CLIMATE CHANGE ADAPTATION PROGRAM

Runoff, Drainage & Erosion Project

Erosion Risk Mapping

Funding for this project has been provided by the Governments of Canada and British Columbia through the Canadian Agricultural Partnership, a federal-provincial-territorial initiative. The program is delivered by the Investment Agriculture Foundation of BC.

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Factsheet #2

Erosion Risk Mapping

Peace Agricultural Adaptation Strategies Working Group

The working groups consist of representatives from many Peace agriculture organizations including:

⇒ BC Branch Canadian Seed Growers Association
⇒ BC Grain Producers Association
⇒ BC Ministry of Agriculture
⇒ Peace Region Forage Seed Association
⇒ Peace River Forage Association of BC
⇒ Peace River Regional Cattlemen's Association
⇒ Peace River Regional District

The Peace Agricultural Adaptations Strategies Working Group is committed to delivering Climate Action projects in the Peace Region.

Project Factsheets:

#1: Runoff, Drainage & Erosion Project
#2: Erosion Risk Mapping
#3: Conversations About Runoff, Drainage & Erosion
#4: Soil, Water & Residue Management Tools

For More Information:

Factsheets & more info at
www.bcgrain.com
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The Value of Erosion Risk Mapping

Effective soil and water management strategies require regional scale assessments of erosion risk in order to prioritize areas most suitable for intervention to prevent long-term impacts to agricultural & environmental resources (e.g. rivers & wetlands).

The mapping of erosion risks enables the evaluation of potential benefits associated with alternative crops or management practices. One of 29 watersheds in northeastern British Columbia was chosen as a case study. This factsheet lays out the results of a reconnaissance level erosion risk mapping exercise for the Saskatoon Creek watershed, and describes the factors that are used to estimate soil loss potential.

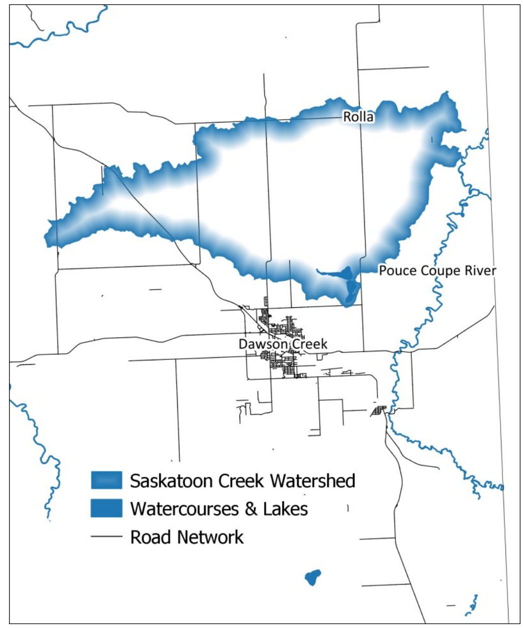
How It's Done

Erosion risks can be modeled on a watershed basin level through a variety of means. The Revised Universal Soil Loss Equation (RUSLE) was adapted in 2002 as a predictive model to estimate the nature and extent of soil erosion under Canadian conditions. This model considers the following factors:

1. Rainfall and Runoff (R)
2. Soil Erodibility (K)
3. Length & Gradient of Slopes (LS)
4. Crop/Vegetation & Management (C)
5. Support Practice Factor (P)

Modern remote sensing technology and geographic information systems enable the calculation of erosion risk factors in a cost effective and efficient manner.

The outcome of the RUSLE calculation is an overview map of soil loss potentials at a regional level, expressed as loss in tonnes/hectare/year. This **soil loss potential** should be compared to the **soil loss tolerance** (i.e. average soil loss in tonnes/hectare/year that will permit current production levels to be maintained economically and indefinitely).



Regional context of the Saskatoon Creek watershed in northeastern BC.

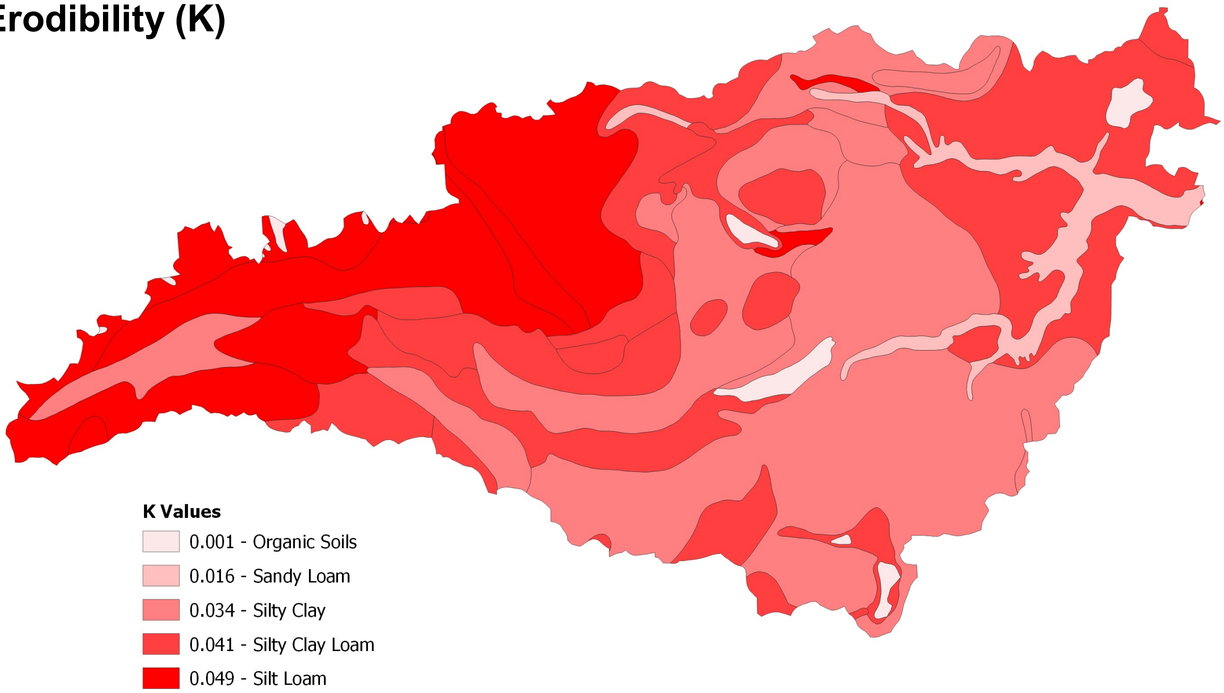
Why Do Producers Care About Erosion Risk

Soil loss rates above the tolerance levels result in significant long term economic losses to producers.

The soil loss tolerance depends on the type and depth of soil, and has been described in the 1-6 t/ha/yr range for most Canadian soils. Medium textured, eroded soils naturally low in nutrients (e.g. luvisolic or gray wooded soils on slopes and knolls, as frequently present in the BC Peace) carry particular risks to erosion and soil loss.

Producers have a robust range of management options at their disposal to reduce erosion risks. **Conservation tillage techniques, retention of crop residue**, and thoughtful **crop rotation planning** have significant returns of investments, both in the short (e.g. fuel savings) and long-term (lower input costs, higher yields).

Soil Erodibility (K)



Rainfall and Runoff (R)

Erosion risks depend on the total amount and distribution of erosive rainfall throughout the year. In Canada, snowmelt on top of frozen or partially frozen soils can play an important role in this as well.

Agriculture and Agri-Food Canada (AAFC) released Isoerodent (R) maps for BC in 2002, which indicates rainfall and runoff erosivity values around 450-500 MJ mm ha^{-1} h^{-1} for the BC Peace Region.

The current predictive climate change models indicate a **potential increase in overall annual precipitation** combined with **increasing intensity and frequency of extreme precipitation events**, which would all increase the rainfall and runoff erosivity values significantly. These predictions reinforce the importance of monitoring and managing soil loss closely to avoid significant short and long term financial losses to agricultural producers in the Peace.

The erosivity value in the RUSLE equation is strictly driven by precipitation and cannot be directly addressed or mitigated by agricultural producers.

Soil Erodibility (K)

The most recent soil survey for the Peace River area of British Columbia was released in 1986 (BC42 Soil Survey). More recently, the BC Ministry of Environment has introduced a digitized version of this map as part of the BC Soil Information Finder Tool. This interactive mapping portal not only provides access to soil map units, but also contains information with regards to crucial factors influencing soil erodibility.

The soil erodibility of different soils have been tested and tabulated for use in RUSLE, with lower K values indicating lower erodibilities. Erodibility can also be determined at a watershed or field level through sampling and laboratory analysis to to add precision to the erosion risk model.

The erosion susceptibility of a soil is guided by its **texture, structure, organic matter, permeability** and the **season of the year** (i.e. more susceptible in the spring with saturated soils and frequent freeze-thaw cycles, less so in the fall when the soil is dry and consolidated after the growing season).

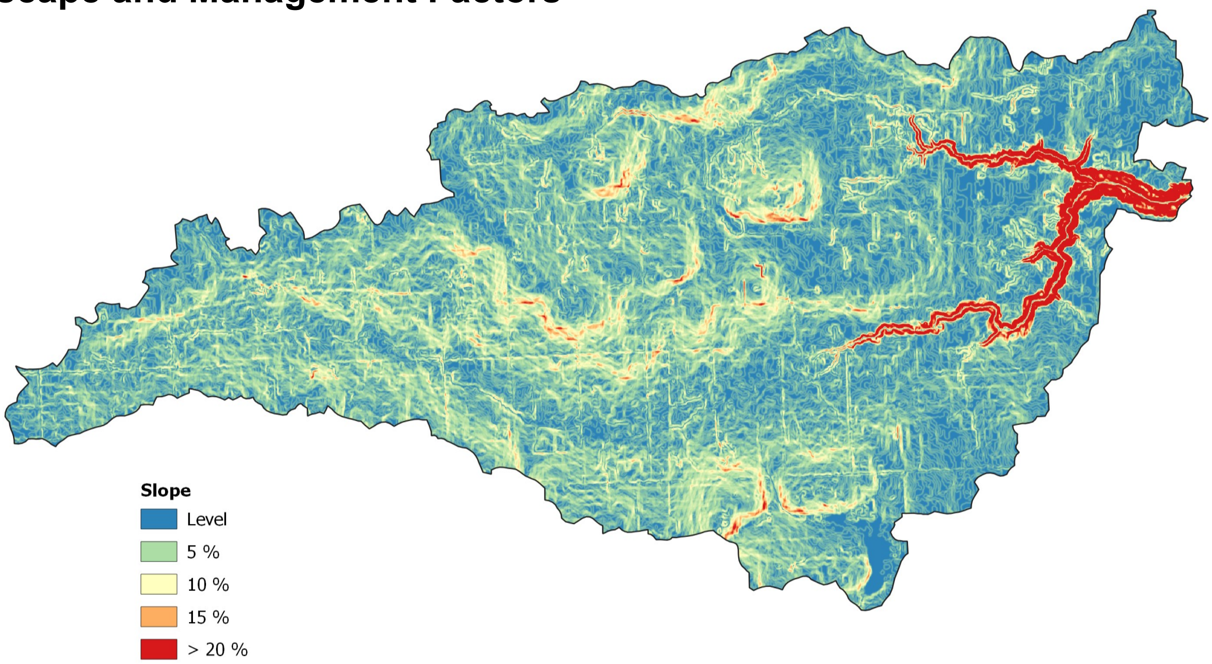
Soil textures between fine sands and coarse silts are generally considered to be at the highest risk of erosion. Medium to coarse sands have considerable large pore space, which generally translates to rapid vertical drainage and few erosion issues, but may also result in moisture retention challenges in dry years.

Clay particles carry an electrostatic charge and form strong bonds, which results in a relatively high resistance against particle displacement. These physical properties of clay particles reduce the risk of erosion.

Soil textures depend on parent materials and modes of deposition therefore they are not subject to management influences.

However, agricultural producers have effective means to influence the structure, aggregate stability, organic matter and permeability of the soil, e.g. through subsoiling in soils with permeability issues, low-till or direct seeding techniques, or any other management techniques that increase organic matter.

Landscape and Management Factors



Landscape Factors (LS)

Erosion risks are directly correlated to the gradient and length of a slope, with steeper and longer slopes representing the highest risks.

These landscape factors are often somewhat difficult and cost intensive to change directly (e.g. through field level land forming). However, agricultural management practices can be used to effectively manage risks associated with topographic factors (i.e. support practices, see below).

Crop & Vegetation Management (C)

A field's susceptibility to erosion is greatly affected by **surface cover, crop canopy** (i.e. complexity & height of the vegetative cover), **soil organic matter, tillage** and the **preceding crop**. Surface cover (e.g. crop residue, live vegetation, rocks) intercepts rain drops at the ground level and disperses their erosive energy. Similarly, the leaves and branches of a standing crop intercept raindrops before they reach the ground surface, thus significantly decreasing their erosive force.

Soil organic matter, which includes all vegetative matter in the soil (live or dead) increases **infiltration rates** and increases the **water holding capacity** of the soil.

Simple techniques such as the retention of crop residue or stubble can be a crucial tool in preventing rill erosion and soil loss.

The type, timing and frequency of tillage significantly influences soil properties, including surface roughness, structure, porosity, density (compaction), as well as soil micro and macrofauna. Well timed tillage practices, which maintain good soil structure, minimize compaction & surface crusting, and retain organic matter are conducive to excellent crop emergence, which reduces erosion risks.

The dimensionless C factor used in RUSLE is a ratio comparing the soil eroded under a specific crop and vegetation management technique to continuous fallow conditions. AAFC has released C factor values for all crop and vegetation management systems in Canada, which can be used in the RUSLE equation.

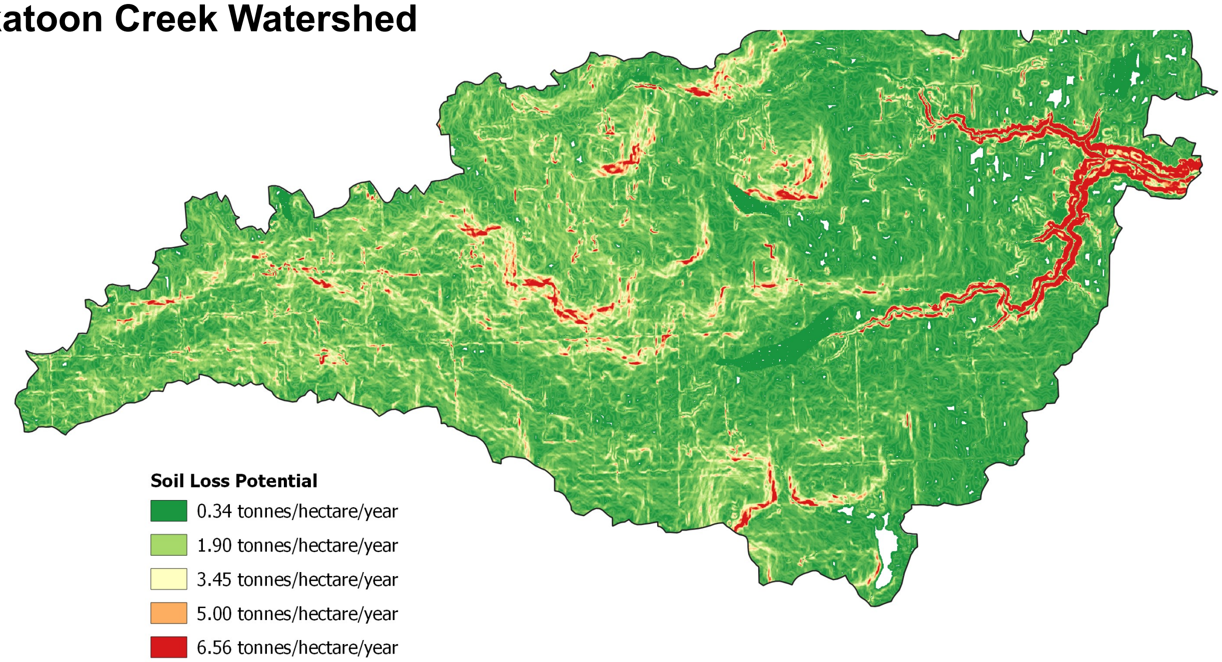
Support Practices (P)

The inclusion of a support practice factor in an estimate of erosion risk allowed for the evaluation of measures and techniques designed to manage erosion, such as **cross slope cultivation, contour farming**, **subsurface drainage** and **grassed waterways**. Depending on local conditions, contour farming alone can reduce the potential soil loss for a field by up to 50%.

Generally, a support practice is most effective when it causes eroded sediments to be deposited far upslope, very close to their source. From a soil conservation perspective, deposition close to the end of the slope is of less benefit. P is used as a dimensionless factor in RUSLE.

P Values can be located in *RUSLEFAC* Revised Universal Soil Loss Equation for Application in Canada

Soil Loss Potential in the Saskatoon Creek Watershed



The C

Resear... the cost of just the annual replacement of nutrients lost through erosion in Canada at between **$15 and $30/ha**. Since then, significant advances in soil conservation have been made and implemented across BC and the rest of Canada.

However, erosion losses carry forward and it takes decades or centuries to rebuild the soil lost through erosion. It is uncertain how badly these historic soil losses have affected the land base's ability to support stable crop production (robustness and resiliency).

...ing climate with more severe and frequent extreme weather events. In addition, agricultural input costs have increased dramatically, further stressing the importance of reducing soil loss risks as much as possible.

The Saskatoon Creek Watershed used in this factsheet covers approximately 22,400 ha of land. Based on the results of the soil loss potential calculations completed as part of the Runoff, Drainage & Erosion Project, the average soil loss potential within this drainage basin was estimated at **1.52 t/ha/yr**.

...perennial cropland, and includes some forested areas with conceivably lower soil loss potentials.

Producers have a range of effective crop management techniques and support practices at their disposal to reduce soil loss. The most effective measures include any techniques that minimize bare soil conditions (e.g. high-speed tillage, perennial crops), increase soil organic matter (e.g. direct seeding) or increase infiltration (e.g. cross slope and contour farming, subsoiling).

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With contributions from: BC Grain Producers Association, Peace River Forage Association of BC, Peace Region Forage Seed Association, Canadian Seed Growers Association, Peace Region Cattlemen's Association, PRRD

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