# DEVELOPING THE NORTHWEST CORRIDOR

## The Potential for Agricultural Development in the
### Fort Vermilion – Fort Nelson Corridor

**Prepared by the**

**Mackenzie Municipal Services Agency**

**For the:**

**Northwest Corridor Development Corporation**
**Northern Alberta Development Council**
**Fort Nelson – Northern Rockies Regional District**
**Municipal District of Mackenzie No. 23**
**Town of Fort Nelson**
**Town of High Level**
**Town of Rainbow Lake**

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# Executive Summary


Agriculture is Alberta's third largest industry behind oil and gas and forestry. Northwest Alberta is a significant contributor to the agricultural sector in Alberta and contains a large portion of the last remaining undeveloped agricultural areas in Canada. It is thought that there may be potential to expand the agricultural land base in northwest Alberta and northeast British Columbia in an attempt to advance the north and encourage the development of the Northwest Corridor.

The Mackenzie Municipal Services Agency was commissioned in January 2003 to prepare a preliminary feasibility study in order to determine if there is potential to expand the agricultural industry in the area between Fort Nelson, British Columbia and Fort Vermillion, Alberta. In order to conduct this study, the best-available data was analyzed using a geographic information system (GIS) software (ArcInfo and Arcmap).

The intent of this study is to assess, at a reconnaissance level, if there is potential for agricultural expansion in northwest Alberta and northeast British Columbia based on the fact that there are existing viable agricultural operations within the region. The findings of this study are intended to be used as a platform for further detailed study and as a preliminary assessment tool for the identification of areas with agricultural potential.

This study has identified areas with the potential to support the growing of agricultural crops and grazing and haying at a reconnaissance level based on a set of predefined criteria outlined in this report. Of the 1.4 million hectares (3.5 million acres) of land within the study area, approximately 667,464 hectares (1.6 million acres or approximately 47%) have agricultural potential. In addition, approximately 540,023 hectares (1.3 million acres or approximately 39%) have potential for forage and grazing. The remaining approximate 192,513 (475,693 acres or approximately 14%) does not appear to have any agricultural potential.

All areas identified with agricultural potential, may not reflect pockets of land within the study area that are subject to microclimatic variations undetectable by this study. Therefore, further ground-level investigation is required to identify those areas not suitable for agricultural purposes within the areas identified by this study as having agricultural potential.

The findings of this study indicate that the climatic conditions (effective growing degree days, season length, temperature, etc) are not the limiting factor to agriculture in the study area. Short-season, frost-resistant crop varieties are best suited for those areas identified as having the agricultural potential. Spring-seeded small grains and/or other crops, which reach maturity within 90-115 days, are best suited to the study area. With regard to the above, crop variety selection will be dependent on the agro climatic resources available on the land in question. The study area is estimated to have variations in growing season length from 100-125 days and crops should be selected that reach maturity approximately 10 days prior to the end of the growing season. It is also assumed that virtually all forage varieties especially native grasses and fescue are suitable for the study area given adequate drainage and soil conditions.

The single most limiting factor to agricultural productivity in the study area appears to be soil type and structure. Certain soil types within the study area, such as Gleysols, and Gray Solonetzics may have undesirable structure and/or drainage. These soils may respond favorably to management, but without further detailed investigation it is difficult to determine the extent of

their response. Soil management techniques and technologies are constantly improving and may increase the productivity of these soils.

Moisture deficit is not of significant concern. It appears as though there is adequate moisture available to support viable agriculture. Water conservation and erosion techniques such as zero till and direct seeding may increase productivity.

A comparative analysis of the agricultural areas in the Municipal District of Mackenzie No. 23, the Northern Rockies – Fort Nelson Regional District, and the areas identified as having agricultural potential concluded the following:

1) In general, the agro climatic resources found in the Municipal District of Mackenzie No. 23 and Northern Rockies – Fort Nelson Regional District portions of the study area are similar. All things considered equal, it is noted that there is little variation estimated in the effective growing degree days, season length, frost free period, growing season start, and growing season end. Therefore, strictly in terms of agro climatic resources, there appears to be relatively similar potential throughout the study area.

2) Soil conditions are variable throughout the study area. However, soil conditions surrounding the Town of High Level appear to be similar to soil conditions that exist elsewhere in the study area. In view of the fact that there is no significant variation in agro climatic resources throughout the study area, all other things considered equal, areas with similar soil properties are likely to display similar potential for agricultural activities.

3) Given similar soil, topographic, and agro climatic conditions, yields in the study area will likely reflect those yields found in the Municipal District of Mackenzie No. 23 and Northern Rockies – Fort Nelson Regional District.

There is a high probability that agricultural crops such as barley, rye, wheat, canola, flax, field peas, and feed oats can be grown in the study area. However, there exists a certain level of uncertainty as to the economic viability of such agricultural pursuits in the study area.This conclusion is premised on a number of factors such as:

1) land clearing costs,
2) distance to markets,
3) remoteness and lack of highway corridor,
4) market conditions

Not considering these extenuating factors and given similar soil, topographic, and agro climatic conditions throughout the study area, it is estimated that there is potential for total yearly revenues of $156 million for growing crops (barley, rye, wheat, canola, flax, field peas, and feed oats). This estimate does not include the revenues generated from other forage and hay grown in areas with potential for foraging and haying.

However, inter-provincial cooperation is required between the provinces of British Columbia and Alberta to further explore the economic viability of opening up study area for agricultural purposes. Further detailed studies are also necessary to identify local soil nutrient regimes, drainage patters, pH, salinity, microclimatic conditions, among others.

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# 1.0 Introduction

In January 2003, the Mackenzie Municipal Services Agency was commissioned by Northern Alberta Development Council, Northwest Corridor Development Corporation, the Municipal District of Mackenzie No. 23, Fort Nelson – Northern Rockies Regional District, the Town of Fort Nelson, the Town of High Level, and the Town of Rainbow Lake to conduct an agricultural feasibility study for the lands between Fort Vermillion, Alberta and Fort Nelson, British Columbia. The general intent is to determine, at a reconnaissance level, if there are any areas capable of supporting agricultural activities.

Agriculture is a significant economic driver of Northwest Alberta. According to a study entitled *"Loss and Fragmentation of Farmland"* prepared by Alberta Agriculture, Food, and Rural Development, the Municipal District of Mackenzie No. 23 currently has 173, 047 hectares (427, 594 acres) of agricultural land in production as of April 2002 (based on the 1996 Statistics Canada Census of Agriculture). The study identified a total of 669 farms of which the mean size is 288 hectares (771 acres). Of the total agricultural land base in the Municipal District of Mackenzie, 55.4% is land in crops, 8.1% is land in summer fallow, and 36.6% is land in pasture.

British Columbia's North Peace Region, as defined by Statistics Canada, is the most significant agricultural area in British Columbia east of the Rocky Mountains with approximately 455,426 hectares (1,125,383 acres) in agricultural production. In 2001, the number of farms reporting total gross farm receipts greater than $2499 was 736 with the majority of activity occurring in the cattle, field crop, grain and oilseed, miscellaneous specialty crop, and wheat industries. Forage crop production is also a significant contributor to the agricultural production of the area.

There may be an opportunity to expand the agricultural land base in the study area. This study provides the basis for an in depth feasibility study for determining the potential for agriculture in the study area.

## *1.1 The Study Area and Scope of the Study*

Due to the large size of the region, the corridor along the proposed Highway 58 extension connecting Rainbow Lake to Fort Nelson was selected for in-depth investigation for this study. The region is broken into two components. The first component is a general overview of the area of northwest Alberta and northeast British Columbia (refer to Schedule 1) between the 55$^{th}$ and 60$^{th}$ parallel. The second component focuses on the corridor between Fort Vermillion, Alberta, and Fort Nelson, British Columbia (refer to Schedule 2).

The detailed study area includes the corridor between Fort Vermillion, Alberta and Fort Nelson British Columbia and is approximately 392 kilometers (243.6 miles) in length.

In addition to the above, and in recognition of the large land requirements necessary to sustain economically viable agricultural activities, the width of the detailed study area will include all those adjacent lands approximately 29.0 kilometers (18 miles) (three townships wide) in width following the proposed highway 58 route.

The level of detail in the study will be limited to identifying those areas with agricultural potentials at a reconnaissance scale only. In addition to the above, areas requiring special attention may be investigated at a larger scale depending on data availability. The general scope of this study is of a reconnaissance nature intended for use as a preliminary assessment tool for determining the potential for expanding the agricultural land base throughout the study area.

This study does not consider the impacts of agriculture on the environment, the economy, and on other stakeholders in any great detail. Where lands are identified as having agricultural potential, further detailed studies will be required to determine the potential impacts of agriculture and how those impacts can be identified and mitigated.

The intent of this study is not to determine an accurate estimate of potential yields or economic returns for agricultural activities. This would require further detailed studies that would include a yield and cost-benefit analysis.

## *1.2 Study Background*

A portion of the study area is being considered for the extension of Highway 58 from Rainbow Lake in Alberta to Fort Nelson in British Columbia known as the “Rainbow Lake – Fort Nelson Connector”.  Previous studies have been conducted on the feasibility of extending highway 58 including the economic impacts and the engineering constraints of the proposed extension. However, our records indicate that there have never been any studies conducted to determine the feasibility of opening this area for agricultural activity.

For the purpose of this study, and as defined in the Agricultural Operations Practices Act (AOPA), an agricultural operation or activity means an agricultural activity conducted on agricultural land for gain or reward or in the hope or expectation of gain or reward, and includes:

- the cultivation of land,
- the raising of livestock, including game-production animals within the meaning of the Livestock Industry Diversification Act and poultry,
- the raising of fur-bearing animals, pheasants or fish,
- the production of agricultural field crops,
- the production of fruit, vegetables, sod, trees, shrubs and other specialty horticultural crops,
- the production of eggs and milk,
- the production of honey,
- the operation of agricultural machinery and equipment, including irrigation pumps,
- the application of fertilizers, insecticides, pesticides, fungicides and herbicides, including the application by ground and aerial spraying, for agricultural purposes.
- The collection, transportation, storage, application, use, transfer and disposal of manure, and
- The abandonment and reclamation of confined feeding operations and manure storage facilities.

This study addresses the following objectives:

1) To determine the suitability of the study area for agricultural activities such as the

production of field crops, the raising of livestock, and grazing.

2) To produce a graphical display showing areas with potentials for supporting agricultural activities.

3) To provide recommendations and suggestions on areas that require further detailed study.

### *1.3 Study Limitations and Uncertainties*

The primary limitation of this study is the lack of high quality data. The Canada Land Inventory (CLI) soils information is not available for a large portion of lands east of Fort Nelson to the Alberta border. Other sources of data include forest cover maps, surficial materials maps, and air photo interpretation. There is small scale soil mapping data available from the Canadian Soil Information System (CANSIS) website. The CANSIS soil data proves to be the most valuable soils resource available at the time of preparing this study.

Digital mapping information is not produced at a consistent scale in the provinces of Alberta and British Columbia. This can be seen on the soil map where there is an obvious inconsistency of soil types along the provincial border. It is assumed that when these soils were interpreted, the surveyors in British Columbia and Alberta worked independently of each other and/or did not use a standard survey method. This inconsistency is an error that this study can not control or correct. This error may have a significant effect on the accuracy of the study findings, especially in the areas in close proximity to the provincial border. For the purpose of this study, the available data was presumed to be accurate as it was used in the querying process.

The only scale at which complete coverage is provided for the study area is 1:1,000,000. Therefore, this scale will form the basis for the study area map. There are digital information available at other scales for certain portions of the study area, but not in its entirety.

The remoteness of the study area presents some difficulties with data collection and ground proofing[1]. It is suggested that this component be implemented as part of a further detailed study at a later date.

Soil surveys in the area were performed through interpretation. Environmental and climatic data are provided from point source locations such as weather and climate measuring stations, and may not be representative of the region. The study area is located in an area that has not been subject to intense surveying and data collection for agricultural projects in the past. All analyses are based on the best available data to produce an acceptable level of accuracy for a reconnaissance type study.

The focus of this report is to provide a preliminary assessment tool for further detailed site inspection and economic cost benefit analysis. The findings of this study are not

[1] Ground proofing refers to conducting on the ground surveys at random or predefined intervals to determine the accuracy of mapping and analysis conducted at a reconnaissance level.

intended for use as a sole resource to base a decision for the expansion of the agricultural sector. Detailed site investigation is required to further investigate the findings of this study and to identify site-specific conditions relating to agricultural productivity.

The available data was produced at a very broad level. This limits the accuracy of this study to the quality of available data. Other limitations include lack of reliable data on soil structure, salinity, stoniness, pH, flooding, and risk of erosion. Budgetary restraints did not permit the use of orthorectified[2] air photo interpretation, vegetation surveys, TRIM data, as well as other digital data sources that may increase the accuracy the findings. The said sources are required for further detailed study.

Ecological systems are very complex involving numerous inter-relationships between flora, fauna, and the natural and physical environment. It is very difficult to accurately predict the environmental conditions, let alone the soils response to management. There are many complex factors such as soil chemistry, hydrological cycles, biological process, and soil structure which require further levels of investigation in order to fully understand the agricultural potential of the study area.

## 1.4 Determinants of Agricultural Feasibility

The following factors are important considerations and determinants for assessing agricultural feasibility. Agricultural feasibility can be assessed using many methods which consider factors such as topography, temperature and moisture, soil structure and profile characteristics, soil depth and depth to bedrock, soil acidity, salt content, and the amount of organic matter, among others.

### i. Soils

Soil structure and profile characteristics are important factors for determining agricultural feasibility. Drainage plays a significant role in agricultural production because it has a significant effect on the productivity of the soil.

The B horizon plays an important role as a moisture reservoir in nearly all soils. In some soils the B horizon also plays an important role as a nutrient reservoir, as nutrients are leached from the overlaying A layer. In order to facilitate nutrient and water intake, plant roots must be capable of penetrating the B horizon. Undesirable soil structure appears to have a greater effect on yields than other non-climatic limitations (McGill, 1982).

The soil depth and depth to bedrock is important because soil depth directly affects its moisture holding-capacity, the quantity of available nutrients, and suitability for irrigation. In many cases, especially when cereal crops are desirable, a soil depth of 1-2 metres over the bedrock is desirable because most cereal crops will root to that depth. Soils less than this depth may produce less than ideal yields for 2 reasons. The first reason is that rooting volume is restricted and the

[2] Orthorectified air photos are geographically corrected for real world coordinates and can be used for numerous land use analyses.

second reason is that shallow soil produces less than desirable conditions because of excess water close to bedrock.

Soil acidity is another factor that affects agricultural feasibility. Most plant growth favours a neutral pH (≅7.0). Soil can be considered acidic at pH's below 6.0 and alkaline at pH's above 8.0. It should also be noted that intensive agriculture may increase acidity (McGill, 1982).

Soil salinity has an impact on agricultural potential. Salts tend to accumulate in areas where groundwater movement is towards the soil surface. Salts interfere with the plants uptake of essential ions and water. Salt concentration is determined by measuring the electrical conductivity (EC)[3] of the soil in solution. The electrical conductivity should not exceed 4 mmho/cm[4]. Soils with an electrical conductivity greater than 4 mmho/cm are generally considered to be saline. Saline soils may require special consideration when selecting crop varieties (Lilley, 1982).

An ideal soil should be well drained, have a deep rooting zone with easy penetration by air water and roots, have good water holding capacity, have a balanced nutrient supply, and resist erosion among many other factors. However, the ideal soil is few and far between, especially within the study area. Agricultural viability is heavily dependant on soil management practices and the ability of farmers to improve and maintain soil conditions in both the short term and the long term. New technologies and emerging management practices are constantly improving the productivity of soils in order to maximize economic returns.

Table 1.0 provides a general outline of the costs and benefits of well and poorly drained soil on agricultural production.

Table 1.0 Costs and benefits of well and poorly drained soils

| **Well Drained Soils** | | **Poorly Drained Soils** | |
|---|---|---|---|
| **Costs** | **Benefits** | **Costs** | **Benefits** |
| Capital costs associated with developing and implementing a soil drainage system | Greater ease of soil management and cultivation | In silt and clay loam textured soils compaction and smearing by machinery or livestock may occur | Can in most cases be managed to improve drainage. |
| | Increased plant growth due to better aeration and nutrient availability | Disturbances to soil structure by machinery | |
| | Easier control of plant and animal diseases | Wet soils are slower to warm up in the spring | |
| | Reduces the risk associated with working conditions | Low soil temperatures restrict root development | |

3 The higher the electrical conductivity value the more saline the soil.
4 Electrical conductivity units

| | | | |
|---|---|---|---|
| | Soils becomes less likely to be compacted | Plants have less ability to intake nutrient and oxygen resulting in less plant growth (yield) | |
| | Provides conditions conducive to soil organisms. | | |

*Source: Department of Primary industries, Water, and Environment, Tasmania Australia 2003.*

For the purposes of this study, organic soils are not considered agriculturally productive (for the growing of cereal and oil seed crops) because detailed data is not available to determine the structure of such soils and because of the following concerns.

1. Organic soils present some unique challenges, especially in northern regions. Organic soils contain at least 40 cm (16 inches) of peat and are typically colder on average than mineral soils because they have differences in soil thermal properties. Organic soils usually occupy low-lying areas, which are subject to cold air drainage. All of the above factors can have a negative effect on crop production. Once organic soils are reclaimed or put into production they tend to subside at a rate of 1-3cm (0.4-1 inch) per year (Agronomic Interpretations Working Group 1995).

2. In assessing organic soils for agricultural productivity, it is important to consider a number of factors including structure, fiber content (fibric, meisc, and humic[5]), nutrient status, and salinity. All of which play an important role in assessing agricultural productivity of organic soils.

3. The structure of organic soil plays an important role because it affects the preparation of the seedbed and plant growth. Organic soils with fibric materials are more difficult to work than organic soils with humic materials because of differences in bulk density. The looser fibric soils make it difficult to prepare an adequate seedbed and suffer from rapid drainage during drier periods. A general rule of thumb in determining which organic soils are suitable for agricultural use is as follows: peats derived from sphagnum mosses are more favorable for agriculture in wetter regions and those peats derived from sedges are more favorable for agriculture in drier regions (Agronomic Interpretations Working Group, 1995).

4. Nutrient supply for organic soils is derived from two basic sources: ground water and surface water. Organic soils can vary in their nutrient levels. A general rule of thumb is that those organic soils that derive water from groundwater tend to have higher nutrient levels than those organic soils that derive water from surface water (Agronomic Interpretations Working Group, 1995).

[5] Fibric, mesic, and humic refer to the level of decomposition of the organic material in organic soils where fibric material is relatively undecomposed, mesic material is at a stage of decomposition between fibric and humic , and humic material are at the most advanced stage of decomposition.

5. Organic soils are commonly deficient in Potassium (K) and micro nutrient deficiencies are also common. Nutrient deficiencies may be minimized through the efficient use of fertilizers.

6. Organic soils in the study area are not considered for the production of agricultural crops. This was in part due to the difficulty in assessing the productivity of organic soils and because of data unavailability. In addition, due to the colder soil temperatures of organic soils coupled with the northern extent of the study area, it is assumed that organic soils are best suited to the production of forage crops with a lower sensitivity to marginal soil and climate conditions.

### ii) Topography

Topography is an important consideration because it affects the soil aspect[6] and hence the soil temperature. In addition to the above, topography may also indicate susceptibility to erosion and soil loss as slopes as small as 2% can have serious erosion problems (McGill, 1982). Slope steepness is often more important than slope length. Slopes in excess of 5% usually cause a reduction in the Canada Land Inventory (CLI) classification for that land. In general, slopes in excess of 10% are not suitable for many agricultural crops.

Slope is a significant determinant of agricultural feasibility for the following reasons:

1) Slopes greater than 10% can be difficult to operate large-scale machinery effectively and efficiently.

2) Generally, there is a direct relationship between steepness of slope and erosion, where steeper slopes tend to have a higher risk of erosion than modest slopes.

3) Grazing is more tolerant of steeper slopes and it is assumed that grazing can occur on slopes of up to 15% and perhaps steeper.

4) Steeper slopes tend to create an imbalance in the drainage pattern where the crest of the hill sheds water creating a rapidly drained area. The toe of the hill generally tends to receive water creating poorly drained areas. As discussed above, drainage has the ability to affect plant growth.

5) Long steep slopes may experience a significant elevation gain. An increase in elevation can have an effect on the growing season length. Under normal adiabatic conditions the higher the elevation, the cooler the climate and the shorter the growing season.

### iii) Climate

[6] Soil aspect refers to the direction that the soil surface faces measured by the cardinal points of a compass. Aspect effects soil temperature and moisture due to variations in the angle of solar radiation received by the ground. A general rule of thumb is that south facing slopes tend to be drier, and tend to have a longer growing season than north facing slopes.

Temperature and moisture are perhaps the two most fundamental limitations to crop production in the Canadian Prairies (McGill, 1982). Temperature dictates the range of crops that can be grown in a region and moisture determines the ultimate yield. The suitability of a specific region for various crops is usually related to the frost-free period. Crops best suited to Alberta conditions have a growing period of between 70-120 days (McGill, 1982). In order to reduce the risk of crop failure and to increase profitability, the average growing period should be about ten days longer than the time it takes to grow the crop to maturity.

In northern regions, the shorter frost-free period is expected to be offset by the longer day light hours experienced in the north. For example the effect of a 100 day frost free period is not equal across the province because day length varies.

The growing season length is longer than the frost-free period because many agricultural crops can withstand short periods of sub-zero temperatures. In general, plant growth starts at temperatures above 5 degrees Celsius.

The temperature is related to the growing season length because the growing season length is based on occurrences of thawing and freezing. Temperature is an important determinant in estimating critical stages in plant phenology[7] as well as practically estimating and timing crop management practices such as the application of fertilizers, herbicides, and pesticides.

For agricultural purposes, temperature may also be measured through heat units and degree days, which can be used as indices of crop production potential. A degree day is defined as the number of degrees Celsius above some minimum temperature (usually 5 or 5.6 degrees Celsius) summed over the year or growing season (McGill, 1982). For example, ten consecutive days with a temperature of 20°C is 150 degree days. Various crops have different heat requirements. For example, in order for wheat to be profitable at least 1100 degree days are required (degrees Celsius) (McGill, 1982).

Research conducted by Dr. Brian Fowler and Brian Duggan of The University of Saskatchewan determined the following average growing degree requirements for a select variety of crops throughout western Canada. The following tables represent their findings:

Table 2.0 Growing degree requirements of a selection of crop types.

| **Crop** | **Growing Degree Day Requirement** |
|---|---|
| Flax | 1200 |
| Hard Red Spring Wheat | 1175 |
| Argentine Canola | 1040 |
| Mustard | 1004 |
| Oats | 961 |
| Barley | 850 |
| Polish Canola | 850 |

[7] Plant Phenology is a branch of science that looks at the relationships between the climate and plant growth cycle.

The Agronomic Interpretations Working Group found the following relationship between effective growing degree days and agricultural limitations on spring-seeded small grains.

Table 3.0 Agricultural limitations to the number of effective growing degree days.

| Number of Effective Growing Degree Days | Limitations |
|---|---|
| 1600 | No limitation |
| 1200 | Close to the point where wheat becomes a minor component in the dominantly barley system. This was considered a moderate heat limitation. |
| 1050 | Spring-seeded small grains occupy less than 50% of the cultivated area. This was considered a severe heat limitation. |
| 900 | Approximate limit of small grain production. This is a very severe heat limitation. |
| 500 | No potential for small grains. |

**iv) Organic Matter**

Organic matter is an important consideration in determining agricultural feasibility. However, the effects of organic matter are more related to the dynamics of the organic matter rather than the total amount.

**v) Rooting Depth**

Rooting depth in this case, refers to the depth of the soil to bedrock or other impenetrable layer.

Rooting depth is of importance because plants must be able to penetrate the soil in order to uptake the essential water and nutrients required to sustain growth. If the rooting depth is restricted, the volume of roots may be restricted limiting the amount of water and nutrient uptake resulting in a less than desirable crop yield. In addition, shallow soils may contain excess accumulations of water collecting on top of an impermeable layer such as bedrock.

For the purpose of this study, soils which have a rooting depth of at least 50 cm (19.7 inches) are considered adequate for agriculture. However, ideally there should be a rooting depth of 100 - 200 cm (39-79 inches) for cereal crops because given the opportunity most cereal crops will root to that depth.

**vi) Aspect**

Aspect has an effect on the amount of solar radiation (sun) received on the ground, which has an effect on growing season length, water availability, and growing season start, among others.

In most cases, it is not expected that aspect will have a significant effect on the agricultural feasibility within the study area because the majority of the study area is on slopes of less than 4%. However, there may be a noticeable difference between areas with southern slopes and areas with northern slopes. This is because southern slopes tend to receive more solar radiation leading to earlier spring thaw and longer growing seasons. Southern and western slopes also tend to be drier than northern and eastern slopes.

**vii) <u>Moisture Regime</u>**

Precipitation plays a significant role in maintaining an adequate water balance within the soil to support plant growth. Not only is the amount of precipitation and evapotranspiration important, but the timing of precipitation has the ability to severely restrict both plant growth and other agricultural activities during harvesting.

The larger the water deficit, the less water is available to the plants for nutrient uptake and photosynthesis. Water deficits have the ability to negatively affect crop yields.

## *1.5 Data Synthesis*

As discussed above, a number of factors are used to assess agricultural feasibility. A number of these factors are included in the CLI soils information, however this information is not available for the study area in its entirety. Therefore, the CANSIS data is used to provide the most comprehensive information available for the study area. Since the intent of this study is of a reconnaissance nature, the broad detail of the CANSIS data meets the study objectives.

There is no single determinant of agricultural feasibility. A number of factors play a role in the assessment of agricultural feasibility. Determining agricultural feasibility at a higher level of detail requires physical analysis of the soil, topography, drainage patterns, and climate to determine nutrient levels, water holding capacity, pH, salinity, stoniness, drainage patterns, and available agro climatic resources among many others. A study at this level can not assess all indicators of agricultural feasibility because of the shear magnitude of the task and the level of technical detail required to make reasonable judgments.

## *1.6 Environmental Impacts*

Although, the focus of this study is not the environmental impacts of agricultural expansion throughout the study area, the following impacts are of significant importance and are considered briefly below. Further detailed study is required to fully explore the significance of each identified environmental impact.

**i) <u>Critical wildlife habitats</u>**

A large portion of the study area is undeveloped and considered “wilderness”. There are likely critical wildlife habitats and protected areas within the study area. Critical wildlife habitats may include breeding grounds, migration corridors, seasonal bedding and denning sites, among others. These areas must be identified and managed to minimize the impact of agricultural activities.

Managing critical wildlife habitats is especially important for red, blue and yellow listed species. Red listed species are those which are considered to be at risk of extirpation or extinction. Blue listed species are species that may be at risk based on current knowledge. Yellow listed species are those that are not currently believed to be at risk, but may require special management practices because they are naturally rare and are associated with deteriorating habitats, or because of concern for their long-term declines.

Currently there are number of red, blue, and yellow listed animal species (including amphibians, fish, birds, and mammals) in the Province of Alberta and British Columbia. These species are of significant importance to the biodiversity of the study area. If further studies reveal that the study area contains critical wildlife habitats for these species, special wildlife management practices will be required to ensure their survival.

The expansion of the agricultural industry, in most cases, requires the conversion of productive habitat to an agricultural use, meaning that wildlife will be forced to increasingly utilize marginal (less favorable) habitats for survival. Further research is required on the impact of the expansion of the agricultural industry on wildlife habitat.

**ii) <u>Water quality</u>**

Water quality is a major concern with agriculture. Agricultural runoffs can include pesticide, and herbicide residues, biological components such as fecal coliforms[8], and nutrients such as nitrogen and phosphorus. These substances can enter the watershed, via groundwater runoff or through percolation and cause numerous water quality issues.

Poor water quality can affect the health of natural ecosystems including fish, mammals, and birds.

**iii) <u>Erosion</u>**

Erosion from wind and water is another concern. Erosion can cause siltation of fish-bearing lakes and streams. Erosion can lead to significant amounts of soil loss, which threatens the viability of agriculture by removing the nutrient rich topsoil.

Soil loss because of water occurs because of heavy runoff water events such as rainstorms. Soil loss due to rainwater runoff has been recorded as high as 10 tonnes per hectare in Alberta in 1966 (heritage community foundation 2002). Soils with high clay content and those that are compacted or have a hardened surface

[8] Fecal coliform is a group of bacteria found in the feces and intestinal tracts of warm-blooded animals, including humans, which aid in the digestion of food. The most common form of fecal coliform is *Escherichia coli*, more frequently known as *E.coli.* E.coli can contaminate a water source and cause potential health hazards for people.

and cannot readily absorb water are at increased risk of water erosion. The soils of the study area seem to fit this category and may experience an increased risk of water erosion. Mitigation through agricultural land management is the best available measure to reduce erosion caused by excess run off.

During times of drought and high winds, soils become more vulnerable to wind erosion. Loss of topsoil reduces the rooting depth and the soils water holding capacity, which affects productivity and leads to further erosion.

Many of the soil types in the study area may resist wind erosion to a certain degree because they most likely have a high clay content and tend to clump together, making it more difficult for wind to break the soil down.

According to Alberta Environment, the area surrounding the Town of High Level has a low wind erosion risk.

## *1.7 Access*

Access to areas with agricultural potential is a concern because there is little or no access throughout the study area.

Highway 58 would likely be the main access point throughout the study area. The extension of Highway 58 west of Rainbow Lake to Fort Nelson is necessary to access the remaining portion of the study area.

Existing oil and gas and forestry access roads may be utilized for access to areas that are not in close proximity to Highway 58. However, some of these roads may require significant upgrades in order to comply with municipal standards.

## *1.8 Economic Feasibility of Agriculture in the Study Area*

Even if this study concludes that there is potential for agricultural activities in certain portions of the study area, it does not necessarily mean that agriculture is economically feasible. Some of the factors affecting the economic feasibility of agriculture in the study area are:

- Distance to markets
- High cost of clearing and converting land for agricultural purposes
- High capital costs
- Financing rates
- Opportunity for value added agriculture
- Opportunity for off-farm employment in close proximity to the agricultural areas of the study area
- Possibility of government tax incentives and grants for the expansion of the agricultural industry (green land conversion in Alberta and expansion of the ALR in British Columbia)
- Yield and produce quality

- Current market prices and projected trends
- Costs associated with the loss of use of other resources such as forestry, oil and gas, and recreation
- Demand for farmland

All of the above factors should be addressed in a cost benefit analysis prior to making a decision on agricultural expansion in the study area.

## *1.9 Natural Resource Extraction*

Natural resource extraction occurs throughout the study area. Forestry operations and oil and gas developments are the primary industries. Forestry is Alberta's third largest industry sector, next to oil and gas, and agriculture.

In Alberta, forests are managed using three types of tenure systems:

- **Forest Management Agreements (FMA):** an area-based agreement between the Province and a company that gives the company the rights to establish, grow, and harvest timber from a particular area of land. The term of the agreement is 20 years with the option for renewal. The FMA gives the company the responsibility of developing their own forest management plan for government approval.

- **Timber Quotas:** give companies the rights to harvest a percentage of the annual allowable cut. This systems is overseen by the Province, which oversees the planning of the area.

- **Timber Permits:** makes available a specified volume of timber to meet local demand for a variety of purposes such as building logs, firewood, and Christmas trees.

In British Columbia, a tenure system is used that allows private forest companies, communities and individuals, to gain the right to harvest timber in public forests. Some examples of tenures used are:

- **Tree Farm Licenses (TFL):** gives a company the rights to harvest timber in a specified area. Companies are required to pay government stumpage fees and annual rent. Companies are given significant forest management responsibilities including the preparation of the five year forest management plans, operational plans, road building, and reforestation.

- **Forest Licenses:** provide the rights to harvest a specific volume of timber from a given area in exchange for payment of stumpage fees and forest management responsibilities such as road building and reforestation. .

- **Tenures** are also available to small sawmill operators, independent manufacturing facilities, and small business loggers based on a completive award system.

In British Columbia, all harvesting in public forests is governed by the *Forest Practices Code* and Forest Practices Regulation.

Forest operations may benefit in the short term from agricultural expansion if commercially viable timber is removed for agricultural purposes. However, forest operations may suffer long-term ramifications given a reduction in their total annual allowable cut. This is assuming that due to an overall reduction of available timber resources, the total annual allowable cut would be reduced in the area to reflect the reduction in forest inventory.

The study area is subject to relatively intense oil and gas activity. In some cases, oil and gas development may be compatible with agriculture. This relationship should be further explored to determine the feasibility of developing oil and gas extraction facilities in conjunction with agricultural operations.

# 2.0 Methods

The methods of data collection and analysis used in this study are described below. A Geographic Information System (Arcinfo and Arc View GIS) software is used to analyze the data.

## *2.1 Data Collection*

1) The study area is defined and digitized to provide a basis for the study.

2) Soils data are collected from Canadian Soils Information System (CANSIS), and other potential data sources.

3) Climate data are collected from Environment Canada, Canadian Soils Information System (CANSIS), and other potential data sources.

4) Topographic data are collected using the Landsat 7 Data, and the CANSIS website.

5) Previous reports are gathered to minimize overlap and to determine what information already exists and is available.

6) Hydrological data are collected to determine water availability.

## *2.2 Analysis of Data*

A number of steps are taken in order to determine the agricultural potential of the study area. The first stage is to develop a base map showing the entire study area to the level of detail necessary to perform a reconnaissance level analysis. Next, the soils, topographical, hydrological, and climate data are overlaid and analyzed. Polygons are identified showing areas with agricultural potential based on soil conditions, environmental factors, and climatic factors. Areas are also identified showing where agriculture is not feasible. A number of attributes are associated with each polygon. These attributes include: area, soil type, landscape classification, frost free period, number of growing degree days, precipitation, elevation range, slope, rooting depth, average temperature, aspect, and moisture availability among others.

Areas identified that have the potential to support agricultural activity are divided into the following categories:

1) Those that could support the production of agricultural crops including cereals.

2) Those that could support the grazing of livestock and the growing of forages, hay, and native varieties of grasses.

It is recognized that not all agricultural activities require the same environmental conditions. However, for the purposes of this study, agricultural potential for crops are assessed on the basis that they share similar requirements such as soils, climate, hydrology, and topography. It is also noted that individual species can range significantly in their requirements and tolerances for certain environmental factors. Therefore, this study does not differentiate between areas that can grow any particular species. Instead, it seeks to identify areas with the potential for growing crops. The species would be determined when a more detailed site investigation is conducted through further studies.

It is assumed that any area identified as having the potential for supporting the growing of agricultural crops including cereals and forages also has the potential for supporting livestock. However, for the purpose of this study, lands that are very marginally suited for the growing of agricultural crops may be identified as potential livestock grazing areas if adequate soils and site conditions prevail.

The following analytical methods are implemented in order to identify all potential agricultural sites.

## 2.3 *Analysis of Soil Data*

Data collected from CANSIS and other sources are analyzed using the following methods.

1) The chief priorities are to obtain and/or adjust data to a common scale (1: 1, 000, 000) and join existing sheets to create a continuous coverage of the study area, which will form the basis for the mapping exercise.

2) Areas with soils that are capable of supporting agricultural activities including the growing of crops with or without improvements being made to the land are identified based on one or more of the following criteria and subject to the following query string as illustrated in Table 4.0.

Table 4.0 Querying criteria used to identify areas with soils conducive to agricultural activities.

| Parameter | Range of values present in the study area | Querying Criteria |
|---|---|---|

| | | |
|---|---|---|
| | | |
| Drainage | Imperfect, Well, Moderate, Poor, Very Poor | Select soils that are imperfectly, moderately and well drained |
| | | |
| Kind of Material | Mineral Soil, Organic Soil, Hard Rock Acidic, Hard Rock Basic, Ice and Snow | Select Mineral Soils as data is not available to support the consideration of Organic soils |
| | | |
| Rooting Depth | Less than 20 cm, 20 -75 cm, 75-150 cm, greater than 150 cm | Select soils with greater than 50 cm rooting depth |
| | | |
| Soil Type | Gray Luvisolic, Eutric Brunisolic, Dystric Brunisolic, , Gray Solenetzic, Gleysol, Organic Crysolic, Regosolic, Fibrosol, Messisol, Humisol, | Select soils that are not frozen, organic, or saturated. |
| | | |

3) Areas with soils that are unable to support agricultural activities such as the growing of cereal and grain crops, but may support forage and grazing are identified based on one or more of the following criteria and subject to the following query string:

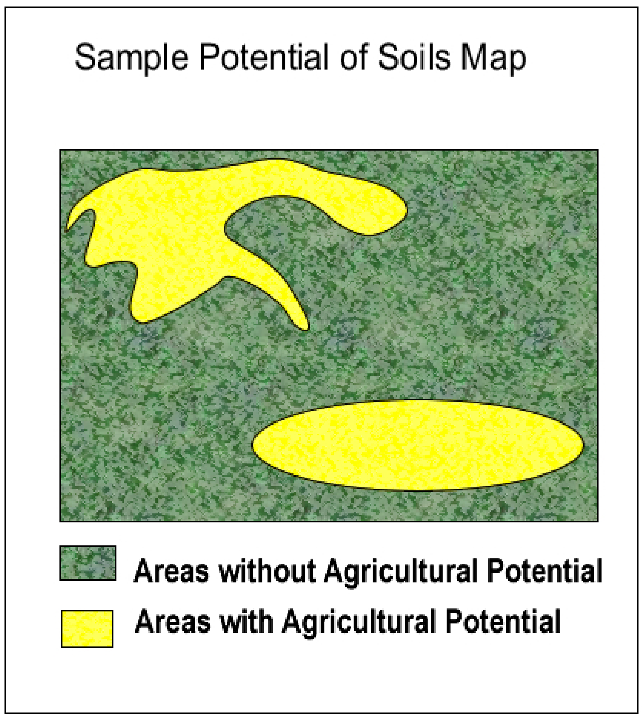
Table 5.0 Querying criteria used to identify areas with soils conducive to forage and grazing.

| **Parameter** | **Range of values present in the study area** | **Querying Criteria** |
|---|---|---|
| | | |
| Drainage | Imperfect, Well, Moderate, Poor, Very Poor | Select soils that are poorly and very poorly drained |
| | | |
| Kind of Material | Mineral Soil, Organic Soil, Hard Rock Acidic, Hard Rock Basic, Ice and Snow | Select soils with Organic Soil |
| | | |
| Rooting Depth | Less than 20 cm, 20 -75 cm, 75-150 cm, greater than 150 cm | Select soils with less than 50 cm rooting depth |
| | | |

| | | |
|---|---|---|
| Soil Type | Gray Luvisolic, Eutric Brunisolic, Dystric Brunisolic, , Gray Solenetzic, Gleysol, Organic Crysolic, Regosolic, Fibrosol, Messisol, Humisol, | Select soils that are organic and/or saturated (Gleysol, Organic Cryosolic, Regosolic, Fibrosol, Messisol, Humisol, |
| | | |
| Slope | less than 4%, 4-9%, 10-15%, 16-30% | Select areas with less than or equal to 15% slope and |
| | | |

Areas that can not support agricultural activities are mapped along with areas that may support agricultural activities. The following diagram graphically illustrates an example of how areas with agricultural potential are identified.

Figure 1.0 Sample Potential of Soils Map




4) Each soil is issued a general classification category between A-D (a system developed by the Mackenzie Municipal Services Agency), where class A soils are expected to be the best available soils for agriculture within the study area and class D soils are expected to be the least agriculturally productive soils within the study area. This system is strictly interpretive and based on deduction and requires further research to fully understand the potential of the soil types of the study area.

## 2.4 Identifying sites for other agricultural activities

Areas that have the capacity to support other agricultural activities[9] are identified based on the following assumptions:

1) Other agricultural activities require similar environmental, soil, and site conditions as required for the growing of crops, and the grazing of livestock.

2) Areas for other agricultural activities have not been identified on an activity-specific basis because further detailed study is required to determine site specific requirements for these activities.

3) Areas that do not meet the requirements for the growing of crops or grazing are not considered suitable for other agricultural activities.

## 2.5 Analysis of Topographic Data

Digital information collected from both the CANSIS and Geogratis websites are analyzed using the following methods.

1) Landsat 7 data are used to create a visual mosaic of the study area, which is mapped separately.

2) A digital elevation model and/or an arc tin model[10] are prepared to create a 3-d image of the study area.

3) Contours for British Columbia and Alberta are joined to provide contour coverage for the study area.

4) Aspect shadings are performed for the entire study area to determine slope aspect.

5) Areas with adverse topography for growing agricultural crops are identified based on the following criteria:

   i) Slopes in excess of 10%
   ii) Creeks and waterways

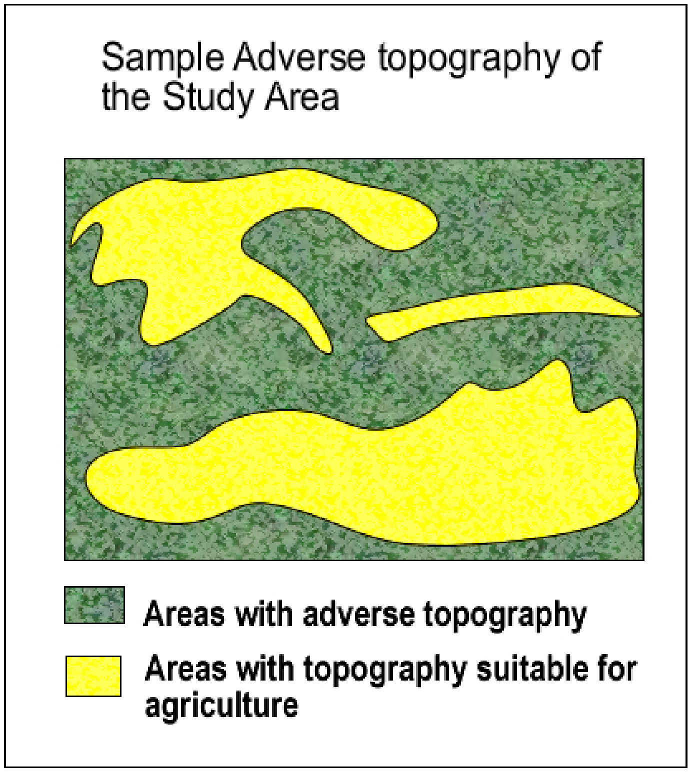
   All areas with adverse topographic features are not considered as potential agricultural areas for the growing of crops such as cereals and grain.

[9] Other agricultural activities may include honey production, value added agriculture such as dairy farms, fur farms, confined feeding operations, etc.
[10] Tin model: means Triangular Irregular Network model – a GIS model used to build a surface from a set of irregularly spaced points.

6) Areas that do not have adverse topography are classified as lands capable of supporting agriculture, subject to all other identified requirements.

Information on topographic features is used to map areas where the topography is conducive to agricultural activity. Figure 2.0 graphically illustrates an example of how areas with adverse topography are identified.

Figure 2.0 Sample adverse topography of the study area




## *2.6 Analysis of Hydrological Data*

Data gathered from CANSIS at a scale of 1:1 000 000, topographic maps, weather stations, and other background sources are analyzed using the following methods.

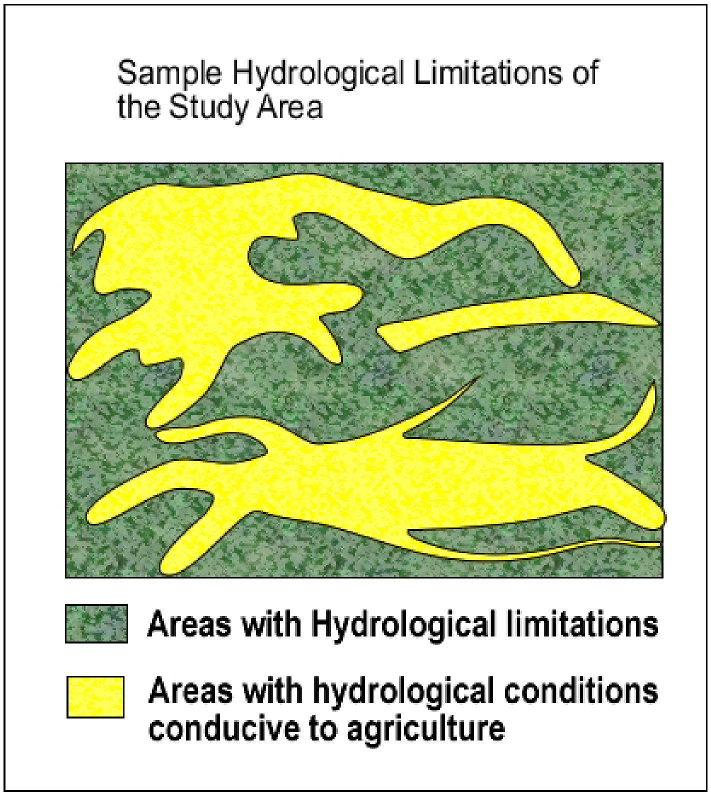
Hydrological mapping of the study area are based on the following criteria:

1) Total annual precipitation, monthly precipitation, and total precipitation during the growing season

2) Lakes, rivers, streams, and standing bodies of water are identified in the study area.

Hydrological information are also mapped showing areas with hydrological limitations. Those areas without severe hydrological limitations are considered as areas with the potential to support agricultural activities. Figure 3.0 graphically illustrates an example of how areas with hydrological limitations are identified.

Figure 3.0 Sample Hydrological Limitations of the study area




## 2.7 *Analysis of Aspect Data*

Aspect data is derived from the Triangular Irregular Network (TIN) model based on the azimuth (compass direction) of the site and change in elevation. Aspect is the direction that the ground faces. It is measured using the points of a compass
The study area is classified into the following aspects:

- North (N)
- Northeast(NE)
- East (E)
- Southeast (SE)
- South (S)
- Southwest (SW)
- West (W)
- Northwest (NW)

The TIN model is prepared at two resolutions. The difference in resolution is the result of differences in available data between the two provinces of the study area. The British Columbian side is at a resolution of 1 pixel equals 20m and the Alberta side is at a resolution of 1 pixel equals 750 m. Both resolutions make it difficult to display the aspect findings in hard copy. Analysis are therefore done in digital format because the map components are too small to be visible when printed.

## *2.8 Analysis of Climatic Data*

Climatic data gathered from weather stations, and other climate data sources are analyzed using the following methods.

1) Digital climatic data are downloaded from the CANSIS website. This data is mapped to show average monthly temperature, maximum monthly temperature, minimum monthly temperature, and the number of growing degree days.

2) Climatic data are processed using the Climate Classification System Version 2.2 developed by Agriculture – Agrifood Canada[1] to determine the following variables for the Alberta portion of the study area:

   i) average start of season
   ii) average end of season
   iii) average length of season
   iv) average occurrence of first frost
   v) moisture deficits and/or moisture abundance
   vi) crop limitations

   The findings of the Climate Classification System software are presented as symbols on a base map, which correspond to a verbal explanation in the legend and in the text of this report.

3) Areas are identified that may have the capability of supporting the growing of crops, not including hay and native forage, using one or more of the following criteria:

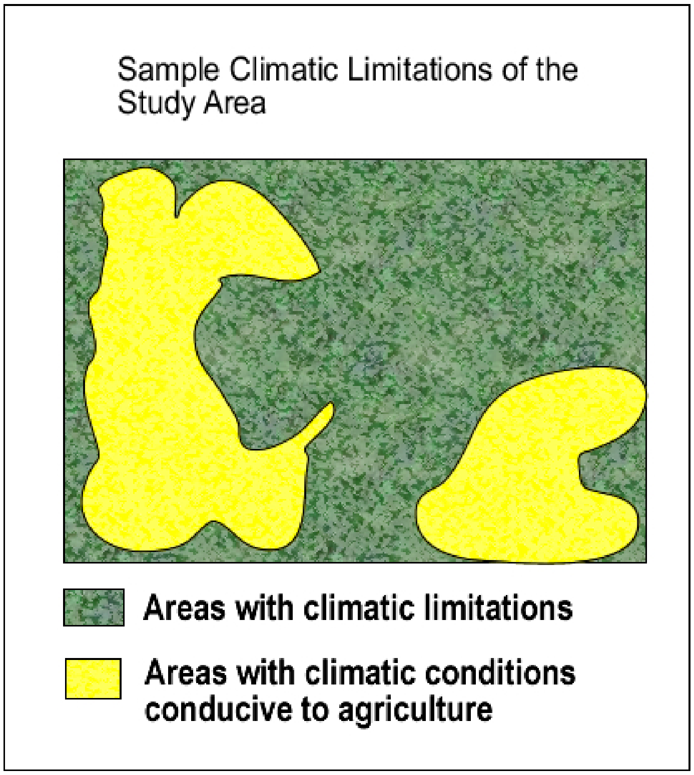
   i) areas where the total number of frost free days is equal to or greater than 80

   ii) Areas where the number of degree days is equal to or greater than 850.

[1] This software is only functional for areas within Alberta. It will not work for any areas in British Columbia

Climatic data are represented on a map showing areas where agricultural activity is a possibility, based on the above information. Figure 4.0 graphically illustrates an example of how areas with agricultural potential are identified.

Figure 4.0 Sample climatic limitations of the study area.




Climatic data measure specific climatic characteristics at specific locations. This data may not reflect accurate local conditions for the entire study area because local variations do occur. Site specific topographic and soil conditions may create microclimates not representative of the data obtained from the closest climate measuring station.

## *2.9 Estimation of Crop Yields and Potential Revenues*

Based on farm-reported crop performance data (1998-2002) from the Mackenzie Region, yields are estimated for the study area for the following crop types:

- Barley
- Wheat
- Flax
- Oats
- Rye
- Canola
- Field Peas

These yields do not consider yield variations between varieties. The average yearly yield for each crop type is used to estimate the average yield in bushels per acre. The following methods are used in estimating crop yields.

1) Data is collected from Statistics Canada 2001 Census of Agriculture to determine the percentage of various crops in relation to the total output grown in 2002 (e.g. 30% wheat, 10% Oats, etc.).

2) The total area of land for each crop type is calculated using the percent of the total area that each crop type occupies. It is assumed that the year 2002 is representative of the average crop distribution.

3) The total area of each crop is multiplied by the estimated yield per acre to determine the total output in bushels for each crop type within the study area.

In addition, the estimated total revenue is calculated (average of all crop type varieties taken over a four year period) based on the Agriculture Financial Services Corporation (AFSC) disaster program price index for the years of 1998-2002 not taking into consideration input costs. Price was determined by calculating the average price of all varieties of a particular crop type (e.g. canola) taken over a period of four years. The following methods are used in estimating potential revenues.

1) The average price per bushel is calculated for the Peace Region averaged over the last four years for each crop type (average price of all crop varieties).

2) The estimated potential revenue for each crop type is calculated by multiplying the average price per bushel by the total number of potential bushels.

3) The findings are graphed showing the potential yields for various reported crop types.

## *2.10 Data Synthesis*

Agricultural feasibility can not be determined by a single variable. It is multi-variant. This study seeks to integrate the best available data in order to identify areas that may support viable agricultural activities. The soil, hydrological, climatic, and topographic data are used collectively to analyze the study area and deductions are made regarding the suitability of site segments for agricultural activities.

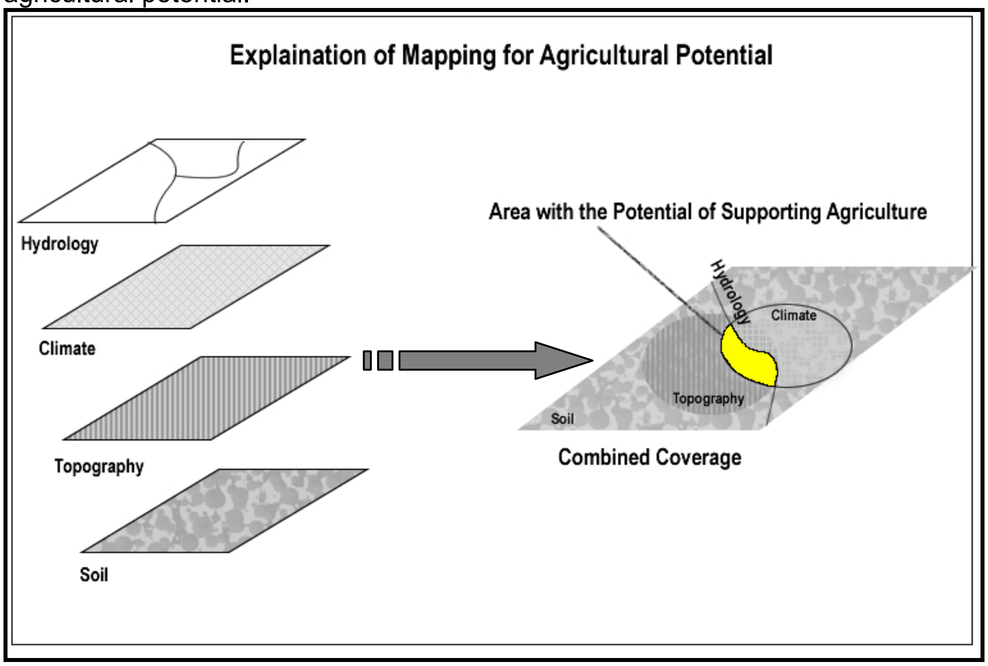
Data types are mapped to produce multi-layered maps where each data set is represented by a separate layer. Please refer to figure 5.0 for a visual explanation of the mapping process used to identify sites with agricultural potential.

Geographic representation of the study area is split into two units in order to simplify the mapping of the study area. The first unit consists of those lands that have the potential for supporting the growing of crops, except for hay and native forage species. The second unit consists of those lands that have the potential for supporting grazing and the growing of hay and native forage species. Each unit is represented on the base map. In order to determine the location of sites with the potential for supporting agricultural activities, the following methods are applied.

1) Identification of areas through a GIS query that meet the requirements for the growing of crops in all the data sets (soil, hydro, topography, climate) at a previous stage of this study.

2) Combining and querying each layer to create the final coverage. The following illustration explains the process for creating the final coverage.

Figure 5.0 Explanation of the mapping process for the identification of sites with agricultural potential.




As illustrated above, the final coverage does not differentiate between units. However, the final coverage shows the product of the query process. It identifies areas with and without agricultural potential.

Areas that do not possess features that are conducive to agricultural activity are identified as non-productive for agriculture.

## 3.0 Discussion of Findings

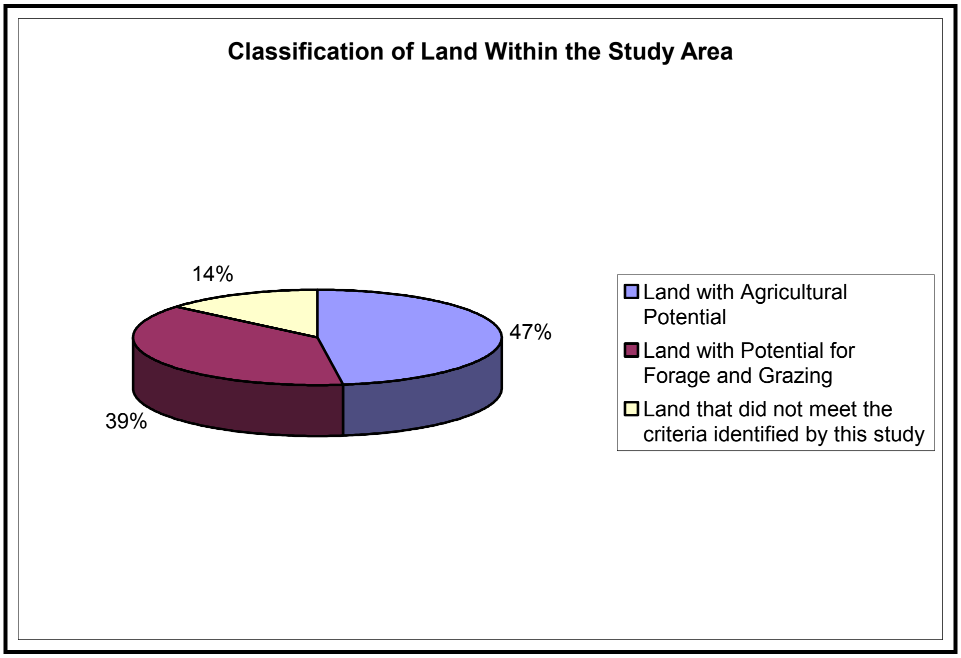
Based on available data sources, it is clear that the area surrounding Fort Vermillion, High Level, and Fort Nelson, currently support agricultural activities. Based on the location and extent of the current agricultural activities within the region, the following deductions are made:

1) Since the soil, climate, topographic, and moisture conditions existing at Fort Vermilion, Fort Nelson, and High Level are similar to conditions that prevail elsewhere in the study area, it is probable that the area may have similar potential for agricultural activities.

2) Micro-climatic conditions may exist in certain locations within the study area that are not measurable with in the context of this study.

Our findings indicate that of the 1.4 million hectares (3.5 million acres) of land within the study area or approximately 667,464 hectares (1.6 million acres) have agricultural potential. In addition, approximately 540,023 hectares (1.3 million acres) have potential for forage and grazing. The remaining approximate192,513 hectares (475,693 acres) did not meet the criteria for either the growing of crops or for foraging and grazing. Chart 1.0 graphically represents the findings of the study.

Chart 1.0 Study findings: results of the querying process




Please refer to Schedule 3 – "Areas with Potential for Agriculture, Haying, and Grazing Map" for a visual representation of the study findings. The areas identified with agricultural potential are primarily located east of the Alberta border with isolated pockets surrounding the Town of Fort Nelson. The area surrounding Fort Vermillion and High Level is identified as having agricultural potential. This area currently supports farming operations. In addition to the above, the Town of Fort Nelson has, in an independent study, identified sites with agricultural potential in the Agricultural Land Reserve (ALR) surrounding Fort Nelson, which closely reflect the areas identified as having agricultural potential by this study.

It is unrealistic to assume that all lands with agricultural potential could be put into production. This is because areas are required for farmsteads, shelterbelts, accesses, dugouts, lagoons, and environmental buffers. In addition, not all land with agricultural potential identified by this study will be cultivated.

Not all areas identified as having agricultural potential are capable of supporting viable agricultural activity. It is assumed that within the areas identified as having agricultural potential there will likely be areas with more potential than others and there will likely be areas without agricultural potential. These variations in agricultural potential are likely due to a number of factors that include soil type, soil structure, soil nutrient regime, moisture regime, and variations in microclimate most of which are not measured by this study because of the study's reconnaissance nature and lack of available data. These variations are not inventoried when this data was collected and are not expressed in the available 1:1,000,000 scale data.

As previously mentioned, it is assumed that areas with agricultural potential will also support foraging and grazing. Available data suggests, it is not likely that areas identified as having potential for foraging and grazing are capable of supporting a viable grain and field crop industry without significant improvements made to the land and intensive management practices. Markets may play a significant factor in determining which agricultural activity (forage production, grazing, field crops, etc.) will be viable on each portion of the study area said to have agricultural potential in general.

This study found that all areas identified as having agricultural potential also have the potential for supporting other agricultural activities such as (bee keeping, unimproved grazing, fish farming, specialty livestock, etc.). Therefore, further investigation is required to identify agricultural activity based site-specific conditions conducive to each activity.

In addition, the variety and/or species of crops and forages will ultimately affect the yield and success of any agricultural pursuit within the study area. Varieties will have to be carefully selected that are best suited to the local conditions found within the study area. It is highly probable that certain varieties grown within the Municipal District of Mackenzie No. 23 and the Regional District of Northern Rockies – Fort Nelson will display similarities in growth patterns, maturity date, and yields within segments of the study area having similar soil, moisture, and climatic characteristics.

Table 6.0 illustrates the estimated potential yields and revenues for barley, rye, wheat, canola, flax, field peas, and feed oats for the study area. The total agricultural land base used in the calculation is 1,200,000 acres (75% of the lands with agricultural potential[11]).

Table 6.0 Estimated yields and revenues for a selection of crop types within the study area.

| Crop | Percent of Total Crops Grown (%)[1] | Total Area Devoted to Crop Type (acres) | Average Yield (Bushels per acre)[2] | Projected Total Output (Bushels) | Average Price[3] | Estimated Yearly Total Revenue |
|---|---|---|---|---|---|---|
| | | | | | | |
| **Barley** | 10.9 | 130,800 | 46 | 6,016,800 | $2.86 | $17,208,048.00 |
| **Rye** | 0.1 | 1,200 | 30 | 36,000 | $5.73 | $206,280.00 |
| **Wheat** | 41.2 | 494,400 | 40 | 19,776,000 | $2.91 | $57,548,160.00 |
| **Canola** | 33 | 396,000 | 23 | 9,108,000 | $6.28 | $57,198,240.00 |
| **Flax** | 0.2 | 2,400 | 17 | 40,800 | $6.88 | $280,704.00 |
| **Peas** | 9.5 | 114,000 | 32 | 3,648,000 | $4.24 | $15,467,520.00 |
| **Oats** | 5.1 | 61,200 | 70 | 4,284,000 | $1.88 | $8,053,920.00 |
| **Totals** | **100** | **1,200,000** | | | | **$155,962,872.00** |

Source[1]: Statistics Canada 2001 Census of Agriculture. Prepared by the Statistics and Data Development Unit, Alberta Agriculture, Food and Rural Development.
Source[2]: Farmer reported variety yields for Peace River Soil Zone
Source[3]: AFSC disaster programs commodity price lists (1998-2002)

[11] 75% was used in the calculation based on the following assumptions:

1) not all lands identified with agricultural potential are arable due to natural features and micro-environmental conditions not conducive to agriculture.
2) not all arable lands would be cultivated.

Chart 2.0 illustrates the estimated yields for a selection of crop types within the study area.

Chart 2.0 Estimated crop yields for a selection of crop types within the study area

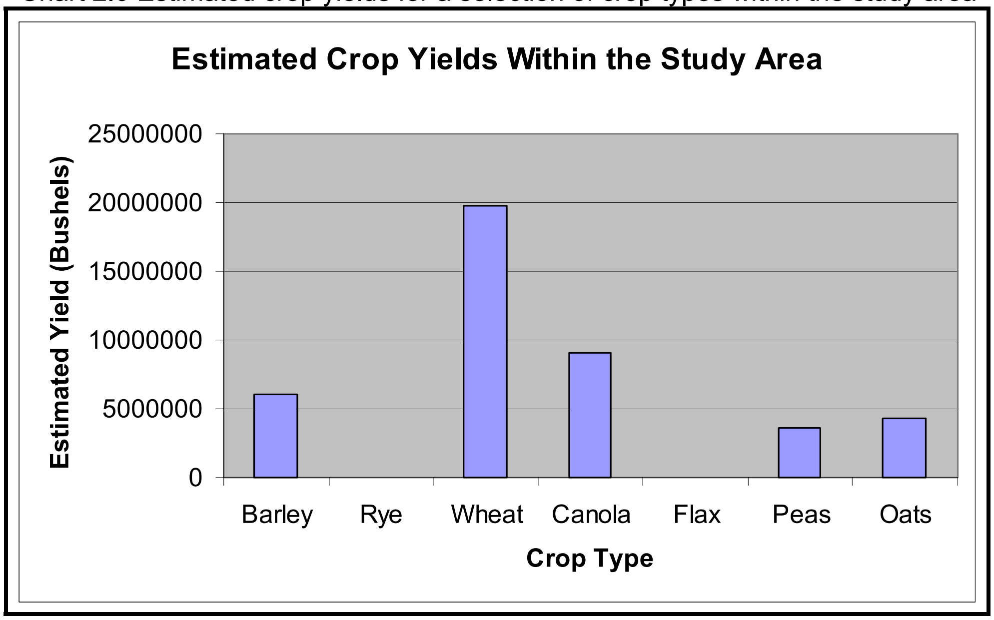
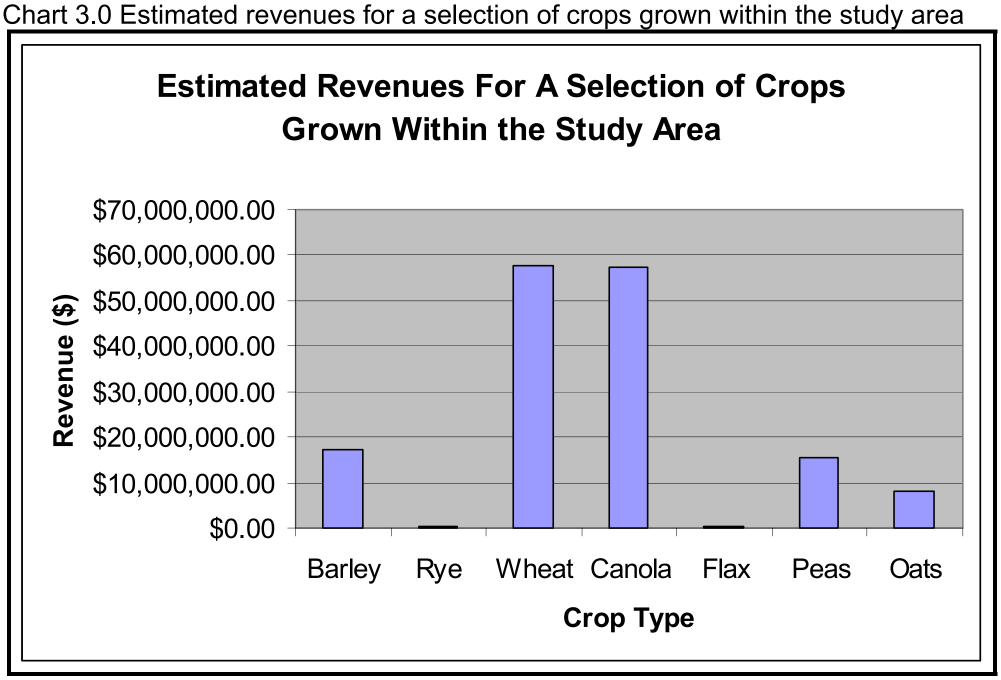



Chart 3.0 illustrates the potential revenues for a selection of crops within the study area.

Chart 3.0 Estimated revenues for a selection of crops grown within the study area




Charts 2.0 and 3.0 represent a generalized estimate for yields and potential revenues for the portion of the study area with the potential for growing agricultural crops.

### 3.1 Data analysis

The findings of the study are based on the amalgamation of data on many different subjects. The following sections describe each data source including a description of the findings, variability, conclusions, and significant features.

**Soils Data**

Please refer to Schedule 4 for the study area soils map. Available soil data are quite generalized, therefore variation from the indicated soil type is probable. As illustrated by Table 7.0 and Table 8.0, there are both mineral and organic soils within the study area.

Table 7.0 Mineral soils within the study area

| | |
|---|---|
| • Gray Luvisolic | • Gray Solonetzic |
| • Eutric Brunisolic | • Dystric Brunisolic |
| • Regosolic | • Gleysolic |

Table 8.0 Organic soils within the study area

| |
|---|
| • Organic Cryosolic |
| • Fibrisol |
| • Mesisol |

Within the mineral soil category, the following soils and there associated properties and limitations are described in Table 9.0.

Table 9.0 Properties and limitations of mineral soils within the study area

| Soil Type | Significant Properties | Limitations | Notes |
|---|---|---|---|
| Gray Luvisolic  http://sis.agr.gc.ca/cansis | Mainly develop in well to imperfectly drained sites, in sandy loam to clay, based-saturated parent materials under forest vegetation in subhumid to humid, mild to very cold climates. | These soils have a thin A horizon which is slightly acidic. They typically have a low organic carbon content and nutrient supplying capacity. These soils may experience crusting, low water holding capacity, low fertility, and low buffering capacity against pH change as a result of the low organic carbon content of the A horizon. (University of Alberta)<br><br>These soils often have a very firm, dense, acidic B horizon, which restricts root growth and impedes water transmission. | Gray Luvisolic soils have been the subject of intense study to find ways of effectively managing these soils. The outcome has been the development of management strategies that allow for significant improvement in the productivity of these soils.<br><br>Gray Luvisols occur typically under boreal or mixed forest vegetation in forest grassland transition zones in a wide range of |

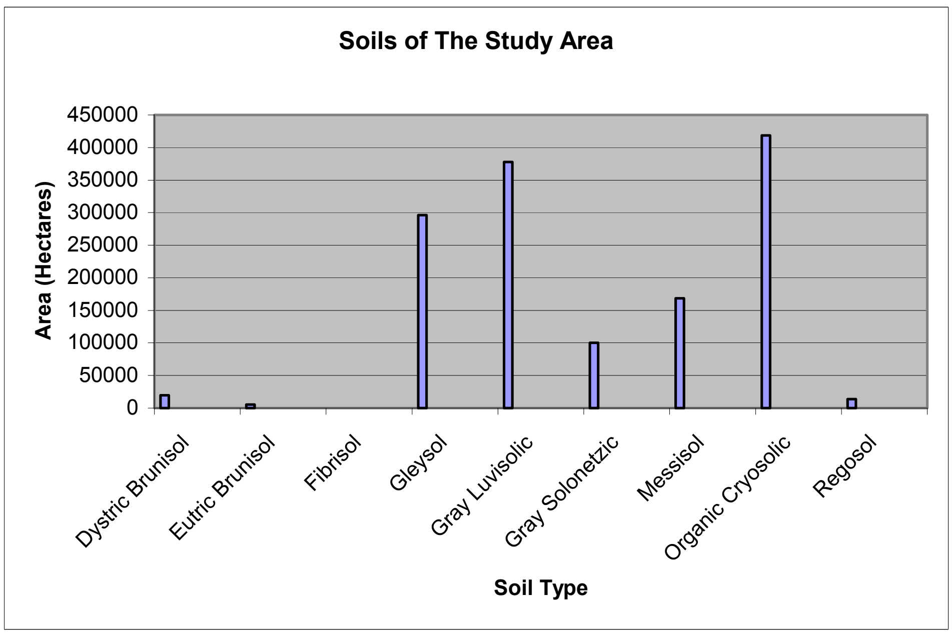
| Soil Type | Significant Properties | Limitations | Notes |
|---|---|---|---|
| | | | climate areas. |
| Eutric Brunisolic<br><br>http://sis.agr.gc.ca/cansis | These soils have a relatively high degree of base saturation (pH over 5.5)<br><br>Eutric-Brunisolic soils lack a well-developed mineral-organic surface horizon<br><br>Eutric Brunisolic soils occur mainly on parent material of high base status under forest or shrub vegetation | These soils may have a lack of nutrient-rich topsoil and can be considered to be relatively dry soils.<br><br>The high base status of these soils indicates that the soil can retain inorganic nutrients such as calcium and potassium, or that leaching is limited. | These soils may benefit from the introduction of organic materials into the topsoil to increase nutrient levels.<br><br>In addition, the high pH of these soils may require management and/or selection of high pH resistant crops. |
| Regosolic<br><br>http://sis.agr.gc.ca/cansis | These soils do not contain a B Horizon and are referred to as weakly developed. Regosolic soils may have buried mineral-organic layers and organic surface horizons. | Regosols may be nutrient deficient and rapidly drained. | |
| Gray Solonetzic<br><br>http://sis.agr.gc.ca/cansis | These soils are characterized by a tough impermeable hardpan that severely restricts root and water penetration of the subsoil.<br><br>According to an internet publication written by Dr. J.R. Bettany of the University of Saskatchewan *"In managing these soils tillage operations and seeding must be done when the soil is at the correct moisture content. If the soil is worked when it is too wet, the structure breaks down and completely. If tillage is left too late, the soil bakes and it becomes almost impossible to get proper penetration of tillage implements. Deep plowing or deep ripping is a management practice* | Some of these soils may not be suitable for agricultural purposes in our study area because the hardpan layer is largely due to high clay content rather than the typical development from parent materials naturally high in, or enriched with sodium salts (Government of Alberta 1988). | These soils may or may not respond favorably to deep plowing methods.<br><br>Solonetzic soils may not respond equally to deep plowing.<br><br>Soils of this order have B horizons that are very hard when dry and swell to a sticky mass of very low permeability when wet.<br><br>These soils usually have a neutral to acidic pH<br><br>Solonetzic soils do not have permafrost within 1m (3.3 feet) |

| Soil Type | Significant Properties | Limitations | Notes |
|---|---|---|---|
| | *designed to break up the compact Bnt horizon which resists penetration by plant roots. Usually done to a depth of 45-75 cm (18-30 in), this practice has proven beneficial in parts of Alberta and North Dakota and, more recently, in the Weyburn area of Saskatchewan. However, deep plowing at insufficient depth or where the subsoil is very saline or stony can do more harm than good. Deep ripping needs special equipment pulled by a powerful tractor. Deep plowing is not a management or reclamation practice for saline soils."* | | of the surface.<br><br>Often crops display a wavy growth pattern in times of moisture stress |
| Dystric Brunisolic<br><br>http://sis.agr.gc.ca/cansis | These soils have a relatively low degree of base saturation (pH less than 5.5)<br><br>Dystric Brunisolic soils lack a well-developed mineral-organic surface horizon<br><br>Dystric Brunisolic soils occur mainly on parent material of low base status under forest or shrub vegetation | These soils may have a lack of nutrient-rich topsoil and can be considered to be relatively dry soils. | These soils may benefit from the introduction of organic materials into the topsoil to increase nutrient levels.<br><br>In addition, the low pH of these soils may require management and/or selection of low pH resistant crops. |

| Soil Type | Significant Properties | Limitations | Notes |
|---|---|---|---|
| Gleysolic<br><br>http://sis.agr.gc.ca/cansis | Gleysolic soils develop in areas where water is added faster than it drains away. Topographical features such as depressions typically support gleysolic soils<br><br>These are poorly drained soils that experience either permanent or temporary saturation. | Gleysolic soils may or may not respond to management depending on the water source. | Management of these soils mainly involves drainage improvements. |

Chart 4.0 summarizes the soil types of the study area.

Chart 4.0 Distribution of Soils in the Study area




As illustrated in Chart 4.0, the dominant soils within the study are Organic Cryosolic, Gray Luvisolic, and Gleysolic. There are minor occurrences of Fibrisol, Eutric Brunisol, Regosol, and Dystric Brunisol. Gray solenetzic and Messisolic soils also occur in certain segments of the study area.

The soils of the study area are grouped into a general rating class formulated by the Mackenzie Municipal Services Agency based on the soils inherent characteristics and ability to respond to land management techniques. Table 10 illustrates the category assigned to each soil type. Group A soils are believed to have the most agricultural potential, while Group D soils are believed to have the least agricultural potential of soils within the study area. However, this approach is strictly interpretive and requires further investigation.

Table 10 Mackenzie Municipal Services Agency's classification of soils within the study area

| Soil Type | Class | Total Area (Hectares) | Notes |
|---|---|---|---|
| Dystric Brunisolic | B | 19 611 | |
| Eutric Brunisolic | B | 5 218 | |
| Gleysol | C | 296 211 | Heavy wet soils that may respond well to management. May be suitable for certain varieties of small grains and may be suitable for forage crops. |
| Gray Luvisolic | A | 377 648 | Are likely the best available soils in the study area. These soils are most likely suitable for the production of crops given current land management practices and technologies. |
| Gray Soloetzic | B | 100 254 | Likely to support the growing of crops if these soils respond favorably to management. |
| Regosol | D | 13 702 | |
| Fibrisol | D | 24 | May respond to management but are somewhat dependant on the organic content level. May be suitable for the forage and grazing. |
| Mesisol | D | 168 299 | May respond to management but are somewhat dependant on the organic content level. May be suitable for the production of forages and grazing. |
| Organic Cryosolic | D | 418 771 | These soils have permafrost within 1 meter of the surface. When the ground cover (sphagnum mosses, woody debris, and vegetative cover) is removed and the surface is disturbed more of the sun's solar radiation penetrates the ground warming the soil. This is because the sphagnum mosses and vegetative ground cover act as an isolative blanket, which does not allow the subsoil to warm up and secondly because once the soil is disturbed it exposes a darker surface that absorbs more heat from the sun. These soils may respond to management but are somewhat dependant on the organic content level. May be suitable for the production of forages and grazing. |

**Drainage Data**

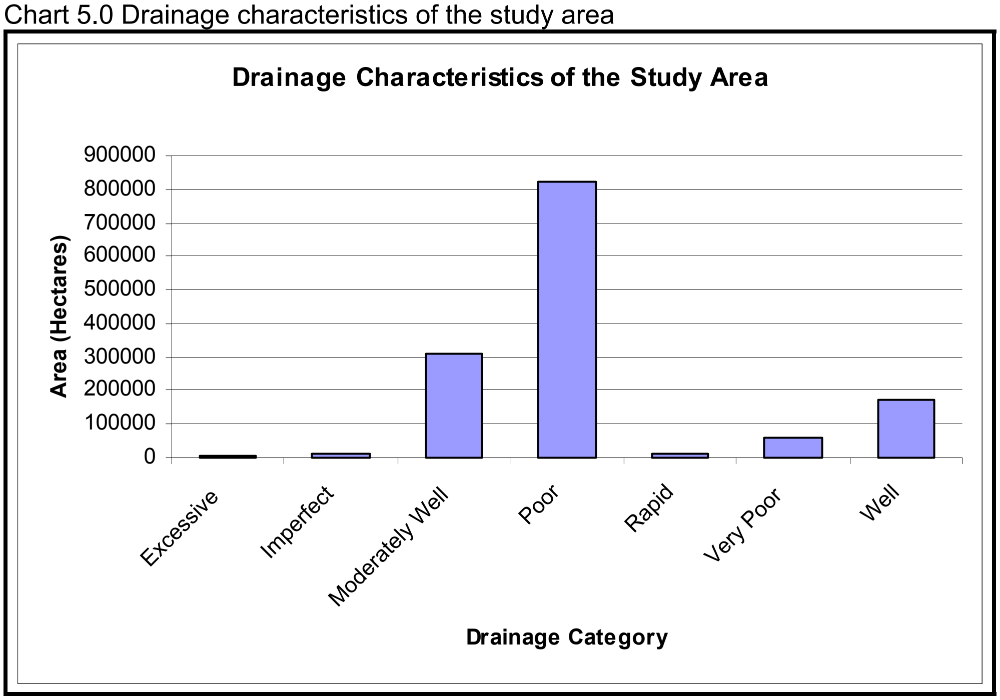
Drainage varies significantly within the study area. This variation is primarily due to a number of factors such as topographical features, soil type, among others. (Please refer to Schedule 13 drainage map for a graphic display of the study area drainage.)

Drainage data within the study comes from CANSIS classified into the following categories:

- Excessive
- Well
- Imperfect
- Very poor
- Rapid
- Moderately well
- Poor

An interpretation of the drainage map reveals that the majority of the study area is well drained, moderately well drained, or poorly drained. Chart 5.0 illustrates the drainage pattern within the study area.

Chart 5.0 Drainage characteristics of the study area




Further investigation of the map reveals the following:

1) Areas with excessive drainage occur on Eutric Brunisolic soils with a slope ranging from 4-9% in areas with parent materials derived from Eolian[12] deposits.

2) Areas with imperfect drainage occur on Gray Luvisolic Soils on slopes ranging from 4-9% with Lacustrine[13] parent materials.

[12] Eolian parent materials are uniform deposits of very fine sand and silt.
[13] Lacustrine parent materials are deposited by glacial lake water and consist mostly of silt and clay.

3) Areas with moderately well drainage occur in a variety of sites including areas with Gray Luvisolic Soils and Gray Solenetzic Soils with slopes ranging from 10-30% with Morainal[14] parent materials.

4) Poorly drained areas occur frequently throughout the study area on Gleysolic and Organic Cryosolic soils with slopes less than 4% on both Lacustrine and Organic[15] parent materials.

5) Rapidly drained areas occur on Dystric Brunisolic soils with a slope ranging from 4-9% in areas with parent materials derived from Eolian deposits.

6) Very poorly drained areas occur on Organic Cryosolic, Gleysolic, and Messisol soils on slopes of less than 4% with Organic, Fluvioglacial[16], and Aluvial[17] parent materials.

7) Well drained sites occur on Gray Luvisolic and Dystric Brunisolic soils with slopes ranging from less than 4% to 9% derived from both Eolian and Fluvioglacial parent materials.

**Slope Data**

Please refer to Schedule 5 for a visual overview of the slopes of the study area. The CANSIS slope data comes organized in the following categories:

- Less than 4%
- 4-9%
- 10-15%
- 16-30%

The majority of the study area occurs on slopes of less than 4%. There are areas around prominent land features that are classified as having a slope of 16-30% and areas classified as having a 4-9% slope. The Mount Watt area is classified as having a slope of 10-15%. Another factor of importance, which this study did not consider in full, is slope length, which is important because the potential for erosion is affected by slope length.

**Rooting Depth**

Please refer to Schedule 6 for a graphic representation of the study area rooting depth. CANSIS data on rooting depth comes grouped as follows:

- Less than 20 cm (7.8 inches)
- 20-75 cm (7.8-29.5 inches)

[14] Morainal parent materials are deposited by ice and consist of a mixture of boulders, stones, sand, silt, and clay.

[15] Organic parent materials are deposited when accumulation of organic material exceeds decomposition. Generally consist of stratified deposits of peat.

[16] Fluviolglacial parent materials are deposited by flowing glacial melt water and consists mainly of sand and/or gravel.

[17] Alluvial parent material is deposited by stream water and consists of a variable deposit of sand, silt, and clay.

- 75-150 cm (29.5-59 inches)
- Greater than 150 cm (59 inches)
- Non-applicable (e.g. Rock/ice)

Rooting depths within the study area vary between 20-75 cm (7.8-29.5 inches) and greater than 150 cm (59 inches). The majority of the study area has a rooting depth of 20-75 cm (7.8 - 29.5 inches).

The data poses some difficulty in identifying areas with rooting depths greater than 50 cm (19.7 inches) because the data comes grouped in categories as described above. It is not possible to separate the data into individual rooting depth classes. Therefore, ground-level investigation is required in order to determine if adequate rooting depth is present on a site specific basis.

**Growing Degree Days**

Refer to Schedule 7 for a graphic representation of the effective growing degree days[18] within the study area.

The number of effective growing degree days above 5 degrees Celsius within the study area ranges from 1152 - 1370. In comparison Beaverlodge, Alberta experiences approximately 1100 effective growing degree days above 5 degrees Celsius per year. The higher number of growing degree days in the study area is attributed to the longer day length factor in the north.

Given the range of 1152 - 1370 effective growing degree days within the study area, the following crops and their equivalent varieties may be suitable for the study area:

- Hard Red Spring Wheat
- Argentine Canola
- Mustard
- Oats
- Barley
- Polish Canola

There will inevitably be variations in growing degree requirements and yields, between select varieties of suitable crops grown in the study area.

The risk involved in agriculture is somewhat related to the species and varieties of crops selected. In general, not accounting for market conditions, crops which require a fewer number of growing degree days may pose less risk in the study area.

In general, the available growing degree days is not seen as a significant limiting factor for agriculture in the study area. However, there will likely be microclimatic conditions in certain locations of the study area that have less than the indicated number of growing degree days. These areas will likely occur in low lying areas or in areas of higher elevation and on northern slopes.

[18] Effective growing degree days is the growing degree days above 5 degrees Celsius corrected for the daylight factor for the north.

**Season Start and Season Duration**

Refer to Schedules 8 and 9 for a graphic representation of growing season start and growing season duration within the study area.

There is little variability between growing season start dates within the study area. The CANSIS data indicates that the growing season starts on average between April 25 and April 27. On average, the frost-free period within the study area is approximately 95-115 days with seasonal fluctuations.

The growing season duration within the study area, based on the available CANSIS data is thought to be an abnormally high estimate. The CANSIS data indicates a range of growing season lengths ranging from 163-167 days. CANSIS estimates the growing season length by determining the number of days between the first and last day of the year when the mean daily air temperature equals or exceeds 5 degrees Celsius plus one additional day. However, these figures appear abnormally high and suggest the following:

1) The growing season length in this case appears to be the average time between the first three consecutive frost-free days in the spring and the first killing frost of the fall.

The provincial average growing season length varies from less than 160 to greater than 185. The growing season length fluctuates on a yearly basis. Data from Alberta Agriculture supports the CANSIS findings.

The growing season length is a limiting factor to agricultural production in the study area. In many cases, successful agriculture within the study area will require the selection of short-season frost-tolerant crops. It is expected that those varieties grown in the Municipal District of Mackenzie No. 23 will be best suited to the study area.

**Canadian Climate Classification System**

Please refer to Schedule 10 for a graphic representation of the findings of the CCS software.

Inferences were made to estimate climatic conditions throughout the study area, but it was found that there is not enough variation in climatic conditions to warrant further investigation.

The estimated growing season length estimated by the CCS software is significantly shorter than the growing season length indicated by the CANSIS data. It is believed the reason for the discrepancy is as follows:

a. The CCS software determines growing season length as the average time between the first five consecutive days in the spring above five degrees Celsius and the first occurrence of frost (zero degrees Celsius) after July 15. (*It is noted that many crops can tolerate short periods of sub-zero temperatures with little or no damage. Therefore the CCS software estimates may be slightly modest.*) The CANSIS data appears to assume the growing season length as the average time between the first three consecutive frost free days in the spring and the first killing frost of the fall.

In addition, the effective growing degree days are also shorter than indicated by the CANSIS data. It is not possible to determine which data set is more accurate. However, it is best to assume the more conservative estimate (865-1169 effective growing degree days) in order to reduce the risk of crop failure and allow for seasonal fluctuations in temperature.

Similarly, it is best to assume the more conservative estimate (100-125 days) of the growing season length for the above said reasons.

According to the CCS findings, aspect is not expected to play a significant role on the growing season length or the number of effective growing degree days. However, this model is more sensitive to elevation change than it is to aspect.

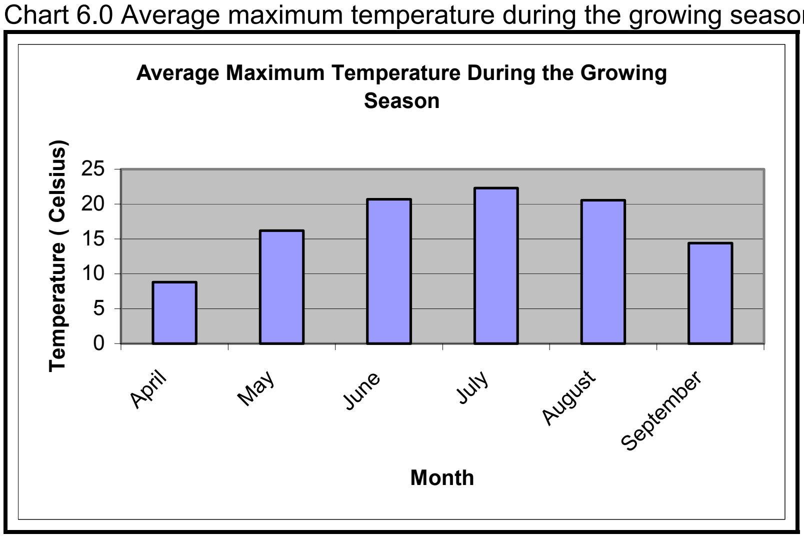
The variation in growing degree days and growing season length as estimated by the CCS software will likely influence the selection of crop varieties within the study area. Special attention will be required in order to ensure that the crop requirements can be met given the estimated agro climatic resources available within the study area.

**Temperature**

Please refer to Schedule 16 for a graphic representation of the temperature characteristics within the study area.

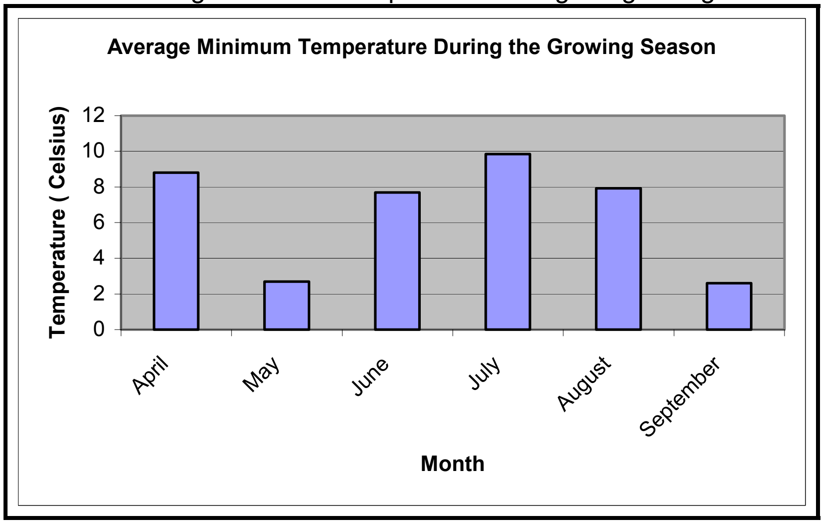
Charts 6.0, 7.0, and 8.0 represent the graphical interpretation of the average maximum temperature, average minimum temperature, and mean temperature within the study area during the growing season.

Chart 6.0 Average maximum temperature during the growing season



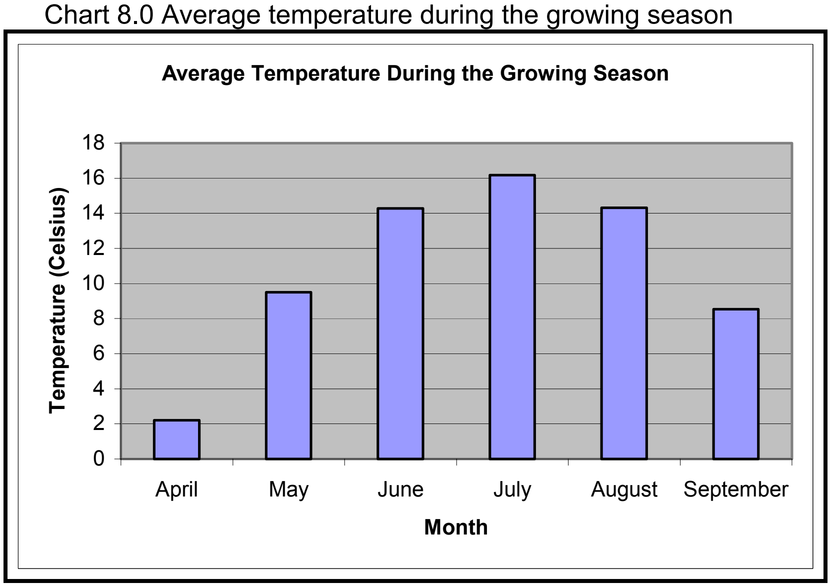

As illustrated above, the warmest months are June, July, and August.

Chart 7.0 Average minimum temperature during the growing season




The average minimum temperature data may not accurately reflect the realities of the ground as seen by a higher average minimum temperature in April than in May. No explanation is available for this unexpected result.

Chart 8.0 Average temperature during the growing season



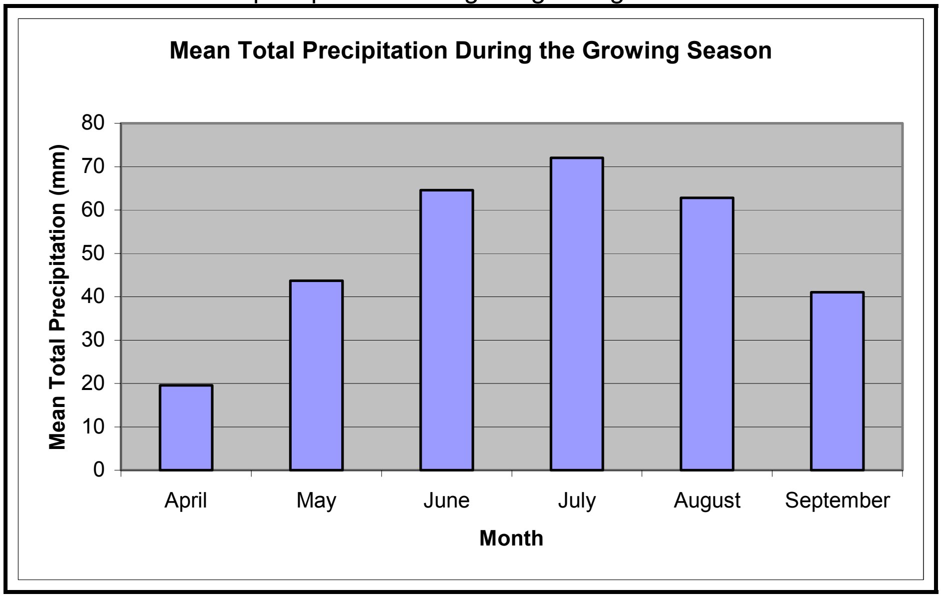

As shown above, the average temperature increases from April until July before decreasing in August and September.

## Precipitation

Please refer to Schedule 11 for a graphic overview of the precipitation patterns and potential for evapotranspiration within the study area.

Chart 9.0 visually outlines the precipitation patterns for the growing season within the study area.

Chart 9.0 Mean total precipitation during the growing season




An analysis of the above chart reveals the following:

1) The majority of the precipitation during the growing season occurs during the months of June, July, and August when it is most needed by agricultural crops.

2) The amount of precipitation occurring in September may interfere with harvest.

3) On average, April does not experience any significant quantities of precipitation. This means that agriculture will be dependent on moisture from snowmelt to allow for spring seeding.

4) Saturated soil conditions may be less likely in April due to lower precipitation levels.

**Water Deficit**

Please refer to Schedule 12 for a graphic representation of the water deficit for the study area.

Field tests are required to determine the water holding capacities of the soils within the study area. Charts 10.0, 11.0, 12.0, 13.0, and 14.0 represent a graphic overview of the potential water deficits of the study area based on the soils water holding capacity. The higher the water deficit value is the less water is available for plant uptake.

Chart 10.0 Average water deficit for soils with a 100mm available water-holding capacity during the growing season

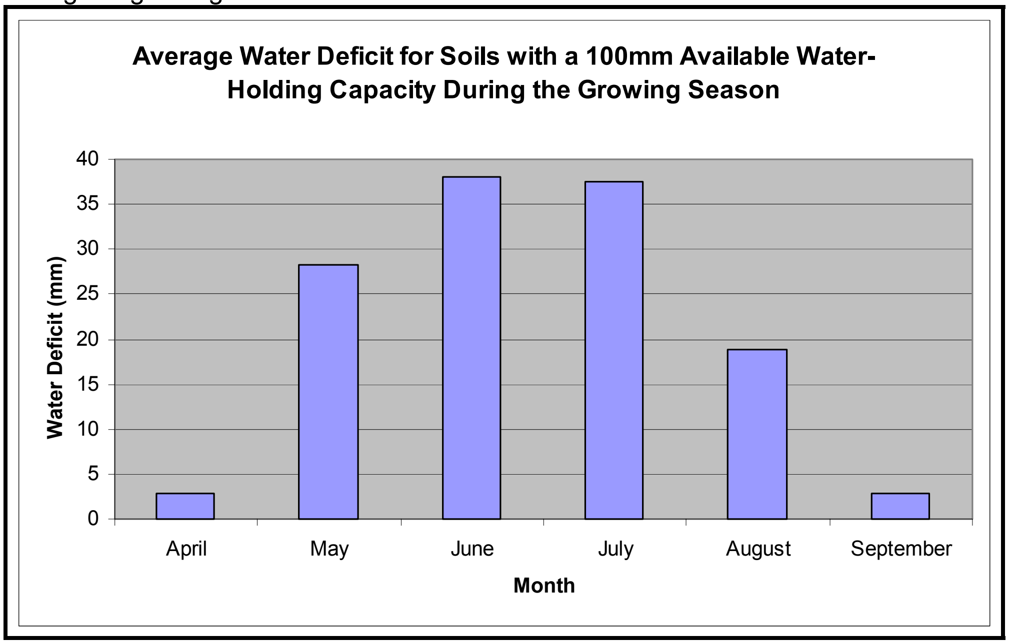



Chart 11.0 Average water deficit for soils with a 150mm available water-holding capacity during the growing season

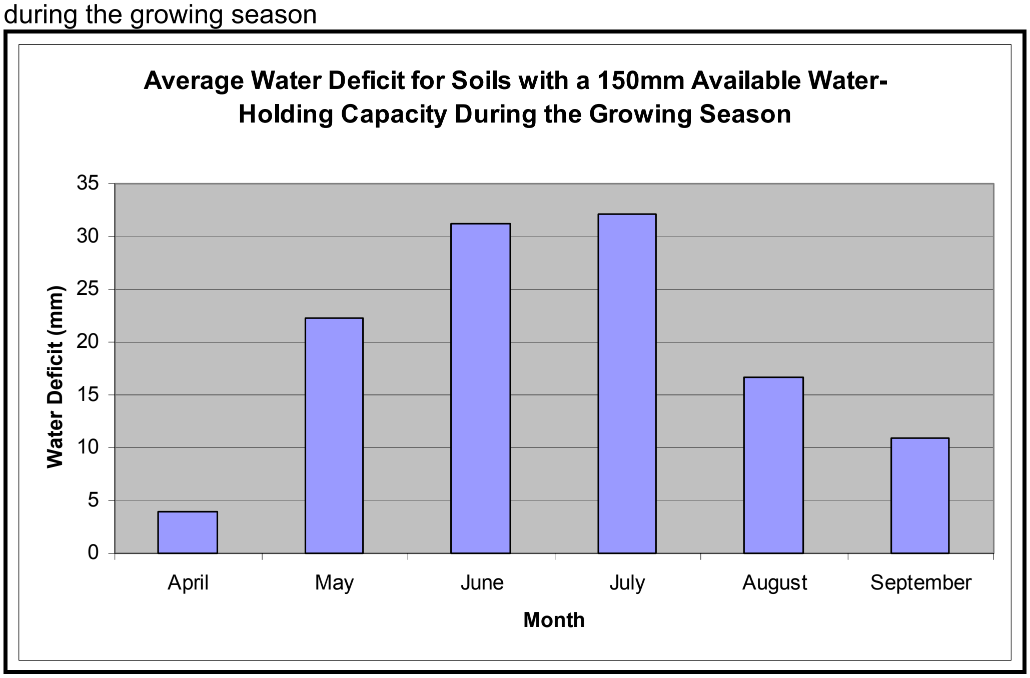


Chart 12.0 Average water deficit for soils with a 200mm available water-holding capacity during the growing season

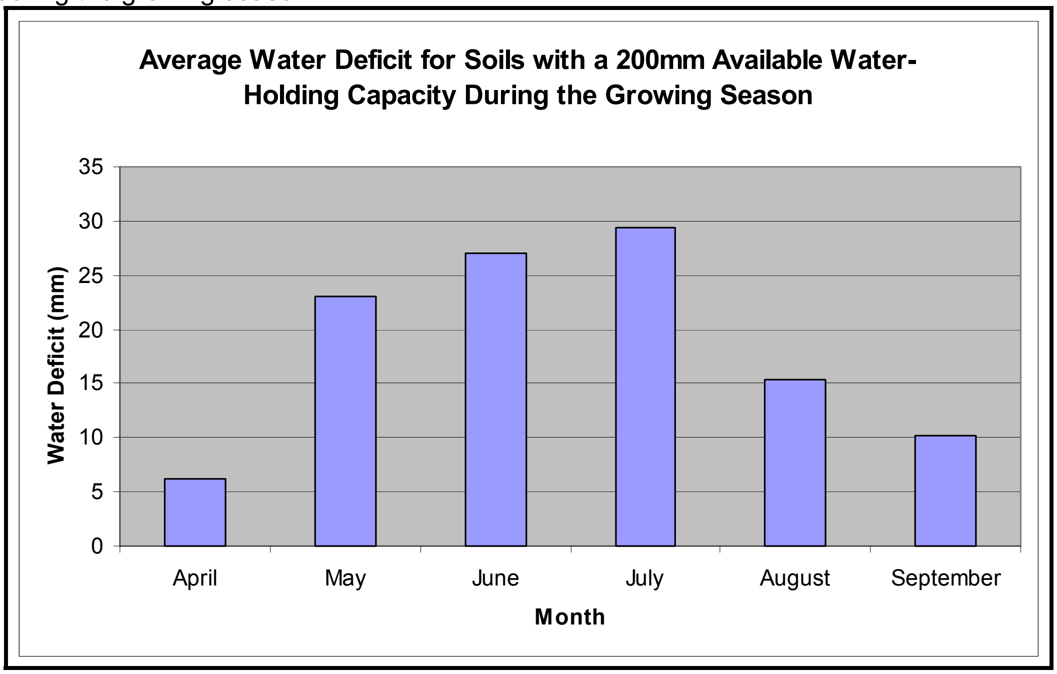



Chart 13.0 Average water deficit for soils with a 250mm available water-holding capacity during the growing season

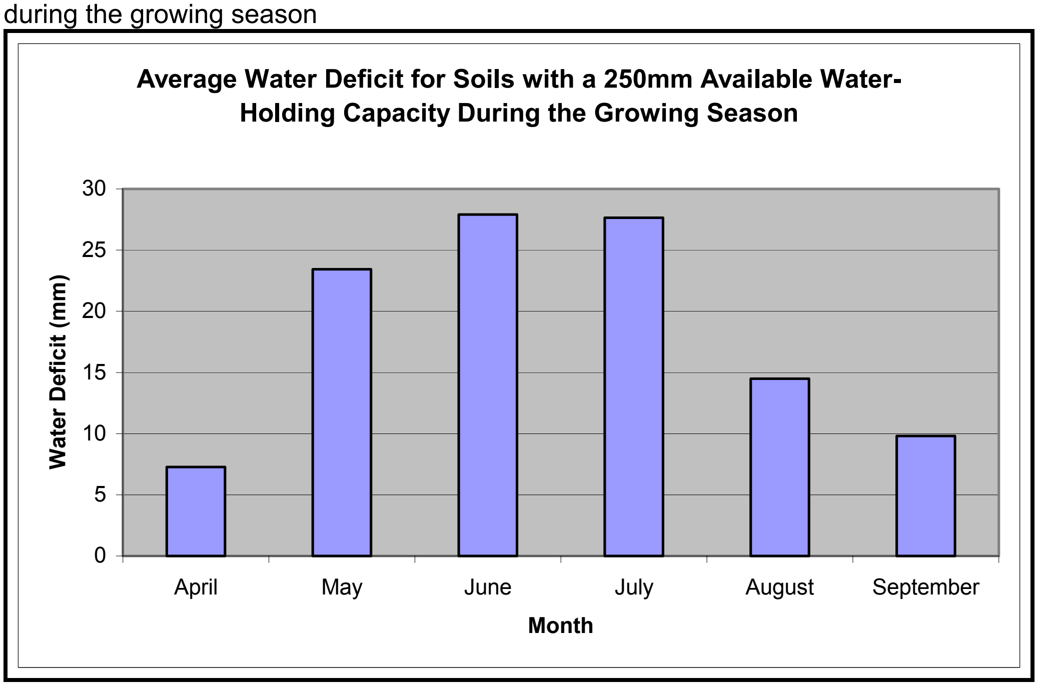
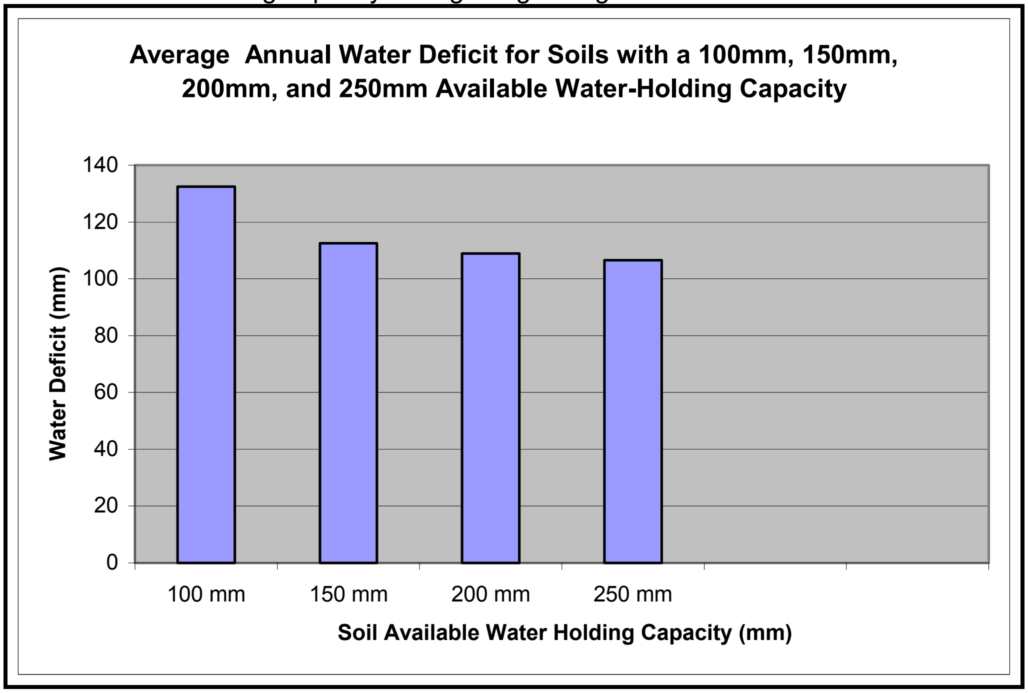


Chart 14.0 Average annual water deficit for soils with a 100, 150mm, 200, and 250mm available water-holding capacity during the growing season




The water deficits in the study area are not expected to have a significant impact on agricultural productivity.

## Other Considerations

### (A) Land and Resource Management Plans (LRMPs) within the Study Area

Land and Resource Management Plans (LRMP) are sub-regional strategic planning documents prepared to address, identify, and effectively manage the diverse resources, interests, and values of a particular region. A LRMP has been conducted for the Fort Nelson Area. The LRMP identifies a number of management objectives and strategies relating to the following:

Table 11.0 Management objectives of the Fort Nelson LRMP.

| | |
|---|---|
| • Access management | • Agriculture |
| • Air Quality | • Biodiversity |
| • Energy (Oil and Gas; Hydroelectric) | • First Nations, Heritage and Culture |
| • Forestry | • Guide Outfitting |
| • Jobs and Community Stability | • Minerals |
| • Outdoor Recreation and Tourism | • Protected Areas |
| • Soil | • Transportation and Utility Corridors |
| • Trapping | • Visual Quality |
| • Water | • Wildlife |

Please refer to Schedule 15 for more information on the above management objectives and strategies.

The LRMP tables represent a diverse array of resources, interests, and values, all of which occur within close proximity to the study area.

Alberta's closest equivalent to the LRMP is the integrated resource management plan (IRP), which are conducted for a specific area. These plans take a comprehensive, integrated approach to managing public land and resources. However, according to our records, no IRP has been completed for the study area.

### (B) First Nations

First nations are a recognized level of government in Canada. The study area is home to a number of first nations bands who may have interests in the study area. The following First Nations have been identified in the study area.

1) Little Red River Cree Nation
2) Tallcree Fist Nation
3) Beaver First Nation
4) Dene Thá First Nation
5) Prophet River Band
6) Dene Tsaa K'Nai First Nation
7) Fort Nelson First Nation

First nations should be involved in the planning process to identify culturally sensitive sites and sites of traditional importance. Land claims and reserves must be identified and planning must be done accordingly.

### (C) Other Resources (Recreation, Hunting, Fishing, Trapping)

The Fort Nelson LRMP identifies a diverse array of user groups in the study area. Each user group has its own values, requirements, and beliefs on how the area should be managed. There are likely extensive opportunities for recreation, hunting, fishing, and trapping within the study area as a large portion is undeveloped wilderness.

In some cases, these users will benefit from increased access to the area, but in other cases, they will suffer from loss of benefits derived from productive land.

### (D) Expansion of the White Zone (Alberta) and the Agricultural Land Reserve (British Columbia)

Northwest Alberta is considered to be one of Canada's last remaining tracts of land with agricultural potential (Alberta Agriculture, Environment, et al 1988).

In Alberta public lands are designated as green zone. Green zones are managed primarily for forest production, watershed protection, recreation and multiple other uses. Agriculture is limited in the green zone to unimproved grazing.

In 1988, approximately half of the provincial land base was in the green zone, a portion of which is removed on an annual basis. The majority of green zone removed is in the Peace River district along the existing green zone boundary.

In British Columbia, certain private and public lands are designated as Agricultural Land Reserve (ALR). The ALR is a provincial zone in which agriculture is recognized as the priority use and other non-agricultural uses are controlled. ALR's are an important planning tool because they take precedence over other legislation and bylaws that pertain to the land. ALR is designated in areas believed to have the potential for agricultural use. There are small pockets of ALR surrounding Fort Nelson, which are the subject of previous study (the results of which are not available at this time). East of Fort Nelson there are currently no ALR's within the study area.

Expansion of the ALR and the Green zone is required to realize the maximum potential for agricultural expansion in the study area.

# 4.0 Conclusion

There are approximately 647,520 hectares (1.6 million acres) of land within the study area boundaries that have the potential for supporting the production of agricultural crops. Assuming that 75 percent of those lands are viable for agricultural production, there are approximately 1.2 million hectares (2.9 million acres) of lands with agricultural potential within the study area. In addition there are approximately 540,023 hectares (1.3 million acres) of land within the study area with the potential for forage and grazing.

It is estimated that there is potential for total yearly revenues of $156 million for growing the agricultural crops best suited to the study area such as (barley, rye, wheat, canola, flax, field peas, and feed oats) not including the revenues generated from other forage and hay grown in areas with potential for foraging and haying.

The study area has a moderate to severe heat limitation that may restrict the range of crops suitable for growth to those mentioned above. However, given the number of effective growing degree days and the variety of crops currently grown within the Municipal District of Mackenzie No. 23, the following spring-seeded small grains and other crops and their equivalent varieties may be suitable for the study area:

- Flax
- Argentine canola
- Oats
- Polish canola
- Wheat
- Hard red spring wheat
- Mustard
- Barley
- Field peas

The climatic characteristics of the study area include a short growing season ranging from 100 to 125 days, which means that crops should be selected that reach maturity within 90-115 days depending on the location within the study area. The effective growing degree days within the study area range between 865 and 1370 (using the lowest number from the CCS software and the highest number from CANSIS) depending on the location within the study area.

Not all soils within the study area are suitable for the production of agricultural crops such as spring-seeded small grains. Organic soils have not been considered for these crops because of data unavailability, lower soil temperature, and nutrient deficiency. However, organic soils are only considered potential candidates for foraging and grazing. Not all mineral soils within the study area have the same potential for crop production. Although the study area is shown to have agricultural potential, there are a number of soil management and agro climatic challenges that must be overcome. Soil type, soil texture, soil temperature, and soil drainage appear to be the most limiting factors to the establishment of agricultural developments in the study area. Management techniques such as deep plowing, sub soiling, and drainage improvement will be required.

Areas that currently have standing water and/or organic soils, including peat accumulations may have agricultural potential through the implementation of land management practices. However, more detailed analysis than this study can provide is required to determine if there is agricultural potential in areas with standing water and/or organic soils.

## *4.1 Land Use Perspective:*

From a land use perspective, there are many considerations relating to the expansion of the agricultural industry in the study area. These considerations are discussed below.

There is a finite supply of land available for forestry operations, oil and gas, and agriculture. The expansion of the agricultural industry into a predominantly forestry and oil and gas extraction area may have an impact on the long term sustainability of forestry and oil and gas operations in the area. There would likely be lost revenues in the forest and oil and gas industry caused by a reduction in the total annual allowable cut resulting from the expansion of the agricultural industry in the study area (a reduction in total timber volume resources).

Typically, most farmers do not solely rely on farm income for financial support. Many require a steady reliable source of off-farm employment. This may be a concern since the study area is undeveloped and remote, the closest town is likely a great distance away. This may be mitigated through identifying opportunities for the establishment of value-added agricultural products and industries in order to decrease the dependency on off-farm income. Some potential value-added industries that could be considered in depth are honey production, dairy products, meat processing, potato products, livestock feeds, cereal production, among others. Promoting value-added agricultural industries is likely to increase the viability of agriculture in the study area.

In order to maximize productivity and take advantage of economies of scale, it is important to strictly control farmland fragmentation. Conflicting land uses will ultimately have its toll on economic returns. Special attention is required to regulate country residential subdivisions within the study area in order to reduce the potential for land use conflicts and maintain large farm unit standards. The study area is separated, for the most part, from rural and urban settlements and may be a prime location for the establishment of large confined feeding operations. However, if country residential development infringes upon these areas, the potential for large-scale confined feeding operations will diminish.

There will likely be a significant cost incurred to the Municipal District of Mackenzie No. 23 and Northern Rockies – Fort Nelson Regional District for developing municipal access roads throughout the study area. Maintenance and snow removal on these roads may also be a concern. There may be opportunities for private public partnership for constructing access roads in order to reduce costs incurred by the local authorities.

Another land use consideration is the phasing of development. There are many options available, but care should be taken in order to make efficient use of municipal access roads. The municipal authorities should play an active role in developing a transportation plan for the area including the development, phasing, and maintenance of access roads to service the area.

Emergency services is another concern. As new areas are settled, the distance between those settlements and available emergency services increases, hence increasing the cost and response times. Agricultural development in the study area may lead to the development of newly created unincorporated areas and hamlets in order to provide the services necessary for the residents who serve the agricultural communities. It is suggested that municipal authorities, in their long-range planning programmes, identify suitable locations for the establishment of these new communities taking into consideration access, water supply, proximity to employment, etc.

A significant limiting factor to the establishment of a viable agricultural industry west of Rainbow Lake is the extension of Highway 58 connecting Rainbow Lake to Fort Nelson. In conjunction with the highway, there will also be the need to extend the electrical grid, telephone lines, and natural gas distribution system to serve new development. Without the extension of Highway 58, it is unlikely that agriculture in that portion of the study area is feasible.

## *4.2 Conversion of Public Lands for Agricultural Purposes*

In British Columbia, the expansion of the Agricultural Land Reserve to include all/some of the areas identified as having agricultural potential in the study area is necessary to protect the agriculturally viable areas for agriculture. Although intensive agriculture is permitted on crown lands through a tenure system, available information suggests the maximum size is 15 hectares (37 acres). This is not a viable size for the type of agricultural development best suited to the study area.

White zone expansion (conversion of green zone to white zone) is required in order to permit agricultural development within the study area. If lands in the green zone are transferred to the white zone, the Municipal District of Mackenzie No. 23 will gain jurisdiction over those lands and agriculture could be permitted. An impact study on the economic implications of green zone conversion (white zone expansion) on the Municipal District of Mackenzie No. 23 is suggested prior to any final decisions on green zone conversion.

The conversion of public lands for agriculture may involve a number of activities such as:

- **clearing the land of its vegetative cover:** This includes trees and shrubs. Some trees may be left as shelterbelts. Commercial harvesting of suitable timber may play a significant role in reducing land clearing costs.

- **piling and burning**: The vegetative cover must be piled and burned

- **seedbed preparation:** The soil must be worked, plowed, and rocks and woody debris removed. Drainage improvements may be necessary.

### *4.3 Inter-provincial cooperation*

Inter-provincial cooperation and long-range planning is paramount to facilitating the expansion of the agricultural industry in the study area. The lifeline of agriculture is the ability to transport products to the market in an efficient and cost-effective manner. The extension of Highway 58, connecting Rainbow Lake to Fort Nelson, is of vital importance to both provincial governments if any agricultural operations in the study area were to succeed. Not only will the extension increase the viability of agricultural pursuits in the area, it will also greatly benefit the oil and gas and forest industry by providing an all-weather east-west connector to access both resources and markets.

## 5.0 Recommendations

The intent of this study is to determine if there is potential for agricultural expansion within the study area. Given the quality, accuracy, and availability of data, this study is limited to a reconnaissance level. Further detailed studies and ground truthing are necessary in order to fully understand the full potential of agriculture within the region.

Certain areas within the study area have been identified as having potential for agricultural production and foraging and grazing. This study focused on a segment of the region centred on the existing and proposed Highway 58 transportation corridor. It is likely that other areas within northwest Alberta and northeast British Columbia have similar agricultural potential to those found in the study area if similar soil and agro climatic conditions exist.

Although there is agricultural potential in the study area, and perhaps the region, it is unknown at this time if agricultural expansion is economically feasible. There are a number of variables that will inevitably affect the economic viability of agricultural expansion in the study area such as commodity prices, demand for farmland expansion, interest rates, access to markets, and land clearing costs. Of significant concern is the potential for lost benefits from oil and gas, forestry, wildlife, recreation, among others.

Portions of the study area encompass both the province of British Columbia and the province of Alberta. Political cooperation is vital to the success of this project. Variations in provincial policy and legislation regarding agriculture, oil and gas, and natural resource management are hurdles that are best overcome through inter-provincial cooperation and planning.

In order to facilitate the expansion of the agricultural industry in northwest Alberta and northeast British Columbia, the following action is recommended:

**Action # 1: That the Province of British Columbia and Alberta establish a joint task force to further explore the possibility of agricultural expansion throughout the region through the implementation of the following inter-provincial studies and initiatives:**

1) Cost benefit analysis of opening the area for agriculture

2) Detailed soil survey to determine variations in soil conditions, nutrient regime, soil temperature and structure of organic soils, stoniness, and salinity.

3) A joint resource and land management plan or integrated resource management plan to identify and manage the diverse array of interests and values within the region, and to develop a prescription for land management including development priorities.

4) To hold a series of public workshops to identify stakeholders, ideas, and concerns.

It is vital that both provinces work in conjunction with each other in order to ensure consist policy and regulations apply across provincial borders, especially in the area of interest.

## 6.0 References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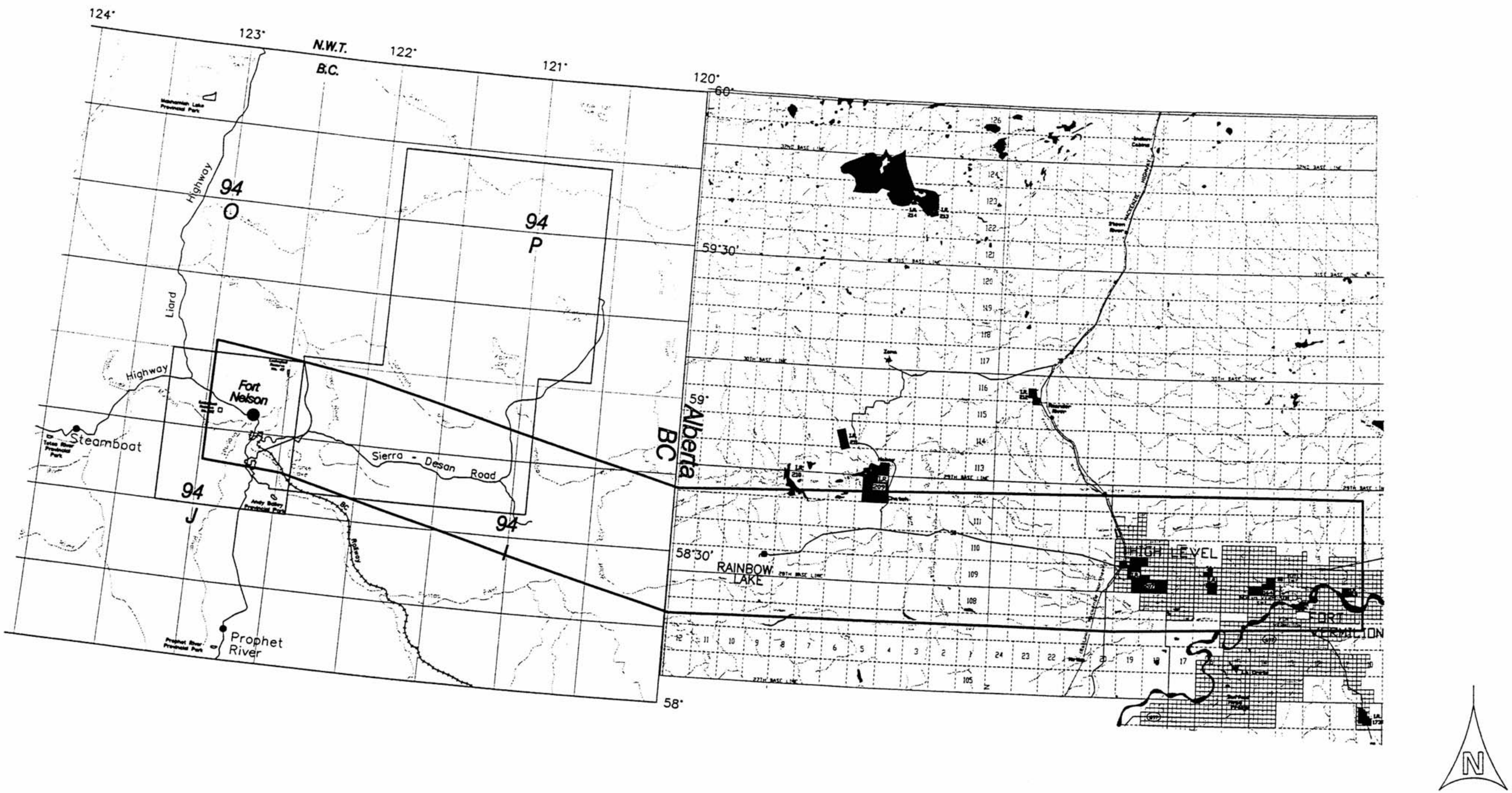
# 7.0 Appendices

*Schedule 1– Context Map*

## Schedule 1

## Northwest Corridor Agricultural Feasibility Study

## CONTEXT MAP




LEGEND

Study Area Boundary

**NORTHWEST CORRIDOR AGRICULTURAL FEASIBILITY STUDY**

REGIONAL CONTEXT MAP

Mackenzie Municipal Services Agency
P.O. Box 450, Berwyn, Alberta T0H 0E0
Phone [780] 338-3862
Fax [780] 338-3811

Date: October 2003
Drawn by:
Checked by:
Dwg No.:
Scale: N T S

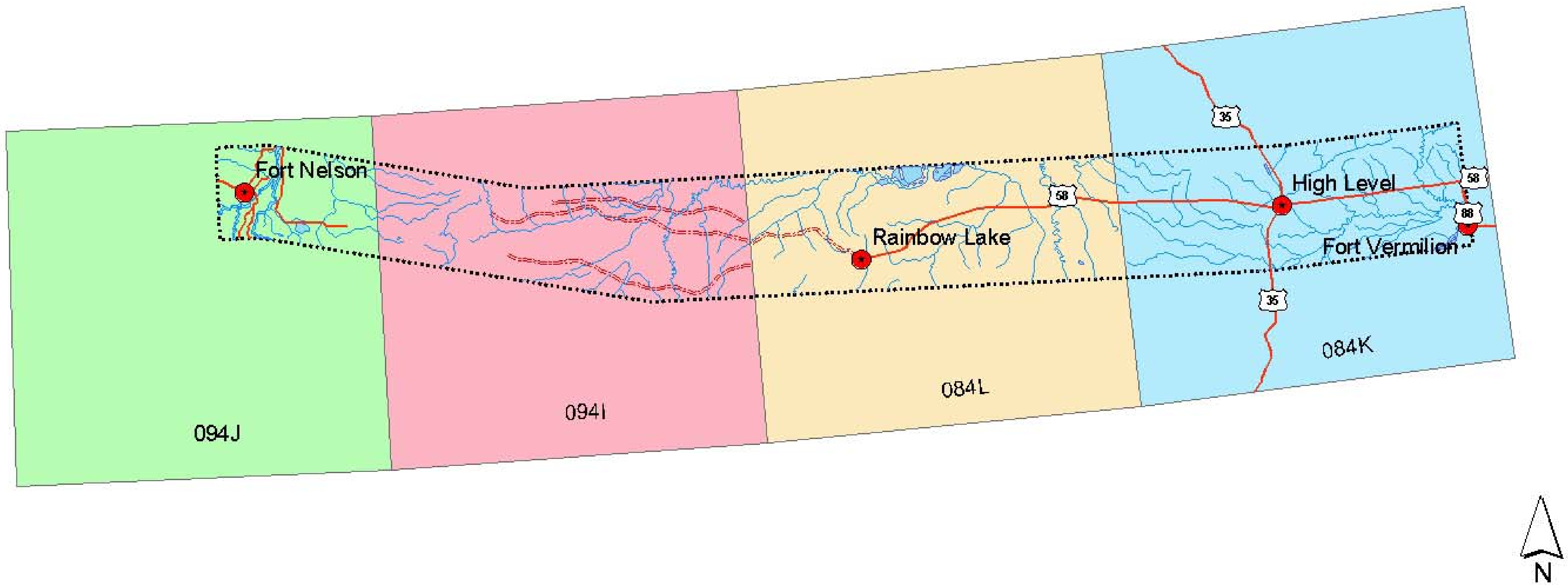
*Schedule 2 – Detailed Study Area Boundary Map*

# Schedule 2

# Northwest Corridor Agricultural Feasibility Study

# Detailed Study Area Boundary Map

# Northwest Corridor Agricultural Feasibility Study
## Detailed Study Area Map




**Legend**

Towns
Roads
Rivers
Proposed Highway 58 Routes
Lakes
Study Area Boundary

1:250 000 NTS Map Sheets
084K
084L
094I
094J

0 15 30 60 90 120 Kilometers


P.O Box 450, Berwyn Alberta T0H 0E0
Phone (780) 338-3862
Fax (780) 338-3862


Date: November 2003

Drawn by: Greg Keller

Checked by: Greg Keller

Schedule: 2

Scale: Approximate 1:1 000 000

*Schedule 3 – Detailed Study Findings Map*

# Schedule 3

# Northwest Corridor Agricultural Feasibility Study

# Detailed Study Findings Map

# Northwest Corridor Agricultural Feasibility Study
## Areas with Potential for Agriculture, Haying, and Grazing


**Legend**

Roads
Town
Rivers
Proposed Highway 58 Routes
Study Area Boundary
Areas with Agricultural Potential
Areas with potential for Forage and Grazing
Lakes

0 20 40 80 Kilometers


P.O Box 450, Berwyn Alberta T0H 0E0
Phone (780) 338-3862
Fax (780) 338-3862


Date: November 2003

Drawn by: Greg Keller

Checked by: Greg Keller

Schedule: 3

Scale:

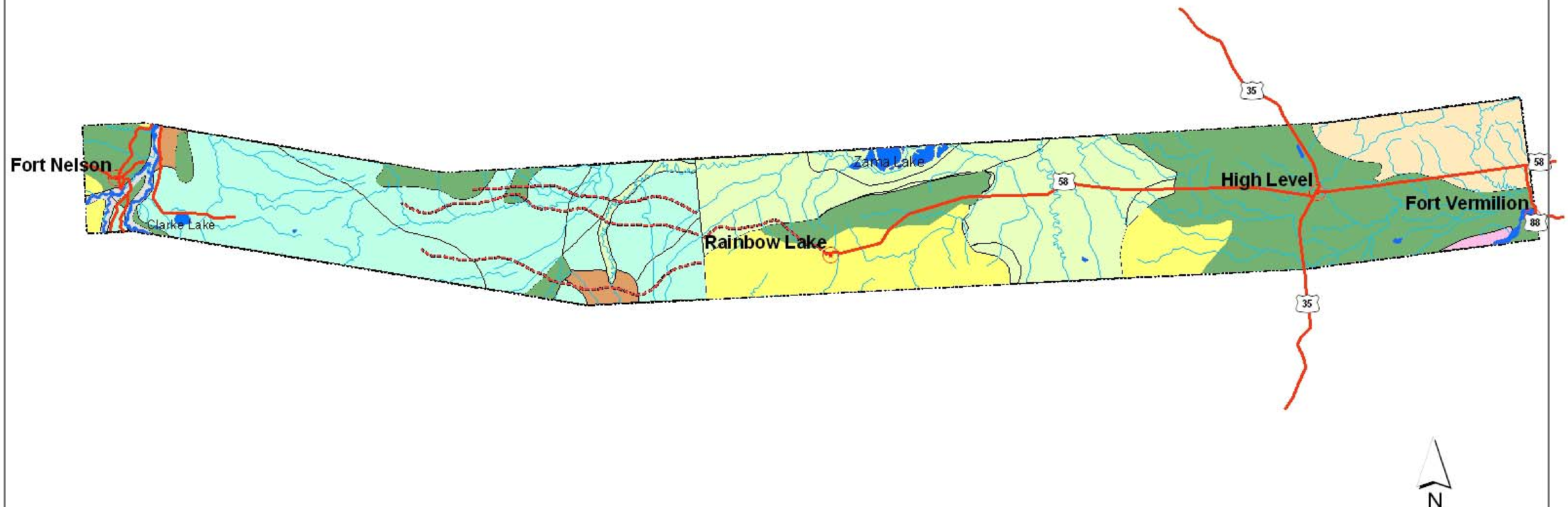
*Schedule 4 – Detailed Study Area Soils Map*

# Schedule 4

# Northwest Corridor Agricultural Feasibility Study

# Detailed Study Area Soils Map

# Northwest Corridor Agricultural Feasibility Study
## Soils Map of the Study Area




**Legend**

- Roads
- Town
- Proposed Highway 58 Routes
- Lakes
- Rivers
- Gray Luvisolic
- Gray Solonetzic
- Eutric Brunisolic
- Organic Cryosolic
- Dystric Brunisolic
- Regosolic
- Gleysolic
- Fibrisol
- Mesisol
- Study Area Boundary



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Date: November 2003

Drawn by: Greg Keller

Checked by: Greg Keller

Schedule: 4

Scale: Approximate 1:1 000 000

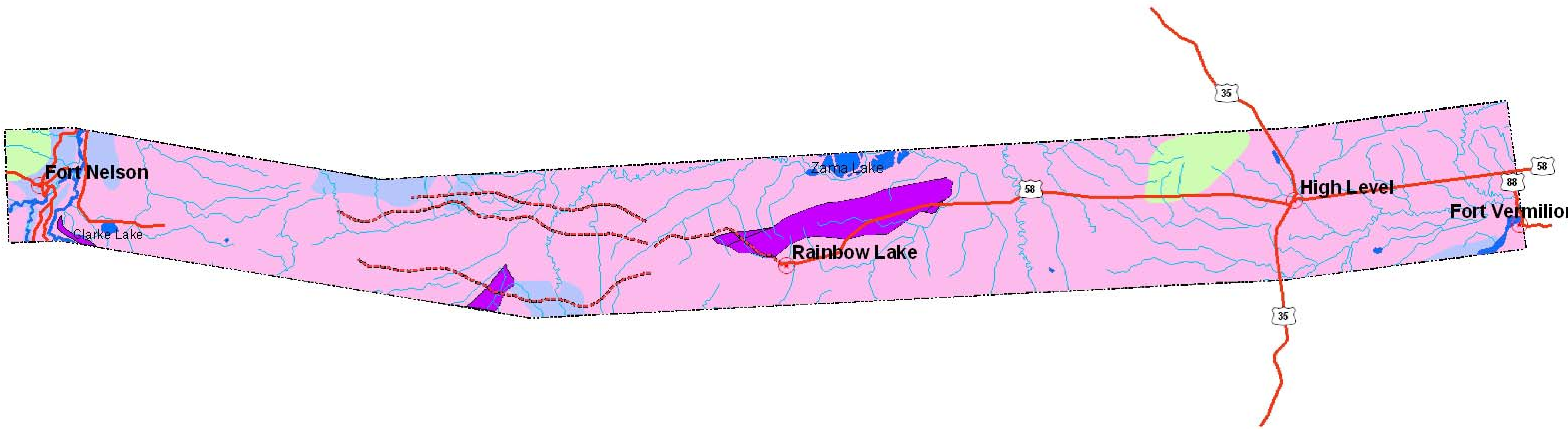
***Schedule 5 – Detailed Study Area Slope Map***

# Schedule 5

# Northwest Corridor Agricultural Feasibility Study

# Detailed Study Area Slope Map

# Northwest Corridor Agricultural Feasibility Study
## Study Area Slope




**Legend**

- Roads
- Town
- Proposed Highway 58 Routes
- Lakes
- Rivers

**Slope**

**Slope**

- <4%
- 4-9%
- 10-15%
- 16-30%
- Study Area Boundary

0 12.5 25 50 75 100 Kilometers

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Fax (780) 338-3862

| | |
|---|---|
| Date: November 2003 | Drawn by: Greg Keller |
| | Checked by: Greg Keller |
| Schedule: 5 | |
| Scale: Approximate 1:1 000 000 | |

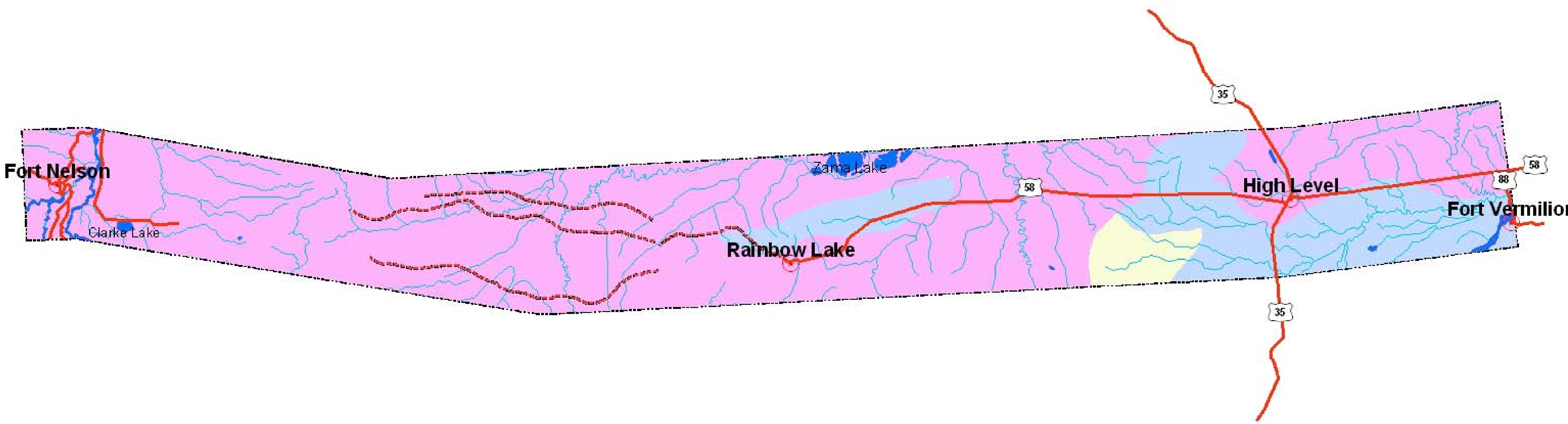
*Schedule 6 – Detailed Study Area Rooting Depth Map*

# Schedule 6

# Northwest Corridor Agricultural Feasibility Study

# Detailed Study Area Rooting Depth Map

# Northwest Corridor Agricultural Feasibility Study
## Rooting Depth in the Study Area




**Legend**

- Roads
- Town
- Proposed Highway 58 Routes
- Lakes
- Rivers

**Rooting Depth**

**Rooting Depth**

- Non-applicable (e.g. rock/ice)
- 20-75 cm
- >150 cm
- Study Area Boundary

0 30 60 120 Kilometers

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Fax (780) 338-3862

Date: November 2003

Drawn by: Greg Keller

Checked by: Greg Keller

Schedule: 6

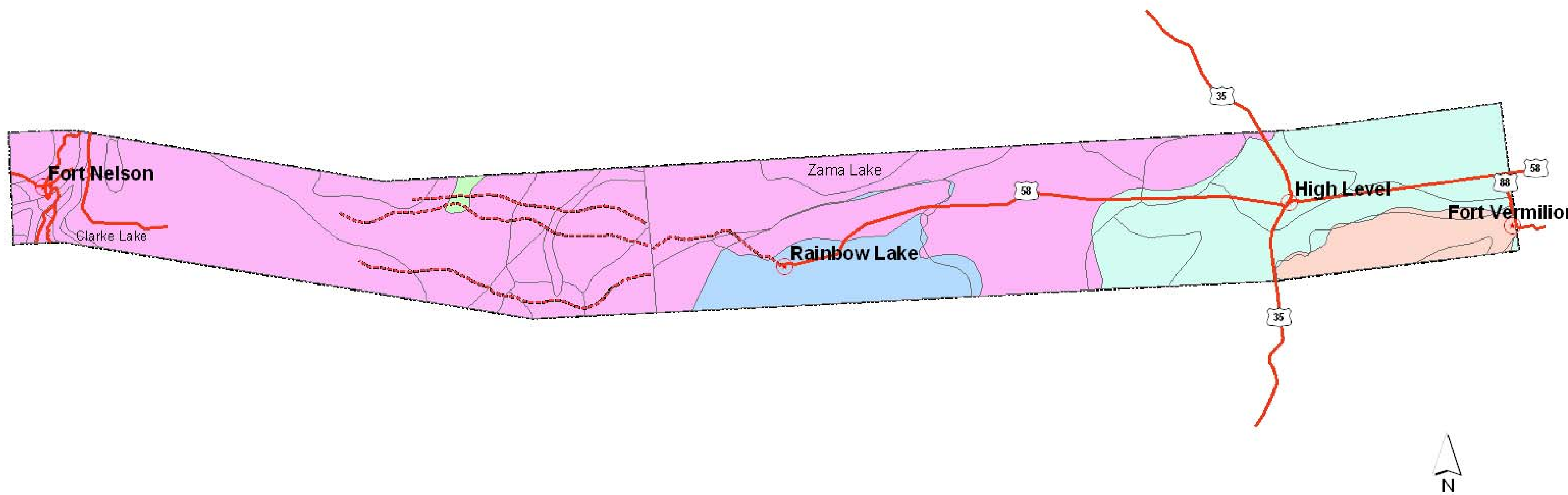
Scale: Approximate 1:1 000 000

# Schedule 7

## Northwest Corridor Agricultural Feasibility Study

## Detailed Study Area Effective Growing Degrees Map

# Northwest Corridor Agricultural Feasibility Study
## Effective Growing Degree Days in the Study Area




**Legend**

- Roads
- Town
- Proposed Highway 58 Routes
- 1152.9
- 1264.7
- 1269.2
- 1295.1
- 1370.3
- Lakes
- Rivers
- Study Area Boundary

0 25 50 100 Kilometers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Fax (780) 338-3862


| | |
|---|---|
| Date: November 2003 | Drawn by: Greg Keller<br>Checked by: Greg Keller |
| Schedule: 7 | |
| Scale: Approximate 1:1 000 000 | |

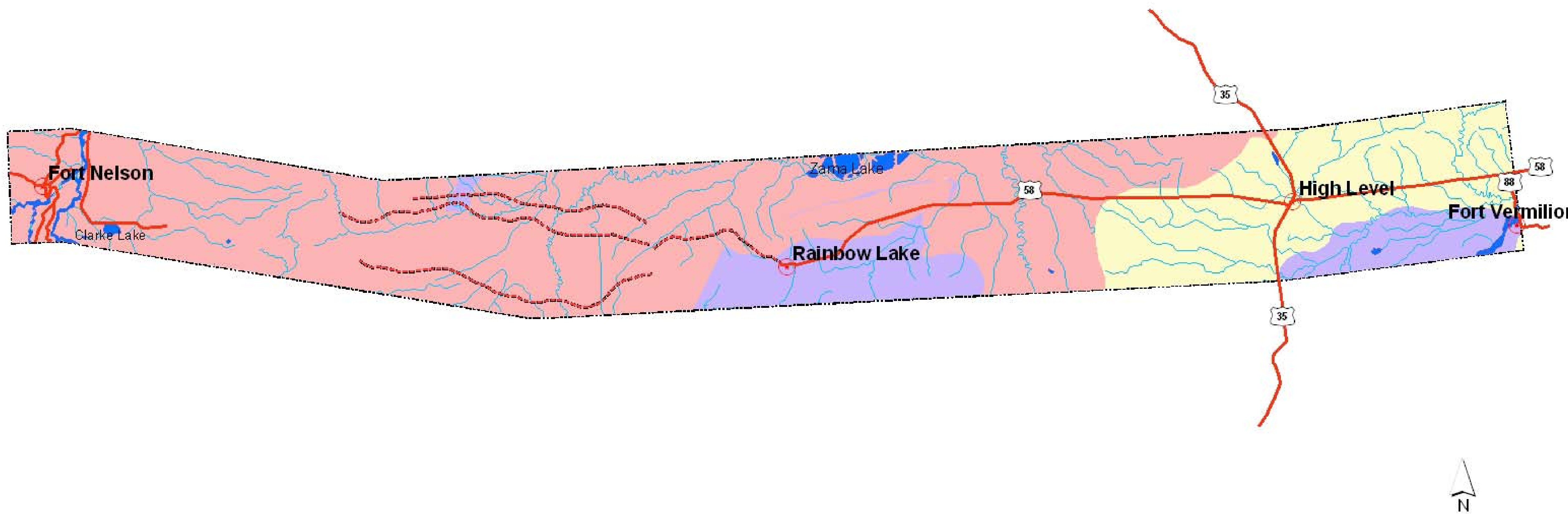
*Schedule 8 – Detailed Study Area Growing Season Start Map*

# Schedule 8

# Northwest Corridor Agricultural Feasibility Study

# Detailed Study Area Growing Season Start Map

# Northwest Corridor Agricultural Feasibility Study
## Estimated Growing Season Start




**Legend**

Roads
Town
Proposed Highway 58 Routes
Lakes
Rivers

Growing Season Start
April 25
April 26
April 27
Study Area Boundary

0 25 50 100 Kilometers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Phone (780) 338-3862
Fax (780) 338-3862


| | |
|---|---|
| Date: November 2003 | Drawn by: Greg Keller<br>Checked by: Greg Keller |
| Schedule: 8 | |
| Scale: Approximate 1:1 000 000 | |

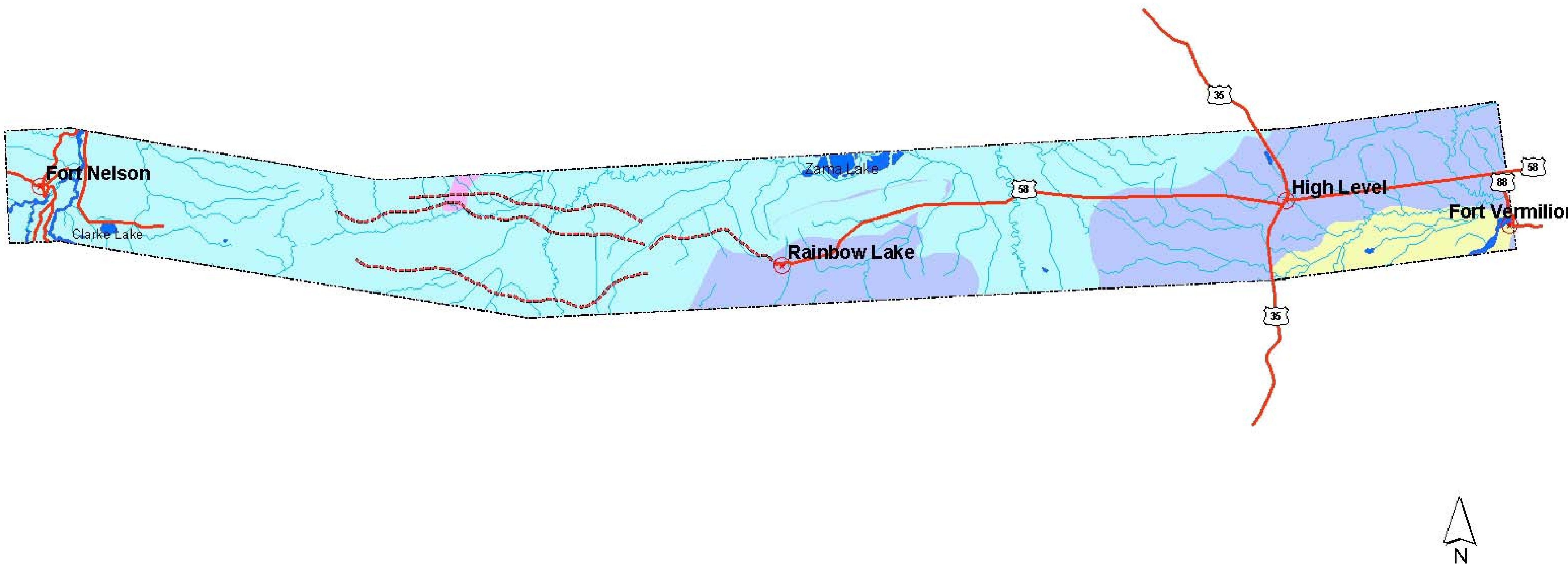
***Schedule 9 – Detailed Study Area Season Duration Map***

# Schedule 9

## Northwest Corridor Agricultural Feasibility Study

## Detailed Study Area Season Duration Map

# Northwest Corridor Agricultural Feasibility Study
## Season Duration within the Study Area




**Legend**

Roads
Town
Proposed Highway 58 Routes
Lakes
Rivers

Growing Season Length
163 Days
164 Days
165 Days
167 Days
Study Area Boundary

0 12.5 25 50 75 100 Kilometers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Phone (780) 338-3862
Fax (780) 338-3862


Date: November 2003

Drawn by: Greg Keller

Checked by: Greg Keller

Schedule: 9

Scale: Approximate 1:1 000 000

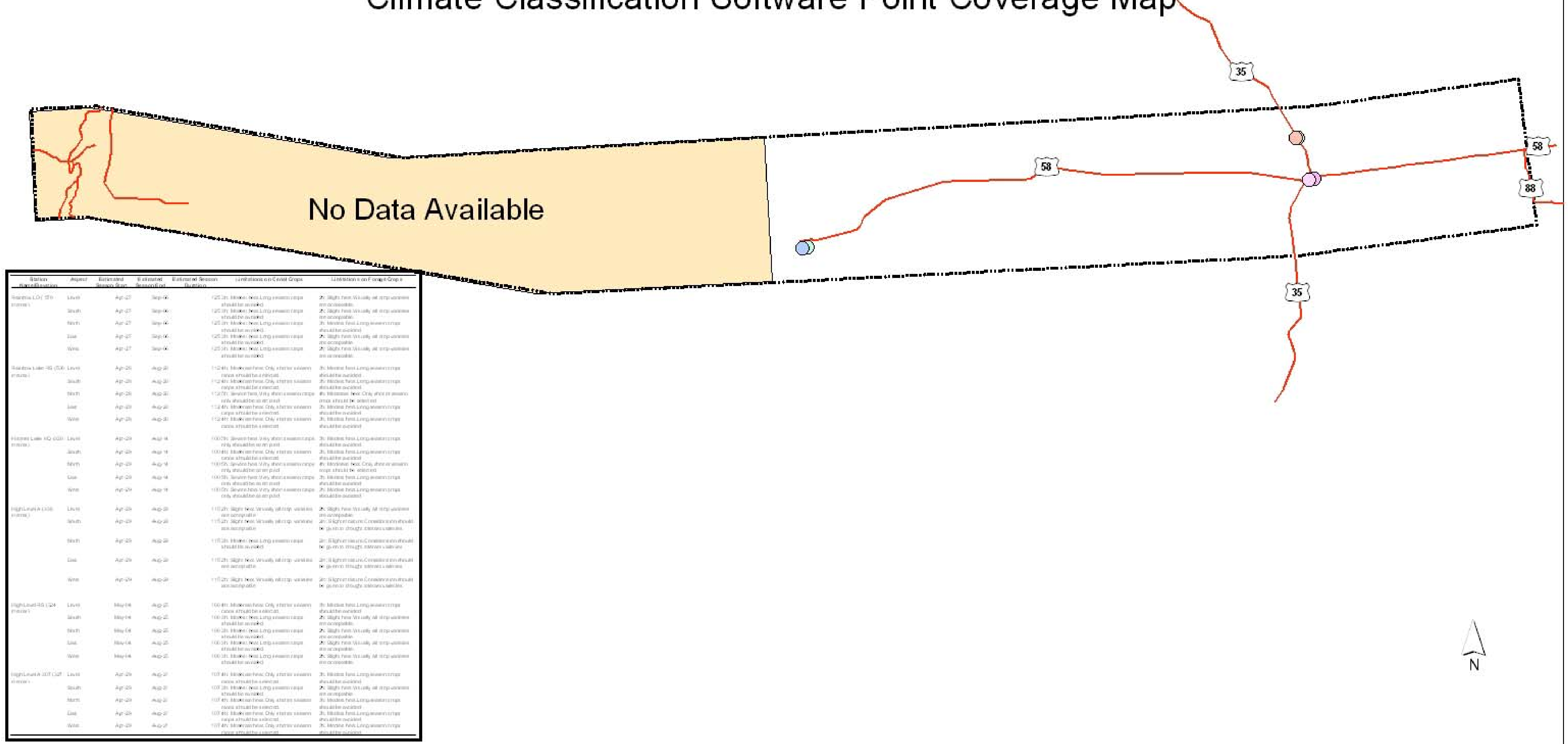
***Schedule 10 – Detailed Study Area Climate Classification System Software Findings Map***

# Schedule 10

# Northwest Corridor Agricultural Feasibility Study

# Detailed Study Area Climate Classification System Software Findings Map

# Northwest Corridor Agricultural Feasibility Study
## Climate Classification Software Point Coverage Map




**Legend**

Station Name
- Footner Lake HQ
- High Level A
- High Level A 307
- High Level RS
- Rainbow LO
- Rainbow Lake RS

Roads
Study Area Boudary

Kilometers: 0 25 50 100

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Fax (780) 338-3862

| | |
|---|---|
| Date: November 2003 | Drawn by: Greg Keller |
| | Checked by: Greg Keller |
| Schedule: 10 | |
| Scale: Approximate 1:1 000 000 | |

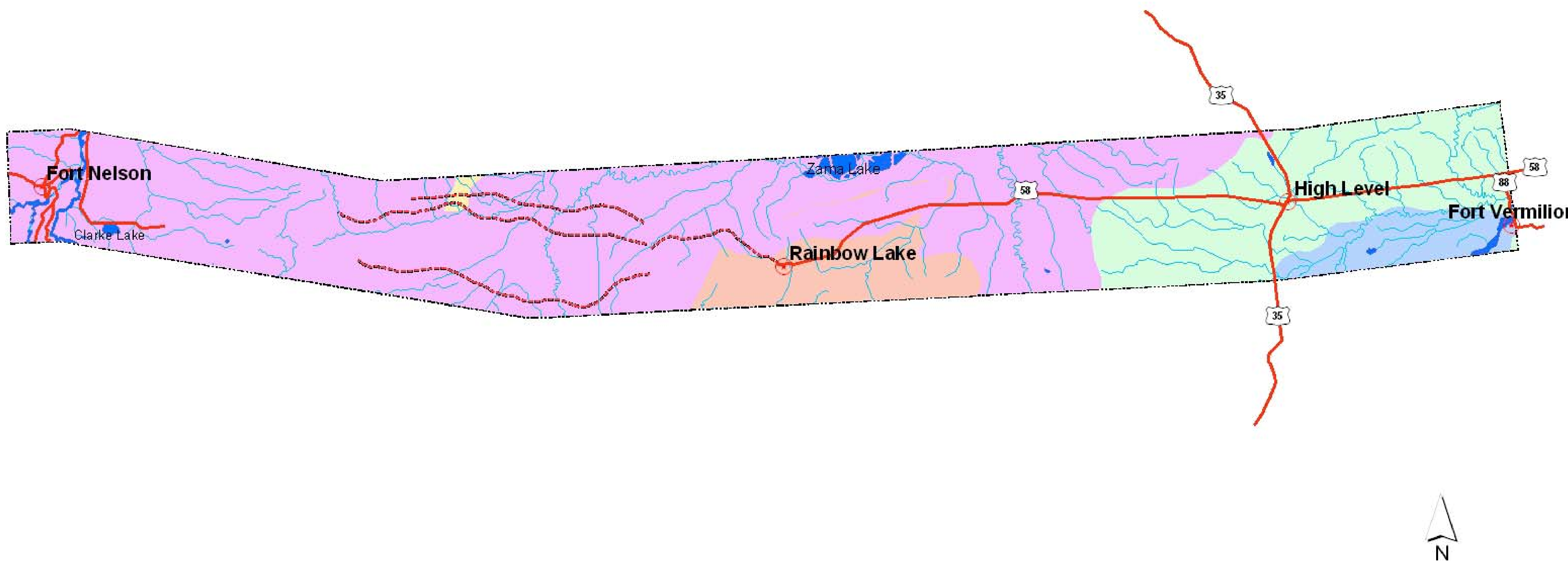
***Schedule 11 – Detailed Study Area Climate Precipitation and Evopotranspiration Maps***

# Schedule 11

# Northwest Corridor Agricultural Feasibility Study

# Detailed Study Area Precipitation Maps

# Northwest Corridor Agricultural Feasibility Study
# Total Annual Precipitation within the Study Area




**Legend**

- Roads
- Town
- Proposed Highway 58 Routes
- Lakes
- Rivers

Total Annual Precipitation
- 379.4 mm
- 380.7 mm
- 400.4 mm
- 411.2 mm
- 448.5 mm
- Study Area Boundary

0 25 50 100 Kilometers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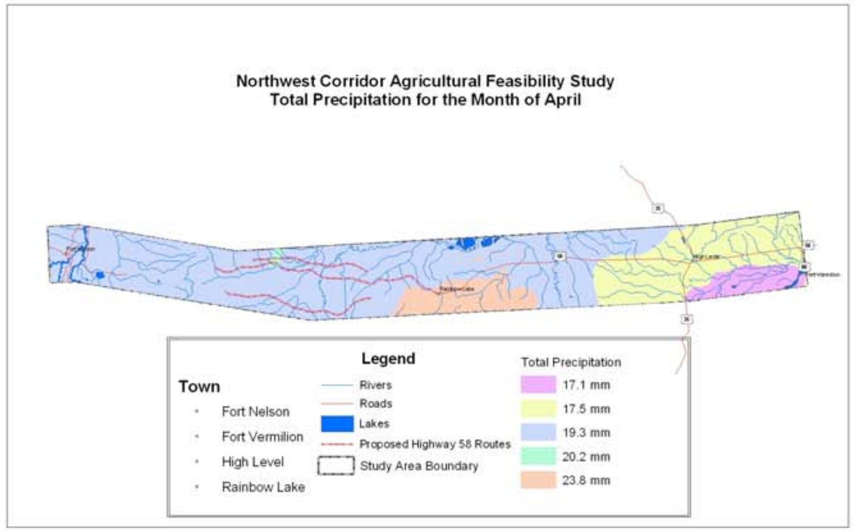
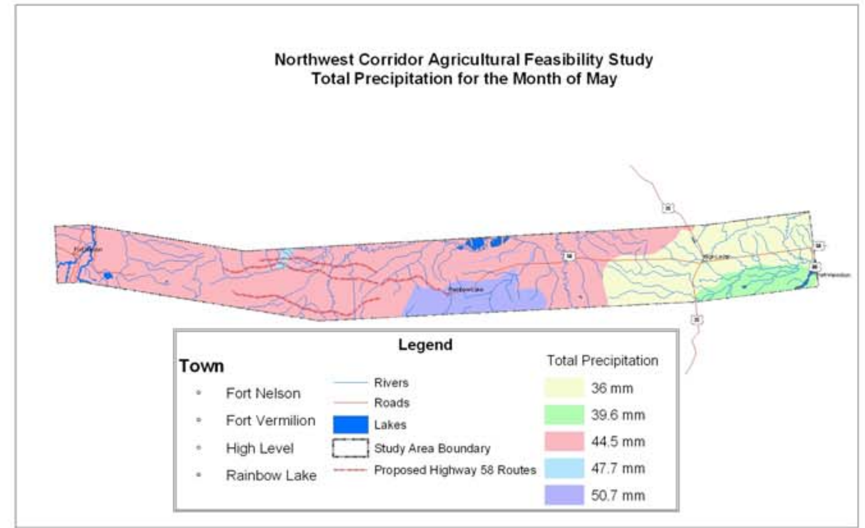
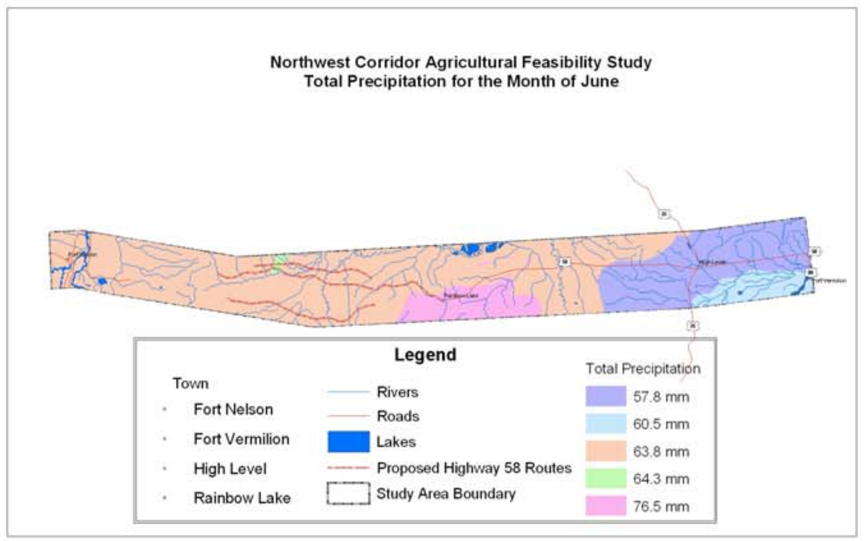
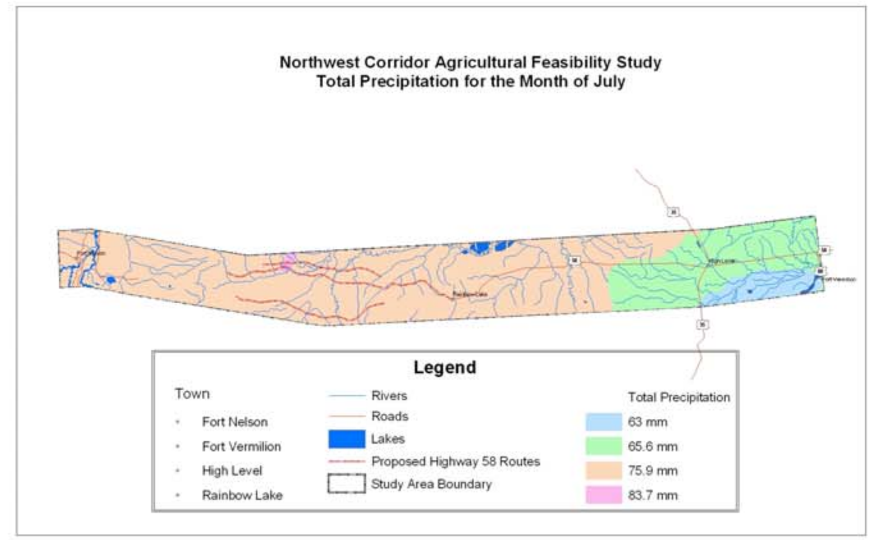
| | |
|---|---|
| Date: November 2003 | Drawn by: Greg Keller |
| | Checked by: Greg Keller |
| Schedule: 11 | |
| Scale: Approximate 1:1 000 000 | |

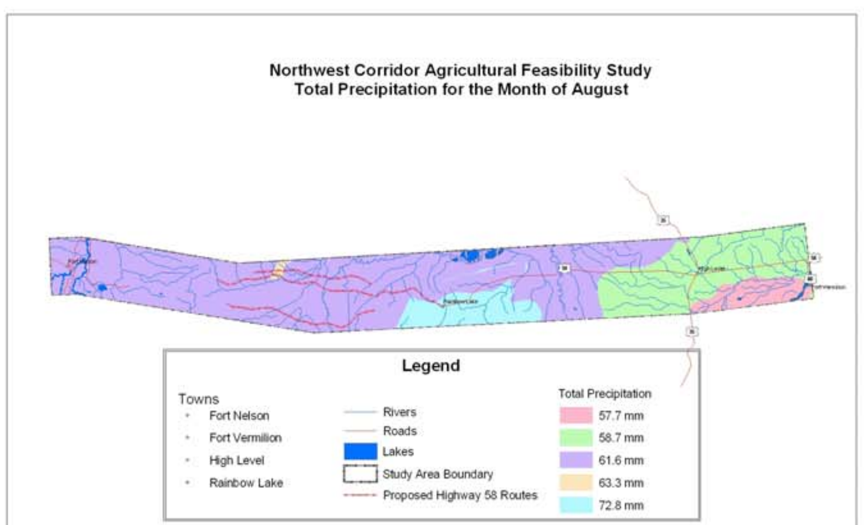
# Total Precipitation During the Growing Season

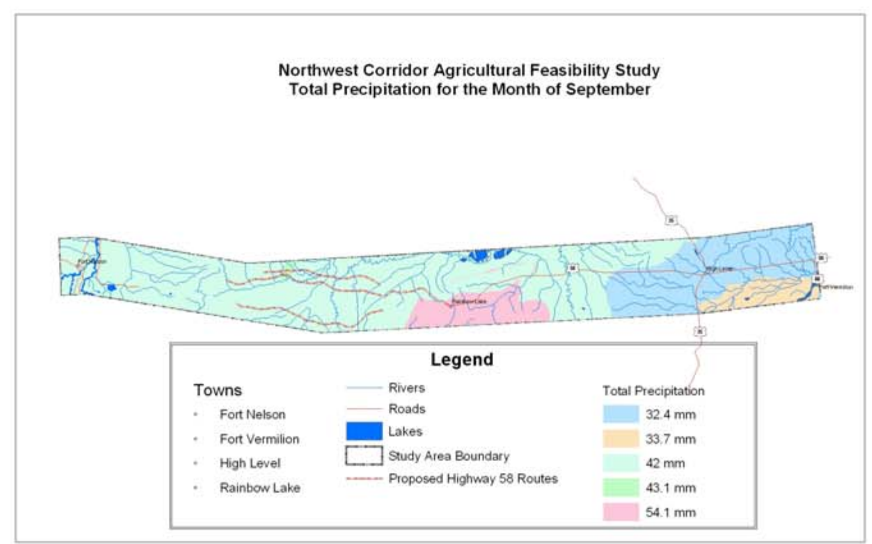


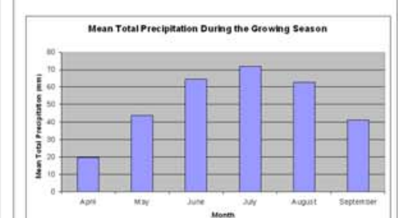

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*Schedule 12 – Detailed Study Area Water Deficit Maps*

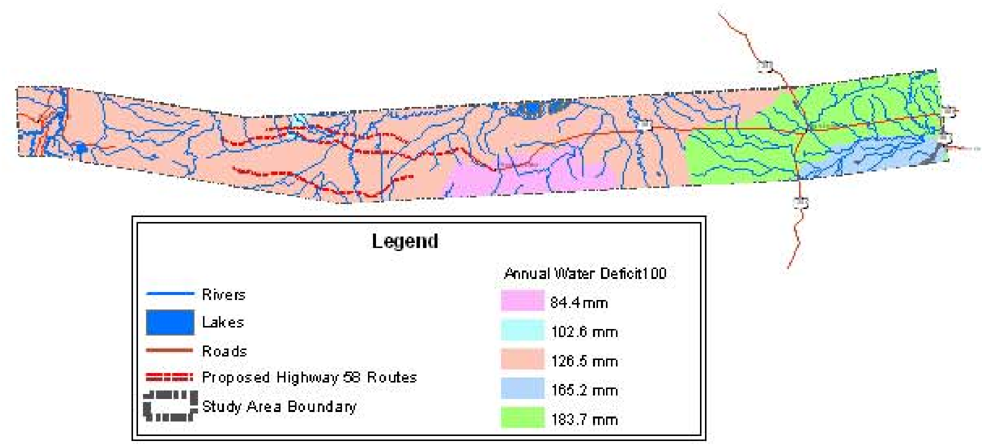
# Schedule 12

# Northwest Corridor Agricultural Feasibility Study

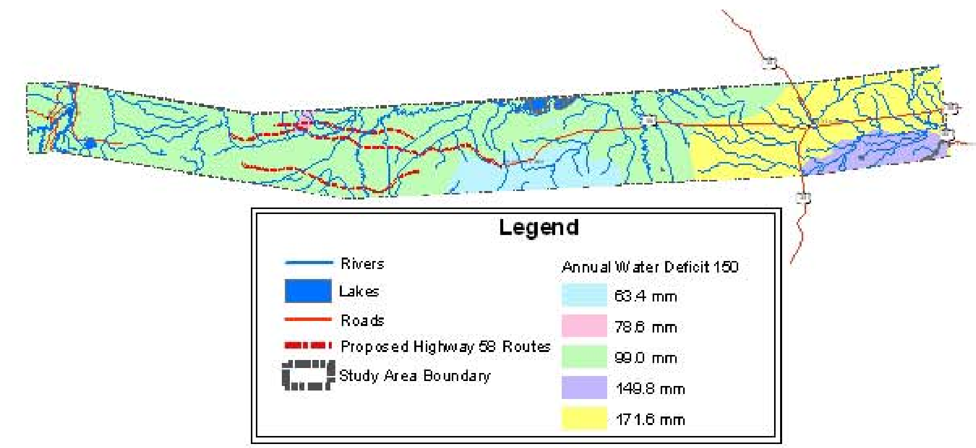
# Detailed Study Area Climate Water Deficit Maps

# Total Annual Water Deficit for Soils with Available Water-Holding Capacities of 100mm, 150,mm, 200mm, and 250mm.

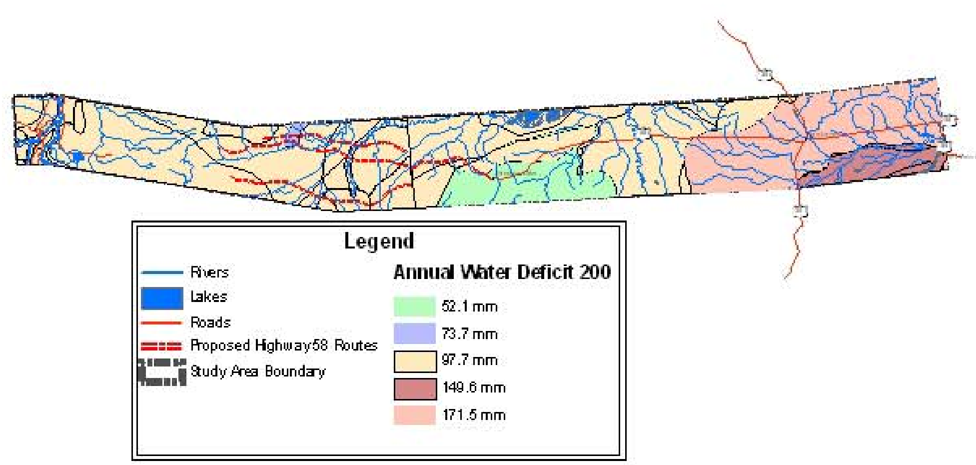
**Northwest Corridor Agricultural Feasibility Study**
**Annual Water Deficit for Soils with a 100 mm Water-Holding Capacity**



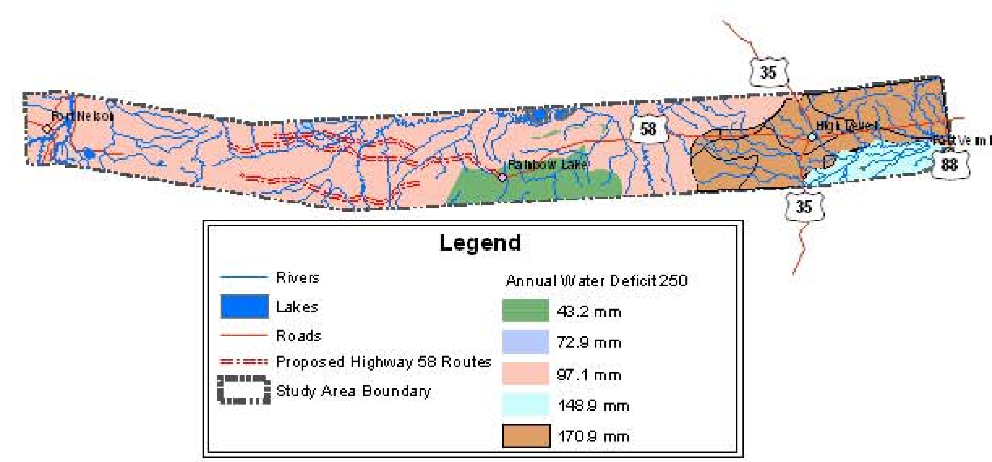

**Northwest Corridor Agricultural Feasibility Study**
**Annual Water Deficit for Soils with a 150 mm Water-Holding Capacity**




**Northwest Corridor Agricultural Feasibility Study**
**Annual Water Deficit for Soils with a 200 mm Water-Holding Capacity**



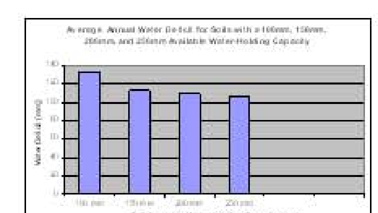

**Northwest Corridor Agricultural Feasibility Study**
**Annual Water Deficit for Soils with a 250 mm Water-Holding Capacity**



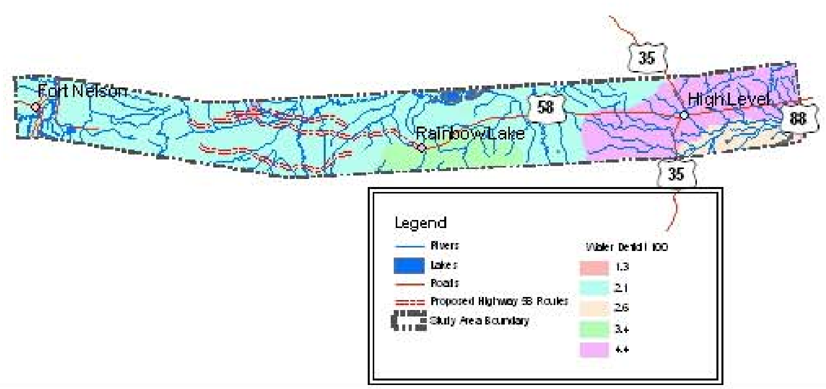

Mackenzie Municipal Services Agency

N

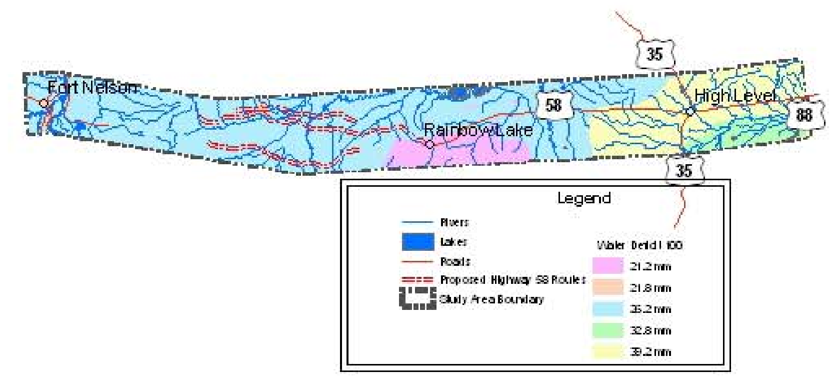
0 25 50 100 Kilometers



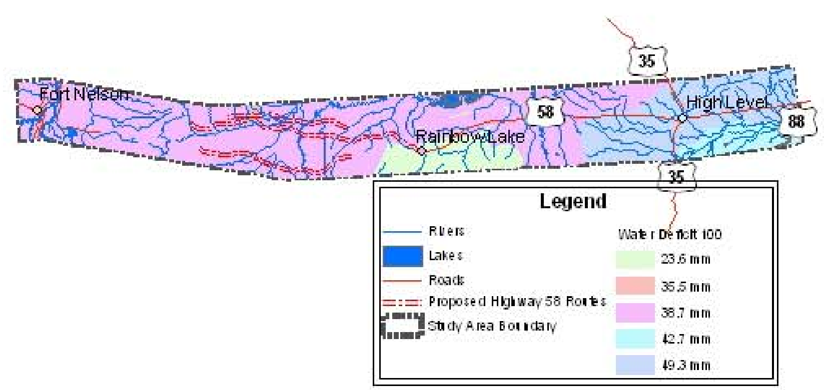
Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 100 mm Water-Holding Capacity for the Month of April



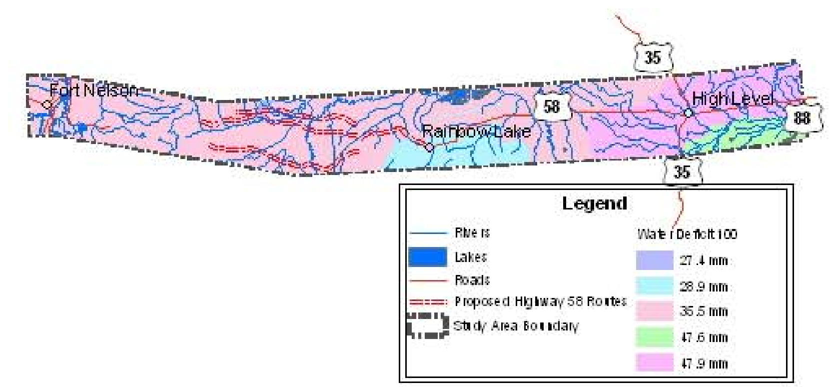

Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 100 mm Water-Holding Capacity for the Month of May



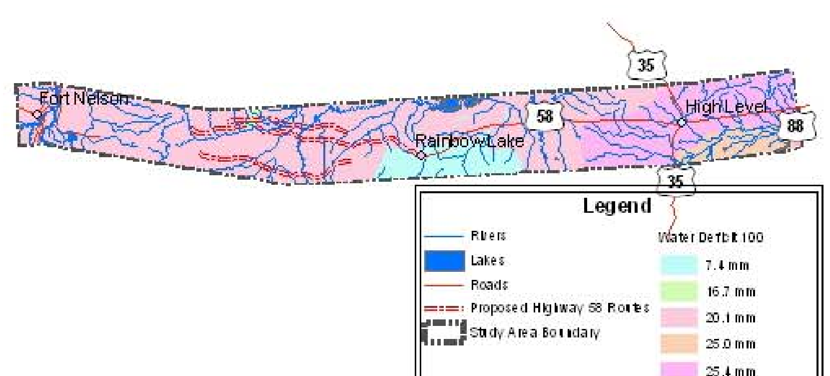

Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 100 mm Water-Holding Capacity for the Month of June



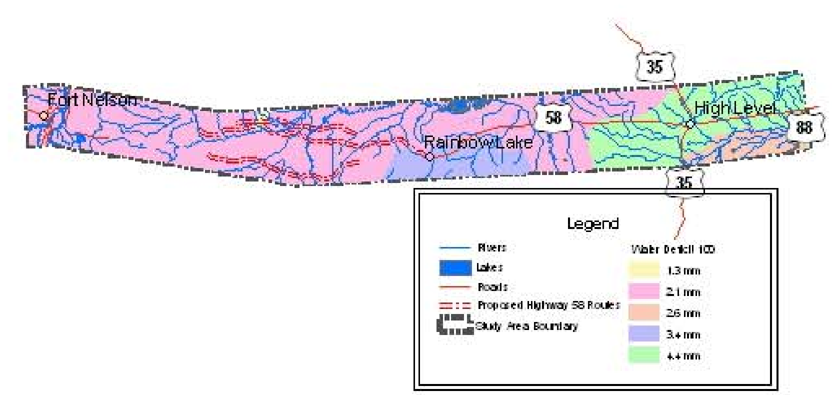

Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 100 mm Water-Holding Capacity for the Month of July




Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 100 mm Water-Holding Capacity for the Month of August

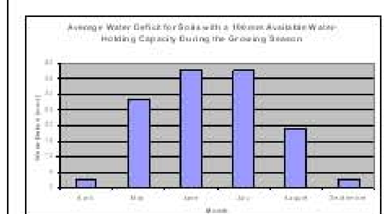



Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 100 mm Water-Holding Capacity for the Month of September



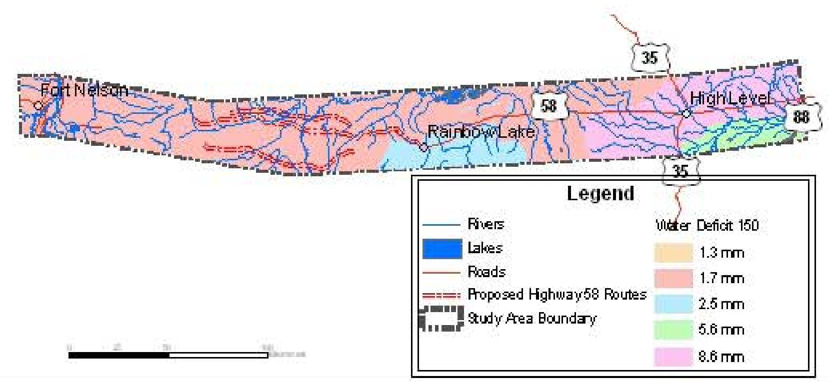

**Water Deficit for Soils with a 100mm Available Water-Holding Capacity During the Growing Season**

N

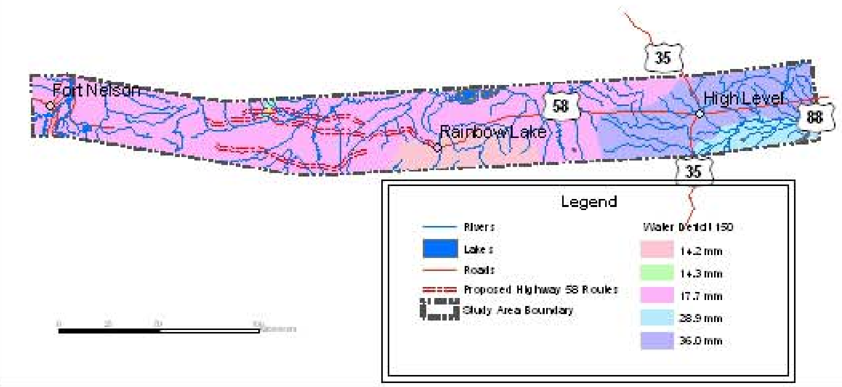



Mackenzie Municipal Services Agency

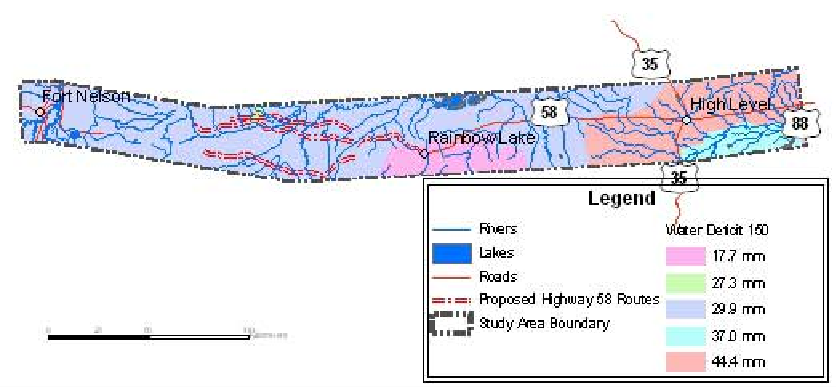
Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 150 mm Water-Holding Capacity for the Month of April



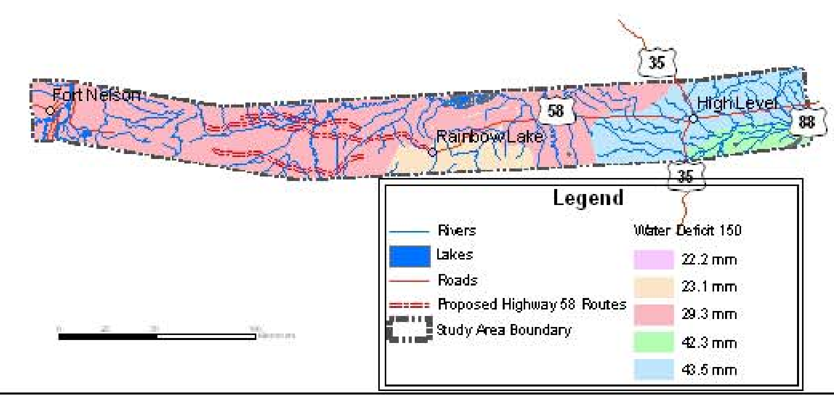

Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 150 mm Water-Holding Capacity for the Month of May



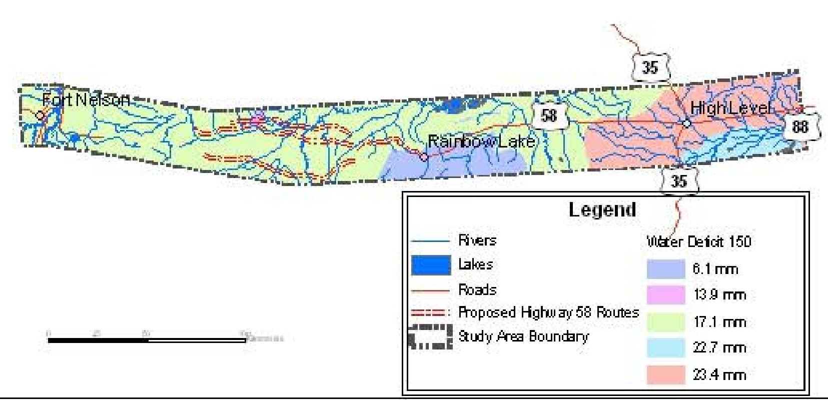

Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 150 mm Water-Holding Capacity for the Month of June



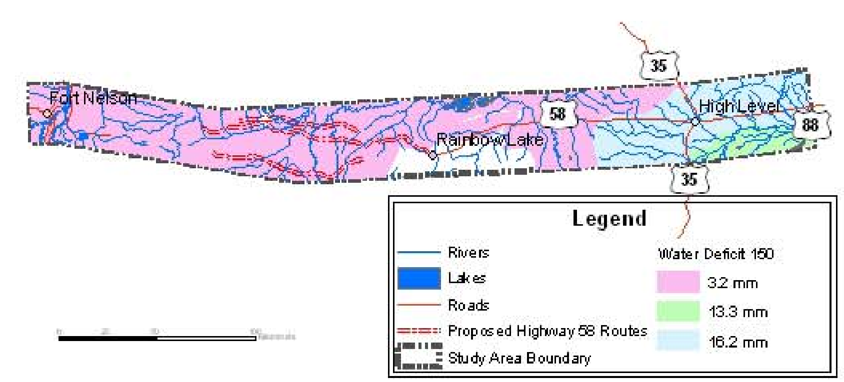

Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 150 mm Water-Holding Capacity for the Month of July




Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 150 mm Water-Holding Capacity for the Month of August

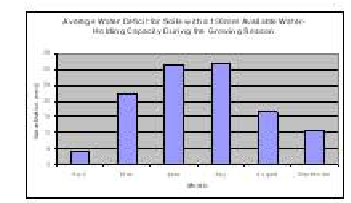



Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 150 mm Water-Holding Capacity for the Month of September



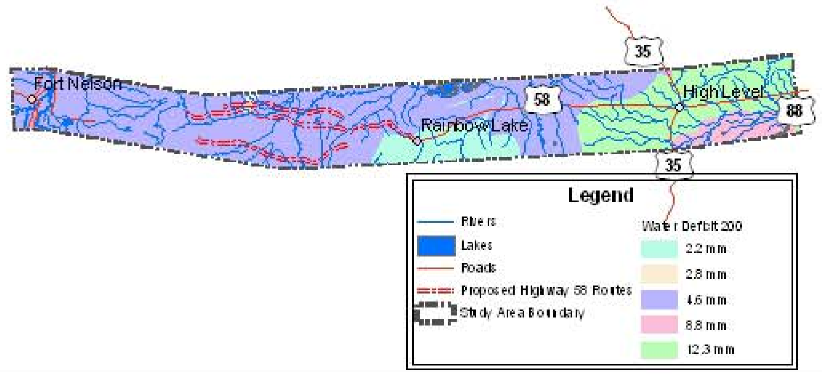

## Water Deficit for Soils with a 150mm Available Water-Holding Capacity During the Growing Season

N

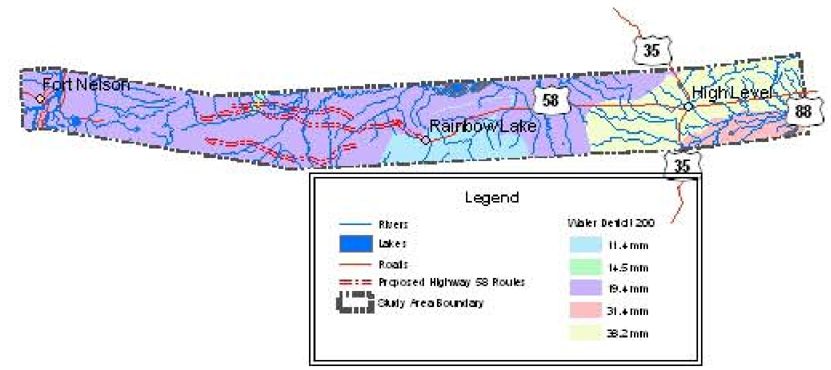


Mackenzie Municipal Services Agency

Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 200 mm Water-Holding Capacity for the Month of April




Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 200 mm Water-Holding Capacity for the Month of May




# Water Deficit for Soils with a 200mm Available Water-Holding Capacity During the Growing Season

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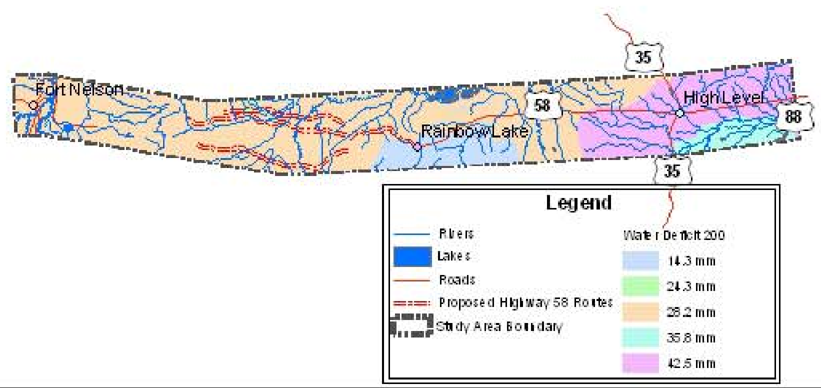
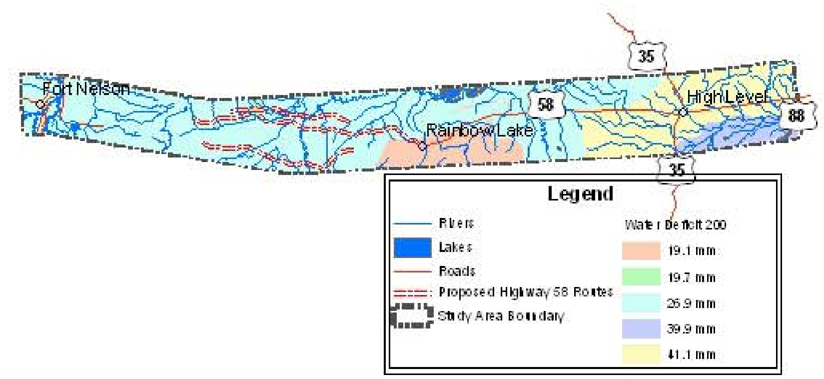
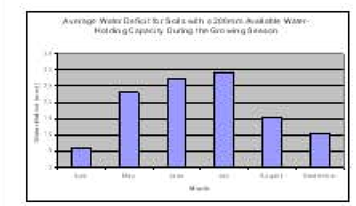
Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 200 mm Water-Holding Capacity for the Month of June

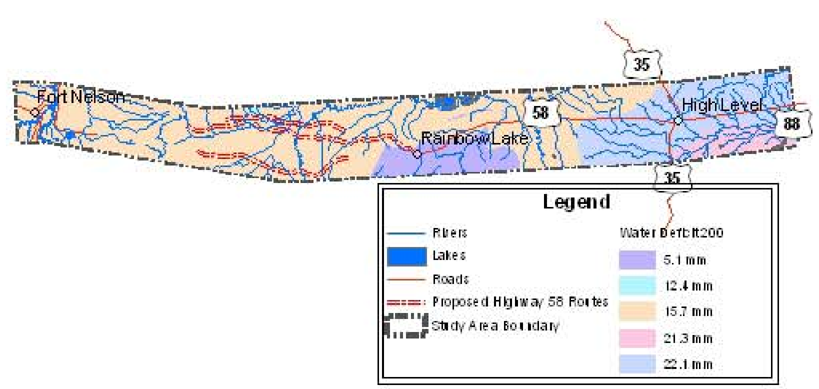



Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 200 mm Water-Holding Capacity for the Month of July

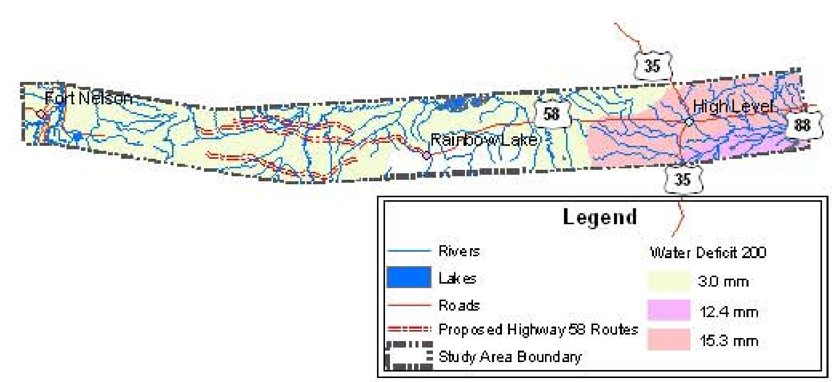


Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 200 mm Water-Holding Capacity for the Month of August

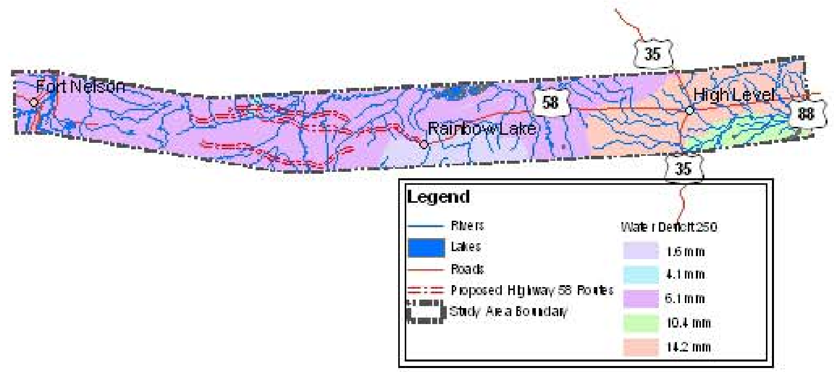



Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 200 mm Water-Holding Capacity for the Month of September

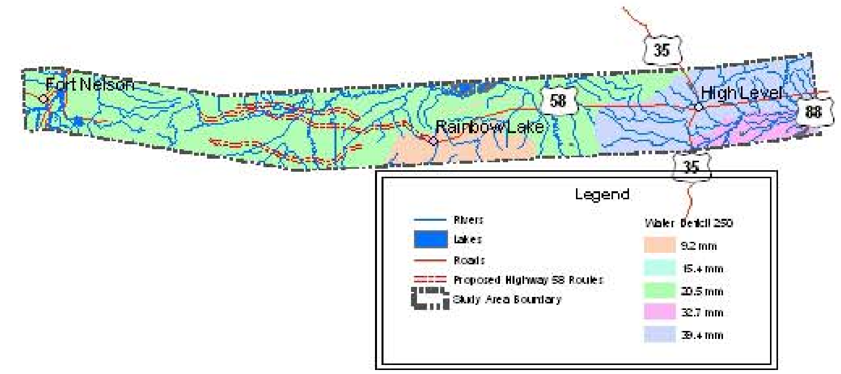



Mackenzie Municipal Services Agency

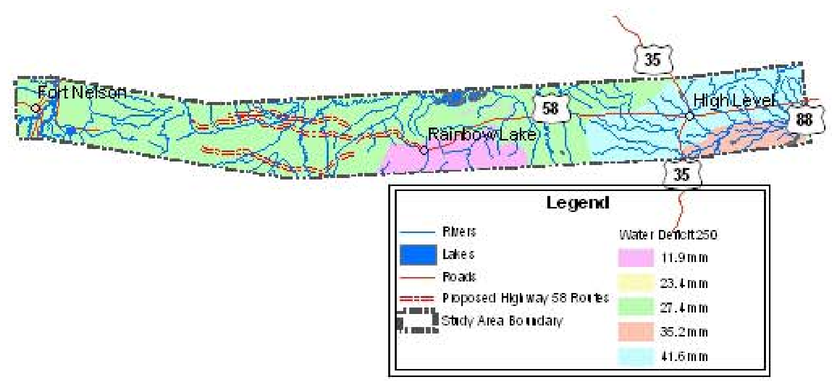
Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 250 mm Water-Holding Capacity for the Month of April



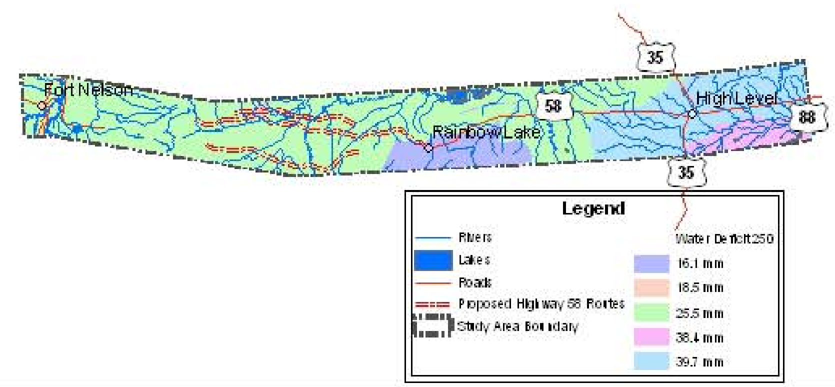

Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 200 mm Water-Holding Capacity for the Month of May



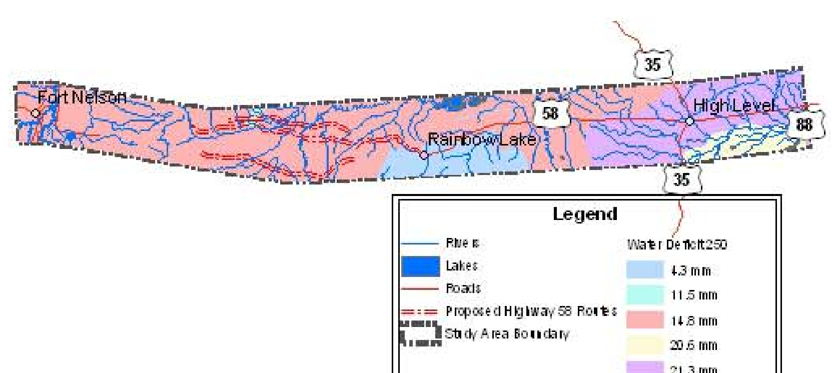

Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 250 mm Water-Holding Capacity for the Month of June



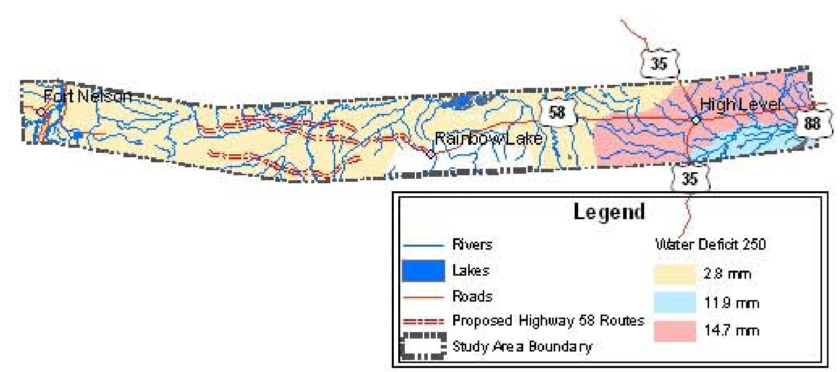

Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 250 mm Water-Holding Capacity for the Month of July




Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 250 mm Water-Holding Capacity for the Month of August

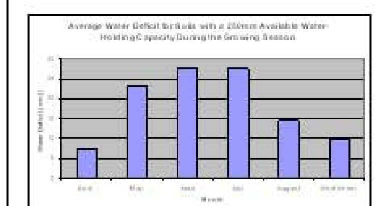



Northwest Corridor Agricultural Feasibility Study
Water Deficit for Soils with a 200 mm Water-Holding Capacity for the Month of September




**Water Deficit for Soils with a 250mm Available Water-Holding Capacity During the Growing Season**

N



Mackenzie Municipal Services Agency

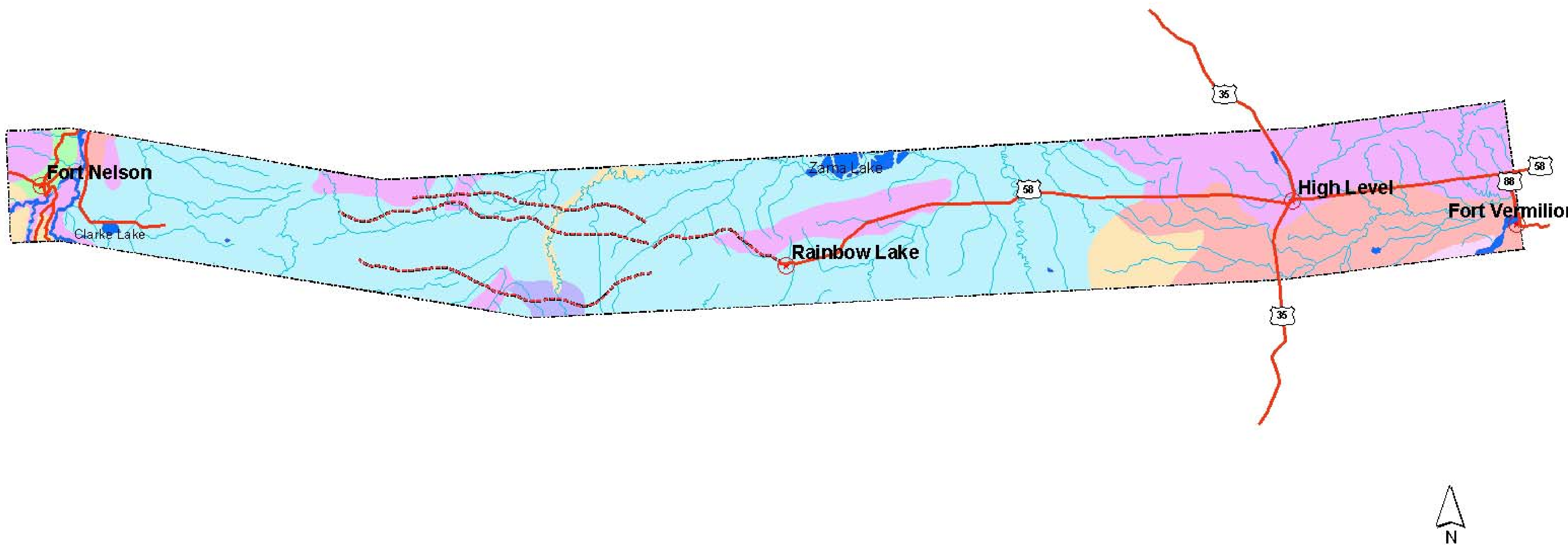
*Schedule 13 – Detailed Study Area Drainage Map*

# Schedule 13

# Northwest Corridor Agricultural Feasibility Study

# Detailed Study Area Drainage Map

# Northwest Corridor Agricultural Feasibility Study
## Study Area Drainage




**Legend**

Roads
Town
Proposed Highway 58 Routes
Lakes
Rivers

Drainage

Excessive
Rapid
Well
Moderately well
Imperfect
Poor
Very poor
Study Area Boundary

0 12.5 25 50 75 100 Kilometers

P.O Box 450, Berwyn Alberta T0H 0E0
Phone (780) 338-3862
Fax (780) 338-3862

Date: November 2003

Drawn by: Greg Keller

Checked by: Greg Keller

Schdule: 13

Scale: Approximate 1:1 000 000

***Schedule 14 – Canadian Climate Classification Software Findings Table***

# Schedule 14

# Northwest Corridor Agricultural Feasibility Study

# Canadian Climate Classification Software Findings Table

| Station Name/Elevation | Aspect | Estimated Season Start | Estimated Season End | Estimated Season Duration (Days) | Effective Growing Degree Days | Limitations on Cereal Crops | Limitations on Forage Crops |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Rainbow LO[19] ( 570 metres) | Level | Apr-27 | Sep-06 | 125 | 1126 | 3h: Modest heat. Long season crops should be avoided. | 2h: Slight heat. Virtually all crop varieties are acceptable. |
| | South | Apr-27 | Sep-06 | 125 | 1126 | 3h: Modest heat. Long season crops should be avoided. | 2h: Slight heat. Virtually all crop varieties are acceptable. |
| | North | Apr-27 | Sep-06 | 125 | 1126 | 3h: Modest heat. Long season crops should be avoided. | 3h: Modest heat. Long season crops should be avoided. |
| | East | Apr-27 | Sep-06 | 125 | 1126 | 3h: Modest heat. Long season crops should be avoided. | 2h: Slight heat. Virtually all crop varieties are acceptable. |
| | West | Apr-27 | Sep-06 | 125 | 1126 | 3h: Modest heat. Long season crops should be avoided. | 2h: Slight heat. Virtually all crop varieties are acceptable. |
| | | | | | | | |
| Rainbow Lake RS[20] (536 metres) | Level | Apr-28 | Aug-20 | 112 | 948 | 4h: Moderate heat. Only shorter season crops should be selected. | 3h: Modest heat. Long season crops should be avoided. |
| | South | Apr-28 | Aug-20 | 112 | 948 | 4h: Moderate heat. Only shorter season crops should be selected. | 3h: Modest heat. Long season crops should be avoided. |
| | North | Apr-28 | Aug-20 | 112 | 948 | 5h: Severe heat. Very short season crops only should be attempted. | 4h: Moderate heat. Only shorter season crops should be selected. |
| | East | Apr-28 | Aug-20 | 112 | 948 | 4h: Moderate heat. Only shorter season crops should be selected. | 3h: Modest heat. Long season crops should be avoided. |
| | West | Apr-28 | Aug-20 | 112 | 948 | 4h: Moderate heat. Only shorter season crops should be selected. | 3h: Modest heat. Long season crops should be avoided. |
| | | | | | | | |
| Footner Lake HQ[21] (320 metres) | Level | Apr-29 | Aug-14 | 100 | 865 | 5h: Severe heat. Very short season crops only should be attempted. | 3h: Modest heat. Long season crops should be avoided. |
| | South | Apr-29 | Aug-14 | 100 | 865 | 4h: Moderate heat. Only shorter season crops should be selected. | 3h: Modest heat. Long season crops should be avoided. |
| | North | Apr-29 | Aug-14 | 100 | 865 | 5h: Severe heat. Very short season crops only should be attempted. | 4h: Moderate heat. Only shorter season crops should be selected. |
| | East | Apr-29 | Aug-14 | 100 | 865 | 5h: Severe heat. Very short season crops only should be attempted. | 3h: Modest heat. Long season crops should be avoided. |

[19] LO refers to Look Out
[20] RS refers to Ranger Station
[21] HQ refers to Headquarters

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | West | Apr-29 | Aug-14 | 100 | 865 | 5h: Severe heat. Very short season crops only should be attempted. | 3h: Modest heat. Long season crops should be avoided. |
| | | | | | | | |
| Steen River RS (297 metres) | Level | May-09 | Aug-24 | 100 | 1060 | 3h: Modest heat. Long season crops should be avoided. | 3h: Modest heat. Long season crops should be avoided. |
| | South | May-09 | Aug-24 | 100 | 1060 | 3h: Modest heat. Long season crops should be avoided. | 2m: Slight moisture. Consideration should be given to drought tolerant varieties. |
| | North | May-09 | Aug-24 | 100 | 1060 | 4h: Moderate heat. Only shorter season crops should be selected. | 3m: Modest moisture. Preference should be given to drought tolerant varieties. |
| | East | May-09 | Aug-24 | 100 | 1060 | 3h: Modest heat. Long season crops should be avoided. | 3m: Modest moisture. Preference should be given to drought tolerant varieties. |
| | West | May-09 | Aug-24 | 100 | 1060 | 3h: Modest heat. Long season crops should be avoided. | 3m: Modest moisture. Preference should be given to drought tolerant varieties. |
| | | | | | | | |
| High Level A[22] (338 metres) | Level | Apr-29 | Aug-29 | 115 | 1169 | 2h: Slight heat. Virtually all crop varieties are acceptable. | 2h: Slight heat. Virtually all crop varieties are acceptable. |
| | South | Apr-29 | Aug-29 | 115 | 1169 | 2h: Slight heat. Virtually all crop varieties are acceptable. | 2m: Slight moisture. Consideration should be given to drought tolerant varieties. |
| | North | Apr-29 | Aug-29 | 115 | 1169 | 3h: Modest heat. Long season crops should be avoided. | 2m: Slight moisture. Consideration should be given to drought tolerant varieties. |
| | East | Apr-29 | Aug-29 | 115 | 1169 | 2h: Slight heat. Virtually all crop varieties are acceptable. | 2m: Slight moisture. Consideration should be given to drought tolerant varieties. |
| | West | Apr-29 | Aug-29 | 115 | 1169 | 2h: Slight heat. Virtually all crop varieties are acceptable. | 2m: Slight moisture. Consideration should be given to drought tolerant varieties. |
| | | | | | | | |
| High Level RS (324 metres) | Level | May-04 | Aug-25 | 106 | 1069 | 4h: Moderate heat. Only shorter season crops should be selected. | 3h: Modest heat. Long season crops should be avoided. |
| | South | May-04 | Aug-25 | 106 | 1068 | 3h: Modest heat. Long season crops should be avoided. | 2h: Slight heat. Virtually all crop varieties are acceptable. |
| | North | May-04 | Aug-25 | 106 | 1069 | 3h: Modest heat. Long season crops should be avoided. | 2h: Slight heat. Virtually all crop varieties are acceptable. |
| | East | May-04 | Aug-25 | 106 | 1069 | 3h: Modest heat. Long season crops should be avoided. | 2h: Slight heat. Virtually all crop varieties are acceptable. |
| | West | May-04 | Aug-25 | 106 | 1069 | 3h: Modest heat. Long season crops should be avoided. | 2h: Slight heat. Virtually all crop varieties are acceptable. |

[22] A refers to Airport

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| High Level A 307 (327 metres) | Level | Apr-29 | Aug-21 | 107 | 1010 | 4h: Moderate heat. Only shorter season crops should be selected. | 3h: Modest heat. Long season crops should be avoided. |
| | South | Apr-29 | Aug-21 | 107 | 1010 | 3h: Modest heat. Long season crops should be avoided. | 2h: Slight heat. Virtually all crop varieties are acceptable. |
| | North | Apr-29 | Aug-21 | 107 | 1010 | 4h: Moderate heat. Only shorter season crops should be selected. | 3h: Modest heat. Long season crops should be avoided. |
| | East | Apr-29 | Aug-21 | 107 | 1010 | 4h: Moderate heat. Only shorter season crops should be selected. | 3h: Modest heat. Long season crops should be avoided. |
| | West | Apr-29 | Aug-21 | 107 | 1010 | 4h: Moderate heat. Only shorter season crops should be selected. | 3h: Modest heat. Long season crops should be avoided. |

## *Schedule 15 – Fort Nelson Land and Resource Management Plan Objectives*

# Schedule 15

# Northwest Corridor Agricultural Feasibility Study

# Fort Nelson Land and Resource Management Plan Objectives

**Access Management**

| Objectives | Strategies |
|---|---|
| • Provide for a level of access that meets the objectives of each RMZ (road and trail construction, maintenance and deactivation and other surface disturbances and construction) | • Where significant access concerns exist conduct an interagency access management planning process<br>• Utilize existing corridors and crossings where practical |
| | • Provide opportunity for stakeholder participation in access management planning<br>• Ensure that resource tenure holders are notified when planning for road deactivation |

**Agriculture**

| Objectives | Strategies |
|---|---|
| • Maintain resources with food production capability for current and future crop and livestock production. | • Crown lands with high agricultural potential, especially those adjacent to existing agricultural developments, to be identified and designated for agricultural use.<br>• Forage utilization near agricultural deeded lands will have an emphasis for domestic animals use.<br>• Crown ALR lands should be managed for agriculture and uses compatible with long-term agriculture potential, as defined by the *Agriculture Land Reserve Act* and Regulations |
| • Provide opportunities for growth and expansion of Agriculture. | • Ensure the integrity of the ALR through the *Agricultural Land Reserve Act* and Regulations.<br>• Support the intent of the ALR and conversion of high quality agricultural land through the Agricultural Land Reserve. |
| | • Apply the provisions of the Soil Conservation Act and the FARM Practices Protection (Right to Farm Act).<br>• Redefine ALR boundaries at a more detailed scale to more accurately capture lands with agricultural capability.<br>• Encourage farming practices that promote soil conservation.<br>• Maintain livestock grazing opportunities on existing tenures and where appropriate provide opportunities for new tenures as indicated by the RMZ direction.<br>• Minimize and mitigate (where necessary) other land, vegetation and water uses or management activities which negatively impact agricultural productivity and |

| | |
|---|---|
| | sustainability (i.e. noxious weed control, problem wildlife).<br>• Enhance the opportunity for agricultural enterprises that contribute to wildlife, environmental, and/or multiple use objectives that could sustain or stimulate rural communities. |

**Air Quality**

| Objectives | Strategies |
|---|---|
| • Maintain acceptable air quality | • All emissions to meet the Provincial air quality standards. |

**Biodiversity**

| Objectives | Strategies |
|---|---|
| • Maintain natural biodiversity throughout the plan area. | • Initiate Landscape Unit planning in priority areas.<br>• Manage natural seral stage distribution by landscape unit using knowledge of natural disturbance patterns.<br>• Identify and map suitable sites for maintaining representative, natural functioning areas.<br>• Link important habitats to maintain connectivity across the landscape. |
| • Maintain rare ecosystems, habitat types, plant and animal species. | • Identify and map ecosystems, habitat types, and plant species designated for long-term monitoring. |
| • Maintain old-growth attributes on specified sites within landscapes. | |

**Energy (Oil and Gas; Hydroelectric)**

| Objectives | Strategies |
|---|---|
| • Maintain opportunities and access for oil and gas exploration, development and transportation | • Promote and encourage oil and gas exploration through a timely and efficient permitting process.<br>• Provide for exploration and development of resources within the regulatory framework. |
| | • Promote and encourage investment in energy exploration and development |

**First Nations, Heritage and Culture**

| Objective | Strategy |
|---|---|
| • Avoid infringement of aboriginal and treaty rights. | • Complete Traditional Use Study (TUS) for each native band.<br>• Encourage local band's participation in archaeological assessment.<br>• Follow existing policies, guidelines or procedures to protect aboriginal or treaty rights.<br>• Identify areas where Treaty or aboriginal rights are being practiced. |
| • Recognize and maintain traditional uses and values. | • Conserve ecological integrity of areas to maintain opportunities for the pursuit of traditional uses. |
| • Recognize and maintain cultural and heritage resources. | • Encourage mapping of areas containing cultural heritage. |
| | • Encourage Archaeological Impact Assessment (AIA)/Archaeological Impact Study (AIS) to supplement and refine Archaeological Overview Assessment (AOA) map. |
| | • Consider undertaking archaeological impact assessments in all areas of High and Medium potential. |
| • Identify and manage significant Heritage Trails. | • Locate and map trail locations with historical significance. |
| | • Develop a management strategy for significant heritage trails. |
| • Identify and manage heritage and archaeological sites and values (priority sites in the river corridors). | • Conserve heritage values through application of a buffer zone, where appropriate. The width of the buffer zone will be site specific and will be decided through lower level planning. All development in the buffer zone will respect and conserve the heritage values of these areas.<br>• Record known archaeological sites with BC Archaeological Branch. |
| | • As part of archaeological impact assessments, consider selective impact assessments of Low Potential areas. |
| | • Encourage cultural heritage overview in areas of known significance.<br>• Conduct activities in a way that is sensitive to known archaeological and heritage values<br>• Develop management strategies for specific sites at the |

| | |
|---|---|
| | operational planning process. |

## Forestry

| Objectives | Strategies |
|---|---|
| • Maintain and/or enhance the continued sustainable supply of timber. | • Promote and encourage forest development through a timely and efficient approval process. |
| | • Minimize non-recoverable losses through aggressive forest fire suppression and pest management, salvage of damaged or killed timber, and prompt reforestation and stand management regimes. |
| | • Balance utilization levels in consideration of other resource values. |
| | • Encourage silvicultural systems that are compatible with other resource values. |
| | • Appropriate lands will be included within the Forest Land Reserve (FLR). |
| | • Promote investment in forest resources. |
| | • Improve forest resource inventory information. |
| | • Work toward reforesting all backlog Not Satisfactorily Restocked (NSR) areas with commercial species. |
| | • Rehabilitate previously disturbed forest land. |
| | • Encourage the identification, inventory and harvest of marginal forest types. |
| | • Quantify the Timber Harvesting Land Base (THLB) and develop policies to reduce loss of the THLB to roads, seismic lines, well sites and other developments. |

## Guide Outfitting

| Objectives | Strategies |
|---|---|
| • Provide and maintain guide outfitting opportunities. | • Minimize impacts of commercial and industrial activities on guide outfitter(s) areas. |
| | • Any coordinated access management planning will include the opportunity for participation by the affected guide outfitter(s). |
| | • Identify campsites, cabins and critical use areas. |
| | • Maintain and manage grazing activities associated with guide outfitting. |
| | • Recognize the rights of existing guide outfitting tenure holders.<br>• Continue the role of guide outfitters in the management of fish and wildlife habitats and populations. |

**Minerals**

| Objectives | Strategies |
|---|---|
| • Maintain opportunities and access for mineral exploration and development. | • Accommodate localized impacts of advanced exploration and development activities. |
| | • Implement revisions to standards of practice and the permitting process in order to address management issues and to provide consistency with the *Forest Practices Code Act of BC*. |
| | • Promote and encourage mineral exploration and development through a timely and efficient permitting process. |
| | • For proposed mine developments captured by the provincial Environmental Assessment Process, the assessment will consider RMZ objectives. For small mine and quarry developments, zone |

| | |
|---|---|
| | objectives will be addressed by the multi-agency regional mine development review process. |
| | • Provide for exploration and development of resources within the regulatory framework. |
| | • Promote and encourage investment in mineral exploration and development. |
| | • Ensure mineral tenure holders are notified prior to road deactivation. |
| | • Manage impacts to visual quality through following the appropriate regulations and guidelines in the *Mines Act* |

**Outdoor Recreation and Tourism**

| Objectives | Strategies |
|---|---|
| • Provide opportunities for a diverse range of recreational values and uses across the biophysical settings of the planning area. | • Identify broad areas of high recreation use or significance. Through operational planning, develop specific prescriptions that recognize the unique recreational features of these areas, and integrate recreational uses with the other values present. |
| | • Operational plans will identify small, special recreation features such as sites and trails and develop site specific practices which recognize these features. |
| • Maintain or enhance ecological integrity in areas subject to impacts from recreational use. | • More detailed plans will address the impact of recreational activity on ecological integrity, for example wildlife disruption, damage to plant communities and water quality. |
| | • Monitor to ensure public and commercial recreation activities do not exceed acceptable limits of use. |
| • Maintain quality of | • Conduct visual quality inventories for |

| | |
|---|---|
| recreation activities. | recreation and tourism areas. |
| • Provide tourism opportunities. | • Identify and provide opportunities for use of Crown land suitable for future development of resort and wilderness tourism operations. |
| • Ensure the continued existence of quality experience in areas used for commercial tourism. | • Manage levels of recreational use to maintain the quality of the experience and the natural environment. |
| • Provide opportunities for existing operators to expand where appropriate, or new operators to come in if an area is able to sustain increased use. | • Identify areas suitable for expansion through inventory |

**Soil**

| Objectives | Strategies |
|---|---|
| • Minimize soil productivity losses.<br><br>• Minimize off-site impacts due to soil disturbance. | • Implement soil disturbance guidelines for all activities.<br>• Use road construction and maintenance procedures designed to minimize impacts |

**Transportation and Utility Corridors**

| Objectives | Strategies |
|---|---|
| • Maintain transportation routes and utility corridors.<br>• Maintain opportunities for communication sites, repeater sites, airstrips. | • Provide for highways to be improved.<br>• Provide for utility corridors and sites to be constructed to accommodate tie-ins, upgrades to existing and twinning of existing pipelines. |
| • Provide opportunities for new transportation, utility corridors and communication sites | • Accommodate expansion of existing and development of new transportation, utility corridors and communication sites and airstrips. |

| | |
|---|---|
| outside of protected areas. | • Provide for new roads to be constructed for industrial, commercial and recreational use. |
| • Reduce wildlife/vehicle interactions (e.g. caribou, moose). | • Inventory and research to determine most effective method to use. (Examples of projects that have been tried with some success are signing, seeding with non palatable species and use of road side deflectors). |

**Trapping**

| Objectives | Strategies |
|---|---|
| • Provide and maintain opportunities for trapping. | • Commercial/industrial operators to work with trappers to minimize impacts of their activities on fur bearer habitat and trap line operations. |
| | • Coordinated access management planning will include the opportunity for participation by the trap line holder. |
| | • Identify campsites, cabins and critical use areas. |
| | • Recognize existing trap line tenure rights. |

**Visual Quality**

| Objectives | Strategies |
|---|---|
| • Manage for visual quality. | • Identify visually sensitive areas, and recommend master VQO's. |
| | • Identify and assess visual values and consider these values in integrated resource management. |
| | • Where established VQO's will guide incidental timber cutting associated with other resource user activities. |
| • Manage for visual quality associated with lakes, respecting their scenic values and | • Establish master VQO's for those lakes which currently do not have a VQO recommended. |

| | |
|---|---|
| visual sensitivities. | currently do not have a VQO recommended. |

**Water**

| **Objectives** | **Strategies** |
|---|---|
| • Ensure existence of acceptable levels of water quality and quantity. | • Identify priority watersheds and conduct the appropriate level of watershed assessment and implement resulting recommendation in operational plans. |
| • Maintain watershed hydrological integrity. | • Upon review of applicable watersheds, implement procedures to rehabilitate negatively impacted watersheds to improve water quality and/or stream flow regimes to a sustainable level. |
| | • Minimize man-made changes to stream configurations. |
| | • Manage resource development adjacent to sensitive water bodies, lakes, wetlands, rivers and streams to minimize negative impacts to water quality. |
| | • Determine and maintain in stream flow requirements for acceptable levels of quality and quantity. |

**Wildlife**

| **Objectives** | **Strategies** |
|---|---|
| • Provide for habitat needs of all wildlife. | • Special attention will be paid to red- and blue-listed species, and regionally important species. |
| • Manage wildlife habitats and populations to meet both consumptive and non-consumptive demands within IRM goals and land capability. | • Identify and map important habitat elements.<br>• Manage forests for a diversity of age classes and forest stand structure across the landscape. |
| | • Identify critical ungulate winter habitats for consideration as Wildlife Habitat Areas. |
| | • Ensure high capability sites are maintained in a suitable state.<br>• Manage wildlife to ensure sustainable |

| | |
|---|---|
| | populations. |
| • Manage for fur bearer habitats. | • Identify and map important fur bearer habitats and habitat components for consideration in more detailed strategic and operational planning process. |
| • Maintain waterfowl habitat and minimize impacts on waterfowl. | • Ensure industrial activity is sensitive to waterfowl habitat by minimizing disturbance and habitat loss.<br>• Conserve critical waterfowl habitat by identifying critical water bodies and reviewing for consideration as Wildlife Habitat Areas. |
| | • Conserve trumpeter swan nesting habitat by providing visual screening, and minimizing disturbance by following guidelines. |
| • Maintain a diversity of non-game wildlife. | • Identify and map stick and cliff nest sites to provide information for operational planning. |
| • Maintain effective spatial and temporal habitat continuity. | • Design connectivity corridors between important habitat areas where ecologically appropriate, (e.g. Wildlife Habitat Areas (WHAs), Forest Ecosystem Networks (FENs)). |
| | • Identify riparian connectivity corridors based on riparian vegetation. |
| | • Industrial development should avoid riparian connectivity areas or where development proceeds, impacts should be minimized on riparian values. |
| • Conserve and maintain the genetic diversity of wild fish stocks. | • Establish a catalogue of wild fish stocks.<br>• Identify and map existing fish distributions. |
| • Maintain sports and sustenance fisheries.<br>• Maintain habitat and water quality for priority fish species (e.g. bull trout, grayling, red-and blue-listed species). | • Manage fish harvest where and as required to maintain sustainable population levels |