AGRICULTURAL INVENTORY & ASSESSMENT

City of Edmonton

City Wide Food and Urban Agriculture Strategy

Draft 4 - September 27, 2012

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Executive Summary

The City of Edmonton is developing a Citywide Food and Urban Agriculture Strategy (STRATEGY) that is exploring opportunities for resilient food systems in Edmonton. This report supports the STRATEGY by providing an inventory of agricultural lands and activities within the City, with a specific focus on Edmonton's three Urban Growth Areas (UGAs); the Northeast, Southeast and Southwest parts of Edmonton.

Using the two most recent Censuses of Agriculture (2006, 2011), in addition to several other data sources, this report describes the trends in primary agriculture - farming and farmland between 2006 and 2011 as well as the biophysical characteristics and agricultural land capability of the three UGAs. The report consists of four sections: 1) Introduction and methodology; 2) Biophysical resources and agricultural capability in the UGAs; and 3) Farming and farmland in Edmonton.

Overall, key findings of this assessment include:

- All three of Edmonton's Urban Growth Areas (UGAs) have a high capability for agriculture. A large majority (70.3%) of lands in the UGAs have soils classified as prime agricultural soils (CLI Class 1 to 3) with significant water holding capacity and high fertility. Length of growing-season, growing degree days, and moisture conditions are supportive of a wide variety of crop types. The three UGAs differ somewhat in their agricultural land capability, with the Northeast having the largest amount of prime agricultural soils (1,850 Ha. Class 1 soils) and slightly higher average growing-season temperatures than the other UGAs. The Southwest UGA also has over 1,000 acres of Class 1 soils.

Table 1 Area, Soil, and Climate Summary for Edmonton's UGAs

Urban Growth Area	**Total Area** (Hectares)[#]	**Prime Agricultural Soil** (Class 1, 2 or 3 in Hectares)	**Prime Agricultural Soil** (Class 1, 2 or 3 as share of total area)	**Average Annual Precipitation** (mm)*	**Average Growing Degree Days** (>5°C)*
Northeast	3,832	3,058	80.4%	469	1,409
Southeast	2,028**	1,168	57.8%	470	1,357
Southwest	2,028**	1,286	63.8%	500	1,391
Total	7,888	5,512	70.3%		

[#] This column is the total gross area and includes lands within the North Saskatchewan River valley

** Area Weighted Mean on values in each UGA*
*** Coincidentally, the areas for the Southeast and Southwest are the same*

- There are significant quantities of land with high capability for agriculture in the surrounding Capital Region including 733,000 Ha. of land with soils classified as prime agricultural soils (CLI Class 1 to 3). However, while the region contains a great deal of prime soils, it is not known what portion of the region has been planned for development and therefore, it is unclear what area will remain available for agriculture in the future.

- Land totalling approximately 69,694 Ha. has been annexed to Edmonton in several phases between the late 1800s and 1982. Most of the land that was annexed prior to 1982 was agricultural land and it has since been developed, primarily for non-agricultural uses. The three UGAs being studied in this assessment comprise a total 7,888 Ha. or 11.3% of the lands remaining largely undeveloped in the originally annexed area.

- Like most large Metropolitan areas in Canada, the City of Edmonton has been experiencing a loss of farms and the conversion of land from agricultural to urban uses. Between 2006 and 2011, the number of census farms (a farm, ranch or other agricultural operation producing agricultural products for sale) decreased by 57% while the land area under agricultural operations decreased by 80%. However, some o f this apparent loss of farmed area is explained by Statistics Canada's "headquarters rule" that guides how data is collected and reported. The City's zoning and tax assessment records indicate that a more modest 15% of the City's farmland was converted to urban uses between 2006 and 2012.

- Land tenure has shifted somewhat in Edmonton. The share of agricultural land owned by farmers (operators) has decreased from 60% to 43% between 2006 and 2011, leaving leased/rented farmland as the predominant form of farmland tenure in Edmonton. However, 57 of 73 farm operators report owning at least some of their land. This pattern may result from a combination of risk management, farmer demographics, and non-farming investors who purchase and hold land for development but wish to maximize revenue in the interim.

- The cost of inputs, especially fertilizer and wages, has increased between 2006 and 2011, a constant trend observed over time/decades. Wages paid per week of work are 19% higher in Edmonton's agricultural sector than in the Province as a whole. In spite of this, profit per farm has doubled and profit per acre has tripled in Edmonton between 2006 and 2011. This may be a result of several factors including increased demand for locally grown fruits and vegetables, more intensive farming practices, changes in commodity types, or changes in commodity prices. Since 2008, historically unprecedented agricultural commodity prices have resulted in overall increases to annual gross farm receipts for both crops and livestock sectors. Of the farms remaining within the City of Edmonton (as reported in the Census of Agriculture 2011), overall farm profitability has increased, as have total wages paid, number of weeks of reported paid

labour. Greenhouses and some other horticultural operations appear to be the only significant farming activities that have remained relatively constant between 2006 and 2011 (Statistics Canada, 2011a).

- Currently, the largest agricultural commodities in Edmonton in terms of growing area are field crops (canola, wheat, alfalfa) followed by barley, hay and fodder crops. Greenhouse products are also significant; the greenhouse industry is dominated by floriculture although there was some shift to greenhouse vegetable growing since the 2006 census.

1. Introduction

This Agriculture Inventory and Assessment is primarily concerned with the current status, trends, and conditions for primary agriculture. It is part of a larger process to develop a City-Wide Food and Urban Agriculture Strategy ("Strategy") for the City of Edmonton. The assessment of biophysical characteristics, agricultural capability, and trends in farming and farmland provides important background information for developing sound policy recommendations regarding agricultural land in the Strategy. Other aspects of an agriculture and food system, such as economic activities associated with agri-value (.e.g. food processing), agri-support services and agri-tourism activities are beyond the scope of this assessment, although they are discussed in other documents. However, we do know, based on 2010 Statistics Canada data, the average Albertan household spends an average of $8,427 annually on food, which translates into approximately $3.4 billion per year spent on food by Edmontonians (Statistics Canada, 2010).

Key research questions explored in this report include:

- How suitable are biophysical conditions (soil quality, temperature, water availability) for agriculture in the Urban Growth Areas (UGAs)?
- To what extent are these conditions unique within the Capital Region?
- What are the major farming activities in Edmonton and in the UGAs? How have these changed over time?
- How is land being used in the UGAs for both agricultural and non-agricultural purposes?

1.1 Study Area

The data available for this study falls into two main categories: data for the City of Edmonton as a whole and data specific to the Urban Growth Areas (UGAs). The biophysical and agricultural capability assessment is focused on the UGAs whereas farmer, farmland, and farming trends are for the City of Edmonton as a whole.

There are currently three Urban Growth Areas within Edmonton. The City boundary and boundaries of each of the three urban growth areas is shown in Figure 1. The locations and boundaries for each of the study areas has been established in conjunction with the City of Edmonton and confirmed to follow parcel boundaries whenever possible. The boundaries of the UGAs follow neighbourhood lines whenever appropriate and closely reflect Figure 3 of the City's draft Growth Coordination Strategy (City of Edmonton, 2012). These boundaries reflect the most accurate depiction of these areas.

SOUTHWEST STUDY AREA

The Southwest UGA is bounded by Winterburn Road to the East, Anthony Henday Drive to the North and the North Saskatchewan River to the East. Approximately 25% of the urban growth area is within the North Saskatchewan River Valley. There are currently six small subdivisions in the area mainly centered around Quadrant Avenue. In 2011 population of the area was 525 (Statistics Canada, 2011). The total area of the Southwest Urban Growth Area is 2,028 hectares (5,011 acres).

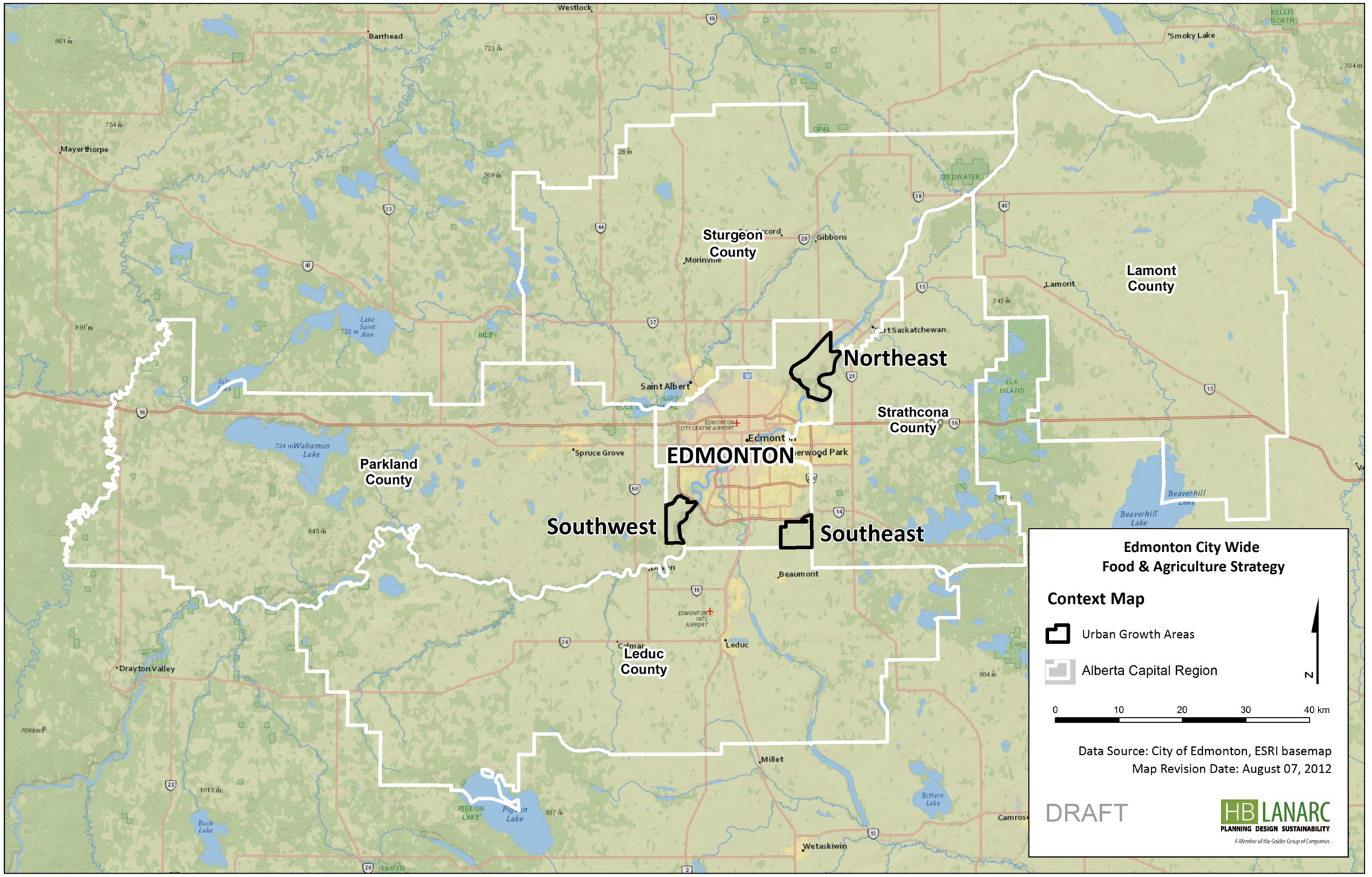
SOUTHEAST STUDY AREA

The Southeast UGA is bounded by Anthony Henday Drive to the North, Meridian Street and Strathcona County to the East, 41st Avenue SW and Leduc County to the South and 50th Street SW to the West. The Southeast area is composed primarily of gently rolling hills and is primarily rural/agricultural in character. In 2011 the population of the area was 279 (Statistics Canada, 2011). There are currently no small-lot subdivisions in the area. The total area of the Southeast UGA is coincidentally the same as the southwest UGA - 2,028 hectares (5,011 acres).

NORTHEAST STUDY AREA

The Northeast UGA is bounded by Manning Drive to the North and Northwest, the North Saskatchewan River to the East and the Anthony Henday Drive right of way to the South. The area is bisected by the Canadian National Railway right of way. Significant sections of this UGA (26% of the total area) are within the North Saskatchewan River valley and ravine system. In 2011 the population of the area was 2,651 (Statistics Canada, 2011). Significant residential developments exist at the Evergreen Trailer Park and Quarry Ridge, and as scattered rural residential subdivisions East of Meridian St. and centered along Fort Road. The North East area is home to a diversity of land uses including the Alberta Hospital Edmonton (1.8% of land area), telecommunications and power lines (2.44% of land area), and recreation areas (4.58% of land area). The total area of the UGA is 3,832 hectares (9,467 acres).

Figure 1 Regional Context Map



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1.2 Study Methods

The assessment of agriculture used several methods to synthesize secondary information sources related to agricultural practices and land uses in Edmonton.

Study methods included a literature review, spatial analysis using geographic information systems (GIS) and an analysis of statistical data using a standard spreadsheet program (Microsoft Excel).

To obtain information related to the history of Edmonton's growth and related municipal policies, a literature review was conducted which included a review of archival policy decisions provided by the City and a review of recent policy documents (such as the Municipal Development Plan).

Biophysical resources, described in Section 2, are drawn from several key sources including the Canada Land Inventory (CLI) and climatic data from both provincial and federal sources. A combination of literature review and mapping of spatial data were used for the analysis.

To understand city-wide farming trends, an assessment of both the 2006 and 2011 Censuses of Agriculture was completed. The Census of Agriculture does have certain data limitations, due to:

a) Units of measurement conversion (e.g. acres to hectares),
b) For confidentiality requirements, data suppression is practiced in geographic areas where very few agricultural operations report,
c) Random rounding of farm operator data, and
d) Data for census farms reporting on incompletely enumerated First Nations and Inuit Reserves and Settlements are not available.

Despite these data limitations, one must understand that the census is a nation-wide, comprehensive snapshot in time (one day every 5 years) of which robust procedures for data quality assurance and quality control are applied. The 2011 Census of Agriculture had a response rate of 95.9%, of which only 1.8% under coverage was reported, primarily on operations reporting less than $10,000 annual sales (Statistics Canada, 2012, General Notes).

Current land uses in the UGAs were analyzed based on both local Assessment Authority information and from air-photo interpretations. Edmonton assesses property (land) value based on the usage of the land as well as the type, style and extent of improvements to the land (such as the addition of a building). The information is provided on a spatial basis using parcel identification codes linked to the City's cadastral fabric (land parcels). Alternatively, air-photo interpretations are used to assess both primary land-uses and agricultural uses in the UGAs. The process of air-photo interpretation includes visual review of photos by an expert who assigns a land-use to each parcel in the UGAs. Through this process, a primary effective land use and primary agricultural use are assigned for each parcel. In the cases where

a parcel had multiple uses, the one that made up the majority of the parcel's area was assigned as its primary use.

1.2.1. Key Data Sources

Information around agriculture in Edmonton is available at different scales depending on the data sources and method of data collection. For this reason, the project team used eight different data sources to validate and cross-reference multiple sources of information. The key data sources for this study included:

1. **Agricultural Census of Canada 2006, 2011:** The Census of Agriculture is a dataset covering all aspects of farms and farming including: farm classification, land use, tenure, crop and livestock statistics, farm business statistics, and farm operator statistics. Please note that 2011 Census data was only recently released and should be considered preliminary. It is subject to revisions that may occur after the submission and publication of this report.

2. **City of Edmonton assessment information:** The Edmonton property assessment information produced by the Edmonton Assessment Authority contains information pertaining to zoning, effective zoning, land value, and parcel sizes.

3. **Primary Land Use and Primary Agricultural Use inventories conducted through air photo interpretation:** The Primary Land Use describes broad categories including agriculture, residential, transportation and the Primary Agricultural Use describes specific agricultural uses such as grains, greenhouses, and field vegetables. Both are based on expert air photo interpretation. Air photo interpretation and analysis was conducted using the Ag-Capture: An Agricultural Land Use Inventory Tool Survey's Field Manual, Version 1.0 (Agri-Food Canada, 2007).

4. **Canada Land Inventory soils mapping:** Canada land Inventory soils mapping contains information pertaining to many aspects of soils within the UGAs including: soil capability class and subclass. CLI assesses soil capability for agriculture considering 11 factors for climate, soils and landscape. It is expressed as 7 classes and limitations are specified. It should be noted that for this assessment the AGRASID database was not used. This is because, while the AGRASID database does have an excellent province-wide coverage, there is incomplete coverage within the City of Edmonton.

5. **Land Suitability Rating System (LSRS):** is an improved CLI, developed in the mid-1990's, which considers 17 factors of climate, soils and landscape. Factors are indexed to improve the description of 'suitability', rather than capability.[i]

6. **City of Edmonton GIS data:** The City served as a source of data and provided datasets pertaining to municipal boundaries, Urban Growth Area boundaries, roads and road classification, the River Valley Overlay and historical growth data.

7. **Climate WNA:** Climate WNA extracts local weather station monthly data for the reference period (1971-2000), and calculates seasonal and annual climate variables for specific locations based on latitude, longitude and elevation for western North America. The data is used to map climatic variables and micro climates in the UGAs.

8. **Archival Land Use Planning Documents:** The City of Edmonton provided a number of archival documents and reports outlining policy decisions focused on farming and farmland in Edmonton from the 1970s to the present, including the Municipal Development Plan (2010).

9. **Landowner survey:** In June of 2012, a letter including a link to an on-line survey was distributed to all of the landowners in the Urban Growth Areas. Of the over 2000 letters that went out, 282 surveys were completed. The objectives of the survey are two fold: 1) to understand what type of activity is currently occurring on the land in the UGAs and 2) to understand what landowner intentions are for the future of their land(s).

Data Caveat:

While there are recognized limitations with all data sources (scale, currency and quality), the available data & information used in this report has been peer reviewed and/or subjected to rigorous science-based methodologies of air photo interpretation and geo-spatial assessment within the strict timelines of the project. Table 2 below summarizes the data sources, the information that was gathered, the coverage of the data, and the year prepared.

[i] LSRS ratings are not available for land within the City of Edmonton so this information was used for context only.

Table 2 Data Source Summary

Main Data Source	Information Gathered	Coverage	Year Prepared	Notes
Census of Agriculture	Farm area, farm types, production and business characteristics.	Whole City of Edmonton, and comparisons to Alberta Capital Region and Alberta.	2006, 2011	Farms reporting are those that are headquartered (e.g. base of operations) within the City of Edmonton - this is according to Statistics Canada's "farm headquarters rule".
Edmonton Assessment	Different types of land use (agricultural, residential, etc.).	UGAs & adjacent parcels	2011	Also used to confirm air photo analysis results.
Air Photos	General Primary Land Uses and specific Primary Agricultural uses within agricultural areas.	UGAs & adjacent parcels	2012	Air photo interpretation has not been ground-verified.
Canada Land Inventory	Soil specific information.	UGAs	1960-1970	Soil information has not been verified by field samples.
City of Edmonton GIS Data	Base mapping, overlays, historical growth data.	Whole City of Edmonton	2012	
Climate WNA	Geographic display of climactic information.	Western North America	1970-2001	Primary data from weather stations extrapolated to cover Edmonton and surrounding areas.
Archival Documents	Policy history, agricultural history, historical land values.	City of Edmonton, Northeast Edmonton	1970-2011	
Landowner survey	Existing and intended uses and agricultural practices.	UGAs	2012	Primary data source, n=282.

1.3 Abbreviations & Definitions

The terms below are used in the inventory and assessment to discuss a range of factors related to agriculture in Edmonton.

Agricultural Capability: Agricultural capability refers to the biophysical potential of land based on a combination of soil class, limiting factors such as topography or salinity, the availability of water, and climate (seasonal temperatures). It does *not* account for factors such as financial viability or legal restrictions on land use (e.g. zoning).

Alberta Capital Region: Also known as the Edmonton Capital Region or Greater Edmonton, this area includes 35 municipalities spread throughout the counties of Strathcona, Lamont, Leduc, Parkland, and Sturgeon (Capital Region Board)**.**

Climate Normals: Climate normals are average climatic conditions over 30 year periods. Climate normals reflect long term trends in climate. Climate extremes and higher variability with climate change are raising questions as to the 'stationarity' of climate normals.

Climatic moisture index: Is also referred to as moisture surplus/deficit (P-PE) and is calculated as precipitation (P) less the potential evapotranspiration (PE).

Evapotranspiration: Evapotranspiration (ET) is used to describe the combined effect of evaporation and transpiration, or the transfer of liquid water to gas, from sources such as soil, water bodies, and plants.

Extensive agriculture: Extensive agriculture refers to a type of production system using lower levels of inputs per land area; inputs may include labour, capital and management practices. Extensive agriculture often refers to large holdings.

Frost-Free Period: The frost-free period is the number of days between the last date of 0°C in the spring and the first date of 0°C in the fall. It provides a measure of the period during which plant growth should occur uninterrupted by frost.

Growing Degree Day (GDD): A measurement of heat available to plants during the growing season. It is commonly used to estimate the suitability of different crop types to a growing area. Growing degree days are counted based on the average of the daily maximum and minimum temperatures greater than a base at which plants would be expected to grow. In general, most crop types begin to grow at around 5° C; therefore this is commonly used as the base temperature form which GDDs are measured.

Growing Season: The time of year in which according to meteorological conditions (temperature, photoperiod, available moisture, etc.) and elevation, growth and development (vegetation) of plants is possible. For annual crops, it's the time necessary for a plant to go through a complete cycle of development; in agricultural practice, the period from the planting and beginning of growth to maturation and harvest. For perennial crops, growing season is closely related to the frost-free period.

Horticulture: The science, art, technology and business of intensive plant cultivation for human use.

Intensive Agriculture: Refers to a type of production system using higher levels of inputs per land area; inputs may include labour, capital and management practices. Intensive agriculture may occur on both small-holdings or large agricultural operations.

Municipal Development Plan (MDP): Each municipality in Alberta is required to develop a Municipal Development Plan (MDP) which guides development for 10-15 years. MDPs are strategic growth and development plans that outline how land is developed, the provision of municipal services such as transportation networks and schools, and policies regarding the protection of agricultural operations. Edmonton's current MDP, *The Way We Grow*, was adopted in 2010.

Overlay: The term "overlay" refers to a special set of regulations that apply in addition to the standard regulations of a land use zone, much as a transparent overlay can be used to superimpose new or different information on an existing map or drawing (City of Edmonton, 2012).

Parcel: A parcel is a specified area of land identified with legal description on a certificate of title for taxation purposes, according to the Torrens system of land registration. This differs from a lot, which is a recognized subdivision of a parcel also with a written legal description that addresses permissions or constraints upon its development (Service Alberta, 2011).

Primary Agriculture: Refers to the production of agricultural crops and livestock occurring mainly on farms but also in greenhouses and inside buildings.

Soil Classification: Soil classes are used to describe and/or rate the characteristics of soil according to physical and chemical properties, surface form, drainage and overall soil quality for a particular purpose. Several soil classification systems exist in Canada and Alberta such as Canada Land Inventory, Soil Landscapes of Canada and AGRASID (Agricultural Regions of Alberta Soil Information Database).

Small holding parcel: Agricultural small holdings are typically parcels of land less than 80 ac as defined by local government's statutory plans (Strathcona County, 2007).

Urban Growth Areas (UGAs): The Urban Growth Areas are areas within the City of Edmonton (in the NE, SE and SW) that have not yet been built-up and have historically been designated as urban reserve (e.g. lands awaiting future development). The UGAs are areas of mainly agricultural land that were annexed by the City in 1980s. At that time over 94,000 acres were annexed to the City of Edmonton.

Today, approximately 19,491 acres (7,888 Ha.) remain in the UGAs which represents 11.3% of the total area of Edmonton or 20.7% of the area of the last annexation. The UGAs do not include other lands within the built up area of Edmonton that are either still vacant or eligible for re-development (e.g. City Centre Airport).

Urban Use: All non-agricultural uses, including recreation (e.g. golf courses) and parks.

1.4 Units of Measurement

Although Canada officially uses the Metric system, there is still significant use of non-metric measurement systems. Within the context of this report, the most relevant measurement is area. In the agricultural sector, acres and square miles remain the most common measuring systems. This report will generally provide area in hectares and acres where possible, (e.g. 1 hectare =2.471 acres). In a few cases, such as where a summary table would be difficult to read due to the volume of information, only one unit is provided. In these cases users of this document may wish to use the Common Conversions list below.

Common conversions include:

- 1 hectare is equal to 10,000 square meters
- 1 hectare is equal to 2.471 acres
- 1 hectare is equal to 0.00386 square miles
- 1 acre is equal to 0.4047 hectares
- 1 section is equal to 640 acres
- 1/4 section is equal to 160 acres

In addition, it is important to note that the maps in this document each have their own scale as shown in the legend. The scales across different maps are not comparable and each should be considered individually. Please read each map carefully for information on scale.

2. Biophysical Resources and Agricultural Capability

This section of the inventory describes soil types, water availability, temperature, agricultural capability, and protected areas in Edmonton's Urban Growth Areas (UGAs). The study examines these physical and climatic features using a literature review and the examination of data from the sources mentioned above. Key findings include:

- Soil capability in Edmonton's UGAs is substantial; between 57.8% (southeast UGA) and 80.4% (northeast UGA) of the UGA land is classified as prime agricultural soil according to the Canada Land Inventory (Classes 1, 2 and 3). A substantial portion (approx. 50%) of both the Northeast and Southwest UGAs are Class 1 soils.
- There is a significant amount of land with prime agricultural soils and high capability for agriculture in the Alberta Capital Region – including 733,000 Ha. of class 1,2,and 3 soils. Prime lands in the UGAs therefore represent a small portion of the regional total, although this doesn't necessarily reflect climate, water availability, or key infrastructure that forms part of agricultural viability. It is also unknown how much of this land has been planned for urban development.
- Agri-climate classifications show that there is a slight heat deficit in Edmonton, which is understandable as Edmonton is Canada's northern-most Provincial capital. Moisture conditions are on average adequate, considering climatic moisture index (precipitation minus potential evapotranspiration) for the majority of Alberta is a deficit. However, water supplies for supplemental irrigation, if needed, are available. Irrigation suitability needs to be determined.
- Temperature in Edmonton provides some limitations for crop growth, but this is generally off-set by Edmonton having one of the longest growing seasons (frost-free periods) in Alberta. Extended photoperiods (longer spring-summer day length) compensate to some degree for the shorter growing season and this is a very important factor for vegetative growth in northerly climates;.
- Environmentally sensitive areas do not appear to be a significant constraint on agriculture in the UGAs and in fact enhance the ability to provide ecosystem services such as biodiversity, nutrient cycling and watershed management (e.g. storm water management).

- Overall, there appears to be significant agricultural capability in all three UGAs based on biophysical resources (soil, temperature, topography, and water) that are supportive of a wide variety of agriculture and agri-food activities, crop and livestock types.

2.1 Soils and Agricultural Capability

2.1.1. Soils and Terrain

Soil type and quality influences the type of crops that can be effectively be grown. Most of the soils in the UGAs are composed of deep, black topsoil which is high in fertility (clack and dark gray chernozems) (Bowser, Kjearsgaard, Peters & Wells, 1962). These soils are characterized by thick, dark coloured surface horizons with high amounts of organic matter and basic nutrients (cations, mainly calcium). The organic matter content of the surface horizon is greater than 1% and has a high nutrient content. High cation exchange capacity (CEC) indicates high fertility of soils.

Parent materials are mainly old lake deposits (glaciolacustrine) and glacial till, with lesser amounts of aeolian (windblown) sand and coarse water-deposited materials. Because they were formed from old lake deposits, Edmonton soils are high in silt and clay and will, therefore, hold moisture well.

Most of the Edmonton area has slopes of less than 5%. In the Southeast Edmonton UGA, soils have developed on loamy Edmonton till. The slopes progress from less than 5% in the Northeast corner of the UGA to 10% or 15% in the Southeast.

The Northeast Edmonton UGA contains large areas of soils ranging in type from silty clay loam to sandy loam texture developed on various parent materials. To the east, this land is bounded by the slope to the Saskatchewan River valley. The river valley has three distinct areas of less steep terrain bounded by the river and the valley slope. Soils beside the river are sandy loam to loam texture, and may be underlain by gravel.

The Southwest Edmonton UGA is primarily composed of silty clay loam developed on glaciolacustrine parent material. There are a small areas of sandy loam in the north beside the ravine, and areas of organic and sandy materials in the south of the UGA.

In Southeast Edmonton, soils developed on loamy Edmonton till. The slopes progress from less than 5% in the northeast corner of the UGA to 10 or 15% in the southeast (Environment Canada, 1972).

2.1.2. Landscapes, Land Forms and Topographical Features

Most steep slopes within the UGAs are associated with the North Saskatchewan River Valley or other stream channels of tributaries to the River Valley. These areas are already identified as Environmentally Significant Areas (ESA's) or buffer areas (by Alberta Capital Region) and may restrict development potential. Development of any kind is normally restricted within flood plains, according to the Municipal Government Act and definition of Environmental Reserves (ER).

Steeply sloped land has an increased risk of erosion and landslide hazard, depending on underlying geology. It is also associated with greater infrastructure costs for development for urban use, and for farming (contour farming, bench terracing, etc.).

This Inventory uses areas with identified topographical limitations as well as federally produced digital elevation models as sources to topographical features. Topographical limitations typically mean areas with slopes greater than that which is feasible for traditional farming methods. Parcels with steep slopes have limited agricultural potential, because of their higher potential for erosion and resulting increase in sedimentation of surface water.

Sloped areas, that is to say slopes that are greater than 5% or 3 degrees, are generally suitable for arable farming, but may require specialized agricultural equipment (Alberta Agriculture and Rural Development, 2012; Agriculture and Agri-Food Canada, 2010). The landscapes in the Edmonton area may be described as generally level to gently rolling plains, which gradually rise to the uplands of the Cooking Lake moraine east of the city (Soil Survey of Edmonton Sheet 83-H).

Most of the more steeply sloped areas in the City are found along the North Saskatchewan River valley. This valley system and adjacent sloped lands often divide parcels into smaller components and may prevent or increase the cost of access to certain portions of an individual parcel. Building roads and bridges to connect separate portions of land is very expensive and challenging due to regulatory requirements. The result is that the isolated portions of the properties are not often used to their agricultural potential. Additionally, both the percent of slope and the pattern or frequency of slopes in different directions affect the uniformity of growth and maturity of crops as well increase the hazard of erosion (Agriculture and Agri-food Canada, 2008).

Surface forms in the Northeast UGA are undulating with low relief (2% slope gradient, slope length of 250m and relief of 3m . Surface forms in the Southwest UGA are undulating with high relief (4% slope gradient, slope length of 250m and relief of 5m). Surface forms in the Southeast UGA are undulating with high relief, and transition to hummocky with low relief (5% slope gradient, slope length of 150m and relief of 5m) on the south-eastern boundary of the city. The surface form of the North Saskatchewan River valley is a stream channel with valley terraces (20% slope gradient, slope length of 500m and relief of 60m). (Source: Alberta Landforms; Quantitative Morphometric Descriptions and Classification of Typical Alberta Landforms, AAFC, 2000).

2.1.3. Soil Capability for Agriculture

Based on the Canada Land Inventory (CLI) (Environment Canada, 1972), soil capability is generally high in Edmonton's Urban Growth Areas. The CLI classes soil on a scale from Class 1 to 7, with 1 representing soil with no significant limitations in use for crops (e.g. the best agricultural soil) and Class 7 representing soils with virtually no capability for crops. Classes 1, 2 and 3 are commonly considered prime agricultural soils and support a wide variety of crop types. These classes account for constraints, or "limiting factors", such as topography, erosion, or salinity, that can make certain crop types less viable. A more detailed description of specific soil classes in the UGAs and agricultural classifications used by the CLI is contained in Appendix A. Please also refer to Appendix B for details on soil capability for each UGA.

An understanding of the application of Canada Land Inventory demonstrates that dependable lands (Classes 1-3) have the greatest capacity for crop production, while Classes 4-6 are lands that have capacity for perennial forages and are generally used for sustainable grazing of livestock (natural pasture lands), or agro-ecological uses such as enhancing wildlife habitat and biodiversity (woodlands and wetlands). Factors such as agro-climate (aridity and heat), topography (slope), and physical impediments (stoniness or drainage) are incorporated in the CLI values. Class 7 is not capable of any form of agriculture and Class 8 is described as urban development.

In Alberta, the total available farm land is one third of Alberta's total land base and totals 52 million ac or 21 million Ha. Of this, approximately 50% is considered as dependable lands (CLI Classes 1-3) for crop production. Class 1 soils comprise the least amount of Alberta's farmlands at 3% of the land area, Class 2 soils encompass 18% of Alberta farmland, and Class 3 soils make up 29%. The remaining farmlands are most suitable for permanent cover, and represent natural pasture lands for livestock and sustainable grazing, woodlands, river valleys and wetlands.

Within the Alberta Capital Region, 63% (733,000 Ha.) of the lands are considered class 1 to 3 soils, 17% (215,000 Ha.) is Class 1 (see Figure 2,Table 3).

In Edmonton, dependable lands (Class 1-3) make up approximately 70% of the three UGAs. Each of the UGAs has a large proportion of land with high capability, with a range of from 57.8% to 80.4% of their areas classified as prime agricultural soils (class 1 to 3). In many areas topography is the only limiting factor identified by the CLI (see Table 2, Figure 2, Figure 3).

Southwest Edmonton consists of a level to gently rolling (or undulating) glaciolacustrine plateau, mainly silty clay loam (Class 1). Part of the topography is rolling, with poorly drained organic soils in the depressions and sandy uplands (Class 3 to 4, multiple subclasses) with low ASWC (available soil water capacity) (water retention), low topsoil organic matter and a susceptibility to wind erosion. Alluvial soils near the North Saskatchewan River are rated as class 3 with multiple types of limitation. Approximately 64% of the southwest UGA is rated as prime agricultural soil.

Southeast Edmonton is characterized by loam textured soils with gradually more diverse undulating high relief to hummocky low relief surface forms (including small wetlands in depressions) progressing from the northwest and southwest corners to the east edge (Environment Canada, 1972). Other than these topographic limitations, there is a small area in the southeast listed as class 4 due to topography and other limitations. This area may have variable topsoil depth, and potentially issues with soil salinity and soil structure (Bowser et. al., 1962). Of the three UGAs, Southeast Edmonton has the lowest area percentage of prime soil with 58% of soils in Classes 1, 2 and 3 combined.

Northeast Edmonton has mainly Class 1 soil capability on the plateau (nearly level to undulating low relief), with some areas of Class 2 with multiple adverse characteristics and a combination of subclasses that represent susceptibility to wind erosion, lower available soil water capacity (ASWC), or saline subsoil. Soils near the North Saskatchewan River range from Class 2 to 4 (cumulative adverse characteristics and combination of subclasses) with limitations posed by low ASWC and gravelly subsoil. The agricultural areas are divided by a ravine 2 to 3 km in length, and by the river valley break. Approximately 80% of the Northeast UGA is prime agricultural soil.

Table 3 Prime Agricultural Soil in Edmonton's UGAs

Urban Growth Area (UGA)	**Total Area of UGA** (Hectares)	**Area of land with Prime Agricultural Soil** (Class 1, 2 and 3 in Hectares)	**% of UGA with Prime Agricultural Soil** (Class 1, 2 and 3)
Northeast Edmonton	3,832	3,083	80.4%
Southeast Edmonton	2,028	1,172	57.8%
Southwest Edmonton	2,028	1,293	63.8%
Total	7,888	5,548	70.4%
Note: The maps show only the primary soil class for each soil unit. However, most soil units may contain secondary and tertiary soil classes as well. All soil classes are used to calculate the area in this table			

Source: Canada Land Inventory.

Figure 2 Primary Soil Quality in Edmonton and Alberta Capital Region.

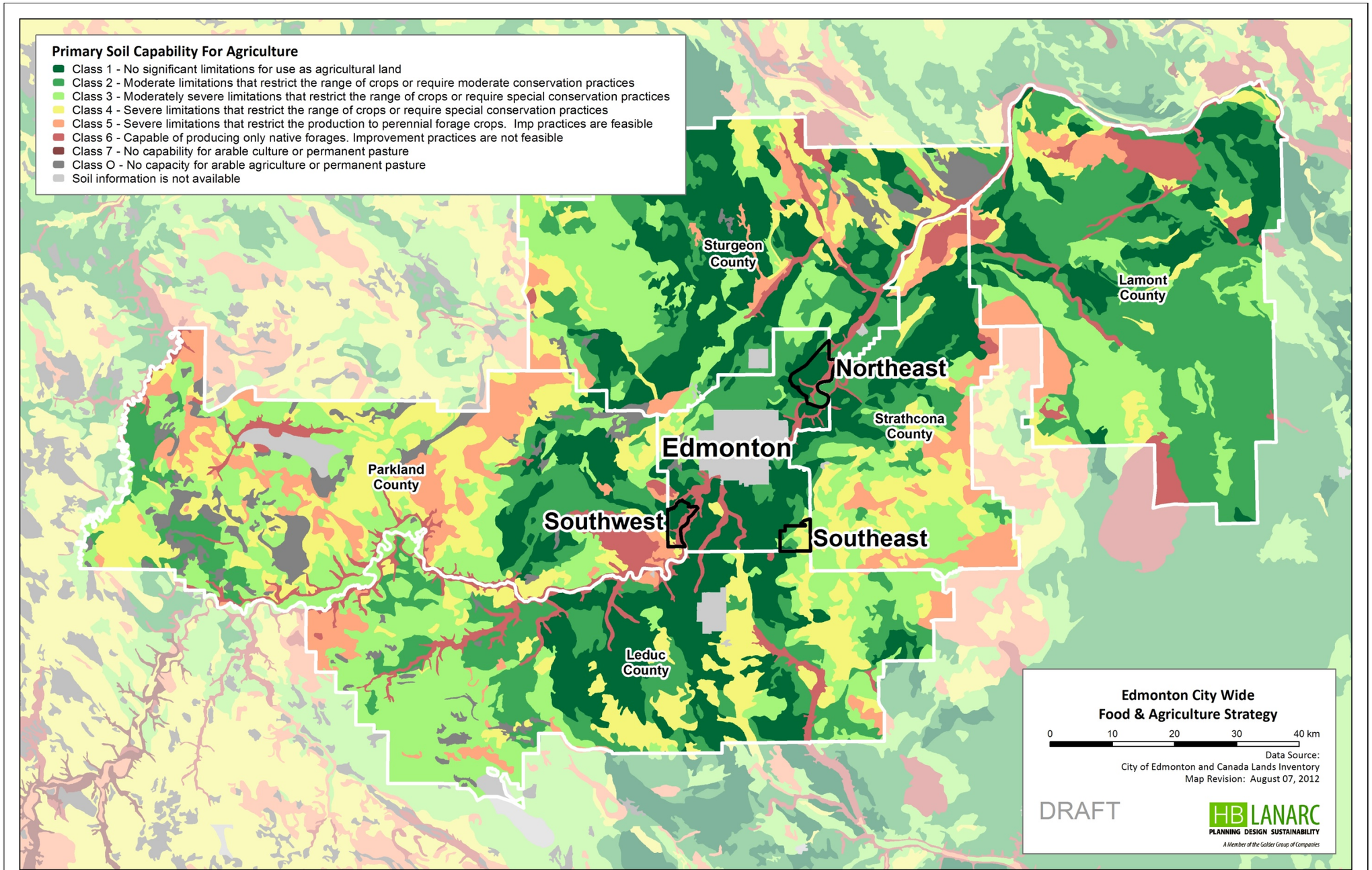

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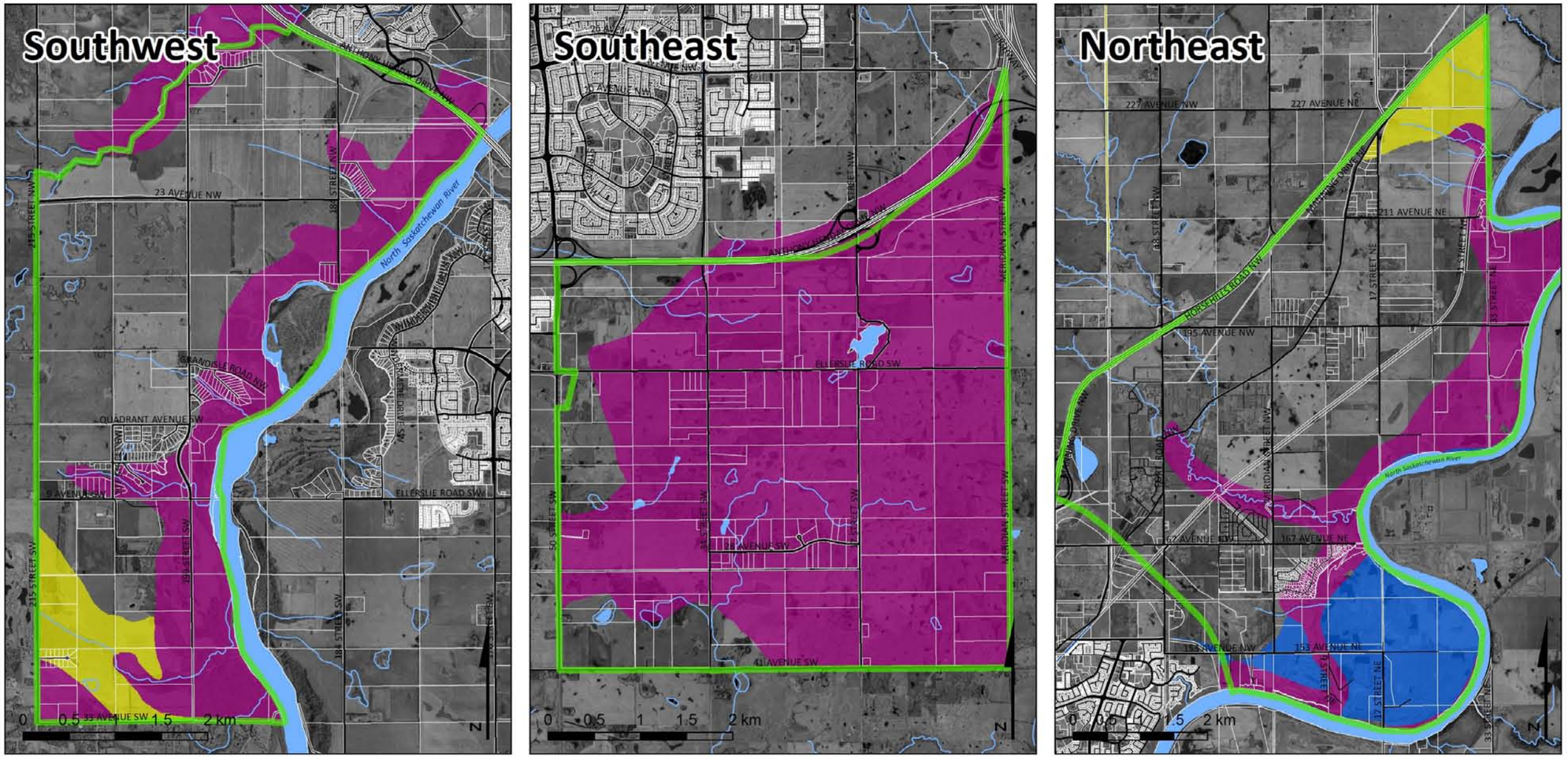
Figure 3 Primary Soil limitations.



Primary Soil Limitations

- Cumulative adverse soil characteristics
- Topography limitation
- Cumulative minor adverse characteristics
- Area Boundaries

Edmonton City Wide Food & Agriculture Strategy

Data Source: City of Edmonton, Canada Lands Inventory
Map Revision Date: May 22, 2012

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2.2 Water Availability and Crop Suitability

Edmonton receives 450-500 mm of precipitation annually (Alberta Agriculture and Rural Development, 2009). Precipitation includes rain, snow, dew and hail. Even over the winter season, precipitation in the form of snow is valuable for agriculture as it helps to keep the soil moist and during spring melt, recharges groundwater and surface water supplies that can later be used for irrigation. Over 70% of mean annual precipitation occurs from May to September, during growing season. Average precipitation varies not only throughout the year but also across the province. The mountains receive the most moisture, with much of the rest of Alberta lying under a "rain-shadow" effect.

Across most of Alberta including all of the Alberta Capital Region, the average annual evaporation exceeds the average annual precipitation. As a result, lake levels and other surface water supplies are vulnerable to high evaporation losses. In general, net evaporation becomes less significant as you move north. Southern Alberta has the highest evaporation losses and large-scale irrigation projects are needed to provide enough water for crop production. Figure 4 illustrates the range in mean annual precipitation across the Alberta Capital Region. The western parts of the region generally receive more rainfall that the east.

Two principle variables are used in determining climate suitability for agricultural crop production. The first is **aridity** (climatic moisture index) and the second is **heat** (temperature). Climatic moisture index is also referred to as moisture surplus/deficit (P-PE) and is calculated as precipitation (P) less the potential evapotranspiration (PE). P-PE is derived from climate normals (1961-1990) that include values for temperature (daily minimum, maximum and mean temperature) and precipitation (rain, snow and total precipitation). Potential evapotranspiration (PE) is estimated using Penman and Thornthwaite method that incorporates day length, light reflection (albedo) and wind speed data with water holding capacity data of soils. The climatic moisture index for the Edmonton area results in a net water deficit of 150 to 200 mm a year (Pedocan Land Evaluation Ltd., 1993) from a combination of water demand for crop growth and summer climate.

On average, the majority of rain falls in June and provides adequate moisture for growing crops. In the absence of average precipitation, crops may require some supplementary water for healthy growth in the form of irrigation.

Irrigation can be used to bridge the gap between the water needs of crops and the amount of annual precipitation. The density and depth of water well records appear to indicate a significant number of sites with available groundwater resources. A map of Water Well Records in Edmonton's UGAs, including well depth, is provided in Figure 5. Surface water supplies are also used for irrigation needs. Irrigation suitability must be evaluated from both a soils perspective, as well as the source water being used. Proper decommissioning of all groundwater wells is required to prevent risk of groundwater

contamination in areas where future development patterns and urban servicing result in the water wells becoming inactive or not being required for use.

Table 4and Table 5 summarize growing season and water needs for various crops and the growing season water deficits for the UGAs. The average water deficit can be read as the water requirements for each crop yield percentile at the reference evapotranspiration value. The water deficit is average precipitation less water needs. The interpretation of this table can be read that for yields at the 90% percentile, a given crop such as Alfalfa would require an additional 275mm of water (likely achieved through irrigation or timely rains).

In the Edmonton context, the amount of rainfall varies somewhat across the three Urban Growth Areas. Mean annual precipitation in the Southwest is highest; with 6% more precipitation than the Southeast and Northeast on average (Alberta Agriculture and Rural Development, 2009). A map of annual precipitation less evaporation (Moisture Deficit) for the region is provided in Figure 5.

Table 4 Average crop water needs (mm) for five crop categories.

Percentile	Cereals	Alfalfa	Oilseed	Pulse Crops	Root Crops	Reference Evapotranspiration Value
Maximum	522	545	506	487	577	841
90th	446	471	446	431	447	752
75th	427	447	425	412	422	705
50th	397	415	395	386	384	655

Source: Pedocan Land Evaluation Ltd., 1993.

Table 5 Average water deficits (mm) for five crop categories.

Percentile	Cereals	Alfalfa	Oilseed	Pulse Crops	Root Crops
90th	-232	-275	-237	-217	-224
75th	-174	-215	-186	-168	-168
50th	-100	-129	-105	-89	-86

Source: Pedocan Land Evaluation Ltd., 1993.

Water requirements for vegetable crops were not available for Edmonton using the same data source. Average crop water needs for select vegetable types is provided below for reference. The information is drawn from Provincial averages and has not been specifically calculated for Edmonton's climate.

Table 6 Average crop water needs (mm) for select vegetables based on Provincial averages.

Cole Crops	Cucumbers	Onions	Peas
440	225	425	375
Note: Cole Crops include broccoli, cabbage, and cauliflower			

Source: Alberta Agriculture and Rural Development, 2007.

Figure 4 Mean Annual Precipitation.

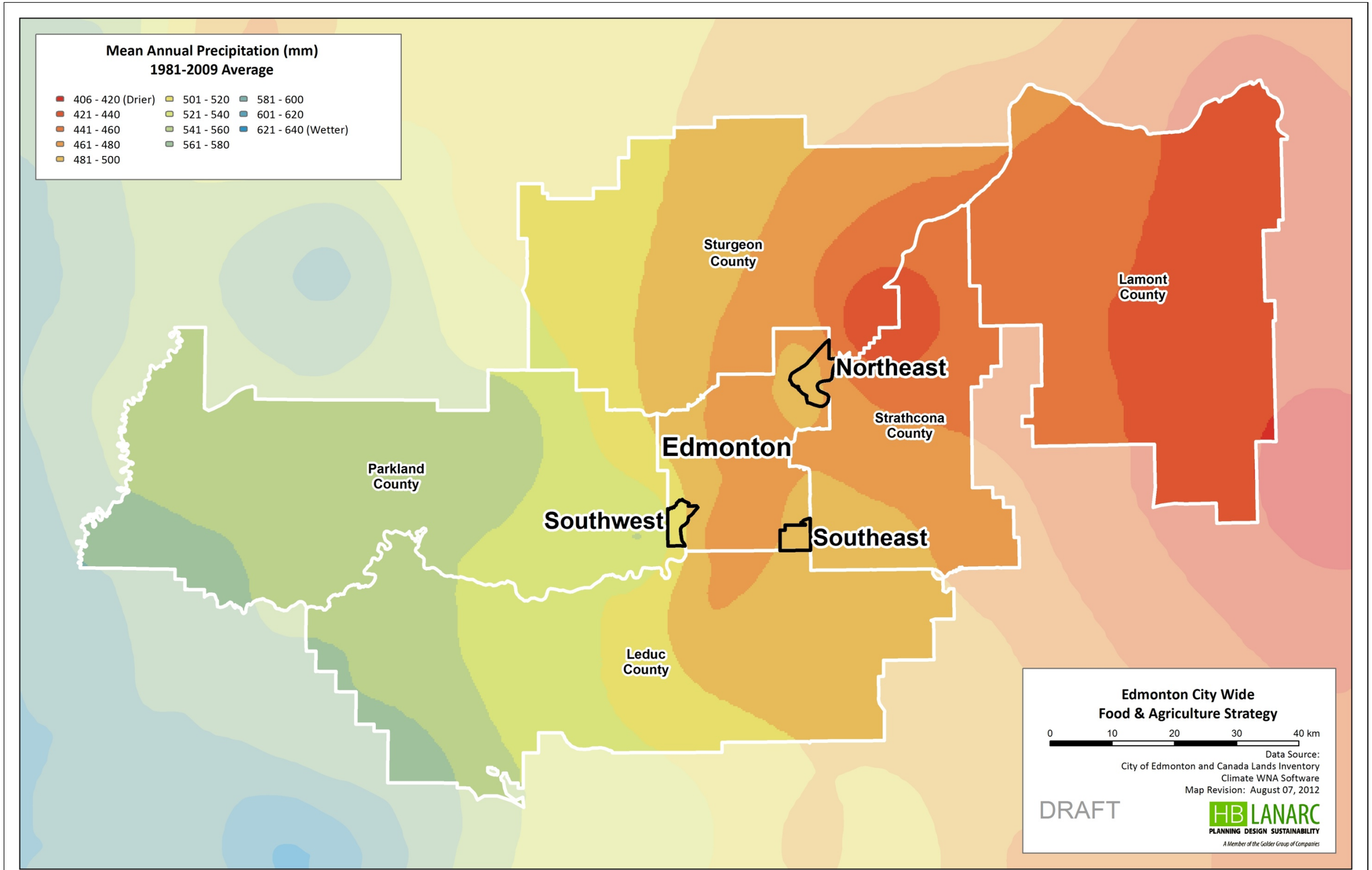

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Figure 5 Annual Climatic Moisture Deficit.

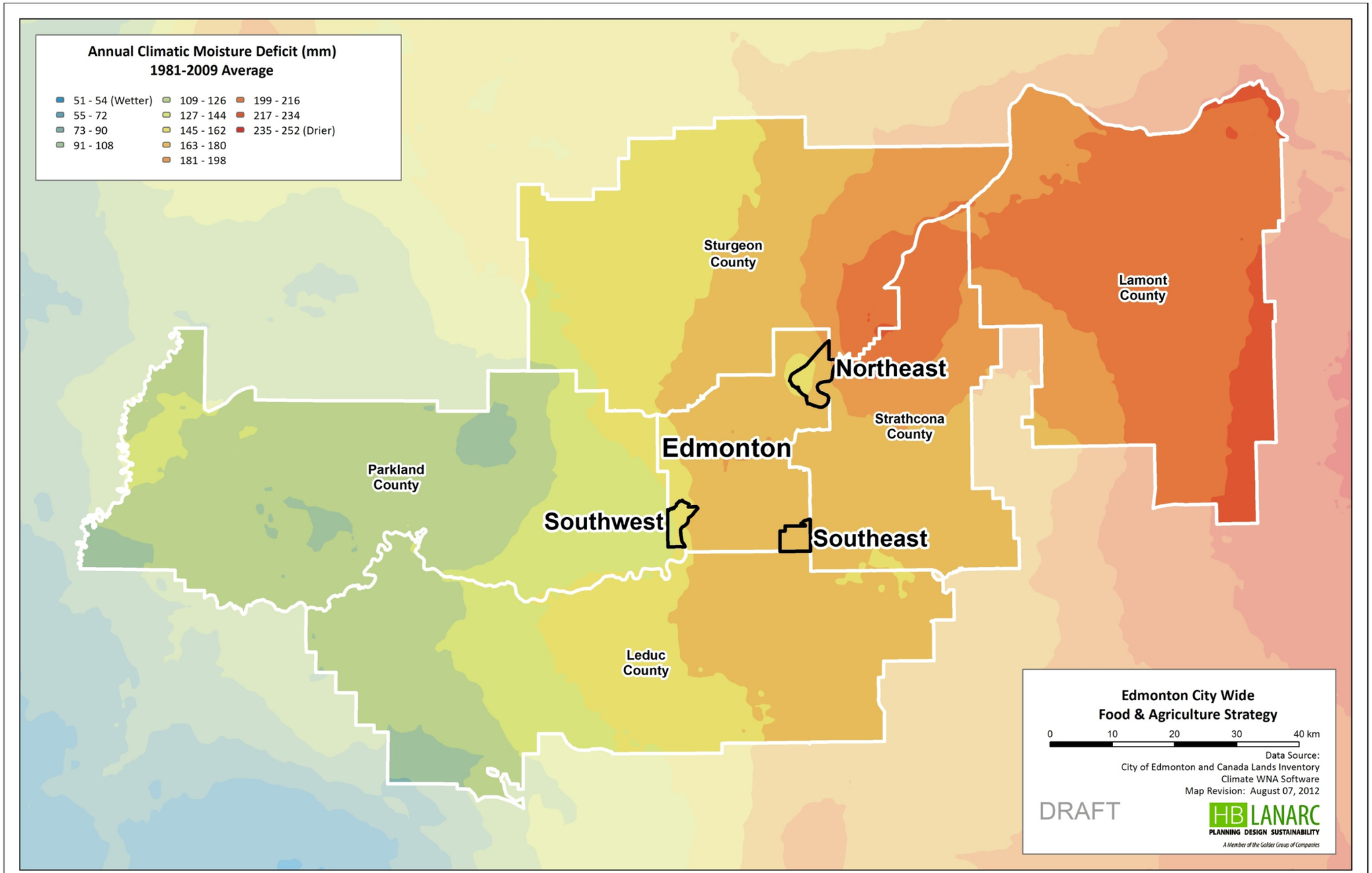

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Figure 6 Map of Growing Degree Days (Above 5 ° C).

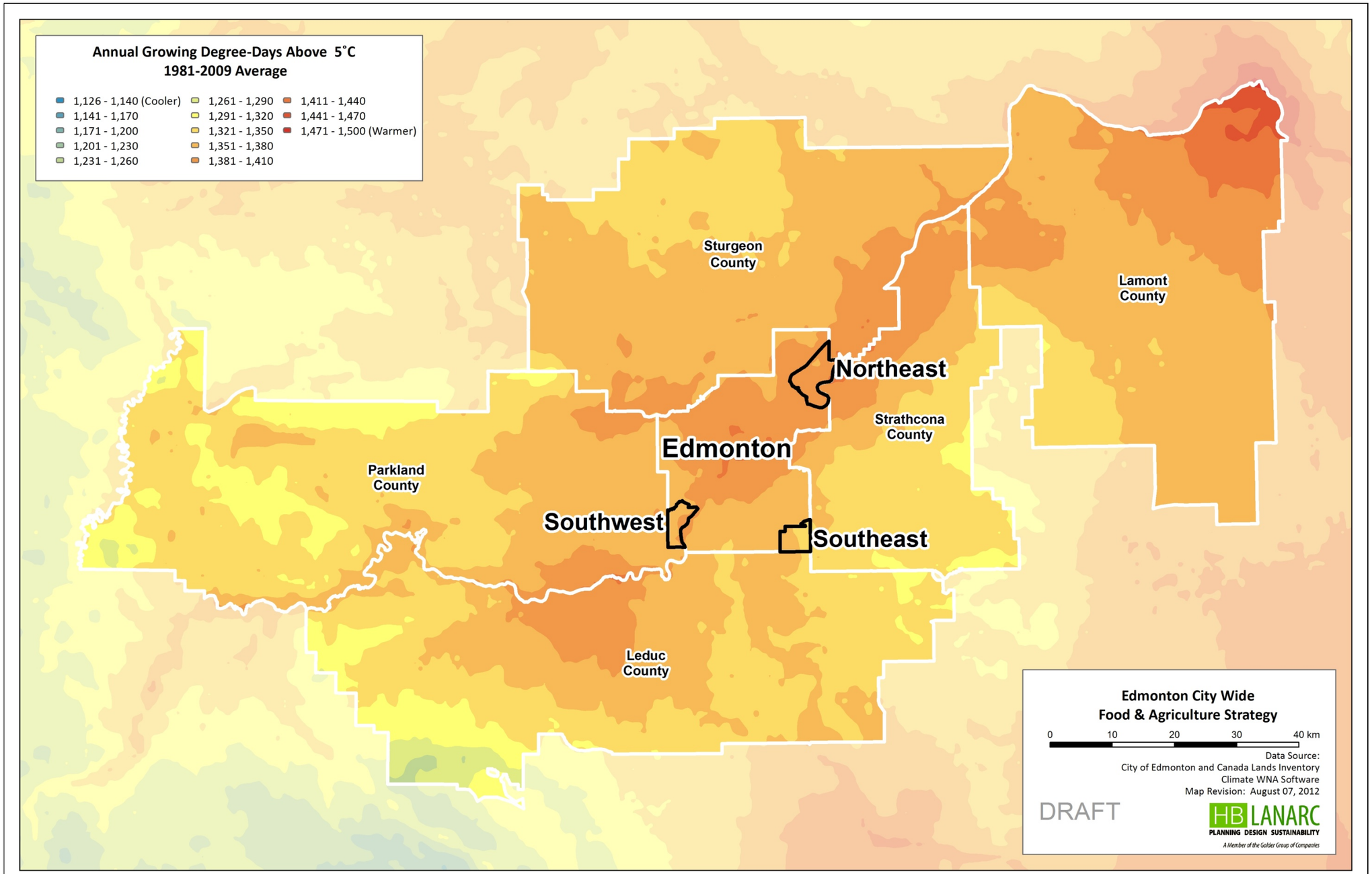

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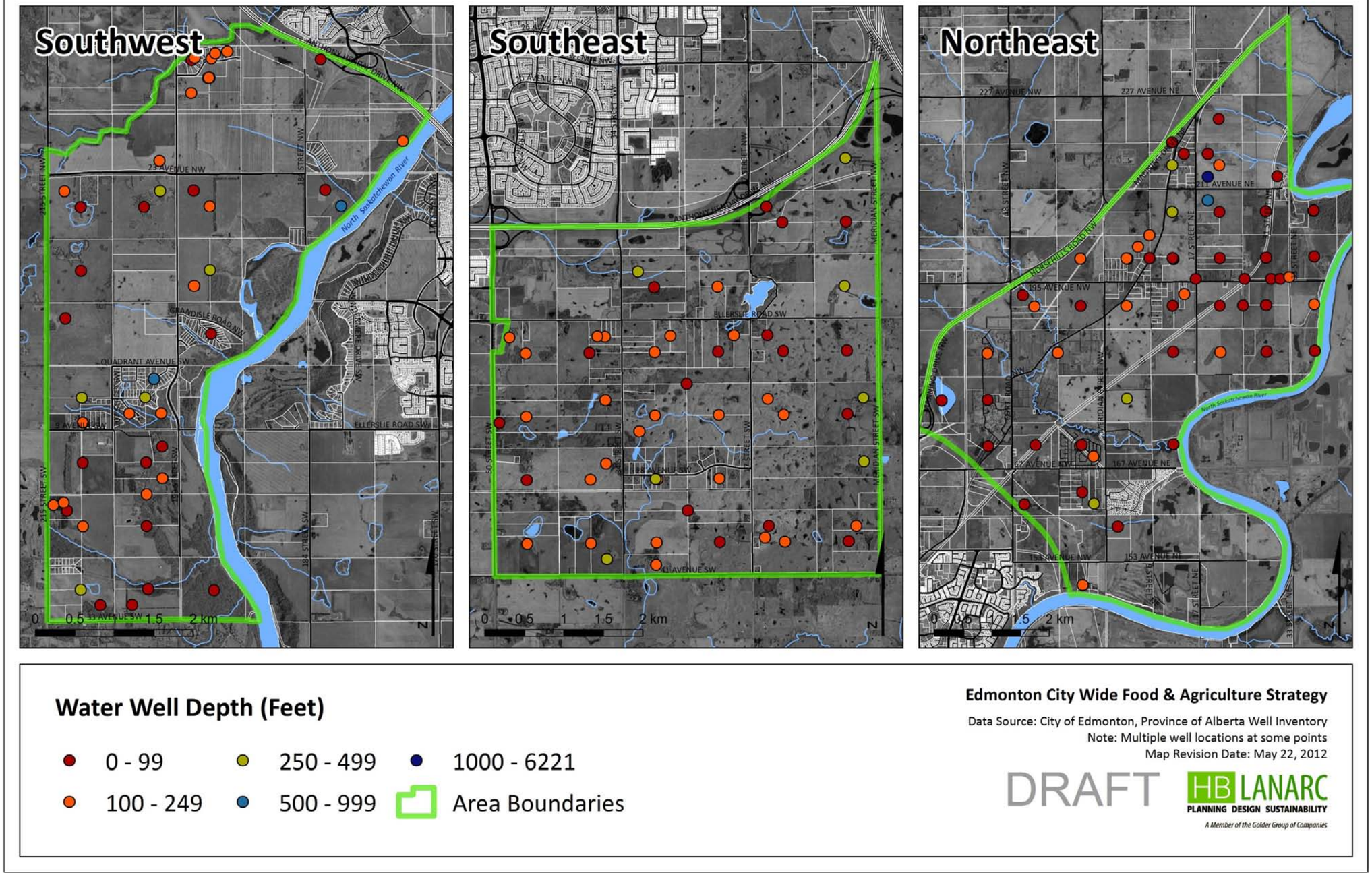
Figure 7 Water Well Depths.



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2.2.1. Temperature and Crop Suitability

Table 7 outlines the minimum threshold temperatures required for some sample crops to grow. Minimum threshold temperatures are used in the calculation of heat units and growing degree days. Vegetables such as potatoes and spinach require warmer soil temperatures than cereals like wheat and barley.

Table 7 Minimum Threshold Temperatures for Growth of Selected Crops.

Crop	Minimum threshold temperature (°C)
Wheat	0.0
Barley	0.0
Spinach	2.2
Lettuce	4.4
General plant growth	5.0
Canola	5.0
Forages	5.0
Potatoes	7.0

Source: Agroclimatic Atlas of Alberta, Agricultural Climate Elements, 2012.

The City of Edmonton is located within the Aspen Parkland Ecoregion and is rated as having an Agroclimate of 2H (slight heat limitation) (Pedocan Land Evaluation Ltd., 1993). 2H is very favourable for crop growth and one of the highest Agroclimate ratings available in Alberta, considering there is no 'Class 1' anywhere in Alberta.

Crops may be described as either cool season or warm season, depending upon the number of days to maturity, and heat unit requirements. Cool season crops include some 30 different vegetables – arugula, beets, beet greens, broccoli, carrots, chard, chicory, claytonia, collards, dandelion, endive, escarole, garlic greens, kale, kohlrabi, leeks, lettuce, mâche, minutina, mizuna, mustard greens, bak choy, parsley, peas, potatoes, radicchio, radish, scallions, sorrel, spinach, tatsoi, turnips, watercress and herbs such as basil, mint. Cool season crops include canola (Polish varieties), oats, barley, most wheats, fall rye, sainfoin and alfalfa.

Warm season vegetables include tomatoes, squash, pumpkins, melons, cucumbers, peppers, eggplant, beans and corn. Warm season crops include durum wheat, mustard, sunflowers, corn, canola (Argentinian varieties), buckwheat, flax & lentils.

There's a large number of forage crop species in both cool season & warm season classes.

Some crops are highly sensitive to frost and others have some frost tolerance, depending upon the species, the growth stage, soil moisture conditions, and growth points (apical vs. basal). In general, the longer the frost-free period, the better it is for plant growth and crops depending upon the species, variety and whether the plants are annuals or perennials. The frost-free period in Edmonton is generally greater than 125 days (Alberta Agriculture and Rural Development, 2009), with the risk of frost occurring

just a few days in May and September (see Table 8). Please also refer to Appendix C for more information on climate trends.

Table 8 Days with Minimum Temperature Below 0°C by Month in Edmonton.

May	June	July	August	September	Total for Growing Season
1.9	0	0	0.07	2.4	4.4

Source: Environment Canada, 2012.

Edmonton has a growing season (measured as the period during which average daily temperature exceeds 5°C) of 180-185 days (Alberta Agriculture and Rural Development, 2010). Growing season varies from 160 days in Northern Alberta to more than 185 days in Southern Alberta. It is also important to note that during the summer, days are longer in Edmonton than in more southerly locations. Frost-free period, degree day calculations, and the length of the growing season do not include the advantages of longer summer day length, which largely compensates for shorter growing season and lower GDDs, making crop production better than might otherwise be expected (Alberta Agriculture and Rural Development, 2009).

Like the length of the frost-free period, Growing Degree Days (GDD) (also called Growing Degree Units (GD)) are a common measurement of the relationship between temperature and crop growth. Figure 6 shows the annual growing degree days within the Alberta Capital Region including the UGAs. The map has been generated using the annual number of GDDs using Climate WNA software (Alberta Agriculture and Rural Development, 2010). From the map, it can be inferred that that the Northeast has the more favourable climate for growing, averaging around 1,409 GDDs versus that of the Southeast which averages 1,357 GDDs.

2.2.2. Overall Suitability: Soil, Precipitation and Temperature Summary

Table 9 summarizes the suitability of the UGAs, region and province for agriculture based on biophysical characteristics (soil, precipitation, temperature and plant growth). It should be noted that these numbers are averages derived from adjacent weather stations. As such, this table should be interpreted with the acknowledgement that there is significant local variability within each UGA and in the City as a whole.

Table 9 Suitability factors of UGAs, Edmonton, Region and the Province for Agriculture.

Area	Total Area (hectares)	Prime Agricultural Soil (Class 1, 2 or 3 as share of total land base area)	Average Annual Precipitation (mm)*	Average Growing Degree Days (>5°C)*
Northeast	3,832	80.4%	469	1,409
Southeast	2,028	57.8%	470	1,357
Southwest	2,028	63.8%	500	1,391
Edmonton	68,437	8.1%	425-525	1350-1431
Region	1,237,869	62.8%	406 - 600	1140 - 1500
Alberta	66,093,437	16.6%**	<350-600+	<1050-1800+
** Area weighted average based on range of values within each UGA* *** Loss of Dependable Agricultural Lands in Canada, Statistics Canada 2005*				

2.3 Environmentally Sensitive Areas and Natural Features

Environmental features can restrict the suitability of land for different purposes. For example, steeply sloped areas near the river valley and protected streams may reduce the potential for large-scale conventional agricultural activities (Alberta Environmental Farm Plan, 2012). Three types of environmental features in the UGA are explored below. Figure 8 shows known environmentally sensitive areas in each of the UGAs. Vegetated areas have been identified by DMTI spatial and generally represent wooded areas.

Agri-environmental practices are very compatible with environmentally significant areas (ESAs) in the provision of ecosystem services such as watershed management (e.g. surface and groundwater recharge, wetland conservation and reclamation, stormwater management), nutrient cycling and enhancing biodiversity by providing habitat (wildlife corridors) and a wide range of plant/crop species. The provision of ecosystem services is a recognized amenity and highly correlated to human well-being (Zhongwei, Zhang, Li, 2010).

2.3.1. North Saskatchewan River Valley and Ravine System Overlay

Environmentally sensitive areas and natural features are present within all of the Urban Growth Areas. The North Saskatchewan River Valley and Ravine System (NSRVRS) and the natural areas in Edmonton's tablelands (defined as the flat areas above river valleys) contain a variety of natural features and ecosystems including wetlands, forest and grasslands that support diverse natural processes and a wide range of species (City of Edmonton, 2010). Accordingly, the amount of area within each UGA that is also within the North Saskatchewan River Valley and Ravine Overlay has been calculated. The purpose of this Overlay is to provide a development setback from the North Saskatchewan River Valley and Ravine System.

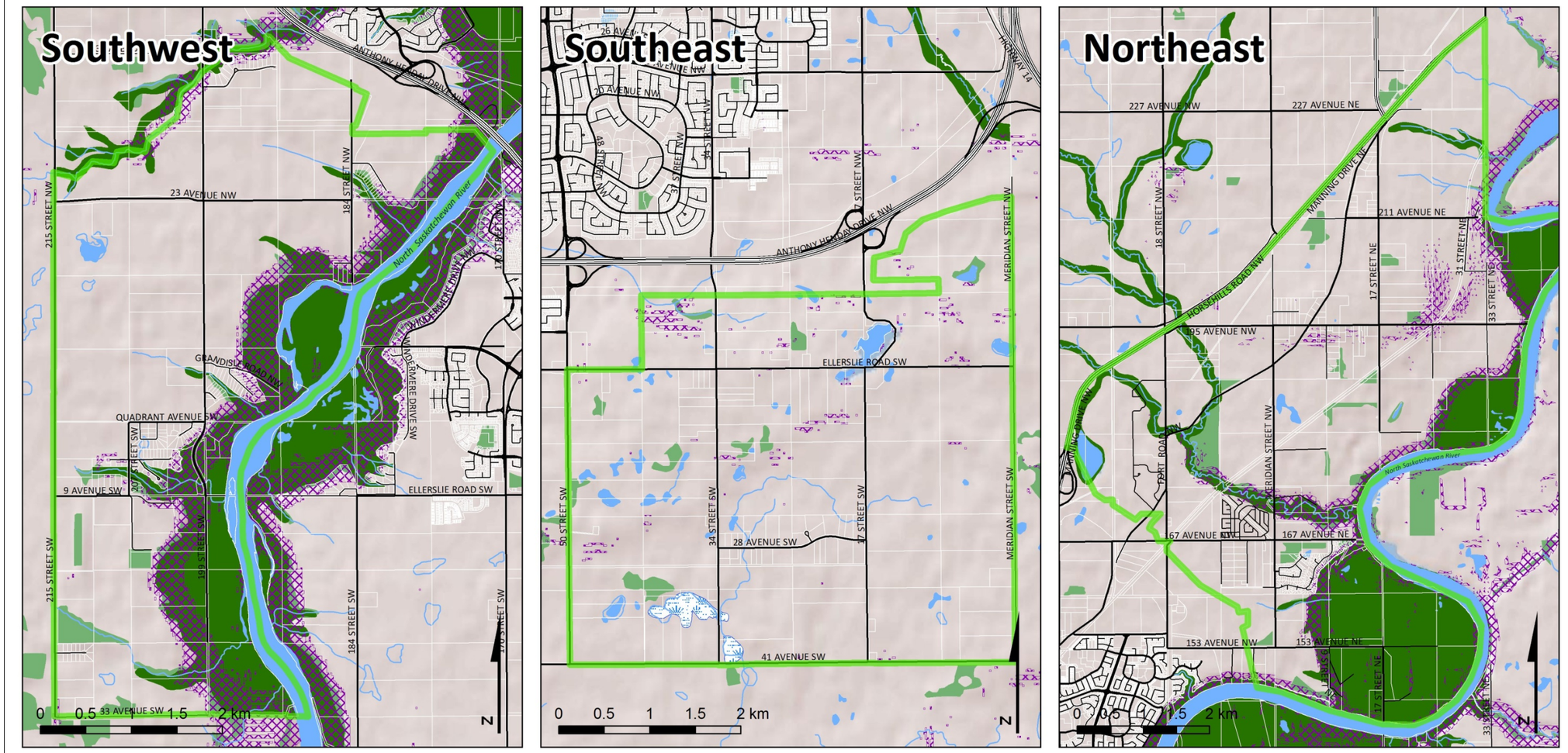
Table 10 Share of UGAs Covered by NSRVRS Overlay.

UGA	Percent Covered by NSRVRS
Southwest	27.9%
Southeast	0.0%
Northeast	26.5%

Source: City of Edmonton GIS 2011.

The SE UGA has a high number of wetlands (due to its hummocky landscape) which would require consideration of provincial wetland policies and interim guidelines to avoid land development impacts on wetland health, form and function. Opportunities to explore agri-tourism and/or other nature-based tourism opportunities in the areas in close proximity to the NS River Valley may be viable, future economic development opportunities.

Figure 8 Environmental Features and Environmentally Sensitive Areas.



Environmental Features

- Water
- Wetlands
- Slopes >3 Degrees
- Vegetated Areas
- North Saskatchewan River Valley and Ravine System
- Urban Growth Areas

Edmonton City Wide Food & Agriculture Strategy

Data Source: City of Edmonton, DMTI Spatial, GeoBase
Map Revision Date: July 6, 2012

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