVILLE | Man. | 170.25 | 33.34 | 127.41 | 147.74 |
| GREAT FALLS | Man. | 192.45 | 51.51 | 126.26 | 157.68 |
| HAMIOTA | Man. | 167.86 | 49.19 | 104.65 | 134.66 |
| HARDING | Man. | 180.03 | 51.92 | 110.62 | 144.20 |
| HODGESON | Man. | 218.10 | 39.01 | 166.49 | 191.34 |
| INDIAN BAY | Man. | 140.74 | 11.28 | 126.24 | 133.12 |
| LANGRUTH | Man. | 197.24 | 41.20 | 142.30 | 168.85 |
| LUNDAR | Man. | 192.65 | 40.19 | 138.77 | 164.88 |
| MACGREGOR | Man. | 170.67 | 45.70 | 109.21 | 139.05 |
| MARQUETTE | Man. | 221.85 | 38.46 | 170.68 | 195.39 |
| MEADOW PORTAGE | Man. | 132.25 | 20.30 | 105.11 | 118.24 |
| MELITA | Man. | 126.71 | 24.22 | 94.76 | 110.12 |
| MINNEDOSA | Man. | 185.49 | 41.25 | 132.49 | 157.65 |
| MNT SIDE GOODLANDS | Man. | 181.77 | 28.12 | 144.07 | 162.34 |
| MOOSEHORN | Man. | 125.11 | 29.32 | 86.69 | 105.08 |
| MORDEN | Man. | 178.31 | 26.80 | 143.88 | 160.22 |
| MORRIS | Man. | 179.75 | 64.35 | 97.05 | 136.31 |
| MYRTLE | Man. | 221.81 | 31.46 | 180.12 | 200.20 |
| NEEPAWA | Man. | 202.26 | 30.43 | 163.16 | 181.72 |
| NINETTE | Man. | 173.41 | 30.78 | 133.86 | 152.63 |
| NIVERVILLE | Man. | 214.52 | 34.93 | 168.59 | 190.63 |
| OAKNER | Man. | 193.17 | 38.98 | 141.59 | 166.43 |
| PEACE GARDENS | Man. | 186.27 | 58.01 | 109.25 | 146.36 |
| PIERSON | Man. | 185.68 | 53.27 | 117.23 | 149.72 |
| PILOT MOUND | Man. | 184.07 | 25.07 | 151.17 | 166.95 |
| PINAWA | Man. | 179.03 | 46.24 | 119.61 | 147.82 |
| PINE FALLS | Man. | 206.51 | 24.69 | 174.11 | 189.65 |
| PLUMAS | Man. | 193.32 | 35.43 | 147.79 | 169.41 |
| PLUM COULEE | Man. | 217.28 | 38.05 | 166.75 | 191.10 |
| PORTAGE LA PRAIRIE | Man. | 225.43 | 33.00 | 183.03 | 203.16 |
| RATHWELL | Man. | 176.25 | 32.09 | 133.56 | 154.18 |
| RIVERS | Man. | 196.17 | 33.70 | 152.87 | 173.43 |
| ROLAND | Man. | 186.65 | 36.19 | 139.01 | 161.90 |
| ROSSBURN | Man. | 203.40 | 28.56 | 165.97 | 183.89 |
| RUSSELL | Man. | 173.95 | 46.83 | 113.78 | 142.34 |
| SELKIRK | Man. | 222.47 | 35.36 | 175.87 | 198.25 |
| SEVEN SISTERS | Man. | 201.70 | 31.00 | 160.53 | 180.37 |
| SHILO | Man. | 144.37 | 4.26 | 138.66 | 141.43 |
| SOMSERSET | Man. | 185.23 | 19.92 | 158.68 | 171.51 |
| SOURIS | Man. | 164.49 | 35.12 | 119.36 | 140.78 |
| SPRAGUE | Man. | 182.49 | 25.89 | 149.22 | 165.02 |
| ST. ALBANS | Man. | 126.75 | 24.88 | 94.79 | 109.96 |
| ST. BONIFACE | Man. | 170.71 | 67.51 | 81.52 | 124.40 |
| STARBUCK | Man. | 218.60 | 36.97 | 169.82 | 193.27 |
| STEINBACK | Man. | 226.70 | 33.09 | 183.34 | 204.10 |
| STONEWALL | Man. | 182.48 | 24.99 | 149.69 | 165.42 |
| STONY MNT. | Man. | 167.94 | 42.72 | 110.84 | 138.47 |
| SWAN RIVER | Man. | 214.13 | 36.19 | 166.63 | 189.41 |
| THE PAS | Man. | 186.45 | 17.86 | 163.50 | 174.40 |
| VIRDEN | Man. | 187.02 | 36.31 | 139.43 | 162.21 |

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|---|---|---|---|---|---|
| VOGAR | Man. | 141.11 | 15.82 | 120.17 | 130.25 |
| WASAGAMING | Man. | 177.83 | 28.83 | 139.69 | 158.05 |
| WASKADA | Man. | 149.71 | 44.40 | 92.66 | 119.74 |
| WILSON CREEK | Man. | 175.67 | 29.04 | 136.84 | 155.63 |
| WINNIPEG | Man. | 230.29 | 27.23 | 195.30 | 211.91 |

Table B12: Soil Moisture Amounts at Heading for Wheat (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 88.00 | 39.25 | 35.66 | 60.96 |
| ARRAN | Sask. | 110.61 | 32.30 | 68.28 | 88.55 |
| AYLSHAM | Sask. | 168.82 | 41.54 | 113.55 | 140.24 |
| BANGOR | Sask. | 69.85 | 32.89 | 26.26 | 47.26 |
| BROADVIEW | Sask. | 103.51 | 41.10 | 50.70 | 75.77 |
| CANORA | Sask. | 108.59 | 41.16 | 53.71 | 80.23 |
| CARDROSE | Sask. | 100.70 | 50.76 | 33.32 | 65.79 |
| CARLYLE | Sask. | 104.50 | 42.15 | 50.33 | 76.04 |
| CARON | Sask. | 73.82 | 34.26 | 29.80 | 50.70 |
| CEYLON | Sask. | 98.30 | 45.10 | 40.35 | 67.86 |
| COTE | Sask. | 109.94 | 36.04 | 61.77 | 85.08 |
| CUPAR | Sask. | 116.43 | 47.67 | 53.96 | 83.87 |
| DAFOE | Sask. | 70.92 | 26.60 | 35.61 | 52.63 |
| DAHINDA | Sask. | 82.19 | 38.25 | 30.74 | 55.72 |
| DAVIDSON | Sask. | 59.87 | 28.92 | 22.71 | 40.35 |
| DAVIN | Sask. | 86.58 | 38.91 | 35.30 | 59.93 |
| DUVAL | Sask. | 68.44 | 30.16 | 28.69 | 47.78 |
| ESTEVAN | Sask. | 76.05 | 34.58 | 31.61 | 52.70 |
| FENWOOD | Sask. | 81.85 | 29.47 | 42.21 | 61.46 |
| FERTILE | Sask. | 119.72 | 32.70 | 76.21 | 97.22 |
| FOAMLAKE | Sask. | 73.52 | 27.75 | 37.86 | 54.79 |
| FORT QU'APPELLE | Sask. | 77.35 | 48.58 | 14.93 | 44.56 |
| FRANCIS | Sask. | 86.00 | 40.30 | 34.22 | 58.80 |
| GOOD SPRIT LAKE | Sask. | 84.23 | 34.04 | 39.03 | 60.81 |
| GRENFELL | Sask. | 105.83 | 40.06 | 54.36 | 78.79 |
| GUERNSEY | Sask. | 34.56 | 14.93 | 14.73 | 24.29 |
| HUBBARD | Sask. | 71.31 | 30.27 | 32.41 | 50.88 |
| HUDSON BAY | Sask. | 110.79 | 37.14 | 63.07 | 85.72 |
| HUMBOLT | Sask. | 72.50 | 28.72 | 35.60 | 53.11 |
| INDIAN HEAD | Sask. | 118.44 | 46.05 | 59.27 | 87.36 |
| KAMSACK | Sask. | 100.72 | 40.47 | 48.71 | 73.40 |
| KELLIHER | Sask. | 75.49 | 28.61 | 37.96 | 55.94 |
| KIPLING | Sask. | 108.99 | 37.19 | 61.20 | 83.88 |
| KRISTNES | Sask. | 66.87 | 27.12 | 30.70 | 48.18 |
| KUROKI | Sask. | 82.09 | 30.46 | 41.99 | 61.25 |
| LANGENBURG | Sask. | 67.21 | 26.40 | 32.15 | 49.05 |
| LEROSS | Sask. | 75.73 | 30.91 | 34.77 | 54.50 |
| LINTLAW | Sask. | 76.78 | 26.61 | 42.59 | 58.82 |
| LIPTON | Sask. | 143.69 | 41.96 | 89.77 | 115.36 |
| LUMSDEN | Sask. | 93.20 | 46.47 | 33.49 | 61.84 |
| MARYFIELD | Sask. | 114.60 | 35.20 | 67.67 | 90.35 |
| MELVILLE | Sask. | 98.62 | 40.74 | 44.79 | 70.67 |
| MIDALE | Sask. | 62.96 | 30.98 | 23.15 | 42.05 |
| MOOSEJAW | Sask. | 102.36 | 39.67 | 51.39 | 75.58 |
| MOOSOMIN | Sask. | 140.82 | 48.12 | 78.99 | 108.34 |
| MUENSTER | Sask. | 65.83 | 27.90 | 29.98 | 47.00 |
| NIPAWIN | Sask. | 123.34 | 43.99 | 66.82 | 93.65 |
| NOKOMIS | Sask. | 55.89 | 29.74 | 17.67 | 35.81 |

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|---|---|---|---|---|---|
| ORMISTON | Sask. | 79.28 | 42.34 | 24.87 | 50.70 |
| OXBOW | Sask. | 105.70 | 45.49 | 47.25 | 75.00 |
| PASWEGIN | Sask. | 79.55 | 27.90 | 42.87 | 60.47 |
| PELLY | Sask. | 117.93 | 38.52 | 67.44 | 91.61 |
| PORCUPINE PLAIN | Sask. | 160.79 | 53.48 | 92.07 | 124.69 |
| PRAIRIE RIVER | Sask. | 100.03 | 35.71 | 52.96 | 75.56 |
| PRECCEVILLE | Sask. | 81.45 | 23.78 | 49.74 | 65.06 |
| QU'APPELLE | Sask. | 104.97 | 40.92 | 52.39 | 77.35 |
| RAYMORE | Sask. | 66.36 | 28.69 | 28.34 | 46.66 |
| REDVERS | Sask. | 106.42 | 36.16 | 58.49 | 81.58 |
| REGINA | Sask. | 110.21 | 49.20 | 46.98 | 77.00 |
| RIDGEDALE | Sask. | 127.68 | 43.08 | 72.32 | 98.60 |
| ROCANVILLE | Sask. | 95.31 | 39.62 | 42.71 | 68.06 |
| SEMANS | Sask. | 58.79 | 27.96 | 22.86 | 39.92 |
| SOMME | Sask. | 137.40 | 45.52 | 77.08 | 106.13 |
| STRASBOURG | Sask. | 68.46 | 27.51 | 33.12 | 49.89 |
| WAPELLA | Sask. | 102.34 | 30.38 | 61.84 | 81.41 |
| WATROUS | Sask. | 87.52 | 33.47 | 44.51 | 64.93 |
| WEYBURN | Sask. | 91.93 | 42.69 | 37.08 | 63.11 |
| WHITEWOOD | Sask. | 114.68 | 41.06 | 61.91 | 86.96 |
| WILCOX | Sask. | 123.85 | 60.05 | 45.17 | 82.84 |
| WISHART | Sask. | 71.88 | 29.64 | 32.52 | 51.48 |
| WYNYARD | Sask. | 73.18 | 30.46 | 33.04 | 52.31 |
| YELLOW GRASS | Sask. | 91.25 | 44.59 | 33.95 | 61.15 |
| YORKTON | Sask. | 99.14 | 35.36 | 53.70 | 75.27 |
| ALTONA | Man. | 138.14 | 39.99 | 85.65 | 110.82 |
| ARORG | Man. | 160.89 | 38.35 | 110.51 | 134.66 |
| BALDUR | Man. | 145.30 | 41.96 | 90.07 | 116.60 |
| BEAUSEJOUR | Man. | 169.90 | 42.85 | 113.56 | 140.60 |
| BEDE | Man. | 113.24 | 38.52 | 62.18 | 86.77 |
| BINSCARTH | Man. | 123.37 | 30.77 | 81.99 | 102.08 |
| BIRCH RIVER | Man. | 163.44 | 30.03 | 123.30 | 142.72 |
| BIRTLE | Man. | 140.67 | 47.37 | 79.80 | 108.70 |
| BISSETT | Man. | 128.79 | 29.61 | 90.74 | 108.81 |
| BOISEVAIN | Man. | 125.05 | 40.20 | 72.24 | 97.55 |
| BRANDON | Man. | 130.80 | 45.37 | 72.50 | 100.17 |
| BROADVALLEY | Man. | 168.78 | 36.55 | 120.05 | 143.60 |
| CARBERRY | Man. | 82.49 | 31.92 | 40.37 | 60.62 |
| CYPRESS RIVER | Man. | 126.98 | 40.90 | 74.43 | 99.37 |
| DAUPHIN | Man. | 151.63 | 49.72 | 87.74 | 118.07 |
| DEERWOOD | Man. | 135.62 | 39.07 | 85.42 | 109.25 |
| DELORAINE | Man. | 148.99 | 41.96 | 93.17 | 120.12 |
| DELTA BEACH | Man. | 133.41 | 34.03 | 88.32 | 110.03 |
| DUGALD | Man. | 171.88 | 42.85 | 114.99 | 142.40 |
| EMERSON | Man. | 152.99 | 42.56 | 98.30 | 124.26 |
| ERIKSDALE | Man. | 119.01 | 32.01 | 76.95 | 97.11 |
| FRASERWOOD | Man. | 140.98 | 34.10 | 95.61 | 117.52 |
| GILBERT PLAIN | Man. | 148.54 | 46.21 | 87.77 | 116.93 |
| GIMLI | Man. | 163.36 | 30.15 | 124.61 | 143.00 |
| GLADSTONE | Man. | 103.12 | 33.98 | 57.42 | 79.61 |
| GLENBORO | Man. | 80.61 | 31.10 | 39.14 | 59.18 |
| GLENLEA | Man. | 178.82 | 44.66 | 119.63 | 148.14 |

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|---|---|---|---|---|---|
| GRAND RAPIDS | Man. | 54.06 | 19.96 | 28.41 | 40.59 |
| GRASS RIVER | Man. | 128.72 | 41.01 | 74.97 | 100.71 |
| GRAYSVILLE | Man. | 118.29 | 38.00 | 69.45 | 92.63 |
| GREAT FALLS | Man. | 146.03 | 50.27 | 81.44 | 112.10 |
| HAMIOTA | Man. | 119.18 | 44.08 | 62.53 | 89.42 |
| HARDING | Man. | 120.14 | 47.88 | 56.14 | 87.11 |
| HODGESON | Man. | 159.21 | 44.45 | 100.31 | 128.68 |
| INDIAN BAY | Man. | 99.14 | 26.66 | 64.88 | 81.14 |
| LANGRUTH | Man. | 147.52 | 36.57 | 98.75 | 122.32 |
| LUNDAR | Man. | 144.41 | 29.62 | 104.58 | 123.92 |
| MACGREGOR | Man. | 114.06 | 41.94 | 57.66 | 85.05 |
| MARQUETTE | Man. | 173.10 | 47.24 | 110.25 | 140.60 |
| MEADOW PORTAGE | Man. | 81.45 | 25.00 | 48.03 | 64.20 |
| MELITA | Man. | 79.87 | 27.47 | 43.57 | 61.02 |
| MINNEDOSA | Man. | 134.10 | 40.04 | 82.64 | 107.07 |
| MNT SIDE GOODLANDS | Man. | 125.77 | 42.61 | 68.65 | 96.33 |
| MOOSEHORN | Man. | 75.98 | 30.26 | 36.30 | 55.31 |
| MORDEN | Man. | 125.87 | 38.94 | 75.84 | 99.59 |
| MORRIS | Man. | 138.38 | 47.95 | 76.76 | 106.01 |
| MYRTLE | Man. | 161.62 | 47.56 | 98.60 | 128.95 |
| NEEPAWA | Man. | 146.03 | 39.24 | 95.61 | 119.54 |
| NINETTE | Man. | 124.66 | 40.44 | 72.70 | 97.37 |
| NIVERVILLE | Man. | 161.18 | 40.84 | 107.48 | 133.25 |
| OAKNER | Man. | 138.80 | 43.57 | 81.05 | 108.86 |
| PEACE GARDENS | Man. | 136.41 | 47.80 | 72.95 | 103.52 |
| PIERSON | Man. | 137.24 | 50.73 | 72.05 | 103.00 |
| PILOT MOUND | Man. | 135.06 | 35.41 | 88.58 | 110.87 |
| PINAWA | Man. | 122.58 | 52.70 | 54.86 | 87.01 |
| PINE FALLS | Man. | 153.79 | 36.59 | 105.76 | 128.80 |
| PLUMAS | Man. | 133.26 | 41.63 | 79.76 | 105.16 |
| PLUM COULEE | Man. | 160.36 | 49.30 | 94.90 | 126.44 |
| PORTAGE LA PRAIRIE | Man. | 178.27 | 42.62 | 123.50 | 149.50 |
| RATHWELL | Man. | 120.03 | 40.52 | 66.12 | 92.15 |
| RIVERS | Man. | 143.11 | 40.50 | 91.06 | 115.77 |
| ROLAND | Man. | 140.87 | 37.74 | 91.19 | 115.05 |
| ROSSBURN | Man. | 146.40 | 41.35 | 92.08 | 118.12 |
| RUSSELL | Man. | 131.74 | 46.58 | 71.89 | 100.30 |
| SELKIRK | Man. | 182.67 | 45.61 | 122.41 | 151.38 |
| SEVEN SISTERS | Man. | 158.42 | 33.89 | 113.33 | 135.10 |
| SHILO | Man. | 76.89 | 21.64 | 47.89 | 61.94 |
| SOMSERSET | Man. | 134.44 | 36.55 | 85.45 | 109.19 |
| SOURIS | Man. | 113.53 | 33.48 | 70.51 | 90.93 |
| SPRAGUE | Man. | 125.86 | 41.20 | 72.91 | 98.05 |
| ST. ALBANS | Man. | 78.07 | 30.33 | 39.10 | 57.60 |
| ST. BONIFACE | Man. | 134.26 | 57.71 | 57.90 | 94.67 |
| STARBUCK | Man. | 166.53 | 48.41 | 102.66 | 133.38 |
| STEINBACK | Man. | 179.40 | 36.80 | 131.17 | 154.26 |
| STONEWALL | Man. | 131.65 | 35.37 | 85.23 | 107.50 |
| STONY MNT. | Man. | 118.02 | 43.82 | 59.44 | 87.78 |
| SWAN RIVER | Man. | 153.34 | 47.35 | 91.13 | 120.95 |
| THE PAS | Man. | 129.00 | 32.35 | 87.42 | 107.16 |
| VIRDEN | Man. | 128.08 | 40.80 | 74.62 | 100.21 |

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|---|---|---|---|---|---|
| VOGAR | Man. | 98.38 | 26.69 | 63.00 | 80.04 |
| WASAGAMING | Man. | 123.14 | 29.83 | 83.53 | 102.62 |
| WASKADA | Man. | 100.70 | 37.55 | 52.45 | 75.35 |
| WILSON CREEK | Man. | 123.11 | 36.68 | 74.07 | 97.80 |
| WINNIPEG | Man. | 177.50 | 39.92 | 126.19 | 150.55 |

Table B13: Plant Moisture Stress at Heading for Wheat (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | -29.24 | 35.04 | -75.96 | -53.38 |
| ARRAN | Sask. | -13.76 | 26.05 | -47.90 | -31.55 |
| AYLSHAM | Sask. | -3.97 | 7.24 | -13.60 | -8.95 |
| BANGOR | Sask. | -28.73 | 35.68 | -76.01 | -53.24 |
| BROADVIEW | Sask. | -21.89 | 31.02 | -61.76 | -42.83 |
| CANORA | Sask. | -20.01 | 27.30 | -56.41 | -38.82 |
| CARDROSE | Sask. | -31.18 | 36.19 | -79.23 | -56.08 |
| CARLYLE | Sask. | -28.58 | 34.68 | -73.14 | -51.99 |
| CARON | Sask. | -43.70 | 37.66 | -92.09 | -69.12 |
| CEYLON | Sask. | -30.40 | 36.81 | -77.70 | -55.25 |
| COTE | Sask. | -11.38 | 14.62 | -30.93 | -21.47 |
| CUPAR | Sask. | -28.49 | 35.42 | -74.91 | -52.68 |
| DAFOE | Sask. | -28.81 | 29.58 | -68.09 | -49.16 |
| DAHINDA | Sask. | -35.32 | 36.92 | -84.98 | -60.87 |
| DAVIDSON | Sask. | -42.69 | 34.95 | -87.60 | -66.28 |
| DAVIN | Sask. | -31.49 | 42.77 | -87.85 | -60.78 |
| DUVAL | Sask. | -23.31 | 27.82 | -59.97 | -42.37 |
| ESTEVAN | Sask. | -28.16 | 30.57 | -67.44 | -48.79 |
| FENWOOD | Sask. | -17.15 | 26.17 | -52.35 | -35.26 |
| FERTILE | Sask. | -12.12 | 23.34 | -43.17 | -28.18 |
| FOAMLAKE | Sask. | -22.17 | 22.91 | -51.60 | -37.63 |
| FORT QU'APPELLE | Sask. | -58.20 | 50.64 | -123.28 | -92.38 |
| FRANCIS | Sask. | -40.74 | 44.27 | -97.64 | -70.63 |
| GOOD SPRIT LAKE | Sask. | -16.81 | 23.12 | -47.52 | -32.72 |
| GRENFELL | Sask. | -20.24 | 31.17 | -60.29 | -41.28 |
| GUERNSEY | Sask. | -51.28 | 34.17 | -96.65 | -74.79 |
| HUBBARD | Sask. | -26.69 | 31.08 | -66.62 | -47.66 |
| HUDSON BAY | Sask. | -13.13 | 17.71 | -35.89 | -25.09 |
| HUMBOLT | Sask. | -26.31 | 25.87 | -59.55 | -43.77 |
| INDIAN HEAD | Sask. | -18.63 | 29.76 | -56.87 | -38.71 |
| KAMSACK | Sask. | -25.22 | 27.39 | -60.41 | -43.71 |
| KELLIHER | Sask. | -19.77 | 28.78 | -57.52 | -39.43 |
| KIPLING | Sask. | -17.33 | 29.31 | -54.99 | -37.12 |
| KRISTNES | Sask. | -32.70 | 33.09 | -76.82 | -55.50 |
| KUROKI | Sask. | -16.22 | 18.31 | -40.33 | -28.75 |
| LANGENBURG | Sask. | -25.63 | 30.15 | -65.66 | -46.37 |
| LEROSS | Sask. | -16.49 | 19.82 | -42.75 | -30.10 |
| LINTLAW | Sask. | -17.52 | 20.84 | -44.30 | -31.58 |
| LIPTON | Sask. | -8.71 | 15.48 | -28.60 | -19.16 |
| LUMSDEN | Sask. | -44.57 | 38.78 | -94.40 | -70.74 |
| MARYFIELD | Sask. | -9.86 | 21.90 | -39.06 | -24.95 |
| MELVILLE | Sask. | -23.65 | 36.98 | -72.51 | -49.02 |
| MIDALE | Sask. | -39.17 | 35.72 | -85.07 | -63.28 |
| MOOSEJAW | Sask. | -32.68 | 30.22 | -71.51 | -53.07 |
| MOOSOMIN | Sask. | -10.21 | 20.88 | -37.04 | -24.30 |
| MUENSTER | Sask. | -29.62 | 24.06 | -60.54 | -45.87 |
| NIPAWIN | Sask. | -17.68 | 21.00 | -44.67 | -31.86 |
| NOKOMIS | Sask. | -47.46 | 38.41 | -96.82 | -73.39 |

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|---|---|---|---|---|---|
| ORMISTON | Sask. | -42.23 | 36.21 | -88.76 | -66.67 |
| OXBOW | Sask. | -28.07 | 36.56 | -75.06 | -52.75 |
| PASWEGIN | Sask. | -16.82 | 17.53 | -39.87 | -28.81 |
| PELLY | Sask. | -13.48 | 27.69 | -49.76 | -32.39 |
| PORCUPINE PLAIN | Sask. | -16.80 | 45.18 | -74.86 | -47.30 |
| PRAIRIE RIVER | Sask. | -24.20 | 28.66 | -61.97 | -43.83 |
| PRECCEVILLE | Sask. | -20.17 | 20.21 | -47.12 | -34.10 |
| QU'APPELLE | Sask. | -19.19 | 31.27 | -59.38 | -40.30 |
| RAYMORE | Sask. | -29.16 | 28.30 | -66.67 | -48.60 |
| REDVERS | Sask. | -27.04 | 36.85 | -75.88 | -52.36 |
| REGINA | Sask. | -31.11 | 33.99 | -74.79 | -54.06 |
| RIDGEDALE | Sask. | -23.91 | 24.76 | -55.72 | -40.62 |
| ROCANVILLE | Sask. | -22.00 | 28.67 | -60.07 | -41.73 |
| SEMANS | Sask. | -41.56 | 38.55 | -91.10 | -67.58 |
| SOMME | Sask. | -10.65 | 15.10 | -30.66 | -21.02 |
| STRASBOURG | Sask. | -28.55 | 30.79 | -68.11 | -49.33 |
| WAPELLA | Sask. | -14.31 | 21.86 | -43.46 | -29.37 |
| WATROUS | Sask. | -22.34 | 30.09 | -61.01 | -42.65 |
| WEYBURN | Sask. | -28.97 | 36.53 | -75.91 | -53.63 |
| WHITEWOOD | Sask. | -16.83 | 27.91 | -52.70 | -35.68 |
| WILCOX | Sask. | -32.03 | 39.31 | -83.54 | -58.88 |
| WISHART | Sask. | -20.79 | 17.63 | -44.20 | -32.92 |
| WYNYARD | Sask. | -19.41 | 22.76 | -49.41 | -35.01 |
| YELLOW GRASS | Sask. | -37.24 | 39.26 | -87.69 | -63.74 |
| YORKTON | Sask. | -16.48 | 26.26 | -50.22 | -34.20 |
| ALTONA | Man. | -8.70 | 15.92 | -29.60 | -19.58 |
| ARORG | Man. | -5.52 | 12.12 | -21.44 | -13.81 |
| BALDUR | Man. | -8.62 | 19.57 | -34.38 | -22.01 |
| BEAUSEJOUR | Man. | -4.68 | 10.87 | -18.97 | -12.12 |
| BEDE | Man. | -18.16 | 29.80 | -57.65 | -38.63 |
| BINSCARTH | Man. | -13.76 | 26.61 | -49.55 | -32.17 |
| BIRCH RIVER | Man. | -4.52 | 8.30 | -15.62 | -10.25 |
| BIRTLE | Man. | -11.61 | 23.68 | -42.05 | -27.60 |
| BISSETT | Man. | -3.29 | 5.65 | -10.54 | -7.10 |
| BOISEVAIN | Man. | -11.90 | 21.11 | -39.63 | -26.34 |
| BRANDON | Man. | -15.37 | 26.00 | -48.79 | -32.93 |
| BROADVALLEY | Man. | -4.22 | 12.86 | -21.36 | -13.08 |
| CARBERRY | Man. | -18.17 | 25.03 | -51.20 | -35.32 |
| CYPRESS RIVER | Man. | -16.33 | 37.59 | -64.64 | -41.70 |
| DAUPHIN | Man. | -9.66 | 18.95 | -34.01 | -22.45 |
| DEERWOOD | Man. | -7.87 | 16.68 | -29.30 | -19.13 |
| DELORAINE | Man. | -7.41 | 16.98 | -30.00 | -19.09 |
| DELTA BEACH | Man. | -4.10 | 11.27 | -19.04 | -11.84 |
| DUGALD | Man. | -3.37 | 6.53 | -12.04 | -7.86 |
| EMERSON | Man. | -9.32 | 20.97 | -36.27 | -23.48 |
| ERIKSDALE | Man. | -8.89 | 18.95 | -33.78 | -21.85 |
| FRASERWOOD | Man. | -6.90 | 18.18 | -31.08 | -19.41 |
| GILBERT PLAIN | Man. | -10.97 | 23.84 | -42.33 | -27.28 |
| GIMLI | Man. | -1.46 | 3.59 | -6.08 | -3.89 |
| GLADSTONE | Man. | -16.59 | 27.29 | -53.29 | -35.48 |
| GLENBORO | Man. | -21.14 | 26.27 | -56.18 | -39.25 |
| GLENLEA | Man. | -3.09 | 11.28 | -18.04 | -10.84 |

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|---|---|---|---|---|---|
| GRAND RAPIDS | Man. | -16.82 | 14.51 | -35.47 | -26.62 |
| GRASS RIVER | Man. | -10.96 | 21.07 | -38.56 | -25.35 |
| GRAYSVILLE | Man. | -12.62 | 20.61 | -39.10 | -26.53 |
| GREAT FALLS | Man. | -12.79 | 31.63 | -53.43 | -34.14 |
| HAMIOTA | Man. | -17.73 | 22.65 | -46.83 | -33.02 |
| HARDING | Man. | -20.19 | 31.93 | -62.87 | -42.22 |
| HODGESON | Man. | -8.86 | 24.13 | -40.84 | -25.44 |
| INDIAN BAY | Man. | -6.64 | 11.49 | -21.40 | -14.39 |
| LANGRUTH | Man. | -4.24 | 12.50 | -20.92 | -12.86 |
| LUNDAR | Man. | -6.24 | 19.78 | -32.84 | -19.92 |
| MACGREGOR | Man. | -17.06 | 37.63 | -67.67 | -43.10 |
| MARQUETTE | Man. | -5.81 | 20.63 | -33.26 | -20.00 |
| MEADOW PORTAGE | Man. | -11.34 | 15.83 | -32.50 | -22.26 |
| MELITA | Man. | -20.70 | 25.63 | -54.56 | -38.28 |
| MINNEDOSA | Man. | -9.55 | 19.86 | -35.07 | -22.95 |
| MNT SIDE GOODLANDS | Man. | -12.30 | 21.97 | -41.75 | -27.48 |
| MOOSEHORN | Man. | -24.94 | 42.40 | -80.54 | -53.90 |
| MORDEN | Man. | -8.08 | 16.01 | -28.65 | -18.88 |
| MORRIS | Man. | -15.87 | 21.94 | -44.06 | -30.67 |
| MYRTLE | Man. | -8.62 | 18.60 | -33.28 | -21.40 |
| NEEPAWA | Man. | -5.88 | 15.28 | -25.51 | -16.19 |
| NINETTE | Man. | -10.75 | 16.90 | -32.47 | -22.16 |
| NIVERVILLE | Man. | -6.32 | 12.32 | -22.52 | -14.75 |
| OAKNER | Man. | -10.71 | 20.09 | -37.34 | -24.52 |
| PEACE GARDENS | Man. | -12.12 | 26.07 | -46.73 | -30.06 |
| PIERSON | Man. | -18.16 | 31.55 | -58.70 | -39.46 |
| PILOT MOUND | Man. | -6.44 | 14.70 | -25.72 | -16.47 |
| PINAWA | Man. | -16.91 | 22.46 | -45.76 | -32.07 |
| PINE FALLS | Man. | -1.89 | 4.60 | -7.93 | -5.04 |
| PLUMAS | Man. | -10.05 | 19.70 | -35.37 | -23.35 |
| PLUM COULEE | Man. | -7.26 | 15.17 | -27.40 | -17.69 |
| PORTAGE LA PRAIRIE | Man. | -4.61 | 15.47 | -24.49 | -15.05 |
| RATHWELL | Man. | -11.49 | 26.42 | -46.65 | -29.67 |
| RIVERS | Man. | -7.79 | 12.51 | -23.87 | -16.24 |
| ROLAND | Man. | -7.58 | 12.60 | -24.16 | -16.20 |
| ROSSBURN | Man. | -7.06 | 19.01 | -32.04 | -20.06 |
| RUSSELL | Man. | -14.01 | 24.72 | -45.77 | -30.69 |
| SELKIRK | Man. | -3.19 | 14.05 | -21.76 | -12.83 |
| SEVEN SISTERS | Man. | -10.61 | 25.05 | -43.94 | -27.85 |
| SHILO | Man. | -19.85 | 23.53 | -51.40 | -36.11 |
| SOMSERSET | Man. | -6.97 | 15.55 | -27.81 | -17.71 |
| SOURIS | Man. | -10.83 | 14.50 | -29.47 | -20.62 |
| SPRAGUE | Man. | -11.58 | 26.42 | -45.53 | -29.41 |
| ST. ALBANS | Man. | -19.77 | 20.74 | -46.42 | -33.77 |
| ST. BONIFACE | Man. | -26.35 | 35.36 | -73.14 | -50.61 |
| STARBUCK | Man. | -7.81 | 20.25 | -34.53 | -21.68 |
| STEINBACK | Man. | -3.07 | 6.06 | -11.02 | -7.21 |
| STONEWALL | Man. | -5.22 | 10.99 | -19.64 | -12.72 |
| STONY MNT. | Man. | -12.00 | 25.31 | -45.83 | -29.46 |
| SWAN RIVER | Man. | -9.58 | 21.60 | -37.95 | -24.35 |
| THE PAS | Man. | -3.52 | 6.83 | -12.30 | -8.13 |
| VIRDEN | Man. | -12.43 | 22.34 | -41.70 | -27.68 |

| | | | | | |
|---|---|---|---|---|---|
| VOGAR | Man. | -3.77 | 7.75 | -14.04 | -9.09 |
| WASAGAMING | Man. | -6.79 | 8.77 | -18.44 | -12.83 |
| WASKADA | Man. | -21.46 | 29.41 | -59.25 | -41.31 |
| WILSON CREEK | Man. | -9.21 | 16.81 | -31.68 | -20.80 |
| WINNIPEG | Man. | -4.05 | 13.05 | -20.82 | -12.86 |

Table B14: Soil Moisture Amounts at Soft Dough for Wheat (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 56.87 | 26.72 | 21.24 | 38.46 |
| ARRAN | Sask. | 90.47 | 33.32 | 46.81 | 67.71 |
| AYLSHAM | Sask. | 148.48 | 42.72 | 91.64 | 119.08 |
| BANGOR | Sask. | 44.37 | 23.37 | 13.39 | 28.31 |
| BROADVIEW | Sask. | 70.29 | 33.10 | 27.75 | 47.95 |
| CANORA | Sask. | 80.50 | 31.72 | 38.21 | 58.65 |
| CARDROSE | Sask. | 62.22 | 33.54 | 17.69 | 39.15 |
| CARLYLE | Sask. | 68.08 | 33.74 | 24.73 | 45.31 |
| CARON | Sask. | 43.66 | 19.10 | 19.12 | 30.77 |
| CEYLON | Sask. | 59.04 | 30.29 | 20.12 | 38.60 |
| COTE | Sask. | 77.26 | 35.73 | 29.50 | 52.61 |
| CUPAR | Sask. | 83.95 | 41.32 | 29.81 | 55.73 |
| DAFOE | Sask. | 46.17 | 29.06 | 7.59 | 26.18 |
| DAHINDA | Sask. | 61.19 | 33.15 | 16.60 | 38.25 |
| DAVIDSON | Sask. | 35.62 | 18.46 | 11.89 | 23.16 |
| DAVIN | Sask. | 57.11 | 34.33 | 11.87 | 33.59 |
| DUVAL | Sask. | 49.13 | 27.73 | 12.59 | 30.13 |
| ESTEVAN | Sask. | 44.25 | 23.66 | 13.84 | 28.28 |
| FENWOOD | Sask. | 62.14 | 32.95 | 17.83 | 39.34 |
| FERTILE | Sask. | 77.73 | 29.09 | 39.04 | 57.72 |
| FOAMLAKE | Sask. | 43.39 | 21.09 | 16.28 | 29.15 |
| FORT QU'APPELLE | Sask. | 48.55 | 35.02 | 3.54 | 24.91 |
| FRANCIS | Sask. | 56.53 | 31.92 | 15.51 | 34.98 |
| GOOD SPRIT LAKE | Sask. | 60.14 | 26.14 | 25.44 | 42.16 |
| GRENFELL | Sask. | 63.16 | 26.21 | 29.48 | 45.47 |
| GUERNSEY | Sask. | 26.25 | 26.79 | -9.32 | 7.81 |
| HUBBARD | Sask. | 44.79 | 24.18 | 13.72 | 28.47 |
| HUDSON BAY | Sask. | 86.70 | 41.37 | 33.53 | 58.77 |
| HUMBOLT | Sask. | 49.59 | 29.43 | 11.77 | 29.73 |
| INDIAN HEAD | Sask. | 81.76 | 42.01 | 27.78 | 53.40 |
| KAMSACK | Sask. | 68.34 | 34.26 | 24.31 | 45.21 |
| KELLIHER | Sask. | 50.45 | 25.57 | 16.92 | 32.99 |
| KIPLING | Sask. | 76.97 | 32.29 | 35.48 | 55.18 |
| KRISTNES | Sask. | 47.33 | 31.67 | 5.09 | 25.50 |
| KUROKI | Sask. | 68.52 | 30.12 | 28.87 | 47.91 |
| LANGENBURG | Sask. | 47.62 | 26.93 | 11.86 | 29.09 |
| LEROSS | Sask. | 52.88 | 29.40 | 13.85 | 32.65 |
| LINTLAW | Sask. | 54.17 | 31.95 | 13.12 | 32.61 |
| LIPTON | Sask. | 109.02 | 51.79 | 42.47 | 74.06 |
| LUMSDEN | Sask. | 66.68 | 35.41 | 21.18 | 42.78 |
| MARYFIELD | Sask. | 77.51 | 33.17 | 33.28 | 54.65 |
| MELVILLE | Sask. | 61.39 | 29.47 | 22.45 | 41.17 |
| MIDALE | Sask. | 35.85 | 20.34 | 9.72 | 22.12 |
| MOOSEJAW | Sask. | 71.40 | 30.52 | 32.18 | 50.80 |
| MOOSOMIN | Sask. | 106.65 | 39.58 | 55.79 | 79.93 |
| MUENSTER | Sask. | 44.55 | 24.53 | 13.03 | 27.99 |
| NIPAWIN | Sask. | 92.19 | 39.39 | 41.58 | 65.60 |
| NOKOMIS | Sask. | 35.97 | 24.60 | 4.37 | 19.37 |

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|---|---|---|---|---|---|
| ORMISTON | Sask. | 50.80 | 31.92 | 9.78 | 29.25 |
| OXBOW | Sask. | 65.77 | 36.05 | 19.44 | 41.43 |
| PASWEGIN | Sask. | 67.87 | 40.56 | 14.53 | 40.12 |
| PELLY | Sask. | 87.34 | 33.62 | 43.21 | 64.38 |
| PORCUPINE PLAIN | Sask. | 132.28 | 58.87 | 56.63 | 92.54 |
| PRAIRIE RIVER | Sask. | 78.29 | 32.02 | 36.04 | 56.35 |
| PRECCEVILLE | Sask. | 56.85 | 28.70 | 18.58 | 37.07 |
| QU'APPELLE | Sask. | 70.60 | 36.61 | 23.55 | 45.89 |
| RAYMORE | Sask. | 54.44 | 37.67 | 4.51 | 28.56 |
| REDVERS | Sask. | 66.33 | 30.14 | 26.39 | 45.62 |
| REGINA | Sask. | 79.18 | 39.17 | 28.85 | 52.74 |
| RIDGEDALE | Sask. | 89.94 | 41.09 | 37.13 | 62.20 |
| ROCANVILLE | Sask. | 69.12 | 24.66 | 36.39 | 52.16 |
| SEMANS | Sask. | 39.90 | 28.57 | 3.18 | 20.61 |
| SOMME | Sask. | 107.94 | 47.39 | 45.02 | 75.33 |
| STRASBOURG | Sask. | 41.01 | 23.86 | 10.36 | 24.91 |
| WAPELLA | Sask. | 71.36 | 27.91 | 34.14 | 52.13 |
| WATROUS | Sask. | 61.98 | 33.49 | 18.95 | 39.38 |
| WEYBURN | Sask. | 59.04 | 33.10 | 16.50 | 36.69 |
| WHITEWOOD | Sask. | 77.44 | 37.47 | 29.28 | 52.14 |
| WILCOX | Sask. | 86.12 | 49.45 | 21.27 | 52.35 |
| WISHART | Sask. | 52.50 | 29.36 | 13.52 | 32.30 |
| WYNYARD | Sask. | 56.02 | 28.08 | 18.96 | 36.78 |
| YELLOW GRASS | Sask. | 57.62 | 30.21 | 18.81 | 37.23 |
| YORKTON | Sask. | 68.67 | 33.03 | 26.22 | 46.37 |
| ALTONA | Man. | 103.16 | 38.31 | 52.83 | 76.95 |
| ARORG | Man. | 128.05 | 43.88 | 70.41 | 98.04 |
| BALDUR | Man. | 108.38 | 38.32 | 57.94 | 82.17 |
| BEAUSEJOUR | Man. | 127.88 | 36.77 | 79.53 | 102.73 |
| BEDE | Man. | 74.89 | 27.55 | 38.37 | 55.96 |
| BINSCARTH | Man. | 84.41 | 36.99 | 34.66 | 58.81 |
| BIRCH RIVER | Man. | 126.92 | 30.29 | 86.43 | 106.02 |
| BIRTLE | Man. | 108.83 | 46.49 | 49.09 | 77.45 |
| BISSETT | Man. | 100.08 | 33.23 | 57.38 | 77.65 |
| BOISEVAIN | Man. | 89.38 | 34.63 | 43.85 | 65.70 |
| BRANDON | Man. | 95.04 | 36.46 | 48.20 | 70.43 |
| BROADVALLEY | Man. | 130.03 | 35.10 | 83.23 | 105.85 |
| CARBERRY | Man. | 53.15 | 21.96 | 24.17 | 38.11 |
| CYPRESS RIVER | Man. | 88.69 | 35.79 | 42.70 | 64.53 |
| DAUPHIN | Man. | 116.37 | 48.30 | 54.31 | 83.77 |
| DEERWOOD | Man. | 104.60 | 36.70 | 57.44 | 79.83 |
| DELORAINE | Man. | 100.78 | 37.15 | 51.25 | 75.19 |
| DELTA BEACH | Man. | 101.37 | 34.42 | 55.75 | 77.72 |
| DUGALD | Man. | 125.37 | 34.46 | 79.53 | 101.67 |
| EMERSON | Man. | 110.07 | 43.90 | 53.66 | 80.44 |
| ERIKSDALE | Man. | 81.57 | 32.13 | 39.31 | 59.59 |
| FRASERWOOD | Man. | 112.28 | 28.56 | 74.28 | 92.63 |
| GILBERT PLAIN | Man. | 116.31 | 38.09 | 66.22 | 90.25 |
| GIMLI | Man. | 127.53 | 30.57 | 88.25 | 106.89 |
| GLADSTONE | Man. | 68.43 | 26.77 | 32.42 | 49.90 |
| GLENBORO | Man. | 58.76 | 28.44 | 20.85 | 39.17 |
| GLENLEA | Man. | 138.67 | 50.20 | 72.14 | 104.18 |

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|---|---|---|---|---|---|
| GRAND RAPIDS | Man. | 40.73 | 24.01 | 9.87 | 24.52 |
| GRASS RIVER | Man. | 93.12 | 36.80 | 44.86 | 67.98 |
| GRAYSVILLE | Man. | 80.10 | 33.66 | 36.85 | 57.38 |
| GREAT FALLS | Man. | 113.46 | 46.51 | 53.69 | 82.06 |
| HAMIOTA | Man. | 87.10 | 43.07 | 31.75 | 58.02 |
| HARDING | Man. | 90.91 | 28.05 | 53.42 | 71.56 |
| HODGESON | Man. | 126.90 | 47.26 | 64.27 | 94.43 |
| INDIAN BAY | Man. | 76.25 | 33.25 | 33.52 | 53.80 |
| LANGRUTH | Man. | 114.79 | 31.93 | 72.21 | 92.78 |
| LUNDAR | Man. | 93.63 | 26.87 | 57.49 | 75.03 |
| MACGREGOR | Man. | 84.42 | 34.55 | 37.95 | 60.51 |
| MARQUETTE | Man. | 135.97 | 39.66 | 83.21 | 108.69 |
| MEADOW PORTAGE | Man. | 62.43 | 21.31 | 33.95 | 47.73 |
| MELITA | Man. | 50.46 | 20.67 | 23.15 | 36.28 |
| MINNEDOSA | Man. | 101.36 | 39.83 | 50.19 | 74.48 |
| MNT SIDE GOODLANDS | Man. | 83.51 | 30.57 | 42.53 | 62.39 |
| MOOSEHORN | Man. | 40.95 | 21.82 | 12.33 | 26.05 |
| MORDEN | Man. | 89.40 | 36.14 | 42.96 | 65.01 |
| MORRIS | Man. | 100.45 | 41.76 | 46.79 | 72.26 |
| MYRTLE | Man. | 120.77 | 36.61 | 72.25 | 95.62 |
| NEEPAWA | Man. | 111.55 | 40.24 | 59.84 | 84.39 |
| NINETTE | Man. | 84.66 | 34.21 | 40.71 | 61.57 |
| NIVERVILLE | Man. | 121.89 | 38.68 | 71.02 | 95.43 |
| OAKNER | Man. | 101.97 | 27.94 | 64.95 | 82.78 |
| PEACE GARDENS | Man. | 106.02 | 41.39 | 51.06 | 77.54 |
| PIERSON | Man. | 97.87 | 45.26 | 39.71 | 67.32 |
| PILOT MOUND | Man. | 89.88 | 36.46 | 42.02 | 64.98 |
| PINAWA | Man. | 86.80 | 48.14 | 24.95 | 54.31 |
| PINE FALLS | Man. | 119.72 | 35.32 | 73.36 | 95.60 |
| PLUMAS | Man. | 92.31 | 34.10 | 47.63 | 69.02 |
| PLUM COULEE | Man. | 118.47 | 38.02 | 68.00 | 92.32 |
| PORTAGE LA PRAIRIE | Man. | 141.70 | 42.39 | 87.23 | 113.09 |
| RATHWELL | Man. | 90.30 | 47.93 | 26.54 | 57.32 |
| RIVERS | Man. | 116.31 | 43.47 | 60.46 | 86.97 |
| ROLAND | Man. | 97.89 | 33.38 | 53.96 | 75.06 |
| ROSSBURN | Man. | 122.04 | 44.36 | 63.76 | 91.70 |
| RUSSELL | Man. | 94.84 | 40.78 | 42.44 | 67.32 |
| SELKIRK | Man. | 146.44 | 40.08 | 93.49 | 118.94 |
| SEVEN SISTERS | Man. | 122.27 | 37.60 | 72.24 | 96.40 |
| SHILO | Man. | 47.09 | 23.47 | 15.53 | 30.85 |
| SOMSERSET | Man. | 103.28 | 34.49 | 57.04 | 79.45 |
| SOURIS | Man. | 80.55 | 38.92 | 30.54 | 54.28 |
| SPRAGUE | Man. | 102.10 | 43.53 | 46.17 | 72.72 |
| ST. ALBANS | Man. | 45.73 | 26.01 | 11.64 | 27.96 |
| ST. BONIFACE | Man. | 100.00 | 50.59 | 33.07 | 65.30 |
| STARBUCK | Man. | 129.93 | 40.36 | 76.68 | 102.29 |
| STEINBACK | Man. | 138.07 | 33.50 | 94.17 | 115.19 |
| STONEWALL | Man. | 103.07 | 40.50 | 49.91 | 75.41 |
| STONY MNT. | Man. | 77.13 | 25.02 | 43.59 | 59.84 |
| SWAN RIVER | Man. | 126.93 | 48.92 | 62.66 | 93.47 |
| THE PAS | Man. | 99.79 | 37.96 | 51.00 | 74.16 |
| VIRDEN | Man. | 93.03 | 40.68 | 39.71 | 65.24 |

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|---|---|---|---|---|---|
| VOGAR | Man. | 79.41 | 26.93 | 43.72 | 60.91 |
| WASAGAMING | Man. | 89.84 | 33.70 | 44.90 | 66.62 |
| WASKADA | Man. | 66.69 | 34.06 | 22.91 | 43.69 |
| WILSON CREEK | Man. | 92.67 | 27.46 | 55.96 | 73.72 |
| WINNIPEG | Man. | 137.56 | 43.50 | 81.66 | 108.20 |

Table B15: Plant Moisture Stress at Soft Dough for Wheat (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | -58.98 | 53.37 | -130.14 | -95.75 |
| ARRAN | Sask. | -25.18 | 34.07 | -69.83 | -48.45 |
| AYLSHAM | Sask. | -6.30 | 11.46 | -21.55 | -14.19 |
| BANGOR | Sask. | -58.16 | 54.56 | -130.46 | -95.64 |
| BROADVIEW | Sask. | -45.21 | 47.07 | -105.69 | -76.98 |
| CANORA | Sask. | -33.67 | 40.01 | -87.02 | -61.24 |
| CARDROSE | Sask. | -62.89 | 57.55 | -139.29 | -102.48 |
| CARLYLE | Sask. | -53.26 | 49.96 | -117.45 | -86.98 |
| CARON | Sask. | -85.03 | 55.02 | -155.73 | -122.17 |
| CEYLON | Sask. | -64.38 | 65.92 | -149.08 | -108.87 |
| COTE | Sask. | -28.26 | 25.06 | -61.77 | -45.56 |
| CUPAR | Sask. | -55.48 | 56.66 | -129.73 | -94.18 |
| DAFOE | Sask. | -55.42 | 45.13 | -115.34 | -86.47 |
| DAHINDA | Sask. | -63.53 | 54.65 | -137.03 | -101.34 |
| DAVIDSON | Sask. | -81.42 | 56.53 | -154.06 | -119.58 |
| DAVIN | Sask. | -61.25 | 63.99 | -145.57 | -105.08 |
| DUVAL | Sask. | -49.09 | 40.99 | -103.11 | -77.17 |
| ESTEVAN | Sask. | -56.46 | 49.80 | -120.46 | -90.08 |
| FENWOOD | Sask. | -33.07 | 31.72 | -75.73 | -55.01 |
| FERTILE | Sask. | -27.55 | 32.07 | -70.22 | -49.62 |
| FOAMLAKE | Sask. | -51.17 | 37.31 | -99.11 | -76.35 |
| FORT QU'APPELLE | Sask. | -104.70 | 69.41 | -193.89 | -151.55 |
| FRANCIS | Sask. | -75.82 | 65.50 | -160.00 | -120.04 |
| GOOD SPRIT LAKE | Sask. | -35.17 | 40.20 | -88.55 | -62.83 |
| GRENFELL | Sask. | -43.15 | 49.43 | -106.67 | -76.52 |
| GUERNSEY | Sask. | -91.95 | 47.99 | -155.66 | -124.96 |
| HUBBARD | Sask. | -59.15 | 49.36 | -122.58 | -92.47 |
| HUDSON BAY | Sask. | -28.41 | 30.53 | -67.64 | -49.02 |
| HUMBOLT | Sask. | -51.13 | 38.77 | -100.95 | -77.30 |
| INDIAN HEAD | Sask. | -40.52 | 47.12 | -101.07 | -72.32 |
| KAMSACK | Sask. | -48.86 | 44.54 | -106.09 | -78.92 |
| KELLIHER | Sask. | -43.98 | 48.45 | -107.51 | -77.07 |
| KIPLING | Sask. | -37.35 | 44.67 | -94.75 | -67.50 |
| KRISTNES | Sask. | -64.57 | 53.95 | -136.51 | -101.74 |
| KUROKI | Sask. | -33.87 | 34.29 | -79.01 | -57.32 |
| LANGENBURG | Sask. | -54.02 | 45.77 | -114.78 | -85.51 |
| LEROSS | Sask. | -41.24 | 32.86 | -84.86 | -63.85 |
| LINTLAW | Sask. | -41.65 | 38.69 | -91.36 | -67.76 |
| LIPTON | Sask. | -25.91 | 40.23 | -77.61 | -53.07 |
| LUMSDEN | Sask. | -80.11 | 58.52 | -155.32 | -119.62 |
| MARYFIELD | Sask. | -25.69 | 27.60 | -62.50 | -44.71 |
| MELVILLE | Sask. | -50.04 | 57.25 | -125.67 | -89.31 |
| MIDALE | Sask. | -76.51 | 52.33 | -143.75 | -111.83 |
| MOOSEJAW | Sask. | -63.04 | 46.43 | -122.70 | -94.38 |
| MOOSOMIN | Sask. | -21.59 | 31.97 | -62.67 | -43.17 |
| MUENSTER | Sask. | -58.63 | 39.47 | -109.35 | -85.27 |
| NIPAWIN | Sask. | -33.85 | 34.80 | -78.58 | -57.35 |
| NOKOMIS | Sask. | -87.12 | 55.72 | -158.71 | -124.72 |

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|---|---|---|---|---|---|
| ORMISTON | Sask. | -78.02 | 56.79 | -150.99 | -116.35 |
| OXBOW | Sask. | -56.39 | 56.66 | -129.19 | -94.63 |
| PASWEGIN | Sask. | -37.14 | 30.60 | -77.37 | -58.07 |
| PELLY | Sask. | -29.45 | 42.46 | -85.18 | -58.45 |
| PORCUPINE PLAIN | Sask. | -29.29 | 68.43 | -117.22 | -75.48 |
| PRAIRIE RIVER | Sask. | -45.81 | 58.50 | -123.00 | -85.88 |
| PRECCEVILLE | Sask. | -38.75 | 27.98 | -76.06 | -58.03 |
| QU'APPELLE | Sask. | -41.05 | 47.71 | -102.35 | -73.25 |
| RAYMORE | Sask. | -57.32 | 44.56 | -116.38 | -87.94 |
| REDVERS | Sask. | -50.99 | 54.35 | -123.02 | -88.33 |
| REGINA | Sask. | -59.66 | 52.29 | -126.86 | -94.96 |
| RIDGEDALE | Sask. | -44.45 | 40.61 | -96.64 | -71.86 |
| ROCANVILLE | Sask. | -44.60 | 37.85 | -94.86 | -70.64 |
| SEMANS | Sask. | -79.44 | 54.65 | -149.67 | -116.33 |
| SOMME | Sask. | -23.89 | 30.58 | -64.49 | -44.93 |
| STRASBOURG | Sask. | -60.55 | 45.51 | -119.03 | -91.27 |
| WAPELLA | Sask. | -34.83 | 29.54 | -74.23 | -55.19 |
| WATROUS | Sask. | -44.54 | 48.09 | -106.34 | -77.00 |
| WEYBURN | Sask. | -58.95 | 55.41 | -130.15 | -96.35 |
| WHITEWOOD | Sask. | -35.45 | 44.63 | -92.80 | -65.58 |
| WILCOX | Sask. | -61.49 | 60.66 | -141.04 | -102.92 |
| WISHART | Sask. | -44.14 | 30.84 | -85.09 | -65.36 |
| WYNYARD | Sask. | -40.91 | 36.05 | -88.48 | -65.60 |
| YELLOW GRASS | Sask. | -68.45 | 60.28 | -145.92 | -109.14 |
| YORKTON | Sask. | -33.81 | 41.13 | -86.66 | -61.57 |
| ALTONA | Man. | -21.81 | 28.48 | -59.23 | -41.29 |
| ARORG | Man. | -11.46 | 19.21 | -36.69 | -24.60 |
| BALDUR | Man. | -17.78 | 29.16 | -56.16 | -37.72 |
| BEAUSEJOUR | Man. | -10.06 | 18.93 | -34.96 | -23.01 |
| BEDE | Man. | -34.60 | 45.72 | -95.20 | -66.02 |
| BINSCARTH | Man. | -29.42 | 30.97 | -71.07 | -50.85 |
| BIRCH RIVER | Man. | -8.71 | 11.52 | -24.11 | -16.66 |
| BIRTLE | Man. | -23.76 | 36.89 | -71.16 | -48.66 |
| BISSETT | Man. | -10.02 | 12.50 | -26.09 | -18.46 |
| BOISEVAIN | Man. | -21.35 | 32.52 | -64.12 | -43.60 |
| BRANDON | Man. | -28.95 | 35.83 | -74.99 | -53.13 |
| BROADVALLEY | Man. | -8.51 | 19.44 | -34.43 | -21.90 |
| CARBERRY | Man. | -37.62 | 39.21 | -89.36 | -64.48 |
| CYPRESS RIVER | Man. | -30.82 | 68.00 | -118.20 | -76.72 |
| DAUPHIN | Man. | -21.52 | 30.56 | -60.80 | -42.16 |
| DEERWOOD | Man. | -14.95 | 26.70 | -49.26 | -32.98 |
| DELORAINE | Man. | -18.29 | 30.59 | -59.07 | -39.36 |
| DELTA BEACH | Man. | -10.86 | 17.76 | -34.40 | -23.06 |
| DUGALD | Man. | -9.25 | 14.28 | -28.25 | -19.08 |
| EMERSON | Man. | -21.19 | 37.52 | -69.40 | -46.51 |
| ERIKSDALE | Man. | -21.44 | 29.14 | -59.76 | -41.38 |
| FRASERWOOD | Man. | -13.67 | 26.18 | -48.49 | -31.68 |
| GILBERT PLAIN | Man. | -21.25 | 34.41 | -66.50 | -44.79 |
| GIMLI | Man. | -3.53 | 7.54 | -13.23 | -8.63 |
| GLADSTONE | Man. | -36.23 | 38.30 | -87.75 | -62.74 |
| GLENBORO | Man. | -40.67 | 37.83 | -91.12 | -66.74 |
| GLENLEA | Man. | -8.63 | 19.60 | -34.61 | -22.09 |

| | | | | | |
|---|---|---|---|---|---|
| GRAND RAPIDS | Man. | -36.42 | 25.92 | -69.73 | -53.92 |
| GRASS RIVER | Man. | -25.16 | 32.15 | -67.33 | -47.12 |
| GRAYSVILLE | Man. | -27.52 | 34.26 | -71.54 | -50.64 |
| GREAT FALLS | Man. | -20.34 | 46.06 | -79.53 | -51.43 |
| HAMIOTA | Man. | -38.77 | 39.09 | -88.99 | -65.15 |
| HARDING | Man. | -36.48 | 42.99 | -93.95 | -66.14 |
| HODGESON | Man. | -17.68 | 34.20 | -63.00 | -41.17 |
| INDIAN BAY | Man. | -15.11 | 18.22 | -38.53 | -27.41 |
| LANGRUTH | Man. | -9.78 | 17.89 | -33.64 | -22.11 |
| LUNDAR | Man. | -14.89 | 28.24 | -52.87 | -34.43 |
| MACGREGOR | Man. | -31.89 | 48.58 | -97.23 | -65.51 |
| MARQUETTE | Man. | -10.26 | 30.21 | -50.45 | -31.04 |
| MEADOW PORTAGE | Man. | -22.46 | 22.40 | -52.40 | -37.92 |
| MELITA | Man. | -42.47 | 36.53 | -90.73 | -67.53 |
| MINNEDOSA | Man. | -21.34 | 27.61 | -56.82 | -39.98 |
| MNT SIDE GOODLANDS | Man. | -25.33 | 38.68 | -77.19 | -52.06 |
| MOOSEHORN | Man. | -51.80 | 59.29 | -129.56 | -92.30 |
| MORDEN | Man. | -18.93 | 26.83 | -53.40 | -37.04 |
| MORRIS | Man. | -30.64 | 35.83 | -76.69 | -54.83 |
| MYRTLE | Man. | -17.28 | 30.86 | -58.18 | -38.48 |
| NEEPAWA | Man. | -13.24 | 21.70 | -41.12 | -27.88 |
| NINETTE | Man. | -22.69 | 26.64 | -56.92 | -40.67 |
| NIVERVILLE | Man. | -14.30 | 23.00 | -44.54 | -30.03 |
| OAKNER | Man. | -20.67 | 27.37 | -56.94 | -39.47 |
| PEACE GARDENS | Man. | -24.71 | 43.29 | -82.19 | -54.49 |
| PIERSON | Man. | -37.66 | 49.08 | -100.74 | -70.79 |
| PILOT MOUND | Man. | -15.87 | 26.04 | -50.05 | -33.65 |
| PINAWA | Man. | -38.27 | 41.99 | -92.23 | -66.61 |
| PINE FALLS | Man. | -6.20 | 10.83 | -20.41 | -13.59 |
| PLUMAS | Man. | -23.85 | 29.58 | -62.60 | -44.05 |
| PLUM COULEE | Man. | -15.75 | 25.19 | -49.20 | -33.08 |
| PORTAGE LA PRAIRIE | Man. | -8.28 | 22.22 | -36.84 | -23.28 |
| RATHWELL | Man. | -25.25 | 38.38 | -76.31 | -51.66 |
| RIVERS | Man. | -16.14 | 23.22 | -45.98 | -31.82 |
| ROLAND | Man. | -18.38 | 23.39 | -49.17 | -34.38 |
| ROSSBURN | Man. | -14.70 | 29.42 | -53.35 | -34.82 |
| RUSSELL | Man. | -29.82 | 41.02 | -82.53 | -57.51 |
| SELKIRK | Man. | -6.64 | 22.57 | -36.46 | -22.12 |
| SEVEN SISTERS | Man. | -13.55 | 26.92 | -49.36 | -32.07 |
| SHILO | Man. | -44.67 | 36.25 | -93.42 | -69.75 |
| SOMSERSET | Man. | -13.41 | 22.13 | -43.07 | -28.70 |
| SOURIS | Man. | -29.72 | 29.95 | -68.21 | -49.94 |
| SPRAGUE | Man. | -25.41 | 39.07 | -75.62 | -51.79 |
| ST. ALBANS | Man. | -44.47 | 35.20 | -90.60 | -68.51 |
| ST. BONIFACE | Man. | -44.93 | 54.01 | -116.39 | -81.98 |
| STARBUCK | Man. | -14.56 | 31.09 | -55.58 | -35.86 |
| STEINBACK | Man. | -6.54 | 9.69 | -19.24 | -13.16 |
| STONEWALL | Man. | -13.23 | 18.62 | -37.67 | -25.95 |
| STONY MNT. | Man. | -25.89 | 36.46 | -74.76 | -51.08 |
| SWAN RIVER | Man. | -18.58 | 33.77 | -62.95 | -41.68 |
| THE PAS | Man. | -12.11 | 20.72 | -38.73 | -26.09 |
| VIRDEN | Man. | -28.23 | 34.56 | -73.52 | -51.83 |

| | | | | | |
|---|---|---|---|---|---|
| VOGAR | Man. | -9.18 | 13.92 | -27.62 | -18.74 |
| WASAGAMING | Man. | -19.17 | 16.29 | -40.89 | -30.39 |
| WASKADA | Man. | -46.87 | 46.51 | -106.63 | -78.26 |
| WILSON CREEK | Man. | -18.38 | 21.78 | -47.49 | -33.40 |
| WINNIPEG | Man. | -8.65 | 21.01 | -35.64 | -22.83 |

Table B16: Soil Moisture Amounts at Maturity for Wheat (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 57.88 | 27.75 | 20.88 | 38.76 |
| ARRAN | Sask. | 86.26 | 34.24 | 41.32 | 62.87 |
| AYLSHAM | Sask. | 144.34 | 44.63 | 84.96 | 113.63 |
| BANGOR | Sask. | 48.44 | 27.52 | 11.97 | 29.53 |
| BROADVIEW | Sask. | 76.71 | 34.22 | 32.74 | 53.61 |
| CANORA | Sask. | 81.54 | 35.78 | 33.83 | 56.89 |
| CARDROSE | Sask. | 59.37 | 34.24 | 13.91 | 35.81 |
| CARLYLE | Sask. | 72.51 | 36.61 | 25.47 | 47.80 |
| CARON | Sask. | 41.54 | 20.39 | 15.35 | 27.78 |
| CEYLON | Sask. | 60.54 | 31.84 | 19.62 | 39.04 |
| COTE | Sask. | 78.33 | 34.30 | 32.35 | 54.63 |
| CUPAR | Sask. | 77.44 | 36.86 | 29.13 | 52.26 |
| DAFOE | Sask. | 47.78 | 33.75 | 2.87 | 24.56 |
| DAHINDA | Sask. | 65.67 | 40.33 | 11.43 | 37.76 |
| DAVIDSON | Sask. | 35.70 | 22.86 | 6.32 | 20.27 |
| DAVIN | Sask. | 55.78 | 32.25 | 13.22 | 33.69 |
| DUVAL | Sask. | 51.62 | 27.43 | 15.48 | 32.83 |
| ESTEVAN | Sask. | 44.08 | 21.43 | 16.55 | 29.62 |
| FENWOOD | Sask. | 72.17 | 30.15 | 31.62 | 51.31 |
| FERTILE | Sask. | 81.17 | 35.45 | 34.01 | 56.78 |
| FOAMLAKE | Sask. | 47.56 | 27.39 | 12.36 | 29.07 |
| FORT QU'APPELLE | Sask. | 45.01 | 34.72 | 0.40 | 21.57 |
| FRANCIS | Sask. | 52.92 | 31.31 | 12.68 | 31.78 |
| GOOD SPRIT LAKE | Sask. | 64.54 | 26.25 | 29.45 | 46.43 |
| GRENFELL | Sask. | 66.93 | 34.61 | 22.45 | 43.56 |
| GUERNSEY | Sask. | 25.89 | 22.34 | -3.83 | 10.52 |
| HUBBARD | Sask. | 48.66 | 28.33 | 12.26 | 29.54 |
| HUDSON BAY | Sask. | 88.14 | 44.65 | 30.76 | 58.00 |
| HUMBOLT | Sask. | 46.41 | 28.18 | 10.19 | 27.38 |
| INDIAN HEAD | Sask. | 81.38 | 38.51 | 31.90 | 55.39 |
| KAMSACK | Sask. | 69.21 | 38.45 | 19.80 | 43.25 |
| KELLIHER | Sask. | 48.56 | 28.87 | 10.70 | 28.84 |
| KIPLING | Sask. | 80.31 | 40.65 | 28.07 | 52.87 |
| KRISTNES | Sask. | 46.62 | 39.16 | -5.60 | 19.64 |
| KUROKI | Sask. | 61.98 | 29.98 | 22.42 | 41.44 |
| LANGENBURG | Sask. | 53.85 | 21.41 | 25.42 | 39.11 |
| LEROSS | Sask. | 65.48 | 40.84 | 11.26 | 37.38 |
| LINTLAW | Sask. | 52.26 | 35.56 | 6.57 | 28.26 |
| LIPTON | Sask. | 106.36 | 45.72 | 47.61 | 75.50 |
| LUMSDEN | Sask. | 64.69 | 38.41 | 15.33 | 38.76 |
| MARYFIELD | Sask. | 80.38 | 41.09 | 25.59 | 52.07 |
| MELVILLE | Sask. | 60.98 | 28.82 | 22.90 | 41.21 |
| MIDALE | Sask. | 37.00 | 20.50 | 10.66 | 23.16 |
| MOOSEJAW | Sask. | 68.90 | 28.93 | 31.72 | 49.37 |
| MOOSOMIN | Sask. | 108.76 | 40.83 | 56.30 | 81.20 |
| MUENSTER | Sask. | 45.49 | 32.10 | 4.24 | 23.82 |
| NIPAWIN | Sask. | 88.95 | 43.43 | 33.14 | 59.63 |
| NOKOMIS | Sask. | 36.49 | 25.65 | 3.53 | 19.18 |

| | | | | | |
|---|---|---|---|---|---|
| ORMISTON | Sask. | 51.26 | 35.22 | 6.00 | 27.48 |
| OXBOW | Sask. | 71.66 | 35.16 | 26.48 | 47.93 |
| PASWEGIN | Sask. | 69.00 | 39.34 | 17.23 | 42.10 |
| PELLY | Sask. | 91.59 | 43.02 | 34.66 | 62.08 |
| PORCUPINE PLAIN | Sask. | 132.21 | 53.91 | 62.94 | 95.82 |
| PRAIRIE RIVER | Sask. | 90.75 | 38.87 | 38.93 | 63.97 |
| PRECCEVILLE | Sask. | 61.21 | 32.55 | 17.69 | 38.75 |
| QU'APPELLE | Sask. | 67.39 | 37.19 | 19.59 | 42.28 |
| RAYMORE | Sask. | 50.18 | 36.25 | 2.14 | 25.28 |
| REDVERS | Sask. | 65.66 | 38.56 | 14.36 | 39.13 |
| REGINA | Sask. | 76.47 | 36.02 | 30.19 | 52.16 |
| RIDGEDALE | Sask. | 84.07 | 42.61 | 29.32 | 55.31 |
| ROCANVILLE | Sask. | 66.65 | 28.30 | 29.09 | 47.19 |
| SEMANS | Sask. | 45.43 | 34.44 | 1.18 | 22.19 |
| SOMME | Sask. | 101.74 | 47.04 | 39.29 | 69.38 |
| STRASBOURG | Sask. | 44.77 | 28.25 | 8.47 | 25.70 |
| WAPELLA | Sask. | 82.29 | 30.10 | 42.05 | 61.52 |
| WATROUS | Sask. | 59.90 | 33.10 | 17.37 | 37.56 |
| WEYBURN | Sask. | 56.58 | 28.01 | 20.59 | 37.68 |
| WHITEWOOD | Sask. | 80.11 | 39.32 | 29.58 | 53.56 |
| WILCOX | Sask. | 80.45 | 40.33 | 27.56 | 52.91 |
| WISHART | Sask. | 56.13 | 32.00 | 13.64 | 34.11 |
| WYNYARD | Sask. | 53.24 | 34.67 | 7.49 | 29.49 |
| YELLOW GRASS | Sask. | 54.49 | 25.89 | 21.22 | 37.01 |
| YORKTON | Sask. | 70.11 | 34.11 | 26.29 | 47.09 |
| ALTONA | Man. | 104.59 | 40.79 | 51.01 | 76.69 |
| ARORG | Man. | 127.71 | 47.59 | 65.19 | 95.16 |
| BALDUR | Man. | 109.77 | 46.53 | 48.53 | 77.95 |
| BEAUSEJOUR | Man. | 130.71 | 47.42 | 68.35 | 98.27 |
| BEDE | Man. | 78.41 | 30.48 | 38.02 | 57.47 |
| BINSCARTH | Man. | 94.54 | 42.39 | 37.06 | 65.09 |
| BIRCH RIVER | Man. | 129.88 | 45.36 | 68.63 | 98.40 |
| BIRTLE | Man. | 109.75 | 52.06 | 42.86 | 74.61 |
| BISSETT | Man. | 104.03 | 38.74 | 54.25 | 77.88 |
| BOISEVAIN | Man. | 99.98 | 39.66 | 47.83 | 72.85 |
| BRANDON | Man. | 93.28 | 37.40 | 45.23 | 68.04 |
| BROADVALLEY | Man. | 130.74 | 46.30 | 69.00 | 98.83 |
| CARBERRY | Man. | 60.72 | 32.18 | 18.26 | 38.68 |
| CYPRESS RIVER | Man. | 93.02 | 41.27 | 39.99 | 65.16 |
| DAUPHIN | Man. | 119.32 | 51.59 | 53.03 | 84.50 |
| DEERWOOD | Man. | 105.15 | 38.90 | 55.16 | 78.89 |
| DELORAINE | Man. | 107.75 | 40.89 | 53.22 | 79.57 |
| DELTA BEACH | Man. | 106.25 | 39.17 | 54.35 | 79.35 |
| DUGALD | Man. | 119.94 | 43.24 | 62.41 | 90.19 |
| EMERSON | Man. | 113.55 | 50.61 | 48.51 | 79.38 |
| ERIKSDALE | Man. | 82.82 | 36.15 | 35.28 | 58.09 |
| FRASERWOOD | Man. | 118.65 | 42.48 | 62.13 | 89.42 |
| GILBERT PLAIN | Man. | 114.05 | 47.31 | 51.77 | 81.69 |
| GIMLI | Man. | 131.48 | 41.55 | 78.09 | 103.43 |
| GLADSTONE | Man. | 78.94 | 35.13 | 31.69 | 54.63 |
| GLENBORO | Man. | 60.76 | 31.03 | 19.38 | 39.38 |
| GLENLEA | Man. | 138.86 | 49.72 | 72.96 | 104.70 |

| | | | | | |
|---|---|---|---|---|---|
| GRAND RAPIDS | Man. | 50.85 | 27.03 | 16.11 | 32.60 |
| GRASS RIVER | Man. | 94.60 | 42.98 | 38.24 | 65.24 |
| GRAYSVILLE | Man. | 78.18 | 37.50 | 29.99 | 52.86 |
| GREAT FALLS | Man. | 111.40 | 47.77 | 50.01 | 79.15 |
| HAMIOTA | Man. | 89.10 | 42.80 | 34.11 | 60.21 |
| HARDING | Man. | 92.55 | 30.53 | 51.74 | 71.49 |
| HODGESON | Man. | 127.98 | 54.17 | 55.56 | 90.60 |
| INDIAN BAY | Man. | 79.46 | 33.42 | 36.52 | 56.90 |
| LANGRUTH | Man. | 111.01 | 35.84 | 63.23 | 86.32 |
| LUNDAR | Man. | 97.65 | 27.45 | 60.60 | 78.61 |
| MACGREGOR | Man. | 84.61 | 31.12 | 42.75 | 63.07 |
| MARQUETTE | Man. | 136.43 | 48.06 | 72.48 | 103.36 |
| MEADOW PORTAGE | Man. | 68.13 | 28.17 | 30.46 | 48.69 |
| MELITA | Man. | 61.37 | 27.90 | 24.50 | 42.23 |
| MINNEDOSA | Man. | 102.84 | 46.27 | 43.37 | 71.60 |
| MNT SIDE GOODLANDS | Man. | 82.93 | 36.46 | 34.05 | 57.74 |
| MOOSEHORN | Man. | 46.91 | 27.05 | 11.43 | 28.43 |
| MORDEN | Man. | 89.76 | 38.18 | 40.70 | 63.99 |
| MORRIS | Man. | 94.17 | 41.43 | 40.92 | 66.20 |
| MYRTLE | Man. | 128.20 | 45.39 | 68.04 | 97.02 |
| NEEPAWA | Man. | 117.67 | 45.63 | 59.04 | 86.87 |
| NINETTE | Man. | 83.84 | 38.13 | 34.84 | 58.10 |
| NIVERVILLE | Man. | 125.33 | 51.43 | 57.69 | 90.15 |
| OAKNER | Man. | 106.35 | 38.51 | 55.32 | 79.90 |
| PEACE GARDENS | Man. | 115.95 | 46.25 | 54.42 | 84.13 |
| PIERSON | Man. | 96.13 | 43.88 | 39.75 | 66.51 |
| PILOT MOUND | Man. | 89.98 | 36.75 | 41.70 | 64.84 |
| PINAWA | Man. | 92.59 | 52.38 | 25.28 | 57.23 |
| PINE FALLS | Man. | 125.78 | 42.31 | 70.25 | 96.88 |
| PLUMAS | Man. | 92.78 | 45.29 | 33.34 | 61.85 |
| PLUM COULEE | Man. | 114.97 | 39.13 | 63.02 | 88.05 |
| PORTAGE LA PRAIRIE | Man. | 141.79 | 46.59 | 81.92 | 110.34 |
| RATHWELL | Man. | 89.23 | 42.86 | 32.21 | 59.74 |
| RIVERS | Man. | 117.35 | 46.34 | 57.80 | 86.07 |
| ROLAND | Man. | 93.64 | 40.22 | 40.70 | 66.13 |
| ROSSBURN | Man. | 122.58 | 48.75 | 58.33 | 89.18 |
| RUSSELL | Man. | 98.39 | 47.04 | 37.95 | 66.64 |
| SELKIRK | Man. | 148.39 | 47.09 | 86.18 | 116.09 |
| SEVEN SISTERS | Man. | 119.36 | 43.32 | 61.74 | 89.56 |
| SHILO | Man. | 56.71 | 34.26 | 10.63 | 33.00 |
| SOMSERSET | Man. | 110.58 | 38.34 | 59.17 | 84.08 |
| SOURIS | Man. | 80.48 | 44.28 | 23.59 | 50.60 |
| SPRAGUE | Man. | 105.36 | 49.13 | 42.23 | 72.20 |
| ST. ALBANS | Man. | 49.10 | 27.42 | 13.17 | 30.37 |
| ST. BONIFACE | Man. | 101.73 | 50.84 | 34.46 | 66.86 |
| STARBUCK | Man. | 126.90 | 44.28 | 68.47 | 96.56 |
| STEINBACK | Man. | 140.35 | 45.64 | 80.55 | 109.18 |
| STONEWALL | Man. | 98.52 | 45.98 | 38.17 | 67.11 |
| STONY MNT. | Man. | 83.34 | 41.98 | 27.06 | 54.33 |
| SWAN RIVER | Man. | 130.80 | 47.58 | 68.30 | 98.26 |
| THE PAS | Man. | 105.63 | 39.76 | 54.55 | 78.80 |
| VIRDEN | Man. | 99.12 | 38.14 | 49.11 | 73.07 |

| | | | | | |
|---|---|---|---|---|---|
| VOGAR | Man. | 83.77 | 31.29 | 42.30 | 62.27 |
| WASAGAMING | Man. | 85.00 | 51.44 | 85.00 | 85.00 |
| WASKADA | Man. | 69.20 | 35.53 | 23.54 | 45.21 |
| WILSON CREEK | Man. | 95.85 | 33.91 | 50.51 | 72.45 |
| WINNIPEG | Man. | 135.10 | 47.64 | 73.89 | 102.94 |

Table B17: Soil Moisture Amounts on Oct.31 for Wheat (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 101.80 | 36.63 | 52.95 | 76.56 |
| ARRAN | Sask. | 149.05 | 41.23 | 95.02 | 120.89 |
| AYLSHAM | Sask. | 215.82 | 45.43 | 155.24 | 184.52 |
| BANGOR | Sask. | 109.80 | 38.26 | 59.17 | 83.55 |
| BROADVIEW | Sask. | 126.73 | 41.40 | 73.53 | 98.78 |
| CANORA | Sask. | 146.89 | 39.77 | 93.58 | 119.41 |
| CARDROSE | Sask. | 100.78 | 52.33 | 31.16 | 64.78 |
| CARLYLE | Sask. | 118.07 | 44.53 | 60.85 | 88.01 |
| CARON | Sask. | 82.44 | 36.64 | 35.36 | 57.71 |
| CEYLON | Sask. | 105.45 | 47.48 | 44.44 | 73.41 |
| COTE | Sask. | 148.38 | 39.44 | 95.79 | 121.21 |
| CUPAR | Sask. | 125.70 | 42.37 | 71.26 | 97.10 |
| DAFOE | Sask. | 94.33 | 40.75 | 40.11 | 66.29 |
| DAHINDA | Sask. | 109.29 | 34.79 | 62.49 | 85.21 |
| DAVIDSON | Sask. | 75.88 | 33.71 | 32.56 | 53.12 |
| DAVIN | Sask. | 98.20 | 40.77 | 44.47 | 70.27 |
| DUVAL | Sask. | 96.85 | 31.91 | 54.80 | 74.99 |
| ESTEVAN | Sask. | 95.49 | 35.82 | 49.46 | 71.31 |
| FENWOOD | Sask. | 126.61 | 32.30 | 83.17 | 104.26 |
| FERTILE | Sask. | 144.61 | 44.96 | 84.79 | 113.67 |
| FOAMLAKE | Sask. | 101.29 | 31.91 | 60.29 | 79.75 |
| FORT QU'APPELLE | Sask. | 79.54 | 45.17 | 21.50 | 49.05 |
| FRANCIS | Sask. | 92.19 | 40.81 | 39.75 | 64.65 |
| GOOD SPRIT LAKE | Sask. | 125.00 | 25.48 | 91.34 | 107.52 |
| GRENFELL | Sask. | 121.05 | 45.75 | 62.26 | 90.17 |
| GUERNSEY | Sask. | 75.41 | 25.53 | 41.36 | 57.81 |
| HUBBARD | Sask. | 89.41 | 32.76 | 47.31 | 67.30 |
| HUDSON BAY | Sask. | 146.02 | 47.89 | 84.49 | 113.70 |
| HUMBOLT | Sask. | 93.30 | 32.48 | 51.56 | 71.37 |
| INDIAN HEAD | Sask. | 132.18 | 46.55 | 72.37 | 100.76 |
| KAMSACK | Sask. | 116.13 | 40.88 | 63.59 | 88.53 |
| KELLIHER | Sask. | 105.04 | 32.74 | 62.97 | 82.94 |
| KIPLING | Sask. | 138.72 | 45.98 | 79.64 | 107.69 |
| KRISTNES | Sask. | 98.01 | 38.16 | 47.13 | 71.72 |
| KUROKI | Sask. | 120.47 | 28.65 | 82.75 | 100.87 |
| LANGENBURG | Sask. | 98.81 | 38.01 | 48.13 | 72.62 |
| LEROSS | Sask. | 109.88 | 33.58 | 65.29 | 86.77 |
| LINTLAW | Sask. | 102.60 | 33.25 | 59.88 | 80.16 |
| LIPTON | Sask. | 153.40 | 51.19 | 87.62 | 118.85 |
| LUMSDEN | Sask. | 107.76 | 49.13 | 44.62 | 74.59 |
| MARYFIELD | Sask. | 141.77 | 50.76 | 74.09 | 106.80 |
| MELVILLE | Sask. | 118.97 | 40.07 | 66.04 | 91.49 |
| MIDALE | Sask. | 84.59 | 38.14 | 35.58 | 58.85 |
| MOOSEJAW | Sask. | 107.51 | 41.48 | 54.21 | 79.51 |
| MOOSOMIN | Sask. | 166.86 | 46.09 | 107.63 | 135.75 |
| MUENSTER | Sask. | 90.21 | 36.19 | 43.70 | 65.78 |
| NIPAWIN | Sask. | 149.21 | 50.89 | 83.81 | 114.86 |
| NOKOMIS | Sask. | 76.70 | 37.32 | 28.74 | 51.51 |

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|---|---|---|---|---|---|
| ORMISTON | Sask. | 87.24 | 39.99 | 35.86 | 60.25 |
| OXBOW | Sask. | 116.07 | 44.29 | 59.17 | 86.18 |
| PASWEGIN | Sask. | 112.91 | 29.61 | 74.01 | 92.66 |
| PELLY | Sask. | 151.90 | 47.46 | 89.70 | 119.48 |
| PORCUPINE PLAIN | Sask. | 199.45 | 54.52 | 128.00 | 162.21 |
| PRAIRIE RIVER | Sask. | 157.77 | 39.67 | 105.44 | 130.60 |
| PRECCEVILLE | Sask. | 113.94 | 32.86 | 69.75 | 91.20 |
| QU'APPELLE | Sask. | 113.37 | 44.42 | 56.29 | 83.39 |
| RAYMORE | Sask. | 95.86 | 31.91 | 53.57 | 73.94 |
| REDVERS | Sask. | 144.39 | 47.59 | 80.94 | 111.61 |
| REGINA | Sask. | 116.86 | 44.71 | 59.40 | 86.67 |
| RIDGEDALE | Sask. | 144.29 | 52.18 | 77.24 | 109.07 |
| ROCANVILLE | Sask. | 130.79 | 44.21 | 71.97 | 100.37 |
| SEMANS | Sask. | 86.38 | 42.56 | 31.69 | 57.65 |
| SOMME | Sask. | 175.88 | 42.58 | 119.35 | 146.58 |
| STRASBOURG | Sask. | 86.04 | 35.17 | 40.85 | 62.31 |
| WAPELLA | Sask. | 155.53 | 45.75 | 94.38 | 123.97 |
| WATROUS | Sask. | 111.08 | 41.08 | 58.29 | 83.35 |
| WEYBURN | Sask. | 102.44 | 40.12 | 50.89 | 75.36 |
| WHITEWOOD | Sask. | 134.88 | 46.47 | 75.16 | 103.51 |
| WILCOX | Sask. | 118.41 | 43.27 | 61.67 | 88.86 |
| WISHART | Sask. | 107.12 | 31.01 | 65.55 | 85.69 |
| WYNYARD | Sask. | 105.55 | 34.06 | 60.61 | 82.22 |
| YELLOW GRASS | Sask. | 104.43 | 44.24 | 47.58 | 74.57 |
| YORKTON | Sask. | 130.21 | 39.80 | 79.07 | 103.35 |
| ALTONA | Man. | 165.37 | 50.11 | 99.55 | 131.10 |
| ARORG | Man. | 189.69 | 51.20 | 122.42 | 154.67 |
| BALDUR | Man. | 173.55 | 51.92 | 105.21 | 138.04 |
| BEAUSEJOUR | Man. | 208.05 | 44.18 | 149.96 | 177.83 |
| BEDE | Man. | 138.75 | 51.06 | 70.97 | 103.63 |
| BINSCARTH | Man. | 158.29 | 46.74 | 95.42 | 125.95 |
| BIRCH RIVER | Man. | 202.39 | 50.00 | 135.72 | 167.94 |
| BIRTLE | Man. | 164.60 | 50.99 | 99.08 | 130.18 |
| BISSETT | Man. | 178.31 | 34.85 | 133.53 | 154.78 |
| BOISEVAIN | Man. | 140.28 | 46.24 | 79.41 | 108.65 |
| BRANDON | Man. | 152.70 | 51.62 | 86.37 | 117.86 |
| BROADVALLEY | Man. | 205.48 | 51.81 | 136.39 | 169.78 |
| CARBERRY | Man. | 111.90 | 37.23 | 62.77 | 86.39 |
| CYPRESS RIVER | Man. | 150.23 | 46.16 | 90.92 | 119.07 |
| DAUPHIN | Man. | 178.61 | 60.60 | 100.73 | 137.70 |
| DEERWOOD | Man. | 157.89 | 44.97 | 100.10 | 127.53 |
| DELORAINE | Man. | 170.06 | 52.85 | 99.42 | 133.60 |
| DELTA BEACH | Man. | 172.99 | 42.22 | 117.04 | 143.99 |
| DUGALD | Man. | 196.51 | 52.50 | 126.66 | 160.39 |
| EMERSON | Man. | 173.68 | 52.70 | 105.96 | 138.11 |
| ERIKSDALE | Man. | 146.12 | 39.88 | 93.63 | 118.84 |
| FRASERWOOD | Man. | 180.23 | 47.52 | 117.01 | 147.53 |
| GILBERT PLAIN | Man. | 184.98 | 59.68 | 106.58 | 144.16 |
| GIMLI | Man. | 200.31 | 33.03 | 157.87 | 178.01 |
| GLADSTONE | Man. | 152.88 | 58.68 | 73.96 | 112.27 |
| GLENBORO | Man. | 122.22 | 35.46 | 74.93 | 97.79 |
| GLENLEA | Man. | 207.32 | 48.14 | 143.52 | 174.25 |

| | | | | | |
|---|---|---|---|---|---|
| GRAND RAPIDS | Man. | 96.00 | 9.60 | 83.66 | 89.52 |
| GRASS RIVER | Man. | 157.57 | 53.64 | 87.04 | 120.89 |
| GRAYSVILLE | Man. | 141.83 | 49.12 | 78.71 | 108.67 |
| GREAT FALLS | Man. | 175.87 | 64.47 | 93.02 | 132.35 |
| HAMIOTA | Man. | 144.29 | 48.36 | 82.16 | 111.65 |
| HARDING | Man. | 156.45 | 56.17 | 80.89 | 117.57 |
| HODGESON | Man. | 201.19 | 55.10 | 128.04 | 163.28 |
| INDIAN BAY | Man. | 138.93 | 20.86 | 112.13 | 124.85 |
| LANGRUTH | Man. | 188.28 | 50.96 | 120.33 | 153.17 |
| LUNDAR | Man. | 177.79 | 52.31 | 107.17 | 141.49 |
| MACGREGOR | Man. | 162.60 | 54.55 | 88.95 | 124.74 |
| MARQUETTE | Man. | 211.59 | 51.79 | 142.69 | 175.96 |
| MEADOW PORTAGE | Man. | 135.43 | 25.12 | 101.84 | 118.09 |
| MELITA | Man. | 105.59 | 38.57 | 54.64 | 79.14 |
| MINNEDOSA | Man. | 156.66 | 48.42 | 94.44 | 123.98 |
| MNT SIDE GOODLANDS | Man. | 150.80 | 48.88 | 85.05 | 116.97 |
| MOOSEHORN | Man. | 110.12 | 38.23 | 59.94 | 84.01 |
| MORDEN | Man. | 153.46 | 43.50 | 97.57 | 124.10 |
| MORRIS | Man. | 160.50 | 59.11 | 84.54 | 120.59 |
| MYRTLE | Man. | 189.08 | 51.76 | 120.36 | 153.47 |
| NEEPAWA | Man. | 174.07 | 46.91 | 113.79 | 142.40 |
| NINETTE | Man. | 139.53 | 44.83 | 81.92 | 109.27 |
| NIVERVILLE | Man. | 188.02 | 56.43 | 113.81 | 149.42 |
| OAKNER | Man. | 169.47 | 49.05 | 104.35 | 135.73 |
| PEACE GARDENS | Man. | 176.65 | 59.52 | 97.63 | 135.70 |
| PIERSON | Man. | 144.24 | 55.96 | 72.34 | 106.47 |
| PILOT MOUND | Man. | 154.84 | 45.03 | 95.62 | 124.04 |
| PINAWA | Man. | 156.82 | 63.06 | 75.78 | 114.25 |
| PINE FALLS | Man. | 199.55 | 38.82 | 148.56 | 173.00 |
| PLUMAS | Man. | 160.77 | 59.53 | 82.57 | 120.06 |
| PLUM COULEE | Man. | 194.11 | 54.58 | 121.65 | 156.56 |
| PORTAGE LA PRAIRIE | Man. | 206.47 | 48.22 | 144.51 | 173.93 |
| RATHWELL | Man. | 165.10 | 46.92 | 102.67 | 132.82 |
| RIVERS | Man. | 166.45 | 42.46 | 111.89 | 137.79 |
| ROLAND | Man. | 148.38 | 51.83 | 80.16 | 112.93 |
| ROSSBURN | Man. | 184.31 | 45.12 | 124.98 | 153.45 |
| RUSSELL | Man. | 150.60 | 52.34 | 83.35 | 115.28 |
| SELKIRK | Man. | 209.50 | 43.11 | 152.54 | 179.93 |
| SEVEN SISTERS | Man. | 181.35 | 47.39 | 118.17 | 148.70 |
| SHILO | Man. | 109.32 | 33.58 | 64.16 | 86.08 |
| SOMSERSET | Man. | 175.64 | 41.74 | 119.68 | 146.80 |
| SOURIS | Man. | 134.83 | 49.58 | 71.13 | 101.37 |
| SPRAGUE | Man. | 167.65 | 40.80 | 115.23 | 140.12 |
| ST. ALBANS | Man. | 102.26 | 37.68 | 52.86 | 76.53 |
| ST. BONIFACE | Man. | 158.87 | 65.90 | 71.68 | 113.67 |
| STARBUCK | Man. | 195.87 | 52.14 | 127.08 | 160.16 |
| STEINBACK | Man. | 213.61 | 50.56 | 147.35 | 179.08 |
| STONEWALL | Man. | 161.44 | 44.51 | 102.85 | 130.99 |
| STONY MNT. | Man. | 146.23 | 53.17 | 74.43 | 109.33 |
| SWAN RIVER | Man. | 189.05 | 52.43 | 120.18 | 153.19 |
| THE PAS | Man. | 175.90 | 32.99 | 133.51 | 153.64 |
| VIRDEN | Man. | 162.76 | 51.94 | 94.64 | 127.28 |

| | | | | | |
|---|---|---|---|---|---|
| VOGAR | Man. | 138.93 | 25.87 | 104.51 | 121.13 |
| WASAGAMING | Man. | 161.12 | 40.94 | 106.87 | 133.00 |
| WASKADA | Man. | 106.15 | 43.93 | 49.70 | 76.50 |
| WILSON CREEK | Man. | 168.67 | 50.06 | 101.74 | 134.12 |
| WINNIPEG | Man. | 204.33 | 47.28 | 143.58 | 172.42 |

Table B18: Accumulated Growing Season Precipitation for Wheat (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 163.41 | 60.65 | 82.54 | 121.62 |
| ARRAN | Sask. | 204.27 | 70.16 | 112.34 | 156.35 |
| AYLSHAM | Sask. | 220.59 | 66.01 | 132.77 | 175.17 |
| BANGOR | Sask. | 172.61 | 80.74 | 65.77 | 117.22 |
| BROADVIEW | Sask. | 204.79 | 78.18 | 104.33 | 152.02 |
| CANORA | Sask. | 215.25 | 60.79 | 134.19 | 173.36 |
| CARDROSE | Sask. | 176.25 | 75.47 | 76.05 | 124.33 |
| CARLYLE | Sask. | 196.60 | 68.79 | 108.21 | 150.17 |
| CARON | Sask. | 149.88 | 49.59 | 86.17 | 116.41 |
| CEYLON | Sask. | 183.72 | 79.51 | 81.55 | 130.05 |
| COTE | Sask. | 192.08 | 79.61 | 85.92 | 137.23 |
| CUPAR | Sask. | 163.34 | 78.06 | 63.03 | 110.65 |
| DAFOE | Sask. | 181.48 | 80.43 | 74.69 | 126.14 |
| DAHINDA | Sask. | 172.77 | 69.69 | 79.03 | 124.54 |
| DAVIDSON | Sask. | 166.52 | 62.41 | 86.32 | 124.39 |
| DAVIN | Sask. | 190.36 | 88.26 | 74.18 | 129.99 |
| DUVAL | Sask. | 170.42 | 65.25 | 84.43 | 125.72 |
| ESTEVAN | Sask. | 182.61 | 67.36 | 96.05 | 137.14 |
| FENWOOD | Sask. | 217.03 | 84.76 | 103.03 | 158.38 |
| FERTILE | Sask. | 205.05 | 57.79 | 128.17 | 165.29 |
| FOAMLAKE | Sask. | 177.15 | 67.76 | 90.08 | 131.41 |
| FORT QU'APPELLE | Sask. | 135.33 | 73.64 | 40.71 | 85.62 |
| FRANCIS | Sask. | 180.55 | 74.03 | 85.42 | 130.58 |
| GOOD SPRIT LAKE | Sask. | 183.62 | 85.82 | 70.23 | 124.74 |
| GRENFELL | Sask. | 176.83 | 69.83 | 87.10 | 129.70 |
| GUERNSEY | Sask. | 156.85 | 74.79 | 57.35 | 105.40 |
| HUBBARD | Sask. | 195.56 | 75.18 | 98.96 | 144.82 |
| HUDSON BAY | Sask. | 211.70 | 74.23 | 116.32 | 161.60 |
| HUMBOLT | Sask. | 175.03 | 65.40 | 90.99 | 130.89 |
| INDIAN HEAD | Sask. | 178.43 | 71.52 | 86.54 | 130.16 |
| KAMSACK | Sask. | 176.65 | 74.34 | 81.13 | 126.47 |
| KELLIHER | Sask. | 175.62 | 82.36 | 69.79 | 120.03 |
| KIPLING | Sask. | 200.37 | 78.68 | 99.27 | 147.26 |
| KRISTNES | Sask. | 177.84 | 80.51 | 70.50 | 122.37 |
| KUROKI | Sask. | 203.26 | 80.25 | 97.72 | 148.36 |
| LANGENBURG | Sask. | 182.59 | 71.38 | 87.82 | 133.48 |
| LEROSS | Sask. | 228.89 | 93.64 | 104.78 | 164.56 |
| LINTLAW | Sask. | 205.14 | 91.62 | 87.42 | 143.30 |
| LIPTON | Sask. | 190.87 | 76.52 | 92.54 | 139.22 |
| LUMSDEN | Sask. | 159.45 | 76.20 | 61.53 | 108.02 |
| MARYFIELD | Sask. | 187.79 | 67.98 | 97.14 | 140.95 |
| MELVILLE | Sask. | 157.41 | 73.23 | 60.66 | 107.17 |
| MIDALE | Sask. | 173.20 | 67.94 | 85.89 | 127.33 |
| MOOSEJAW | Sask. | 154.35 | 57.99 | 79.83 | 115.21 |
| MOOSOMIN | Sask. | 221.77 | 77.83 | 121.76 | 169.23 |
| MUENSTER | Sask. | 174.68 | 67.29 | 88.21 | 129.26 |
| NIPAWIN | Sask. | 187.85 | 68.94 | 99.26 | 141.32 |
| NOKOMIS | Sask. | 163.32 | 75.63 | 66.14 | 112.27 |

| | | | | | |
|---|---|---|---|---|---|
| ORMISTON | Sask. | 152.95 | 72.25 | 60.12 | 104.19 |
| OXBOW | Sask. | 191.92 | 73.68 | 97.24 | 142.18 |
| PASWEGIN | Sask. | 206.96 | 76.11 | 106.97 | 154.90 |
| PELLY | Sask. | 228.09 | 80.41 | 122.72 | 173.17 |
| PORCUPINE PLAIN | Sask. | 219.44 | 85.93 | 109.02 | 161.44 |
| PRAIRIE RIVER | Sask. | 221.34 | 75.81 | 121.44 | 169.41 |
| PRECCEVILLE | Sask. | 200.09 | 54.88 | 126.91 | 162.28 |
| QU'APPELLE | Sask. | 184.17 | 78.73 | 83.00 | 131.02 |
| RAYMORE | Sask. | 180.98 | 80.08 | 74.85 | 125.96 |
| REDVERS | Sask. | 185.73 | 98.89 | 54.43 | 117.69 |
| REGINA | Sask. | 171.50 | 65.38 | 87.48 | 127.36 |
| RIDGEDALE | Sask. | 185.36 | 72.82 | 91.79 | 136.21 |
| ROCANVILLE | Sask. | 161.60 | 53.98 | 89.93 | 124.46 |
| SEMANS | Sask. | 170.93 | 78.75 | 69.74 | 117.78 |
| SOMME | Sask. | 186.27 | 74.38 | 87.51 | 135.10 |
| STRASBOURG | Sask. | 183.86 | 76.12 | 86.04 | 132.48 |
| WAPELLA | Sask. | 181.92 | 50.35 | 114.78 | 147.23 |
| WATROUS | Sask. | 191.11 | 80.10 | 88.18 | 137.04 |
| WEYBURN | Sask. | 172.93 | 79.80 | 70.39 | 119.07 |
| WHITEWOOD | Sask. | 200.18 | 91.81 | 82.21 | 138.21 |
| WILCOX | Sask. | 172.13 | 74.94 | 73.84 | 120.94 |
| WISHART | Sask. | 181.51 | 65.11 | 95.06 | 136.71 |
| WYNYARD | Sask. | 187.48 | 65.67 | 100.82 | 142.49 |
| YELLOW GRASS | Sask. | 178.79 | 70.27 | 88.49 | 131.36 |
| YORKTON | Sask. | 198.37 | 78.31 | 97.75 | 145.51 |
| ALTONA | Man. | 202.57 | 61.22 | 122.14 | 160.69 |
| ARORG | Man. | 209.89 | 71.13 | 116.45 | 161.24 |
| BALDUR | Man. | 221.88 | 80.89 | 115.40 | 166.55 |
| BEAUSEJOUR | Man. | 226.70 | 69.53 | 135.27 | 179.14 |
| BEDE | Man. | 197.60 | 60.12 | 117.92 | 156.29 |
| BINSCARTH | Man. | 191.81 | 53.54 | 119.80 | 154.76 |
| BIRCH RIVER | Man. | 206.20 | 78.51 | 101.51 | 152.10 |
| BIRTLE | Man. | 223.45 | 86.87 | 111.81 | 164.81 |
| BISSETT | Man. | 215.11 | 72.32 | 122.17 | 166.29 |
| BOISEVAIN | Man. | 223.81 | 76.01 | 123.85 | 171.81 |
| BRANDON | Man. | 206.72 | 74.12 | 111.48 | 156.69 |
| BROADVALLEY | Man. | 210.47 | 73.70 | 112.19 | 159.69 |
| CARBERRY | Man. | 206.00 | 62.08 | 124.09 | 163.48 |
| CYPRESS RIVER | Man. | 214.18 | 71.67 | 122.08 | 165.80 |
| DAUPHIN | Man. | 211.33 | 84.86 | 102.28 | 154.05 |
| DEERWOOD | Man. | 226.91 | 89.21 | 112.28 | 166.69 |
| DELORAINE | Man. | 218.20 | 71.93 | 122.29 | 168.64 |
| DELTA BEACH | Man. | 216.16 | 66.91 | 127.48 | 170.19 |
| DUGALD | Man. | 225.08 | 75.29 | 124.91 | 173.28 |
| EMERSON | Man. | 224.18 | 85.39 | 114.45 | 166.54 |
| ERIKSDALE | Man. | 201.18 | 74.15 | 103.67 | 150.46 |
| FRASERWOOD | Man. | 226.01 | 67.89 | 135.69 | 179.30 |
| GILBERT PLAIN | Man. | 192.12 | 79.18 | 88.10 | 137.96 |
| GIMLI | Man. | 214.90 | 63.97 | 132.69 | 171.72 |
| GLADSTONE | Man. | 189.81 | 65.60 | 101.57 | 144.41 |
| GLENBORO | Man. | 207.13 | 69.29 | 114.73 | 159.38 |
| GLENLEA | Man. | 229.56 | 80.94 | 122.29 | 173.95 |

| | | | | | |
|---|---|---|---|---|---|
| GRAND RAPIDS | Man. | 207.29 | 71.79 | 115.03 | 158.83 |
| GRASS RIVER | Man. | 191.20 | 62.95 | 108.65 | 148.21 |
| GRAYSVILLE | Man. | 201.50 | 78.27 | 100.92 | 148.67 |
| GREAT FALLS | Man. | 164.61 | 74.24 | 69.22 | 114.51 |
| HAMIOTA | Man. | 196.55 | 68.94 | 107.96 | 150.01 |
| HARDING | Man. | 189.93 | 52.09 | 120.30 | 153.99 |
| HODGESON | Man. | 252.32 | 88.00 | 135.48 | 191.78 |
| INDIAN BAY | Man. | 250.83 | 76.62 | 152.38 | 199.11 |
| LANGRUTH | Man. | 196.91 | 55.50 | 122.90 | 158.66 |
| LUNDAR | Man. | 182.06 | 51.36 | 112.71 | 146.41 |
| MACGREGOR | Man. | 196.01 | 62.20 | 112.35 | 152.96 |
| MARQUETTE | Man. | 215.50 | 71.07 | 120.96 | 166.61 |
| MEADOW PORTAGE | Man. | 200.11 | 68.24 | 108.89 | 153.02 |
| MELITA | Man. | 248.17 | 77.20 | 146.17 | 195.21 |
| MINNEDOSA | Man. | 220.77 | 75.07 | 124.31 | 170.10 |
| MNT SIDE GOODLANDS | Man. | 193.77 | 70.49 | 99.26 | 145.06 |
| MOOSEHORN | Man. | 166.21 | 74.47 | 68.55 | 115.35 |
| MORDEN | Man. | 198.81 | 65.55 | 114.58 | 154.57 |
| MORRIS | Man. | 175.92 | 64.96 | 92.46 | 132.08 |
| MYRTLE | Man. | 211.72 | 68.24 | 121.29 | 164.84 |
| NEEPAWA | Man. | 212.38 | 81.58 | 107.55 | 157.32 |
| NINETTE | Man. | 206.22 | 85.88 | 95.86 | 148.25 |
| NIVERVILLE | Man. | 214.03 | 77.91 | 111.57 | 160.74 |
| OAKNER | Man. | 212.58 | 54.32 | 140.59 | 175.26 |
| PEACE GARDENS | Man. | 250.87 | 98.70 | 119.84 | 182.97 |
| PIERSON | Man. | 193.27 | 74.48 | 97.56 | 142.99 |
| PILOT MOUND | Man. | 215.30 | 75.08 | 116.66 | 163.94 |
| PINAWA | Man. | 170.14 | 84.53 | 61.51 | 113.08 |
| PINE FALLS | Man. | 218.55 | 61.42 | 137.94 | 176.60 |
| PLUMAS | Man. | 192.93 | 65.72 | 106.67 | 148.04 |
| PLUM COULEE | Man. | 196.25 | 59.64 | 117.06 | 155.22 |
| PORTAGE LA PRAIRIE | Man. | 210.00 | 71.53 | 118.08 | 161.72 |
| RATHWELL | Man. | 194.02 | 74.60 | 94.77 | 142.69 |
| RIVERS | Man. | 221.88 | 76.55 | 123.51 | 170.20 |
| ROLAND | Man. | 198.18 | 72.01 | 103.38 | 148.92 |
| ROSSBURN | Man. | 218.08 | 79.85 | 113.28 | 163.55 |
| RUSSELL | Man. | 200.66 | 76.23 | 102.70 | 149.21 |
| SELKIRK | Man. | 218.22 | 78.56 | 114.42 | 164.32 |
| SEVEN SISTERS | Man. | 222.08 | 100.26 | 88.69 | 153.10 |
| SHILO | Man. | 184.53 | 75.46 | 83.04 | 132.31 |
| SOMSERSET | Man. | 226.85 | 64.09 | 140.94 | 182.57 |
| SOURIS | Man. | 206.90 | 89.04 | 92.48 | 146.80 |
| SPRAGUE | Man. | 255.75 | 92.54 | 136.84 | 193.29 |
| ST. ALBANS | Man. | 206.89 | 72.26 | 112.20 | 157.54 |
| ST. BONIFACE | Man. | 168.14 | 83.98 | 57.02 | 110.53 |
| STARBUCK | Man. | 221.80 | 73.53 | 124.78 | 171.44 |
| STEINBACK | Man. | 224.97 | 59.07 | 147.56 | 184.63 |
| STONEWALL | Man. | 227.23 | 96.26 | 100.89 | 161.49 |
| STONY MNT. | Man. | 196.34 | 56.23 | 120.96 | 157.48 |
| SWAN RIVER | Man. | 206.23 | 67.59 | 117.43 | 159.99 |
| THE PAS | Man. | 189.51 | 63.65 | 107.72 | 146.55 |
| VIRDEN | Man. | 185.37 | 63.71 | 101.82 | 141.85 |

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|---|---|---|---|---|---|
| VOGAR | Man. | 202.25 | 61.13 | 121.23 | 160.25 |
| WASAGAMING | Man. | 226.24 | 106.24 | 85.44 | 153.26 |
| WASKADA | Man. | 196.66 | 81.27 | 92.22 | 141.80 |
| WILSON CREEK | Man. | 202.96 | 65.50 | 115.39 | 157.76 |
| WINNIPEG | Man. | 207.00 | 73.07 | 113.11 | 157.68 |

Table B19: Accumulated Growing Season Actual Evapotranspiration for Wheat (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 239.93 | 49.58 | 306.03 | 274.08 |
| ARRAN | Sask. | 275.23 | 51.81 | 343.12 | 310.62 |
| AYLSHAM | Sask. | 278.68 | 20.58 | 306.06 | 292.84 |
| BANGOR | Sask. | 234.37 | 56.75 | 309.46 | 273.30 |
| BROADVIEW | Sask. | 267.81 | 44.05 | 324.41 | 297.54 |
| CANORA | Sask. | 278.32 | 37.53 | 328.36 | 304.17 |
| CARDROSE | Sask. | 247.88 | 54.70 | 320.51 | 285.52 |
| CARLYLE | Sask. | 259.23 | 48.15 | 321.10 | 291.73 |
| CARON | Sask. | 226.52 | 55.43 | 297.75 | 263.93 |
| CEYLON | Sask. | 253.36 | 67.58 | 340.20 | 298.98 |
| COTE | Sask. | 264.98 | 56.84 | 340.77 | 304.14 |
| CUPAR | Sask. | 243.26 | 68.25 | 330.96 | 289.33 |
| DAFOE | Sask. | 235.78 | 43.07 | 292.97 | 265.42 |
| DAHINDA | Sask. | 233.90 | 45.90 | 295.64 | 265.67 |
| DAVIDSON | Sask. | 224.85 | 50.46 | 289.69 | 258.91 |
| DAVIN | Sask. | 236.45 | 70.14 | 328.77 | 284.42 |
| DUVAL | Sask. | 223.14 | 38.31 | 273.62 | 249.38 |
| ESTEVAN | Sask. | 238.43 | 46.65 | 298.38 | 269.92 |
| FENWOOD | Sask. | 242.68 | 31.09 | 284.50 | 264.20 |
| FERTILE | Sask. | 276.75 | 29.29 | 315.72 | 296.90 |
| FOAMLAKE | Sask. | 243.91 | 46.92 | 304.19 | 275.57 |
| FORT QU'APPELLE | Sask. | 204.79 | 70.70 | 295.64 | 252.51 |
| FRANCIS | Sask. | 246.30 | 68.60 | 334.45 | 292.60 |
| GOOD SPRIT LAKE | Sask. | 232.40 | 75.98 | 332.79 | 284.52 |
| GRENFELL | Sask. | 257.43 | 56.59 | 330.14 | 295.62 |
| GUERNSEY | Sask. | 198.15 | 47.85 | 261.81 | 231.07 |
| HUBBARD | Sask. | 252.17 | 48.72 | 314.78 | 285.06 |
| HUDSON BAY | Sask. | 273.98 | 30.00 | 312.53 | 294.23 |
| HUMBOLT | Sask. | 240.62 | 38.32 | 289.85 | 266.48 |
| INDIAN HEAD | Sask. | 253.77 | 52.50 | 321.22 | 289.20 |
| KAMSACK | Sask. | 247.43 | 52.39 | 314.75 | 282.79 |
| KELLIHER | Sask. | 237.40 | 68.80 | 325.81 | 283.84 |
| KIPLING | Sask. | 272.32 | 41.26 | 325.34 | 300.17 |
| KRISTNES | Sask. | 238.07 | 45.35 | 298.54 | 269.31 |
| KUROKI | Sask. | 253.22 | 54.92 | 325.43 | 290.78 |
| LANGENBURG | Sask. | 239.58 | 48.11 | 303.45 | 272.68 |
| LEROSS | Sask. | 274.36 | 31.45 | 316.03 | 295.96 |
| LINTLAW | Sask. | 254.18 | 49.35 | 317.60 | 287.49 |
| LIPTON | Sask. | 280.69 | 62.05 | 360.42 | 322.57 |
| LUMSDEN | Sask. | 223.95 | 69.69 | 313.50 | 270.99 |
| MARYFIELD | Sask. | 266.49 | 30.43 | 307.06 | 287.45 |
| MELVILLE | Sask. | 245.20 | 54.28 | 316.91 | 282.43 |
| MIDALE | Sask. | 232.05 | 51.76 | 298.56 | 266.98 |
| MOOSEJAW | Sask. | 234.96 | 47.28 | 295.72 | 266.88 |
| MOOSOMIN | Sask. | 271.26 | 32.16 | 312.59 | 292.97 |
| MUENSTER | Sask. | 227.88 | 36.55 | 274.85 | 252.55 |
| NIPAWIN | Sask. | 262.83 | 44.33 | 319.80 | 292.75 |

| | | | | | |
|---|---|---|---|---|---|
| NOKOMIS | Sask. | 211.97 | 56.64 | 284.76 | 250.21 |
| ORMISTON | Sask. | 213.54 | 52.90 | 281.53 | 249.25 |
| OXBOW | Sask. | 254.48 | 47.24 | 315.18 | 286.37 |
| PASWEGIN | Sask. | 243.79 | 42.37 | 299.46 | 272.78 |
| PELLY | Sask. | 285.39 | 52.76 | 354.53 | 321.43 |
| PORCUPINE PLAIN | Sask. | 271.32 | 37.03 | 318.90 | 296.31 |
| PRAIRIE RIVER | Sask. | 281.20 | 66.93 | 369.40 | 327.05 |
| PRECCEVILLE | Sask. | 259.69 | 28.89 | 298.20 | 279.59 |
| QU'APPELLE | Sask. | 253.97 | 57.38 | 327.70 | 292.70 |
| RAYMORE | Sask. | 231.06 | 42.32 | 287.15 | 260.13 |
| REDVERS | Sask. | 264.73 | 45.76 | 325.48 | 296.21 |
| REGINA | Sask. | 243.44 | 56.73 | 316.34 | 281.73 |
| RIDGEDALE | Sask. | 268.97 | 54.26 | 338.69 | 305.59 |
| ROCANVILLE | Sask. | 246.44 | 40.76 | 300.56 | 274.49 |
| SEMANS | Sask. | 215.39 | 58.32 | 290.34 | 254.76 |
| SOMME | Sask. | 267.53 | 26.87 | 303.20 | 286.02 |
| STRASBOURG | Sask. | 235.82 | 51.47 | 301.96 | 270.56 |
| WAPELLA | Sask. | 259.98 | 30.03 | 300.03 | 280.68 |
| WATROUS | Sask. | 248.86 | 57.25 | 322.42 | 287.50 |
| WEYBURN | Sask. | 240.90 | 51.13 | 306.60 | 275.41 |
| WHITEWOOD | Sask. | 261.39 | 57.70 | 335.53 | 300.34 |
| WILCOX | Sask. | 250.99 | 55.94 | 324.35 | 289.20 |
| WISHART | Sask. | 242.88 | 30.24 | 283.03 | 263.69 |
| WYNYARD | Sask. | 239.34 | 34.61 | 285.01 | 263.05 |
| YELLOW GRASS | Sask. | 248.92 | 53.92 | 318.21 | 285.31 |
| YORKTON | Sask. | 257.02 | 39.32 | 307.54 | 283.56 |
| ALTONA | Man. | 270.35 | 30.35 | 310.22 | 291.11 |
| ARORG | Man. | 283.47 | 20.53 | 310.44 | 297.52 |
| BALDUR | Man. | 289.18 | 28.39 | 326.55 | 308.60 |
| BEAUSEJOUR | Man. | 292.63 | 22.65 | 322.41 | 308.12 |
| BEDE | Man. | 268.74 | 35.80 | 316.18 | 293.33 |
| BINSCARTH | Man. | 276.40 | 33.82 | 321.88 | 299.80 |
| BIRCH RIVER | Man. | 285.39 | 61.46 | 367.33 | 327.73 |
| BIRTLE | Man. | 277.52 | 39.98 | 328.89 | 304.50 |
| BISSETT | Man. | 262.91 | 46.65 | 322.86 | 294.40 |
| BOISEVAIN | Man. | 263.63 | 32.85 | 306.84 | 286.11 |
| BRANDON | Man. | 277.17 | 31.92 | 318.19 | 298.72 |
| BROADVALLEY | Man. | 281.39 | 18.13 | 305.56 | 293.88 |
| CARBERRY | Man. | 253.04 | 36.46 | 301.15 | 278.02 |
| CYPRESS RIVER | Man. | 278.04 | 32.66 | 320.01 | 300.08 |
| DAUPHIN | Man. | 268.00 | 33.53 | 311.09 | 290.64 |
| DEERWOOD | Man. | 265.71 | 26.56 | 299.84 | 283.63 |
| DELORAINE | Man. | 280.49 | 32.11 | 323.31 | 302.62 |
| DELTA BEACH | Man. | 262.25 | 20.00 | 288.75 | 275.99 |
| DUGALD | Man. | 299.27 | 37.18 | 348.74 | 324.86 |
| EMERSON | Man. | 280.92 | 38.26 | 330.08 | 306.74 |
| ERIKSDALE | Man. | 271.68 | 28.78 | 309.52 | 291.36 |
| FRASERWOOD | Man. | 281.82 | 22.21 | 311.37 | 297.10 |
| GILBERT PLAIN | Man. | 274.61 | 55.08 | 346.96 | 312.28 |
| GIMLI | Man. | 262.75 | 13.81 | 280.50 | 272.08 |
| GLADSTONE | Man. | 265.17 | 40.38 | 319.48 | 293.11 |
| GLENBORO | Man. | 258.83 | 40.25 | 312.50 | 286.56 |

| | | | | | |
|---|---|---|---|---|---|
| GLENLEA | Man. | 287.89 | 25.32 | 321.44 | 305.28 |
| GRAND RAPIDS | Man. | 209.39 | 27.13 | 244.25 | 227.70 |
| GRASS RIVER | Man. | 273.41 | 29.64 | 312.28 | 293.65 |
| GRAYSVILLE | Man. | 273.46 | 40.03 | 324.89 | 300.48 |
| GREAT FALLS | Man. | 231.61 | 56.52 | 304.24 | 269.76 |
| HAMIOTA | Man. | 262.37 | 35.99 | 308.61 | 286.66 |
| HARDING | Man. | 270.66 | 38.61 | 322.27 | 297.30 |
| HODGESON | Man. | 302.29 | 31.26 | 343.80 | 323.80 |
| INDIAN BAY | Man. | 265.34 | 22.97 | 294.85 | 280.84 |
| LANGRUTH | Man. | 262.36 | 20.26 | 289.37 | 276.32 |
| LUNDAR | Man. | 265.97 | 26.64 | 301.94 | 284.46 |
| MACGREGOR | Man. | 263.48 | 46.07 | 325.44 | 295.36 |
| MARQUETTE | Man. | 274.41 | 32.42 | 317.53 | 296.71 |
| MEADOW PORTAGE | Man. | 237.26 | 25.07 | 270.78 | 254.56 |
| MELITA | Man. | 278.51 | 28.54 | 316.23 | 298.09 |
| MINNEDOSA | Man. | 286.50 | 32.01 | 327.64 | 308.11 |
| MNT SIDE GOODLANDS | Man. | 263.90 | 30.57 | 304.88 | 285.02 |
| MOOSEHORN | Man. | 220.79 | 54.64 | 292.45 | 258.11 |
| MORDEN | Man. | 259.91 | 23.99 | 290.74 | 276.10 |
| MORRIS | Man. | 255.29 | 48.23 | 317.28 | 287.85 |
| MYRTLE | Man. | 291.99 | 30.92 | 332.96 | 313.23 |
| NEEPAWA | Man. | 269.03 | 21.27 | 296.36 | 283.39 |
| NINETTE | Man. | 265.51 | 40.11 | 317.06 | 292.59 |
| NIVERVILLE | Man. | 287.37 | 26.25 | 321.89 | 305.32 |
| OAKNER | Man. | 283.12 | 24.30 | 315.32 | 299.81 |
| PEACE GARDENS | Man. | 287.62 | 50.99 | 355.32 | 322.70 |
| PIERSON | Man. | 270.28 | 45.16 | 328.31 | 300.76 |
| PILOT MOUND | Man. | 277.28 | 25.43 | 310.68 | 294.67 |
| PINAWA | Man. | 239.75 | 49.11 | 302.85 | 272.90 |
| PINE FALLS | Man. | 273.69 | 16.56 | 295.43 | 285.00 |
| PLUMAS | Man. | 271.58 | 31.25 | 312.59 | 292.92 |
| PLUM COULEE | Man. | 282.39 | 24.62 | 315.07 | 299.32 |
| PORTAGE LA PRAIRIE | Man. | 271.37 | 23.61 | 301.70 | 287.30 |
| RATHWELL | Man. | 267.23 | 38.95 | 319.05 | 294.03 |
| RIVERS | Man. | 270.61 | 21.19 | 297.84 | 284.91 |
| ROLAND | Man. | 271.42 | 22.00 | 300.38 | 286.47 |
| ROSSBURN | Man. | 276.59 | 45.70 | 336.58 | 307.81 |
| RUSSELL | Man. | 260.93 | 46.37 | 320.52 | 292.23 |
| SELKIRK | Man. | 262.66 | 25.90 | 296.87 | 280.42 |
| SEVEN SISTERS | Man. | 263.28 | 19.77 | 289.59 | 276.89 |
| SHILO | Man. | 242.18 | 30.14 | 282.71 | 263.03 |
| SOMSERSET | Man. | 279.06 | 26.34 | 314.37 | 297.26 |
| SOURIS | Man. | 268.23 | 41.39 | 321.41 | 296.17 |
| SPRAGUE | Man. | 291.88 | 29.32 | 329.57 | 311.68 |
| ST. ALBANS | Man. | 255.36 | 34.62 | 300.72 | 279.00 |
| ST. BONIFACE | Man. | 232.44 | 57.89 | 309.03 | 272.15 |
| STARBUCK | Man. | 292.52 | 36.44 | 340.60 | 317.48 |
| STEINBACH | Man. | 284.08 | 18.88 | 308.82 | 296.97 |
| STONEWALL | Man. | 277.30 | 26.57 | 312.17 | 295.45 |
| STONY MNT. | Man. | 264.32 | 34.17 | 310.13 | 287.93 |
| SWAN RIVER | Man. | 271.91 | 32.68 | 314.85 | 294.27 |
| THE PAS | Man. | 252.64 | 18.13 | 275.94 | 264.88 |

| | | | | | |
|---|---|---|---|---|---|
| VIRDEN | Man. | 263.86 | 30.56 | 303.94 | 284.73 |
| VOGAR | Man. | 227.18 | 17.90 | 250.89 | 239.47 |
| WASAGAMING | Man. | 296.98 | 84.50 | 408.97 | 355.03 |
| WASKADA | Man. | 263.10 | 50.80 | 328.38 | 297.39 |
| WILSON CREEK | Man. | 269.64 | 21.29 | 298.10 | 284.33 |
| WINNIPEG | Man. | 274.02 | 23.78 | 304.58 | 290.08 |

Table B20: Soil Moisture Amounts at the First Cut of Alfalfa (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 47.50 | 29.32 | 8.40 | 27.29 |
| ARRAN | Sask. | 53.31 | 25.38 | 20.69 | 36.18 |
| AYLSHAM | Sask. | 92.57 | 47.53 | 29.33 | 59.87 |
| BANGOR | Sask. | 37.91 | 34.46 | -7.69 | 14.27 |
| BROADVIEW | Sask. | 53.83 | 33.93 | 10.23 | 30.93 |
| CANORA | Sask. | 62.18 | 36.78 | 13.14 | 36.84 |
| CARDROSE | Sask. | 62.87 | 41.51 | 7.75 | 34.31 |
| CARLYLE | Sask. | 53.33 | 33.59 | 10.17 | 30.66 |
| CARON | Sask. | 38.68 | 21.81 | 10.65 | 23.96 |
| CEYLON | Sask. | 56.21 | 40.35 | 4.36 | 28.98 |
| COTE | Sask. | 52.82 | 35.02 | 6.13 | 28.69 |
| CUPAR | Sask. | 53.80 | 34.37 | 9.63 | 30.60 |
| DAFOE | Sask. | 38.72 | 25.06 | 5.44 | 21.47 |
| DAHINDA | Sask. | 40.37 | 25.15 | 6.54 | 22.97 |
| DAVIDSON | Sask. | 29.32 | 22.01 | 1.04 | 14.47 |
| DAVIN | Sask. | 49.39 | 38.21 | -0.91 | 23.25 |
| DUVAL | Sask. | 33.21 | 21.99 | 4.23 | 18.15 |
| ESTEVAN | Sask. | 41.65 | 32.47 | -0.06 | 19.74 |
| FENWOOD | Sask. | 50.96 | 38.85 | -1.29 | 24.08 |
| FERTILE | Sask. | 67.29 | 32.32 | 24.29 | 45.06 |
| FOAMLAKE | Sask. | 39.55 | 27.23 | 4.55 | 21.16 |
| FORT QU'APPELLE | Sask. | 45.38 | 41.02 | -7.33 | 17.69 |
| FRANCIS | Sask. | 45.26 | 28.88 | 8.14 | 25.76 |
| GOOD SPRIT LAKE | Sask. | 46.96 | 27.42 | 10.74 | 28.15 |
| GRENFELL | Sask. | 50.95 | 28.57 | 14.25 | 31.67 |
| GUERNSEY | Sask. | 15.69 | 12.84 | -1.35 | 6.86 |
| HUBBARD | Sask. | 36.35 | 23.89 | 5.64 | 20.22 |
| HUDSON BAY | Sask. | 58.08 | 30.72 | 18.61 | 37.34 |
| HUMBOLT | Sask. | 33.49 | 22.85 | 4.13 | 18.07 |
| INDIAN HEAD | Sask. | 61.00 | 38.29 | 11.80 | 35.15 |
| KAMSACK | Sask. | 46.59 | 30.04 | 7.99 | 26.31 |
| KELLIHER | Sask. | 37.16 | 25.45 | 4.45 | 19.97 |
| KIPLING | Sask. | 56.21 | 37.05 | 8.60 | 31.20 |
| KRISTNES | Sask. | 35.84 | 30.36 | -4.64 | 14.93 |
| KUROKI | Sask. | 42.70 | 31.12 | 1.78 | 21.41 |
| LANGENBURG | Sask. | 32.08 | 20.50 | 4.86 | 17.97 |
| LEROSS | Sask. | 39.17 | 25.45 | 5.44 | 21.69 |
| LINTLAW | Sask. | 38.74 | 28.11 | 2.63 | 19.77 |
| LIPTON | Sask. | 66.65 | 31.41 | 26.30 | 45.45 |
| LUMSDEN | Sask. | 52.18 | 31.95 | 11.13 | 30.61 |
| MARYFIELD | Sask. | 53.72 | 22.70 | 23.45 | 38.08 |
| MELVILLE | Sask. | 50.02 | 39.54 | -2.22 | 22.90 |
| MIDALE | Sask. | 34.08 | 27.20 | -0.87 | 15.72 |
| MOOSEJAW | Sask. | 56.91 | 29.75 | 18.68 | 36.83 |
| MOOSOMIN | Sask. | 83.90 | 49.16 | 20.73 | 50.72 |
| MUENSTER | Sask. | 33.29 | 21.61 | 5.52 | 18.70 |
| NIPAWIN | Sask. | 65.33 | 38.13 | 16.34 | 39.59 |
| NOKOMIS | Sask. | 28.73 | 24.92 | -3.30 | 11.91 |

| | | | | | |
|---|---|---|---|---|---|
| ORMISTON | Sask. | 39.91 | 25.79 | 6.77 | 22.50 |
| OXBOW | Sask. | 52.87 | 33.57 | 9.73 | 30.21 |
| PASWEGIN | Sask. | 41.46 | 25.54 | 7.91 | 23.99 |
| PELLY | Sask. | 62.89 | 31.83 | 21.99 | 41.41 |
| PORCUPINE PLAIN | Sask. | 97.87 | 54.10 | 28.35 | 61.35 |
| PRAIRIE RIVER | Sask. | 55.14 | 34.32 | 9.96 | 31.66 |
| PRECCEVILLE | Sask. | 40.25 | 21.88 | 11.08 | 25.18 |
| QU'APPELLE | Sask. | 53.93 | 33.15 | 11.33 | 31.55 |
| RAYMORE | Sask. | 37.31 | 32.33 | -5.54 | 15.10 |
| REDVERS | Sask. | 58.35 | 40.99 | 4.02 | 30.18 |
| REGINA | Sask. | 57.42 | 33.08 | 14.90 | 35.09 |
| RIDGEDALE | Sask. | 71.33 | 35.86 | 25.25 | 47.12 |
| ROCANVILLE | Sask. | 46.80 | 31.82 | 4.56 | 24.91 |
| SEMANS | Sask. | 27.98 | 21.76 | 0.02 | 13.29 |
| SOMME | Sask. | 77.95 | 50.78 | 10.54 | 43.02 |
| STRASBOURG | Sask. | 36.38 | 24.54 | 4.84 | 19.81 |
| WAPELLA | Sask. | 48.51 | 28.80 | 10.11 | 28.67 |
| WATROUS | Sask. | 42.89 | 25.75 | 9.79 | 25.50 |
| WEYBURN | Sask. | 51.93 | 41.26 | -1.09 | 24.08 |
| WHITEWOOD | Sask. | 61.10 | 39.65 | 10.14 | 34.33 |
| WILCOX | Sask. | 68.38 | 49.70 | 3.26 | 34.44 |
| WISHART | Sask. | 38.73 | 31.82 | -3.51 | 16.84 |
| WYNYARD | Sask. | 39.31 | 31.87 | -2.70 | 17.47 |
| YELLOW GRASS | Sask. | 45.35 | 34.02 | 1.63 | 22.38 |
| YORKTON | Sask. | 50.21 | 34.18 | 6.30 | 27.14 |
| ALTONA | Man. | 82.69 | 42.70 | 26.64 | 53.53 |
| ARORG | Man. | 86.76 | 33.89 | 42.24 | 63.58 |
| BALDUR | Man. | 84.39 | 45.02 | 25.14 | 53.60 |
| BEAUSEJOUR | Man. | 104.66 | 43.56 | 47.38 | 74.86 |
| BEDE | Man. | 63.96 | 33.52 | 19.53 | 40.93 |
| BINSCARTH | Man. | 56.86 | 34.08 | 11.01 | 33.27 |
| BIRCH RIVER | Man. | 88.43 | 25.77 | 54.07 | 70.67 |
| BIRTLE | Man. | 81.18 | 49.80 | 17.19 | 47.57 |
| BISSETT | Man. | 77.69 | 35.40 | 32.21 | 53.80 |
| BOISEVAIN | Man. | 82.06 | 44.61 | 23.46 | 51.55 |
| BRANDON | Man. | 70.57 | 42.45 | 16.02 | 41.92 |
| BROADVALLEY | Man. | 97.25 | 24.72 | 64.29 | 80.22 |
| CARBERRY | Man. | 44.96 | 23.40 | 14.08 | 28.93 |
| CYPRESS RIVER | Man. | 68.80 | 37.47 | 20.66 | 43.51 |
| DAUPHIN | Man. | 91.70 | 52.84 | 23.81 | 56.03 |
| DEERWOOD | Man. | 88.81 | 40.65 | 36.58 | 61.38 |
| DELORAINE | Man. | 107.12 | 45.44 | 46.66 | 75.86 |
| DELTA BEACH | Man. | 77.58 | 31.43 | 35.92 | 55.98 |
| DUGALD | Man. | 111.19 | 45.88 | 50.28 | 79.63 |
| EMERSON | Man. | 85.18 | 43.47 | 29.32 | 55.83 |
| ERIKSDALE | Man. | 69.62 | 36.66 | 21.46 | 44.54 |
| FRASERWOOD | Man. | 82.17 | 24.64 | 49.40 | 65.22 |
| GILBERT PLAIN | Man. | 77.51 | 39.59 | 25.51 | 50.44 |
| GIMLI | Man. | 109.65 | 38.46 | 60.24 | 83.69 |
| GLADSTONE | Man. | 49.60 | 26.04 | 14.58 | 31.59 |
| GLENBORO | Man. | 44.39 | 32.30 | 1.32 | 22.13 |
| GLENLEA | Man. | 101.28 | 50.09 | 34.90 | 66.87 |

| | | | | | |
|---|---|---|---|---|---|
| GRAND RAPIDS | Man. | 34.46 | 25.74 | 1.37 | 17.08 |
| GRASS RIVER | Man. | 70.74 | 34.74 | 25.22 | 47.02 |
| GRAYSVILLE | Man. | 68.07 | 36.00 | 21.81 | 43.77 |
| GREAT FALLS | Man. | 82.24 | 37.84 | 33.62 | 56.70 |
| HAMIOTA | Man. | 66.14 | 37.81 | 17.55 | 40.61 |
| HARDING | Man. | 64.58 | 35.03 | 17.75 | 40.41 |
| HODGESON | Man. | 93.24 | 37.37 | 43.72 | 67.57 |
| INDIAN BAY | Man. | 68.30 | 33.86 | 24.80 | 45.45 |
| LANGRUTH | Man. | 90.73 | 32.42 | 47.50 | 68.39 |
| LUNDAR | Man. | 83.02 | 24.76 | 49.72 | 65.89 |
| MACGREGOR | Man. | 55.56 | 20.44 | 28.07 | 41.42 |
| MARQUETTE | Man. | 97.78 | 41.36 | 42.76 | 69.32 |
| MEADOW PORTAGE | Man. | 50.51 | 30.65 | 9.54 | 29.36 |
| MELITA | Man. | 47.08 | 36.96 | -1.75 | 21.73 |
| MINNEDOSA | Man. | 72.36 | 36.36 | 25.64 | 47.82 |
| MNT SIDE GOODLANDS | Man. | 77.42 | 38.31 | 26.06 | 50.95 |
| MOOSEHORN | Man. | 43.79 | 28.23 | 6.77 | 24.51 |
| MORDEN | Man. | 72.86 | 31.94 | 31.82 | 51.30 |
| MORRIS | Man. | 78.01 | 39.71 | 26.99 | 51.21 |
| MYRTLE | Man. | 86.75 | 38.01 | 36.37 | 60.63 |
| NEEPAWA | Man. | 85.10 | 49.15 | 21.95 | 51.93 |
| NINETTE | Man. | 76.20 | 46.29 | 16.71 | 44.95 |
| NIVERVILLE | Man. | 84.85 | 38.37 | 34.39 | 58.60 |
| OAKNER | Man. | 78.68 | 42.59 | 22.23 | 49.42 |
| PEACE GARDENS | Man. | 98.15 | 59.46 | 19.21 | 57.25 |
| PIERSON | Man. | 71.21 | 38.94 | 21.17 | 44.92 |
| PILOT MOUND | Man. | 85.24 | 39.10 | 33.93 | 58.54 |
| PINAWA | Man. | 74.78 | 46.14 | 15.48 | 43.63 |
| PINE FALLS | Man. | 99.95 | 36.64 | 51.85 | 74.92 |
| PLUMAS | Man. | 78.17 | 40.51 | 26.11 | 50.83 |
| PLUM COULEE | Man. | 88.96 | 44.24 | 30.22 | 58.52 |
| PORTAGE LA PRAIRIE | Man. | 103.40 | 43.16 | 47.94 | 74.26 |
| RATHWELL | Man. | 61.79 | 30.77 | 20.86 | 40.62 |
| RIVERS | Man. | 78.99 | 38.95 | 28.94 | 52.70 |
| ROLAND | Man. | 80.59 | 35.43 | 33.96 | 56.36 |
| ROSSBURN | Man. | 86.62 | 46.98 | 24.96 | 54.53 |
| RUSSELL | Man. | 70.67 | 39.38 | 20.06 | 44.08 |
| SELKIRK | Man. | 107.94 | 47.43 | 45.28 | 75.40 |
| SEVEN SISTERS | Man. | 105.59 | 45.65 | 44.87 | 74.19 |
| SHILO | Man. | 43.17 | 24.80 | 9.91 | 26.03 |
| SOMSERSET | Man. | 82.72 | 40.11 | 28.95 | 55.00 |
| SOURIS | Man. | 63.51 | 41.29 | 10.44 | 35.63 |
| SPRAGUE | Man. | 85.33 | 48.75 | 22.68 | 52.42 |
| ST. ALBANS | Man. | 42.93 | 33.62 | -0.27 | 20.24 |
| ST. BONIFACE | Man. | 79.00 | 45.20 | 19.19 | 47.99 |
| STARBUCK | Man. | 99.95 | 43.30 | 42.82 | 70.29 |
| STEINBACH | Man. | 108.91 | 44.38 | 50.75 | 78.60 |
| STONEWALL | Man. | 75.51 | 29.62 | 36.63 | 55.28 |
| STONY MNT. | Man. | 64.15 | 34.23 | 18.40 | 40.54 |
| SWAN RIVER | Man. | 84.86 | 44.50 | 26.40 | 54.43 |
| THE PAS | Man. | 74.49 | 36.64 | 27.40 | 49.76 |
| VIRDEN | Man. | 66.44 | 30.09 | 27.00 | 45.88 |

| | | | | | |
|---|---|---|---|---|---|
| VOGAR | Man. | 63.63 | 29.78 | 24.16 | 43.17 |
| WASAGAMING | Man. | 59.52 | 29.39 | 20.63 | 39.36 |
| WASKADA | Man. | 54.94 | 34.68 | 10.37 | 31.53 |
| WILSON CREEK | Man. | 63.06 | 27.08 | 26.85 | 44.37 |
| WINNIPEG | Man. | 104.07 | 42.91 | 48.93 | 75.10 |

Table B21: Plant Moisture Stress at the First Cut of Alfalfa (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | -79.60 | 64.48 | -165.58 | -124.03 |
| ARRAN | Sask. | -66.44 | 52.48 | -133.88 | -101.86 |
| AYLSHAM | Sask. | -38.55 | 33.42 | -83.01 | -61.54 |
| BANGOR | Sask. | -67.81 | 58.47 | -145.17 | -107.92 |
| BROADVIEW | Sask. | -78.00 | 55.61 | -149.46 | -115.54 |
| CANORA | Sask. | -66.34 | 61.99 | -148.99 | -109.05 |
| CARDROSE | Sask. | -91.74 | 61.17 | -172.96 | -133.83 |
| CARLYLE | Sask. | -96.43 | 61.55 | -175.52 | -137.97 |
| CARON | Sask. | -111.86 | 53.93 | -181.15 | -148.26 |
| CEYLON | Sask. | -88.31 | 81.01 | -192.41 | -142.99 |
| COTE | Sask. | -65.04 | 43.70 | -123.31 | -95.15 |
| CUPAR | Sask. | -103.04 | 62.42 | -183.24 | -145.17 |
| DAFOE | Sask. | -86.03 | 53.33 | -156.84 | -122.72 |
| DAHINDA | Sask. | -103.23 | 58.77 | -182.27 | -143.90 |
| DAVIDSON | Sask. | -116.25 | 48.43 | -178.48 | -148.94 |
| DAVIN | Sask. | -93.93 | 73.65 | -190.88 | -144.31 |
| DUVAL | Sask. | -75.01 | 49.31 | -139.99 | -108.78 |
| ESTEVAN | Sask. | -78.75 | 57.06 | -152.07 | -117.27 |
| FENWOOD | Sask. | -48.18 | 48.05 | -112.80 | -81.43 |
| FERTILE | Sask. | -53.25 | 52.64 | -123.28 | -89.47 |
| FOAMLAKE | Sask. | -74.03 | 49.58 | -137.73 | -107.49 |
| FORT QU'APPELLE | Sask. | -127.95 | 73.53 | -222.44 | -177.59 |
| FRANCIS | Sask. | -117.36 | 69.15 | -206.22 | -164.04 |
| GOOD SPRIT LAKE | Sask. | -56.61 | 53.42 | -127.19 | -93.26 |
| GRENFELL | Sask. | -71.84 | 49.42 | -135.34 | -105.19 |
| GUERNSEY | Sask. | -117.16 | 53.06 | -187.60 | -153.66 |
| HUBBARD | Sask. | -85.27 | 56.49 | -157.86 | -123.40 |
| HUDSON BAY | Sask. | -61.70 | 50.33 | -126.37 | -95.67 |
| HUMBOLT | Sask. | -85.90 | 45.46 | -144.32 | -116.59 |
| INDIAN HEAD | Sask. | -78.45 | 53.89 | -147.70 | -114.82 |
| KAMSACK | Sask. | -93.52 | 53.79 | -162.64 | -129.82 |
| KELLIHER | Sask. | -68.97 | 57.65 | -143.05 | -107.88 |
| KIPLING | Sask. | -63.91 | 53.75 | -132.99 | -100.20 |
| KRISTNES | Sask. | -85.67 | 55.90 | -160.21 | -124.19 |
| KUROKI | Sask. | -57.32 | 45.66 | -117.36 | -88.55 |
| LANGENBURG | Sask. | -70.44 | 48.80 | -135.24 | -104.02 |
| LEROSS | Sask. | -62.57 | 46.03 | -123.57 | -94.19 |
| LINTLAW | Sask. | -70.94 | 46.93 | -131.25 | -102.62 |
| LIPTON | Sask. | -71.77 | 45.96 | -130.83 | -102.79 |
| LUMSDEN | Sask. | -123.60 | 62.00 | -203.27 | -165.45 |
| MARYFIELD | Sask. | -53.27 | 42.40 | -109.81 | -82.49 |
| MELVILLE | Sask. | -73.71 | 56.72 | -148.65 | -112.62 |
| MIDALE | Sask. | -101.01 | 59.65 | -177.67 | -141.28 |
| MOOSEJAW | Sask. | -95.59 | 49.72 | -159.47 | -129.15 |
| MOOSOMIN | Sask. | -47.40 | 47.76 | -108.78 | -79.64 |
| MUENSTER | Sask. | -99.54 | 46.92 | -159.83 | -131.21 |
| NIPAWIN | Sask. | -74.96 | 52.06 | -141.86 | -110.10 |
| NOKOMIS | Sask. | -121.60 | 63.87 | -203.67 | -164.71 |

| | | | | | |
|---|---|---|---|---|---|
| ORMISTON | Sask. | -108.45 | 54.57 | -178.57 | -145.28 |
| OXBOW | Sask. | -86.69 | 63.54 | -168.34 | -129.58 |
| PASWEGIN | Sask. | -63.38 | 41.87 | -118.38 | -92.02 |
| PELLY | Sask. | -59.32 | 54.45 | -129.28 | -96.07 |
| PORCUPINE PLAIN | Sask. | -58.40 | 90.85 | -175.14 | -119.72 |
| PRAIRIE RIVER | Sask. | -89.23 | 81.50 | -196.50 | -144.97 |
| PRECCEVILLE | Sask. | -62.17 | 47.63 | -125.68 | -94.99 |
| QU'APPELLE | Sask. | -76.56 | 59.24 | -152.68 | -116.55 |
| RAYMORE | Sask. | -87.07 | 55.61 | -160.76 | -125.27 |
| REDVERS | Sask. | -71.94 | 66.39 | -159.92 | -117.54 |
| REGINA | Sask. | -102.51 | 55.75 | -174.15 | -140.14 |
| RIDGEDALE | Sask. | -89.91 | 53.34 | -158.46 | -125.92 |
| ROCANVILLE | Sask. | -71.26 | 48.98 | -136.29 | -104.96 |
| SEMANS | Sask. | -106.21 | 64.30 | -188.83 | -149.61 |
| SOMME | Sask. | -50.62 | 50.35 | -117.47 | -85.26 |
| STRASBOURG | Sask. | -93.18 | 57.62 | -167.22 | -132.07 |
| WAPELLA | Sask. | -63.62 | 46.52 | -125.65 | -95.67 |
| WATROUS | Sask. | -86.24 | 60.12 | -163.50 | -126.82 |
| WEYBURN | Sask. | -89.63 | 58.33 | -164.58 | -129.00 |
| WHITEWOOD | Sask. | -66.33 | 57.29 | -139.94 | -104.99 |
| WILCOX | Sask. | -90.18 | 64.87 | -175.18 | -134.48 |
| WISHART | Sask. | -66.44 | 42.40 | -122.74 | -95.62 |
| WYNYARD | Sask. | -65.58 | 45.64 | -125.73 | -96.85 |
| YELLOW GRASS | Sask. | -105.47 | 65.29 | -189.37 | -149.55 |
| YORKTON | Sask. | -61.68 | 50.27 | -126.28 | -95.61 |
| ALTONA | Man. | -45.15 | 50.48 | -111.41 | -79.63 |
| ARORG | Man. | -35.82 | 36.27 | -83.46 | -60.62 |
| BALDUR | Man. | -42.97 | 45.52 | -102.89 | -74.11 |
| BEAUSEJOUR | Man. | -35.10 | 40.89 | -88.88 | -63.07 |
| BEDE | Man. | -53.99 | 56.54 | -128.92 | -92.83 |
| BINSCARTH | Man. | -69.12 | 51.91 | -138.94 | -105.04 |
| BIRCH RIVER | Man. | -42.97 | 48.61 | -107.78 | -76.46 |
| BIRTLE | Man. | -56.40 | 51.00 | -121.94 | -90.83 |
| BISSETT | Man. | -22.29 | 28.27 | -58.62 | -41.37 |
| BOISEVAIN | Man. | -41.92 | 49.43 | -106.86 | -75.73 |
| BRANDON | Man. | -62.98 | 55.10 | -133.78 | -100.18 |
| BROADVALLEY | Man. | -27.20 | 33.77 | -72.23 | -50.47 |
| CARBERRY | Man. | -65.73 | 52.21 | -134.62 | -101.50 |
| CYPRESS RIVER | Man. | -59.48 | 75.50 | -156.51 | -110.45 |
| DAUPHIN | Man. | -48.14 | 48.72 | -110.74 | -81.02 |
| DEERWOOD | Man. | -28.03 | 37.37 | -76.04 | -53.25 |
| DELORAINE | Man. | -26.87 | 42.62 | -83.57 | -56.19 |
| DELTA BEACH | Man. | -26.77 | 33.61 | -71.30 | -49.85 |
| DUGALD | Man. | -26.96 | 35.16 | -73.65 | -51.15 |
| EMERSON | Man. | -52.91 | 94.64 | -174.52 | -116.79 |
| ERIKSDALE | Man. | -42.05 | 43.61 | -99.35 | -71.89 |
| FRASERWOOD | Man. | -33.92 | 43.71 | -92.07 | -63.99 |
| GILBERT PLAIN | Man. | -52.89 | 51.45 | -120.48 | -88.08 |
| GIMLI | Man. | -16.02 | 28.33 | -52.43 | -35.15 |
| GLADSTONE | Man. | -66.60 | 47.77 | -130.85 | -99.66 |
| GLENBORO | Man. | -71.61 | 54.16 | -143.82 | -108.93 |
| GLENLEA | Man. | -36.40 | 38.98 | -88.05 | -63.17 |

| | | | | | |
|---|---|---|---|---|---|
| GRAND RAPIDS | Man. | -51.51 | 37.33 | -99.48 | -76.71 |
| GRASS RIVER | Man. | -44.64 | 46.09 | -105.05 | -76.13 |
| GRAYSVILLE | Man. | -45.71 | 45.55 | -104.25 | -76.46 |
| GREAT FALLS | Man. | -35.84 | 47.59 | -96.99 | -67.96 |
| HAMIOTA | Man. | -79.10 | 52.36 | -146.39 | -114.44 |
| HARDING | Man. | -74.60 | 57.55 | -151.53 | -114.31 |
| HODGESON | Man. | -34.09 | 45.37 | -94.21 | -65.26 |
| INDIAN BAY | Man. | -23.15 | 32.05 | -64.33 | -44.78 |
| LANGRUTH | Man. | -23.98 | 38.09 | -74.77 | -50.22 |
| LUNDAR | Man. | -29.93 | 41.53 | -85.79 | -58.67 |
| MACGREGOR | Man. | -55.76 | 57.47 | -133.07 | -95.54 |
| MARQUETTE | Man. | -29.20 | 41.99 | -85.06 | -58.08 |
| MEADOW PORTAGE | Man. | -36.48 | 38.16 | -87.49 | -62.81 |
| MELITA | Man. | -70.62 | 57.08 | -146.03 | -109.77 |
| MINNEDOSA | Man. | -54.15 | 43.34 | -109.84 | -83.40 |
| MNT SIDE GOODLANDS | Man. | -34.26 | 44.16 | -93.47 | -64.78 |
| MOOSEHORN | Man. | -60.99 | 77.32 | -162.40 | -113.81 |
| MORDEN | Man. | -35.05 | 41.70 | -88.64 | -63.20 |
| MORRIS | Man. | -61.52 | 50.99 | -127.05 | -95.94 |
| MYRTLE | Man. | -48.05 | 47.40 | -110.87 | -80.62 |
| NEEPAWA | Man. | -38.62 | 44.12 | -95.32 | -68.41 |
| NINETTE | Man. | -45.82 | 47.03 | -106.26 | -77.57 |
| NIVERVILLE | Man. | -51.63 | 39.93 | -104.13 | -78.94 |
| OAKNER | Man. | -54.41 | 53.01 | -124.66 | -90.83 |
| PEACE GARDENS | Man. | -47.09 | 65.10 | -133.52 | -91.88 |
| PIERSON | Man. | -74.76 | 56.96 | -147.96 | -113.21 |
| PILOT MOUND | Man. | -27.27 | 34.33 | -72.33 | -50.72 |
| PINAWA | Man. | -49.05 | 46.88 | -109.29 | -80.69 |
| PINE FALLS | Man. | -18.80 | 26.94 | -54.16 | -37.20 |
| PLUMAS | Man. | -44.04 | 41.12 | -96.87 | -71.79 |
| PLUM COULEE | Man. | -45.35 | 43.67 | -103.34 | -75.40 |
| PORTAGE LA PRAIRIE | Man. | -30.64 | 37.46 | -78.77 | -55.92 |
| RATHWELL | Man. | -47.11 | 44.33 | -106.09 | -77.62 |
| RIVERS | Man. | -45.58 | 44.56 | -102.84 | -75.66 |
| ROLAND | Man. | -42.31 | 36.05 | -89.77 | -66.97 |
| ROSSBURN | Man. | -35.17 | 38.52 | -85.73 | -61.48 |
| RUSSELL | Man. | -61.94 | 55.12 | -132.78 | -99.15 |
| SELKIRK | Man. | -29.32 | 40.36 | -82.64 | -57.01 |
| SEVEN SISTERS | Man. | -33.34 | 55.64 | -107.36 | -71.61 |
| SHILO | Man. | -46.84 | 40.68 | -101.39 | -74.96 |
| SOMSERSET | Man. | -27.34 | 34.39 | -73.45 | -51.11 |
| SOURIS | Man. | -59.53 | 48.18 | -121.43 | -92.05 |
| SPRAGUE | Man. | -35.39 | 55.39 | -106.56 | -72.78 |
| ST. ALBANS | Man. | -60.90 | 49.84 | -124.94 | -94.54 |
| ST. BONIFACE | Man. | -83.87 | 73.07 | -180.56 | -134.00 |
| STARBUCK | Man. | -39.79 | 47.27 | -102.16 | -72.16 |
| STEINBACH | Man. | -30.94 | 40.35 | -83.81 | -58.49 |
| STONEWALL | Man. | -29.62 | 35.29 | -75.94 | -53.72 |
| STONY MNT. | Man. | -54.53 | 50.69 | -122.30 | -89.51 |
| SWAN RIVER | Man. | -49.15 | 48.64 | -113.05 | -82.42 |
| THE PAS | Man. | -30.53 | 32.36 | -72.11 | -52.37 |
| VIRDEN | Man. | -55.62 | 45.96 | -115.84 | -87.01 |

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|---|---|---|---|---|---|
| VOGAR | Man. | -14.15 | 20.65 | -41.52 | -28.34 |
| WASAGAMING | Man. | -56.61 | 44.62 | -115.65 | -87.22 |
| WASKADA | Man. | -77.29 | 53.11 | -145.54 | -113.14 |
| WILSON CREEK | Man. | -34.94 | 37.60 | -85.20 | -60.88 |
| WINNIPEG | Man. | -32.42 | 38.74 | -82.21 | -58.57 |

Table B22: Accumulated Precipitation Amounts to the First Cut of Alfalfa (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 96.07 | 48.27 | 31.71 | 62.81 |
| ARRAN | Sask. | 115.82 | 51.48 | 49.66 | 81.07 |
| AYLSHAM | Sask. | 121.49 | 62.81 | 37.93 | 78.28 |
| BANGOR | Sask. | 107.96 | 70.40 | 14.80 | 59.67 |
| BROADVIEW | Sask. | 122.39 | 69.76 | 32.75 | 75.30 |
| CANORA | Sask. | 122.99 | 50.61 | 55.51 | 88.12 |
| CARDROSE | Sask. | 119.78 | 58.08 | 42.66 | 79.82 |
| CARLYLE | Sask. | 118.95 | 54.13 | 49.39 | 82.41 |
| CARON | Sask. | 96.66 | 42.22 | 42.41 | 68.16 |
| CEYLON | Sask. | 120.02 | 73.69 | 25.34 | 70.29 |
| COTE | Sask. | 108.97 | 58.10 | 31.50 | 68.94 |
| CUPAR | Sask. | 100.90 | 56.38 | 28.45 | 62.85 |
| DAFOE | Sask. | 114.15 | 57.13 | 38.31 | 74.85 |
| DAHINDA | Sask. | 92.31 | 43.26 | 34.13 | 62.38 |
| DAVIDSON | Sask. | 104.84 | 54.80 | 34.43 | 67.85 |
| DAVIN | Sask. | 125.39 | 69.28 | 34.19 | 78.00 |
| DUVAL | Sask. | 95.85 | 50.30 | 29.56 | 61.39 |
| ESTEVAN | Sask. | 113.89 | 62.59 | 33.46 | 71.64 |
| FENWOOD | Sask. | 122.17 | 79.60 | 15.12 | 67.09 |
| FERTILE | Sask. | 120.81 | 49.10 | 55.49 | 87.03 |
| FOAMLAKE | Sask. | 114.29 | 52.98 | 46.22 | 78.53 |
| FORT QU'APPELLE | Sask. | 89.86 | 57.70 | 15.72 | 50.91 |
| FRANCIS | Sask. | 115.68 | 54.32 | 45.88 | 79.01 |
| GOOD SPRIT LAKE | Sask. | 119.48 | 57.65 | 43.31 | 79.93 |
| GRENFELL | Sask. | 108.26 | 56.49 | 35.67 | 70.13 |
| GUERNSEY | Sask. | 92.80 | 50.90 | 25.23 | 57.79 |
| HUBBARD | Sask. | 126.56 | 61.38 | 47.68 | 85.12 |
| HUDSON BAY | Sask. | 123.41 | 52.61 | 55.80 | 87.89 |
| HUMBOLT | Sask. | 103.97 | 51.87 | 37.32 | 68.96 |
| INDIAN HEAD | Sask. | 110.94 | 58.61 | 35.62 | 71.37 |
| KAMSACK | Sask. | 106.56 | 54.14 | 36.99 | 70.02 |
| KELLIHER | Sask. | 111.83 | 59.42 | 35.48 | 71.72 |
| KIPLING | Sask. | 115.45 | 70.25 | 25.18 | 68.03 |
| KRISTNES | Sask. | 108.37 | 66.78 | 19.32 | 62.35 |
| KUROKI | Sask. | 116.88 | 67.57 | 28.02 | 70.66 |
| LANGENBURG | Sask. | 98.10 | 52.94 | 27.82 | 61.68 |
| LEROSS | Sask. | 133.08 | 52.65 | 63.31 | 96.91 |
| LINTLAW | Sask. | 132.30 | 66.41 | 46.97 | 87.48 |
| LIPTON | Sask. | 110.76 | 50.76 | 45.54 | 76.50 |
| LUMSDEN | Sask. | 101.86 | 55.25 | 30.87 | 64.57 |
| MARYFIELD | Sask. | 99.46 | 35.98 | 51.48 | 74.66 |
| MELVILLE | Sask. | 97.71 | 66.00 | 10.52 | 52.44 |
| MIDALE | Sask. | 110.22 | 58.75 | 34.72 | 70.56 |
| MOOSEJAW | Sask. | 95.48 | 49.08 | 32.42 | 62.36 |
| MOOSOMIN | Sask. | 130.06 | 70.52 | 39.44 | 82.45 |
| MUENSTER | Sask. | 107.81 | 49.03 | 44.80 | 74.71 |
| NIPAWIN | Sask. | 112.40 | 56.44 | 39.87 | 74.30 |

| | | | | | |
|---|---|---|---|---|---|
| NOKOMIS | Sask. | 103.46 | 61.86 | 23.97 | 61.70 |
| ORMISTON | Sask. | 94.03 | 54.26 | 24.31 | 57.40 |
| OXBOW | Sask. | 114.91 | 58.57 | 39.65 | 75.38 |
| PASWEGIN | Sask. | 117.48 | 56.26 | 43.58 | 79.00 |
| PELLY | Sask. | 135.30 | 55.65 | 63.78 | 97.73 |
| PORCUPINE PLAIN | Sask. | 137.56 | 70.50 | 46.96 | 89.97 |
| PRAIRIE RIVER | Sask. | 133.35 | 61.91 | 51.86 | 91.00 |
| PRECCEVILLE | Sask. | 109.07 | 41.18 | 54.16 | 80.69 |
| QU'APPELLE | Sask. | 116.61 | 56.24 | 44.34 | 78.65 |
| RAYMORE | Sask. | 102.45 | 57.13 | 26.73 | 63.20 |
| REDVERS | Sask. | 113.61 | 80.75 | 6.59 | 58.13 |
| REGINA | Sask. | 108.77 | 53.65 | 39.83 | 72.56 |
| RIDGEDALE | Sask. | 123.31 | 53.52 | 54.53 | 87.18 |
| ROCANVILLE | Sask. | 82.27 | 49.71 | 16.27 | 48.07 |
| SEMANS | Sask. | 95.88 | 49.89 | 31.78 | 62.21 |
| SOMME | Sask. | 109.15 | 60.04 | 29.43 | 67.84 |
| STRASBOURG | Sask. | 117.81 | 60.03 | 40.67 | 77.29 |
| WAPELLA | Sask. | 93.79 | 41.13 | 38.95 | 65.46 |
| WATROUS | Sask. | 117.54 | 58.39 | 42.51 | 78.12 |
| WEYBURN | Sask. | 111.13 | 64.18 | 28.67 | 67.82 |
| WHITEWOOD | Sask. | 124.00 | 70.69 | 33.16 | 76.28 |
| WILCOX | Sask. | 108.58 | 65.49 | 22.77 | 63.85 |
| WISHART | Sask. | 98.04 | 50.43 | 31.08 | 63.35 |
| WYNYARD | Sask. | 109.60 | 58.88 | 32.01 | 69.27 |
| YELLOW GRASS | Sask. | 107.82 | 59.21 | 31.74 | 67.86 |
| YORKTON | Sask. | 119.24 | 67.95 | 31.92 | 73.37 |
| ALTONA | Man. | 108.44 | 46.34 | 47.62 | 76.79 |
| ARORG | Man. | 112.56 | 46.79 | 51.09 | 80.56 |
| BALDUR | Man. | 124.77 | 56.17 | 50.83 | 86.35 |
| BEAUSEJOUR | Man. | 131.74 | 49.78 | 66.27 | 97.69 |
| BEDE | Man. | 115.71 | 57.37 | 39.67 | 76.29 |
| BINSCARTH | Man. | 100.14 | 44.85 | 39.82 | 69.11 |
| BIRCH RIVER | Man. | 123.74 | 47.40 | 60.54 | 91.09 |
| BIRTLE | Man. | 133.46 | 66.78 | 47.64 | 88.38 |
| BISSETT | Man. | 119.52 | 52.34 | 52.27 | 84.19 |
| BOISEVAIN | Man. | 126.31 | 59.83 | 47.72 | 85.39 |
| BRANDON | Man. | 120.36 | 60.96 | 42.03 | 79.21 |
| BROADVALLEY | Man. | 121.88 | 46.66 | 59.67 | 89.73 |
| CARBERRY | Man. | 117.55 | 42.47 | 61.51 | 88.46 |
| CYPRESS RIVER | Man. | 121.79 | 52.39 | 54.47 | 86.43 |
| DAUPHIN | Man. | 127.48 | 69.13 | 38.65 | 80.82 |
| DEERWOOD | Man. | 132.69 | 70.23 | 42.45 | 85.29 |
| DELORAINE | Man. | 138.29 | 61.04 | 57.08 | 96.30 |
| DELTA BEACH | Man. | 116.03 | 48.52 | 51.73 | 82.70 |
| DUGALD | Man. | 136.14 | 59.16 | 57.60 | 95.44 |
| EMERSON | Man. | 125.25 | 63.11 | 44.15 | 82.65 |
| ERIKSDALE | Man. | 123.02 | 59.81 | 44.44 | 82.11 |
| FRASERWOOD | Man. | 123.63 | 49.74 | 57.46 | 89.41 |
| GILBERT PLAIN | Man. | 106.22 | 51.23 | 38.93 | 71.19 |
| GIMLI | Man. | 126.35 | 49.34 | 62.95 | 93.05 |
| GLADSTONE | Man. | 102.05 | 43.19 | 43.97 | 72.17 |
| GLENBORO | Man. | 109.55 | 48.62 | 44.72 | 76.05 |

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|---|---|---|---|---|---|
| GLENLEA | Man. | 127.37 | 57.78 | 50.79 | 87.67 |
| GRAND RAPIDS | Man. | 125.37 | 57.85 | 51.03 | 86.32 |
| GRASS RIVER | Man. | 111.48 | 49.63 | 46.44 | 77.58 |
| GRAYSVILLE | Man. | 119.54 | 56.39 | 47.08 | 81.48 |
| GREAT FALLS | Man. | 97.50 | 50.12 | 33.10 | 63.67 |
| HAMIOTA | Man. | 117.00 | 51.65 | 50.63 | 82.13 |
| HARDING | Man. | 101.29 | 47.99 | 37.14 | 68.18 |
| HODGESON | Man. | 141.22 | 68.98 | 49.80 | 93.83 |
| INDIAN BAY | Man. | 149.63 | 64.11 | 67.25 | 106.36 |
| LANGRUTH | Man. | 117.85 | 46.79 | 55.46 | 85.61 |
| LUNDAR | Man. | 114.23 | 34.88 | 67.32 | 90.10 |
| MACGREGOR | Man. | 107.94 | 43.30 | 49.70 | 77.98 |
| MARQUETTE | Man. | 119.08 | 61.08 | 37.83 | 77.06 |
| MEADOW PORTAGE | Man. | 109.20 | 67.58 | 18.85 | 62.57 |
| MELITA | Man. | 146.05 | 72.75 | 49.93 | 96.14 |
| MINNEDOSA | Man. | 127.31 | 54.73 | 56.99 | 90.37 |
| MNT SIDE GOODLANDS | Man. | 121.31 | 59.80 | 41.15 | 79.99 |
| MOOSEHORN | Man. | 113.72 | 57.29 | 38.58 | 74.59 |
| MORDEN | Man. | 115.23 | 50.50 | 50.33 | 81.14 |
| MORRIS | Man. | 102.13 | 52.11 | 35.17 | 66.96 |
| MYRTLE | Man. | 113.35 | 53.20 | 42.84 | 76.80 |
| NEEPAWA | Man. | 117.87 | 58.48 | 42.72 | 78.39 |
| NINETTE | Man. | 132.76 | 69.54 | 43.41 | 85.82 |
| NIVERVILLE | Man. | 116.38 | 54.61 | 44.57 | 79.03 |
| OAKNER | Man. | 119.36 | 46.78 | 57.36 | 87.22 |
| PEACE GARDENS | Man. | 148.30 | 77.28 | 45.69 | 95.13 |
| PIERSON | Man. | 115.60 | 62.64 | 35.11 | 73.32 |
| PILOT MOUND | Man. | 133.48 | 51.06 | 66.46 | 98.61 |
| PINAWA | Man. | 99.93 | 57.46 | 26.09 | 61.14 |
| PINE FALLS | Man. | 128.26 | 47.65 | 65.72 | 95.72 |
| PLUMAS | Man. | 118.78 | 50.08 | 54.43 | 84.98 |
| PLUM COULEE | Man. | 110.07 | 54.00 | 38.38 | 72.92 |
| PORTAGE LA PRAIRIE | Man. | 121.92 | 57.26 | 48.33 | 83.26 |
| RATHWELL | Man. | 107.43 | 47.43 | 44.32 | 74.79 |
| RIVERS | Man. | 124.63 | 57.36 | 50.93 | 85.92 |
| ROLAND | Man. | 120.29 | 53.07 | 50.43 | 83.99 |
| ROSSBURN | Man. | 120.39 | 51.35 | 52.99 | 85.32 |
| RUSSELL | Man. | 122.67 | 56.41 | 50.19 | 84.59 |
| SELKIRK | Man. | 121.96 | 52.80 | 52.21 | 85.74 |
| SEVEN SISTERS | Man. | 140.67 | 67.82 | 50.45 | 94.01 |
| SHILO | Man. | 104.88 | 47.63 | 41.03 | 71.97 |
| SOMSERSET | Man. | 125.09 | 54.72 | 51.73 | 87.28 |
| SOURIS | Man. | 124.47 | 62.11 | 44.66 | 82.54 |
| SPRAGUE | Man. | 142.23 | 61.31 | 63.45 | 100.85 |
| ST. ALBANS | Man. | 127.98 | 60.44 | 50.32 | 87.18 |
| ST. BONIFACE | Man. | 98.88 | 58.04 | 22.08 | 59.06 |
| STARBUCK | Man. | 130.02 | 60.48 | 50.22 | 88.59 |
| STEINBACH | Man. | 130.52 | 52.93 | 61.16 | 94.37 |
| STONEWALL | Man. | 121.99 | 45.54 | 62.22 | 90.88 |
| STONY MNT. | Man. | 113.86 | 53.96 | 41.73 | 76.63 |
| SWAN RIVER | Man. | 109.05 | 52.33 | 40.31 | 73.26 |
| THE PAS | Man. | 111.97 | 51.97 | 45.18 | 76.89 |

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|---|---|---|---|---|---|
| VIRDEN | Man. | 101.17 | 40.10 | 48.63 | 73.79 |
| VOGAR | Man. | 114.24 | 47.44 | 51.37 | 81.65 |
| WASAGAMING | Man. | 140.26 | 55.75 | 66.49 | 102.01 |
| WASKADA | Man. | 117.52 | 62.27 | 37.51 | 75.49 |
| WILSON CREEK | Man. | 107.25 | 54.36 | 34.58 | 69.74 |
| WINNIPEG | Man. | 119.80 | 52.61 | 52.20 | 84.29 |

Table B23: Accumulated Actual Evapotranspiration to the first cut of Alfalfa (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 167.27 | 46.36 | 229.08 | 199.21 |
| ARRAN | Sask. | 200.33 | 42.79 | 255.31 | 229.21 |
| AYLSHAM | Sask. | 197.13 | 33.02 | 241.05 | 219.84 |
| BANGOR | Sask. | 185.71 | 41.63 | 240.79 | 214.26 |
| BROADVIEW | Sask. | 186.04 | 42.99 | 241.28 | 215.05 |
| CANORA | Sask. | 195.73 | 45.18 | 255.97 | 226.86 |
| CARDROSE | Sask. | 174.21 | 53.49 | 245.23 | 211.02 |
| CARLYLE | Sask. | 174.42 | 44.10 | 231.08 | 204.18 |
| CARON | Sask. | 157.16 | 44.71 | 214.61 | 187.34 |
| CEYLON | Sask. | 180.41 | 66.56 | 265.94 | 225.34 |
| COTE | Sask. | 185.75 | 41.30 | 240.82 | 214.21 |
| CUPAR | Sask. | 162.12 | 44.17 | 218.88 | 191.94 |
| DAFOE | Sask. | 173.69 | 42.95 | 230.72 | 203.24 |
| DAHINDA | Sask. | 143.89 | 40.04 | 197.75 | 171.60 |
| DAVIDSON | Sask. | 154.67 | 43.37 | 210.41 | 183.95 |
| DAVIN | Sask. | 168.77 | 54.90 | 241.03 | 206.32 |
| DUVAL | Sask. | 154.01 | 41.61 | 208.85 | 182.52 |
| ESTEVAN | Sask. | 169.76 | 42.66 | 224.58 | 198.56 |
| FENWOOD | Sask. | 178.35 | 40.30 | 232.56 | 206.24 |
| FERTILE | Sask. | 188.29 | 43.03 | 245.53 | 217.89 |
| FOAMLAKE | Sask. | 183.56 | 37.90 | 232.27 | 209.15 |
| FORT QU'APPELLE | Sask. | 141.99 | 60.52 | 219.75 | 182.84 |
| FRANCIS | Sask. | 167.46 | 54.14 | 237.03 | 204.01 |
| GOOD SPRIT LAKE | Sask. | 189.85 | 38.71 | 241.00 | 216.41 |
| GRENFELL | Sask. | 184.25 | 42.76 | 239.19 | 213.11 |
| GUERNSEY | Sask. | 139.04 | 45.71 | 199.73 | 170.49 |
| HUBBARD | Sask. | 186.92 | 42.42 | 241.43 | 215.55 |
| HUDSON BAY | Sask. | 201.31 | 35.85 | 247.37 | 225.51 |
| HUMBOLT | Sask. | 168.49 | 40.40 | 220.41 | 195.76 |
| INDIAN HEAD | Sask. | 174.25 | 40.67 | 226.51 | 201.70 |
| KAMSACK | Sask. | 168.02 | 42.63 | 222.80 | 196.80 |
| KELLIHER | Sask. | 182.60 | 44.04 | 239.19 | 212.33 |
| KIPLING | Sask. | 193.00 | 42.73 | 247.91 | 221.84 |
| KRISTNES | Sask. | 178.12 | 40.33 | 231.90 | 205.91 |
| KUROKI | Sask. | 191.46 | 35.84 | 238.59 | 215.97 |
| LANGENBURG | Sask. | 176.54 | 40.76 | 230.65 | 204.58 |
| LEROSS | Sask. | 213.93 | 35.13 | 260.49 | 238.07 |
| LINTLAW | Sask. | 197.55 | 35.06 | 242.60 | 221.21 |
| LIPTON | Sask. | 190.28 | 40.18 | 241.91 | 217.40 |
| LUMSDEN | Sask. | 145.92 | 53.31 | 214.42 | 181.90 |
| MARYFIELD | Sask. | 181.47 | 36.89 | 230.67 | 206.89 |
| MELVILLE | Sask. | 173.32 | 44.89 | 232.62 | 204.11 |
| MIDALE | Sask. | 165.02 | 44.32 | 221.97 | 194.93 |
| MOOSEJAW | Sask. | 156.89 | 41.87 | 210.70 | 185.15 |
| MOOSOMIN | Sask. | 191.58 | 40.43 | 243.53 | 218.87 |
| MUENSTER | Sask. | 155.58 | 34.74 | 200.22 | 179.03 |
| NIPAWIN | Sask. | 180.42 | 36.37 | 227.15 | 204.97 |

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|---|---|---|---|---|---|
| NOKOMIS | Sask. | 148.00 | 50.99 | 213.53 | 182.42 |
| ORMISTON | Sask. | 141.18 | 45.56 | 199.72 | 171.93 |
| OXBOW | Sask. | 173.08 | 46.79 | 233.21 | 204.67 |
| PASWEGIN | Sask. | 181.67 | 34.01 | 226.35 | 204.94 |
| PELLY | Sask. | 222.88 | 37.81 | 271.47 | 248.40 |
| PORCUPINE PLAIN | Sask. | 202.56 | 43.81 | 258.85 | 232.13 |
| PRAIRIE RIVER | Sask. | 215.94 | 61.59 | 297.00 | 258.06 |
| PRECCEVILLE | Sask. | 191.32 | 33.50 | 235.99 | 214.40 |
| QU'APPELLE | Sask. | 181.59 | 48.93 | 244.47 | 214.62 |
| RAYMORE | Sask. | 159.38 | 39.31 | 211.48 | 186.38 |
| REDVERS | Sask. | 192.22 | 51.02 | 259.83 | 227.27 |
| REGINA | Sask. | 161.64 | 45.20 | 219.72 | 192.15 |
| RIDGEDALE | Sask. | 190.60 | 41.71 | 244.19 | 218.75 |
| ROCANVILLE | Sask. | 165.18 | 46.13 | 226.42 | 196.91 |
| SEMANS | Sask. | 157.49 | 51.04 | 223.08 | 191.94 |
| SOMME | Sask. | 195.08 | 35.70 | 242.48 | 219.64 |
| STRASBOURG | Sask. | 169.81 | 46.89 | 230.06 | 201.46 |
| WAPELLA | Sask. | 178.84 | 31.19 | 220.43 | 200.33 |
| WATROUS | Sask. | 172.98 | 48.88 | 235.80 | 205.98 |
| WEYBURN | Sask. | 163.58 | 42.64 | 218.38 | 192.37 |
| WHITEWOOD | Sask. | 189.57 | 44.79 | 247.13 | 219.80 |
| WILCOX | Sask. | 169.93 | 51.03 | 236.80 | 204.78 |
| WISHART | Sask. | 174.02 | 32.99 | 217.82 | 196.72 |
| WYNYARD | Sask. | 172.43 | 36.53 | 220.56 | 197.45 |
| YELLOW GRASS | Sask. | 167.49 | 45.36 | 225.78 | 198.11 |
| YORKTON | Sask. | 185.01 | 41.34 | 238.13 | 212.92 |
| ALTONA | Man. | 179.33 | 42.09 | 234.57 | 208.08 |
| ARORG | Man. | 203.23 | 34.77 | 248.90 | 227.01 |
| BALDUR | Man. | 202.77 | 40.86 | 256.55 | 230.72 |
| BEAUSEJOUR | Man. | 206.45 | 30.52 | 246.58 | 227.32 |
| BEDE | Man. | 190.31 | 42.18 | 246.21 | 219.29 |
| BINSCARTH | Man. | 183.62 | 41.22 | 239.07 | 212.15 |
| BIRCH RIVER | Man. | 214.07 | 38.12 | 264.91 | 240.34 |
| BIRTLE | Man. | 192.81 | 38.33 | 242.06 | 218.68 |
| BISSETT | Man. | 202.48 | 33.97 | 246.13 | 225.41 |
| BOISEVAIN | Man. | 184.66 | 37.91 | 234.46 | 210.59 |
| BRANDON | Man. | 186.19 | 40.81 | 238.63 | 213.74 |
| BROADVALLEY | Man. | 205.65 | 31.56 | 247.74 | 227.40 |
| CARBERRY | Man. | 174.78 | 41.53 | 229.58 | 203.23 |
| CYPRESS RIVER | Man. | 194.01 | 41.86 | 247.81 | 222.27 |
| DAUPHIN | Man. | 189.39 | 38.52 | 238.89 | 215.39 |
| DEERWOOD | Man. | 196.76 | 33.76 | 240.15 | 219.55 |
| DELORAINE | Man. | 211.41 | 32.06 | 254.05 | 233.46 |
| DELTA BEACH | Man. | 187.87 | 31.16 | 229.17 | 209.28 |
| DUGALD | Man. | 210.81 | 37.11 | 260.08 | 236.34 |
| EMERSON | Man. | 194.43 | 41.00 | 247.12 | 222.11 |
| ERIKSDALE | Man. | 197.57 | 34.60 | 243.01 | 221.23 |
| FRASERWOOD | Man. | 204.07 | 37.05 | 253.36 | 229.56 |
| GILBERT PLAIN | Man. | 196.94 | 39.48 | 248.80 | 223.94 |
| GIMLI | Man. | 197.25 | 24.49 | 228.72 | 213.78 |
| GLADSTONE | Man. | 182.26 | 44.58 | 242.23 | 213.12 |
| GLENBORO | Man. | 173.25 | 42.50 | 229.92 | 202.53 |

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|---|---|---|---|---|---|
| GLENLEA | Man. | 195.11 | 36.60 | 243.62 | 220.25 |
| GRAND RAPIDS | Man. | 170.75 | 26.84 | 205.23 | 188.86 |
| GRASS RIVER | Man. | 198.86 | 40.80 | 252.33 | 226.73 |
| GRAYSVILLE | Man. | 198.33 | 39.64 | 249.27 | 225.09 |
| GREAT FALLS | Man. | 170.03 | 47.32 | 230.83 | 201.97 |
| HAMIOTA | Man. | 172.05 | 40.52 | 224.12 | 199.40 |
| HARDING | Man. | 177.44 | 48.62 | 242.43 | 210.99 |
| HODGESON | Man. | 226.91 | 37.38 | 276.46 | 252.60 |
| INDIAN BAY | Man. | 201.72 | 27.29 | 236.79 | 220.14 |
| LANGRUTH | Man. | 190.59 | 37.74 | 240.91 | 216.59 |
| LUNDAR | Man. | 199.93 | 37.13 | 249.87 | 225.62 |
| MACGREGOR | Man. | 184.70 | 50.93 | 253.20 | 219.95 |
| MARQUETTE | Man. | 191.91 | 40.58 | 245.90 | 219.83 |
| MEADOW PORTAGE | Man. | 174.17 | 35.44 | 221.55 | 198.63 |
| MELITA | Man. | 197.23 | 42.37 | 253.21 | 226.30 |
| MINNEDOSA | Man. | 197.69 | 33.67 | 240.97 | 220.42 |
| MNT SIDE GOODLANDS | Man. | 192.92 | 30.03 | 233.18 | 213.67 |
| MOOSEHORN | Man. | 178.14 | 50.16 | 243.92 | 212.40 |
| MORDEN | Man. | 185.02 | 34.47 | 229.31 | 208.29 |
| MORRIS | Man. | 167.51 | 49.98 | 231.74 | 201.25 |
| MYRTLE | Man. | 199.52 | 39.38 | 251.71 | 226.57 |
| NEEPAWA | Man. | 190.94 | 31.25 | 231.10 | 212.03 |
| NINETTE | Man. | 191.28 | 34.88 | 236.10 | 214.82 |
| NIVERVILLE | Man. | 187.27 | 36.78 | 235.63 | 212.42 |
| OAKNER | Man. | 190.38 | 41.75 | 245.72 | 219.07 |
| PEACE GARDENS | Man. | 199.70 | 57.77 | 276.40 | 239.44 |
| PIERSON | Man. | 177.79 | 43.46 | 233.64 | 207.12 |
| PILOT MOUND | Man. | 205.70 | 31.93 | 247.61 | 227.51 |
| PINAWA | Man. | 178.25 | 45.39 | 236.58 | 208.89 |
| PINE FALLS | Man. | 204.80 | 26.40 | 239.44 | 222.83 |
| PLUMAS | Man. | 197.43 | 37.84 | 246.05 | 222.97 |
| PLUM COULEE | Man. | 185.16 | 42.34 | 241.38 | 214.29 |
| PORTAGE LA PRAIRIE | Man. | 191.69 | 33.38 | 234.58 | 214.22 |
| RATHWELL | Man. | 187.45 | 39.90 | 240.54 | 214.90 |
| RIVERS | Man. | 188.69 | 31.59 | 229.28 | 210.01 |
| ROLAND | Man. | 187.39 | 31.89 | 229.36 | 209.20 |
| ROSSBURN | Man. | 207.58 | 34.30 | 252.60 | 231.01 |
| RUSSELL | Man. | 184.14 | 40.72 | 236.46 | 211.62 |
| SELKIRK | Man. | 181.98 | 37.77 | 231.89 | 207.89 |
| SEVEN SISTERS | Man. | 194.35 | 40.82 | 248.65 | 222.43 |
| SHILO | Man. | 189.20 | 24.77 | 222.41 | 206.32 |
| SOMSERSET | Man. | 201.70 | 32.80 | 245.67 | 224.37 |
| SOURIS | Man. | 185.66 | 30.71 | 225.13 | 206.39 |
| SPRAGUE | Man. | 214.67 | 33.97 | 258.32 | 237.60 |
| ST. ALBANS | Man. | 190.49 | 37.13 | 238.20 | 215.55 |
| ST. BONIFACE | Man. | 145.50 | 60.83 | 225.99 | 187.23 |
| STARBUCK | Man. | 202.23 | 41.32 | 256.75 | 230.53 |
| STEINBACH | Man. | 197.34 | 32.09 | 239.39 | 219.26 |
| STONEWALL | Man. | 201.95 | 31.58 | 243.40 | 223.52 |
| STONY MNT. | Man. | 183.58 | 43.79 | 242.12 | 213.80 |
| SWAN RIVER | Man. | 188.51 | 37.02 | 237.14 | 213.83 |
| THE PAS | Man. | 198.48 | 25.56 | 231.33 | 215.74 |

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|---|---|---|---|---|---|
| VIRDEN | Man. | 181.14 | 39.28 | 232.62 | 207.97 |
| VOGAR | Man. | 176.07 | 21.83 | 205.01 | 191.07 |
| WASAGAMING | Man. | 230.17 | 31.61 | 272.00 | 251.86 |
| WASKADA | Man. | 177.53 | 46.75 | 237.60 | 209.08 |
| WILSON CREEK | Man. | 199.25 | 35.36 | 246.53 | 223.65 |
| WINNIPEG | Man. | 191.41 | 29.67 | 229.53 | 211.43 |

Table B24: Soil Moisture Amounts at the Second Cut of Alfalfa (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 28.16 | 20.29 | 1.10 | 14.18 |
| ARRAN | Sask. | 44.81 | 26.21 | 10.47 | 26.91 |
| AYLSHAM | Sask. | 78.01 | 37.99 | 27.46 | 51.87 |
| BANGOR | Sask. | 24.83 | 22.97 | -5.56 | 9.08 |
| BROADVIEW | Sask. | 39.85 | 29.52 | 1.92 | 19.92 |
| CANORA | Sask. | 43.65 | 25.31 | 9.81 | 26.18 |
| CARDROSE | Sask. | 35.70 | 32.84 | -7.91 | 13.10 |
| CARLYLE | Sask. | 38.52 | 25.77 | 5.41 | 21.12 |
| CARON | Sask. | 19.18 | 14.18 | 0.96 | 9.61 |
| CEYLON | Sask. | 33.75 | 25.33 | 1.19 | 16.65 |
| COTE | Sask. | 37.15 | 20.68 | 9.57 | 22.90 |
| CUPAR | Sask. | 38.20 | 23.77 | 7.66 | 22.16 |
| DAFOE | Sask. | 28.90 | 36.75 | -19.90 | 3.61 |
| DAHINDA | Sask. | 36.76 | 30.81 | -4.67 | 15.44 |
| DAVIDSON | Sask. | 18.54 | 20.77 | -8.14 | 4.52 |
| DAVIN | Sask. | 30.57 | 26.86 | -4.79 | 12.19 |
| DUVAL | Sask. | 24.75 | 18.18 | 0.79 | 12.30 |
| ESTEVAN | Sask. | 21.50 | 13.84 | 3.72 | 12.16 |
| FENWOOD | Sask. | 40.08 | 25.47 | 5.82 | 22.45 |
| FERTILE | Sask. | 41.38 | 27.10 | 5.33 | 22.74 |
| FOAMLAKE | Sask. | 25.10 | 21.89 | -3.04 | 10.32 |
| FORT QU'APPELLE | Sask. | 23.74 | 25.02 | -8.41 | 6.85 |
| FRANCIS | Sask. | 26.28 | 21.20 | -0.97 | 11.97 |
| GOOD SPRIT LAKE | Sask. | 30.62 | 18.27 | 6.49 | 18.09 |
| GRENFELL | Sask. | 31.27 | 26.24 | -2.45 | 13.55 |
| GUERNSEY | Sask. | 10.04 | 9.99 | -3.25 | 3.17 |
| HUBBARD | Sask. | 26.62 | 25.91 | -6.67 | 9.13 |
| HUDSON BAY | Sask. | 50.50 | 33.13 | 7.93 | 28.14 |
| HUMBOLT | Sask. | 21.57 | 22.30 | -7.09 | 6.52 |
| INDIAN HEAD | Sask. | 38.72 | 23.22 | 8.88 | 23.04 |
| KAMSACK | Sask. | 31.48 | 23.18 | 1.69 | 15.83 |
| KELLIHER | Sask. | 26.15 | 21.39 | -1.34 | 11.71 |
| KIPLING | Sask. | 42.42 | 33.50 | -0.62 | 19.81 |
| KRISTNES | Sask. | 26.37 | 30.18 | -13.87 | 5.58 |
| KUROKI | Sask. | 35.99 | 24.49 | 3.79 | 19.24 |
| LANGENBURG | Sask. | 31.13 | 17.78 | 7.52 | 18.89 |
| LEROSS | Sask. | 37.83 | 35.72 | -9.51 | 13.29 |
| LINTLAW | Sask. | 32.05 | 32.04 | -9.12 | 10.43 |
| LIPTON | Sask. | 46.62 | 23.13 | 16.90 | 31.01 |
| LUMSDEN | Sask. | 31.46 | 21.95 | 3.26 | 16.65 |
| MARYFIELD | Sask. | 45.69 | 39.73 | -7.29 | 18.31 |
| MELVILLE | Sask. | 29.04 | 21.05 | 1.23 | 14.60 |
| MIDALE | Sask. | 18.26 | 13.29 | 1.18 | 9.28 |
| MOOSEJAW | Sask. | 33.47 | 20.68 | 6.90 | 19.51 |
| MOOSOMIN | Sask. | 58.94 | 32.25 | 17.50 | 37.17 |
| MUENSTER | Sask. | 24.92 | 26.13 | -8.66 | 7.28 |
| NIPAWIN | Sask. | 45.26 | 29.24 | 7.69 | 25.53 |
| NOKOMIS | Sask. | 18.37 | 20.29 | -7.70 | 4.68 |

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|---|---|---|---|---|---|
| ORMISTON | Sask. | 25.40 | 25.60 | -7.50 | 8.12 |
| OXBOW | Sask. | 38.50 | 27.68 | 2.93 | 19.82 |
| PASWEGIN | Sask. | 43.06 | 33.09 | -0.45 | 20.43 |
| PELLY | Sask. | 56.20 | 33.01 | 12.91 | 33.66 |
| PORCUPINE PLAIN | Sask. | 74.85 | 39.13 | 24.56 | 48.44 |
| PRAIRIE RIVER | Sask. | 63.48 | 36.94 | 14.67 | 38.14 |
| PRECCEVILLE | Sask. | 34.69 | 27.20 | -1.57 | 15.95 |
| QU'APPELLE | Sask. | 32.21 | 24.19 | 1.12 | 15.88 |
| RAYMORE | Sask. | 26.34 | 26.19 | -8.37 | 8.35 |
| REDVERS | Sask. | 33.87 | 25.54 | -0.04 | 16.30 |
| REGINA | Sask. | 37.13 | 21.59 | 9.38 | 22.55 |
| RIDGEDALE | Sask. | 44.04 | 39.58 | -6.82 | 17.32 |
| ROCANVILLE | Sask. | 33.30 | 19.36 | 7.59 | 19.98 |
| SEMANS | Sask. | 22.41 | 25.06 | -9.79 | 5.50 |
| SOMME | Sask. | 50.72 | 31.53 | 8.86 | 29.02 |
| STRASBOURG | Sask. | 23.38 | 24.92 | -8.64 | 6.56 |
| WAPELLA | Sask. | 46.36 | 28.59 | 8.24 | 26.66 |
| WATROUS | Sask. | 26.34 | 20.65 | -0.19 | 12.40 |
| WEYBURN | Sask. | 27.21 | 17.67 | 4.51 | 15.28 |
| WHITEWOOD | Sask. | 41.79 | 34.01 | -1.91 | 18.83 |
| WILCOX | Sask. | 38.97 | 26.19 | 4.63 | 21.08 |
| WISHART | Sask. | 33.34 | 28.29 | -4.22 | 13.88 |
| WYNYARD | Sask. | 27.32 | 24.24 | -4.67 | 10.71 |
| YELLOW GRASS | Sask. | 26.67 | 17.46 | 4.22 | 14.88 |
| YORKTON | Sask. | 35.51 | 26.57 | 1.36 | 17.57 |
| ALTONA | Man. | 55.94 | 31.30 | 14.82 | 34.53 |
| ARORG | Man. | 69.47 | 46.49 | 8.39 | 37.67 |
| BALDUR | Man. | 56.00 | 41.88 | 0.88 | 27.36 |
| BEAUSEJOUR | Man. | 68.47 | 37.09 | 19.70 | 43.10 |
| BEDE | Man. | 40.74 | 26.97 | 4.99 | 22.21 |
| BINSCARTH | Man. | 47.16 | 32.46 | 3.50 | 24.70 |
| BIRCH RIVER | Man. | 68.00 | 34.82 | 21.57 | 44.01 |
| BIRTLE | Man. | 58.45 | 38.51 | 8.97 | 32.46 |
| BISSETT | Man. | 56.67 | 28.30 | 20.30 | 37.56 |
| BOISEVAIN | Man. | 53.40 | 30.33 | 13.53 | 32.66 |
| BRANDON | Man. | 47.37 | 28.32 | 10.98 | 28.25 |
| BROADVALLEY | Man. | 70.97 | 39.80 | 17.91 | 43.55 |
| CARBERRY | Man. | 34.24 | 29.19 | -4.28 | 14.24 |
| CYPRESS RIVER | Man. | 47.17 | 33.14 | 4.59 | 24.80 |
| DAUPHIN | Man. | 63.62 | 38.46 | 14.21 | 37.67 |
| DEERWOOD | Man. | 59.86 | 38.11 | 10.89 | 34.14 |
| DELORAINE | Man. | 62.39 | 38.12 | 11.57 | 36.13 |
| DELTA BEACH | Man. | 61.03 | 34.86 | 14.83 | 37.08 |
| DUGALD | Man. | 64.57 | 32.32 | 21.57 | 42.33 |
| EMERSON | Man. | 59.48 | 38.16 | 10.45 | 33.73 |
| ERIKSDALE | Man. | 47.09 | 39.90 | -5.37 | 19.80 |
| FRASERWOOD | Man. | 62.64 | 29.86 | 22.92 | 42.10 |
| GILBERT PLAIN | Man. | 60.38 | 35.91 | 13.20 | 35.82 |
| GIMLI | Man. | 76.80 | 37.67 | 28.39 | 51.37 |
| GLADSTONE | Man. | 38.84 | 28.26 | 0.83 | 19.28 |
| GLENBORO | Man. | 31.43 | 22.62 | 1.27 | 15.85 |
| GLENLEA | Man. | 74.71 | 48.07 | 11.00 | 41.69 |

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|---|---|---|---|---|---|
| GRAND RAPIDS | Man. | 35.47 | 25.82 | 2.30 | 18.05 |
| GRASS RIVER | Man. | 47.74 | 32.72 | 4.82 | 25.39 |
| GRAYSVILLE | Man. | 37.73 | 24.33 | 6.47 | 21.31 |
| GREAT FALLS | Man. | 56.60 | 30.33 | 17.62 | 36.12 |
| HAMIOTA | Man. | 44.73 | 27.15 | 9.84 | 26.40 |
| HARDING | Man. | 48.43 | 24.37 | 15.85 | 31.61 |
| HODGESON | Man. | 74.59 | 46.14 | 13.34 | 42.85 |
| INDIAN BAY | Man. | 48.54 | 32.80 | 6.39 | 26.40 |
| LANGRUTH | Man. | 64.28 | 31.63 | 22.11 | 42.49 |
| LUNDAR | Man. | 45.94 | 16.30 | 23.93 | 34.63 |
| MACGREGOR | Man. | 39.37 | 21.49 | 10.47 | 24.50 |
| MARQUETTE | Man. | 73.80 | 41.02 | 19.22 | 45.58 |
| MEADOW PORTAGE | Man. | 38.05 | 23.41 | 6.75 | 21.89 |
| MELITA | Man. | 34.49 | 23.17 | 3.87 | 18.59 |
| MINNEDOSA | Man. | 52.41 | 36.25 | 5.84 | 27.95 |
| MNT SIDE GOODLANDS | Man. | 45.63 | 31.73 | 3.09 | 23.70 |
| MOOSEHORN | Man. | 27.17 | 17.41 | 4.34 | 15.28 |
| MORDEN | Man. | 47.30 | 28.17 | 11.10 | 28.29 |
| MORRIS | Man. | 47.69 | 30.10 | 9.02 | 27.38 |
| MYRTLE | Man. | 67.32 | 34.62 | 21.44 | 43.54 |
| NEEPAWA | Man. | 66.75 | 39.19 | 16.39 | 40.30 |
| NINETTE | Man. | 45.74 | 29.15 | 8.28 | 26.06 |
| NIVERVILLE | Man. | 61.67 | 36.77 | 13.32 | 36.52 |
| OAKNER | Man. | 54.82 | 32.88 | 11.24 | 32.23 |
| PEACE GARDENS | Man. | 67.08 | 40.81 | 12.90 | 39.00 |
| PIERSON | Man. | 47.41 | 28.43 | 10.89 | 28.23 |
| PILOT MOUND | Man. | 49.86 | 35.75 | 2.90 | 25.41 |
| PINAWA | Man. | 48.16 | 38.13 | -0.84 | 22.42 |
| PINE FALLS | Man. | 66.99 | 32.32 | 24.56 | 44.91 |
| PLUMAS | Man. | 48.85 | 34.81 | 3.16 | 25.07 |
| PLUM COULEE | Man. | 58.56 | 29.32 | 19.63 | 38.39 |
| PORTAGE LA PRAIRIE | Man. | 74.08 | 37.69 | 25.65 | 48.64 |
| RATHWELL | Man. | 41.26 | 26.58 | 5.90 | 22.97 |
| RIVERS | Man. | 58.89 | 31.21 | 18.79 | 37.83 |
| ROLAND | Man. | 47.27 | 31.03 | 6.43 | 26.05 |
| ROSSBURN | Man. | 69.68 | 43.92 | 12.04 | 39.68 |
| RUSSELL | Man. | 49.09 | 28.47 | 12.51 | 29.87 |
| SELKIRK | Man. | 81.63 | 54.26 | 9.94 | 44.40 |
| SEVEN SISTERS | Man. | 66.15 | 47.13 | 3.30 | 33.67 |
| SHILO | Man. | 31.70 | 31.68 | -10.91 | 9.77 |
| SOMSERSET | Man. | 61.24 | 39.17 | 8.73 | 34.17 |
| SOURIS | Man. | 42.67 | 35.25 | -2.63 | 18.88 |
| SPRAGUE | Man. | 63.39 | 44.45 | 6.26 | 33.38 |
| ST. ALBANS | Man. | 22.50 | 16.04 | 1.47 | 11.54 |
| ST. BONIFACE | Man. | 56.01 | 37.60 | 6.25 | 30.21 |
| STARBUCK | Man. | 65.76 | 36.68 | 17.37 | 40.64 |
| STEINBACH | Man. | 73.11 | 34.68 | 27.67 | 49.42 |
| STONEWALL | Man. | 54.60 | 48.85 | -9.51 | 21.24 |
| STONY MNT. | Man. | 45.57 | 38.82 | -6.64 | 18.71 |
| SWAN RIVER | Man. | 67.05 | 32.21 | 24.74 | 45.02 |
| THE PAS | Man. | 65.47 | 38.73 | 15.70 | 39.33 |
| VIRDEN | Man. | 51.17 | 29.18 | 12.90 | 31.24 |

| | | | | | |
|---|---|---|---|---|---|
| VOGAR | Man. | 52.63 | 36.46 | 4.31 | 27.58 |
| WASAGAMING | Man. | 52.66 | 41.25 | -2.11 | 24.28 |
| WASKADA | Man. | 37.08 | 26.03 | 3.63 | 19.51 |
| WILSON CREEK | Man. | 53.74 | 37.11 | 4.13 | 28.13 |
| WINNIPEG | Man. | 70.06 | 37.64 | 21.70 | 44.66 |

Table B25: Plant Moisture Stress at the Second Cut of Alfalfa (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | -198.54 | 94.87 | -325.05 | -263.91 |
| ARRAN | Sask. | -162.39 | 75.79 | -261.70 | -214.15 |
| AYLSHAM | Sask. | -104.32 | 62.49 | -187.46 | -147.31 |
| BANGOR | Sask. | -182.46 | 95.01 | -308.17 | -247.64 |
| BROADVIEW | Sask. | -190.07 | 84.08 | -298.11 | -246.82 |
| CANORA | Sask. | -164.90 | 89.59 | -284.65 | -226.71 |
| CARDROSE | Sask. | -211.31 | 99.79 | -343.80 | -279.97 |
| CARLYLE | Sask. | -210.48 | 100.29 | -339.36 | -278.18 |
| CARON | Sask. | -256.77 | 71.41 | -348.54 | -304.98 |
| CEYLON | Sask. | -205.15 | 104.30 | -339.17 | -275.55 |
| COTE | Sask. | -170.92 | 63.74 | -255.92 | -214.84 |
| CUPAR | Sask. | -224.84 | 99.48 | -352.67 | -291.99 |
| DAFOE | Sask. | -197.05 | 83.06 | -307.34 | -254.20 |
| DAHINDA | Sask. | -225.58 | 89.30 | -345.69 | -287.38 |
| DAVIDSON | Sask. | -254.07 | 77.11 | -353.16 | -306.12 |
| DAVIN | Sask. | -210.55 | 116.03 | -363.28 | -289.91 |
| DUVAL | Sask. | -179.03 | 74.25 | -276.87 | -229.89 |
| ESTEVAN | Sask. | -187.43 | 91.31 | -304.76 | -249.06 |
| FENWOOD | Sask. | -122.18 | 71.25 | -218.01 | -171.49 |
| FERTILE | Sask. | -149.68 | 79.77 | -255.81 | -204.56 |
| FOAMLAKE | Sask. | -191.24 | 70.62 | -281.98 | -238.91 |
| FORT QU'APPELLE | Sask. | -298.75 | 110.33 | -440.53 | -373.23 |
| FRANCIS | Sask. | -255.37 | 100.06 | -383.95 | -322.91 |
| GOOD SPRIT LAKE | Sask. | -146.77 | 74.33 | -244.98 | -197.76 |
| GRENFELL | Sask. | -189.21 | 76.45 | -287.45 | -240.81 |
| GUERNSEY | Sask. | -253.86 | 78.12 | -357.80 | -307.61 |
| HUBBARD | Sask. | -213.38 | 85.78 | -323.60 | -271.28 |
| HUDSON BAY | Sask. | -156.35 | 87.08 | -268.25 | -215.13 |
| HUMBOLT | Sask. | -200.85 | 68.81 | -289.27 | -247.29 |
| INDIAN HEAD | Sask. | -184.46 | 90.10 | -300.24 | -245.28 |
| KAMSACK | Sask. | -210.58 | 87.66 | -323.22 | -269.75 |
| KELLIHER | Sask. | -182.00 | 87.21 | -294.07 | -240.87 |
| KIPLING | Sask. | -169.02 | 85.98 | -279.50 | -227.05 |
| KRISTNES | Sask. | -209.85 | 91.47 | -331.81 | -272.87 |
| KUROKI | Sask. | -147.81 | 79.00 | -251.70 | -201.85 |
| LANGENBURG | Sask. | -180.61 | 79.49 | -286.16 | -235.30 |
| LEROSS | Sask. | -174.19 | 81.26 | -281.89 | -230.02 |
| LINTLAW | Sask. | -188.43 | 82.55 | -294.50 | -244.15 |
| LIPTON | Sask. | -176.92 | 88.60 | -290.78 | -236.73 |
| LUMSDEN | Sask. | -255.86 | 93.05 | -375.43 | -318.67 |
| MARYFIELD | Sask. | -156.67 | 52.89 | -227.20 | -193.11 |
| MELVILLE | Sask. | -190.58 | 91.63 | -311.64 | -253.44 |
| MIDALE | Sask. | -233.80 | 87.57 | -346.33 | -292.91 |
| MOOSEJAW | Sask. | -216.18 | 74.67 | -312.13 | -266.58 |
| MOOSOMIN | Sask. | -119.79 | 79.39 | -221.80 | -173.37 |
| MUENSTER | Sask. | -215.76 | 76.68 | -314.29 | -267.52 |
| NIPAWIN | Sask. | -177.72 | 86.89 | -289.38 | -236.37 |
| NOKOMIS | Sask. | -259.33 | 95.23 | -381.69 | -323.60 |

| | | | | | |
|---|---|---|---|---|---|
| ORMISTON | Sask. | -235.64 | 90.97 | -352.54 | -297.05 |
| OXBOW | Sask. | -206.96 | 98.71 | -333.81 | -273.59 |
| PASWEGIN | Sask. | -152.81 | 73.28 | -249.17 | -202.93 |
| PELLY | Sask. | -156.51 | 84.80 | -267.72 | -214.43 |
| PORCUPINE PLAIN | Sask. | -119.10 | 92.26 | -237.65 | -181.38 |
| PRAIRIE RIVER | Sask. | -182.56 | 99.35 | -313.83 | -250.72 |
| PRECCEVILLE | Sask. | -166.88 | 62.93 | -250.79 | -210.24 |
| QU'APPELLE | Sask. | -186.06 | 87.96 | -299.08 | -245.43 |
| RAYMORE | Sask. | -189.37 | 89.69 | -308.24 | -250.99 |
| REDVERS | Sask. | -185.20 | 106.01 | -325.94 | -258.13 |
| REGINA | Sask. | -222.72 | 84.41 | -331.19 | -279.70 |
| RIDGEDALE | Sask. | -205.97 | 86.33 | -316.91 | -264.25 |
| ROCANVILLE | Sask. | -177.71 | 68.60 | -268.79 | -224.91 |
| SEMANS | Sask. | -247.53 | 107.97 | -386.28 | -320.42 |
| SOMME | Sask. | -134.60 | 94.87 | -260.56 | -199.87 |
| STRASBOURG | Sask. | -217.24 | 85.09 | -326.58 | -274.68 |
| WAPELLA | Sask. | -168.01 | 67.67 | -258.24 | -214.64 |
| WATROUS | Sask. | -196.59 | 90.37 | -312.71 | -257.59 |
| WEYBURN | Sask. | -207.39 | 96.39 | -331.26 | -272.46 |
| WHITEWOOD | Sask. | -166.36 | 93.31 | -286.27 | -229.35 |
| WILCOX | Sask. | -221.29 | 108.24 | -363.24 | -295.22 |
| WISHART | Sask. | -173.40 | 75.74 | -273.95 | -225.51 |
| WYNYARD | Sask. | -162.05 | 73.47 | -258.99 | -212.38 |
| YELLOW GRASS | Sask. | -231.44 | 98.93 | -358.57 | -298.22 |
| YORKTON | Sask. | -156.65 | 79.24 | -258.47 | -210.14 |
| ALTONA | Man. | -125.78 | 88.32 | -241.80 | -186.19 |
| ARORG | Man. | -111.54 | 65.02 | -196.96 | -156.02 |
| BALDUR | Man. | -120.19 | 82.05 | -228.19 | -176.31 |
| BEAUSEJOUR | Man. | -102.81 | 75.13 | -201.61 | -154.21 |
| BEDE | Man. | -151.08 | 89.79 | -270.08 | -212.77 |
| BINSCARTH | Man. | -174.44 | 70.80 | -269.67 | -223.44 |
| BIRCH RIVER | Man. | -123.92 | 59.02 | -202.61 | -164.58 |
| BIRTLE | Man. | -140.53 | 92.75 | -259.72 | -203.14 |
| BISSETT | Man. | -90.32 | 54.13 | -159.87 | -126.85 |
| BOISEVAIN | Man. | -103.28 | 75.69 | -202.82 | -155.05 |
| BRANDON | Man. | -155.16 | 84.17 | -263.31 | -211.97 |
| BROADVALLEY | Man. | -94.71 | 58.11 | -172.20 | -134.75 |
| CARBERRY | Man. | -159.52 | 82.38 | -268.21 | -215.95 |
| CYPRESS RIVER | Man. | -142.37 | 112.64 | -287.11 | -218.40 |
| DAUPHIN | Man. | -125.42 | 83.81 | -233.12 | -181.99 |
| DEERWOOD | Man. | -83.42 | 71.90 | -175.81 | -131.95 |
| DELORAINE | Man. | -91.46 | 80.52 | -198.82 | -146.93 |
| DELTA BEACH | Man. | -90.73 | 63.04 | -174.29 | -134.04 |
| DUGALD | Man. | -97.74 | 65.01 | -184.22 | -142.46 |
| EMERSON | Man. | -115.08 | 99.17 | -242.52 | -182.02 |
| ERIKSDALE | Man. | -131.66 | 71.61 | -225.83 | -180.64 |
| FRASERWOOD | Man. | -106.83 | 67.58 | -196.73 | -153.32 |
| GILBERT PLAIN | Man. | -143.07 | 79.76 | -247.85 | -197.63 |
| GIMLI | Man. | -58.68 | 50.68 | -123.80 | -92.89 |
| GLADSTONE | Man. | -179.76 | 66.22 | -268.83 | -225.58 |
| GLENBORO | Man. | -167.21 | 83.21 | -278.16 | -224.54 |
| GLENLEA | Man. | -104.23 | 76.91 | -206.17 | -157.07 |

| | | | | | |
|---|---|---|---|---|---|
| GRAND RAPIDS | Man. | -123.61 | 65.08 | -207.24 | -167.54 |
| GRASS RIVER | Man. | -139.20 | 79.99 | -244.10 | -193.83 |
| GRAYSVILLE | Man. | -135.54 | 75.05 | -231.98 | -186.20 |
| GREAT FALLS | Man. | -96.60 | 75.59 | -193.73 | -147.62 |
| HAMIOTA | Man. | -183.27 | 85.05 | -292.57 | -240.68 |
| HARDING | Man. | -175.33 | 76.34 | -277.39 | -228.01 |
| HODGESON | Man. | -118.62 | 77.58 | -221.62 | -171.99 |
| INDIAN BAY | Man. | -80.01 | 57.80 | -154.28 | -119.02 |
| LANGRUTH | Man. | -87.99 | 60.20 | -168.26 | -129.47 |
| LUNDAR | Man. | -113.12 | 60.04 | -194.18 | -154.78 |
| MACGREGOR | Man. | -149.96 | 76.72 | -253.15 | -203.05 |
| MARQUETTE | Man. | -91.80 | 68.90 | -183.46 | -139.20 |
| MEADOW PORTAGE | Man. | -108.60 | 57.74 | -185.79 | -148.44 |
| MELITA | Man. | -169.68 | 88.33 | -286.39 | -230.28 |
| MINNEDOSA | Man. | -144.98 | 71.16 | -236.42 | -193.01 |
| MNT SIDE GOODLANDS | Man. | -118.11 | 74.13 | -217.49 | -169.33 |
| MOOSEHORN | Man. | -160.80 | 105.51 | -299.17 | -232.86 |
| MORDEN | Man. | -107.45 | 73.92 | -202.44 | -157.35 |
| MORRIS | Man. | -145.81 | 81.29 | -250.27 | -200.68 |
| MYRTLE | Man. | -130.02 | 80.33 | -236.49 | -185.21 |
| NEEPAWA | Man. | -108.35 | 74.40 | -203.96 | -158.58 |
| NINETTE | Man. | -123.05 | 80.15 | -226.05 | -177.15 |
| NIVERVILLE | Man. | -136.76 | 77.74 | -238.98 | -189.93 |
| OAKNER | Man. | -140.73 | 75.34 | -240.58 | -192.49 |
| PEACE GARDENS | Man. | -117.62 | 109.04 | -262.40 | -192.65 |
| PIERSON | Man. | -177.91 | 93.52 | -298.07 | -241.03 |
| PILOT MOUND | Man. | -102.68 | 70.21 | -194.91 | -150.70 |
| PINAWA | Man. | -133.14 | 88.46 | -246.81 | -192.85 |
| PINE FALLS | Man. | -73.35 | 53.47 | -143.53 | -109.87 |
| PLUMAS | Man. | -133.02 | 70.00 | -224.89 | -180.83 |
| PLUM COULEE | Man. | -123.82 | 77.63 | -226.89 | -177.23 |
| PORTAGE LA PRAIRIE | Man. | -88.80 | 65.75 | -173.29 | -133.18 |
| RATHWELL | Man. | -139.54 | 78.12 | -243.47 | -193.29 |
| RIVERS | Man. | -115.70 | 77.45 | -215.22 | -167.98 |
| ROLAND | Man. | -123.27 | 64.75 | -208.50 | -167.56 |
| ROSSBURN | Man. | -104.85 | 75.51 | -203.96 | -156.42 |
| RUSSELL | Man. | -155.37 | 88.22 | -268.73 | -214.92 |
| SELKIRK | Man. | -82.02 | 73.76 | -179.47 | -132.62 |
| SEVEN SISTERS | Man. | -89.62 | 78.67 | -194.52 | -143.83 |
| SHILO | Man. | -150.15 | 72.18 | -247.24 | -200.11 |
| SOMSERSET | Man. | -91.77 | 56.23 | -167.15 | -130.62 |
| SOURIS | Man. | -161.15 | 91.49 | -278.72 | -222.91 |
| SPRAGUE | Man. | -109.31 | 95.82 | -232.44 | -173.99 |
| ST. ALBANS | Man. | -166.87 | 83.29 | -276.01 | -223.75 |
| ST. BONIFACE | Man. | -168.43 | 114.47 | -319.90 | -246.96 |
| STARBUCK | Man. | -112.53 | 92.85 | -235.04 | -176.13 |
| STEINBACH | Man. | -86.17 | 65.54 | -172.05 | -130.93 |
| STONEWALL | Man. | -101.52 | 64.87 | -186.66 | -145.83 |
| STONY MNT. | Man. | -151.24 | 76.35 | -253.93 | -204.07 |
| SWAN RIVER | Man. | -124.25 | 83.83 | -234.38 | -181.59 |
| THE PAS | Man. | -96.57 | 71.48 | -188.42 | -144.82 |
| VIRDEN | Man. | -151.10 | 74.03 | -248.18 | -201.66 |

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|---|---|---|---|---|---|
| VOGAR | Man. | -61.10 | 43.03 | -118.13 | -90.66 |
| WASAGAMING | Man. | -167.73 | 65.84 | -255.15 | -213.03 |
| WASKADA | Man. | -192.24 | 79.98 | -295.01 | -246.23 |
| WILSON CREEK | Man. | -111.03 | 52.04 | -180.61 | -146.94 |
| WINNIPEG | Man. | -92.38 | 70.07 | -182.42 | -139.68 |

Table B26: Accumulated Precipitation Amounts to the Second Cut of Alfalfa (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 163.20 | 60.65 | 82.32 | 121.41 |
| ARRAN | Sask. | 220.88 | 64.68 | 136.12 | 176.70 |
| AYLSHAM | Sask. | 236.50 | 71.31 | 141.63 | 187.44 |
| BANGOR | Sask. | 185.98 | 82.44 | 76.90 | 129.43 |
| BROADVIEW | Sask. | 207.97 | 82.90 | 101.45 | 152.02 |
| CANORA | Sask. | 223.48 | 65.33 | 136.14 | 178.40 |
| CARDROSE | Sask. | 184.30 | 82.55 | 74.71 | 127.51 |
| CARLYLE | Sask. | 203.19 | 71.05 | 111.90 | 155.24 |
| CARON | Sask. | 150.39 | 49.56 | 86.71 | 116.94 |
| CEYLON | Sask. | 180.67 | 66.76 | 94.88 | 135.60 |
| COTE | Sask. | 203.51 | 67.72 | 113.21 | 156.85 |
| CUPAR | Sask. | 178.34 | 70.32 | 87.99 | 130.88 |
| DAFOE | Sask. | 190.90 | 93.11 | 67.28 | 126.85 |
| DAHINDA | Sask. | 176.18 | 65.45 | 88.14 | 130.89 |
| DAVIDSON | Sask. | 172.06 | 67.15 | 85.77 | 126.73 |
| DAVIN | Sask. | 198.34 | 86.29 | 84.76 | 139.32 |
| DUVAL | Sask. | 172.76 | 65.87 | 85.96 | 127.64 |
| ESTEVAN | Sask. | 182.33 | 67.47 | 95.64 | 136.79 |
| FENWOOD | Sask. | 223.33 | 89.44 | 103.03 | 161.44 |
| FERTILE | Sask. | 203.15 | 53.71 | 131.69 | 166.19 |
| FOAMLAKE | Sask. | 189.69 | 64.15 | 107.25 | 146.39 |
| FORT QU'APPELLE | Sask. | 137.00 | 76.99 | 38.07 | 85.03 |
| FRANCIS | Sask. | 184.00 | 73.94 | 88.98 | 134.09 |
| GOOD SPRIT LAKE | Sask. | 215.05 | 63.86 | 130.67 | 171.24 |
| GRENFELL | Sask. | 180.26 | 68.13 | 92.71 | 134.27 |
| GUERNSEY | Sask. | 159.56 | 74.96 | 59.84 | 107.99 |
| HUBBARD | Sask. | 203.14 | 82.90 | 96.61 | 147.18 |
| HUDSON BAY | Sask. | 227.05 | 82.26 | 121.34 | 171.52 |
| HUMBOLT | Sask. | 182.52 | 71.11 | 91.15 | 134.53 |
| INDIAN HEAD | Sask. | 184.34 | 69.65 | 94.84 | 137.32 |
| KAMSACK | Sask. | 182.56 | 74.03 | 87.43 | 132.59 |
| KELLIHER | Sask. | 195.34 | 75.03 | 98.92 | 144.69 |
| KIPLING | Sask. | 206.64 | 84.04 | 98.65 | 149.92 |
| KRISTNES | Sask. | 183.99 | 82.23 | 74.35 | 127.34 |
| KUROKI | Sask. | 221.48 | 82.85 | 112.53 | 164.81 |
| LANGENBURG | Sask. | 191.61 | 75.34 | 91.59 | 139.78 |
| LEROSS | Sask. | 237.79 | 100.04 | 105.21 | 169.06 |
| LINTLAW | Sask. | 218.22 | 93.55 | 98.00 | 155.07 |
| LIPTON | Sask. | 206.12 | 62.30 | 126.06 | 164.06 |
| LUMSDEN | Sask. | 165.10 | 73.60 | 70.52 | 115.42 |
| MARYFIELD | Sask. | 190.84 | 70.58 | 96.72 | 142.21 |
| MELVILLE | Sask. | 161.78 | 75.52 | 62.01 | 109.98 |
| MIDALE | Sask. | 176.71 | 68.99 | 88.07 | 130.15 |
| MOOSEJAW | Sask. | 155.29 | 59.90 | 78.32 | 114.86 |
| MOOSOMIN | Sask. | 224.33 | 81.33 | 119.82 | 169.43 |
| MUENSTER | Sask. | 183.27 | 71.13 | 91.86 | 135.25 |
| NIPAWIN | Sask. | 193.68 | 71.90 | 101.28 | 145.14 |

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|---|---|---|---|---|---|
| NOKOMIS | Sask. | 168.64 | 78.47 | 67.81 | 115.67 |
| ORMISTON | Sask. | 154.73 | 73.54 | 60.23 | 105.09 |
| OXBOW | Sask. | 194.89 | 76.95 | 96.02 | 142.95 |
| PASWEGIN | Sask. | 223.85 | 82.94 | 114.78 | 167.12 |
| PELLY | Sask. | 252.88 | 77.27 | 151.55 | 200.10 |
| PORCUPINE PLAIN | Sask. | 229.55 | 80.42 | 126.21 | 175.27 |
| PRAIRIE RIVER | Sask. | 247.59 | 83.25 | 137.59 | 190.47 |
| PRECCEVILLE | Sask. | 212.81 | 60.65 | 131.94 | 171.02 |
| QU'APPELLE | Sask. | 189.95 | 74.85 | 93.77 | 139.42 |
| RAYMORE | Sask. | 185.37 | 79.08 | 80.56 | 131.04 |
| REDVERS | Sask. | 188.82 | 98.82 | 57.62 | 120.83 |
| REGINA | Sask. | 177.57 | 64.41 | 94.81 | 134.10 |
| RIDGEDALE | Sask. | 197.32 | 79.56 | 95.09 | 143.62 |
| ROCANVILLE | Sask. | 162.01 | 53.34 | 91.20 | 125.32 |
| SEMANS | Sask. | 172.69 | 79.51 | 70.52 | 119.02 |
| SOMME | Sask. | 193.70 | 78.21 | 89.85 | 139.89 |
| STRASBOURG | Sask. | 189.51 | 77.89 | 89.42 | 136.94 |
| WAPELLA | Sask. | 189.19 | 50.88 | 121.35 | 154.14 |
| WATROUS | Sask. | 197.40 | 78.07 | 97.07 | 144.70 |
| WEYBURN | Sask. | 173.53 | 78.65 | 72.47 | 120.45 |
| WHITEWOOD | Sask. | 209.21 | 89.19 | 94.60 | 149.00 |
| WILCOX | Sask. | 175.87 | 78.25 | 73.26 | 122.43 |
| WISHART | Sask. | 190.34 | 65.93 | 102.81 | 144.99 |
| WYNYARD | Sask. | 192.87 | 63.68 | 108.84 | 149.25 |
| YELLOW GRASS | Sask. | 180.13 | 70.05 | 90.12 | 132.85 |
| YORKTON | Sask. | 205.33 | 83.40 | 98.16 | 149.03 |
| ALTONA | Man. | 198.07 | 63.92 | 114.10 | 154.35 |
| ARORG | Man. | 215.00 | 77.92 | 112.64 | 161.71 |
| BALDUR | Man. | 219.37 | 86.55 | 105.45 | 160.17 |
| BEAUSEJOUR | Man. | 226.51 | 69.28 | 135.41 | 179.12 |
| BEDE | Man. | 196.70 | 62.06 | 114.45 | 154.07 |
| BINSCARTH | Man. | 197.17 | 53.12 | 125.72 | 160.41 |
| BIRCH RIVER | Man. | 232.96 | 64.84 | 146.50 | 188.29 |
| BIRTLE | Man. | 228.87 | 88.71 | 114.88 | 168.99 |
| BISSETT | Man. | 216.85 | 71.92 | 124.44 | 168.31 |
| BOISEVAIN | Man. | 218.25 | 76.43 | 117.75 | 165.97 |
| BRANDON | Man. | 207.48 | 74.87 | 111.28 | 156.95 |
| BROADVALLEY | Man. | 219.63 | 81.81 | 110.54 | 163.26 |
| CARBERRY | Man. | 206.37 | 62.88 | 123.40 | 163.30 |
| CYPRESS RIVER | Man. | 213.06 | 74.51 | 117.32 | 162.77 |
| DAUPHIN | Man. | 214.35 | 86.65 | 103.00 | 155.86 |
| DEERWOOD | Man. | 229.18 | 99.68 | 101.08 | 161.89 |
| DELORAINE | Man. | 221.56 | 81.36 | 113.08 | 165.50 |
| DELTA BEACH | Man. | 219.78 | 68.32 | 129.24 | 172.85 |
| DUGALD | Man. | 223.96 | 79.36 | 118.38 | 169.36 |
| EMERSON | Man. | 218.84 | 90.18 | 102.96 | 157.97 |
| ERIKSDALE | Man. | 209.12 | 82.83 | 100.21 | 152.47 |
| FRASERWOOD | Man. | 227.25 | 70.40 | 133.59 | 178.81 |
| GILBERT PLAIN | Man. | 207.47 | 75.11 | 108.79 | 156.09 |
| GIMLI | Man. | 221.91 | 65.63 | 137.57 | 177.60 |
| GLADSTONE | Man. | 186.13 | 62.69 | 101.81 | 142.75 |
| GLENBORO | Man. | 205.34 | 72.83 | 108.23 | 155.16 |

| | | | | | |
|---|---|---|---|---|---|
| GLENLEA | Man. | 229.94 | 84.39 | 118.09 | 171.96 |
| GRAND RAPIDS | Man. | 221.36 | 77.98 | 121.16 | 168.73 |
| GRASS RIVER | Man. | 194.92 | 67.70 | 106.14 | 148.69 |
| GRAYSVILLE | Man. | 198.07 | 76.61 | 99.63 | 146.36 |
| GREAT FALLS | Man. | 172.67 | 75.94 | 75.08 | 121.41 |
| HAMIOTA | Man. | 197.59 | 70.55 | 106.93 | 149.97 |
| HARDING | Man. | 192.12 | 55.63 | 117.75 | 153.73 |
| HODGESON | Man. | 258.20 | 95.47 | 131.45 | 192.52 |
| INDIAN BAY | Man. | 254.01 | 80.26 | 150.87 | 199.83 |
| LANGRUTH | Man. | 211.91 | 62.30 | 128.83 | 168.98 |
| LUNDAR | Man. | 179.51 | 50.89 | 110.80 | 144.19 |
| MACGREGOR | Man. | 192.19 | 67.18 | 101.83 | 145.70 |
| MARQUETTE | Man. | 216.40 | 73.59 | 118.50 | 165.77 |
| MEADOW PORTAGE | Man. | 205.45 | 69.87 | 112.06 | 157.25 |
| MELITA | Man. | 246.06 | 80.59 | 139.58 | 190.77 |
| MINNEDOSA | Man. | 224.07 | 78.74 | 122.89 | 170.92 |
| MNT SIDE GOODLANDS | Man. | 197.22 | 78.69 | 91.73 | 142.85 |
| MOOSEHORN | Man. | 172.39 | 74.17 | 75.12 | 121.73 |
| MORDEN | Man. | 198.47 | 67.51 | 111.72 | 152.90 |
| MORRIS | Man. | 174.00 | 69.09 | 85.22 | 127.36 |
| MYRTLE | Man. | 211.03 | 73.88 | 113.11 | 160.27 |
| NEEPAWA | Man. | 215.76 | 82.07 | 110.30 | 160.36 |
| NINETTE | Man. | 214.31 | 81.48 | 109.60 | 159.31 |
| NIVERVILLE | Man. | 212.34 | 79.43 | 107.89 | 158.01 |
| OAKNER | Man. | 212.97 | 58.36 | 135.62 | 172.87 |
| PEACE GARDENS | Man. | 250.73 | 98.67 | 119.72 | 182.84 |
| PIERSON | Man. | 192.74 | 76.71 | 94.17 | 140.97 |
| PILOT MOUND | Man. | 215.18 | 78.29 | 112.33 | 161.63 |
| PINAWA | Man. | 169.72 | 85.59 | 59.74 | 111.95 |
| PINE FALLS | Man. | 219.76 | 62.85 | 137.27 | 176.83 |
| PLUMAS | Man. | 195.92 | 69.67 | 104.48 | 148.34 |
| PLUM COULEE | Man. | 194.11 | 63.80 | 109.41 | 150.22 |
| PORTAGE LA PRAIRIE | Man. | 212.01 | 76.10 | 114.22 | 160.64 |
| RATHWELL | Man. | 191.40 | 78.76 | 86.61 | 137.21 |
| RIVERS | Man. | 223.07 | 76.78 | 124.41 | 171.25 |
| ROLAND | Man. | 194.52 | 73.95 | 97.18 | 143.94 |
| ROSSBURN | Man. | 230.89 | 80.41 | 125.35 | 175.97 |
| RUSSELL | Man. | 206.22 | 74.30 | 110.74 | 156.07 |
| SELKIRK | Man. | 218.93 | 81.74 | 110.94 | 162.85 |
| SEVEN SISTERS | Man. | 220.72 | 105.45 | 80.12 | 148.07 |
| SHILO | Man. | 186.37 | 78.69 | 80.53 | 131.91 |
| SOMSERSET | Man. | 231.65 | 76.33 | 129.32 | 178.90 |
| SOURIS | Man. | 209.99 | 85.72 | 99.84 | 152.13 |
| SPRAGUE | Man. | 255.32 | 88.80 | 141.21 | 195.38 |
| ST. ALBANS | Man. | 202.58 | 72.75 | 107.24 | 152.89 |
| ST. BONIFACE | Man. | 170.75 | 86.52 | 56.27 | 111.40 |
| STARBUCK | Man. | 223.10 | 81.71 | 115.28 | 167.13 |
| STEINBACH | Man. | 223.96 | 63.95 | 140.16 | 180.28 |
| STONEWALL | Man. | 227.01 | 96.65 | 100.15 | 160.99 |
| STONY MNT. | Man. | 194.64 | 54.74 | 121.01 | 156.76 |
| SWAN RIVER | Man. | 211.63 | 67.54 | 122.91 | 165.44 |
| THE PAS | Man. | 211.41 | 71.93 | 118.97 | 162.85 |

| | | | | | |
|---|---|---|---|---|---|
| VIRDEN | Man. | 187.08 | 67.11 | 99.07 | 141.24 |
| VOGAR | Man. | 212.58 | 70.16 | 119.60 | 164.38 |
| WASAGAMING | Man. | 264.38 | 103.07 | 127.53 | 193.47 |
| WASKADA | Man. | 195.60 | 81.51 | 90.86 | 140.58 |
| WILSON CREEK | Man. | 209.68 | 76.39 | 107.56 | 156.97 |
| WINNIPEG | Man. | 206.75 | 73.32 | 112.53 | 157.25 |

Table B27: Accumulated Actual Evapotranspiration to the Second Cut of Alfalfa (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 253.61 | 69.59 | 346.39 | 301.55 |
| ARRAN | Sask. | 312.74 | 58.31 | 389.15 | 352.56 |
| AYLSHAM | Sask. | 325.75 | 52.03 | 394.97 | 361.55 |
| BANGOR | Sask. | 276.67 | 70.04 | 369.35 | 324.72 |
| BROADVIEW | Sask. | 284.90 | 64.14 | 367.32 | 328.20 |
| CANORA | Sask. | 312.58 | 69.26 | 405.17 | 360.37 |
| CARDROSE | Sask. | 265.52 | 86.36 | 380.19 | 324.94 |
| CARLYLE | Sask. | 273.20 | 67.79 | 360.30 | 318.95 |
| CARON | Sask. | 230.19 | 61.62 | 309.37 | 271.78 |
| CEYLON | Sask. | 262.81 | 70.91 | 353.93 | 310.68 |
| COTE | Sask. | 293.70 | 54.97 | 367.00 | 331.58 |
| CUPAR | Sask. | 255.58 | 69.91 | 345.41 | 302.77 |
| DAFOE | Sask. | 258.49 | 63.33 | 342.57 | 302.06 |
| DAHINDA | Sask. | 230.55 | 60.11 | 311.40 | 272.15 |
| DAVIDSON | Sask. | 232.59 | 60.66 | 310.54 | 273.54 |
| DAVIN | Sask. | 260.42 | 86.61 | 374.43 | 319.66 |
| DUVAL | Sask. | 238.83 | 61.79 | 320.26 | 281.16 |
| ESTEVAN | Sask. | 257.77 | 71.29 | 349.37 | 305.89 |
| FENWOOD | Sask. | 290.03 | 59.77 | 370.42 | 331.39 |
| FERTILE | Sask. | 295.68 | 58.00 | 372.84 | 335.58 |
| FOAMLAKE | Sask. | 274.05 | 56.11 | 346.15 | 311.93 |
| FORT QU'APPELLE | Sask. | 207.94 | 87.06 | 319.81 | 266.70 |
| FRANCIS | Sask. | 254.45 | 80.59 | 358.01 | 308.85 |
| GOOD SPRIT LAKE | Sask. | 301.48 | 60.26 | 381.10 | 342.82 |
| GRENFELL | Sask. | 275.10 | 64.89 | 358.48 | 318.90 |
| GUERNSEY | Sask. | 211.35 | 67.13 | 300.66 | 257.53 |
| HUBBARD | Sask. | 274.78 | 70.05 | 364.80 | 322.07 |
| HUDSON BAY | Sask. | 312.14 | 61.79 | 391.54 | 353.85 |
| HUMBOLT | Sask. | 258.37 | 57.24 | 331.92 | 297.00 |
| INDIAN HEAD | Sask. | 269.33 | 67.32 | 355.84 | 314.77 |
| KAMSACK | Sask. | 258.90 | 65.76 | 343.40 | 303.28 |
| KELLIHER | Sask. | 277.04 | 67.10 | 363.26 | 322.33 |
| KIPLING | Sask. | 297.15 | 64.85 | 380.47 | 340.92 |
| KRISTNES | Sask. | 261.51 | 69.54 | 354.23 | 309.42 |
| KUROKI | Sask. | 302.59 | 65.09 | 388.19 | 347.11 |
| LANGENBURG | Sask. | 270.20 | 71.37 | 364.96 | 319.30 |
| LEROSS | Sask. | 315.75 | 59.24 | 394.26 | 356.45 |
| LINTLAW | Sask. | 288.74 | 63.57 | 370.43 | 331.65 |
| LIPTON | Sask. | 307.47 | 60.60 | 385.34 | 348.38 |
| LUMSDEN | Sask. | 229.14 | 79.41 | 331.18 | 282.74 |
| MARYFIELD | Sask. | 278.28 | 47.07 | 341.05 | 310.72 |
| MELVILLE | Sask. | 258.34 | 77.15 | 360.28 | 311.27 |
| MIDALE | Sask. | 247.15 | 67.00 | 333.24 | 292.37 |
| MOOSEJAW | Sask. | 240.00 | 63.63 | 321.77 | 282.96 |
| MOOSOMIN | Sask. | 309.18 | 64.51 | 392.07 | 352.72 |
| MUENSTER | Sask. | 239.13 | 55.19 | 310.05 | 276.39 |
| NIPAWIN | Sask. | 283.47 | 64.15 | 365.90 | 326.77 |

| | | | | | |
|---|---|---|---|---|---|
| NOKOMIS | Sask. | 223.37 | 74.57 | 319.19 | 273.70 |
| ORMISTON | Sask. | 215.55 | 69.79 | 305.23 | 262.66 |
| OXBOW | Sask. | 264.12 | 73.97 | 359.17 | 314.05 |
| PASWEGIN | Sask. | 286.79 | 62.54 | 369.03 | 329.56 |
| PELLY | Sask. | 344.37 | 59.98 | 423.02 | 385.33 |
| PORCUPINE PLAIN | Sask. | 323.05 | 73.47 | 417.46 | 372.64 |
| PRAIRIE RIVER | Sask. | 320.14 | 69.65 | 412.16 | 367.92 |
| PRECCEVILLE | Sask. | 300.26 | 45.88 | 361.44 | 331.87 |
| QU'APPELLE | Sask. | 276.35 | 71.65 | 368.42 | 324.71 |
| RAYMORE | Sask. | 251.53 | 67.07 | 340.42 | 297.61 |
| REDVERS | Sask. | 289.10 | 78.80 | 393.72 | 343.32 |
| REGINA | Sask. | 251.35 | 66.93 | 337.36 | 296.53 |
| RIDGEDALE | Sask. | 291.35 | 66.27 | 376.50 | 336.08 |
| ROCANVILLE | Sask. | 258.07 | 61.03 | 339.10 | 300.06 |
| SEMANS | Sask. | 238.81 | 73.25 | 332.93 | 288.25 |
| SOMME | Sask. | 306.56 | 68.55 | 397.57 | 353.72 |
| STRASBOURG | Sask. | 254.24 | 67.41 | 340.87 | 299.75 |
| WAPELLA | Sask. | 276.12 | 46.61 | 338.27 | 308.24 |
| WATROUS | Sask. | 269.22 | 73.73 | 363.96 | 318.99 |
| WEYBURN | Sask. | 250.00 | 76.96 | 348.90 | 301.95 |
| WHITEWOOD | Sask. | 292.84 | 73.57 | 387.38 | 342.50 |
| WILCOX | Sask. | 262.97 | 82.88 | 371.65 | 319.57 |
| WISHART | Sask. | 271.47 | 57.86 | 348.29 | 311.27 |
| WYNYARD | Sask. | 265.51 | 57.87 | 341.86 | 305.15 |
| YELLOW GRASS | Sask. | 257.44 | 72.99 | 351.23 | 306.71 |
| YORKTON | Sask. | 285.20 | 64.84 | 368.52 | 328.97 |
| ALTONA | Man. | 293.25 | 67.27 | 381.63 | 339.26 |
| ARORG | Man. | 322.24 | 50.99 | 389.22 | 357.12 |
| BALDUR | Man. | 324.03 | 66.33 | 411.34 | 369.40 |
| BEAUSEJOUR | Man. | 336.69 | 46.51 | 397.85 | 368.50 |
| BEDE | Man. | 293.86 | 62.50 | 376.69 | 336.80 |
| BINSCARTH | Man. | 289.83 | 51.54 | 359.16 | 325.50 |
| BIRCH RIVER | Man. | 343.15 | 43.89 | 401.68 | 373.39 |
| BIRTLE | Man. | 310.22 | 66.89 | 396.18 | 355.38 |
| BISSETT | Man. | 319.76 | 52.44 | 387.15 | 355.16 |
| BOISEVAIN | Man. | 305.71 | 61.20 | 386.19 | 347.57 |
| BRANDON | Man. | 296.56 | 60.81 | 374.71 | 337.61 |
| BROADVALLEY | Man. | 327.93 | 44.20 | 386.87 | 358.39 |
| CARBERRY | Man. | 273.83 | 63.00 | 356.95 | 316.98 |
| CYPRESS RIVER | Man. | 305.90 | 60.04 | 383.05 | 346.43 |
| DAUPHIN | Man. | 303.59 | 65.00 | 387.11 | 347.46 |
| DEERWOOD | Man. | 317.69 | 58.69 | 393.11 | 357.31 |
| DELORAINE | Man. | 336.18 | 66.55 | 424.92 | 382.03 |
| DELTA BEACH | Man. | 306.73 | 47.69 | 369.93 | 339.49 |
| DUGALD | Man. | 347.38 | 68.29 | 438.23 | 394.36 |
| EMERSON | Man. | 313.62 | 65.44 | 397.71 | 357.79 |
| ERIKSDALE | Man. | 304.53 | 52.47 | 373.53 | 340.42 |
| FRASERWOOD | Man. | 325.27 | 51.56 | 393.86 | 360.74 |
| GILBERT PLAIN | Man. | 314.33 | 58.53 | 391.23 | 354.37 |
| GIMLI | Man. | 323.78 | 37.99 | 372.60 | 349.42 |
| GLADSTONE | Man. | 276.22 | 50.97 | 344.77 | 311.49 |
| GLENBORO | Man. | 280.71 | 65.83 | 368.49 | 326.07 |

| | | | | | |
|---|---|---|---|---|---|
| GLENLEA | Man. | 320.07 | 61.06 | 400.98 | 362.01 |
| GRAND RAPIDS | Man. | 261.83 | 47.83 | 323.28 | 294.11 |
| GRASS RIVER | Man. | 302.88 | 60.70 | 382.48 | 344.34 |
| GRAYSVILLE | Man. | 305.71 | 64.76 | 388.92 | 349.42 |
| GREAT FALLS | Man. | 272.89 | 72.85 | 366.50 | 322.06 |
| HAMIOTA | Man. | 272.71 | 63.79 | 354.68 | 315.77 |
| HARDING | Man. | 284.32 | 54.72 | 357.47 | 322.08 |
| HODGESON | Man. | 358.01 | 57.36 | 434.17 | 397.47 |
| INDIAN BAY | Man. | 323.60 | 45.83 | 382.49 | 354.54 |
| LANGRUTH | Man. | 309.45 | 45.85 | 370.58 | 341.04 |
| LUNDAR | Man. | 300.88 | 43.82 | 360.05 | 331.29 |
| MACGREGOR | Man. | 285.05 | 61.53 | 367.81 | 327.63 |
| MARQUETTE | Man. | 312.35 | 60.78 | 393.22 | 354.17 |
| MEADOW PORTAGE | Man. | 282.56 | 47.19 | 345.64 | 315.12 |
| MELITA | Man. | 309.35 | 63.98 | 393.88 | 353.24 |
| MINNEDOSA | Man. | 312.37 | 54.88 | 382.90 | 349.42 |
| MNT SIDE GOODLANDS | Man. | 300.37 | 55.79 | 375.16 | 338.92 |
| MOOSEHORN | Man. | 253.08 | 76.57 | 353.49 | 305.37 |
| MORDEN | Man. | 293.09 | 56.36 | 365.51 | 331.13 |
| MORRIS | Man. | 267.24 | 75.49 | 364.24 | 318.19 |
| MYRTLE | Man. | 316.23 | 60.92 | 396.97 | 358.08 |
| NEEPAWA | Man. | 303.75 | 51.52 | 369.95 | 338.52 |
| NINETTE | Man. | 305.87 | 58.39 | 380.90 | 345.28 |
| NIVERVILLE | Man. | 305.51 | 60.43 | 384.97 | 346.84 |
| OAKNER | Man. | 307.69 | 56.66 | 382.78 | 346.62 |
| PEACE GARDENS | Man. | 332.12 | 98.06 | 462.31 | 399.59 |
| PIERSON | Man. | 277.90 | 70.16 | 368.06 | 325.26 |
| PILOT MOUND | Man. | 321.42 | 52.74 | 390.70 | 357.49 |
| PINAWA | Man. | 274.48 | 80.87 | 378.40 | 329.07 |
| PINE FALLS | Man. | 328.64 | 38.63 | 379.34 | 355.02 |
| PLUMAS | Man. | 306.80 | 58.24 | 383.25 | 346.58 |
| PLUM COULEE | Man. | 299.34 | 63.28 | 383.35 | 342.87 |
| PORTAGE LA PRAIRIE | Man. | 310.94 | 53.94 | 380.26 | 347.35 |
| RATHWELL | Man. | 290.67 | 64.91 | 377.03 | 335.33 |
| RIVERS | Man. | 305.38 | 56.17 | 377.56 | 343.30 |
| ROLAND | Man. | 294.51 | 51.38 | 362.15 | 329.66 |
| ROSSBURN | Man. | 334.36 | 55.87 | 407.69 | 372.52 |
| RUSSELL | Man. | 289.01 | 66.16 | 374.02 | 333.66 |
| SELKIRK | Man. | 303.48 | 60.89 | 383.94 | 345.25 |
| SEVEN SISTERS | Man. | 310.48 | 55.81 | 384.90 | 348.94 |
| SHILO | Man. | 280.04 | 53.42 | 351.89 | 317.01 |
| SOMSERSET | Man. | 328.27 | 49.33 | 394.40 | 362.36 |
| SOURIS | Man. | 290.95 | 54.63 | 361.15 | 327.83 |
| SPRAGUE | Man. | 345.48 | 61.29 | 424.23 | 386.85 |
| ST. ALBANS | Man. | 285.81 | 64.38 | 370.18 | 329.79 |
| ST. BONIFACE | Man. | 240.04 | 95.99 | 367.06 | 305.89 |
| STARBUCK | Man. | 328.78 | 67.08 | 417.29 | 374.73 |
| STEINBACH | Man. | 325.69 | 42.28 | 381.09 | 354.57 |
| STONEWALL | Man. | 320.49 | 50.48 | 386.75 | 354.97 |
| STONY MNT. | Man. | 280.14 | 55.24 | 354.44 | 318.37 |
| SWAN RIVER | Man. | 308.17 | 65.67 | 394.44 | 353.09 |
| THE PAS | Man. | 306.22 | 48.07 | 367.99 | 338.67 |

| | | | | | |
|---|---|---|---|---|---|
| VIRDEN | Man. | 280.61 | 60.30 | 359.69 | 321.80 |
| VOGAR | Man. | 282.21 | 36.34 | 330.38 | 307.18 |
| WASAGAMING | Man. | 359.31 | 49.08 | 424.48 | 393.08 |
| WASKADA | Man. | 273.01 | 67.66 | 359.96 | 318.69 |
| WILSON CREEK | Man. | 310.73 | 44.88 | 370.73 | 341.70 |
| WINNIPEG | Man. | 311.29 | 51.80 | 377.85 | 346.25 |

Table B28: Soil Moisture Amounts on October 31 for Alfalfa (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 47.70 | 21.27 | 19.34 | 33.05 |
| ARRAN | Sask. | 84.13 | 38.13 | 34.17 | 58.09 |
| AYLSHAM | Sask. | 115.40 | 43.06 | 57.98 | 85.73 |
| BANGOR | Sask. | 61.86 | 33.29 | 17.82 | 39.03 |
| BROADVIEW | Sask. | 67.53 | 37.57 | 19.25 | 42.17 |
| CANORA | Sask. | 81.77 | 33.99 | 36.20 | 58.28 |
| CARDROSE | Sask. | 48.14 | 47.57 | -15.15 | 15.41 |
| CARLYLE | Sask. | 52.43 | 29.31 | 14.76 | 32.64 |
| CARON | Sask. | 38.28 | 26.44 | 4.30 | 20.43 |
| CEYLON | Sask. | 50.18 | 34.68 | 5.62 | 26.77 |
| COTE | Sask. | 71.98 | 24.01 | 39.97 | 55.44 |
| CUPAR | Sask. | 56.02 | 27.63 | 20.51 | 37.37 |
| DAFOE | Sask. | 58.93 | 39.91 | 5.84 | 31.47 |
| DAHINDA | Sask. | 46.71 | 22.84 | 15.99 | 30.90 |
| DAVIDSON | Sask. | 38.65 | 29.78 | 0.38 | 18.55 |
| DAVIN | Sask. | 45.95 | 32.19 | 3.53 | 23.90 |
| DUVAL | Sask. | 47.94 | 28.79 | 10.00 | 28.22 |
| ESTEVAN | Sask. | 46.28 | 29.98 | 7.76 | 26.05 |
| FENWOOD | Sask. | 74.14 | 37.56 | 23.62 | 48.15 |
| FERTILE | Sask. | 77.36 | 45.05 | 17.43 | 46.37 |
| FOAMLAKE | Sask. | 50.34 | 24.69 | 18.61 | 33.67 |
| FORT QU'APPELLE | Sask. | 39.96 | 29.67 | 1.84 | 19.93 |
| FRANCIS | Sask. | 41.47 | 25.22 | 9.07 | 24.45 |
| GOOD SPRIT LAKE | Sask. | 69.38 | 33.49 | 25.13 | 46.40 |
| GRENFELL | Sask. | 60.90 | 36.79 | 13.62 | 36.06 |
| GUERNSEY | Sask. | 32.90 | 21.76 | 3.89 | 17.91 |
| HUBBARD | Sask. | 50.94 | 33.56 | 7.81 | 28.29 |
| HUDSON BAY | Sask. | 84.20 | 40.58 | 32.06 | 56.81 |
| HUMBOLT | Sask. | 50.97 | 32.37 | 9.38 | 29.12 |
| INDIAN HEAD | Sask. | 62.17 | 31.98 | 21.07 | 40.58 |
| KAMSACK | Sask. | 55.69 | 27.66 | 20.15 | 37.02 |
| KELLIHER | Sask. | 58.50 | 35.41 | 12.99 | 34.59 |
| KIPLING | Sask. | 76.02 | 45.01 | 18.18 | 45.64 |
| KRISTNES | Sask. | 56.90 | 32.93 | 12.99 | 34.21 |
| KUROKI | Sask. | 69.10 | 31.95 | 27.05 | 47.25 |
| LANGENBURG | Sask. | 51.27 | 36.12 | 3.11 | 26.38 |
| LEROSS | Sask. | 71.98 | 41.83 | 16.45 | 43.20 |
| LINTLAW | Sask. | 59.43 | 29.91 | 21.00 | 39.24 |
| LIPTON | Sask. | 66.81 | 31.88 | 25.84 | 45.29 |
| LUMSDEN | Sask. | 49.15 | 35.69 | 3.29 | 25.06 |
| MARYFIELD | Sask. | 83.29 | 53.36 | 12.14 | 46.52 |
| MELVILLE | Sask. | 61.00 | 32.22 | 18.43 | 38.89 |
| MIDALE | Sask. | 38.80 | 26.43 | 4.84 | 20.96 |
| MOOSEJAW | Sask. | 49.70 | 31.40 | 9.36 | 28.51 |
| MOOSOMIN | Sask. | 86.89 | 45.70 | 28.16 | 56.04 |
| MUENSTER | Sask. | 51.49 | 34.00 | 7.81 | 28.55 |
| NIPAWIN | Sask. | 79.03 | 33.66 | 35.77 | 56.31 |
| NOKOMIS | Sask. | 40.05 | 31.86 | -0.89 | 18.55 |

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|---|---|---|---|---|---|
| ORMISTON | Sask. | 40.06 | 28.30 | 3.69 | 20.96 |
| OXBOW | Sask. | 55.37 | 34.68 | 10.82 | 31.97 |
| PASWEGIN | Sask. | 66.67 | 37.02 | 18.04 | 41.35 |
| PELLY | Sask. | 87.70 | 36.87 | 39.39 | 62.52 |
| PORCUPINE PLAIN | Sask. | 108.74 | 42.56 | 52.97 | 79.67 |
| PRAIRIE RIVER | Sask. | 90.91 | 32.59 | 47.91 | 68.59 |
| PRECCEVILLE | Sask. | 63.64 | 33.62 | 18.42 | 40.37 |
| QU'APPELLE | Sask. | 54.13 | 30.51 | 14.93 | 33.53 |
| RAYMORE | Sask. | 56.53 | 34.76 | 10.47 | 32.65 |
| REDVERS | Sask. | 72.36 | 39.95 | 19.08 | 44.83 |
| REGINA | Sask. | 52.59 | 30.39 | 13.55 | 32.08 |
| RIDGEDALE | Sask. | 79.27 | 43.65 | 23.18 | 49.81 |
| ROCANVILLE | Sask. | 74.50 | 39.05 | 22.55 | 47.64 |
| SEMANS | Sask. | 46.51 | 36.43 | -0.30 | 21.92 |
| SOMME | Sask. | 98.89 | 35.18 | 52.18 | 74.69 |
| STRASBOURG | Sask. | 43.60 | 32.26 | 2.15 | 21.82 |
| WAPELLA | Sask. | 89.20 | 42.03 | 33.02 | 60.20 |
| WATROUS | Sask. | 57.36 | 36.24 | 10.79 | 32.90 |
| WEYBURN | Sask. | 46.44 | 25.61 | 13.53 | 29.15 |
| WHITEWOOD | Sask. | 71.23 | 41.49 | 17.92 | 43.23 |
| WILCOX | Sask. | 51.46 | 31.21 | 10.52 | 30.14 |
| WISHART | Sask. | 61.41 | 31.31 | 19.44 | 39.77 |
| WYNYARD | Sask. | 64.64 | 37.67 | 14.94 | 38.84 |
| YELLOW GRASS | Sask. | 47.99 | 29.38 | 10.23 | 28.16 |
| YORKTON | Sask. | 67.89 | 33.19 | 25.23 | 45.48 |
| ALTONA | Man. | 83.07 | 43.13 | 26.41 | 53.57 |
| ARORG | Man. | 118.33 | 62.21 | 36.61 | 75.78 |
| BALDUR | Man. | 86.22 | 45.94 | 25.75 | 54.80 |
| BEAUSEJOUR | Man. | 116.56 | 44.88 | 57.55 | 85.86 |
| BEDE | Man. | 68.97 | 49.46 | 3.31 | 34.94 |
| BINSCARTH | Man. | 86.50 | 45.60 | 25.17 | 54.95 |
| BIRCH RIVER | Man. | 107.80 | 36.40 | 59.27 | 82.72 |
| BIRTLE | Man. | 83.86 | 43.44 | 28.04 | 54.54 |
| BISSETT | Man. | 125.46 | 52.09 | 58.53 | 90.30 |
| BOISEVAIN | Man. | 70.00 | 44.08 | 11.98 | 39.85 |
| BRANDON | Man. | 71.46 | 40.67 | 19.20 | 44.01 |
| BROADVALLEY | Man. | 138.09 | 70.09 | 44.64 | 89.80 |
| CARBERRY | Man. | 61.00 | 35.12 | 14.66 | 36.94 |
| CYPRESS RIVER | Man. | 79.24 | 44.64 | 21.89 | 49.11 |
| DAUPHIN | Man. | 92.45 | 47.77 | 31.07 | 60.21 |
| DEERWOOD | Man. | 88.98 | 50.93 | 23.54 | 54.61 |
| DELORAINE | Man. | 95.70 | 59.89 | 15.64 | 54.38 |
| DELTA BEACH | Man. | 99.60 | 42.08 | 43.84 | 70.70 |
| DUGALD | Man. | 102.61 | 40.89 | 48.21 | 74.48 |
| EMERSON | Man. | 91.10 | 50.17 | 26.63 | 57.24 |
| ERIKSDALE | Man. | 88.55 | 50.81 | 21.67 | 53.80 |
| FRASERWOOD | Man. | 110.25 | 52.37 | 40.58 | 74.22 |
| GILBERT PLAIN | Man. | 100.49 | 51.48 | 32.86 | 65.28 |
| GIMLI | Man. | 131.42 | 54.57 | 61.29 | 94.58 |
| GLADSTONE | Man. | 85.54 | 49.20 | 19.37 | 51.50 |
| GLENBORO | Man. | 70.03 | 42.50 | 13.35 | 40.74 |
| GLENLEA | Man. | 110.93 | 50.71 | 43.72 | 76.09 |

| | | | | | |
|---|---|---|---|---|---|
| GRAND RAPIDS | Man. | 84.02 | 22.44 | 55.19 | 68.88 |
| GRASS RIVER | Man. | 84.86 | 49.39 | 19.90 | 51.07 |
| GRAYSVILLE | Man. | 75.00 | 45.19 | 16.93 | 44.50 |
| GREAT FALLS | Man. | 96.87 | 52.97 | 28.81 | 61.12 |
| HAMIOTA | Man. | 69.32 | 35.78 | 23.34 | 45.17 |
| HARDING | Man. | 80.82 | 41.03 | 25.63 | 52.42 |
| HODGESON | Man. | 126.90 | 58.82 | 48.81 | 86.44 |
| INDIAN BAY | Man. | 96.23 | 37.90 | 47.53 | 70.65 |
| LANGRUTH | Man. | 121.70 | 60.61 | 40.89 | 79.95 |
| LUNDAR | Man. | 105.02 | 47.16 | 41.35 | 72.29 |
| MACGREGOR | Man. | 89.45 | 54.15 | 16.34 | 51.87 |
| MARQUETTE | Man. | 115.77 | 51.02 | 47.89 | 80.66 |
| MEADOW PORTAGE | Man. | 99.94 | 39.10 | 47.67 | 72.96 |
| MELITA | Man. | 47.22 | 33.52 | 2.93 | 24.22 |
| MINNEDOSA | Man. | 81.71 | 37.71 | 33.25 | 56.26 |
| MNT SIDE GOODLANDS | Man. | 73.72 | 40.44 | 19.34 | 45.74 |
| MOOSEHORN | Man. | 71.43 | 38.16 | 21.34 | 45.36 |
| MORDEN | Man. | 78.82 | 42.17 | 24.63 | 50.36 |
| MORRIS | Man. | 78.15 | 42.60 | 23.41 | 49.39 |
| MYRTLE | Man. | 89.84 | 41.76 | 34.39 | 61.11 |
| NEEPAWA | Man. | 92.55 | 49.82 | 28.53 | 58.92 |
| NINETTE | Man. | 66.71 | 40.34 | 14.87 | 39.48 |
| NIVERVILLE | Man. | 91.10 | 38.91 | 39.93 | 64.49 |
| OAKNER | Man. | 87.43 | 42.26 | 31.32 | 58.35 |
| PEACE GARDENS | Man. | 109.71 | 62.78 | 26.36 | 66.52 |
| PIERSON | Man. | 61.67 | 36.86 | 14.31 | 36.79 |
| PILOT MOUND | Man. | 89.00 | 47.42 | 26.64 | 56.57 |
| PINAWA | Man. | 100.10 | 56.55 | 27.44 | 61.93 |
| PINE FALLS | Man. | 127.26 | 50.86 | 60.44 | 92.47 |
| PLUMAS | Man. | 89.37 | 54.24 | 18.12 | 52.27 |
| PLUM COULEE | Man. | 96.67 | 42.15 | 40.71 | 67.67 |
| PORTAGE LA PRAIRIE | Man. | 106.77 | 50.90 | 41.37 | 72.42 |
| RATHWELL | Man. | 90.64 | 42.80 | 33.70 | 61.19 |
| RIVERS | Man. | 74.29 | 30.82 | 34.69 | 53.49 |
| ROLAND | Man. | 72.55 | 45.04 | 13.26 | 41.74 |
| ROSSBURN | Man. | 109.62 | 49.86 | 44.05 | 75.51 |
| RUSSELL | Man. | 79.48 | 43.30 | 23.84 | 50.25 |
| SELKIRK | Man. | 117.65 | 56.44 | 43.08 | 78.93 |
| SEVEN SISTERS | Man. | 113.11 | 56.93 | 37.19 | 73.88 |
| SHILO | Man. | 59.92 | 36.33 | 11.06 | 34.78 |
| SOMSERSET | Man. | 112.24 | 51.38 | 43.36 | 76.74 |
| SOURIS | Man. | 67.93 | 40.62 | 15.74 | 40.52 |
| SPRAGUE | Man. | 102.46 | 47.56 | 41.34 | 70.36 |
| ST. ALBANS | Man. | 52.82 | 36.61 | 4.80 | 27.81 |
| ST. BONIFACE | Man. | 79.99 | 45.64 | 19.60 | 48.68 |
| STARBUCK | Man. | 100.75 | 43.14 | 43.83 | 71.20 |
| STEINBACH | Man. | 113.93 | 49.43 | 49.16 | 80.17 |
| STONEWALL | Man. | 92.44 | 48.97 | 27.98 | 58.94 |
| STONY MNT. | Man. | 77.80 | 46.68 | 14.77 | 45.40 |
| SWAN RIVER | Man. | 97.82 | 40.18 | 45.03 | 70.33 |
| THE PAS | Man. | 118.43 | 40.81 | 65.99 | 90.88 |
| VIRDEN | Man. | 82.41 | 48.88 | 18.31 | 49.03 |

| | | | | | |
|---|---|---|---|---|---|
| VOGAR | Man. | 110.11 | 41.36 | 55.08 | 81.66 |
| WASAGAMING | Man. | 95.67 | 41.05 | 41.27 | 67.47 |
| WASKADA | Man. | 46.46 | 35.49 | 0.85 | 22.50 |
| WILSON CREEK | Man. | 109.07 | 56.27 | 33.85 | 70.25 |
| WINNIPEG | Man. | 107.45 | 48.06 | 45.70 | 75.01 |

Table B29: Soil Moisture Amounts at the Silking Stage of Corn (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 110.06 | 34.67 | 63.83 | 86.17 |
| ARRAN | Sask. | 140.54 | 23.88 | 109.24 | 124.23 |
| AYLSHAM | Sask. | 183.13 | 35.93 | 135.32 | 158.41 |
| BANGOR | Sask. | 98.02 | 23.65 | 66.73 | 81.79 |
| BROADVIEW | Sask. | 124.23 | 32.87 | 82.00 | 102.05 |
| CANORA | Sask. | 126.85 | 29.51 | 87.50 | 106.52 |
| CARDROSE | Sask. | 112.00 | 46.06 | 50.85 | 80.31 |
| CARLYLE | Sask. | 117.91 | 36.59 | 70.89 | 93.21 |
| CARON | Sask. | 92.10 | 33.07 | 49.61 | 69.78 |
| CEYLON | Sask. | 112.47 | 32.89 | 70.21 | 90.27 |
| COTE | Sask. | 127.17 | 25.11 | 93.69 | 109.87 |
| CUPAR | Sask. | 131.63 | 44.71 | 74.19 | 101.46 |
| DAFOE | Sask. | 95.11 | 21.23 | 66.92 | 80.50 |
| DAHINDA | Sask. | 103.18 | 42.49 | 46.03 | 73.78 |
| DAVIDSON | Sask. | 78.75 | 25.89 | 45.49 | 61.28 |
| DAVIN | Sask. | 101.53 | 32.07 | 59.31 | 79.59 |
| DUVAL | Sask. | 91.48 | 26.18 | 56.98 | 73.55 |
| ESTEVAN | Sask. | 93.36 | 23.85 | 62.71 | 77.26 |
| FENWOOD | Sask. | 102.96 | 13.04 | 85.42 | 93.93 |
| FERTILE | Sask. | 126.12 | 29.56 | 86.79 | 105.78 |
| FOAMLAKE | Sask. | 94.46 | 18.53 | 70.64 | 81.95 |
| FORT QU'APPELLE | Sask. | 90.26 | 43.14 | 34.82 | 61.14 |
| FRANCIS | Sask. | 104.51 | 40.18 | 52.88 | 77.39 |
| GOOD SPRIT LAKE | Sask. | 103.81 | 18.46 | 79.43 | 91.15 |
| GRENFELL | Sask. | 121.87 | 29.40 | 84.09 | 102.03 |
| GUERNSEY | Sask. | 57.11 | 20.38 | 30.10 | 43.11 |
| HUBBARD | Sask. | 93.86 | 22.85 | 64.49 | 78.43 |
| HUDSON BAY | Sask. | 134.33 | 27.39 | 99.13 | 115.84 |
| HUMBOLT | Sask. | 96.40 | 24.42 | 65.01 | 79.91 |
| INDIAN HEAD | Sask. | 130.98 | 40.94 | 78.37 | 103.34 |
| KAMSACK | Sask. | 115.45 | 36.22 | 68.92 | 91.01 |
| KELLIHER | Sask. | 95.84 | 21.61 | 68.08 | 81.26 |
| KIPLING | Sask. | 130.51 | 31.40 | 90.17 | 109.32 |
| KRISTNES | Sask. | 90.41 | 22.78 | 60.03 | 74.71 |
| KUROKI | Sask. | 104.34 | 17.52 | 81.30 | 92.36 |
| LANGENBURG | Sask. | 101.59 | 21.79 | 72.66 | 86.60 |
| LEROSS | Sask. | 99.75 | 14.76 | 80.19 | 89.61 |
| LINTLAW | Sask. | 99.41 | 17.74 | 76.62 | 87.44 |
| LIPTON | Sask. | 162.38 | 46.91 | 102.11 | 130.72 |
| LUMSDEN | Sask. | 110.26 | 51.60 | 43.95 | 75.43 |
| MARYFIELD | Sask. | 127.83 | 30.05 | 87.76 | 107.12 |
| MELVILLE | Sask. | 114.64 | 31.02 | 73.66 | 93.37 |
| MIDALE | Sask. | 83.64 | 24.36 | 52.34 | 67.20 |
| MOOSEJAW | Sask. | 122.61 | 41.49 | 69.30 | 94.61 |
| MOOSOMIN | Sask. | 151.64 | 36.26 | 105.04 | 127.16 |
| MUENSTER | Sask. | 89.30 | 26.10 | 55.76 | 71.68 |
| NIPAWIN | Sask. | 135.96 | 37.98 | 87.15 | 110.32 |
| NOKOMIS | Sask. | 76.56 | 30.83 | 36.94 | 55.75 |

| | | | | | |
|---|---|---|---|---|---|
| ORMISTON | Sask. | 95.11 | 39.32 | 44.58 | 68.56 |
| OXBOW | Sask. | 115.93 | 40.39 | 64.03 | 88.67 |
| PASWEGIN | Sask. | 101.69 | 20.34 | 74.94 | 87.78 |
| PELLY | Sask. | 141.32 | 23.69 | 110.28 | 125.14 |
| PORCUPINE PLAIN | Sask. | 175.23 | 41.23 | 122.25 | 147.40 |
| PRAIRIE RIVER | Sask. | 133.69 | 25.16 | 100.58 | 116.48 |
| PRECCEVILLE | Sask. | 104.66 | 24.10 | 72.44 | 88.03 |
| QU'APPELLE | Sask. | 122.32 | 35.40 | 76.83 | 98.42 |
| RAYMORE | Sask. | 93.78 | 31.51 | 52.02 | 72.13 |
| REDVERS | Sask. | 126.63 | 29.37 | 87.71 | 106.46 |
| REGINA | Sask. | 122.64 | 44.99 | 64.82 | 92.27 |
| RIDGEDALE | Sask. | 148.14 | 38.72 | 98.38 | 122.00 |
| ROCANVILLE | Sask. | 118.23 | 28.21 | 80.77 | 98.82 |
| SEMANS | Sask. | 82.07 | 30.68 | 42.66 | 61.37 |
| SOMME | Sask. | 152.45 | 39.05 | 100.61 | 125.58 |
| STRASBOURG | Sask. | 89.75 | 22.65 | 60.65 | 74.46 |
| WAPELLA | Sask. | 125.33 | 24.01 | 93.32 | 108.79 |
| WATROUS | Sask. | 108.27 | 31.32 | 68.02 | 87.13 |
| WEYBURN | Sask. | 107.18 | 34.10 | 63.36 | 84.16 |
| WHITEWOOD | Sask. | 128.58 | 32.52 | 86.79 | 106.63 |
| WILCOX | Sask. | 135.52 | 50.40 | 69.44 | 101.10 |
| WISHART | Sask. | 97.63 | 15.37 | 77.23 | 87.06 |
| WYNYARD | Sask. | 99.34 | 19.95 | 73.05 | 85.68 |
| YELLOW GRASS | Sask. | 104.46 | 37.32 | 56.50 | 79.27 |
| YORKTON | Sask. | 115.00 | 25.18 | 82.64 | 98.00 |
| ALTONA | Man. | 147.57 | 32.74 | 104.57 | 125.18 |
| ARORG | Man. | 180.69 | 28.68 | 143.01 | 161.07 |
| BALDUR | Man. | 155.88 | 31.95 | 113.82 | 134.02 |
| BEAUSEJOUR | Man. | 181.09 | 36.59 | 132.97 | 156.06 |
| BEDE | Man. | 129.80 | 30.53 | 89.34 | 108.83 |
| BINSCARTH | Man. | 136.21 | 33.59 | 91.03 | 112.96 |
| BIRCH RIVER | Man. | 181.55 | 36.10 | 133.42 | 156.68 |
| BIRTLE | Man. | 153.78 | 41.39 | 100.59 | 125.84 |
| BISSETT | Man. | 150.68 | 21.63 | 122.89 | 136.08 |
| BOISEVAIN | Man. | 140.10 | 30.42 | 100.14 | 119.29 |
| BRANDON | Man. | 144.80 | 33.54 | 101.70 | 122.16 |
| BROADVALLEY | Man. | 182.09 | 31.21 | 140.47 | 160.58 |
| CARBERRY | Man. | 100.60 | 23.93 | 69.02 | 84.21 |
| CYPRESS RIVER | Man. | 139.99 | 23.58 | 109.69 | 124.07 |
| DAUPHIN | Man. | 165.18 | 41.15 | 112.30 | 137.40 |
| DEERWOOD | Man. | 144.61 | 27.90 | 108.77 | 125.78 |
| DELORAINE | Man. | 156.17 | 26.30 | 121.18 | 138.07 |
| DELTA BEACH | Man. | 145.74 | 33.85 | 100.88 | 122.48 |
| DUGALD | Man. | 176.40 | 27.36 | 140.07 | 157.58 |
| EMERSON | Man. | 161.02 | 31.71 | 120.28 | 139.62 |
| ERIKSDALE | Man. | 133.62 | 23.45 | 102.79 | 117.59 |
| FRASERWOOD | Man. | 160.24 | 37.14 | 110.82 | 134.68 |
| GILBERT PLAIN | Man. | 168.48 | 34.53 | 123.12 | 144.86 |
| GIMLI | Man. | 172.58 | 19.39 | 147.66 | 159.49 |
| GLADSTONE | Man. | 127.59 | 29.90 | 87.38 | 106.90 |
| GLENBORO | Man. | 101.06 | 24.78 | 68.02 | 83.99 |
| GLENLEA | Man. | 180.37 | 45.34 | 120.28 | 149.22 |

| | | | | | |
|---|---|---|---|---|---|
| GRAND RAPIDS | Man. | 72.58 | 12.38 | 56.67 | 64.22 |
| GRASS RIVER | Man. | 148.70 | 32.30 | 106.34 | 126.64 |
| GRAYSVILLE | Man. | 132.65 | 28.14 | 96.48 | 113.65 |
| GREAT FALLS | Man. | 156.67 | 45.48 | 98.23 | 125.97 |
| HAMIOTA | Man. | 128.99 | 35.37 | 83.53 | 105.11 |
| HARDING | Man. | 141.11 | 34.53 | 94.95 | 117.28 |
| HODGESON | Man. | 185.42 | 33.77 | 140.59 | 162.19 |
| INDIAN BAY | Man. | 111.83 | 17.64 | 89.16 | 99.92 |
| LANGRUTH | Man. | 159.66 | 35.58 | 112.22 | 135.15 |
| LUNDAR | Man. | 152.85 | 22.65 | 122.39 | 137.18 |
| MACGREGOR | Man. | 133.27 | 41.45 | 77.52 | 104.59 |
| MARQUETTE | Man. | 178.12 | 38.56 | 126.81 | 151.59 |
| MEADOW PORTAGE | Man. | 109.30 | 14.39 | 90.05 | 99.36 |
| MELITA | Man. | 101.23 | 14.35 | 82.27 | 91.39 |
| MINNEDOSA | Man. | 152.96 | 35.97 | 106.75 | 128.69 |
| MNT SIDE GOODLANDS | Man. | 131.08 | 24.42 | 98.34 | 114.21 |
| MOOSEHORN | Man. | 92.51 | 26.23 | 58.12 | 74.60 |
| MORDEN | Man. | 144.55 | 26.95 | 109.91 | 126.35 |
| MORRIS | Man. | 153.62 | 46.83 | 93.44 | 122.01 |
| MYRTLE | Man. | 171.76 | 34.61 | 125.88 | 147.98 |
| NEEPAWA | Man. | 159.97 | 28.07 | 123.90 | 141.02 |
| NINETTE | Man. | 140.11 | 24.70 | 108.38 | 123.44 |
| NIVERVILLE | Man. | 171.17 | 47.99 | 108.06 | 138.34 |
| OAKNER | Man. | 143.29 | 29.90 | 103.66 | 122.75 |
| PEACE GARDENS | Man. | 156.41 | 41.60 | 101.18 | 127.79 |
| PIERSON | Man. | 146.74 | 47.76 | 85.36 | 114.50 |
| PILOT MOUND | Man. | 140.04 | 24.26 | 108.17 | 123.44 |
| PINAWA | Man. | 136.63 | 46.27 | 77.17 | 105.40 |
| PINE FALLS | Man. | 169.48 | 20.89 | 142.05 | 155.21 |
| PLUMAS | Man. | 148.79 | 30.98 | 108.20 | 127.64 |
| PLUM COULEE | Man. | 170.42 | 36.06 | 122.54 | 145.61 |
| PORTAGE LA PRAIRIE | Man. | 185.15 | 34.07 | 141.38 | 162.16 |
| RATHWELL | Man. | 139.57 | 28.61 | 101.50 | 119.88 |
| RIVERS | Man. | 158.91 | 33.70 | 115.61 | 136.16 |
| ROLAND | Man. | 149.64 | 31.93 | 107.62 | 127.80 |
| ROSSBURN | Man. | 170.96 | 29.51 | 132.25 | 150.80 |
| RUSSELL | Man. | 141.98 | 40.19 | 90.34 | 114.85 |
| SELKIRK | Man. | 178.37 | 39.80 | 125.85 | 151.11 |
| SEVEN SISTERS | Man. | 166.19 | 21.32 | 137.83 | 151.52 |
| SHILO | Man. | 104.61 | 13.91 | 85.90 | 94.98 |
| SOMSERSET | Man. | 144.91 | 22.25 | 115.08 | 129.54 |
| SOURIS | Man. | 134.44 | 26.79 | 100.01 | 116.35 |
| SPRAGUE | Man. | 144.34 | 31.23 | 104.21 | 123.26 |
| ST. ALBANS | Man. | 101.55 | 17.00 | 79.28 | 89.94 |
| ST. BONIFACE | Man. | 125.18 | 65.25 | 38.97 | 80.42 |
| STARBUCK | Man. | 175.11 | 38.93 | 123.74 | 148.44 |
| STEINBACH | Man. | 184.01 | 28.18 | 147.08 | 164.76 |
| STONEWALL | Man. | 147.68 | 29.19 | 109.37 | 127.74 |
| STONY MNT. | Man. | 125.52 | 29.08 | 86.54 | 105.43 |
| SWAN RIVER | Man. | 170.37 | 41.28 | 116.13 | 142.13 |
| THE PAS | Man. | 145.18 | 21.34 | 117.76 | 130.78 |
| VIRDEN | Man. | 143.41 | 40.20 | 90.72 | 115.95 |

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|---|---|---|---|---|---|
| VOGAR | Man. | 113.88 | 17.09 | 91.23 | 102.14 |
| WASAGAMING | Man. | 150.41 | 20.97 | 122.61 | 136.00 |
| WASKADA | Man. | 124.93 | 39.29 | 74.45 | 98.41 |
| WILSON CREEK | Man. | 139.59 | 23.50 | 108.18 | 123.38 |
| WINNIPEG | Man. | 186.66 | 32.94 | 144.33 | 164.42 |

Table B30: Plant Moisture Stress at the Silking Stage of Corn (mm)

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | -74.43 | 38.67 | -125.99 | -101.07 |
| ARRAN | Sask. | -61.25 | 35.88 | -108.26 | -85.75 |
| AYLSHAM | Sask. | -36.91 | 27.24 | -73.16 | -55.66 |
| BANGOR | Sask. | -76.77 | 38.78 | -128.08 | -103.37 |
| BROADVIEW | Sask. | -68.94 | 37.76 | -117.45 | -94.42 |
| CANORA | Sask. | -66.69 | 34.14 | -112.20 | -90.21 |
| CARDROSE | Sask. | -77.85 | 36.37 | -126.13 | -102.87 |
| CARLYLE | Sask. | -75.38 | 37.36 | -123.39 | -100.60 |
| CARON | Sask. | -93.72 | 40.68 | -145.99 | -121.18 |
| CEYLON | Sask. | -76.53 | 41.59 | -129.98 | -104.61 |
| COTE | Sask. | -63.01 | 30.51 | -103.69 | -84.03 |
| CUPAR | Sask. | -83.44 | 50.71 | -148.60 | -117.67 |
| DAFOE | Sask. | -74.61 | 34.79 | -120.81 | -98.55 |
| DAHINDA | Sask. | -83.20 | 43.12 | -141.20 | -113.04 |
| DAVIDSON | Sask. | -96.91 | 39.02 | -147.05 | -123.24 |
| DAVIN | Sask. | -88.85 | 50.45 | -155.25 | -123.35 |
| DUVAL | Sask. | -71.75 | 32.12 | -114.07 | -93.75 |
| ESTEVAN | Sask. | -74.62 | 33.33 | -117.44 | -97.11 |
| FENWOOD | Sask. | -60.04 | 29.63 | -99.89 | -80.54 |
| FERTILE | Sask. | -55.27 | 25.55 | -89.25 | -72.84 |
| FOAMLAKE | Sask. | -76.41 | 29.97 | -114.93 | -96.64 |
| FORT QU'APPELLE | Sask. | -103.58 | 48.27 | -165.61 | -136.17 |
| FRANCIS | Sask. | -94.37 | 47.92 | -155.95 | -126.72 |
| GOOD SPRIT LAKE | Sask. | -69.05 | 38.17 | -119.48 | -95.23 |
| GRENFELL | Sask. | -69.53 | 39.36 | -120.11 | -96.10 |
| GUERNSEY | Sask. | -108.75 | 34.22 | -154.11 | -132.26 |
| HUBBARD | Sask. | -84.99 | 35.85 | -131.06 | -109.19 |
| HUDSON BAY | Sask. | -55.68 | 28.92 | -92.84 | -75.20 |
| HUMBOLT | Sask. | -78.27 | 31.70 | -119.01 | -99.67 |
| INDIAN HEAD | Sask. | -66.36 | 40.12 | -117.92 | -93.45 |
| KAMSACK | Sask. | -74.63 | 36.78 | -121.90 | -99.46 |
| KELLIHER | Sask. | -75.43 | 40.91 | -128.00 | -103.04 |
| KIPLING | Sask. | -65.57 | 38.67 | -115.25 | -91.67 |
| KRISTNES | Sask. | -88.36 | 44.68 | -147.95 | -119.15 |
| KUROKI | Sask. | -64.34 | 32.82 | -107.50 | -86.79 |
| LANGENBURG | Sask. | -76.61 | 39.93 | -129.62 | -104.08 |
| LEROSS | Sask. | -70.23 | 29.89 | -109.84 | -90.76 |
| LINTLAW | Sask. | -71.20 | 34.80 | -115.92 | -94.69 |
| LIPTON | Sask. | -65.31 | 41.86 | -119.10 | -93.56 |
| LUMSDEN | Sask. | -90.84 | 42.53 | -145.49 | -119.55 |
| MARYFIELD | Sask. | -56.90 | 22.05 | -86.30 | -72.09 |
| MELVILLE | Sask. | -73.48 | 43.82 | -131.37 | -103.54 |
| MIDALE | Sask. | -87.26 | 36.37 | -133.99 | -111.80 |
| MOOSEJAW | Sask. | -76.77 | 34.12 | -120.61 | -99.80 |
| MOOSOMIN | Sask. | -45.87 | 28.90 | -83.01 | -65.38 |
| MUENSTER | Sask. | -79.88 | 30.51 | -119.08 | -100.47 |
| NIPAWIN | Sask. | -62.90 | 37.90 | -111.60 | -88.48 |
| NOKOMIS | Sask. | -102.74 | 42.29 | -157.08 | -131.28 |

| | | | | | |
|---|---|---|---|---|---|
| ORMISTON | Sask. | -87.20 | 40.24 | -138.92 | -114.37 |
| OXBOW | Sask. | -86.10 | 44.75 | -143.60 | -116.30 |
| PASWEGIN | Sask. | -66.33 | 33.93 | -110.95 | -89.54 |
| PELLY | Sask. | -65.35 | 40.32 | -118.20 | -92.90 |
| PORCUPINE PLAIN | Sask. | -51.88 | 40.34 | -103.72 | -79.11 |
| PRAIRIE RIVER | Sask. | -66.06 | 41.99 | -121.34 | -94.79 |
| PRECCEVILLE | Sask. | -79.23 | 33.51 | -124.02 | -102.35 |
| QU'APPELLE | Sask. | -69.03 | 35.10 | -114.14 | -92.73 |
| RAYMORE | Sask. | -76.15 | 36.84 | -124.97 | -101.45 |
| REDVERS | Sask. | -75.85 | 41.74 | -131.18 | -104.53 |
| REGINA | Sask. | -77.62 | 38.34 | -126.89 | -103.50 |
| RIDGEDALE | Sask. | -70.70 | 39.68 | -121.69 | -97.48 |
| ROCANVILLE | Sask. | -68.66 | 27.32 | -104.93 | -87.45 |
| SEMANS | Sask. | -98.37 | 36.87 | -145.75 | -123.26 |
| SOMME | Sask. | -56.10 | 40.81 | -110.28 | -84.18 |
| STRASBOURG | Sask. | -83.87 | 36.56 | -130.84 | -108.54 |
| WAPELLA | Sask. | -62.44 | 25.67 | -96.66 | -80.12 |
| WATROUS | Sask. | -72.37 | 40.93 | -124.97 | -100.00 |
| WEYBURN | Sask. | -74.02 | 41.40 | -127.22 | -101.97 |
| WHITEWOOD | Sask. | -63.35 | 38.86 | -113.29 | -89.58 |
| WILCOX | Sask. | -82.52 | 45.42 | -142.08 | -113.54 |
| WISHART | Sask. | -79.26 | 28.87 | -117.60 | -99.13 |
| WYNYARD | Sask. | -70.00 | 32.83 | -113.26 | -92.49 |
| YELLOW GRASS | Sask. | -83.91 | 45.08 | -141.85 | -114.35 |
| YORKTON | Sask. | -60.66 | 33.43 | -103.62 | -83.23 |
| ALTONA | Man. | -42.39 | 28.92 | -80.38 | -62.17 |
| ARORG | Man. | -40.42 | 25.25 | -73.58 | -57.69 |
| BALDUR | Man. | -45.07 | 28.95 | -83.18 | -64.87 |
| BEAUSEJOUR | Man. | -34.83 | 24.60 | -67.18 | -51.66 |
| BEDE | Man. | -58.47 | 37.58 | -108.27 | -84.29 |
| BINSCARTH | Man. | -60.18 | 25.18 | -94.05 | -77.61 |
| BIRCH RIVER | Man. | -46.75 | 27.25 | -83.09 | -65.52 |
| BIRTLE | Man. | -51.51 | 35.99 | -97.75 | -75.80 |
| BISSETT | Man. | -34.09 | 20.07 | -59.88 | -47.64 |
| BOISEVAIN | Man. | -45.26 | 34.66 | -90.79 | -68.97 |
| BRANDON | Man. | -54.76 | 33.55 | -97.87 | -77.41 |
| BROADVALLEY | Man. | -33.44 | 31.65 | -75.65 | -55.25 |
| CARBERRY | Man. | -61.86 | 31.11 | -102.91 | -83.17 |
| CYPRESS RIVER | Man. | -48.88 | 35.80 | -94.88 | -73.05 |
| DAUPHIN | Man. | -43.22 | 26.99 | -77.90 | -61.44 |
| DEERWOOD | Man. | -38.46 | 29.78 | -76.73 | -58.56 |
| DELORAINE | Man. | -42.32 | 28.73 | -80.55 | -62.09 |
| DELTA BEACH | Man. | -34.99 | 17.43 | -58.08 | -46.96 |
| DUGALD | Man. | -34.78 | 24.50 | -67.31 | -51.64 |
| EMERSON | Man. | -51.07 | 64.03 | -133.35 | -94.29 |
| ERIKSDALE | Man. | -50.16 | 30.02 | -89.64 | -70.70 |
| FRASERWOOD | Man. | -39.22 | 23.59 | -70.60 | -55.45 |
| GILBERT PLAIN | Man. | -52.62 | 35.26 | -98.95 | -76.74 |
| GIMLI | Man. | -26.14 | 16.44 | -47.27 | -37.24 |
| GLADSTONE | Man. | -60.29 | 29.31 | -99.71 | -80.57 |
| GLENBORO | Man. | -62.93 | 25.83 | -97.38 | -80.73 |
| GLENLEA | Man. | -30.80 | 24.69 | -63.52 | -47.76 |

| | | | | | |
|---|---|---|---|---|---|
| GRAND RAPIDS | Man. | -59.40 | 21.80 | -87.42 | -74.12 |
| GRASS RIVER | Man. | -52.96 | 32.68 | -95.82 | -75.28 |
| GRAYSVILLE | Man. | -53.05 | 34.59 | -97.49 | -76.39 |
| GREAT FALLS | Man. | -39.56 | 39.46 | -90.27 | -66.20 |
| HAMIOTA | Man. | -60.91 | 31.46 | -101.34 | -82.15 |
| HARDING | Man. | -72.28 | 38.93 | -124.32 | -99.14 |
| HODGESON | Man. | -49.20 | 36.35 | -97.46 | -74.20 |
| INDIAN BAY | Man. | -39.50 | 21.69 | -67.37 | -54.14 |
| LANGRUTH | Man. | -32.98 | 19.30 | -58.72 | -46.28 |
| LUNDAR | Man. | -41.78 | 30.45 | -82.73 | -62.85 |
| MACGREGOR | Man. | -54.74 | 38.05 | -105.91 | -81.07 |
| MARQUETTE | Man. | -30.18 | 27.98 | -67.40 | -49.43 |
| MEADOW PORTAGE | Man. | -48.04 | 19.89 | -74.63 | -61.77 |
| MELITA | Man. | -68.08 | 30.49 | -108.37 | -89.00 |
| MINNEDOSA | Man. | -48.28 | 26.54 | -82.39 | -66.20 |
| MNT SIDE GOODLANDS | Man. | -49.33 | 30.18 | -89.79 | -70.18 |
| MOOSEHORN | Man. | -62.66 | 34.27 | -107.60 | -86.07 |
| MORDEN | Man. | -41.49 | 27.86 | -77.29 | -60.29 |
| MORRIS | Man. | -45.79 | 31.87 | -86.75 | -67.31 |
| MYRTLE | Man. | -45.17 | 33.83 | -90.00 | -68.41 |
| NEEPAWA | Man. | -39.99 | 25.44 | -72.67 | -57.16 |
| NINETTE | Man. | -48.57 | 32.15 | -89.89 | -70.28 |
| NIVERVILLE | Man. | -45.24 | 35.64 | -92.11 | -69.62 |
| OAKNER | Man. | -49.00 | 25.63 | -82.96 | -66.61 |
| PEACE GARDENS | Man. | -48.26 | 38.02 | -98.73 | -74.41 |
| PIERSON | Man. | -58.98 | 40.15 | -110.58 | -86.08 |
| PILOT MOUND | Man. | -42.47 | 24.25 | -74.33 | -59.06 |
| PINAWA | Man. | -51.84 | 32.82 | -94.01 | -73.99 |
| PINE FALLS | Man. | -30.80 | 21.24 | -58.68 | -45.31 |
| PLUMAS | Man. | -51.92 | 28.45 | -89.20 | -71.35 |
| PLUM COULEE | Man. | -39.19 | 28.90 | -77.55 | -59.07 |
| PORTAGE LA PRAIRIE | Man. | -29.81 | 27.01 | -64.51 | -48.04 |
| RATHWELL | Man. | -50.22 | 31.70 | -92.40 | -72.03 |
| RIVERS | Man. | -40.55 | 27.68 | -76.11 | -59.23 |
| ROLAND | Man. | -41.55 | 24.97 | -74.42 | -58.63 |
| ROSSBURN | Man. | -41.93 | 31.60 | -83.37 | -63.51 |
| RUSSELL | Man. | -53.47 | 36.16 | -99.93 | -77.88 |
| SELKIRK | Man. | -25.46 | 22.66 | -55.37 | -40.99 |
| SEVEN SISTERS | Man. | -37.94 | 30.03 | -77.89 | -58.60 |
| SHILO | Man. | -68.37 | 28.62 | -106.87 | -88.18 |
| SOMSERSET | Man. | -42.12 | 23.38 | -73.46 | -58.27 |
| SOURIS | Man. | -57.78 | 31.65 | -98.45 | -79.15 |
| SPRAGUE | Man. | -46.29 | 32.48 | -88.02 | -68.21 |
| ST. ALBANS | Man. | -66.49 | 33.79 | -110.77 | -89.57 |
| ST. BONIFACE | Man. | -60.06 | 44.04 | -118.24 | -90.27 |
| STARBUCK | Man. | -41.78 | 35.44 | -88.54 | -66.06 |
| STEINBACH | Man. | -29.44 | 23.99 | -60.88 | -45.83 |
| STONEWALL | Man. | -38.89 | 20.63 | -65.96 | -52.98 |
| STONY MNT. | Man. | -47.11 | 26.98 | -83.28 | -65.75 |
| SWAN RIVER | Man. | -45.82 | 36.62 | -93.92 | -70.87 |
| THE PAS | Man. | -38.81 | 24.10 | -69.78 | -55.07 |
| VIRDEN | Man. | -51.54 | 28.84 | -89.33 | -71.24 |

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|---|---|---|---|---|---|
| VOGAR | Man. | -34.09 | 15.27 | -54.33 | -44.58 |
| WASAGAMING | Man. | -65.53 | 34.71 | -111.53 | -89.38 |
| WASKADA | Man. | -66.85 | 36.01 | -113.13 | -91.16 |
| WILSON CREEK | Man. | -48.56 | 20.74 | -76.28 | -62.87 |
| WINNIPEG | Man. | -31.16 | 26.22 | -64.85 | -48.85 |

Table B31: Soil Moisture Amounts at the Silage Stage of Corn (mm)
Note: Any value of 0.00 represents 14 years or less of data.

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 54.07 | 22.92 | 23.51 | 38.28 |
| ARRAN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| AYLSHAM | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| BANGOR | Sask. | 50.14 | 32.27 | 7.11 | 27.91 |
| BROADVIEW | Sask. | 66.79 | 29.26 | 29.19 | 47.04 |
| CANORA | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| CARDROSE | Sask. | 63.00 | 44.37 | 4.09 | 32.48 |
| CARLYLE | Sask. | 63.18 | 37.17 | 15.41 | 38.09 |
| CARON | Sask. | 43.52 | 20.65 | 16.99 | 29.58 |
| CEYLON | Sask. | 58.18 | 31.63 | 17.54 | 36.83 |
| COTE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| CUPAR | Sask. | 74.15 | 28.94 | 36.22 | 54.38 |
| DAFOE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| DAHINDA | Sask. | 58.14 | 26.69 | 22.24 | 39.67 |
| DAVIDSON | Sask. | 29.78 | 13.62 | 12.27 | 20.58 |
| DAVIN | Sask. | 60.08 | 34.07 | 14.84 | 36.63 |
| DUVAL | Sask. | 44.35 | 26.57 | 9.29 | 26.15 |
| ESTEVAN | Sask. | 47.45 | 24.13 | 16.44 | 31.16 |
| FENWOOD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| FERTILE | Sask. | 66.40 | 25.83 | 31.96 | 48.60 |
| FOAMLAKE | Sask. | 50.53 | 30.09 | 11.04 | 29.98 |
| FORT QU'APPELLE | Sask. | 37.90 | 19.35 | 12.54 | 24.69 |
| FRANCIS | Sask. | 50.02 | 31.21 | 9.91 | 28.95 |
| GOOD SPRIT LAKE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| GRENFELL | Sask. | 65.17 | 37.36 | 17.17 | 39.96 |
| GUERNSEY | Sask. | 21.64 | 11.77 | 5.94 | 13.53 |
| HUBBARD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| HUDSON BAY | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| HUMBOLT | Sask. | 43.23 | 26.06 | 8.75 | 25.35 |
| INDIAN HEAD | Sask. | 73.57 | 36.43 | 26.76 | 48.98 |
| KAMSACK | Sask. | 64.87 | 28.99 | 27.62 | 45.30 |
| KELLIHER | Sask. | 43.57 | 30.87 | 2.05 | 22.21 |
| KIPLING | Sask. | 71.59 | 34.02 | 26.50 | 48.21 |
| KRISTNES | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| KUROKI | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LANGENBURG | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LEROSS | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LINTLAW | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LIPTON | Sask. | 93.10 | 47.25 | 31.14 | 60.83 |
| LUMSDEN | Sask. | 64.85 | 44.86 | 7.21 | 34.57 |
| MARYFIELD | Sask. | 77.82 | 43.42 | 19.61 | 47.82 |
| MELVILLE | Sask. | 65.29 | 31.33 | 23.61 | 43.74 |
| MIDALE | Sask. | 42.11 | 26.32 | 8.29 | 24.34 |
| MOOSEJAW | Sask. | 71.70 | 37.74 | 23.21 | 46.23 |
| MOOSOMIN | Sask. | 93.87 | 39.34 | 43.33 | 67.32 |
| MUENSTER | Sask. | 42.29 | 26.61 | 8.10 | 24.33 |
| NIPAWIN | Sask. | 79.84 | 31.04 | 39.95 | 58.88 |

| | | | | | |
|---|---|---|---|---|---|
| NOKOMIS | Sask. | 33.65 | 16.95 | 11.88 | 22.22 |
| ORMISTON | Sask. | 53.83 | 35.04 | 8.81 | 30.18 |
| OXBOW | Sask. | 67.40 | 37.14 | 19.68 | 42.34 |
| PASWEGIN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PELLY | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PORCUPINE PLAIN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PRAIRIE RIVER | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PRECCEVILLE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| QU'APPELLE | Sask. | 55.84 | 24.90 | 23.85 | 39.04 |
| RAYMORE | Sask. | 38.74 | 14.15 | 19.77 | 28.96 |
| REDVERS | Sask. | 72.24 | 34.11 | 26.51 | 48.67 |
| REGINA | Sask. | 65.50 | 29.54 | 27.54 | 45.56 |
| RIDGEDALE | Sask. | 94.48 | 49.04 | 29.93 | 60.94 |
| ROCANVILLE | Sask. | 59.15 | 24.30 | 26.82 | 42.43 |
| SEMANS | Sask. | 35.72 | 22.68 | 6.58 | 20.41 |
| SOMME | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| STRASBOURG | Sask. | 41.03 | 24.14 | 10.01 | 24.74 |
| WAPELLA | Sask. | 88.03 | 42.52 | 30.85 | 58.61 |
| WATROUS | Sask. | 50.93 | 21.64 | 23.12 | 36.32 |
| WEYBURN | Sask. | 56.41 | 27.96 | 20.49 | 37.54 |
| WHITEWOOD | Sask. | 75.54 | 35.57 | 29.82 | 51.52 |
| WILCOX | Sask. | 82.60 | 52.69 | 13.25 | 46.56 |
| WISHART | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| WYNYARD | Sask. | 45.90 | 22.81 | 15.22 | 30.11 |
| YELLOW GRASS | Sask. | 52.49 | 27.42 | 17.26 | 33.99 |
| YORKTON | Sask. | 67.47 | 30.04 | 28.88 | 47.20 |
| ALTONA | Man. | 101.15 | 40.39 | 48.04 | 73.53 |
| ARORG | Man. | 124.20 | 52.26 | 54.67 | 88.25 |
| BALDUR | Man. | 89.23 | 33.36 | 45.21 | 66.38 |
| BEAUSEJOUR | Man. | 113.08 | 37.19 | 64.01 | 87.61 |
| BEDE | Man. | 85.68 | 41.02 | 31.31 | 57.50 |
| BINSCARTH | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| BIRCH RIVER | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| BIRTLE | Man. | 90.27 | 45.77 | 31.46 | 59.38 |
| BISSETT | Man. | 101.96 | 41.09 | 48.12 | 73.89 |
| BOISEVAIN | Man. | 80.51 | 28.90 | 42.37 | 60.71 |
| BRANDON | Man. | 86.83 | 35.98 | 40.60 | 62.54 |
| BROADVALLEY | Man. | 128.98 | 59.21 | 49.34 | 88.00 |
| CARBERRY | Man. | 56.82 | 31.24 | 15.42 | 35.36 |
| CYPRESS RIVER | Man. | 83.46 | 35.75 | 37.52 | 59.33 |
| DAUPHIN | Man. | 107.02 | 44.30 | 50.10 | 77.12 |
| DEERWOOD | Man. | 90.46 | 30.80 | 50.88 | 69.67 |
| DELORAINE | Man. | 103.97 | 41.18 | 49.19 | 75.64 |
| DELTA BEACH | Man. | 84.71 | 26.63 | 49.28 | 66.39 |
| DUGALD | Man. | 115.24 | 30.40 | 74.70 | 94.29 |
| EMERSON | Man. | 104.25 | 41.56 | 50.84 | 76.19 |
| ERIKSDALE | Man. | 86.22 | 43.88 | 28.16 | 56.12 |
| FRASERWOOD | Man. | 106.58 | 45.26 | 46.08 | 75.35 |
| GILBERT PLAIN | Man. | 102.24 | 43.93 | 44.02 | 72.06 |
| GIMLI | Man. | 132.03 | 46.67 | 72.06 | 100.53 |
| GLADSTONE | Man. | 84.51 | 41.07 | 29.26 | 56.08 |
| GLENBORO | Man. | 52.35 | 30.31 | 11.93 | 31.46 |

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|---|---|---|---|---|---|
| GLENLEA | Man. | 107.53 | 32.92 | 63.73 | 84.88 |
| GRAND RAPIDS | Man. | 57.80 | 33.76 | 12.55 | 34.47 |
| GRASS RIVER | Man. | 86.75 | 42.94 | 30.39 | 57.42 |
| GRAYSVILLE | Man. | 76.29 | 35.30 | 30.93 | 52.47 |
| GREAT FALLS | Man. | 113.86 | 46.87 | 53.64 | 82.23 |
| HAMIOTA | Man. | 85.99 | 42.89 | 30.87 | 57.04 |
| HARDING | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| HODGESON | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| INDIAN BAY | Man. | 75.76 | 30.13 | 37.05 | 55.43 |
| LANGRUTH | Man. | 110.66 | 43.07 | 53.08 | 80.94 |
| LUNDAR | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MACGREGOR | Man. | 78.42 | 33.24 | 33.71 | 55.41 |
| MARQUETTE | Man. | 114.34 | 30.87 | 73.18 | 93.07 |
| MEADOW PORTAGE | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MELITA | Man. | 58.55 | 25.51 | 24.85 | 41.05 |
| MINNEDOSA | Man. | 85.56 | 38.93 | 34.42 | 58.93 |
| MNT SIDE GOODLANDS | Man. | 92.39 | 41.59 | 36.45 | 63.61 |
| MOOSEHORN | Man. | 56.11 | 32.92 | 12.72 | 33.56 |
| MORDEN | Man. | 86.81 | 32.41 | 45.16 | 64.93 |
| MORRIS | Man. | 94.47 | 41.10 | 41.66 | 66.73 |
| MYRTLE | Man. | 105.76 | 38.95 | 54.14 | 79.00 |
| NEEPAWA | Man. | 106.35 | 39.98 | 54.97 | 79.36 |
| NINETTE | Man. | 88.80 | 39.52 | 38.01 | 62.12 |
| NIVERVILLE | Man. | 110.85 | 38.37 | 60.21 | 84.56 |
| OAKNER | Man. | 89.71 | 40.85 | 35.24 | 61.56 |
| PEACE GARDENS | Man. | 112.69 | 49.62 | 45.95 | 78.35 |
| PIERSON | Man. | 86.24 | 32.75 | 44.16 | 64.14 |
| PILOT MOUND | Man. | 85.52 | 33.57 | 41.33 | 62.56 |
| PINAWA | Man. | 89.66 | 49.33 | 26.28 | 56.37 |
| PINE FALLS | Man. | 117.71 | 45.11 | 58.19 | 86.81 |
| PLUMAS | Man. | 88.62 | 44.66 | 29.94 | 58.07 |
| PLUM COULEE | Man. | 109.23 | 38.44 | 58.19 | 82.78 |
| PORTAGE LA PRAIRIE | Man. | 127.64 | 39.20 | 77.27 | 101.18 |
| RATHWELL | Man. | 78.47 | 34.07 | 33.14 | 55.03 |
| RIVERS | Man. | 104.65 | 31.63 | 63.10 | 83.02 |
| ROLAND | Man. | 83.55 | 32.03 | 41.40 | 61.65 |
| ROSSBURN | Man. | 121.72 | 51.88 | 52.85 | 86.03 |
| RUSSELL | Man. | 83.33 | 42.95 | 28.14 | 54.34 |
| SELKIRK | Man. | 126.51 | 41.60 | 71.54 | 97.97 |
| SEVEN SISTERS | Man. | 119.84 | 47.25 | 56.50 | 87.19 |
| SHILO | Man. | 60.36 | 31.89 | 17.47 | 38.29 |
| SOMSERSET | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SOURIS | Man. | 79.68 | 40.03 | 28.24 | 52.66 |
| SPRAGUE | Man. | 92.45 | 38.11 | 43.48 | 66.73 |
| ST. ALBANS | Man. | 50.38 | 29.45 | 11.80 | 30.27 |
| ST. BONIFACE | Man. | 84.75 | 54.69 | 12.39 | 47.24 |
| STARBUCK | Man. | 112.76 | 45.84 | 52.28 | 81.36 |
| STEINBACH | Man. | 130.43 | 39.94 | 77.96 | 103.11 |
| STONEWALL | Man. | 79.53 | 26.10 | 45.18 | 61.68 |
| STONY MNT. | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SWAN RIVER | Man. | 110.49 | 41.26 | 55.81 | 82.15 |
| THE PAS | Man. | 87.85 | 36.07 | 40.32 | 63.14 |

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|---|---|---|---|---|---|
| VIRDEN | Man. | 94.65 | 42.75 | 38.58 | 65.45 |
| VOGAR | Man. | 75.04 | 28.44 | 37.20 | 55.47 |
| WASAGAMING | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| WASKADA | Man. | 70.33 | 36.36 | 23.60 | 45.79 |
| WILSON CREEK | Man. | 90.72 | 41.23 | 35.45 | 62.23 |
| WINNIPEG | Man. | 124.35 | 36.78 | 77.09 | 99.53 |

Table B32: Plant Moisture Stress at the Silage Stage of Corn (mm)
Note: Any value of 0.00 represents 14 years of less of data.

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | -128.23 | 57.98 | -205.54 | -168.18 |
| ARRAN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| AYLSHAM | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| BANGOR | Sask. | -138.31 | 67.39 | -228.16 | -184.74 |
| BROADVIEW | Sask. | -120.12 | 63.15 | -201.27 | -162.75 |
| CANORA | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| CARDROSE | Sask. | -143.24 | 67.17 | -232.42 | -189.45 |
| CARLYLE | Sask. | -133.08 | 69.49 | -222.38 | -179.99 |
| CARON | Sask. | -172.74 | 56.02 | -244.72 | -210.55 |
| CEYLON | Sask. | -137.76 | 70.91 | -228.88 | -185.63 |
| COTE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| CUPAR | Sask. | -144.75 | 86.07 | -257.54 | -203.54 |
| DAFOE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| DAHINDA | Sask. | -140.48 | 62.15 | -224.07 | -183.49 |
| DAVIDSON | Sask. | -181.01 | 54.21 | -250.67 | -217.60 |
| DAVIN | Sask. | -173.74 | 78.25 | -277.63 | -227.57 |
| DUVAL | Sask. | -117.74 | 46.05 | -178.50 | -149.28 |
| ESTEVAN | Sask. | -125.14 | 50.38 | -189.88 | -159.15 |
| FENWOOD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| FERTILE | Sask. | -97.30 | 45.15 | -157.50 | -128.41 |
| FOAMLAKE | Sask. | -134.46 | 60.88 | -214.36 | -176.04 |
| FORT QU'APPELLE | Sask. | -213.18 | 67.23 | -301.27 | -259.09 |
| FRANCIS | Sask. | -177.27 | 80.66 | -280.93 | -231.72 |
| GOOD SPRIT LAKE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| GRENFELL | Sask. | -123.97 | 62.28 | -204.00 | -166.01 |
| GUERNSEY | Sask. | -192.80 | 61.74 | -275.13 | -235.34 |
| HUBBARD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| HUDSON BAY | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| HUMBOLT | Sask. | -150.84 | 62.25 | -233.21 | -193.54 |
| INDIAN HEAD | Sask. | -113.32 | 64.97 | -196.81 | -157.18 |
| KAMSACK | Sask. | -130.82 | 69.80 | -220.51 | -177.93 |
| KELLIHER | Sask. | -142.98 | 79.06 | -249.32 | -197.69 |
| KIPLING | Sask. | -124.27 | 79.85 | -230.09 | -179.13 |
| KRISTNES | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| KUROKI | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LANGENBURG | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LEROSS | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LINTLAW | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LIPTON | Sask. | -109.34 | 67.08 | -197.31 | -155.16 |
| LUMSDEN | Sask. | -170.29 | 76.06 | -268.02 | -221.63 |
| MARYFIELD | Sask. | -100.69 | 37.07 | -150.39 | -126.31 |
| MELVILLE | Sask. | -136.99 | 78.10 | -240.90 | -190.72 |
| MIDALE | Sask. | -155.69 | 57.92 | -230.11 | -194.78 |
| MOOSEJAW | Sask. | -134.26 | 55.37 | -205.41 | -171.63 |
| MOOSOMIN | Sask. | -71.36 | 48.86 | -134.15 | -104.34 |
| MUENSTER | Sask. | -164.02 | 58.93 | -239.75 | -203.80 |
| NIPAWIN | Sask. | -115.13 | 71.27 | -206.71 | -163.24 |

| | | | | | |
|---|---|---|---|---|---|
| NOKOMIS | Sask. | -190.93 | 66.38 | -276.23 | -235.74 |
| ORMISTON | Sask. | -153.53 | 71.33 | -245.19 | -201.68 |
| OXBOW | Sask. | -156.18 | 82.02 | -261.57 | -211.55 |
| PASWEGIN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PELLY | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PORCUPINE PLAIN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PRAIRIE RIVER | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PRECCEVILLE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| QU'APPELLE | Sask. | -130.08 | 57.69 | -204.22 | -169.03 |
| RAYMORE | Sask. | -136.53 | 57.13 | -213.11 | -176.00 |
| REDVERS | Sask. | -118.94 | 76.39 | -221.35 | -171.72 |
| REGINA | Sask. | -140.33 | 65.80 | -224.88 | -184.74 |
| RIDGEDALE | Sask. | -155.11 | 67.18 | -243.55 | -201.07 |
| ROCANVILLE | Sask. | -113.55 | 37.94 | -164.02 | -139.65 |
| SEMANS | Sask. | -182.51 | 72.67 | -275.90 | -231.57 |
| SOMME | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| STRASBOURG | Sask. | -150.58 | 59.88 | -227.53 | -191.00 |
| WAPELLA | Sask. | -98.05 | 29.64 | -137.91 | -118.56 |
| WATROUS | Sask. | -136.26 | 75.95 | -233.87 | -187.53 |
| WEYBURN | Sask. | -130.27 | 61.29 | -209.03 | -171.64 |
| WHITEWOOD | Sask. | -115.21 | 68.81 | -203.64 | -161.66 |
| WILCOX | Sask. | -168.38 | 80.68 | -274.58 | -223.57 |
| WISHART | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| WYNYARD | Sask. | -114.75 | 52.03 | -184.74 | -150.76 |
| YELLOW GRASS | Sask. | -151.02 | 67.50 | -237.75 | -196.58 |
| YORKTON | Sask. | -106.45 | 61.58 | -185.58 | -148.02 |
| ALTONA | Man. | -64.00 | 41.57 | -118.66 | -92.43 |
| ARORG | Man. | -67.23 | 42.10 | -123.24 | -96.19 |
| BALDUR | Man. | -74.68 | 43.95 | -132.66 | -104.78 |
| BEAUSEJOUR | Man. | -56.70 | 37.65 | -106.38 | -82.50 |
| BEDE | Man. | -93.50 | 59.73 | -172.67 | -134.54 |
| BINSCARTH | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| BIRCH RIVER | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| BIRTLE | Man. | -97.90 | 72.34 | -190.86 | -146.73 |
| BISSETT | Man. | -47.64 | 26.41 | -82.25 | -65.68 |
| BOISEVAIN | Man. | -66.23 | 41.01 | -120.34 | -94.32 |
| BRANDON | Man. | -90.02 | 49.92 | -154.17 | -123.72 |
| BROADVALLEY | Man. | -54.93 | 50.31 | -122.60 | -89.75 |
| CARBERRY | Man. | -110.19 | 44.14 | -168.69 | -140.52 |
| CYPRESS RIVER | Man. | -75.67 | 48.54 | -138.04 | -108.43 |
| DAUPHIN | Man. | -70.47 | 49.87 | -134.56 | -104.14 |
| DEERWOOD | Man. | -54.19 | 38.76 | -103.99 | -80.35 |
| DELORAINE | Man. | -62.47 | 44.66 | -121.89 | -93.20 |
| DELTA BEACH | Man. | -51.12 | 24.97 | -84.34 | -68.30 |
| DUGALD | Man. | -56.25 | 36.73 | -105.23 | -81.56 |
| EMERSON | Man. | -63.83 | 48.75 | -126.48 | -96.74 |
| ERIKSDALE | Man. | -88.42 | 45.37 | -148.45 | -119.54 |
| FRASERWOOD | Man. | -57.09 | 31.51 | -99.21 | -78.83 |
| GILBERT PLAIN | Man. | -87.33 | 59.99 | -166.84 | -128.55 |
| GIMLI | Man. | -35.18 | 21.29 | -62.54 | -49.56 |
| GLADSTONE | Man. | -95.38 | 45.08 | -156.01 | -126.57 |
| GLENBORO | Man. | -101.36 | 40.31 | -155.11 | -129.13 |

| | | | | | |
|---|---|---|---|---|---|
| GLENLEA | Man. | -50.17 | 46.28 | -111.75 | -82.01 |
| GRAND RAPIDS | Man. | -77.83 | 29.45 | -117.30 | -98.17 |
| GRASS RIVER | Man. | -87.09 | 48.15 | -150.29 | -119.98 |
| GRAYSVILLE | Man. | -87.90 | 53.20 | -156.26 | -123.81 |
| GREAT FALLS | Man. | -56.67 | 62.43 | -136.89 | -98.81 |
| HAMIOTA | Man. | -104.24 | 62.74 | -184.87 | -146.59 |
| HARDING | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| HODGESON | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| INDIAN BAY | Man. | -60.47 | 32.77 | -102.58 | -82.59 |
| LANGRUTH | Man. | -46.61 | 27.97 | -84.00 | -65.91 |
| LUNDAR | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MACGREGOR | Man. | -85.26 | 60.37 | -166.46 | -127.04 |
| MARQUETTE | Man. | -44.50 | 46.80 | -106.91 | -76.75 |
| MEADOW PORTAGE | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MELITA | Man. | -103.59 | 45.02 | -163.06 | -134.47 |
| MINNEDOSA | Man. | -96.65 | 47.28 | -158.77 | -128.99 |
| MNT SIDE GOODLANDS | Man. | -77.77 | 50.40 | -145.55 | -112.64 |
| MOOSEHORN | Man. | -108.22 | 62.06 | -190.00 | -150.73 |
| MORDEN | Man. | -62.41 | 40.01 | -113.83 | -89.42 |
| MORRIS | Man. | -74.09 | 47.59 | -135.24 | -106.21 |
| MYRTLE | Man. | -65.29 | 49.16 | -130.44 | -99.06 |
| NEEPAWA | Man. | -58.22 | 38.62 | -107.86 | -84.30 |
| NINETTE | Man. | -76.50 | 49.39 | -139.97 | -109.84 |
| NIVERVILLE | Man. | -76.37 | 57.64 | -152.42 | -115.85 |
| OAKNER | Man. | -81.71 | 37.34 | -131.51 | -107.44 |
| PEACE GARDENS | Man. | -62.81 | 43.54 | -121.38 | -92.94 |
| PIERSON | Man. | -100.06 | 67.95 | -187.38 | -145.92 |
| PILOT MOUND | Man. | -72.45 | 40.51 | -125.78 | -100.16 |
| PINAWA | Man. | -88.15 | 57.37 | -161.87 | -126.87 |
| PINE FALLS | Man. | -43.29 | 31.35 | -84.66 | -64.76 |
| PLUMAS | Man. | -85.27 | 39.48 | -137.13 | -112.27 |
| PLUM COULEE | Man. | -59.63 | 41.26 | -114.41 | -88.02 |
| PORTAGE LA PRAIRIE | Man. | -40.19 | 37.78 | -88.73 | -65.69 |
| RATHWELL | Man. | -77.66 | 47.87 | -141.34 | -110.59 |
| RIVERS | Man. | -61.68 | 45.01 | -120.80 | -92.46 |
| ROLAND | Man. | -71.00 | 40.70 | -124.57 | -98.84 |
| ROSSBURN | Man. | -68.15 | 66.57 | -156.53 | -113.95 |
| RUSSELL | Man. | -107.29 | 73.57 | -201.82 | -156.95 |
| SELKIRK | Man. | -38.32 | 39.76 | -90.85 | -65.60 |
| SEVEN SISTERS | Man. | -57.64 | 39.22 | -110.22 | -84.74 |
| SHILO | Man. | -104.02 | 43.83 | -162.97 | -134.35 |
| SOMSERSET | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SOURIS | Man. | -95.38 | 57.18 | -168.85 | -133.97 |
| SPRAGUE | Man. | -75.07 | 50.97 | -140.56 | -109.47 |
| ST. ALBANS | Man. | -112.88 | 54.90 | -184.82 | -150.38 |
| ST. BONIFACE | Man. | -105.29 | 81.25 | -212.81 | -161.03 |
| STARBUCK | Man. | -66.13 | 68.02 | -155.89 | -112.73 |
| STEINBACH | Man. | -47.09 | 47.56 | -109.57 | -79.62 |
| STONEWALL | Man. | -63.46 | 33.98 | -108.19 | -86.70 |
| STONY MNT. | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SWAN RIVER | Man. | -77.18 | 60.13 | -156.87 | -118.49 |
| THE PAS | Man. | -70.14 | 47.35 | -132.54 | -102.58 |

| | | | | | |
|---|---|---|---|---|---|
| VIRDEN | Man. | -81.24 | 50.59 | -147.58 | -115.79 |
| VOGAR | Man. | -46.49 | 24.48 | -79.06 | -63.33 |
| WASAGAMING | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| WASKADA | Man. | -118.01 | 71.33 | -209.68 | -166.16 |
| WILSON CREEK | Man. | -69.06 | 26.25 | -104.25 | -87.20 |
| WINNIPEG | Man. | -42.92 | 37.37 | -90.95 | -68.15 |

Table B33: Soil Moisture Amount at Maturity for Corn (mm)
Note: any value of 0.00 represents 14 years or less of data.

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 51.15 | 29.23 | 11.97 | 30.96 |
| ARRAN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| AYLSHAM | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| BANGOR | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| BROADVIEW | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| CANORA | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| CARDROSE | Sask. | 50.31 | 27.02 | 14.09 | 31.64 |
| CARLYLE | Sask. | 52.75 | 27.78 | 17.05 | 33.99 |
| CARON | Sask. | 38.30 | 19.52 | 13.22 | 25.13 |
| CEYLON | Sask. | 43.76 | 27.08 | 8.14 | 25.23 |
| COTE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| CUPAR | Sask. | 60.55 | 25.00 | 27.36 | 43.35 |
| DAFOE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| DAHINDA | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| DAVIDSON | Sask. | 28.59 | 19.13 | 4.00 | 15.67 |
| DAVIN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| DUVAL | Sask. | 32.33 | 15.82 | 11.24 | 21.43 |
| ESTEVAN | Sask. | 42.60 | 29.44 | 4.77 | 22.73 |
| FENWOOD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| FERTILE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| FOAMLAKE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| FORT QU'APPELLE | Sask. | 34.18 | 17.13 | 11.64 | 22.47 |
| FRANCIS | Sask. | 46.13 | 25.96 | 12.11 | 28.40 |
| GOOD SPRIT LAKE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| GRENFELL | Sask. | 56.91 | 39.50 | 4.85 | 29.85 |
| GUERNSEY | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| HUBBARD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| HUDSON BAY | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| HUMBOLT | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| INDIAN HEAD | Sask. | 62.85 | 35.26 | 17.54 | 39.05 |
| KAMSACK | Sask. | 52.97 | 25.54 | 18.73 | 35.32 |
| KELLIHER | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| KIPLING | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| KRISTNES | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| KUROKI | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LANGENBURG | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LEROSS | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LINTLAW | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LIPTON | Sask. | 81.67 | 53.33 | 10.38 | 44.87 |
| LUMSDEN | Sask. | 56.83 | 44.60 | -0.47 | 26.73 |
| MARYFIELD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| MELVILLE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| MIDALE | Sask. | 35.30 | 26.23 | 1.59 | 17.59 |
| MOOSEJAW | Sask. | 56.70 | 30.46 | 17.55 | 36.13 |
| MOOSOMIN | Sask. | 78.36 | 30.32 | 38.40 | 57.59 |
| MUENSTER | Sask. | 40.02 | 38.29 | -11.48 | 13.52 |
| NIPAWIN | Sask. | 63.45 | 25.74 | 28.94 | 45.67 |

| | | | | | |
|---|---|---|---|---|---|
| NOKOMIS | Sask. | 31.27 | 23.77 | 0.72 | 15.22 |
| ORMISTON | Sask. | 37.16 | 19.68 | 11.87 | 23.88 |
| OXBOW | Sask. | 62.77 | 41.30 | 8.12 | 34.44 |
| PASWEGIN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PELLY | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PORCUPINE PLAIN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PRAIRIE RIVER | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PRECCEVILLE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| QU'APPELLE | Sask. | 47.67 | 26.87 | 12.17 | 29.24 |
| RAYMORE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| REDVERS | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| REGINA | Sask. | 52.31 | 24.36 | 21.01 | 35.87 |
| RIDGEDALE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| ROCANVILLE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| SEMANS | Sask. | 31.27 | 28.19 | -5.67 | 12.02 |
| SOMME | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| STRASBOURG | Sask. | 31.03 | 24.62 | -0.61 | 14.41 |
| WAPELLA | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| WATROUS | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| WEYBURN | Sask. | 45.68 | 24.83 | 13.15 | 28.73 |
| WHITEWOOD | Sask. | 62.37 | 45.62 | 1.68 | 30.98 |
| WILCOX | Sask. | 70.67 | 56.02 | -3.57 | 32.19 |
| WISHART | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| WYNYARD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| YELLOW GRASS | Sask. | 42.33 | 27.59 | 6.88 | 23.71 |
| YORKTON | Sask. | 59.19 | 32.82 | 15.05 | 36.48 |
| ALTONA | Man. | 79.08 | 22.58 | 49.29 | 63.62 |
| ARORG | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| BALDUR | Man. | 90.01 | 37.88 | 39.62 | 63.95 |
| BEAUSEJOUR | Man. | 105.55 | 42.90 | 48.47 | 76.03 |
| BEDE | Man. | 72.60 | 39.76 | 19.58 | 45.20 |
| BINSCARTH | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| BIRCH RIVER | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| BIRTLE | Man. | 81.11 | 47.10 | 18.69 | 48.75 |
| BISSETT | Man. | 92.65 | 48.60 | 28.23 | 59.25 |
| BOISEVAIN | Man. | 77.10 | 39.59 | 24.64 | 49.90 |
| BRANDON | Man. | 79.74 | 35.52 | 34.10 | 55.76 |
| BROADVALLEY | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| CARBERRY | Man. | 60.62 | 40.98 | 5.51 | 32.27 |
| CYPRESS RIVER | Man. | 76.74 | 38.92 | 25.74 | 50.16 |
| DAUPHIN | Man. | 92.27 | 42.89 | 37.15 | 63.32 |
| DEERWOOD | Man. | 84.31 | 40.58 | 32.16 | 56.92 |
| DELORAINE | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| DELTA BEACH | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| DUGALD | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| EMERSON | Man. | 99.71 | 47.28 | 38.95 | 67.79 |
| ERIKSDALE | Man. | 88.78 | 56.76 | 12.44 | 49.51 |
| FRASERWOOD | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| GILBERT PLAIN | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| GIMLI | Man. | 119.31 | 51.95 | 50.33 | 83.57 |
| GLADSTONE | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| GLENBORO | Man. | 64.16 | 40.03 | 10.32 | 36.46 |

| | | | | | |
|---|---|---|---|---|---|
| GLENLEA | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| GRAND RAPIDS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| GRASS RIVER | Man. | 70.74 | 31.07 | 29.41 | 49.37 |
| GRAYSVILLE | Man. | 63.55 | 33.62 | 20.36 | 40.86 |
| GREAT FALLS | Man. | 106.10 | 46.21 | 46.72 | 74.91 |
| HAMIOTA | Man. | 68.28 | 25.74 | 35.21 | 50.91 |
| HARDING | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| HODGESON | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| INDIAN BAY | Man. | 76.45 | 39.65 | 24.46 | 49.37 |
| LANGRUTH | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| LUNDAR | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MACGREGOR | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MARQUETTE | Man. | 118.24 | 47.47 | 54.78 | 85.48 |
| MEADOW PORTAGE | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MELITA | Man. | 49.98 | 33.58 | 5.31 | 26.88 |
| MINNEDOSA | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MNT SIDE GOODLANDS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MOOSEHORN | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MORDEN | Man. | 79.56 | 35.06 | 34.51 | 55.90 |
| MORRIS | Man. | 82.72 | 38.68 | 33.01 | 56.61 |
| MYRTLE | Man. | 87.50 | 25.93 | 52.83 | 69.61 |
| NEEPAWA | Man. | 99.19 | 45.31 | 39.67 | 68.20 |
| NINETTE | Man. | 71.29 | 39.31 | 20.77 | 44.75 |
| NIVERVILLE | Man. | 100.06 | 37.47 | 50.10 | 74.24 |
| OAKNER | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| PEACE GARDENS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| PIERSON | Man. | 75.55 | 34.50 | 31.22 | 52.27 |
| PILOT MOUND | Man. | 89.39 | 41.35 | 34.25 | 60.90 |
| PINAWA | Man. | 81.36 | 56.28 | 7.29 | 42.87 |
| PINE FALLS | Man. | 105.53 | 57.32 | 28.91 | 65.98 |
| PLUMAS | Man. | 85.82 | 46.05 | 24.79 | 54.18 |
| PLUM COULEE | Man. | 95.74 | 40.31 | 42.22 | 68.01 |
| PORTAGE LA PRAIRIE | Man. | 120.69 | 42.99 | 65.45 | 91.67 |
| RATHWELL | Man. | 77.37 | 32.64 | 33.62 | 54.82 |
| RIVERS | Man. | 82.66 | 28.33 | 45.18 | 63.23 |
| ROLAND | Man. | 78.86 | 33.27 | 34.97 | 56.07 |
| ROSSBURN | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| RUSSELL | Man. | 74.06 | 30.51 | 33.16 | 52.98 |
| SELKIRK | Man. | 112.40 | 39.76 | 59.50 | 85.04 |
| SEVEN SISTERS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SHILO | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SOMSERSET | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SOURIS | Man. | 59.65 | 27.28 | 23.84 | 41.02 |
| SPRAGUE | Man. | 86.73 | 41.59 | 33.30 | 58.66 |
| ST. ALBANS | Man. | 47.84 | 35.11 | 1.80 | 23.86 |
| ST. BONIFACE | Man. | 77.04 | 41.59 | 21.70 | 48.42 |
| STARBUCK | Man. | 101.99 | 38.93 | 50.39 | 75.24 |
| STEINBACH | Man. | 121.22 | 46.07 | 60.35 | 89.62 |
| STONEWALL | Man. | 74.22 | 29.69 | 34.88 | 53.83 |
| STONY MNT. | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SWAN RIVER | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| THE PAS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | |
|---|---|---|---|---|---|
| VIRDEN | Man. | 84.27 | 41.44 | 29.44 | 55.84 |
| VOGAR | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| WASAGAMING | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| WASKADA | Man. | 58.16 | 36.14 | 11.72 | 33.77 |
| WILSON CREEK | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| WINNIPEG | Man. | 119.96 | 42.25 | 65.67 | 91.44 |

Table B34: Plant Moisture Stress at Maturity for Corn (mm)
Note: any value of 0.00 represents 14 years or less of data.

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | -156.29 | 58.00 | -234.04 | -196.36 |
| ARRAN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| AYLSHAM | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| BANGOR | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| BROADVIEW | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| CANORA | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| CARDROSE | Sask. | -187.38 | 67.78 | -278.25 | -234.22 |
| CARLYLE | Sask. | -167.09 | 83.11 | -273.89 | -223.19 |
| CARON | Sask. | -204.14 | 59.38 | -280.44 | -244.22 |
| CEYLON | Sask. | -169.88 | 87.76 | -285.28 | -229.91 |
| COTE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| CUPAR | Sask. | -184.02 | 100.05 | -316.86 | -252.85 |
| DAFOE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| DAHINDA | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| DAVIDSON | Sask. | -222.27 | 65.17 | -306.02 | -266.26 |
| DAVIN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| DUVAL | Sask. | -145.90 | 52.68 | -216.15 | -182.20 |
| ESTEVAN | Sask. | -146.30 | 55.83 | -218.04 | -183.99 |
| FENWOOD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| FERTILE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| FOAMLAKE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| FORT QU'APPELLE | Sask. | -266.02 | 61.80 | -347.36 | -308.29 |
| FRANCIS | Sask. | -214.69 | 86.46 | -327.99 | -273.74 |
| GOOD SPRIT LAKE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| GRENFELL | Sask. | -164.24 | 73.63 | -261.28 | -214.68 |
| GUERNSEY | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| HUBBARD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| HUDSON BAY | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| HUMBOLT | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| INDIAN HEAD | Sask. | -142.56 | 76.53 | -240.90 | -194.22 |
| KAMSACK | Sask. | -180.46 | 85.05 | -294.47 | -239.22 |
| KELLIHER | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| KIPLING | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| KRISTNES | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| KUROKI | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LANGENBURG | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LEROSS | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LINTLAW | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LIPTON | Sask. | -135.65 | 75.61 | -236.72 | -187.82 |
| LUMSDEN | Sask. | -203.08 | 84.02 | -311.05 | -259.80 |
| MARYFIELD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| MELVILLE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| MIDALE | Sask. | -183.86 | 63.90 | -265.97 | -226.99 |
| MOOSEJAW | Sask. | -158.92 | 59.14 | -234.91 | -198.84 |
| MOOSOMIN | Sask. | -93.09 | 62.17 | -175.02 | -135.68 |
| MUENSTER | Sask. | -196.98 | 46.24 | -259.17 | -228.98 |
| NIPAWIN | Sask. | -178.83 | 92.05 | -302.23 | -242.43 |

| | | | | | |
|---|---|---|---|---|---|
| NOKOMIS | Sask. | -228.56 | 77.40 | -328.02 | -280.80 |
| ORMISTON | Sask. | -186.35 | 75.98 | -283.99 | -237.64 |
| OXBOW | Sask. | -192.90 | 101.84 | -327.65 | -262.76 |
| PASWEGIN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PELLY | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PORCUPINE PLAIN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PRAIRIE RIVER | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PRECCEVILLE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| QU'APPELLE | Sask. | -162.31 | 67.23 | -251.13 | -208.43 |
| RAYMORE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| REDVERS | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| REGINA | Sask. | -178.17 | 71.52 | -270.08 | -226.45 |
| RIDGEDALE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| ROCANVILLE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| SEMANS | Sask. | -219.15 | 75.34 | -317.87 | -270.60 |
| SOMME | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| STRASBOURG | Sask. | -188.02 | 72.83 | -281.61 | -237.18 |
| WAPELLA | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| WATROUS | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| WEYBURN | Sask. | -158.26 | 69.29 | -249.06 | -205.58 |
| WHITEWOOD | Sask. | -155.46 | 77.07 | -258.00 | -208.49 |
| WILCOX | Sask. | -201.86 | 90.31 | -321.55 | -263.90 |
| WISHART | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| WYNYARD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| YELLOW GRASS | Sask. | -181.67 | 75.93 | -279.25 | -232.93 |
| YORKTON | Sask. | -141.27 | 79.26 | -247.87 | -196.11 |
| ALTONA | Man. | -73.99 | 47.29 | -136.39 | -106.39 |
| ARORG | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| BALDUR | Man. | -87.74 | 50.47 | -154.89 | -122.47 |
| BEAUSEJOUR | Man. | -66.53 | 46.41 | -128.27 | -98.46 |
| BEDE | Man. | -103.20 | 71.50 | -198.54 | -152.46 |
| BINSCARTH | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| BIRCH RIVER | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| BIRTLE | Man. | -136.75 | 73.41 | -234.04 | -187.18 |
| BISSETT | Man. | -62.53 | 28.68 | -100.55 | -82.24 |
| BOISEVAIN | Man. | -78.25 | 46.25 | -139.55 | -110.03 |
| BRANDON | Man. | -109.44 | 57.44 | -183.25 | -148.21 |
| BROADVALLEY | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| CARBERRY | Man. | -128.97 | 53.53 | -200.97 | -166.02 |
| CYPRESS RIVER | Man. | -87.09 | 55.76 | -160.15 | -125.17 |
| DAUPHIN | Man. | -90.12 | 61.62 | -169.30 | -131.71 |
| DEERWOOD | Man. | -62.72 | 44.31 | -119.67 | -92.64 |
| DELORAINE | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| DELTA BEACH | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| DUGALD | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| EMERSON | Man. | -74.48 | 55.00 | -145.15 | -111.60 |
| ERIKSDALE | Man. | -101.87 | 57.99 | -179.86 | -142.00 |
| FRASERWOOD | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| GILBERT PLAIN | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| GIMLI | Man. | -43.03 | 26.23 | -77.86 | -61.08 |
| GLADSTONE | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| GLENBORO | Man. | -117.86 | 43.88 | -176.88 | -148.22 |

| | | | | | |
|---|---|---|---|---|---|
| GLENLEA | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| GRAND RAPIDS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| GRASS RIVER | Man. | -113.95 | 56.39 | -188.97 | -152.74 |
| GRAYSVILLE | Man. | -104.27 | 61.01 | -182.66 | -145.45 |
| GREAT FALLS | Man. | -62.75 | 66.43 | -148.11 | -107.59 |
| HAMIOTA | Man. | -130.91 | 74.22 | -226.29 | -181.01 |
| HARDING | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| HODGESON | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| INDIAN BAY | Man. | -66.16 | 34.88 | -111.91 | -89.99 |
| LANGRUTH | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| LUNDAR | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MACGREGOR | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MARQUETTE | Man. | -49.04 | 51.02 | -117.25 | -84.25 |
| MEADOW PORTAGE | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MELITA | Man. | -121.56 | 51.66 | -190.28 | -157.10 |
| MINNEDOSA | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MNT SIDE GOODLANDS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MOOSEHORN | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MORDEN | Man. | -73.22 | 45.67 | -131.91 | -104.05 |
| MORRIS | Man. | -89.18 | 53.21 | -157.56 | -125.10 |
| MYRTLE | Man. | -80.59 | 56.50 | -156.12 | -119.58 |
| NEEPAWA | Man. | -71.37 | 44.71 | -130.11 | -101.95 |
| NINETTE | Man. | -93.21 | 61.32 | -172.01 | -134.60 |
| NIVERVILLE | Man. | -92.73 | 67.34 | -182.52 | -139.13 |
| OAKNER | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| PEACE GARDENS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| PIERSON | Man. | -120.02 | 78.93 | -221.44 | -173.29 |
| PILOT MOUND | Man. | -82.51 | 50.78 | -150.22 | -117.50 |
| PINAWA | Man. | -107.61 | 69.14 | -198.62 | -154.90 |
| PINE FALLS | Man. | -50.20 | 41.55 | -105.75 | -78.87 |
| PLUMAS | Man. | -107.74 | 42.69 | -164.31 | -137.07 |
| PLUM COULEE | Man. | -68.69 | 45.36 | -128.91 | -99.89 |
| PORTAGE LA PRAIRIE | Man. | -47.46 | 43.72 | -103.64 | -76.97 |
| RATHWELL | Man. | -87.98 | 55.95 | -162.98 | -126.64 |
| RIVERS | Man. | -78.86 | 55.38 | -152.13 | -116.84 |
| ROLAND | Man. | -84.72 | 48.17 | -148.28 | -117.72 |
| ROSSBURN | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| RUSSELL | Man. | -120.72 | 78.59 | -226.07 | -175.02 |
| SELKIRK | Man. | -42.82 | 45.94 | -103.93 | -74.42 |
| SEVEN SISTERS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SHILO | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SOMSERSET | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SOURIS | Man. | -113.49 | 50.45 | -179.70 | -147.94 |
| SPRAGUE | Man. | -87.93 | 57.18 | -161.40 | -126.52 |
| ST. ALBANS | Man. | -133.19 | 61.34 | -213.64 | -175.09 |
| ST. BONIFACE | Man. | -126.66 | 96.38 | -254.87 | -192.96 |
| STARBUCK | Man. | -83.25 | 79.66 | -188.82 | -137.97 |
| STEINBACH | Man. | -47.06 | 34.98 | -93.28 | -71.06 |
| STONEWALL | Man. | -79.85 | 36.52 | -128.24 | -104.93 |
| STONY MNT. | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SWAN RIVER | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| THE PAS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | |
|---|---|---|---|---|---|
| VIRDEN | Man. | -99.68 | 65.48 | -186.32 | -144.60 |
| VOGAR | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| WASAGAMING | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| WASKADA | Man. | -142.96 | 83.82 | -250.67 | -199.54 |
| WILSON CREEK | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| WINNIPEG | Man. | -48.58 | 41.39 | -101.77 | -76.52 |

Table B35: Accumulated Actual Evapotranspiration to Maturity for Corn (mm)
Note: any value of 0.00 represents 14 years or less of data.

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 265.59 | 60.07 | 346.13 | 307.10 |
| ARRAN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| AYLSHAM | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| BANGOR | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| BROADVIEW | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| CANORA | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| CARDROSE | Sask. | 257.96 | 69.26 | 350.82 | 305.82 |
| CARLYLE | Sask. | 276.87 | 64.63 | 359.92 | 320.50 |
| CARON | Sask. | 246.10 | 65.62 | 330.42 | 290.40 |
| CEYLON | Sask. | 260.84 | 62.90 | 343.56 | 303.87 |
| COTE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| CUPAR | Sask. | 266.54 | 83.75 | 377.73 | 324.15 |
| DAFOE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| DAHINDA | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| DAVIDSON | Sask. | 226.96 | 59.23 | 303.08 | 266.95 |
| DAVIN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| DUVAL | Sask. | 240.85 | 53.06 | 311.60 | 277.41 |
| ESTEVAN | Sask. | 258.10 | 53.86 | 327.31 | 294.45 |
| FENWOOD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| FERTILE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| FOAMLAKE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| FORT QU'APPELLE | Sask. | 193.61 | 68.60 | 283.91 | 240.54 |
| FRANCIS | Sask. | 256.64 | 78.26 | 359.19 | 310.09 |
| GOOD SPRIT LAKE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| GRENFELL | Sask. | 270.84 | 76.06 | 371.07 | 322.94 |
| GUERNSEY | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| HUBBARD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| HUDSON BAY | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| HUMBOLT | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| INDIAN HEAD | Sask. | 279.51 | 68.30 | 367.27 | 325.61 |
| KAMSACK | Sask. | 254.12 | 69.59 | 347.41 | 302.20 |
| KELLIHER | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| KIPLING | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| KRISTNES | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| KUROKI | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LANGENBURG | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LEROSS | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LINTLAW | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LIPTON | Sask. | 312.42 | 75.63 | 413.52 | 364.61 |
| LUMSDEN | Sask. | 242.70 | 80.11 | 345.64 | 296.77 |
| MARYFIELD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| MELVILLE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| MIDALE | Sask. | 253.50 | 56.97 | 326.71 | 291.96 |
| MOOSEJAW | Sask. | 257.30 | 61.86 | 336.79 | 299.06 |
| MOOSOMIN | Sask. | 318.46 | 65.37 | 404.61 | 363.24 |
| MUENSTER | Sask. | 227.37 | 49.31 | 293.70 | 261.50 |

| | | | | | |
|---|---|---|---|---|---|
| NIPAWIN | Sask. | 243.93 | 88.07 | 362.01 | 304.79 |
| NOKOMIS | Sask. | 220.30 | 70.59 | 311.01 | 267.95 |
| ORMISTON | Sask. | 231.52 | 66.33 | 316.76 | 276.29 |
| OXBOW | Sask. | 262.89 | 76.95 | 364.71 | 315.68 |
| PASWEGIN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PELLY | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PORCUPINE PLAIN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PRAIRIE RIVER | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PRECCEVILLE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| QU'APPELLE | Sask. | 269.47 | 65.74 | 356.33 | 314.57 |
| RAYMORE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| REDVERS | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| REGINA | Sask. | 257.55 | 64.66 | 340.64 | 301.19 |
| RIDGEDALE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| ROCANVILLE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| SEMANS | Sask. | 223.08 | 56.56 | 297.19 | 261.71 |
| SOMME | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| STRASBOURG | Sask. | 239.91 | 63.86 | 321.96 | 283.01 |
| WAPELLA | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| WATROUS | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| WEYBURN | Sask. | 261.44 | 65.45 | 347.20 | 306.14 |
| WHITEWOOD | Sask. | 271.81 | 70.62 | 365.76 | 320.39 |
| WILCOX | Sask. | 253.78 | 79.78 | 359.51 | 308.59 |
| WISHART | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| WYNYARD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| YELLOW GRASS | Sask. | 272.53 | 70.10 | 362.60 | 319.84 |
| YORKTON | Sask. | 275.24 | 68.58 | 367.49 | 322.70 |
| ALTONA | Man. | 301.89 | 36.46 | 350.00 | 326.87 |
| ARORG | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| BALDUR | Man. | 331.80 | 41.00 | 386.35 | 360.01 |
| BEAUSEJOUR | Man. | 344.38 | 39.14 | 396.46 | 371.31 |
| BEDE | Man. | 311.81 | 59.10 | 390.62 | 352.53 |
| BINSCARTH | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| BIRCH RIVER | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| BIRTLE | Man. | 293.38 | 64.96 | 379.47 | 338.00 |
| BISSETT | Man. | 302.88 | 38.15 | 353.44 | 329.09 |
| BOISEVAIN | Man. | 311.43 | 46.73 | 373.35 | 343.53 |
| BRANDON | Man. | 313.11 | 46.54 | 372.91 | 344.53 |
| BROADVALLEY | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| CARBERRY | Man. | 274.52 | 41.41 | 330.22 | 303.18 |
| CYPRESS RIVER | Man. | 318.37 | 48.26 | 381.61 | 351.34 |
| DAUPHIN | Man. | 301.98 | 56.88 | 375.07 | 340.37 |
| DEERWOOD | Man. | 309.80 | 47.63 | 371.00 | 341.95 |
| DELORAINE | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| DELTA BEACH | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| DUGALD | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| EMERSON | Man. | 315.66 | 42.20 | 369.89 | 344.15 |
| ERIKSDALE | Man. | 304.16 | 51.93 | 374.00 | 340.09 |
| FRASERWOOD | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| GILBERT PLAIN | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| GIMLI | Man. | 309.27 | 22.63 | 339.32 | 324.84 |
| GLADSTONE | Man. | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | |
|---|---|---|---|---|---|
| GLENBORO | Man. | 293.85 | 41.92 | 350.23 | 322.86 |
| GLENLEA | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| GRAND RAPIDS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| GRASS RIVER | Man. | 304.35 | 47.19 | 367.13 | 336.81 |
| GRAYSVILLE | Man. | 301.12 | 66.53 | 386.61 | 346.03 |
| GREAT FALLS | Man. | 271.54 | 67.14 | 357.82 | 316.86 |
| HAMIOTA | Man. | 292.58 | 61.71 | 371.89 | 334.24 |
| HARDING | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| HODGESON | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| INDIAN BAY | Man. | 305.02 | 37.64 | 354.39 | 330.73 |
| LANGRUTH | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| LUNDAR | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MACGREGOR | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MARQUETTE | Man. | 329.48 | 48.03 | 393.68 | 362.62 |
| MEADOW PORTAGE | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MELITA | Man. | 311.26 | 29.39 | 350.36 | 331.48 |
| MINNEDOSA | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MNT SIDE GOODLANDS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MOOSEHORN | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MORDEN | Man. | 290.28 | 40.95 | 342.90 | 317.92 |
| MORRIS | Man. | 280.82 | 65.85 | 365.44 | 325.27 |
| MYRTLE | Man. | 330.64 | 50.91 | 398.70 | 365.77 |
| NEEPAWA | Man. | 318.62 | 38.81 | 369.61 | 345.17 |
| NINETTE | Man. | 301.31 | 60.03 | 378.44 | 341.82 |
| NIVERVILLE | Man. | 318.11 | 63.45 | 402.71 | 361.83 |
| OAKNER | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| PEACE GARDENS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| PIERSON | Man. | 302.89 | 67.65 | 389.82 | 348.55 |
| PILOT MOUND | Man. | 321.38 | 47.27 | 384.41 | 353.95 |
| PINAWA | Man. | 266.31 | 75.24 | 365.34 | 317.77 |
| PINE FALLS | Man. | 320.17 | 31.82 | 362.70 | 342.12 |
| PLUMAS | Man. | 306.37 | 43.20 | 363.62 | 336.05 |
| PLUM COULEE | Man. | 318.54 | 43.47 | 376.25 | 348.45 |
| PORTAGE LA PRAIRIE | Man. | 323.39 | 41.56 | 376.80 | 351.44 |
| RATHWELL | Man. | 307.94 | 54.37 | 380.82 | 345.51 |
| RIVERS | Man. | 313.23 | 41.78 | 368.51 | 341.89 |
| ROLAND | Man. | 307.16 | 39.94 | 359.86 | 334.52 |
| ROSSBURN | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| RUSSELL | Man. | 293.52 | 73.10 | 391.51 | 344.03 |
| SELKIRK | Man. | 315.72 | 39.67 | 368.49 | 343.01 |
| SEVEN SISTERS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SHILO | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SOMSERSET | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SOURIS | Man. | 294.61 | 44.01 | 352.37 | 324.67 |
| SPRAGUE | Man. | 336.98 | 49.11 | 400.08 | 370.13 |
| ST. ALBANS | Man. | 268.87 | 50.89 | 335.61 | 303.63 |
| ST. BONIFACE | Man. | 236.78 | 88.64 | 354.71 | 297.77 |
| STARBUCK | Man. | 330.03 | 66.79 | 418.55 | 375.91 |
| STEINBACH | Man. | 335.67 | 32.61 | 378.75 | 358.04 |
| STONEWALL | Man. | 316.10 | 41.48 | 371.08 | 344.60 |
| STONY MNT. | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SWAN RIVER | Man. | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | |
|---|---|---|---|---|---|
| THE PAS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| VIRDEN | Man. | 300.48 | 57.13 | 376.08 | 339.67 |
| VOGAR | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| WASAGAMING | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| WASKADA | Man. | 281.83 | 75.17 | 378.42 | 332.57 |
| WILSON CREEK | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| WINNIPEG | Man. | 321.21 | 40.31 | 373.01 | 348.42 |

Table B36: Accumulated Precipitation to Maturity for Corn (mm)
Note: any value of 0.00 represents 14 years or less of data.

| Station | | Mean | Std. | 10% | 25% |
|---|---|---|---|---|---|
| AMULET | Sask. | 205.95 | 71.13 | 110.59 | 156.80 |
| ARRAN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| AYLSHAM | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| BANGOR | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| BROADVIEW | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| CANORA | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| CARDROSE | Sask. | 216.68 | 89.36 | 96.88 | 154.93 |
| CARLYLE | Sask. | 225.77 | 82.37 | 119.92 | 170.17 |
| CARON | Sask. | 184.51 | 59.59 | 107.94 | 144.29 |
| CEYLON | Sask. | 201.72 | 87.76 | 86.32 | 141.69 |
| COTE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| CUPAR | Sask. | 209.89 | 83.15 | 99.49 | 152.68 |
| DAFOE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| DAHINDA | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| DAVIDSON | Sask. | 191.64 | 72.79 | 98.10 | 142.50 |
| DAVIN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| DUVAL | Sask. | 195.95 | 74.17 | 97.05 | 144.84 |
| ESTEVAN | Sask. | 227.63 | 89.34 | 112.84 | 167.33 |
| FENWOOD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| FERTILE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| FOAMLAKE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| FORT QU'APPELLE | Sask. | 144.00 | 76.33 | 43.53 | 91.79 |
| FRANCIS | Sask. | 211.08 | 76.31 | 111.09 | 158.96 |
| GOOD SPRIT LAKE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| GRENFELL | Sask. | 203.36 | 83.15 | 93.79 | 146.40 |
| GUERNSEY | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| HUBBARD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| HUDSON BAY | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| HUMBOLT | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| INDIAN HEAD | Sask. | 217.31 | 84.25 | 109.05 | 160.44 |
| KAMSACK | Sask. | 191.32 | 76.03 | 89.39 | 138.78 |
| KELLIHER | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| KIPLING | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| KRISTNES | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| KUROKI | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LANGENBURG | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LEROSS | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LINTLAW | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| LIPTON | Sask. | 242.32 | 72.09 | 145.96 | 192.58 |
| LUMSDEN | Sask. | 192.72 | 81.66 | 87.79 | 137.60 |
| MARYFIELD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| MELVILLE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| MIDALE | Sask. | 213.66 | 81.62 | 108.77 | 158.56 |
| MOOSEJAW | Sask. | 182.53 | 70.17 | 92.37 | 135.17 |
| MOOSOMIN | Sask. | 272.24 | 104.54 | 134.47 | 200.63 |
| MUENSTER | Sask. | 191.95 | 60.26 | 110.89 | 150.24 |
| NIPAWIN | Sask. | 184.96 | 80.82 | 76.61 | 129.11 |

| | | | | | |
|---|---|---|---|---|---|
| NOKOMIS | Sask. | 189.12 | 83.60 | 81.70 | 132.69 |
| ORMISTON | Sask. | 179.87 | 80.91 | 75.90 | 125.25 |
| OXBOW | Sask. | 224.32 | 82.93 | 114.58 | 167.42 |
| PASWEGIN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PELLY | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PORCUPINE PLAIN | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PRAIRIE RIVER | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| PRECCEVILLE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| QU'APPELLE | Sask. | 211.13 | 79.41 | 106.21 | 156.65 |
| RAYMORE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| REDVERS | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| REGINA | Sask. | 194.71 | 70.84 | 103.68 | 146.89 |
| RIDGEDALE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| ROCANVILLE | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| SEMANS | Sask. | 187.41 | 75.32 | 88.70 | 135.96 |
| SOMME | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| STRASBOURG | Sask. | 198.49 | 77.68 | 98.68 | 146.06 |
| WAPELLA | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| WATROUS | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| WEYBURN | Sask. | 205.09 | 89.92 | 87.26 | 143.67 |
| WHITEWOOD | Sask. | 206.47 | 81.21 | 98.43 | 150.59 |
| WILCOX | Sask. | 201.99 | 88.02 | 85.34 | 141.52 |
| WISHART | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| WYNYARD | Sask. | 0.00 | 0.00 | 0.00 | 0.00 |
| YELLOW GRASS | Sask. | 214.99 | 84.13 | 106.88 | 158.20 |
| YORKTON | Sask. | 231.29 | 109.79 | 83.62 | 155.31 |
| ALTONA | Man. | 232.10 | 62.61 | 149.48 | 189.21 |
| ARORG | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| BALDUR | Man. | 267.58 | 82.83 | 157.38 | 210.59 |
| BEAUSEJOUR | Man. | 282.70 | 74.50 | 183.59 | 231.44 |
| BEDE | Man. | 254.94 | 106.92 | 112.38 | 181.27 |
| BINSCARTH | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| BIRCH RIVER | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| BIRTLE | Man. | 244.20 | 90.19 | 124.67 | 182.24 |
| BISSETT | Man. | 265.56 | 98.12 | 135.51 | 198.14 |
| BOISEVAIN | Man. | 275.00 | 92.97 | 151.79 | 211.13 |
| BRANDON | Man. | 257.83 | 90.99 | 140.91 | 196.41 |
| BROADVALLEY | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| CARBERRY | Man. | 255.25 | 77.27 | 151.31 | 201.77 |
| CYPRESS RIVER | Man. | 262.70 | 97.68 | 134.69 | 195.98 |
| DAUPHIN | Man. | 244.31 | 106.24 | 107.79 | 172.60 |
| DEERWOOD | Man. | 281.10 | 124.18 | 121.53 | 197.28 |
| DELORAINE | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| DELTA BEACH | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| DUGALD | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| EMERSON | Man. | 264.51 | 90.13 | 148.70 | 203.68 |
| ERIKSDALE | Man. | 277.44 | 144.11 | 83.61 | 177.71 |
| FRASERWOOD | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| GILBERT PLAIN | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| GIMLI | Man. | 274.10 | 102.58 | 137.90 | 203.52 |
| GLADSTONE | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| GLENBORO | Man. | 283.33 | 110.89 | 134.18 | 206.59 |

| | | | | | |
|---|---|---|---|---|---|
| GLENLEA | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| GRAND RAPIDS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| GRASS RIVER | Man. | 221.84 | 72.56 | 125.31 | 171.92 |
| GRAYSVILLE | Man. | 236.77 | 92.77 | 117.56 | 174.15 |
| GREAT FALLS | Man. | 219.54 | 100.49 | 90.41 | 151.71 |
| HAMIOTA | Man. | 231.04 | 70.77 | 140.09 | 183.27 |
| HARDING | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| HODGESON | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| INDIAN BAY | Man. | 319.04 | 98.93 | 189.31 | 251.48 |
| LANGRUTH | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| LUNDAR | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MACGREGOR | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MARQUETTE | Man. | 276.86 | 88.56 | 158.47 | 215.75 |
| MEADOW PORTAGE | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MELITA | Man. | 301.10 | 97.05 | 171.98 | 234.32 |
| MINNEDOSA | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MNT SIDE GOODLANDS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MOOSEHORN | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| MORDEN | Man. | 239.68 | 83.26 | 132.69 | 183.48 |
| MORRIS | Man. | 204.42 | 78.23 | 103.89 | 151.61 |
| MYRTLE | Man. | 239.01 | 68.87 | 146.94 | 191.49 |
| NEEPAWA | Man. | 263.17 | 100.15 | 131.61 | 194.67 |
| NINETTE | Man. | 249.79 | 99.62 | 121.77 | 182.54 |
| NIVERVILLE | Man. | 261.37 | 78.81 | 156.29 | 207.07 |
| OAKNER | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| PEACE GARDENS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| PIERSON | Man. | 232.24 | 90.74 | 115.64 | 170.99 |
| PILOT MOUND | Man. | 274.35 | 94.99 | 147.69 | 208.90 |
| PINAWA | Man. | 219.23 | 131.83 | 45.70 | 129.05 |
| PINE FALLS | Man. | 276.99 | 101.71 | 141.03 | 206.81 |
| PLUMAS | Man. | 251.54 | 99.13 | 120.16 | 183.44 |
| PLUM COULEE | Man. | 234.72 | 86.78 | 119.50 | 175.02 |
| PORTAGE LA PRAIRIE | Man. | 264.72 | 94.49 | 143.30 | 200.94 |
| RATHWELL | Man. | 249.97 | 94.63 | 123.11 | 184.58 |
| RIVERS | Man. | 255.73 | 91.09 | 135.20 | 193.24 |
| ROLAND | Man. | 238.44 | 84.43 | 127.04 | 180.60 |
| ROSSBURN | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| RUSSELL | Man. | 227.29 | 98.42 | 95.35 | 159.28 |
| SELKIRK | Man. | 258.36 | 65.63 | 171.05 | 213.21 |
| SEVEN SISTERS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SHILO | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SOMSERSET | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SOURIS | Man. | 228.37 | 81.09 | 121.93 | 172.98 |
| SPRAGUE | Man. | 313.98 | 102.03 | 182.88 | 245.12 |
| ST. ALBANS | Man. | 238.20 | 89.59 | 120.72 | 177.01 |
| ST. BONIFACE | Man. | 192.35 | 87.38 | 76.10 | 132.23 |
| STARBUCK | Man. | 265.50 | 91.75 | 143.90 | 202.47 |
| STEINBACH | Man. | 285.17 | 79.37 | 180.31 | 230.72 |
| STONEWALL | Man. | 249.92 | 70.52 | 156.46 | 201.47 |
| STONY MNT. | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| SWAN RIVER | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| THE PAS | Man. | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | |
|---|---|---|---|---|---|
| VIRDEN | Man. | 234.20 | 93.37 | 110.65 | 170.15 |
| VOGAR | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| WASAGAMING | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| WASKADA | Man. | 225.66 | 95.38 | 103.10 | 161.28 |
| WILSON CREEK | Man. | 0.00 | 0.00 | 0.00 | 0.00 |
| WINNIPEG | Man. | 261.41 | 87.22 | 149.34 | 202.54 |

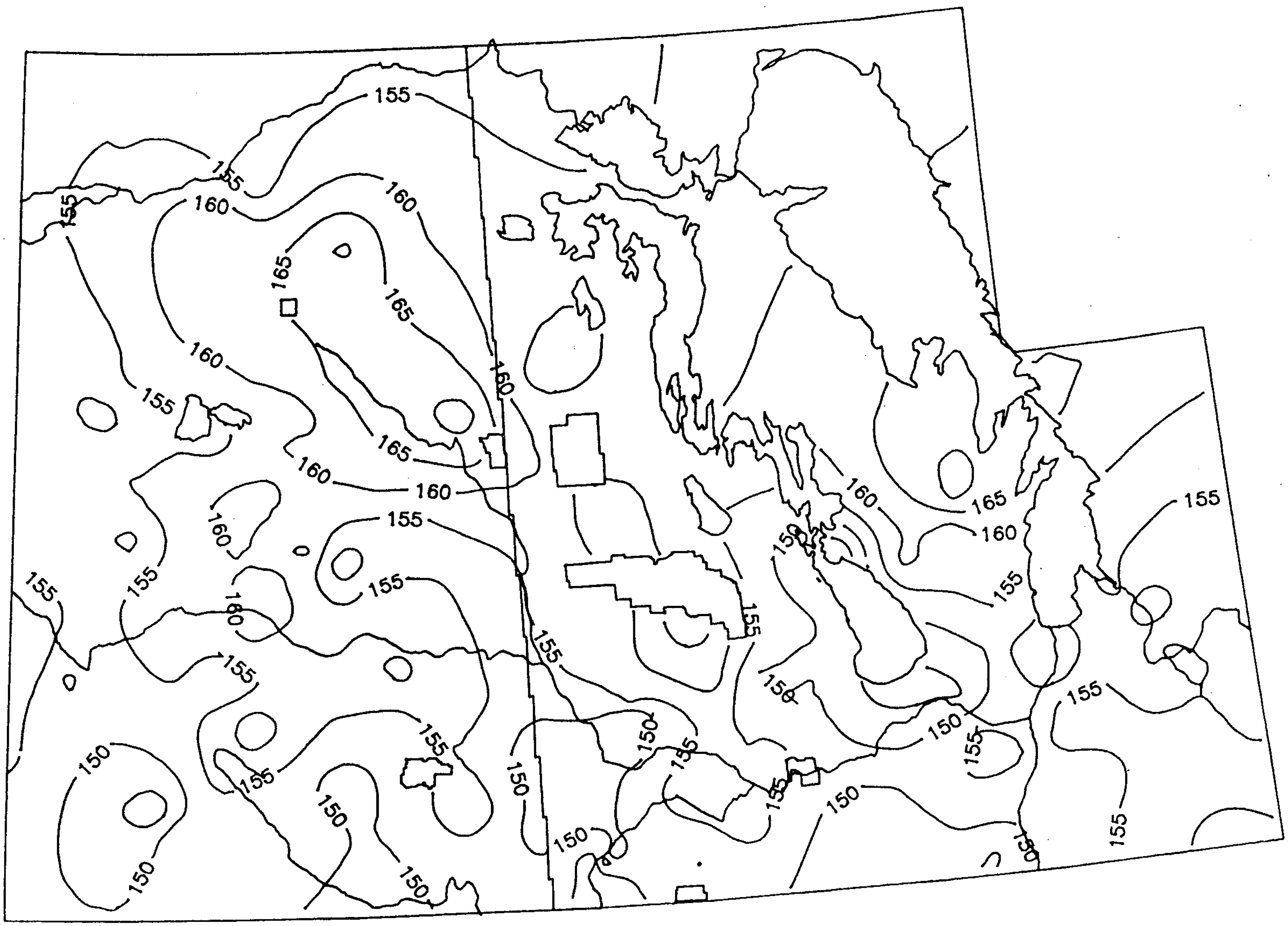


Figure 1: Dates after which the Risk of Occurrence of the Last Spring Frost of 0°C has been reduced to 25%

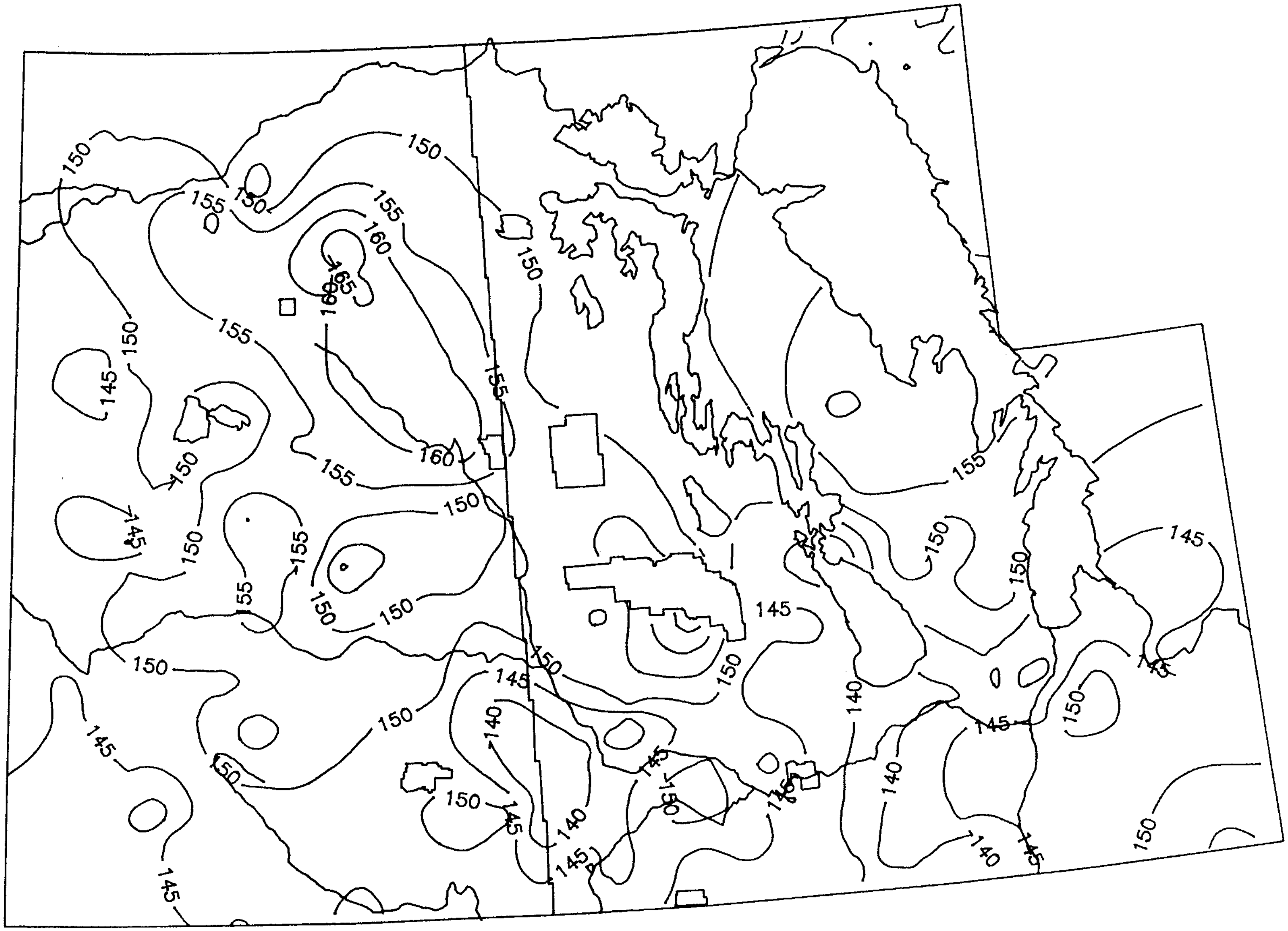


Figure 2: Dates after which the Risk of Occurrence of the Last Spring Frost of -2.2°C has been reduced to 10%

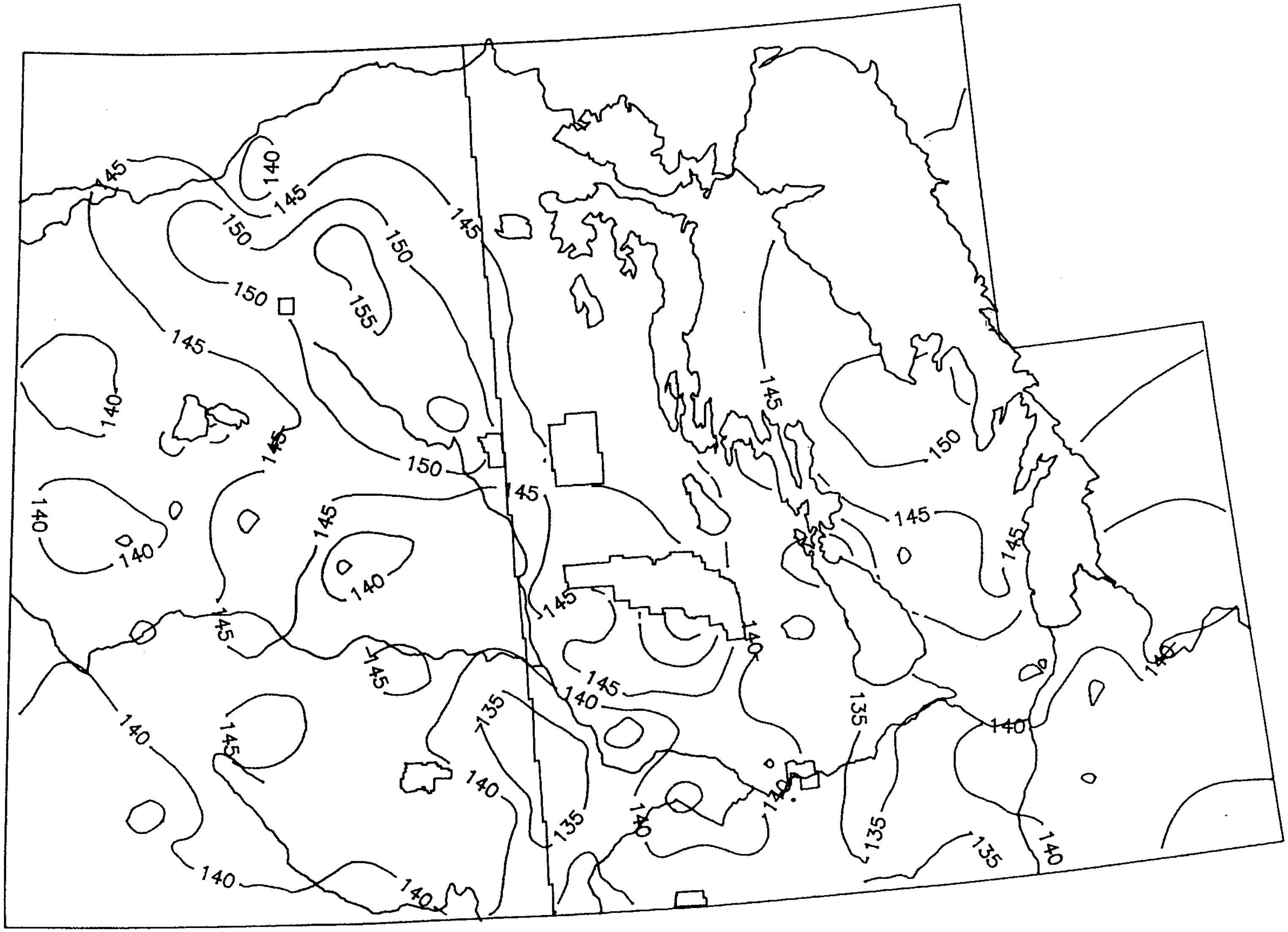


Figure 3: Dates after which the Risk of Occurrence of the Last Spring Frost of -2.2°C has been reduced to 25%

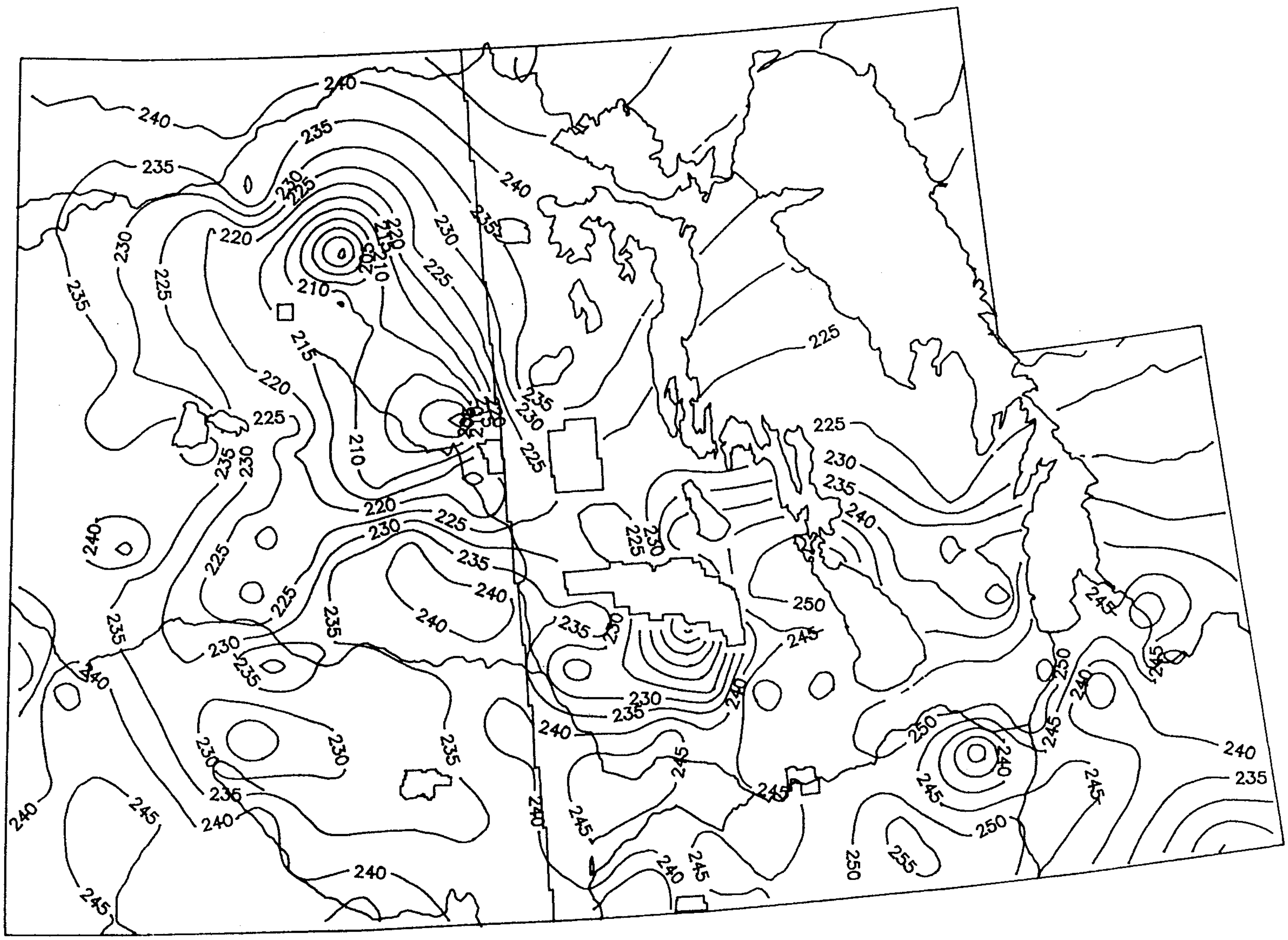


Figure 4: Dates before which the occurrence of the First Fall Frost (0°C) is at a 10% Risk

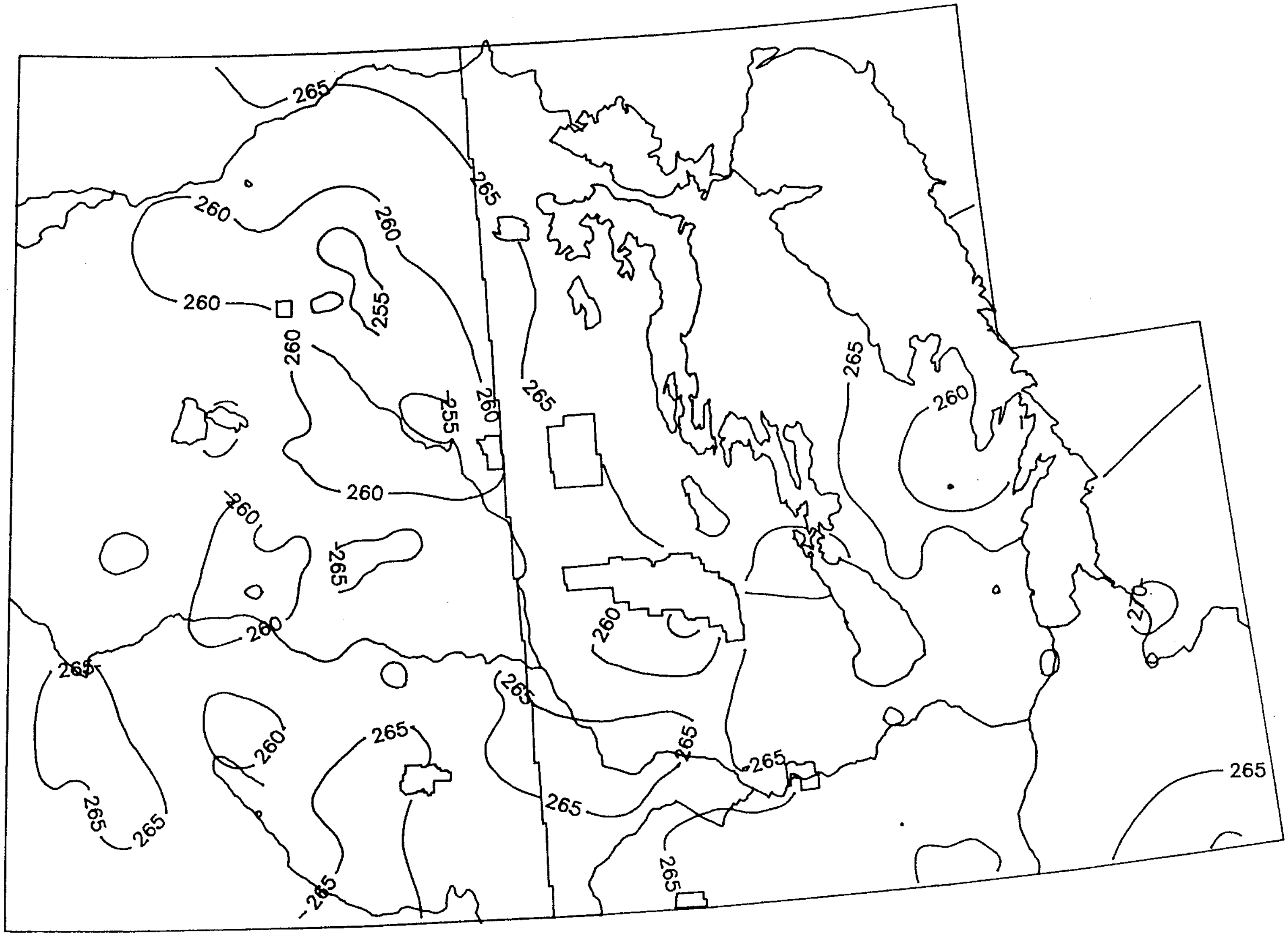


Figure 5: Average Date of Occurrence of the First Fall Frost at −2.2°C

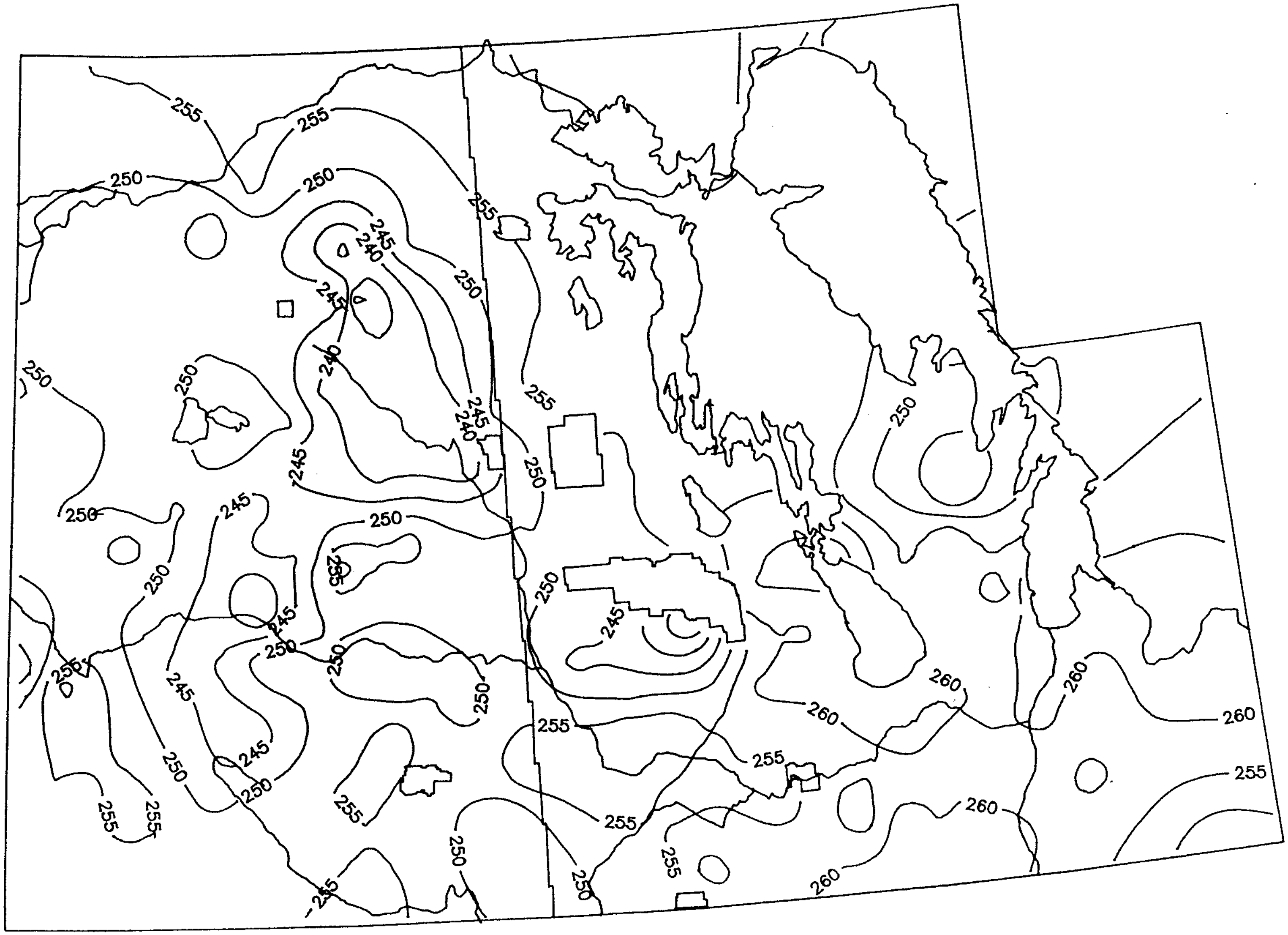


Figure 6: Dates before which the occurrence of the First Fall Frost (-2.2°C) is at a 10% Risk

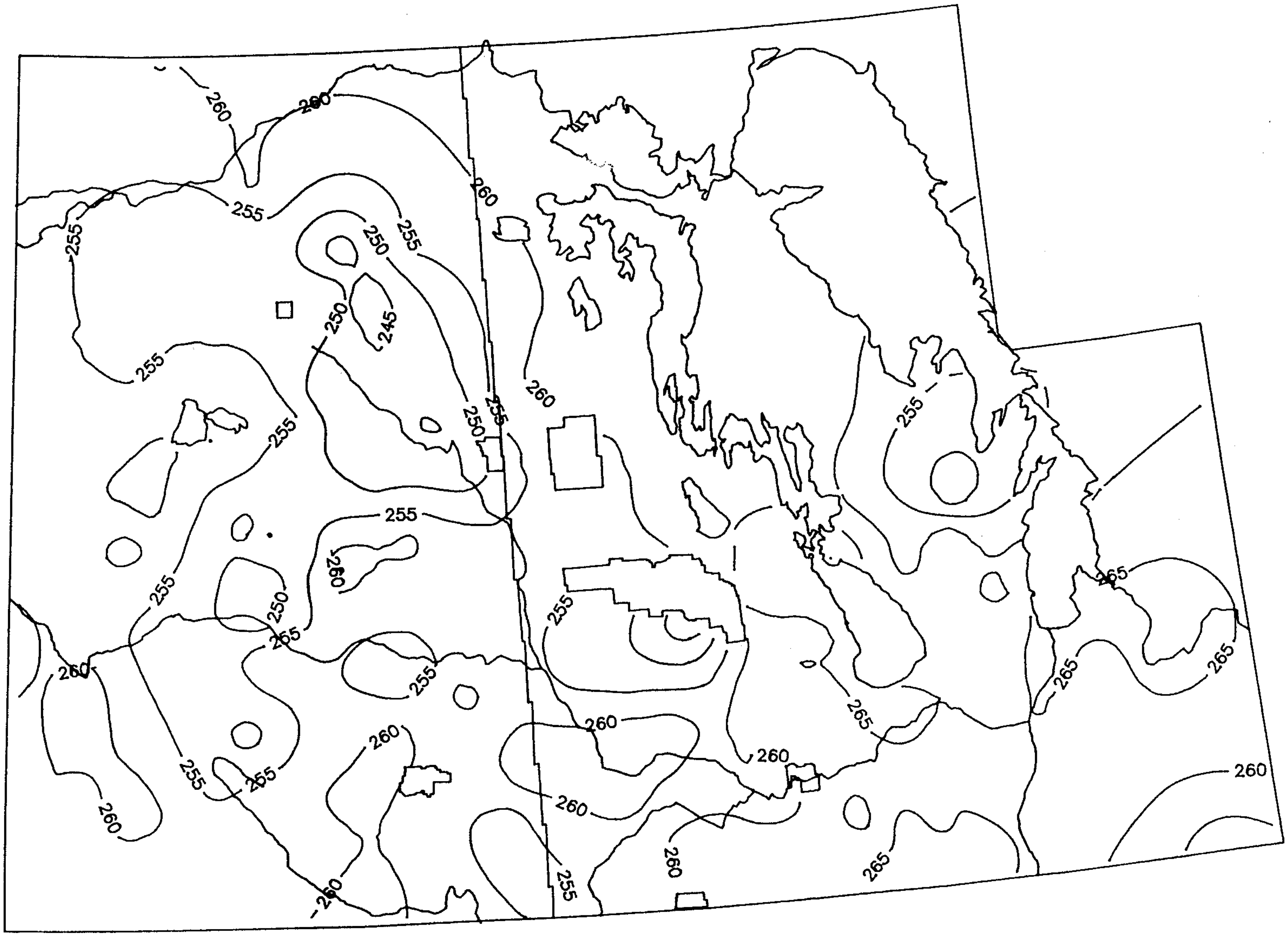


Figure 7: Dates before which the occurrence of the First Fall Frost (-2.2°C) is at a 25% Risk

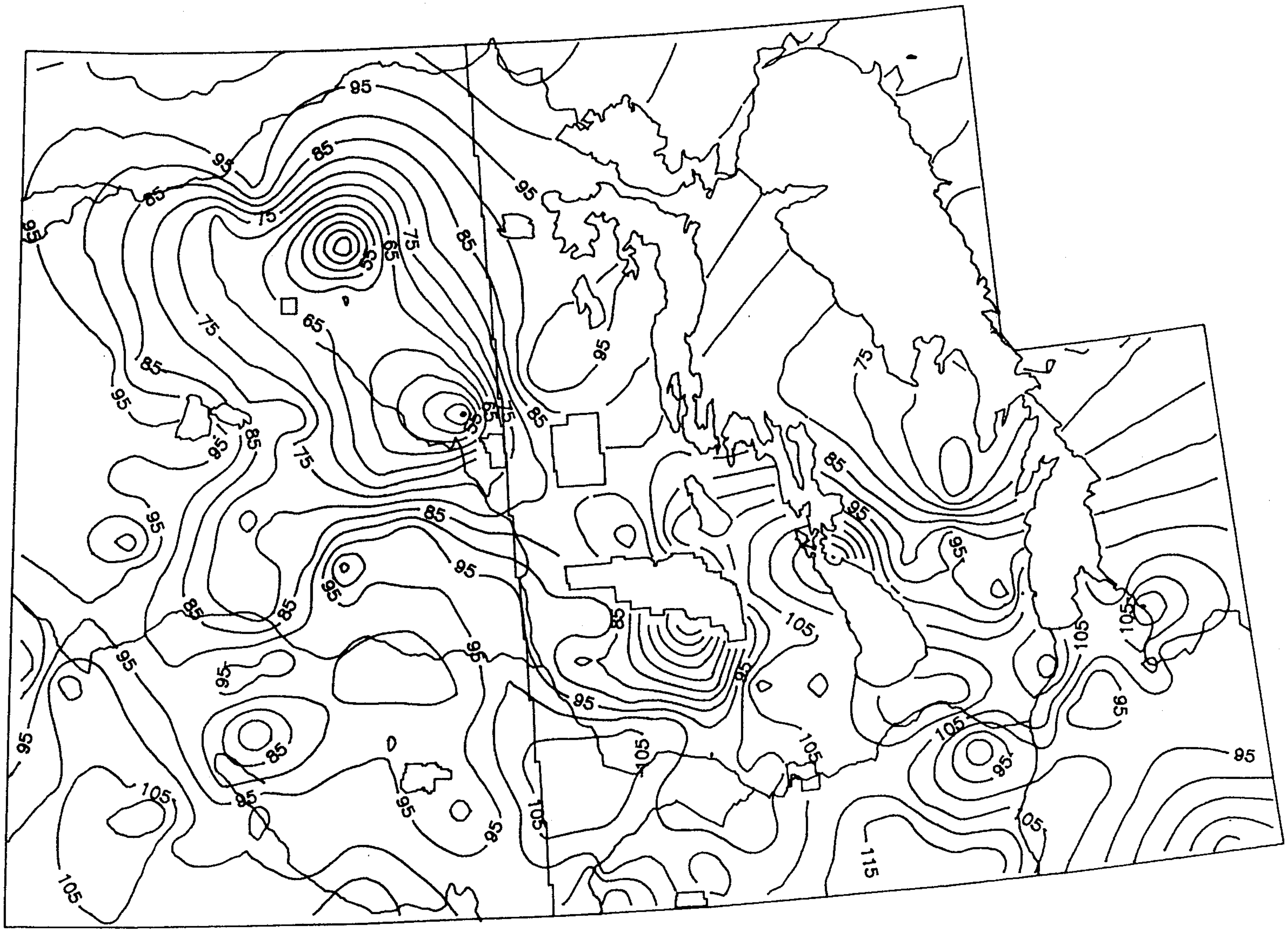


Figure 8: Length of the Frost-Free Period above 0°C at a 25% Risk

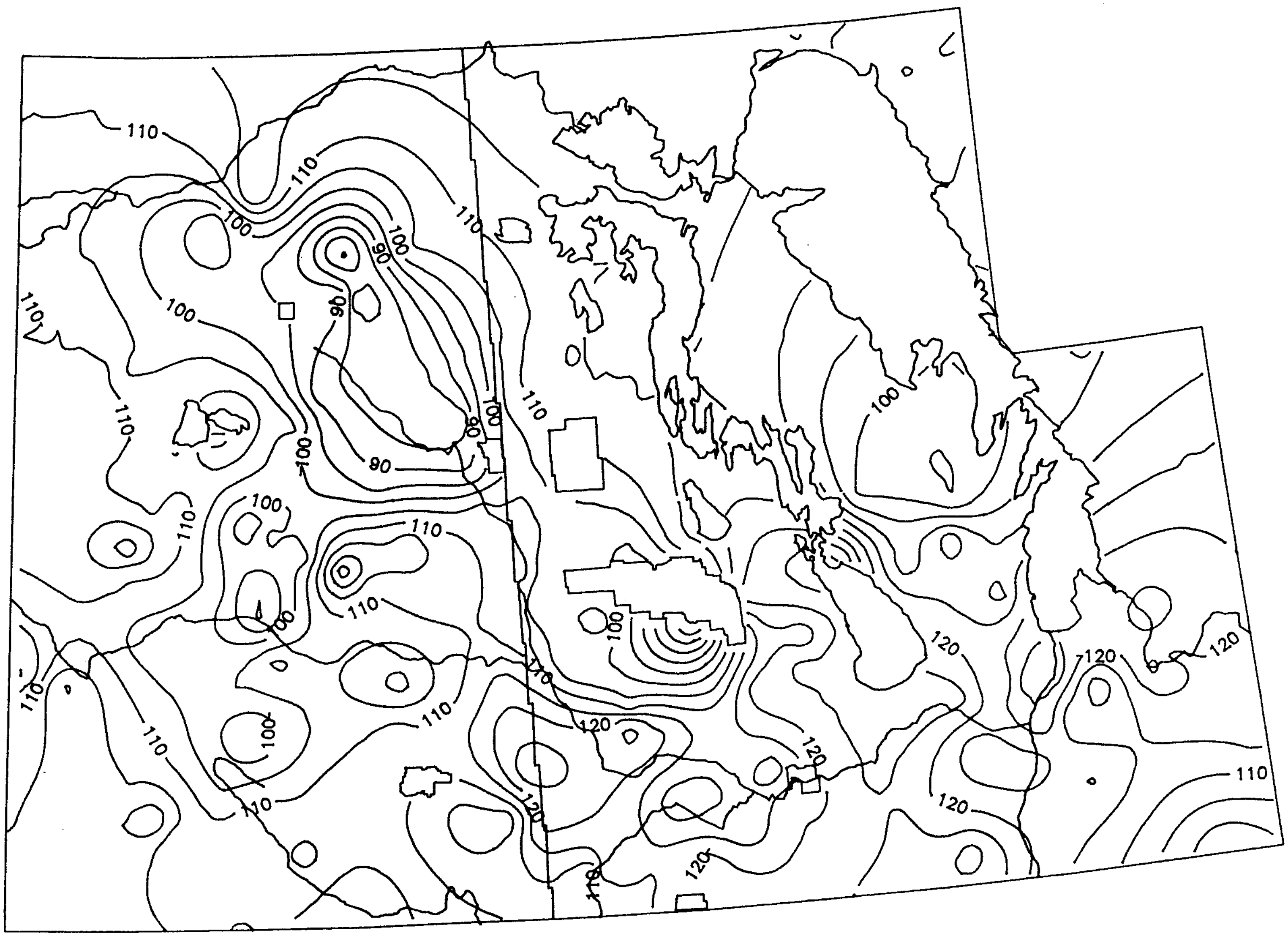


Figure 9: Length of the Frost-Free Period above -2.2°C at a 10% Risk

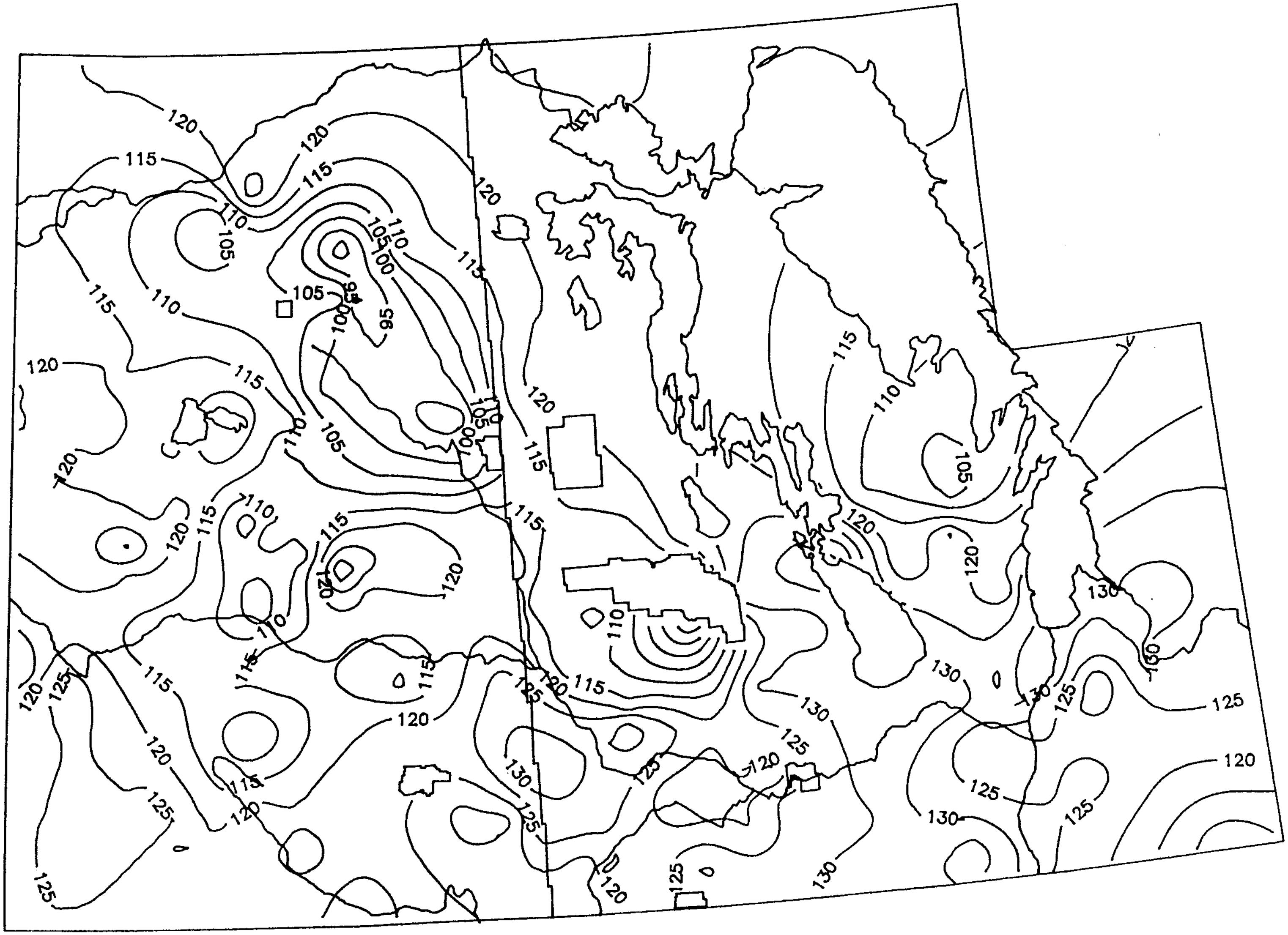


Figure 10: Length of the Frost-Free Period above −2.2°C at a 25% Risk

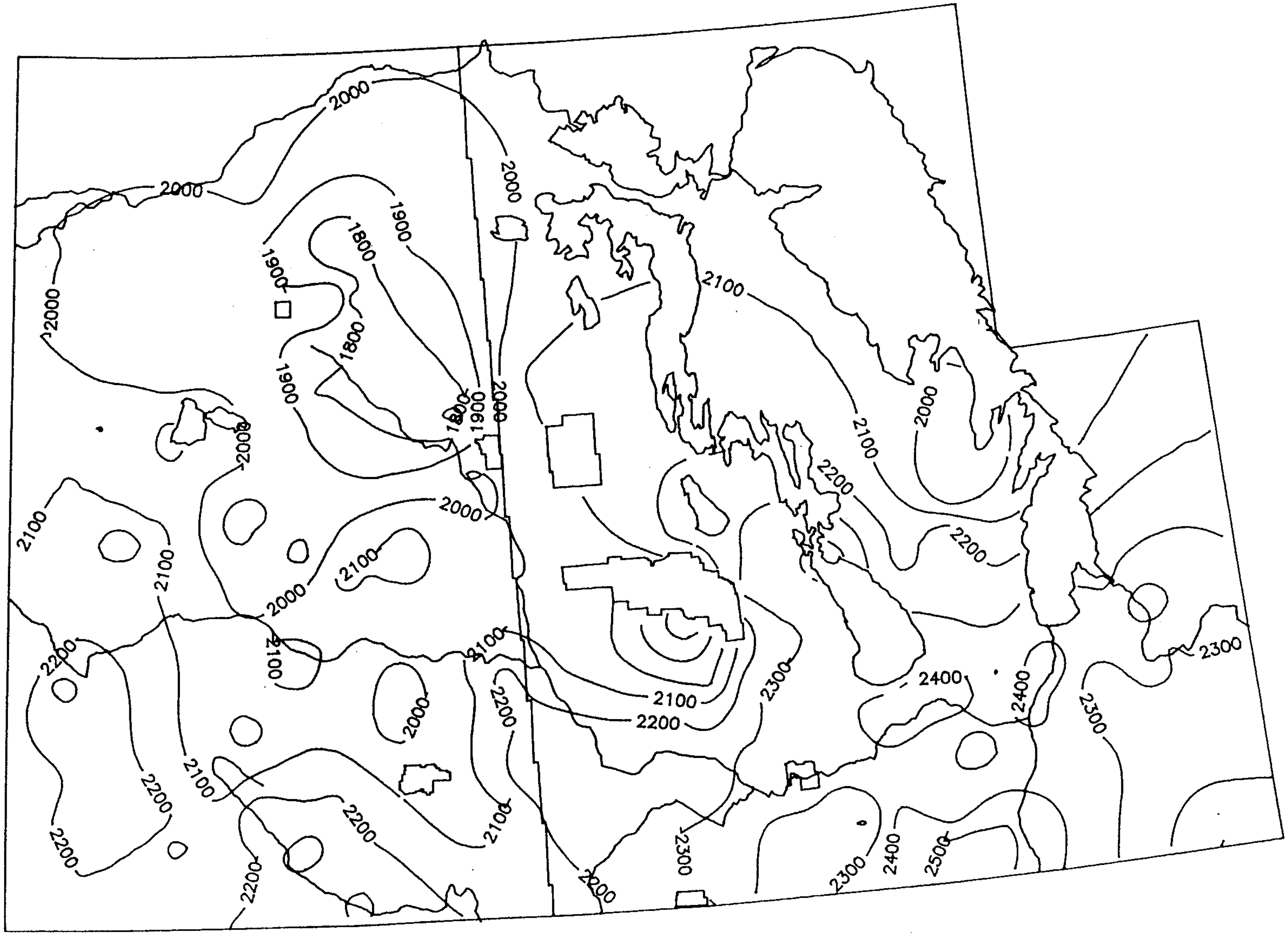


Figure 11: Minimum Accumulation of Corn Heat Units at a 25% Risk

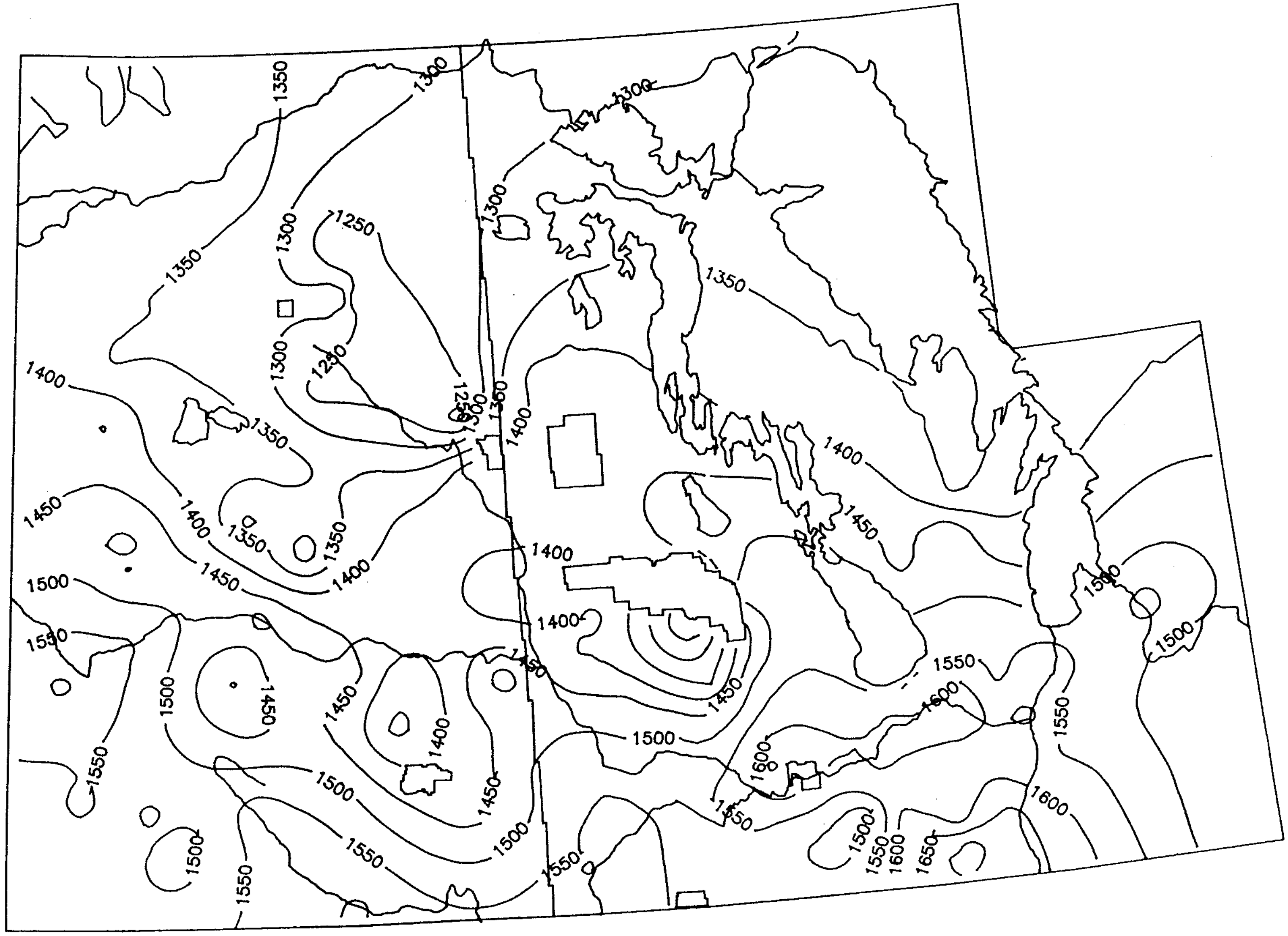


Figure 12: Minimum Accumulation of Growing Degree Days (5°C) at a 25% Risk

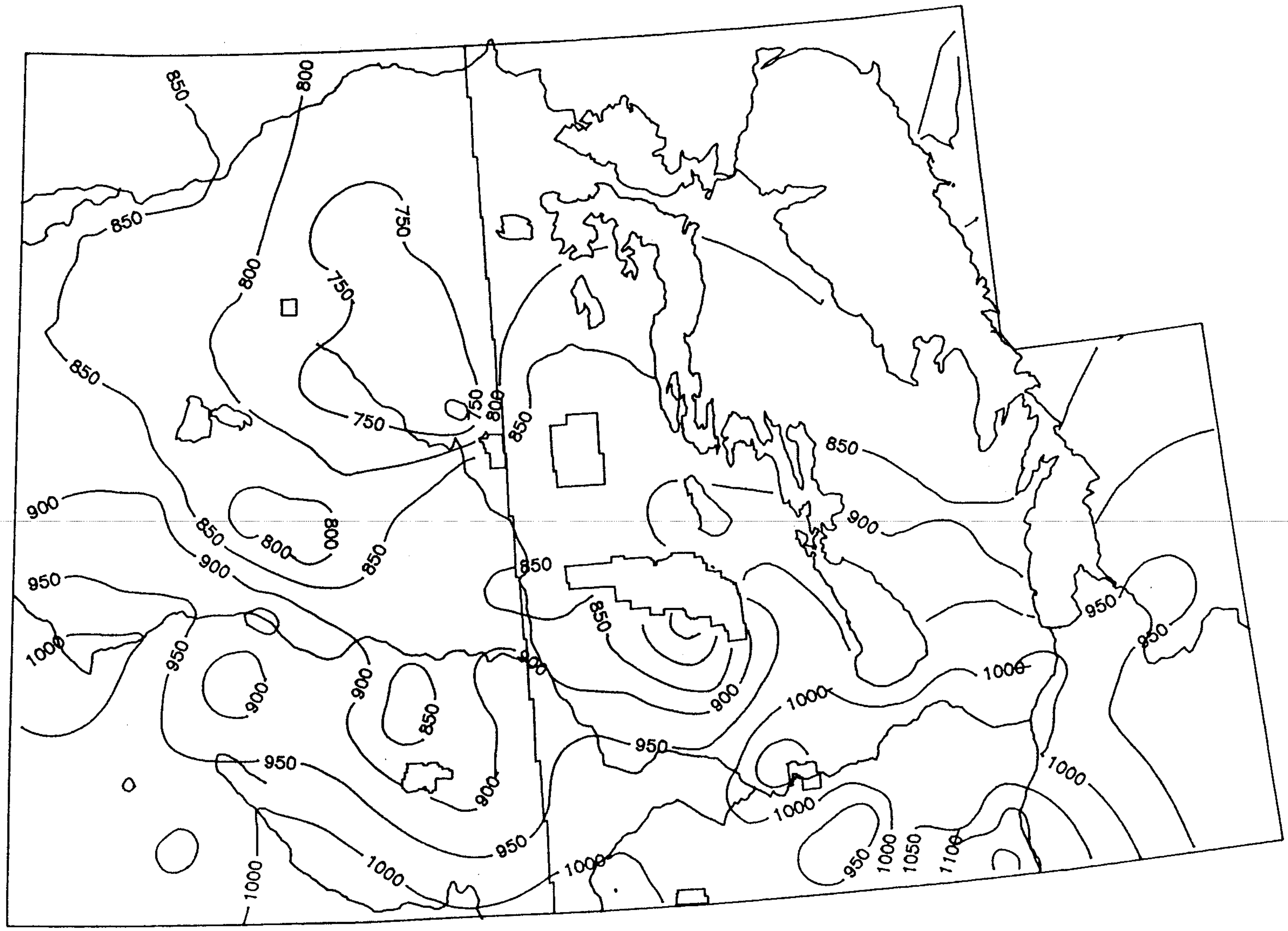


Figure 13: Average Accumulated Number of Growing Degree Days above 10°C

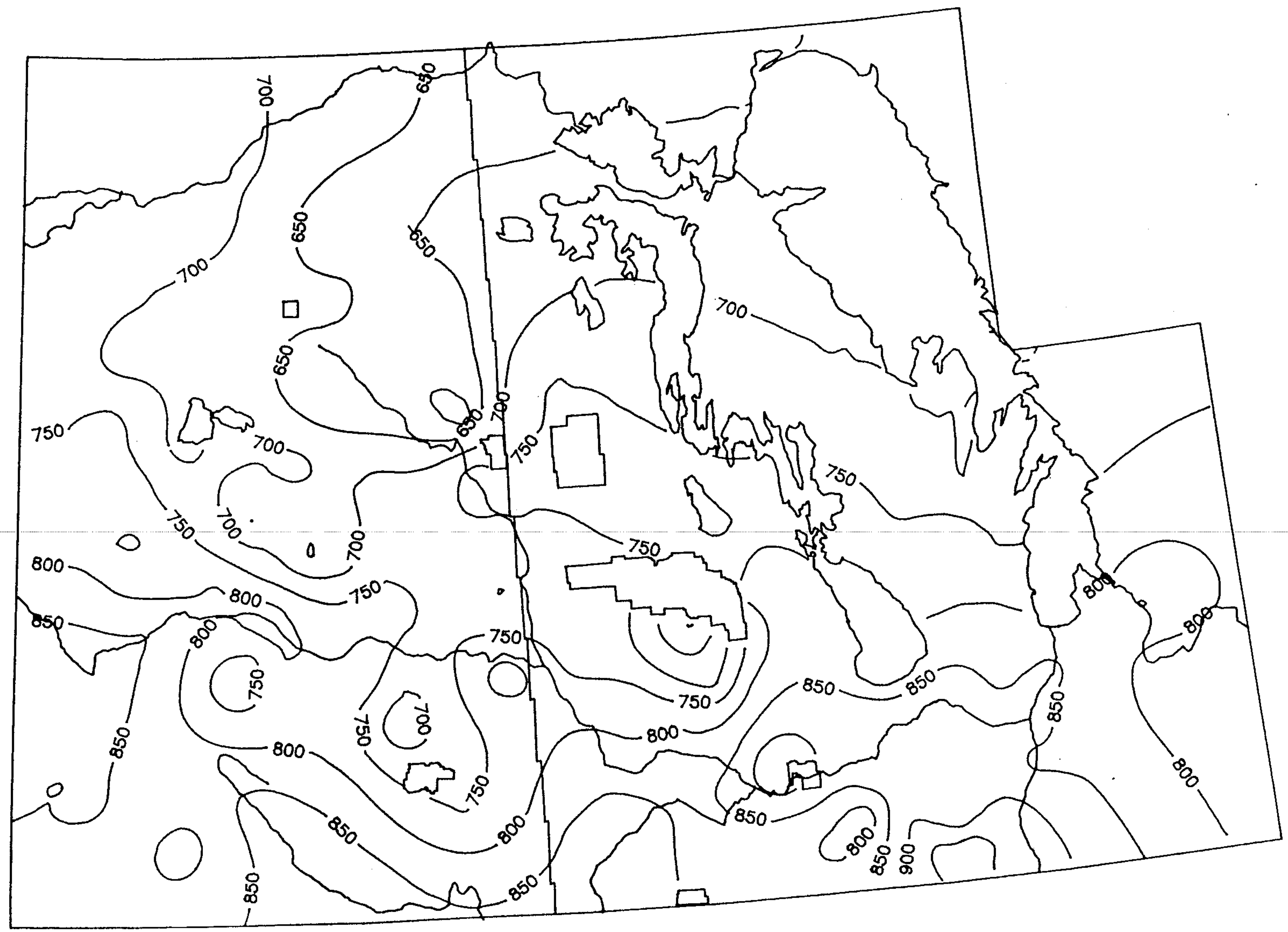


Figure 14: Minimum Accumulation of Growing Degree Days (10°C) at a 10% Risk

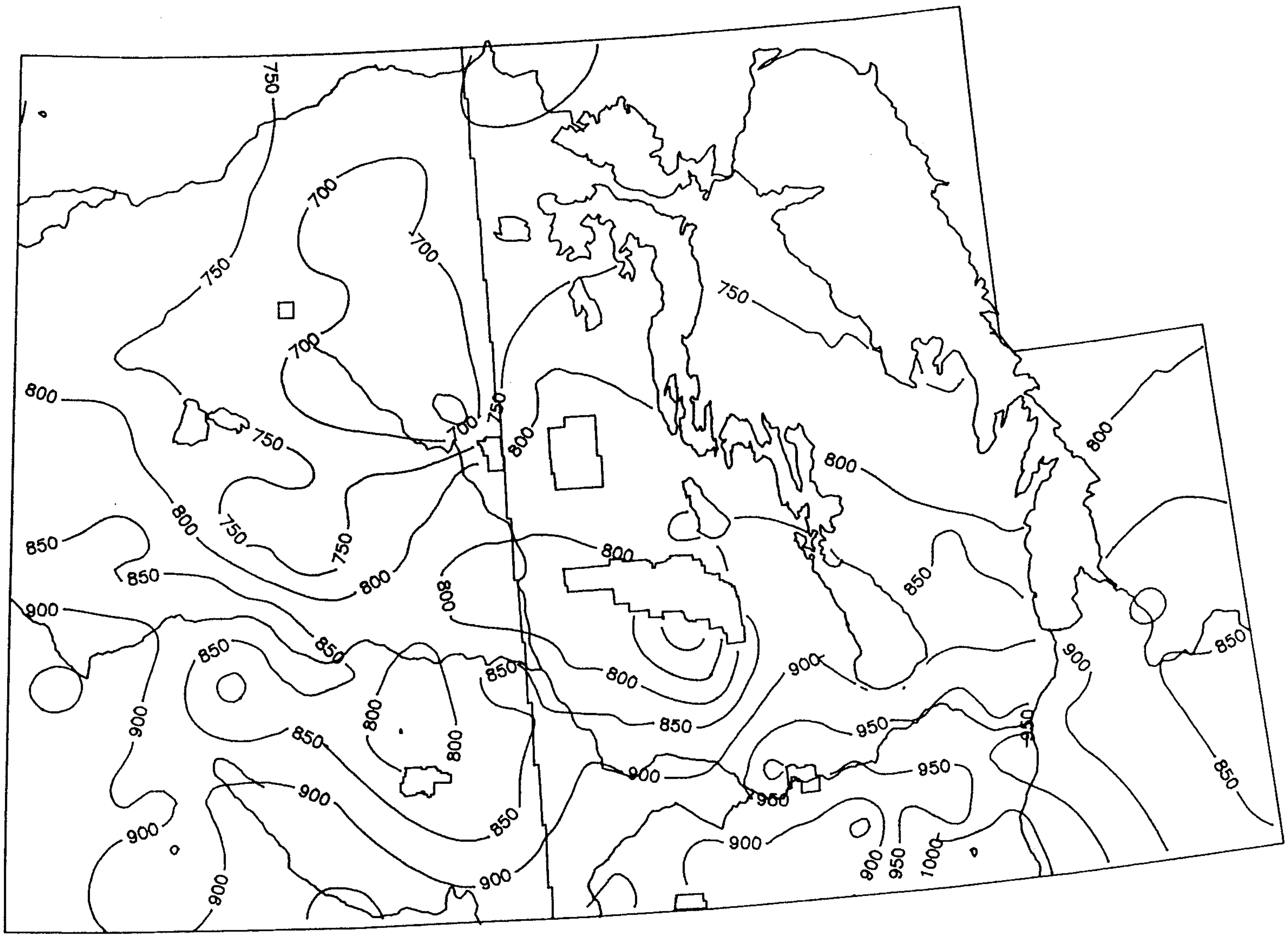


Figure 15: Minimum Accumulation of Growing Degree Days (10°C) at a 25% Risk

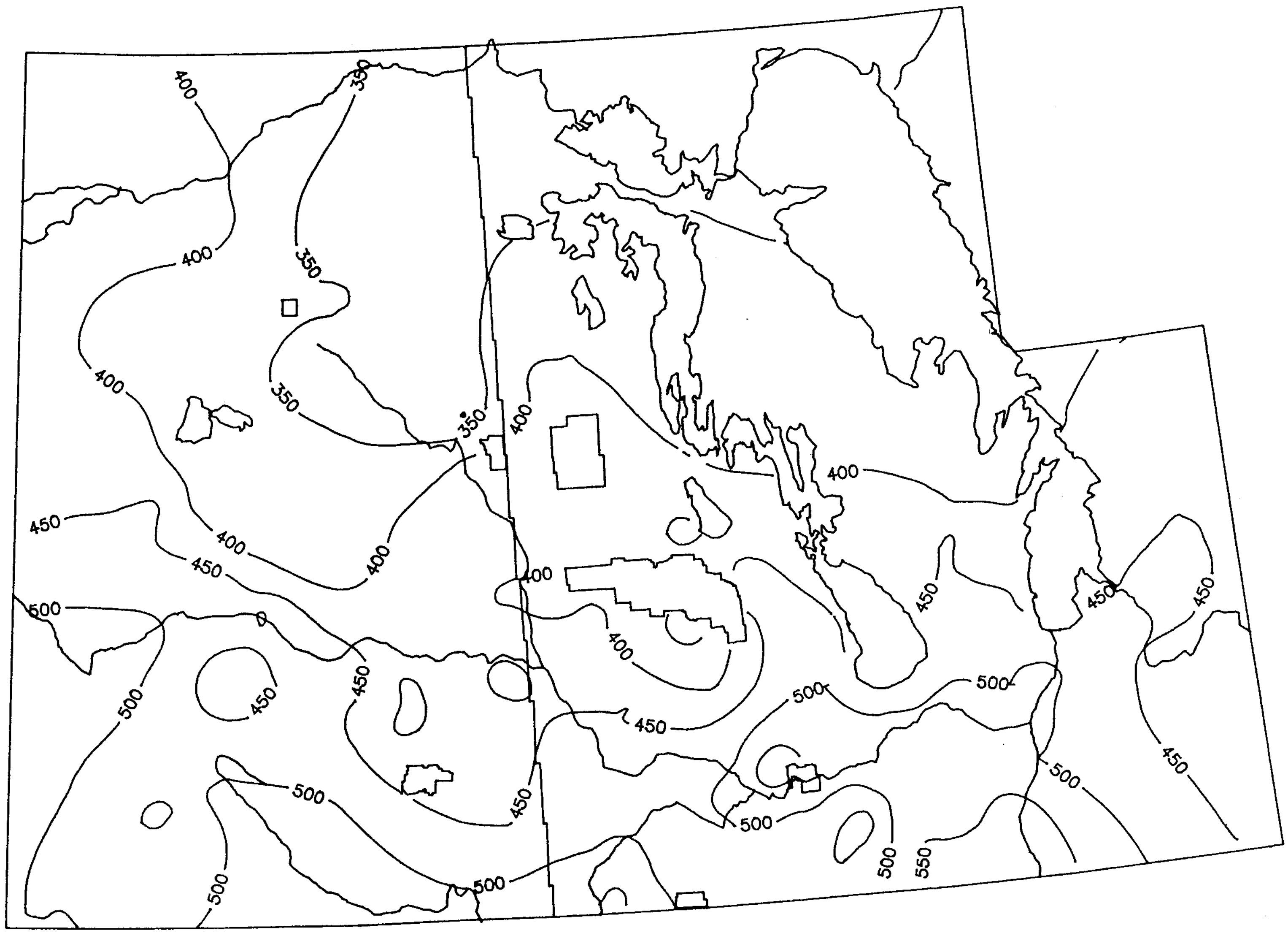


Figure 16: Average Accumulated Number of Growing Degree Days above 15°C

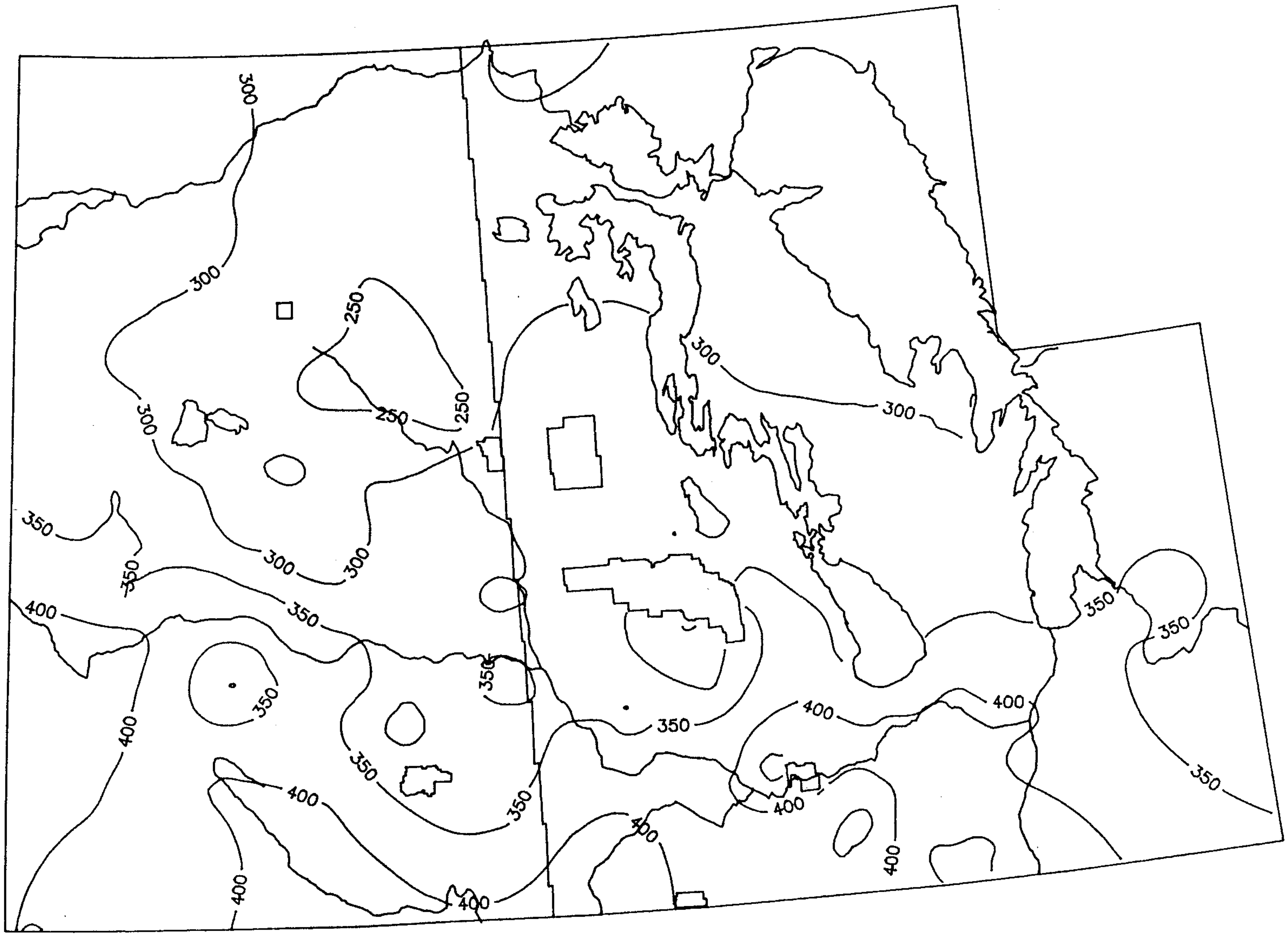


Figure 17: Minimum Accumulation of Growing Degree Days (15°C) at a 10% Risk

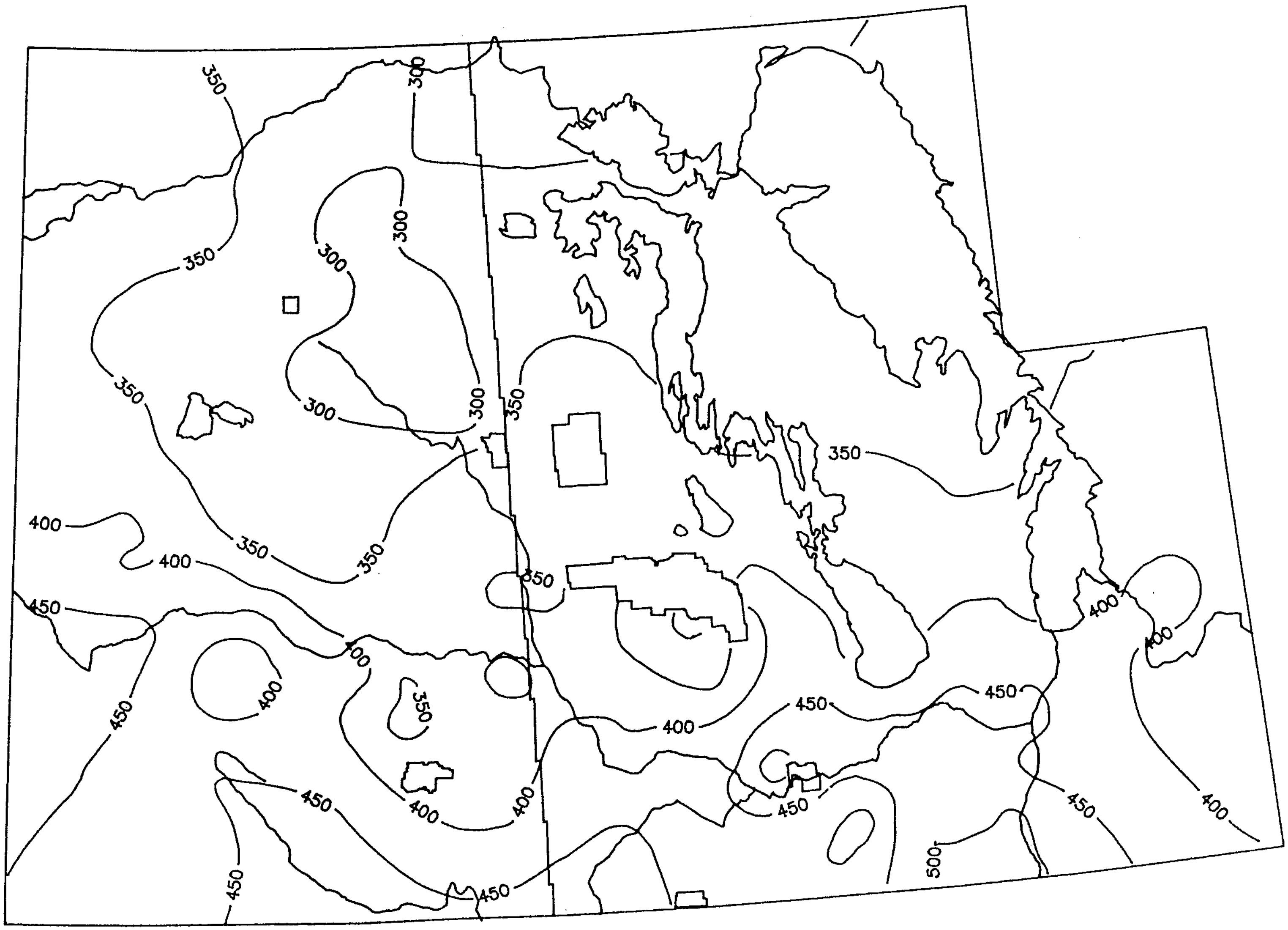


Figure 18: Minimum Accumulation of Growing Degree Days (15°C) at a 25% Risk

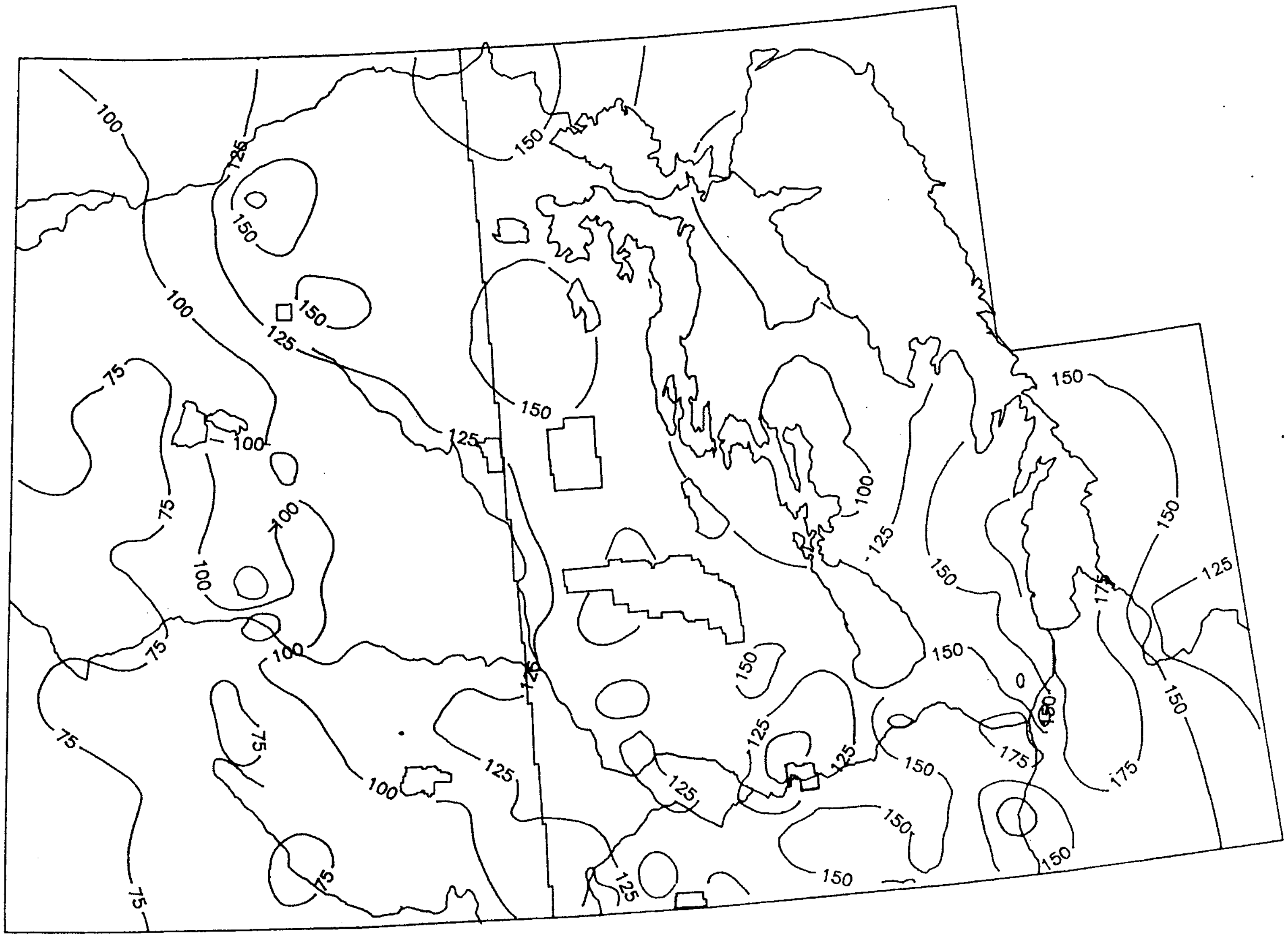


Figure 19: 10% Risk of Soil Moisture Amounts at Planting for Wheat (mm). Over the long term, one year in ten will have this much or less moisture in the soil.

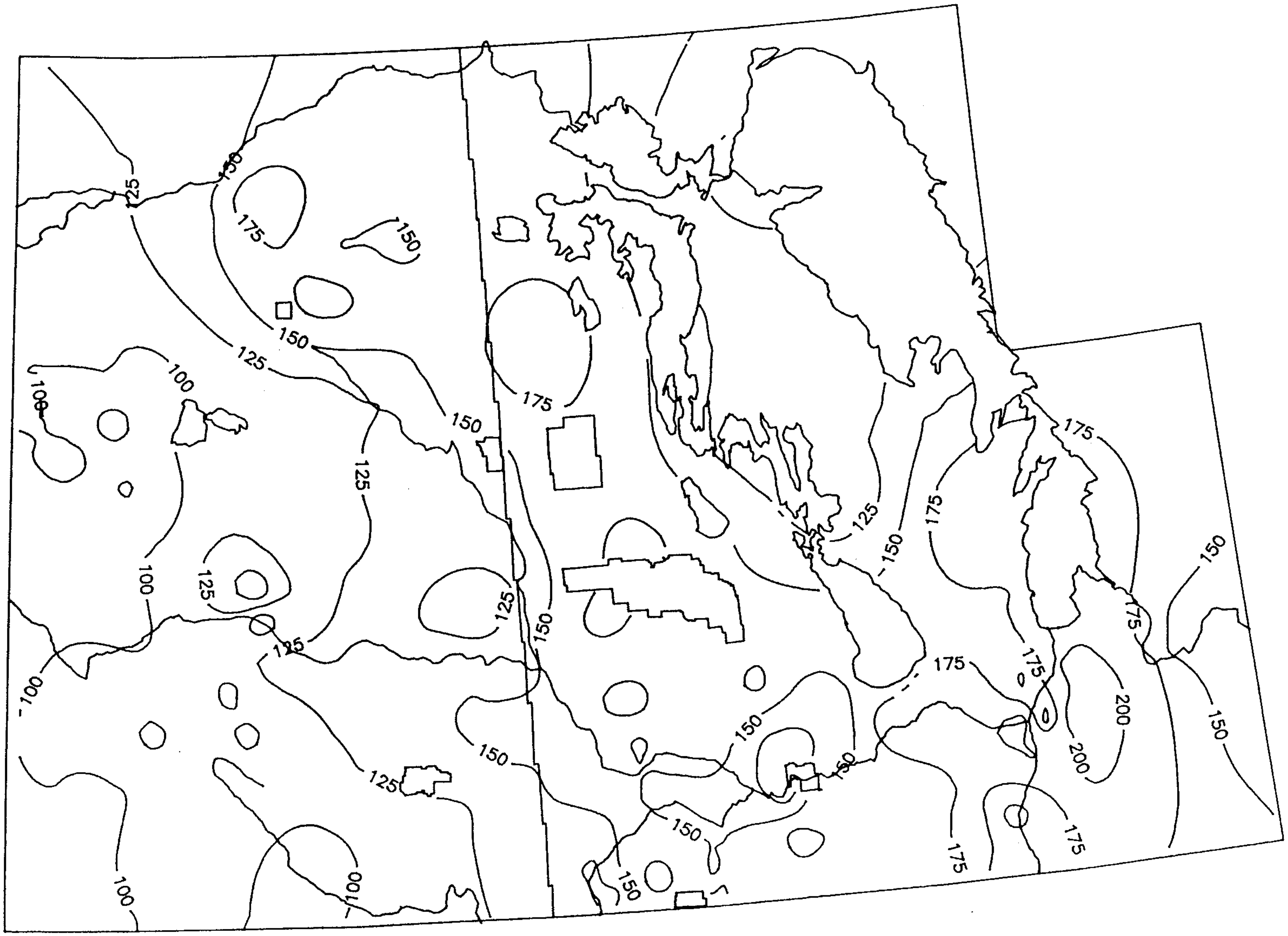


Figure 20: 25% Risk of Soil Moisture Amounts at Planting for Wheat (mm). Over the long term, one year in four will have this much or less moisture in the soil.

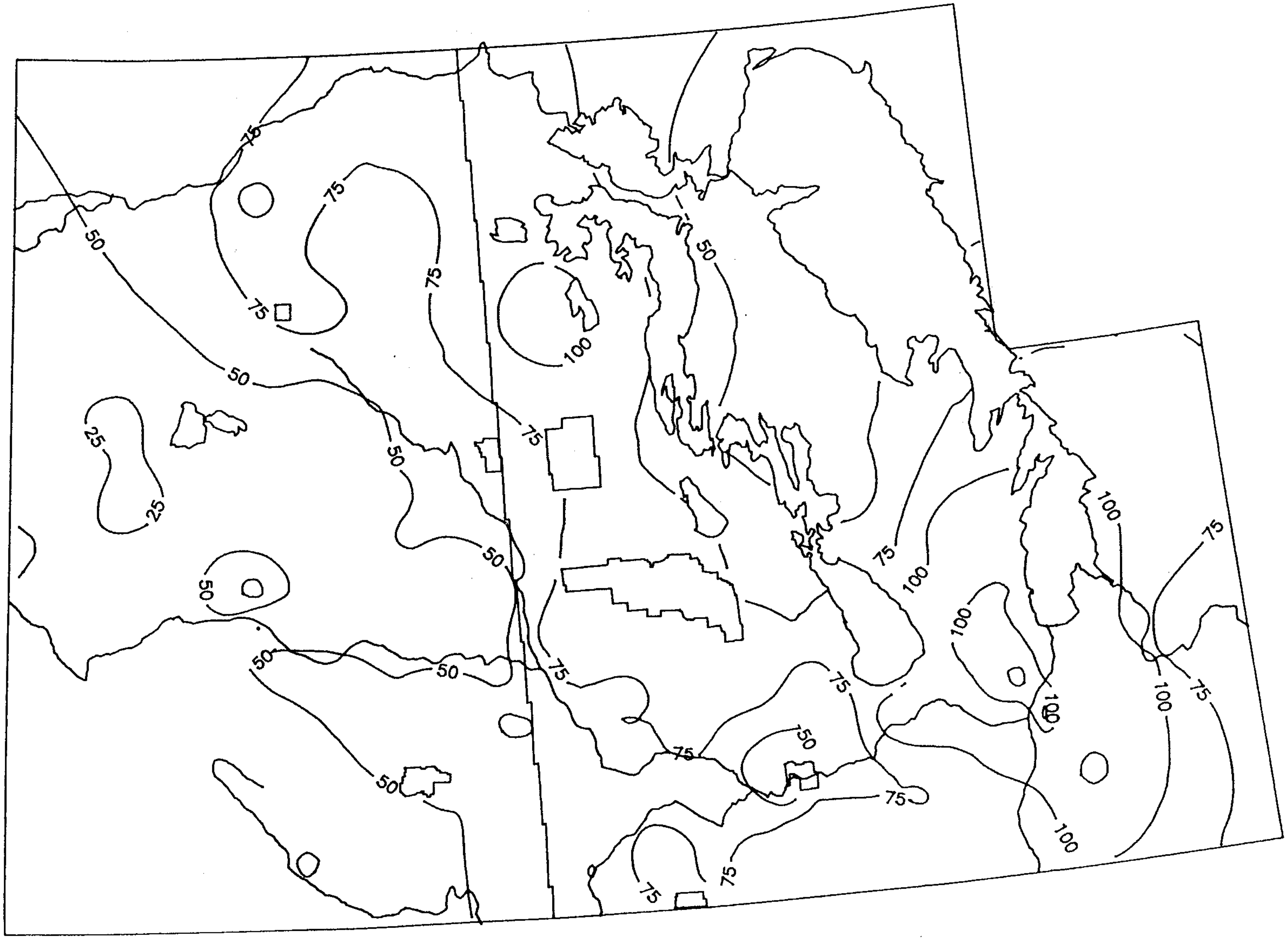


Figure 21: 10% Risk of Soil Moisture Amounts at the Heading Stage of Wheat (mm). Over the long term, one year in ten will have this much or less moisture in the soil.

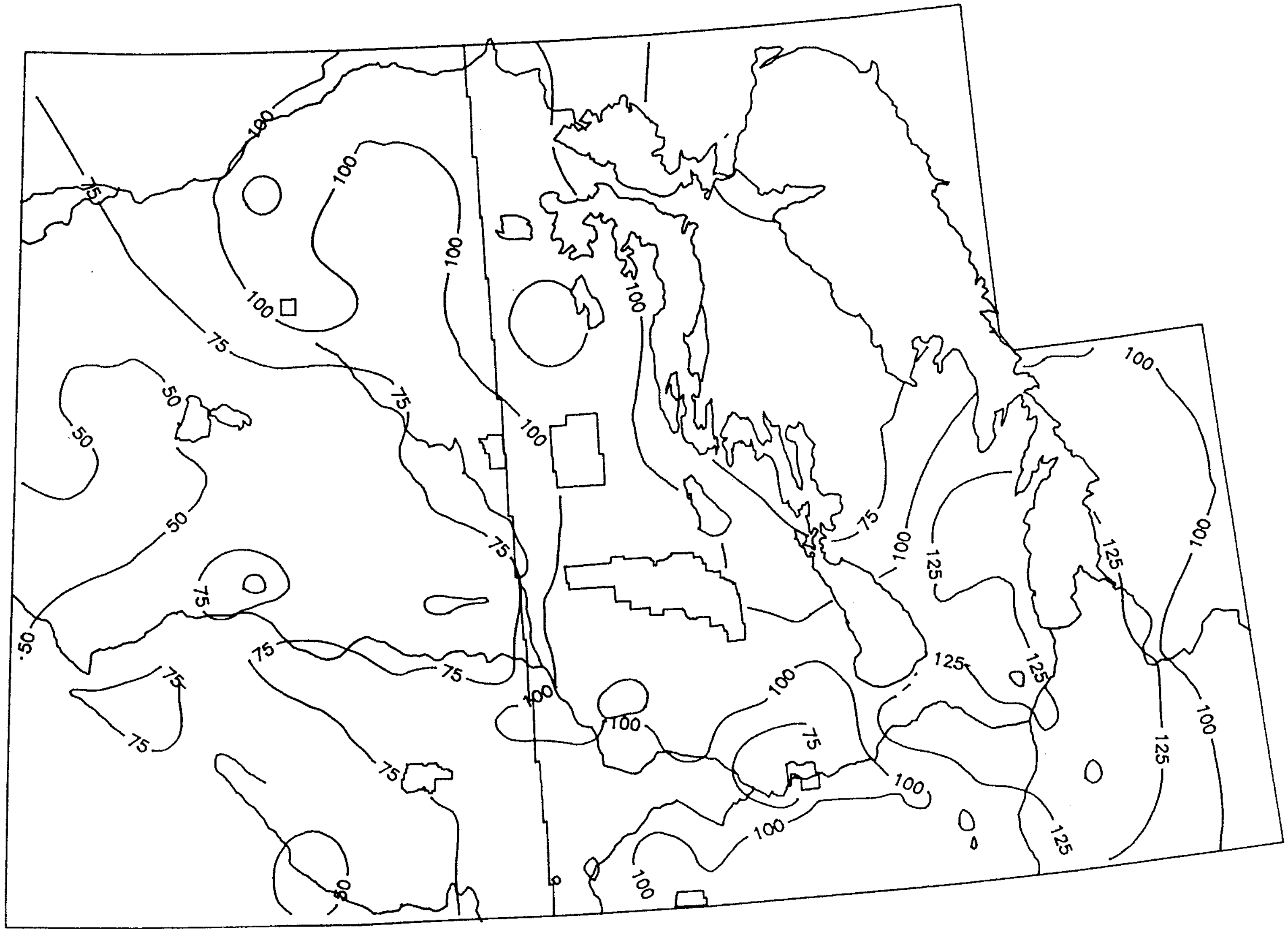


Figure 22: 25% Risk of Soil Moisture Amounts at the Heading Stage of Wheat (mm). Over the long term, one year in four will have this much or less moisture in the soil.

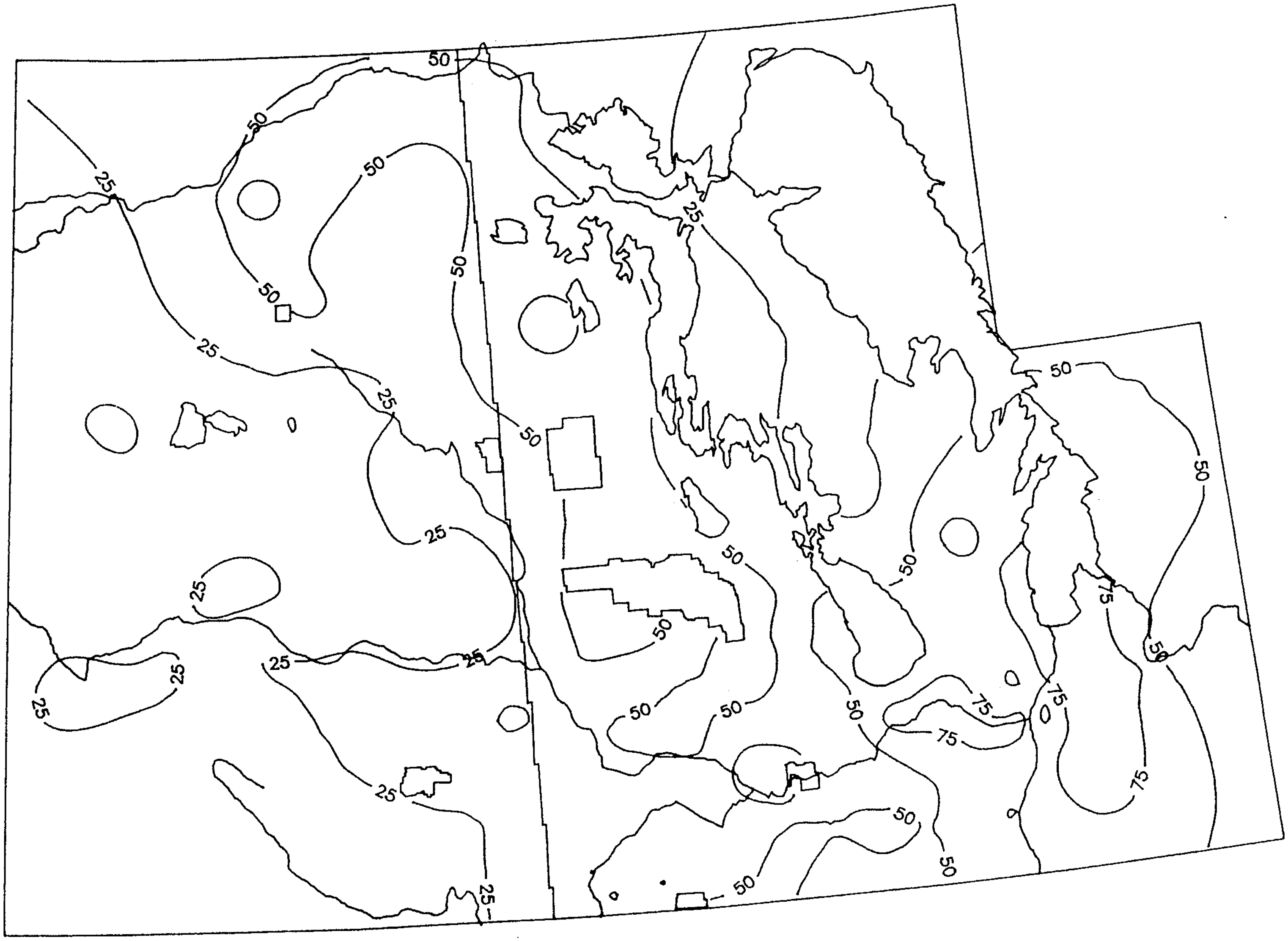


Figure 23: 10% Risk of Soil Moisture Amounts at the Soft Dough Stage of Wheat (mm). Over the long term, one year in ten will have this much or less moisture in the soil.

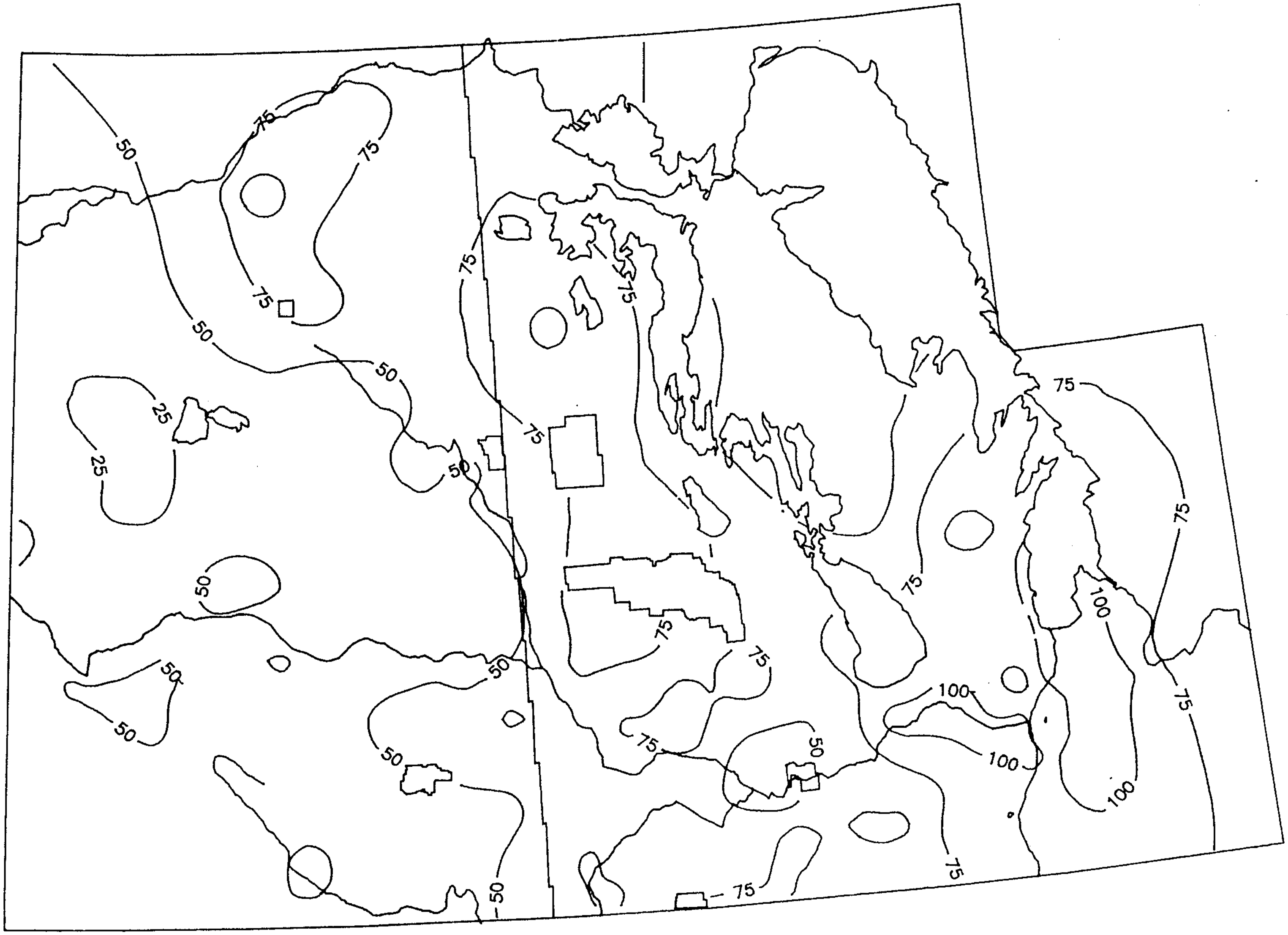


Figure 24: 25% Risk of Soil Moisture Amounts at the Soft Dough Stage of Wheat (mm). Over the long term, one year in four will have this much or less moisture in the soil.

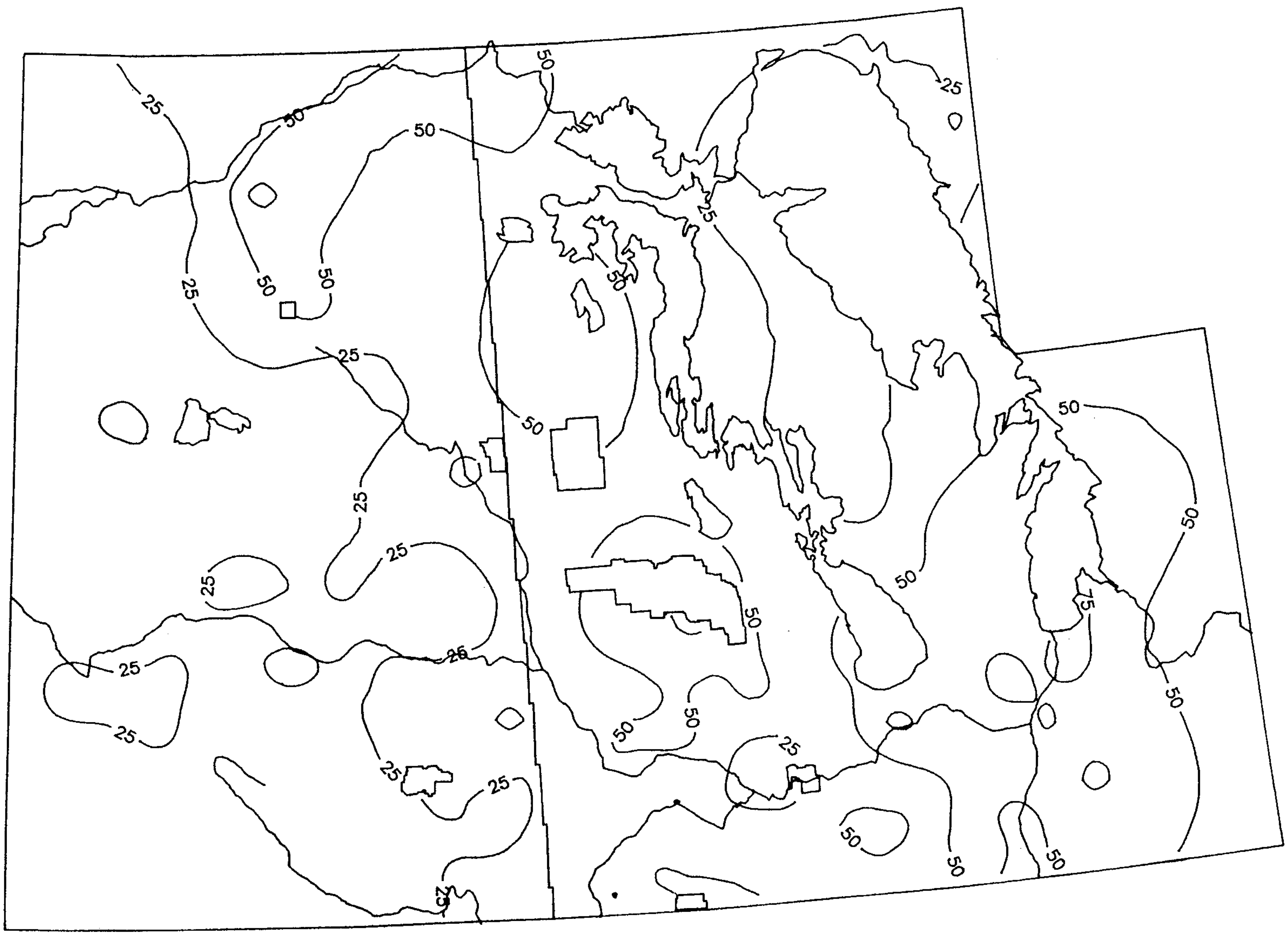


Figure 25: 10% Risk of Soil Moisture Amounts at Maturity of Wheat (mm). Over the long term, one year in ten will have this much or less moisture in the soil.

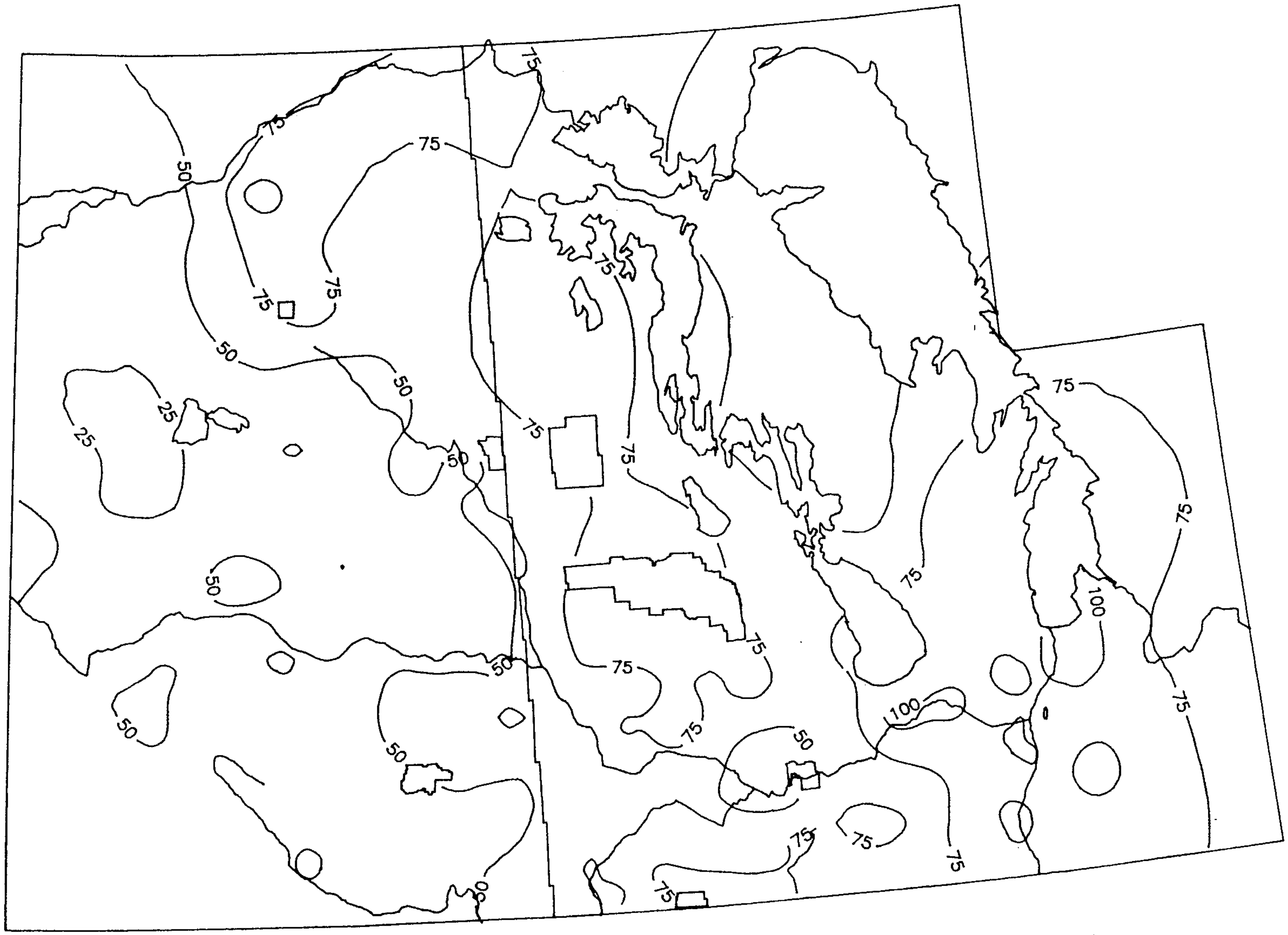


Figure 26: 25% Risk of Soil Moisture Amounts at Maturity of Wheat (mm). Over the long term, one year in four will have this much or less moisture in the soil.

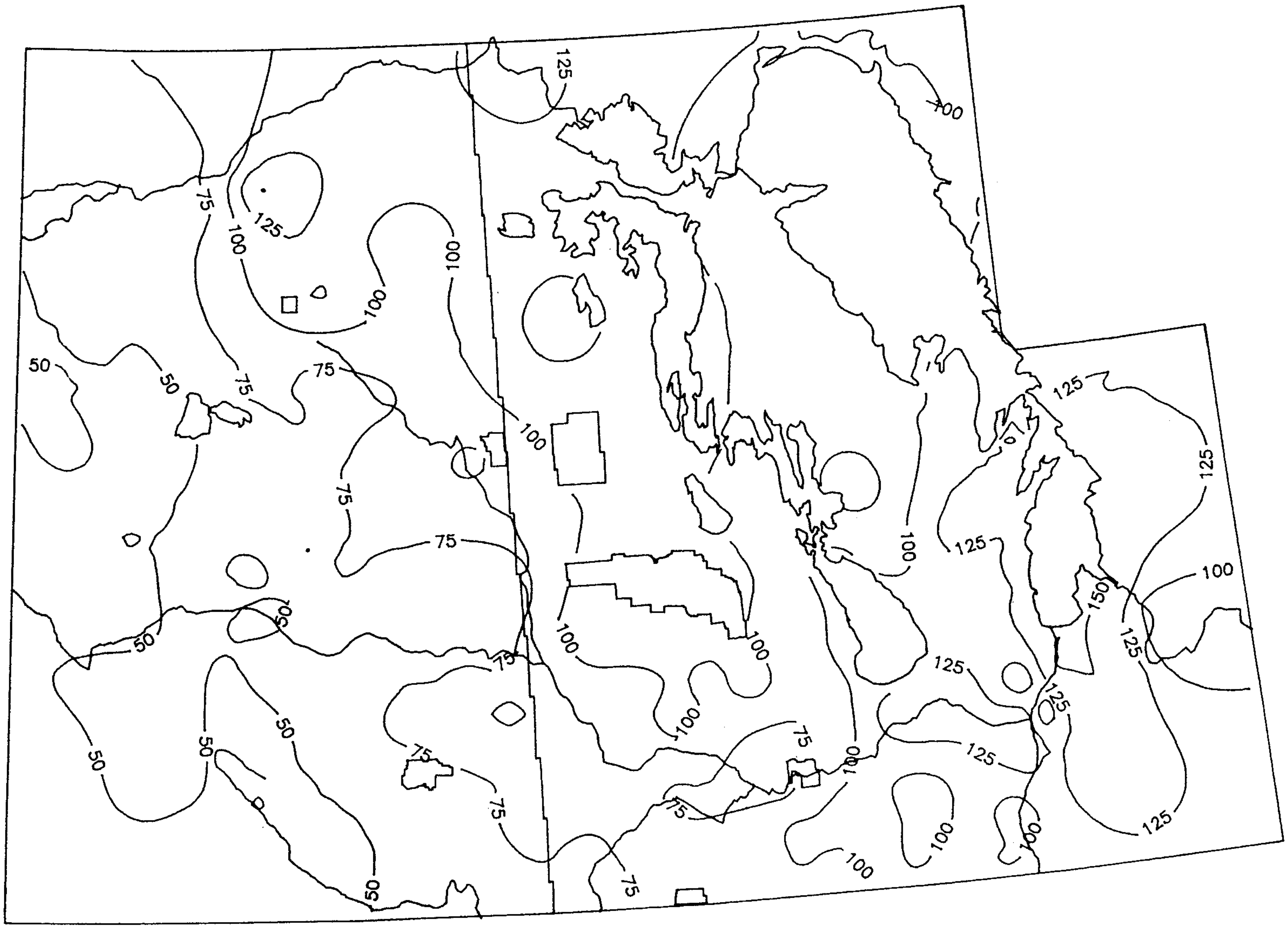


Figure 27: 10% Risk of Soil Moisture Amounts on October 31 for Wheat (mm). Over the long term, one year in ten will have this much or less moisture in the soil.

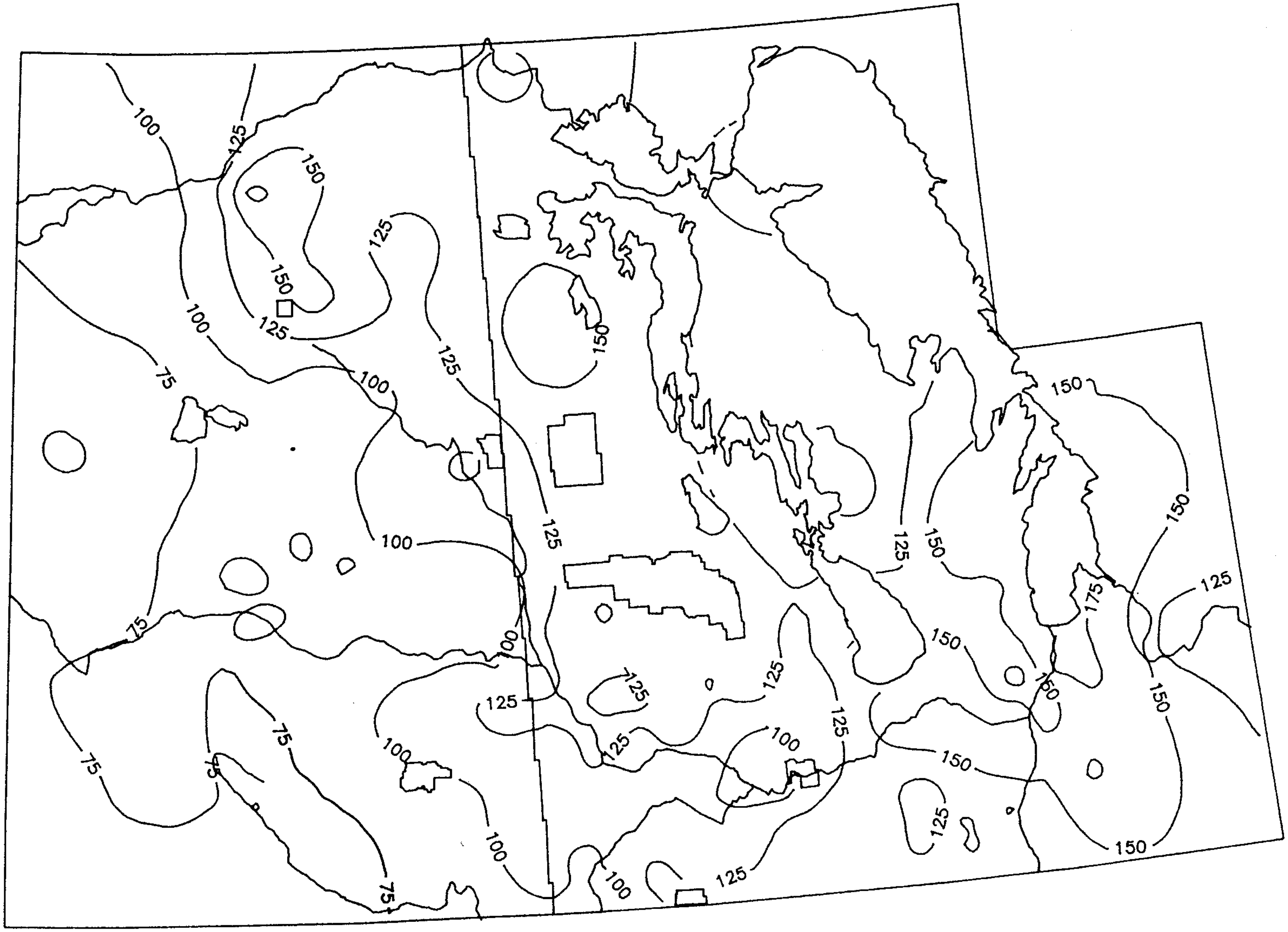


Figure 28: 25% Risk of Soil Moisture Amounts on October 31 for Wheat (mm). Over the long term, one year in four will have this much or less moisture in the soil.

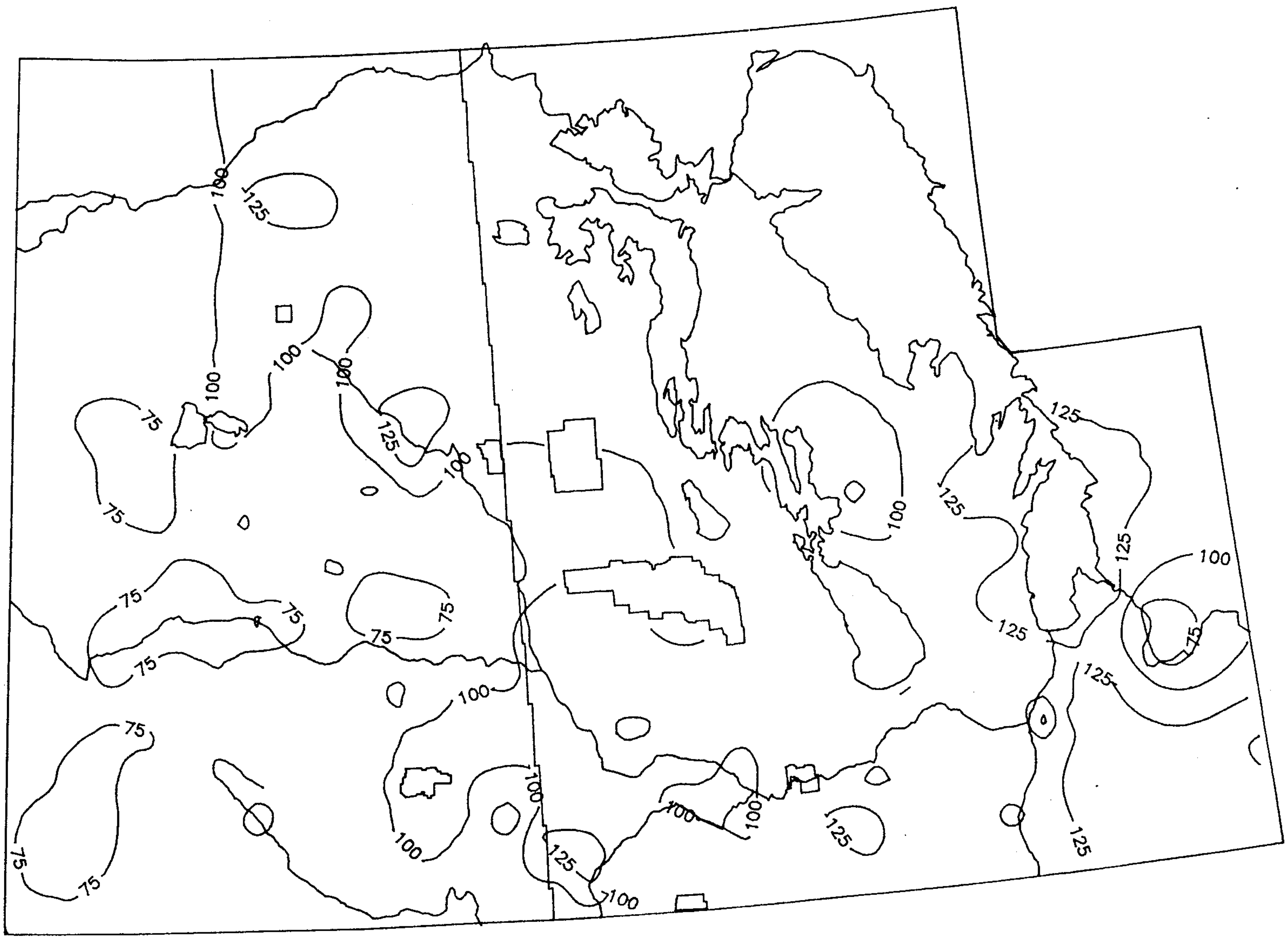


Figure 29: 10% Risk of Growing Season Precipitation for Wheat (mm). Over the long term, one year in ten will have this much or less growing season precipitation.

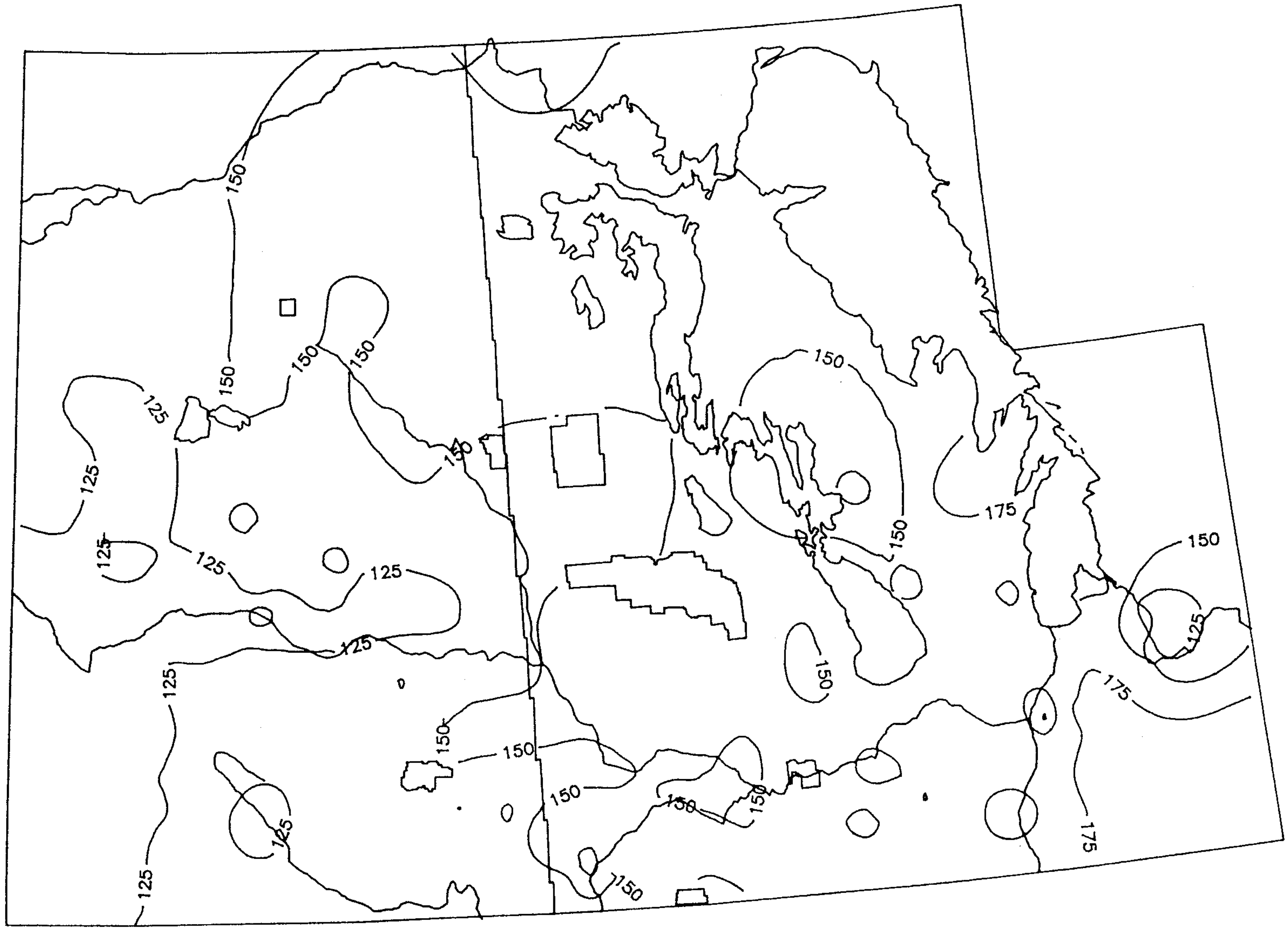


Figure 30: 25% Risk of Growing Season Precipitation for Wheat (mm). Over the long term, one year in four will have this much or less growing season precipitation.

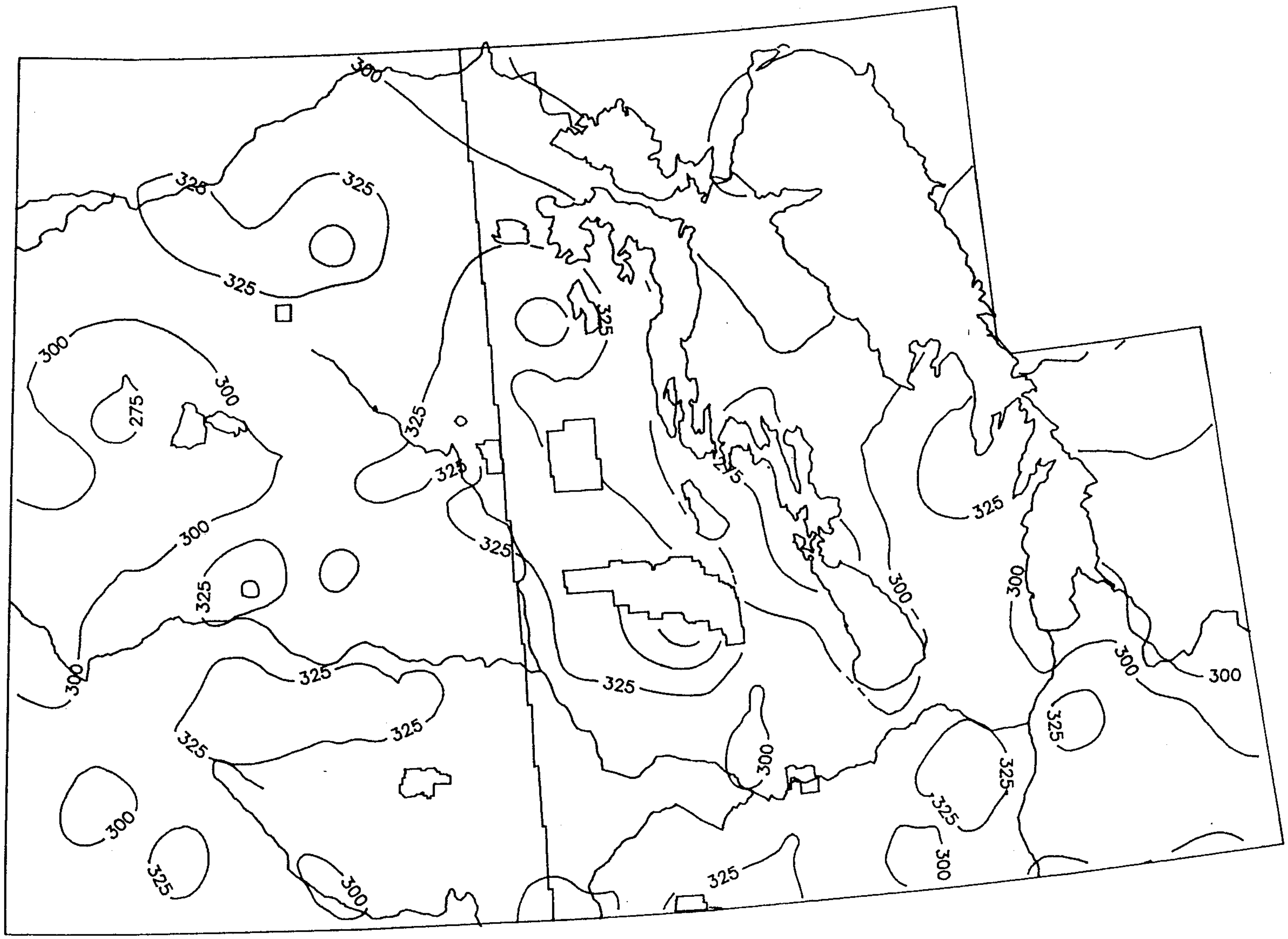


Figure 31: 10% Risk of Growing Season Actual Evapotranspiration for Wheat (mm). Over the long term, one year in ten will have this much or more growing season actual evapotranspiration.

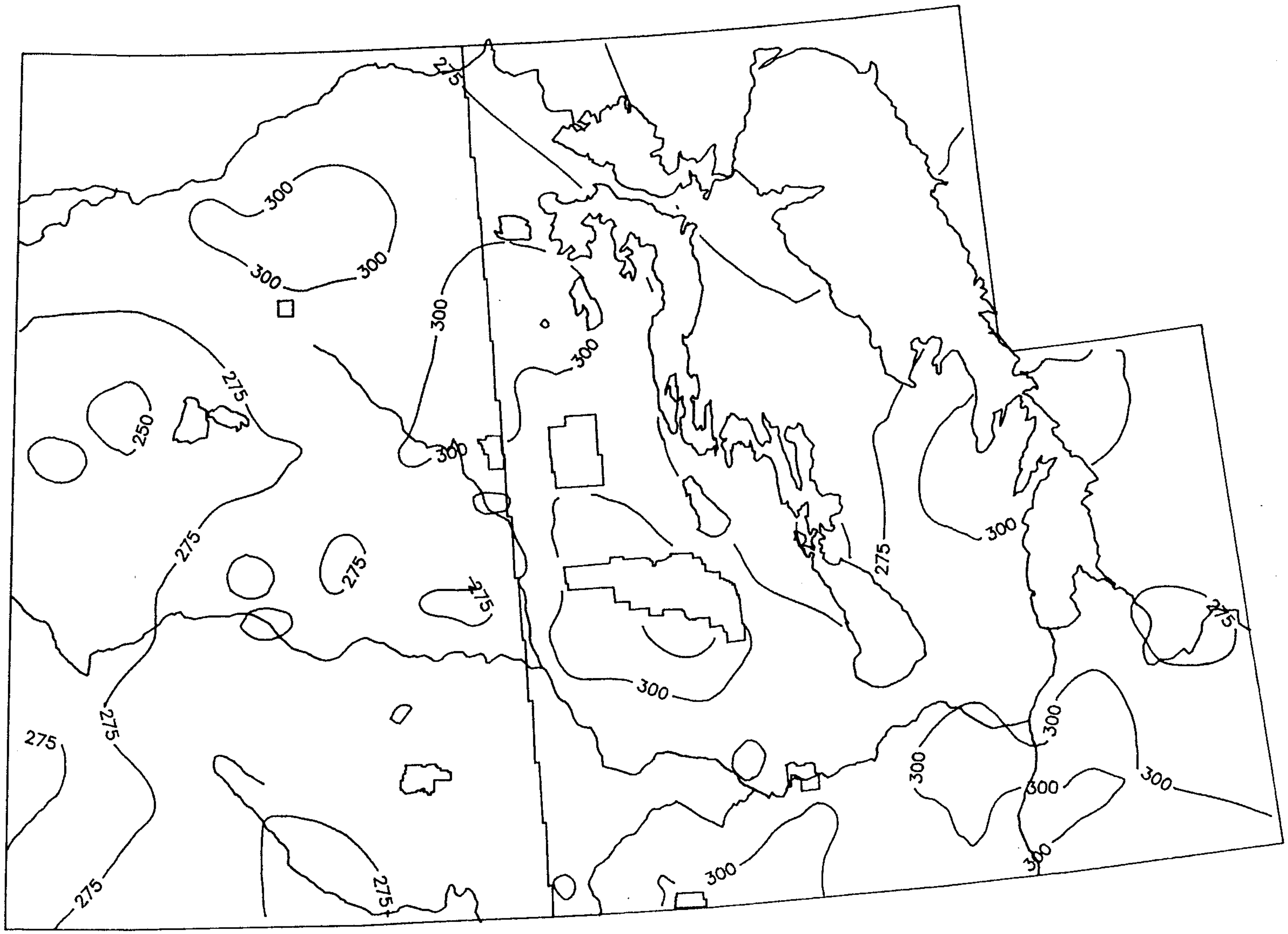


Figure 32: 25% Risk of Growing Season Actual Evapotranspiration for Wheat (mm). Over the long term, one year in four will have this much or more growing season actual evapotranspiration.

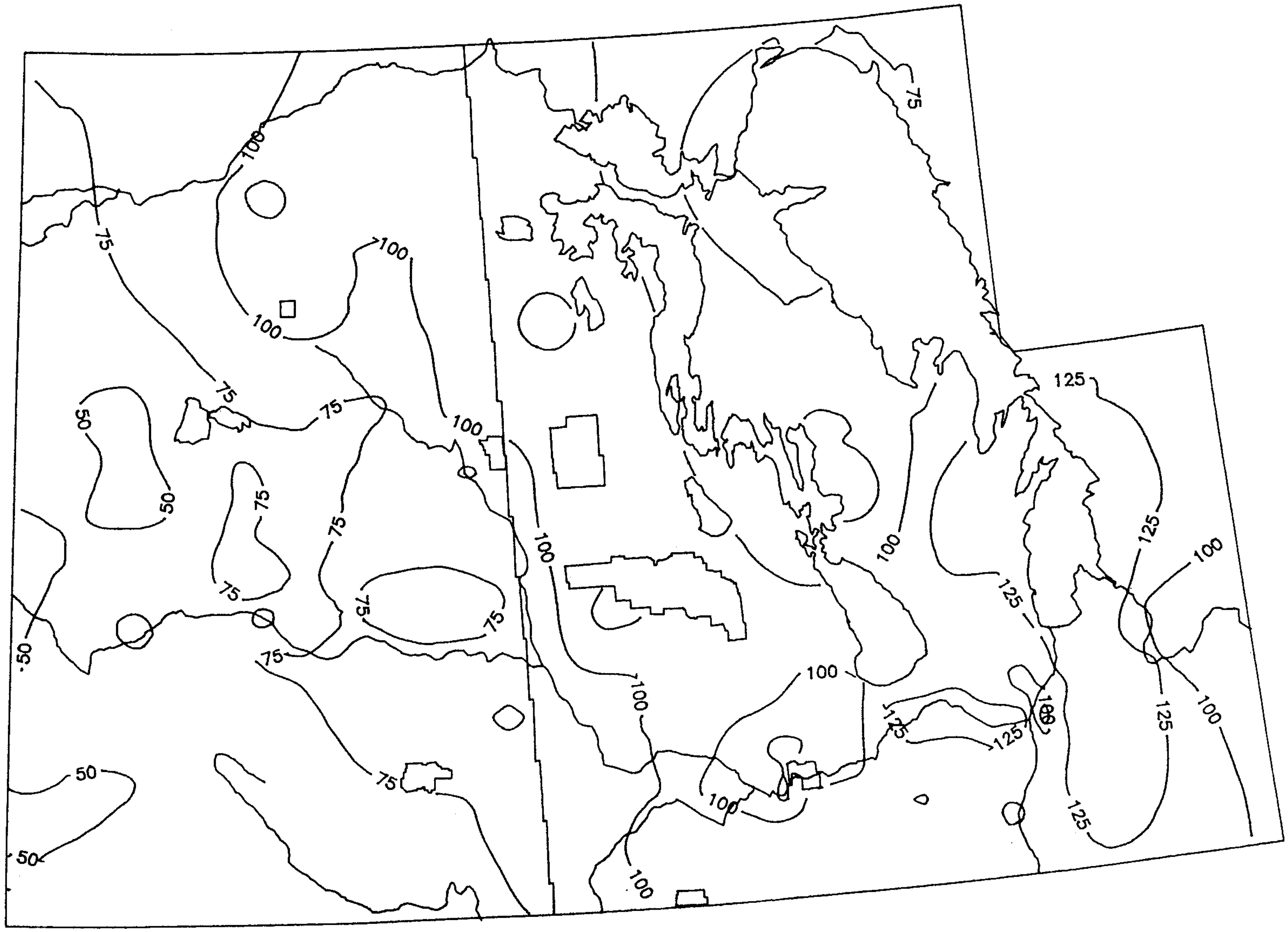


Figure 33: 10% Risk of Soil Moisture Amounts at the Silking Stage of Corn (mm). Over the long term, one year in ten will have this much or less moisture in the soil.

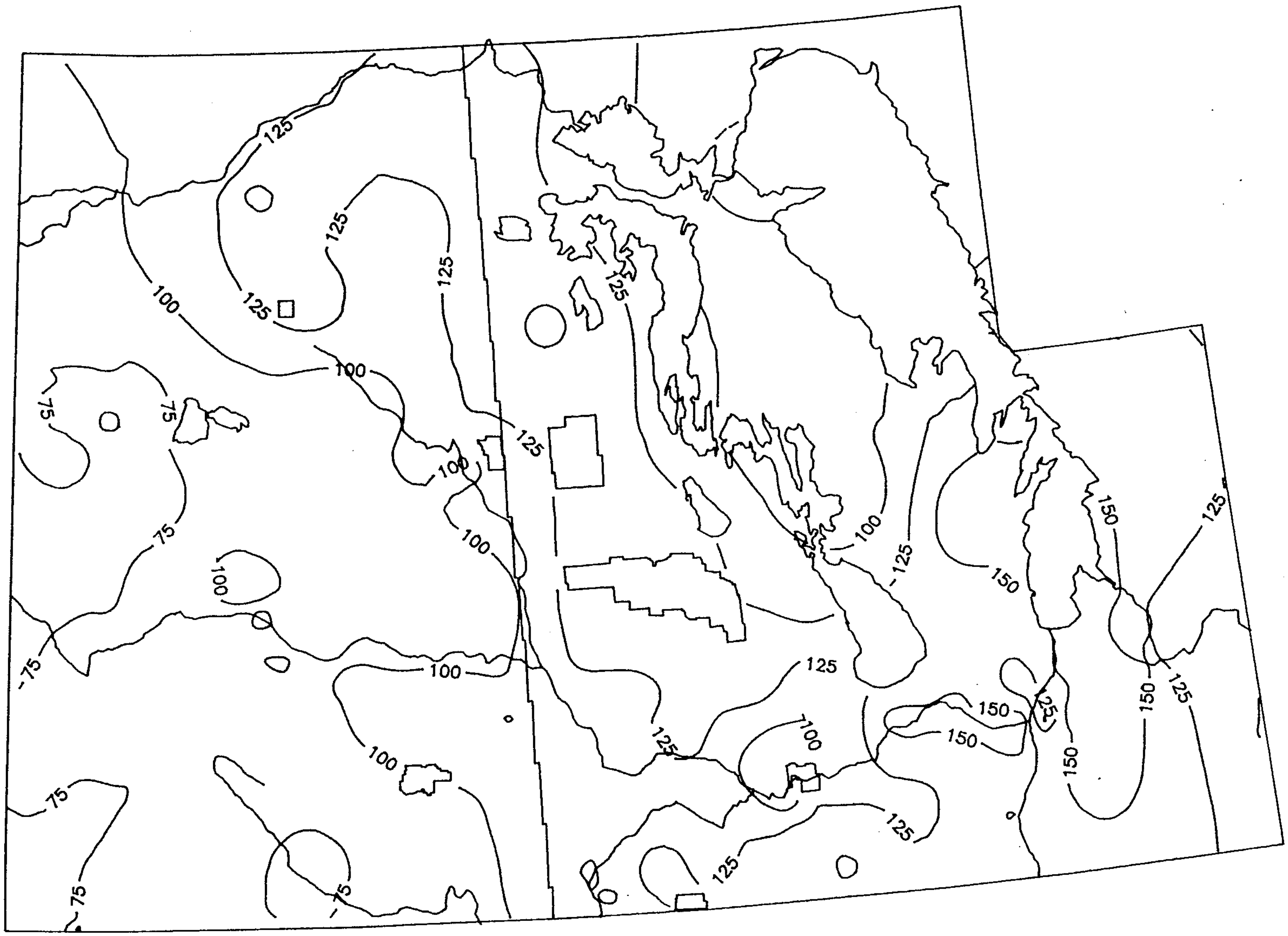


Figure 34: 25% Risk of Soil Moisture Amounts at the Silking Stage of Corn (mm). Over the long term, one year in four will have this much or less moisture in the soil.

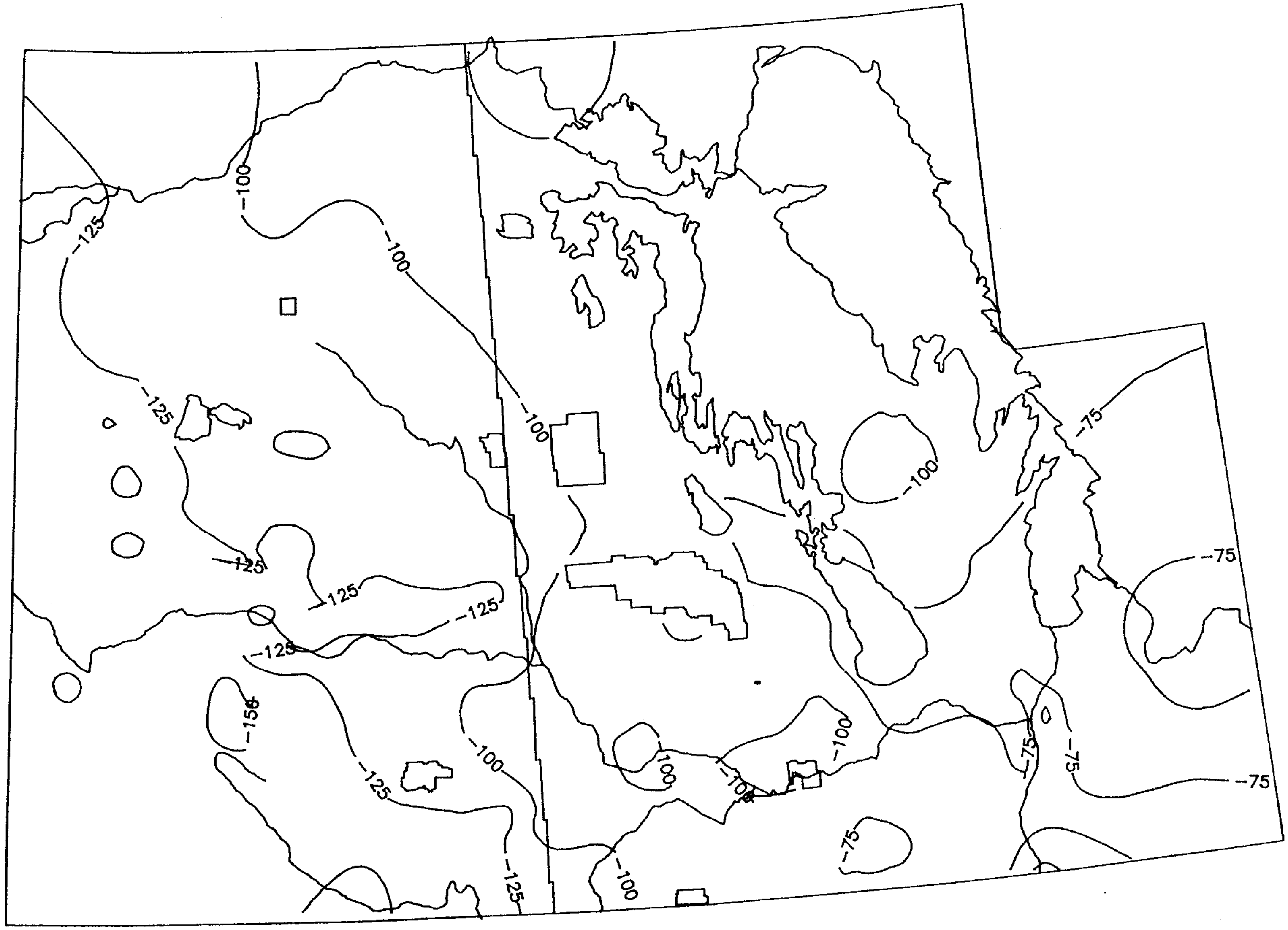


Figure 35: 10% Risk of Plant Moisture Stress at the Silking Stage of Corn (mm). Over the long term, one year in ten will have this much or more plant moisture stress.

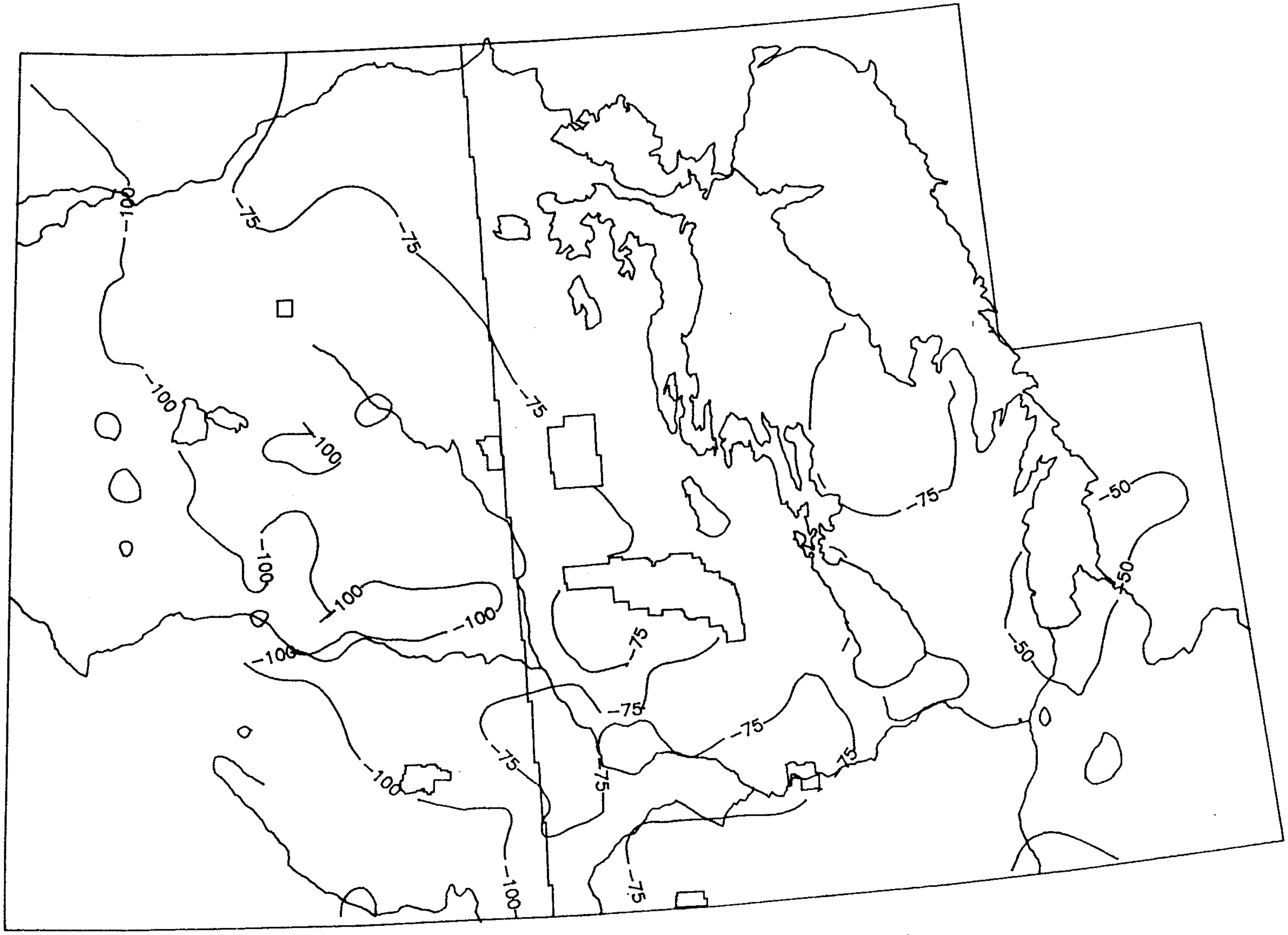


Figure 36: 25% Risk of Plant Moisture Stress at the Silking Stage of Corn (mm). Over the long term, one year in four will have this much or more plant moisture stress.

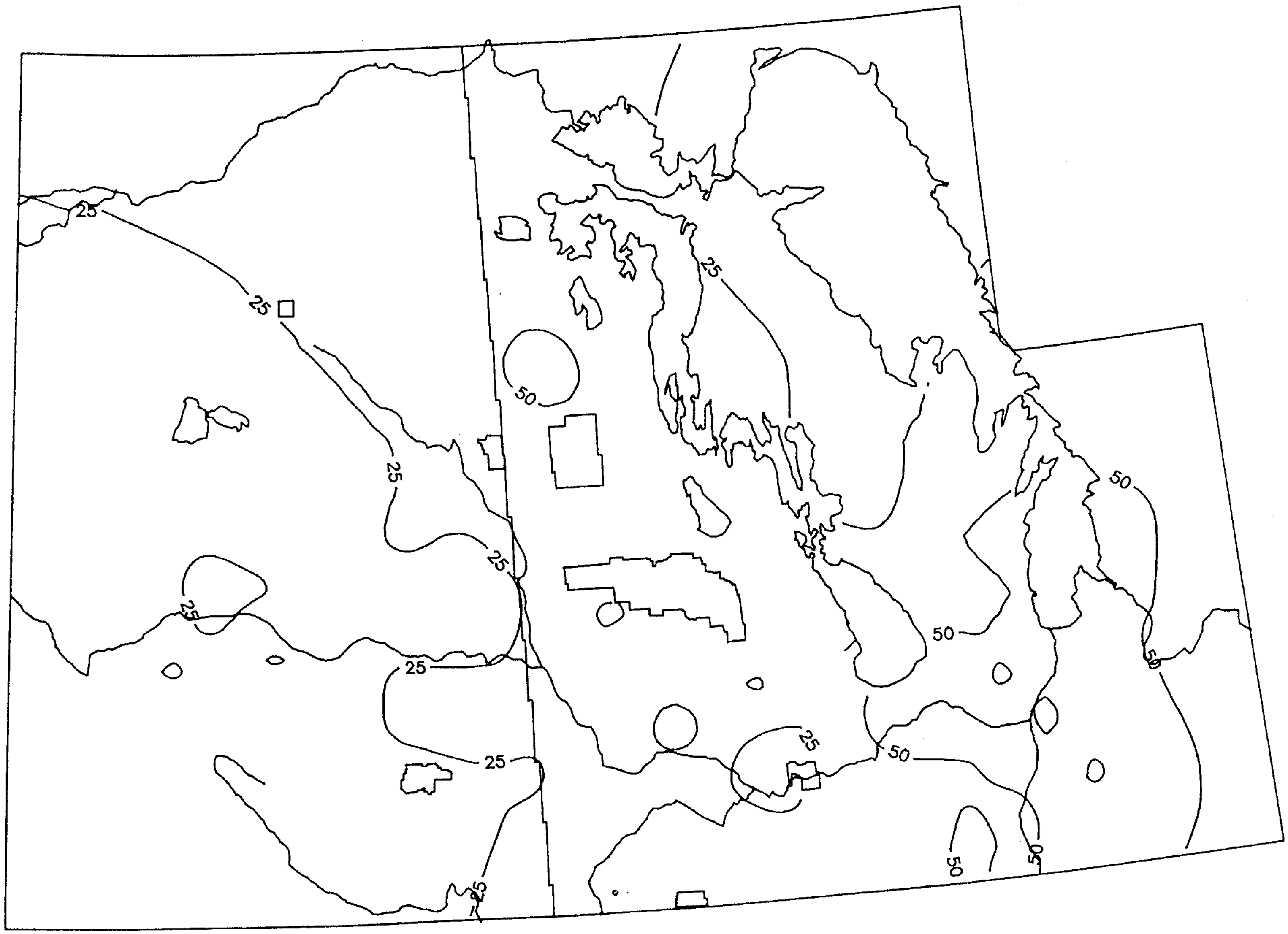


Figure 37: 10% Risk of Soil Moisture Amounts at the Silage Stage of Corn (mm). Over the long term, one year in ten will have this much or less moisture in the soil.

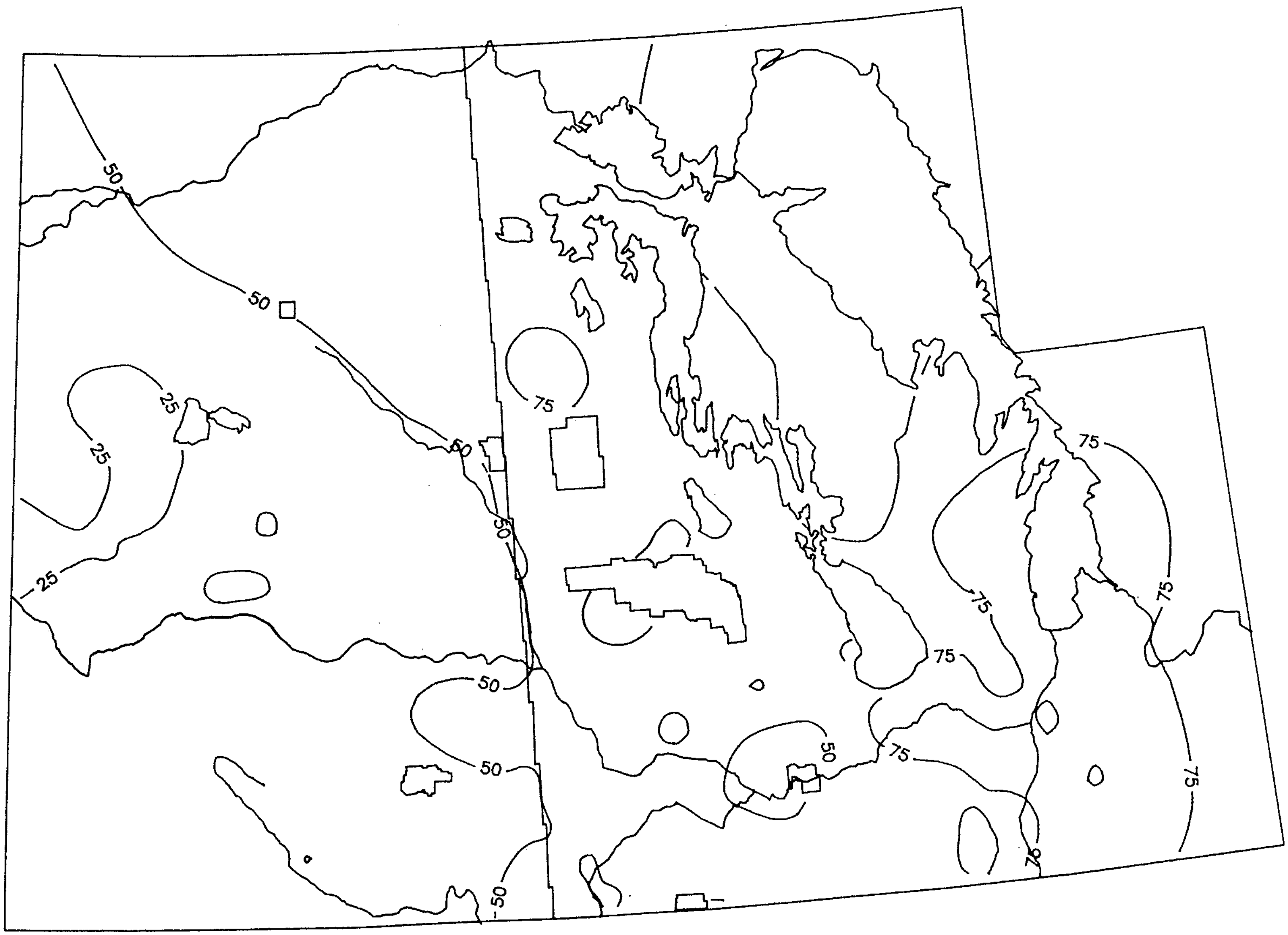


Figure 38: 25% Risk of Soil Moisture Amounts at the Silage Stage of Corn (mm). Over the long term, one year in four will have this much or less moisture in the soil.

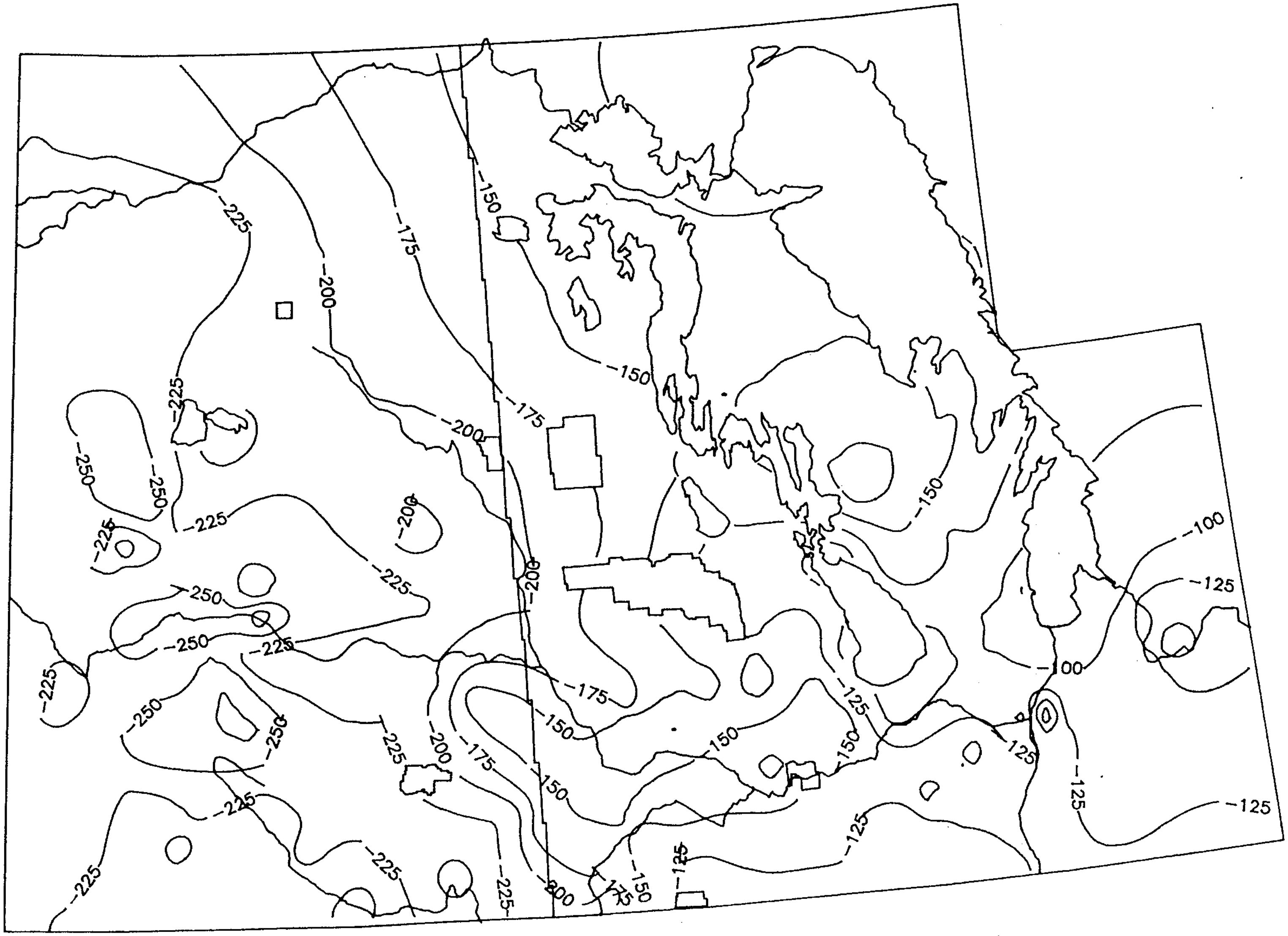


Figure 39: 10% Risk of Plant Moisture Stress at the Silage Stage of Corn (mm). Over the long term, one year in ten will have this much or more plant moisture stress.

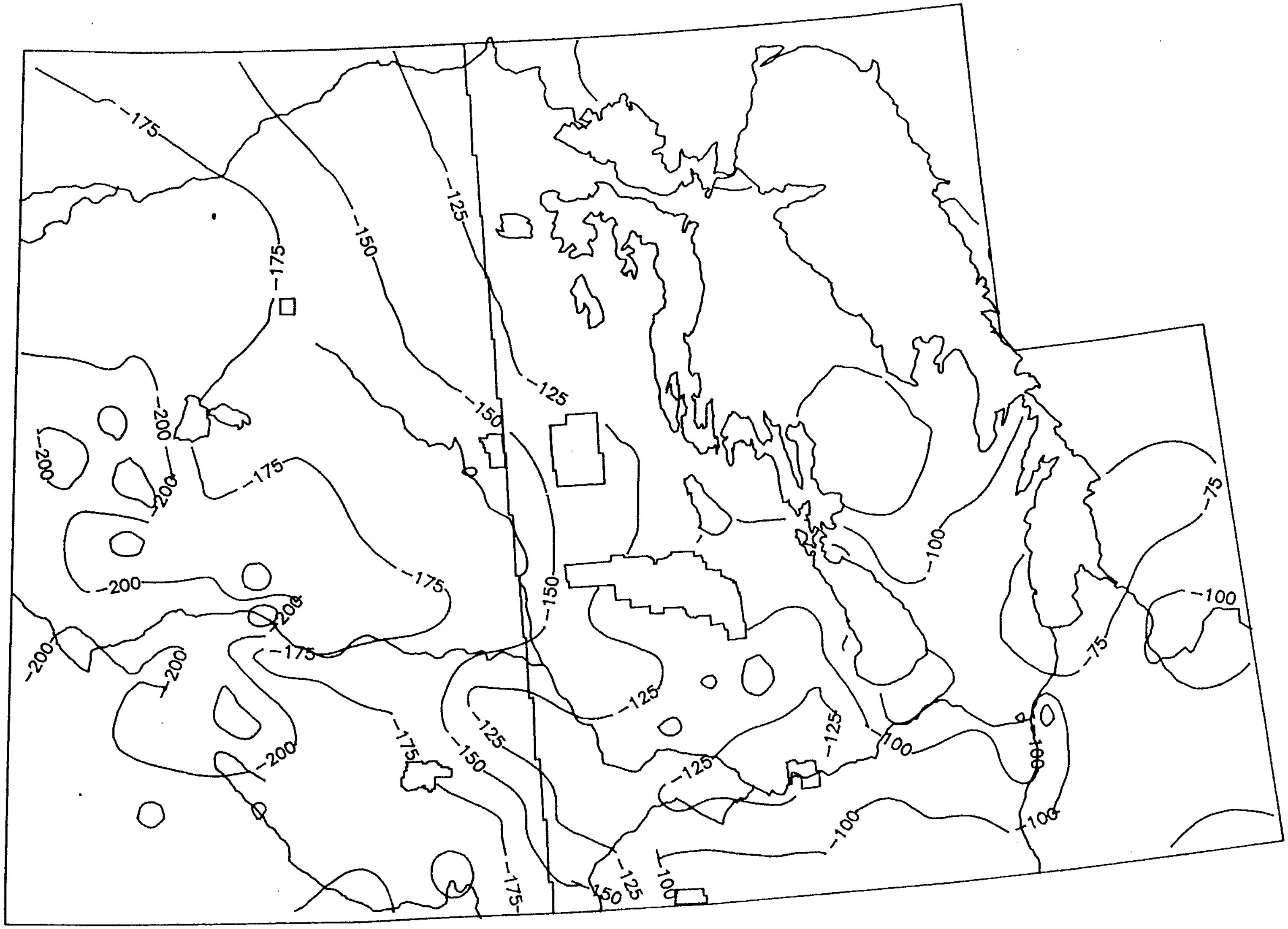


Figure 40: 25% Risk of Plant Moisture Stress at the Silage Stage of Corn (mm). Over the long term, one year in four will have this much or more plant moisture stress.

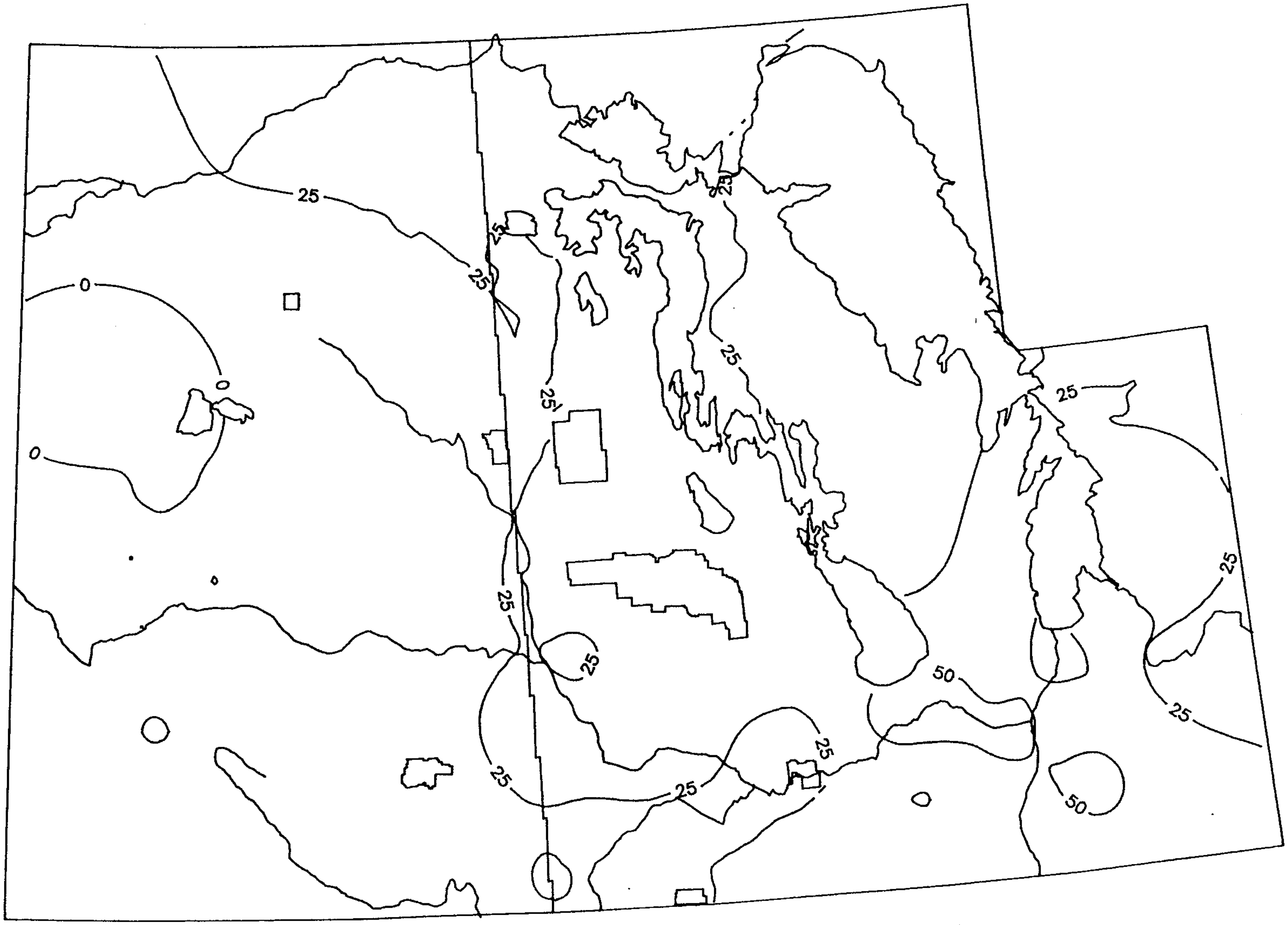


Figure 41: 10% Risk of Soil Moisture Amounts at the Grain Stage of Corn (mm). Over the long term, one year in ten will have this much or less moisture in the soil.

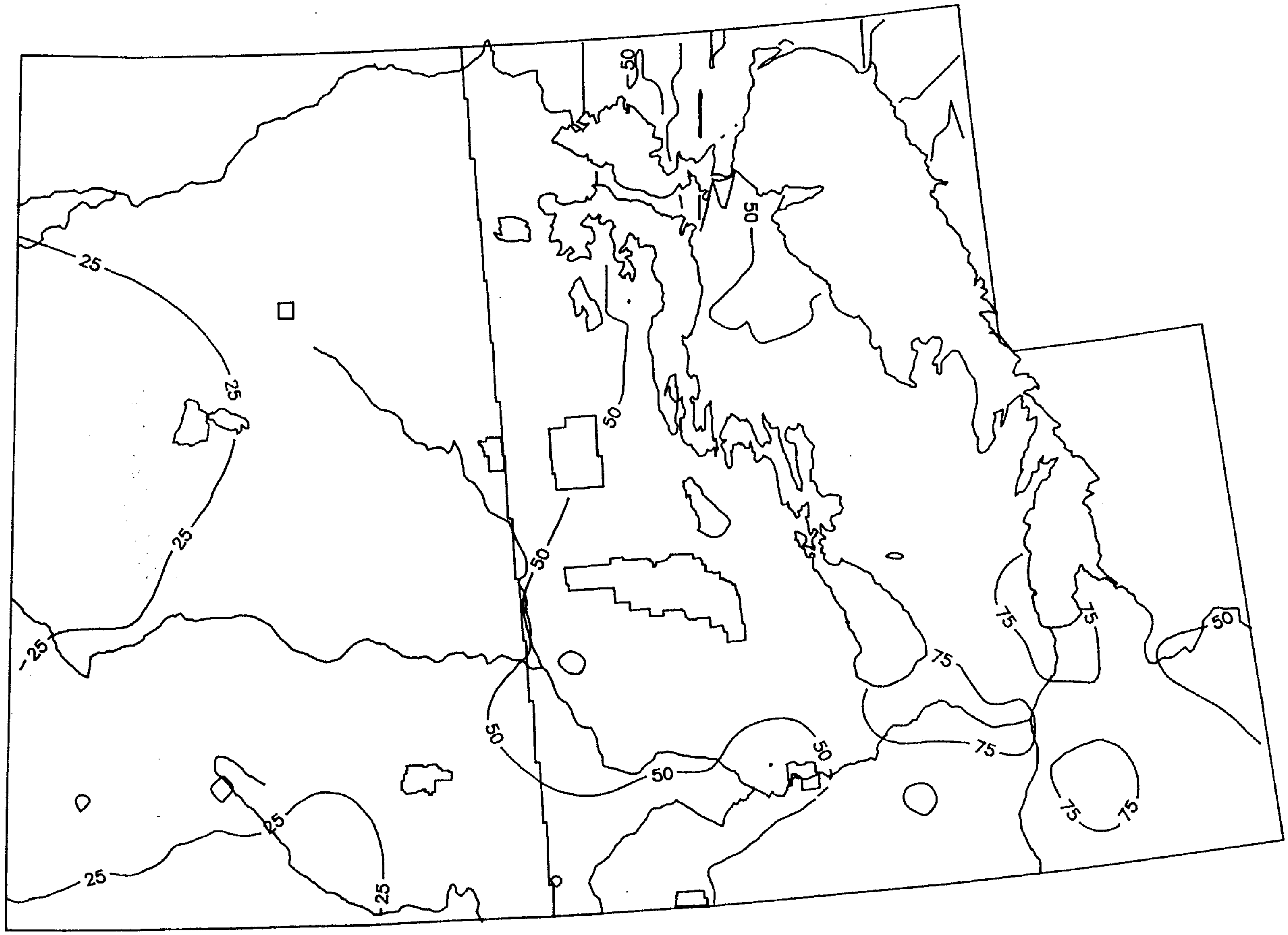


Figure 42: 25% Risk of Soil Moisture Amounts at the Grain Stage of Corn (mm). Over the long term, one year in four will have this much or less moisture in the soil.

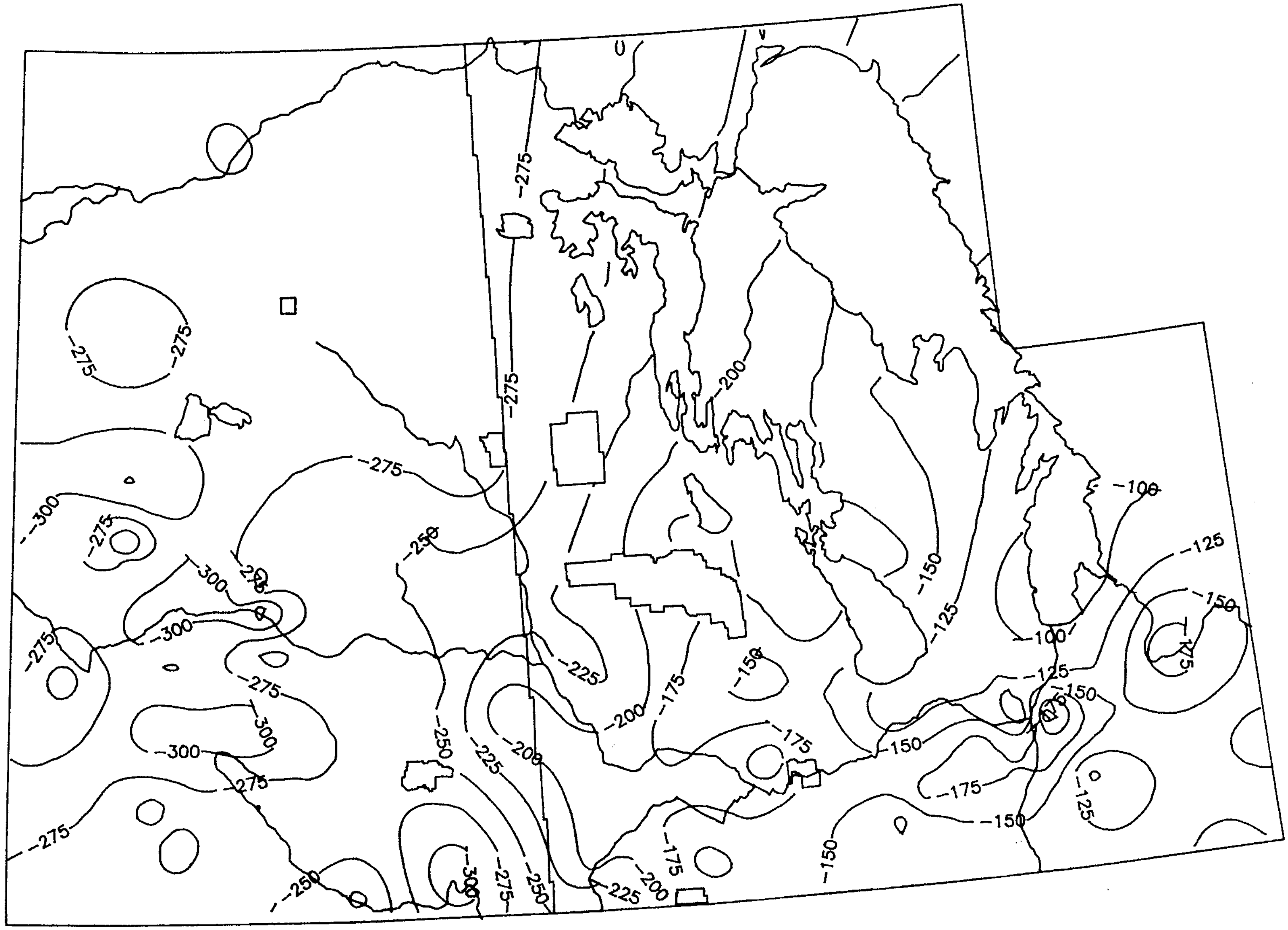


Figure 43: 10% Risk of Plant Moisture Stress at the Grain Stage of Corn (mm). Over the long term, one year in ten will have this much or more plant moisture stress.

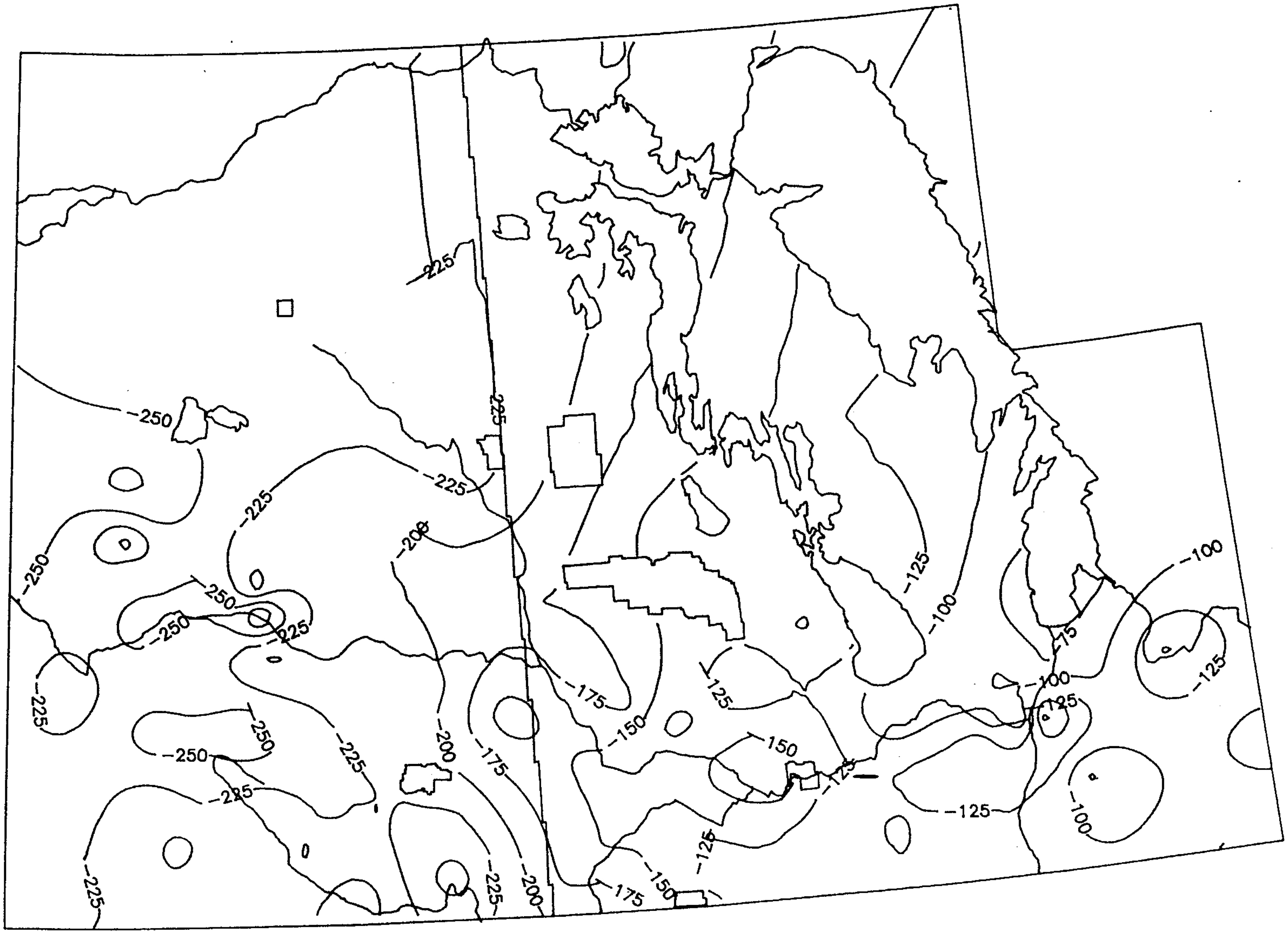


Figure 44: 25% Risk of Plant Moisture Stress at the Grain Stage of Corn (mm). Over the long term, one year in four will have this much or more plant moisture stress.

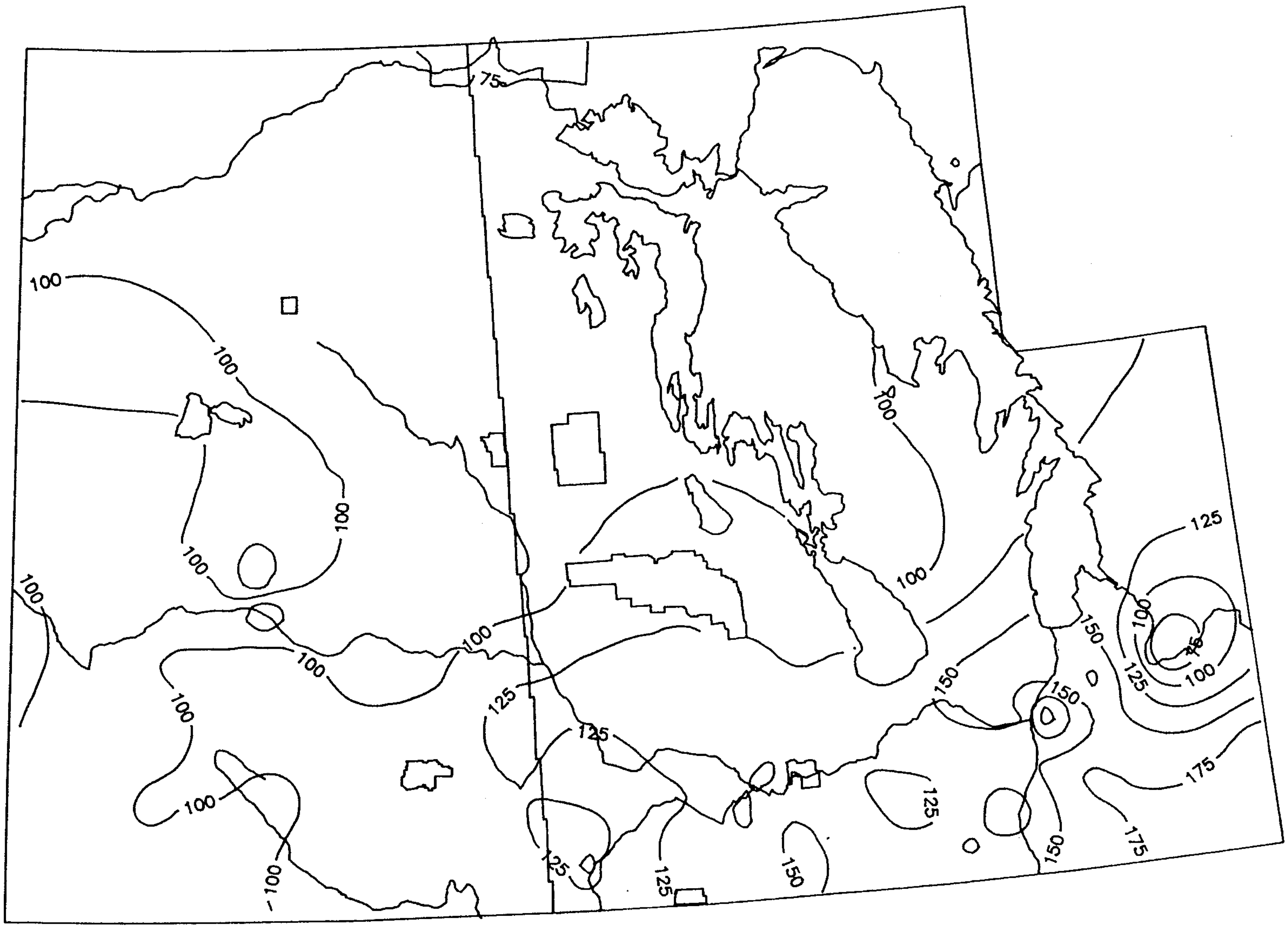


Figure 45: 10% Risk of Growing Season Precipitation for Corn (mm). Over the long term, one year in ten will have this much or less growing season precipitation.

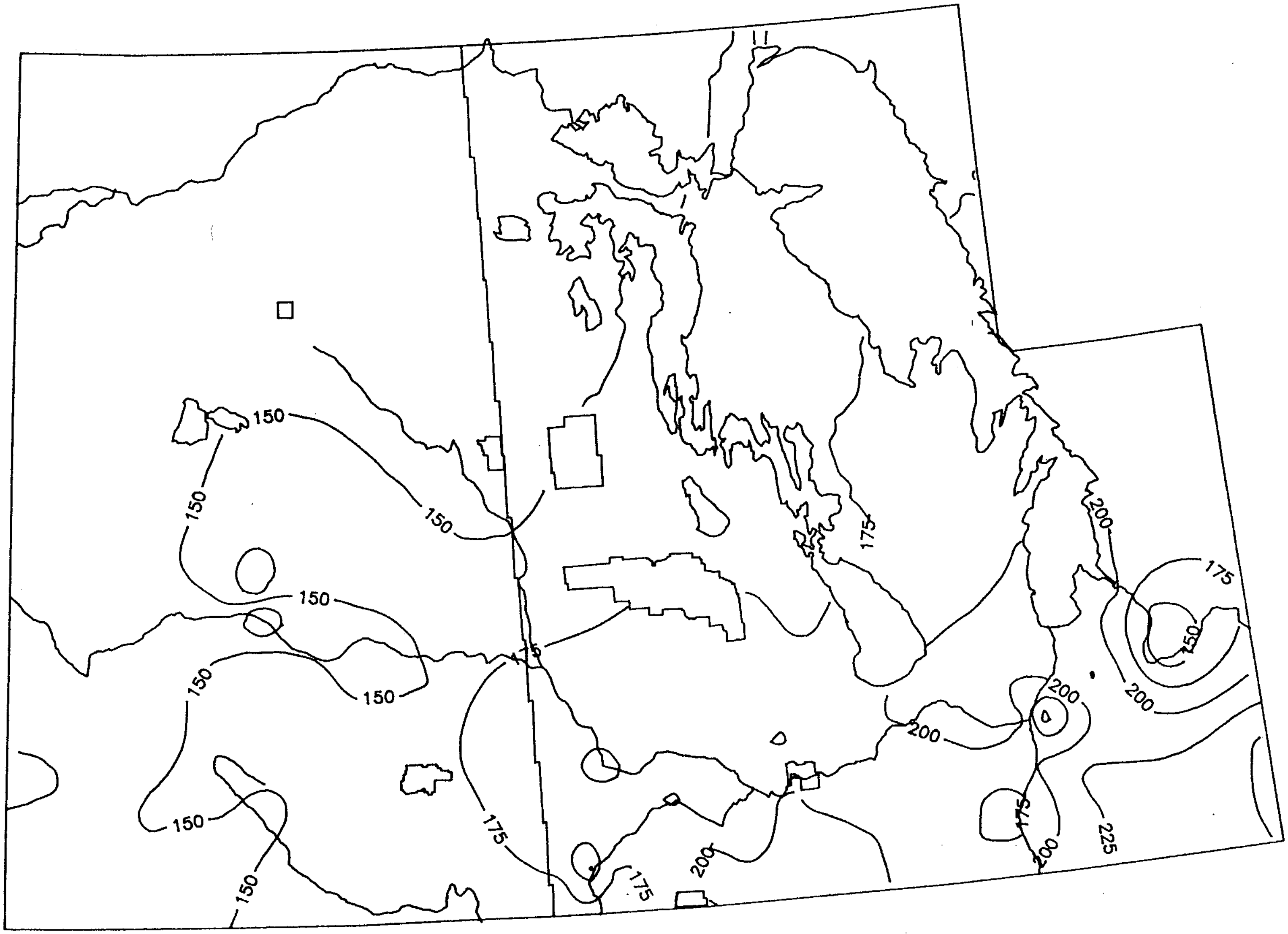


Figure 46: 25% Risk of Growing Season Precipitation for Corn (mm). Over the long term, one year in four will have this much or less growing season precipitation.

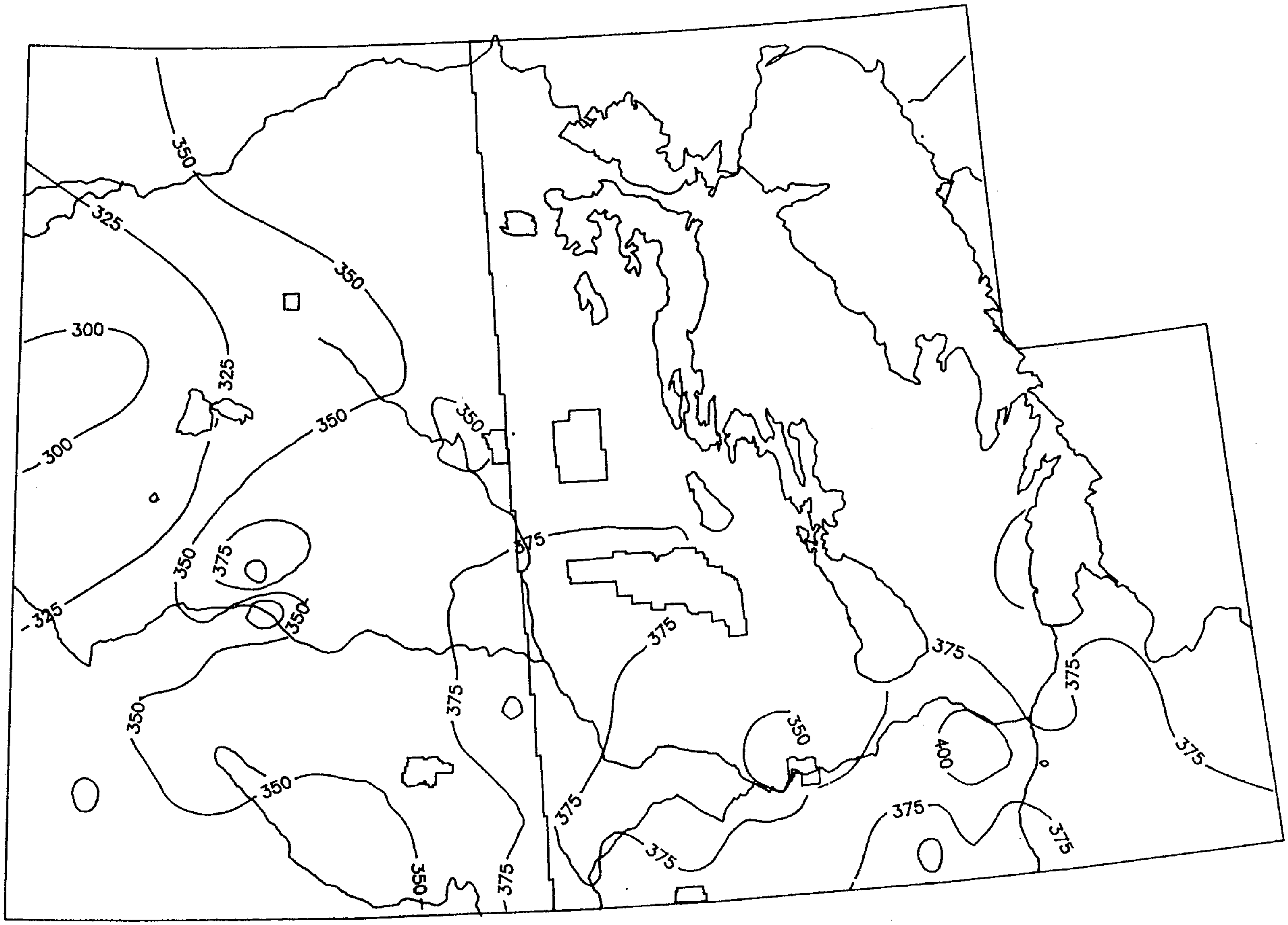


Figure 47: 10% Risk of Growing Season Actual Evapotranspiration for Corn (mm). Over the long term, one year in ten will have this much or more growing season actual evapotranspiration.

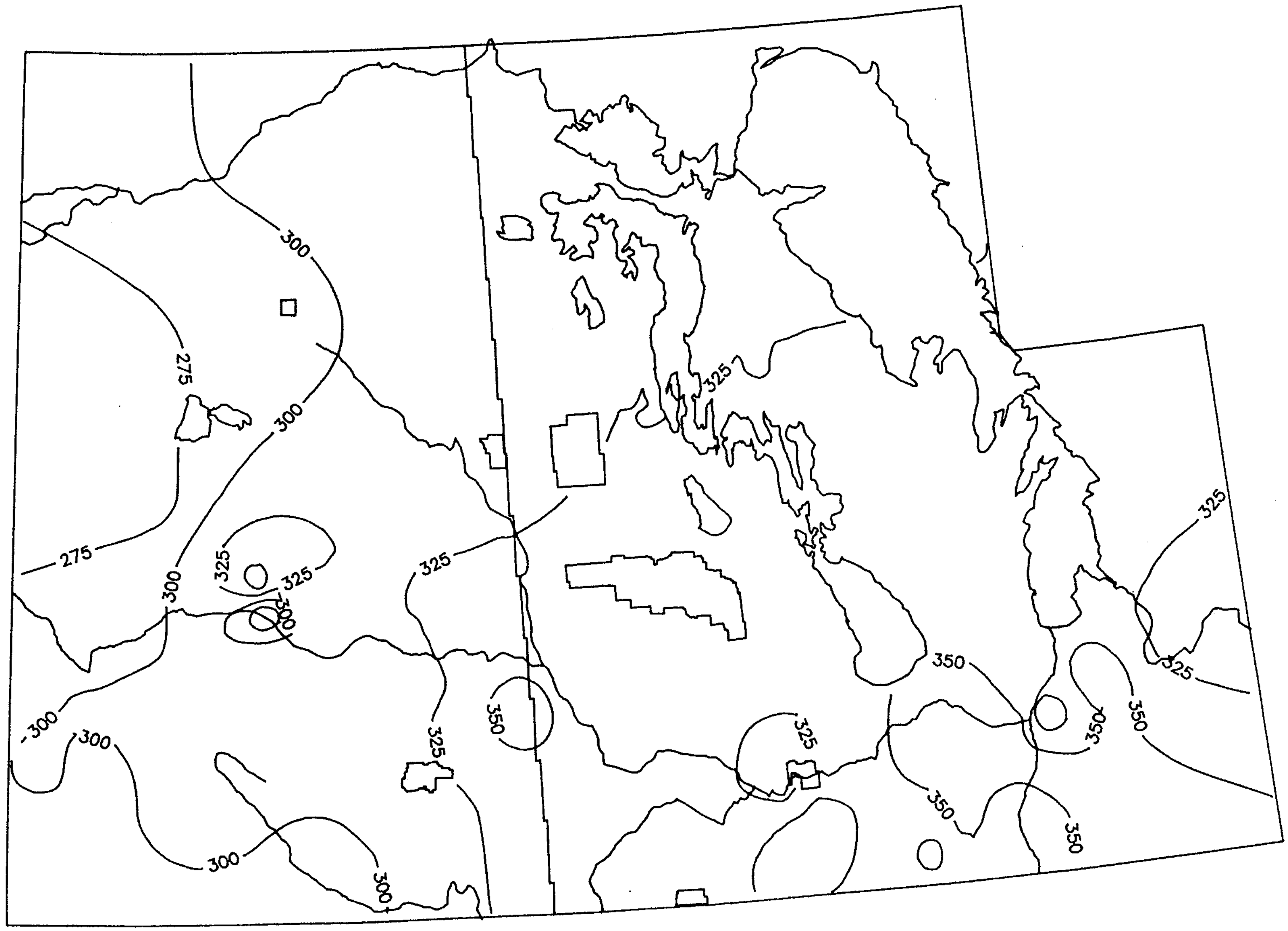


Figure 48: 25% Risk of Growing Season Actual Evapotranspiration for Corn (mm). Over the long term, one year in four will have this much or more growing season actual evapotranspiration.

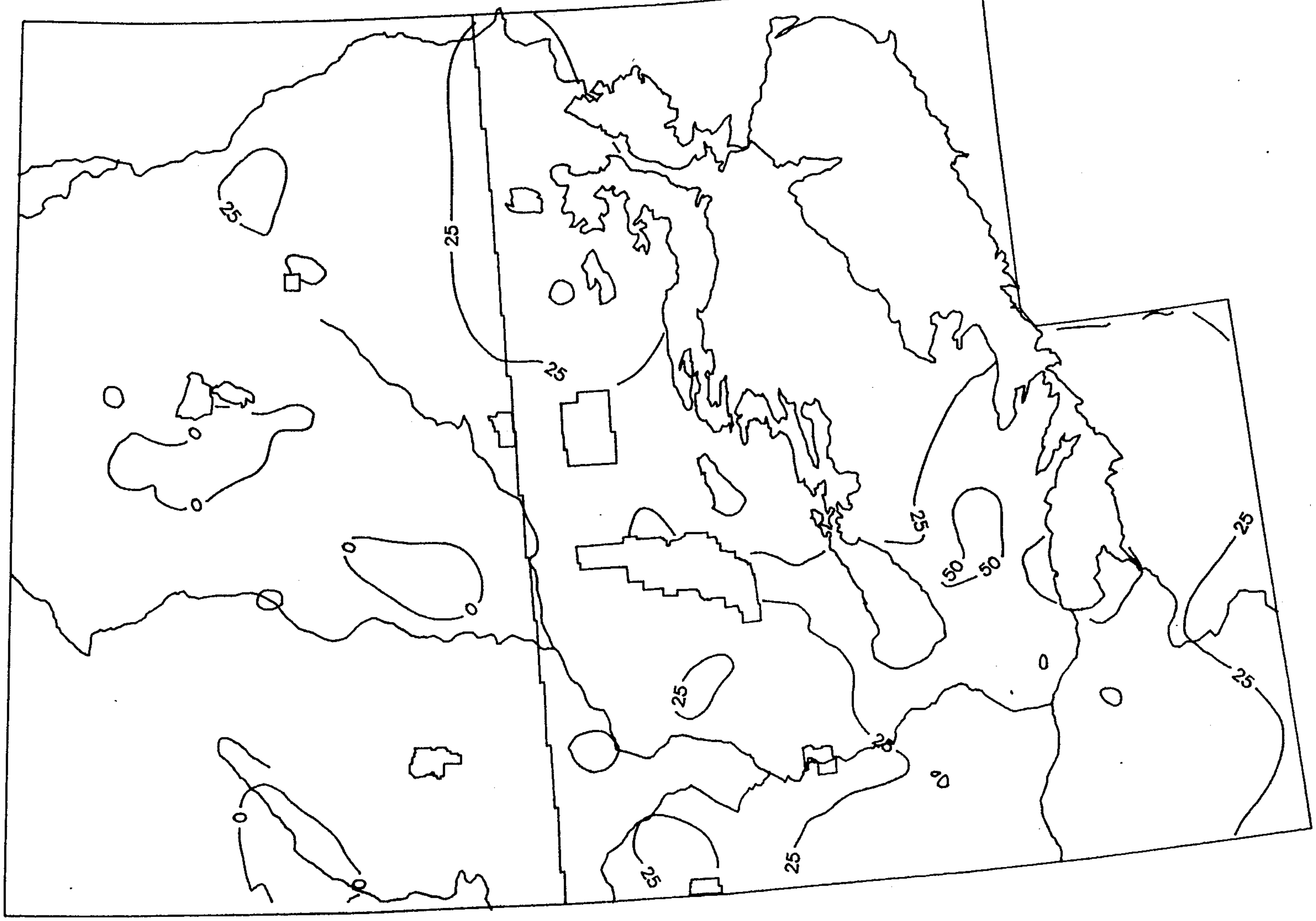


Figure 49: 10% Risk of Soil Moisture Amounts at the First Cut of Alfalfa (mm). Over the long term, one year in ten will have this much or less moisture in the soil.

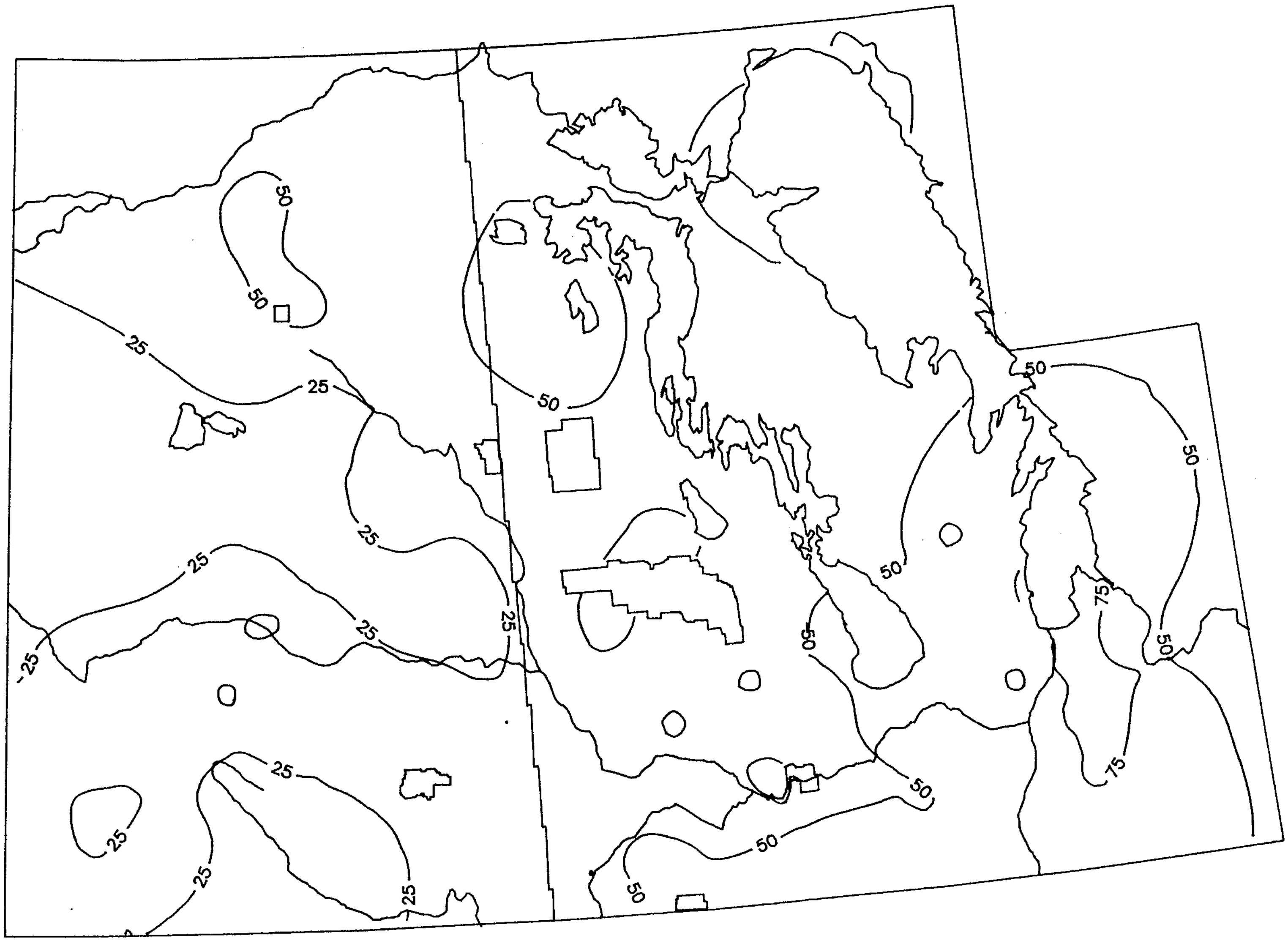


Figure 50: 25% Risk of Soil Moisture Amounts at the First Cut of Alfalfa (mm). Over the long term, one year in four will have this much or less moisture in the soil.

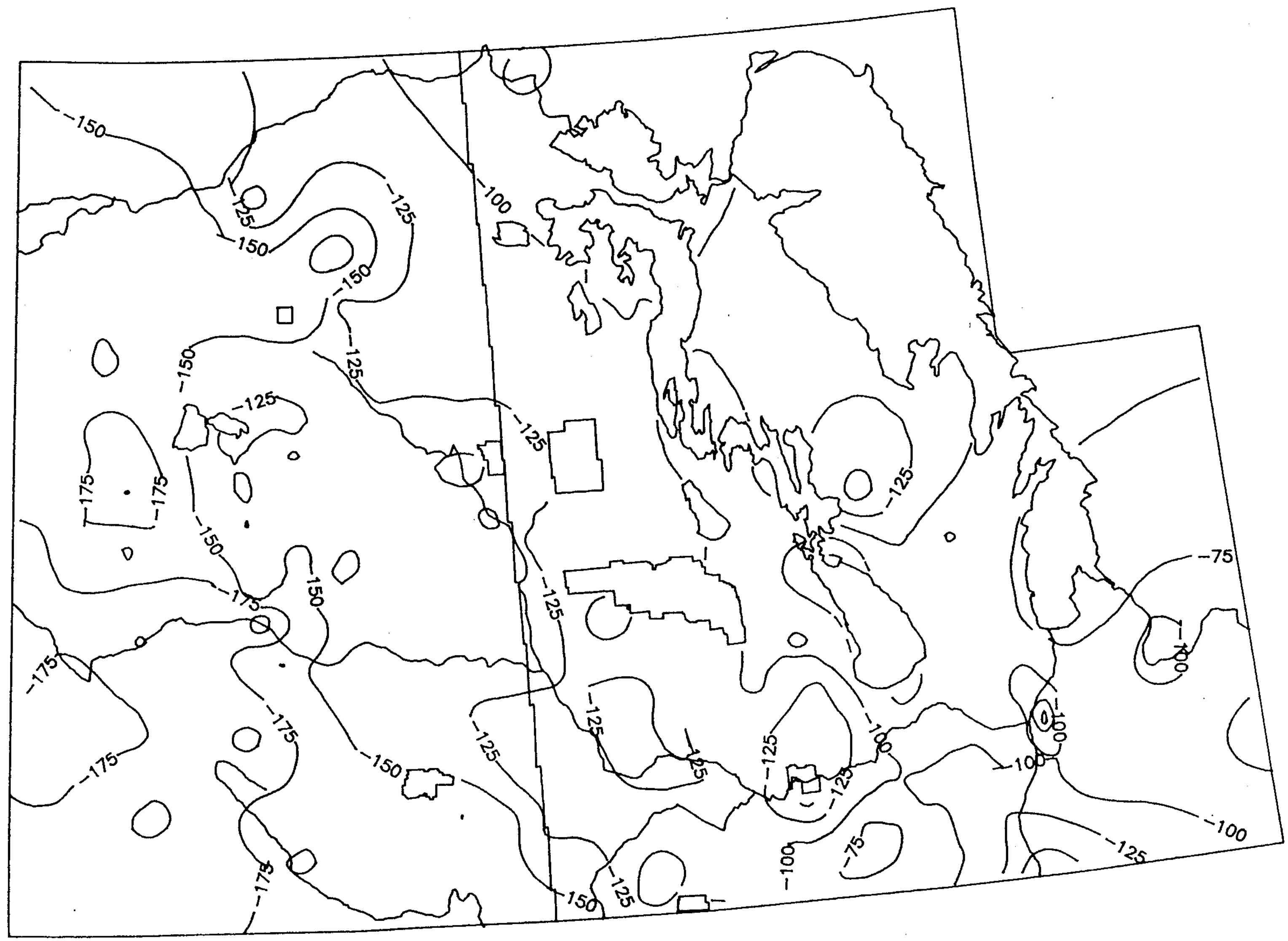


Figure 51: 10% Risk of Plant Moisture Stress at the First Cut of Alfalfa (mm). Over the long term, one year in ten will have this much or more plant moisture stress.

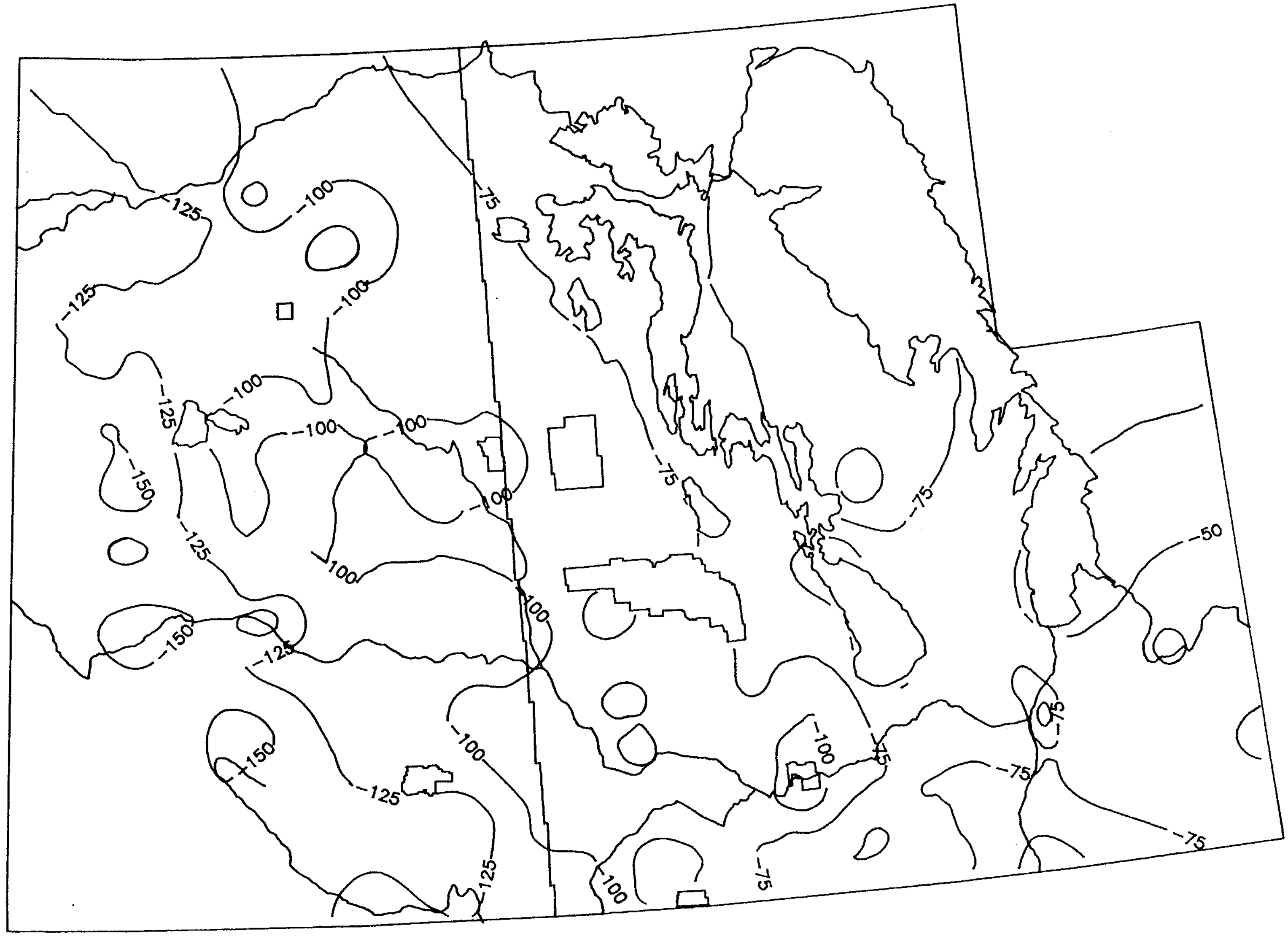


Figure 52: 25% Risk of Plant Moisture Stress at the First Cut of Alfalfa (mm). Over the long term, one year in four will have this much or more plant moisture stress.

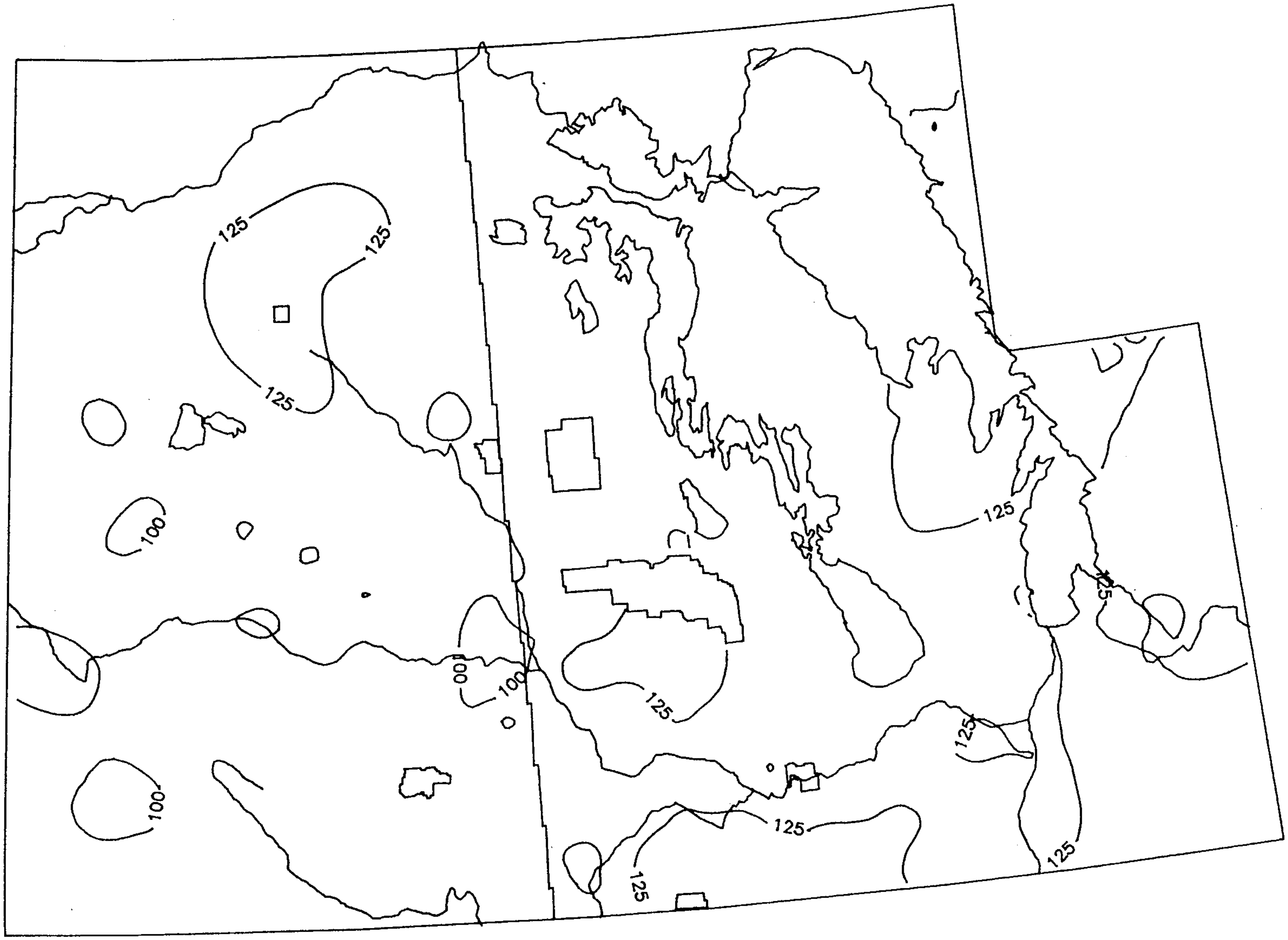


Figure 53: Average Accumulated Precipitation to the First Cut of Alfalfa (mm).

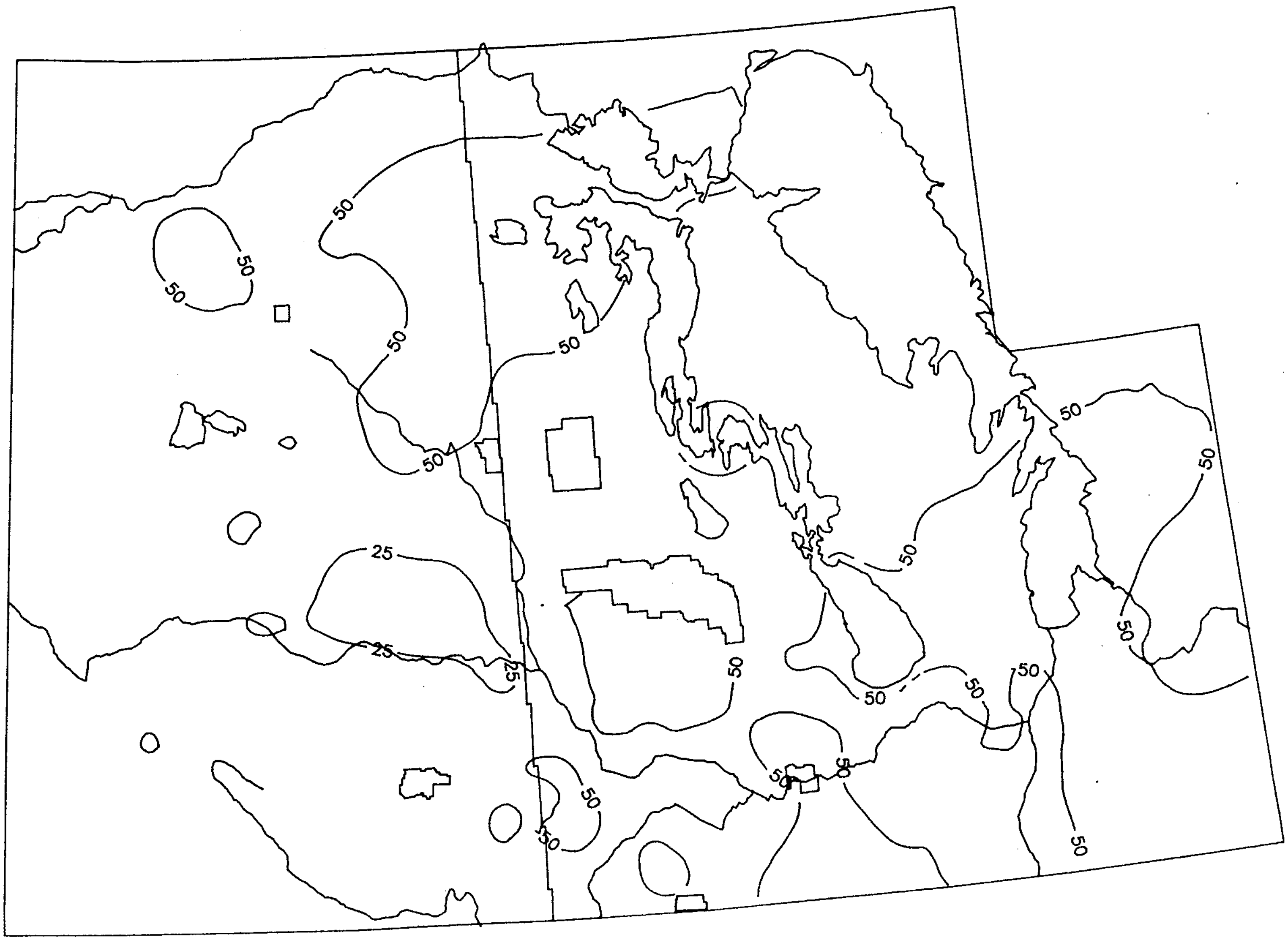


Figure 54: 10% Risk of Precipitation to the First Cut of Alfalfa (mm). Over the long term, one year in ten will have this much or less precipitation to the first cut of alfalfa.

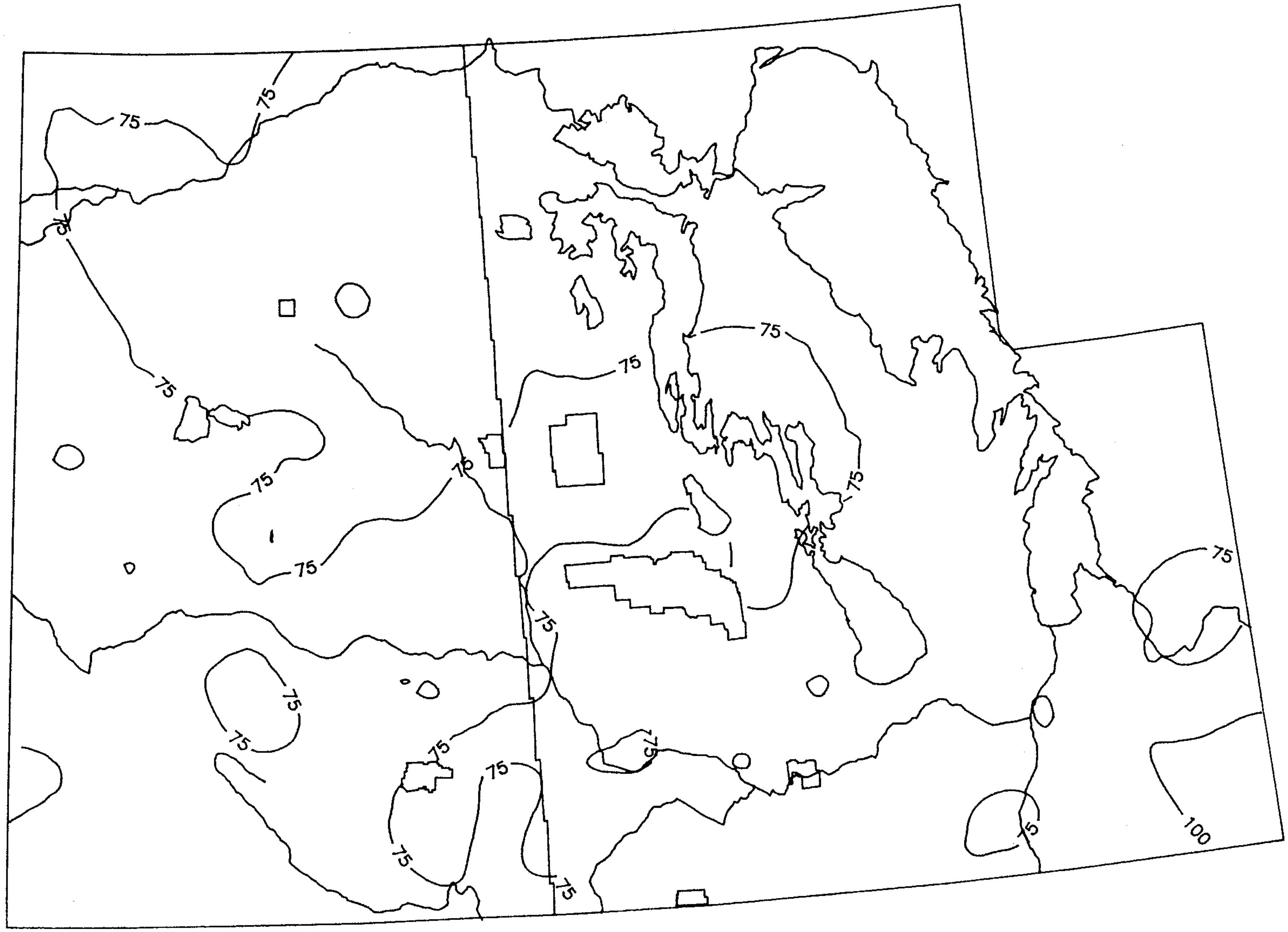


Figure 55: 25% Risk of Precipitation to the First Cut of Alfalfa (mm). Over the long term, one year in four will have this much or less precipitation to the first cut of alfalfa.

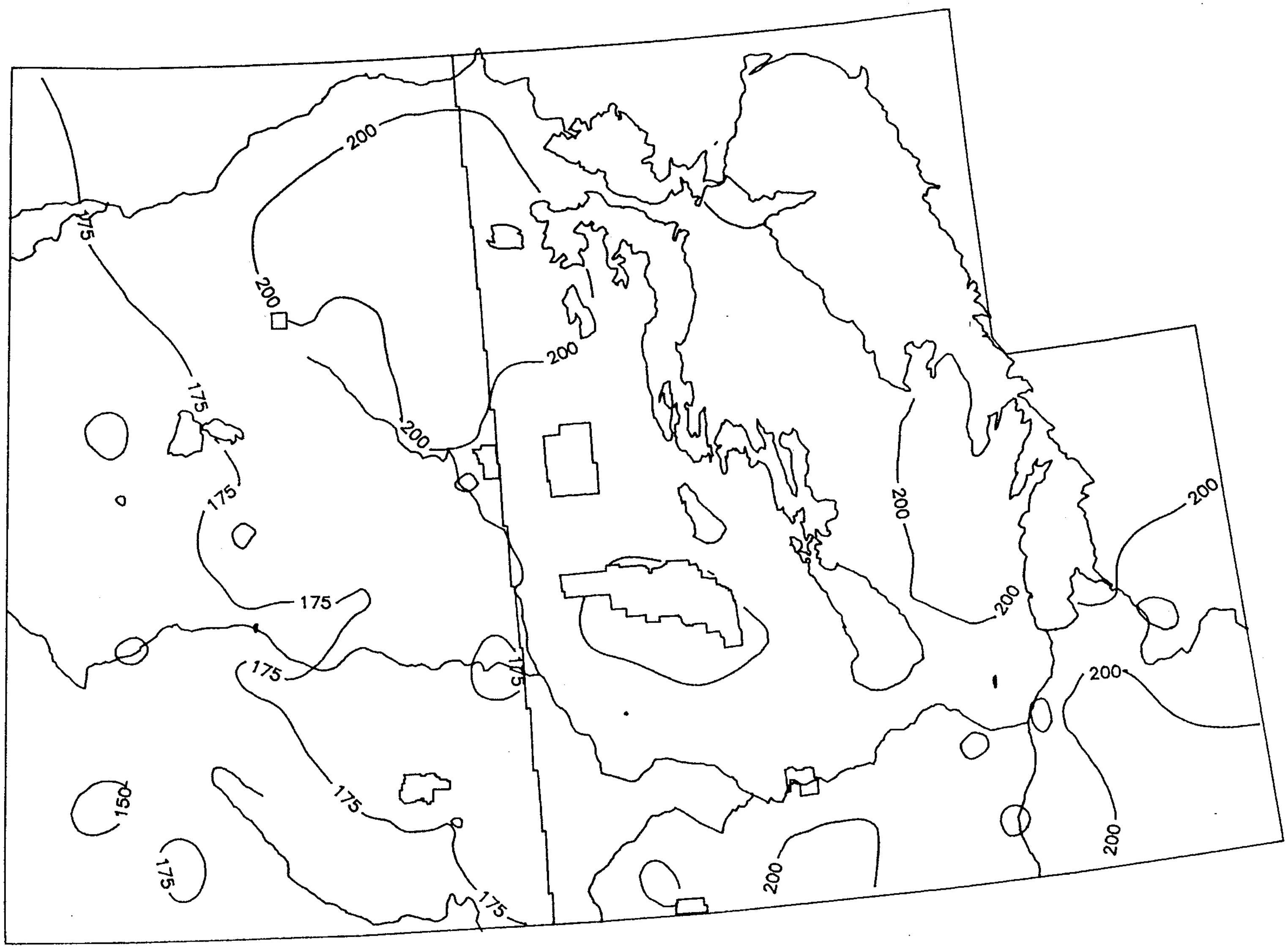


Figure 56: Average Accumulated Actual Evapotranspiration to the First Cut of Alfalfa (mm).

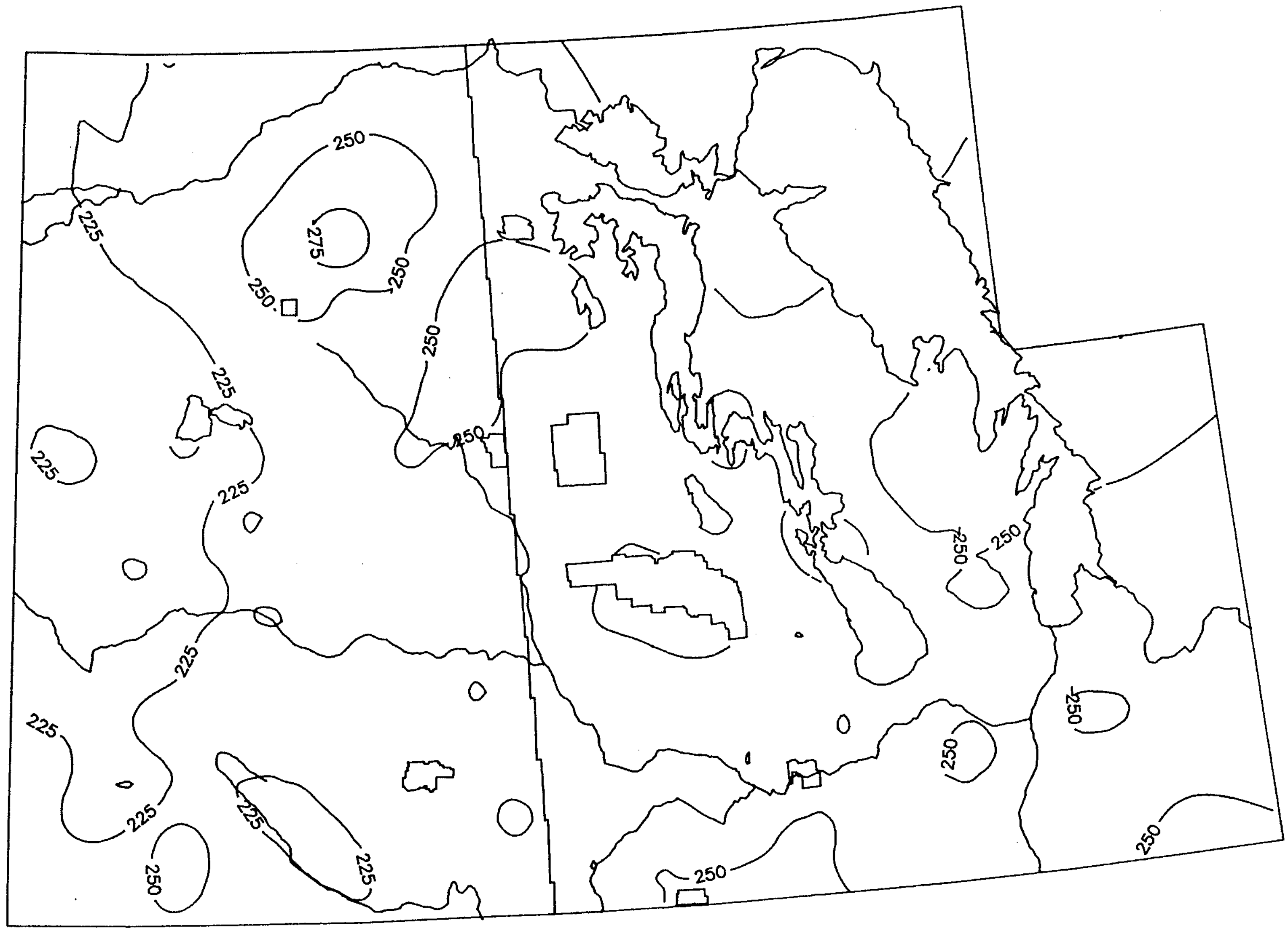


Figure 57: 10% Risk of Actual Evapotranspiration to the First Cut of Alfalfa (mm). Over the long term, one year in ten will have this much or more actual evapotranspiration to the first cut of alfalfa.

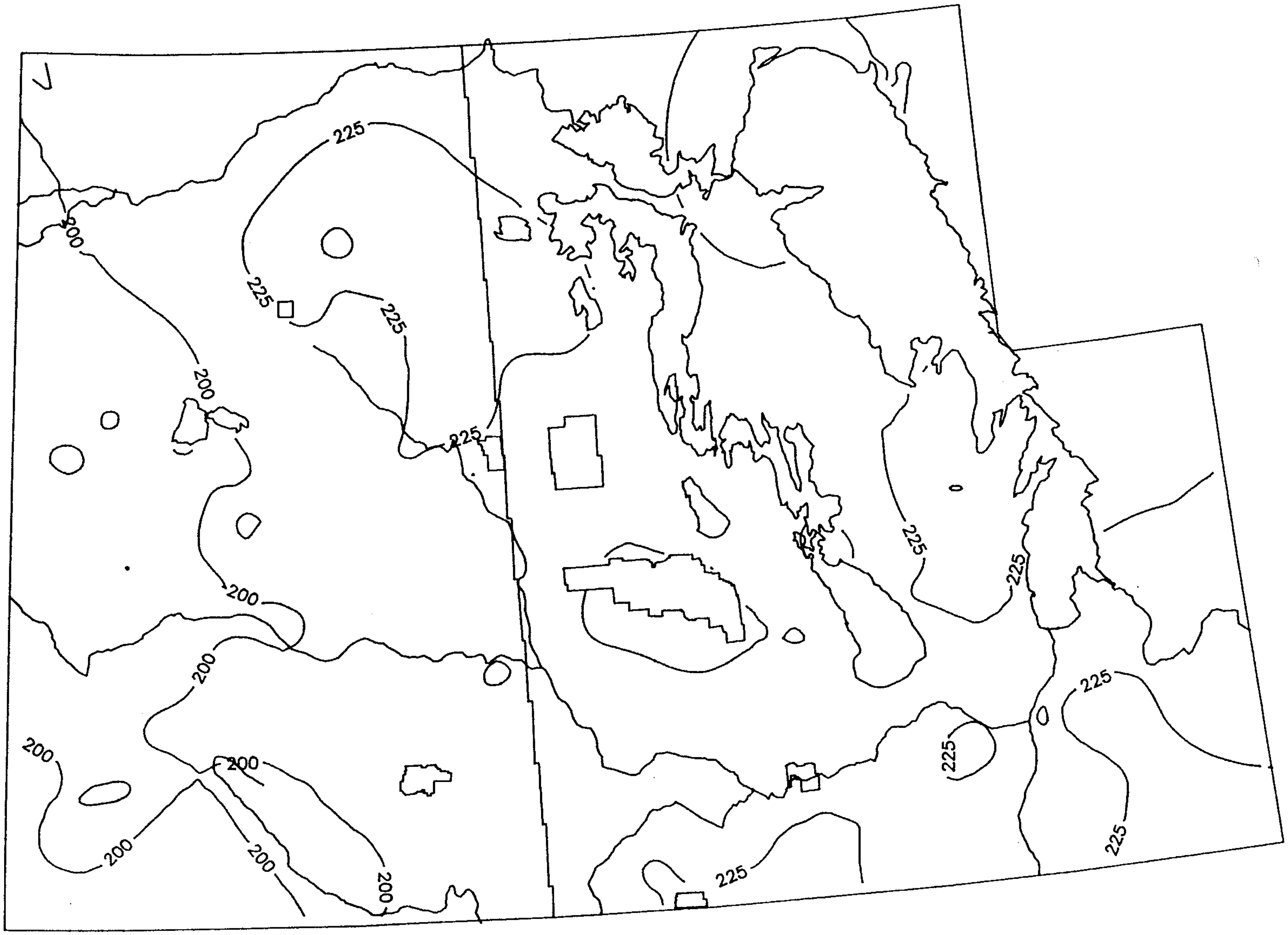


Figure 58: 25% Risk of Actual Evapotranspiration to the First Cut of Alfalfa (mm). Over the long term, one year in four will have this much or more actual evapotranspiration to the first cut of alfalfa.

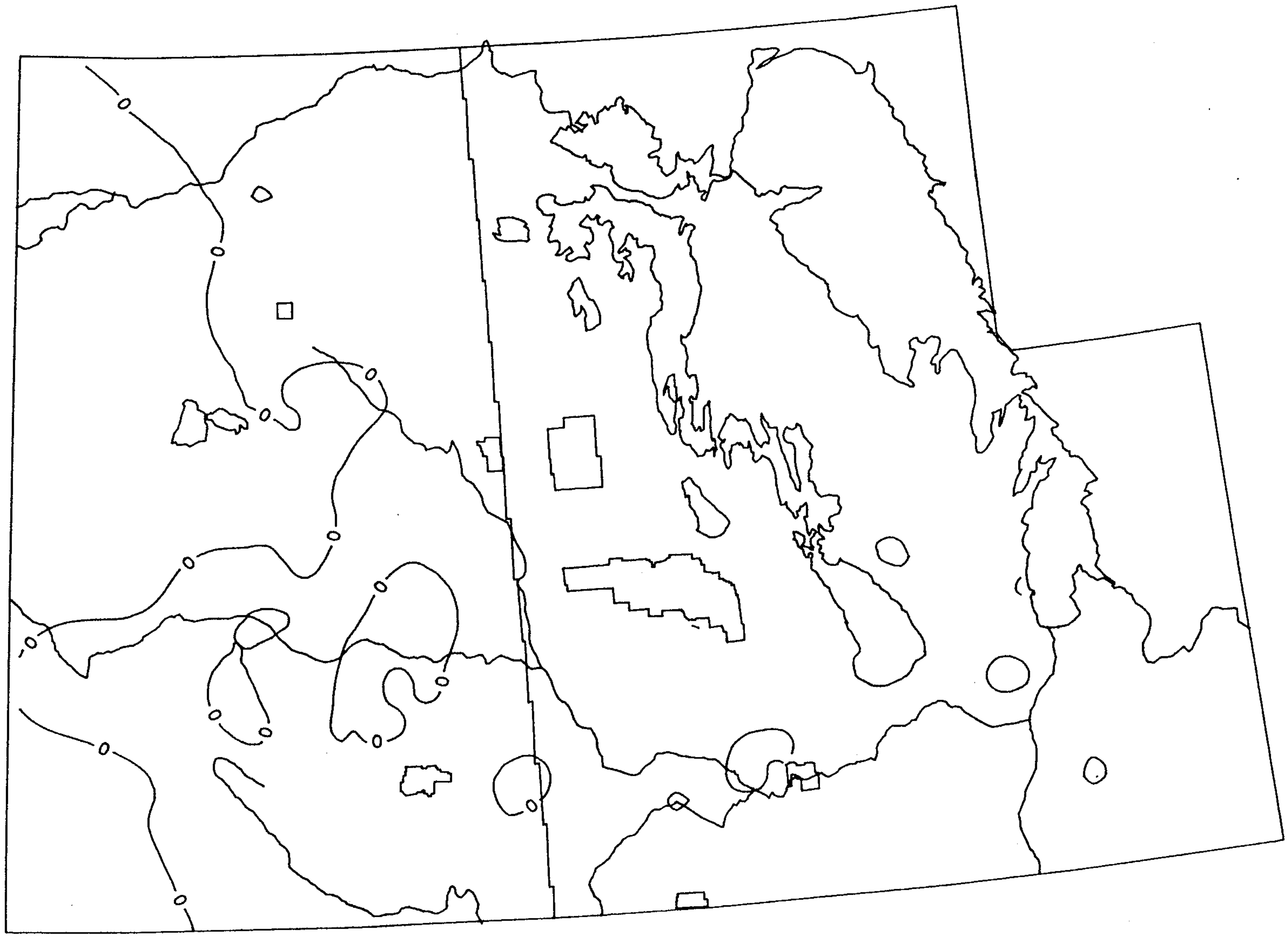


Figure 59: 10% Risk of Soil Moisture Amounts at the Second Cut of Alfalfa (mm). Over the long term, one year in ten will have this much or less moisture in the soil.

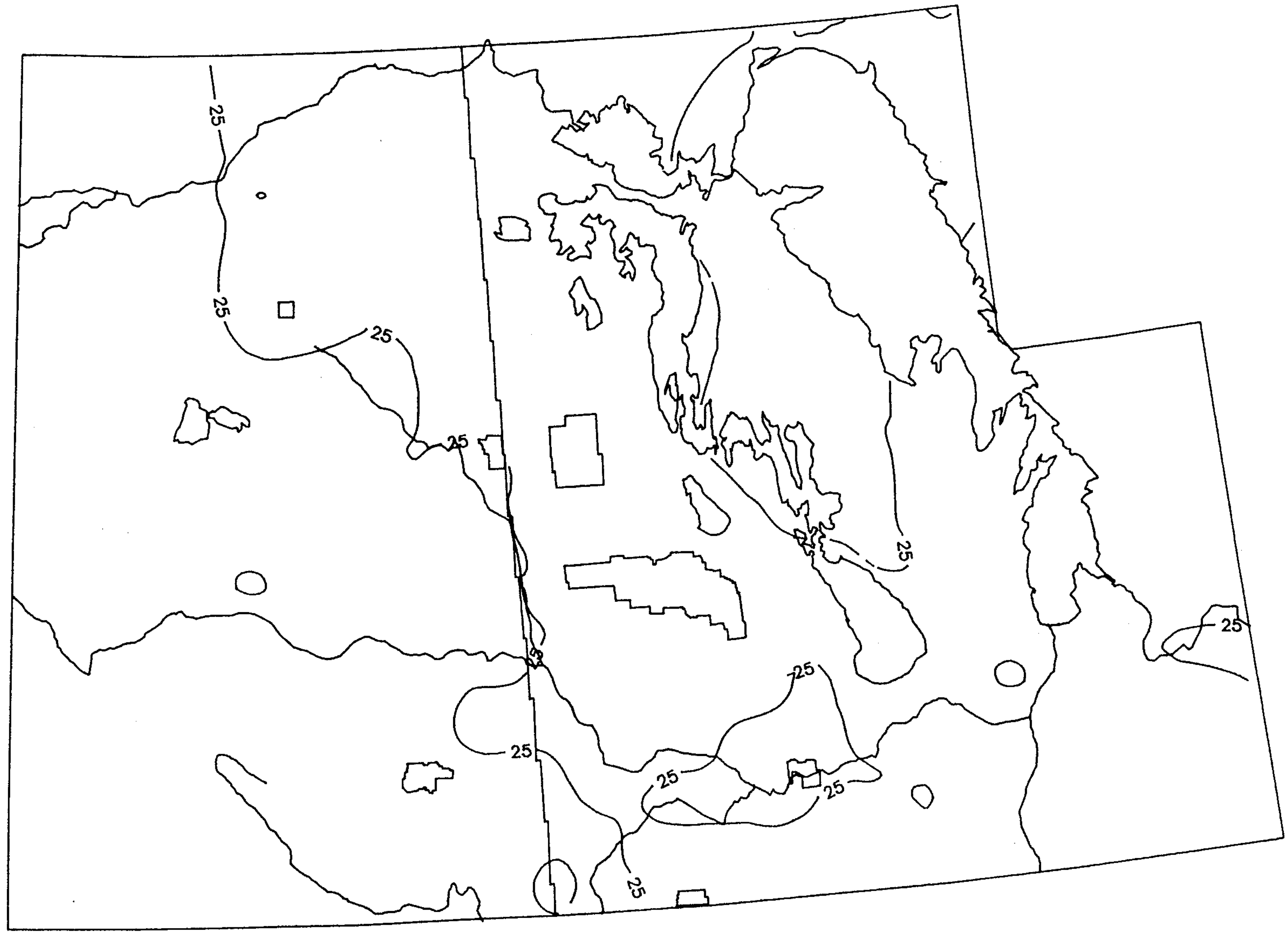


Figure 60: 25% Risk of Soil Moisture Amounts at the Second Cut of Alfalfa (mm). Over the long term, one year in four will have this much or less moisture in the soil.

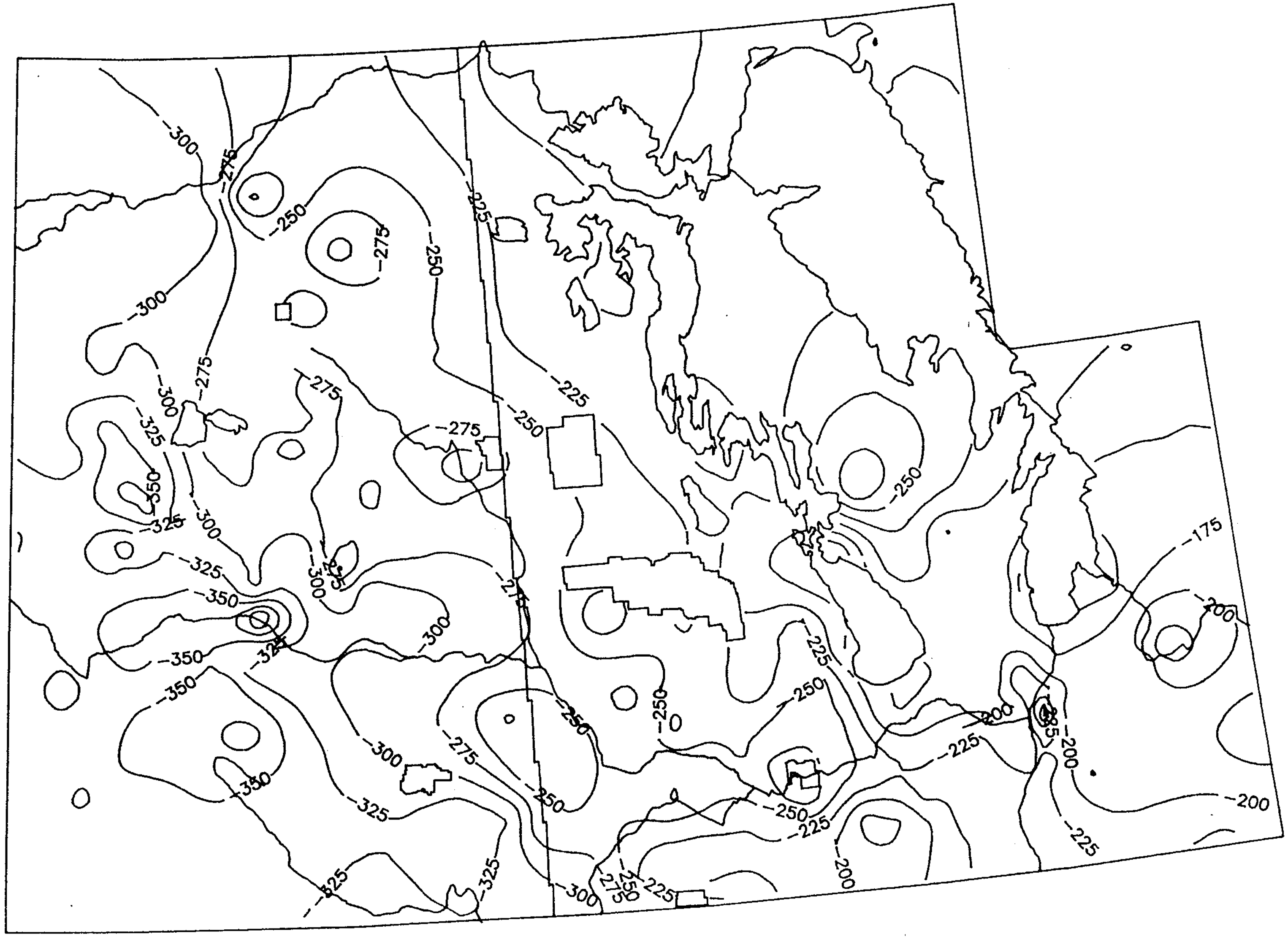

Figure 61: 10% Risk of Plant Moisture Stress at the Second Cut of Alfalfa (mm). Over the long term, one year in ten will have this much or more plant moisture stress.

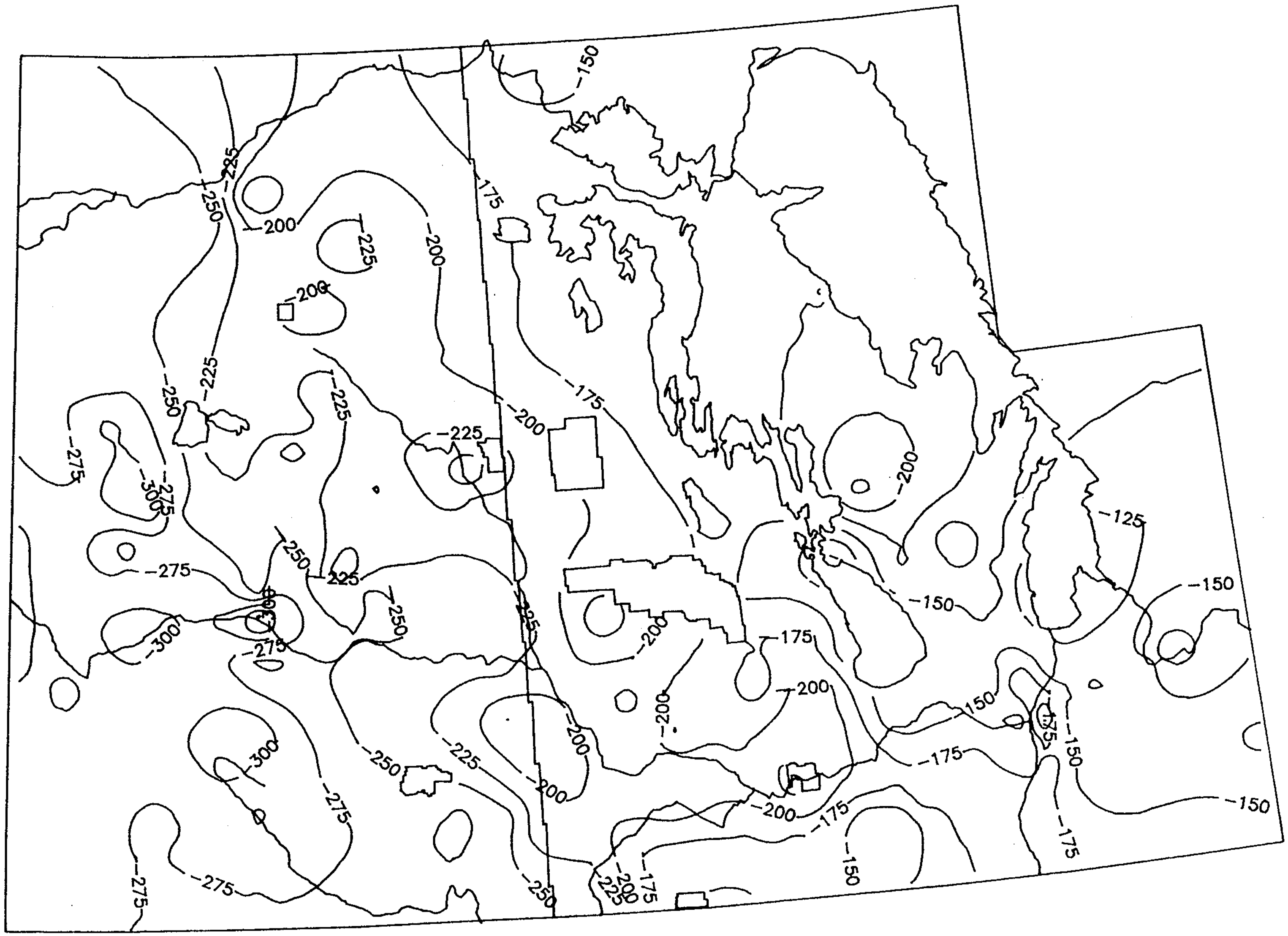


Figure 62: 25% Risk of Plant Moisture Stress at the Second Cut of Alfalfa (mm). Over the long term, one year in four will have this much or more plant moisture stress.

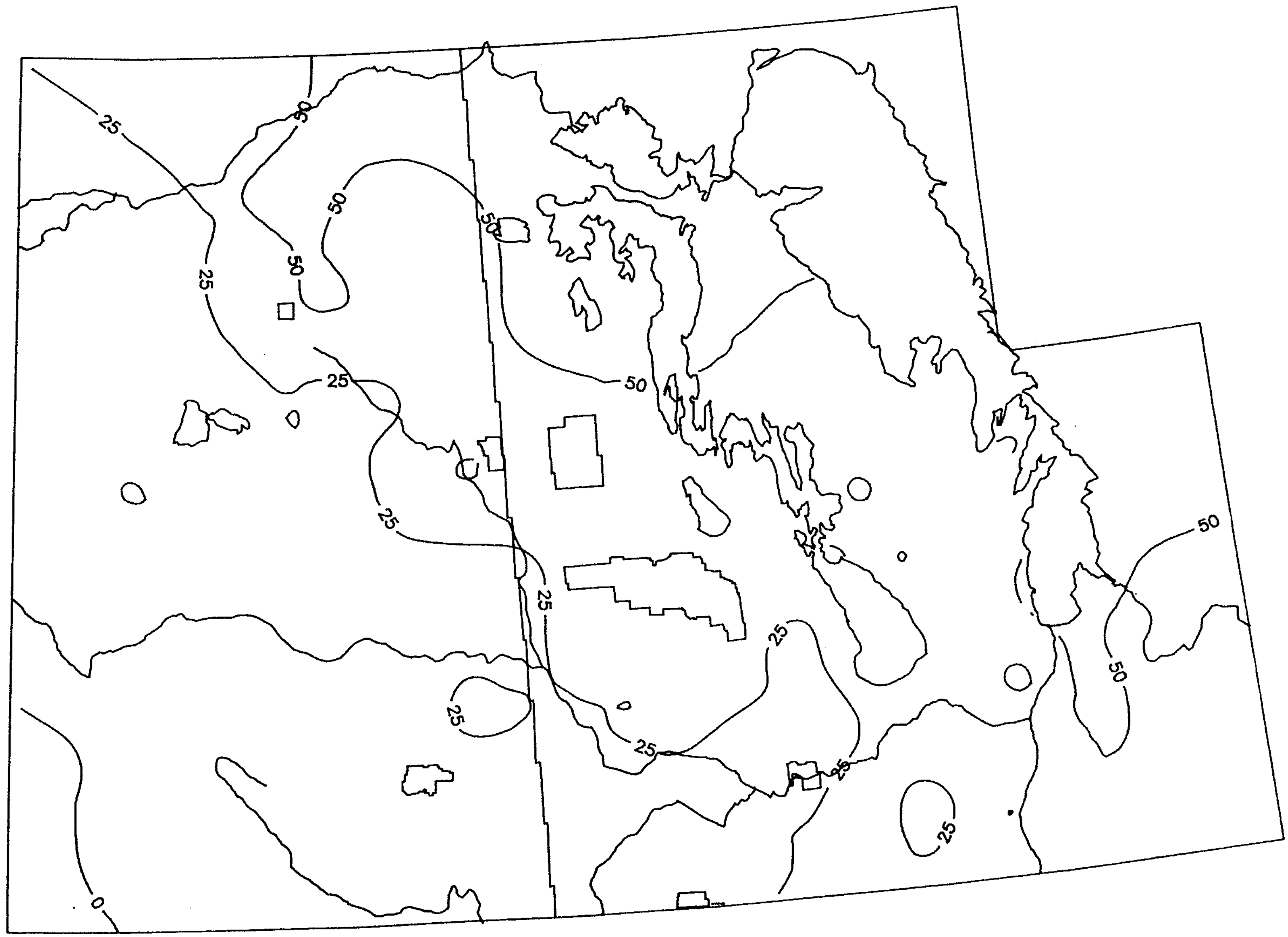


Figure 63: 10% Risk of Soil Moisture Amounts on October 31 for Alfalfa (mm). Over the long term, one year in ten will have this much or less moisture in the soil.

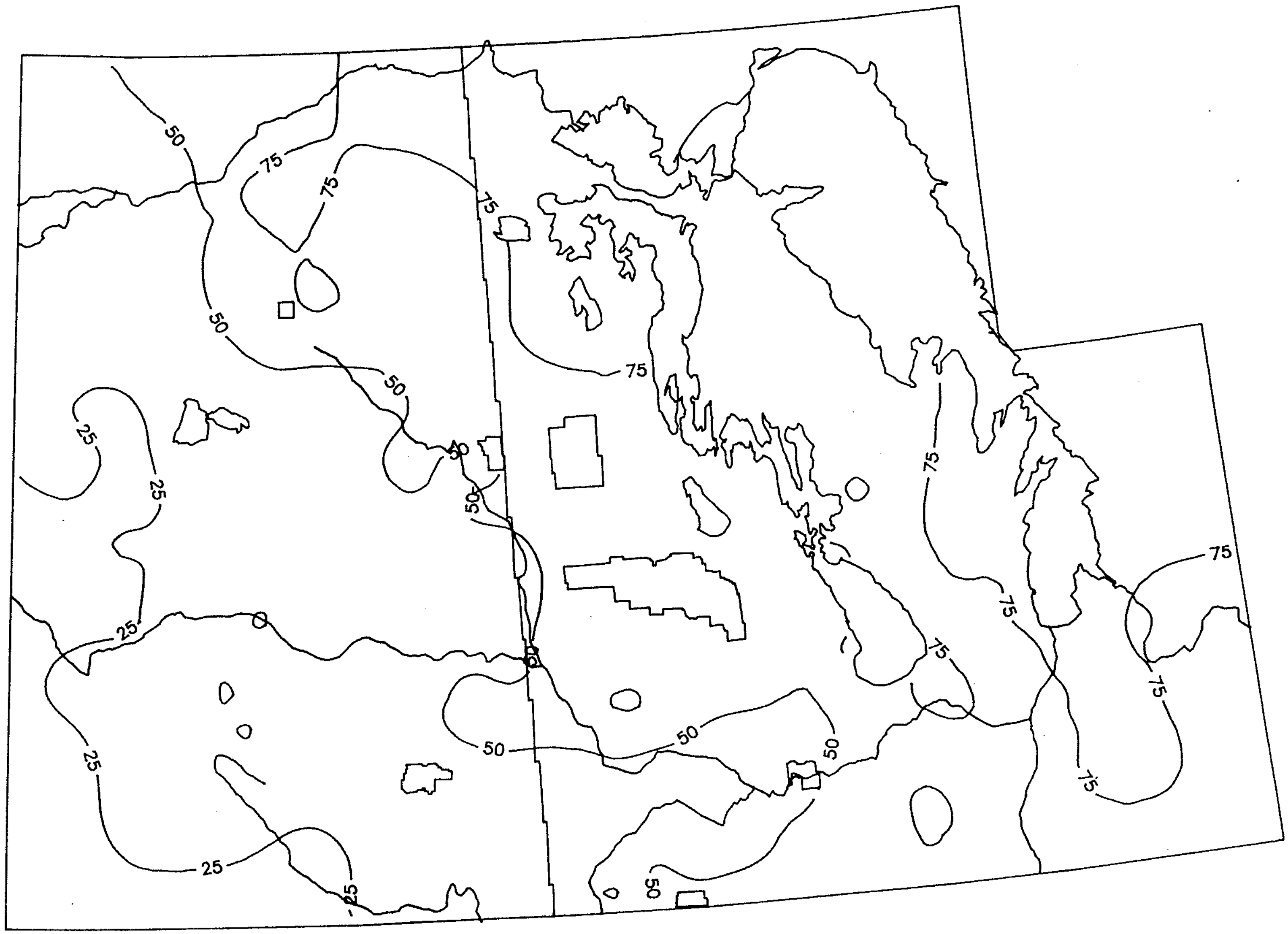


Figure 64: 25% Risk of Soil Moisture Amounts on October 31 for Alfalfa (mm). Over the long term, one year in four will have this much or less moisture in the soil.

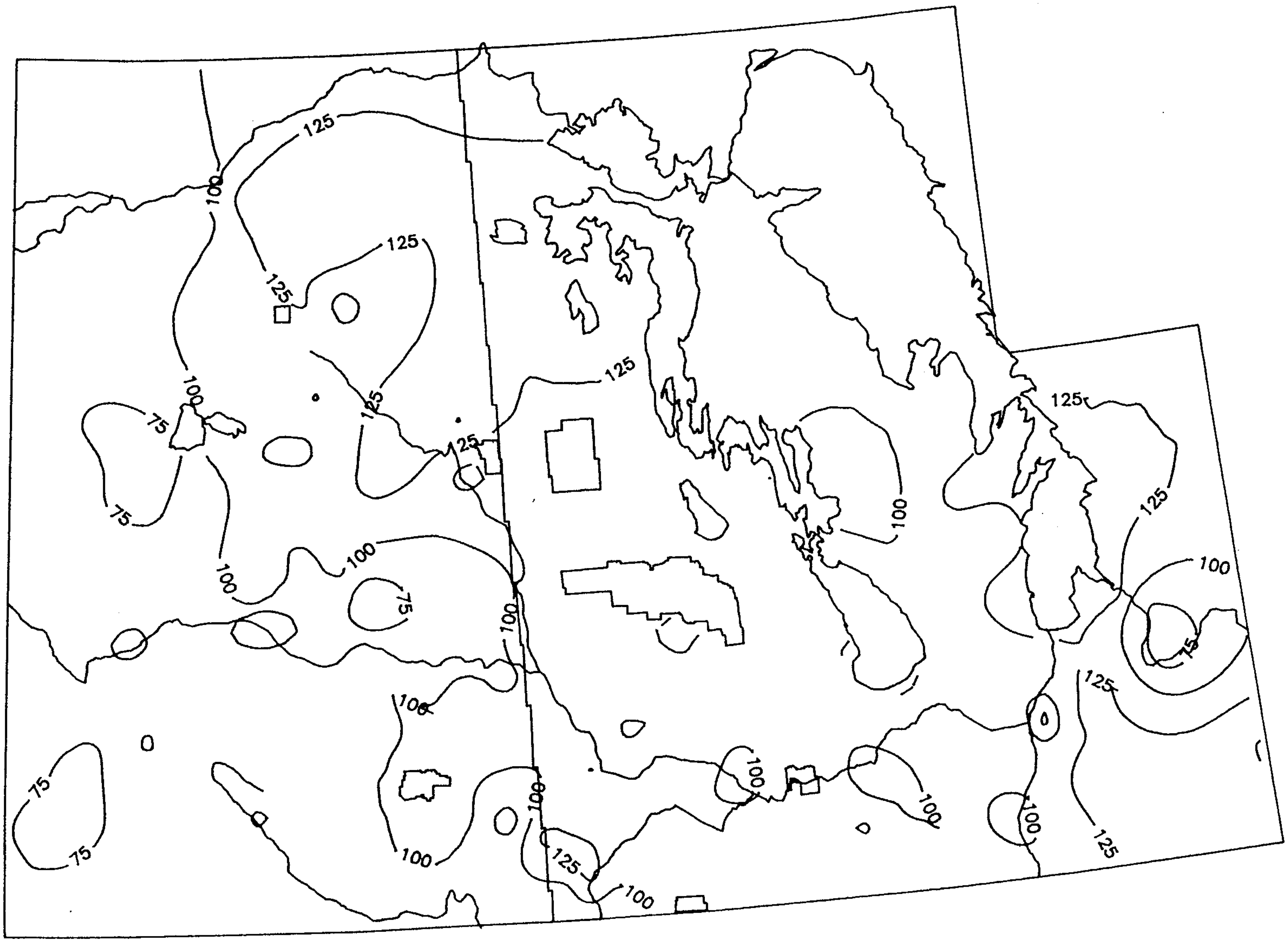


Figure 65: 10% Risk of Precipitation to the Second Cut of Alfalfa (mm). Over the long term, one year in ten will have this much or less precipitation to the second cut of alfalfa.

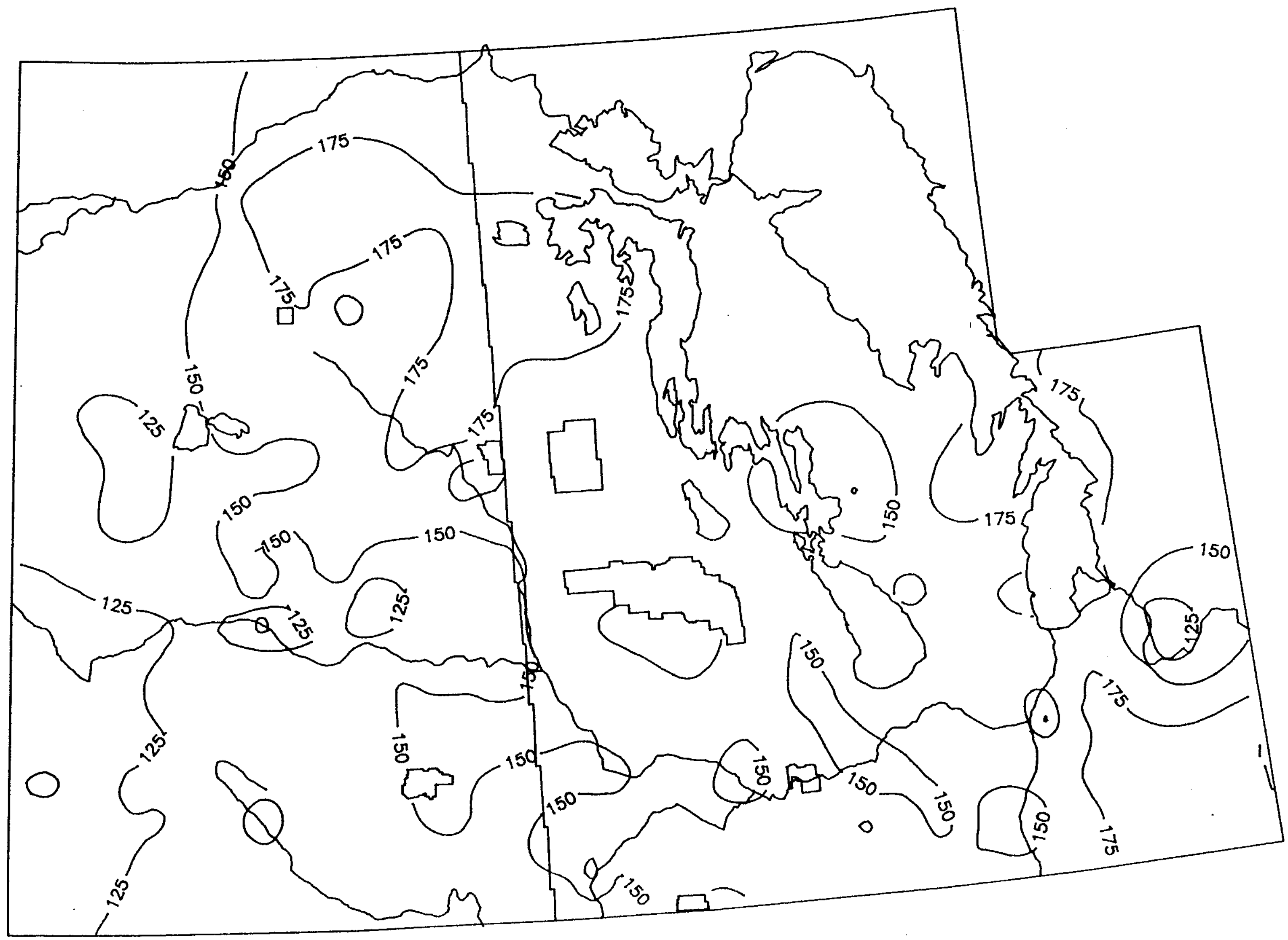


Figure 66: 25% Risk of Precipitation to the Second Cut of Alfalfa (mm). Over the long term, one year in four will have this much or less precipitation to the second cut of alfalfa.

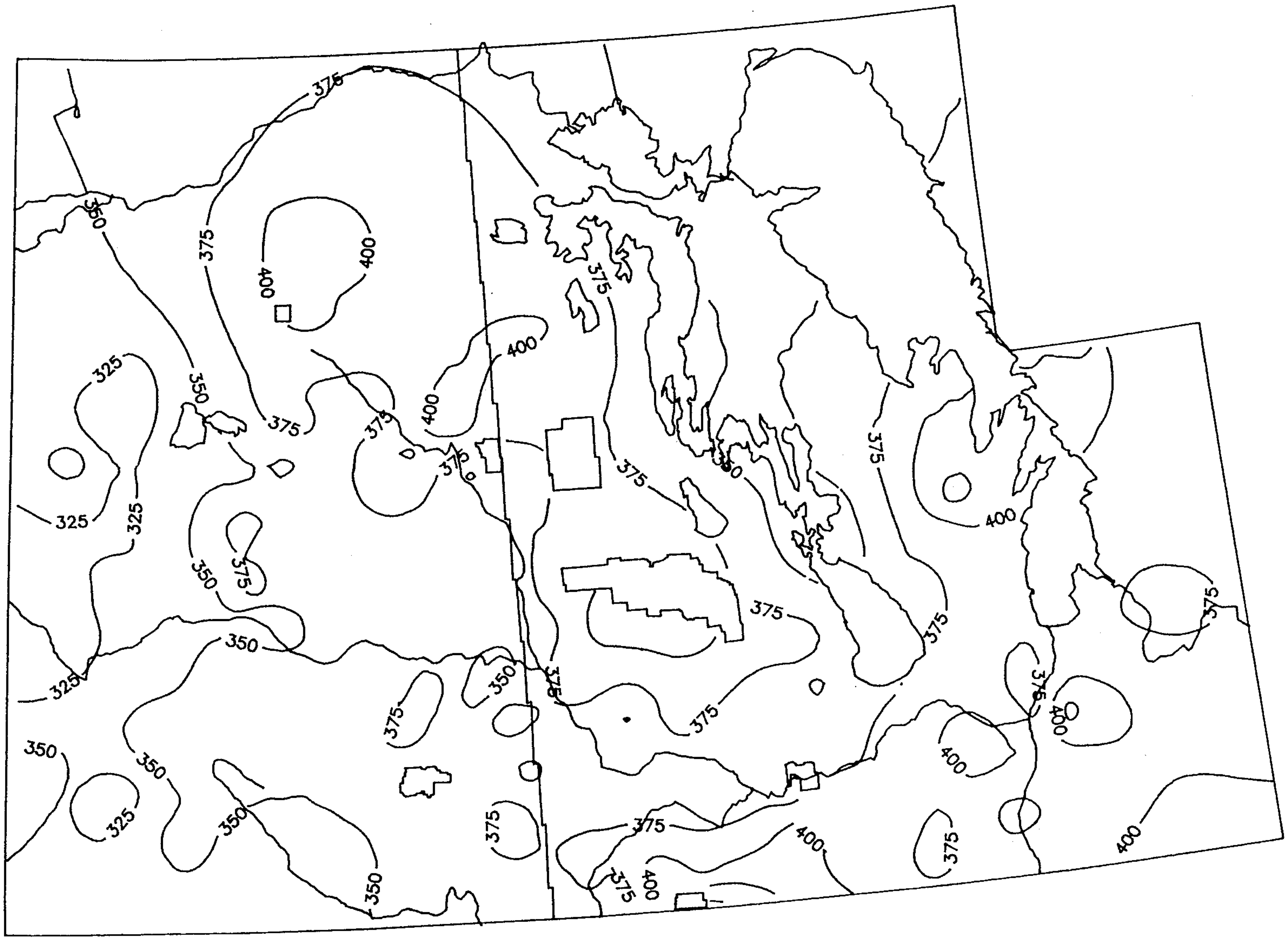


Figure 67: 10% Risk of Actual Evapotranspiration to the Second Cut of Alfalfa (mm). Over the long term, one year in ten will have this much or more actual evapotranspiration to the second cut of alfalfa.

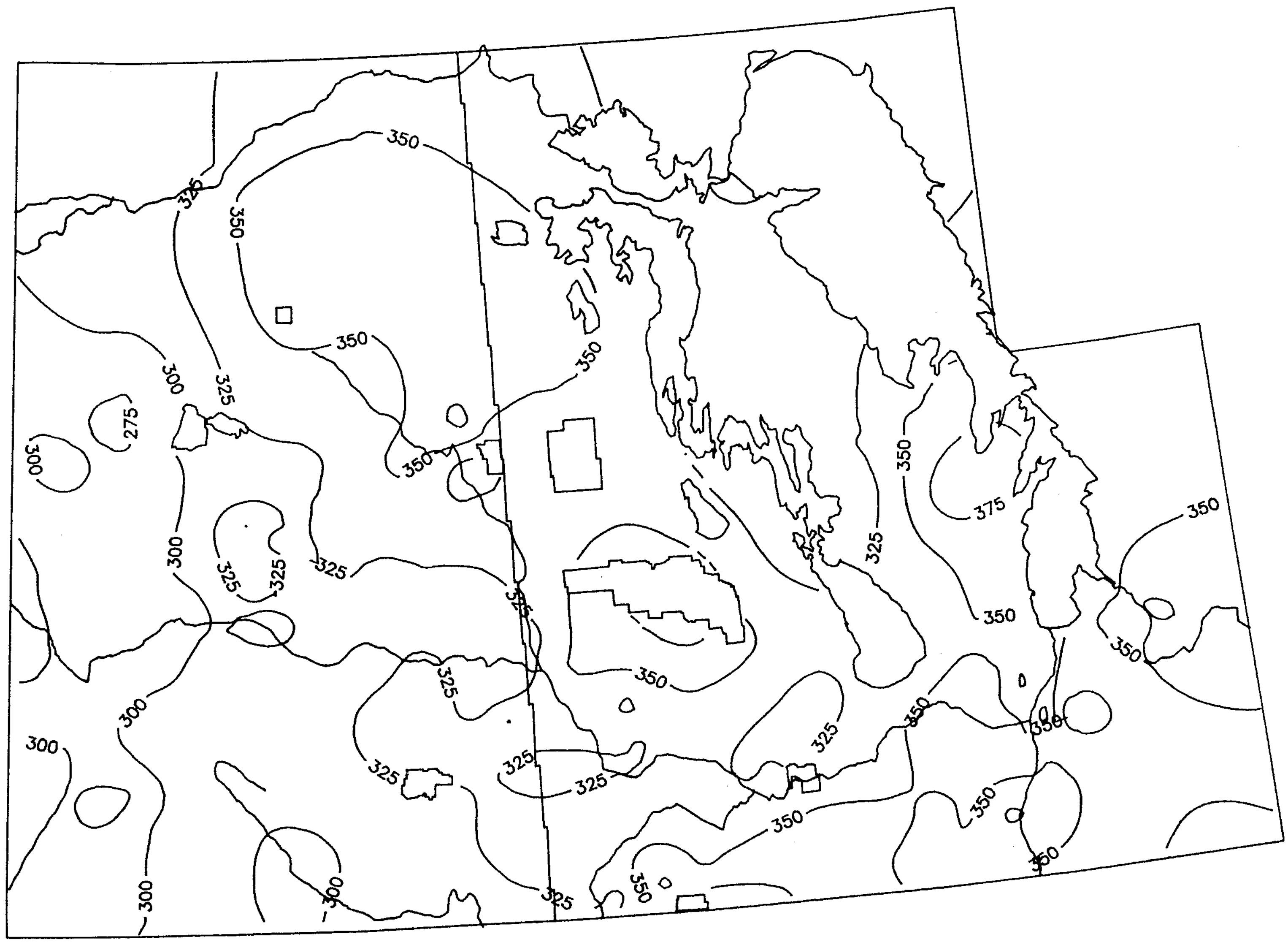


Figure 68: 25% Risk of Actual Evapotranspiration to the Second Cut of Alfalfa (mm). Over the long term, one year in four will have this much or more actual evapotranspiration to the second cut of alfalfa.