CLIMATE CHANGE ADAPTATION PROGRAM

Runoff, Drainage & Erosion Project

Conversations About Runoff, Drainage, and Erosion

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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CANADIAN AGRICULTURAL PARTNERSHIP

BRITISH COLUMBIA

Canada

Climate Action Initiative

Date:
October 2019

Factsheet #3

Conversations About Runoff, Drainage & Erosion

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.

Overview of the Factsheet

This factsheet is part of the technology transfer for the Runoff, Drainage & Erosion Project, a BC Climate Action Initiative. There are 4 linked factsheets in this series. *(see side bar at the left)*

In conversations with producers and readers trying to understand runoff, erosion and drainage, we will ask probing questions:

1. What portion of the watershed are we in? Upper, central or lower?
2. Where are we in the landscape? Knoll, midslope or depression?
3. What are the dominant soil & water flow processes happening in those watershed and landscape positions?
4. What runoff, drainage or erosion issues result from these processes?
5. What types of management options can reduce water runoff & erosion?
6. Are there options for managing drainage issues?

Saskatoon Creek Watershed is used here as a case study to examine the RUSLE factors introduced in factsheet #2 at a detailed process level as we travel from the western or upper watershed to the eastern or lower watershed.

The processes in the central part of the watershed (above) are different than those of the lower watershed (below).

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
www.peaceforageseed.ca
www.peaceforage.bc.ca

Geographic Applicability	This study was conducted in the Peace River Region of BC and the approaches taken can be applied to other areas in BC.
Commodity Relevance	This study was conducted on agricultural lands in the Peace Region. It was cross commodity in scope with relevance to cattle / livestock operations, grain / oilseeds, forage / grazing, and legume / grass seed production.
Project Timeline	February 2019 to October 2019

Project Objectives:

1. Assess the extent and nature of current runoff, drainage and erosion management practices currently in use in the Peace.
2. Review & summarize relevant management practices that are not currently used in the Peace Region (but have potential for adoption).
3. Identify the management practices with the greatest potential (high applicability & economic feasibility) for adoption in the Peace Region.
4. Deliver information to producers through effective knowledge transfer.

RUSLE or Revised Universal Soil Loss Equation

A = R x K x LS x C x P

This equation is used to predict annual soil losses or **A**. It can also be used to facilitate conversations on how to reduce runoff & soil losses.

Key Factors of RUSLE

R = rainfall erosivity

This factor considers the total rainfall but also the intensity & seasonal distribution. The bigger the raindrop size, the higher the rainfall intensity & kinetic energy that moves water & soil particles.

K = soil erodibility

This is influenced by infiltration capacity & structural stability. Basic soil properties associated with high K values are texture (silt or very fine sand), structure (blocky, platy or massive), impervious layers in profile & a tendency to crust on surface.

L = length of slope

S = slope steepness or gradient

The topographic factors are often grouped together. The complexity of slopes and the ratio of rill to inter-rill erosion need to be considered.

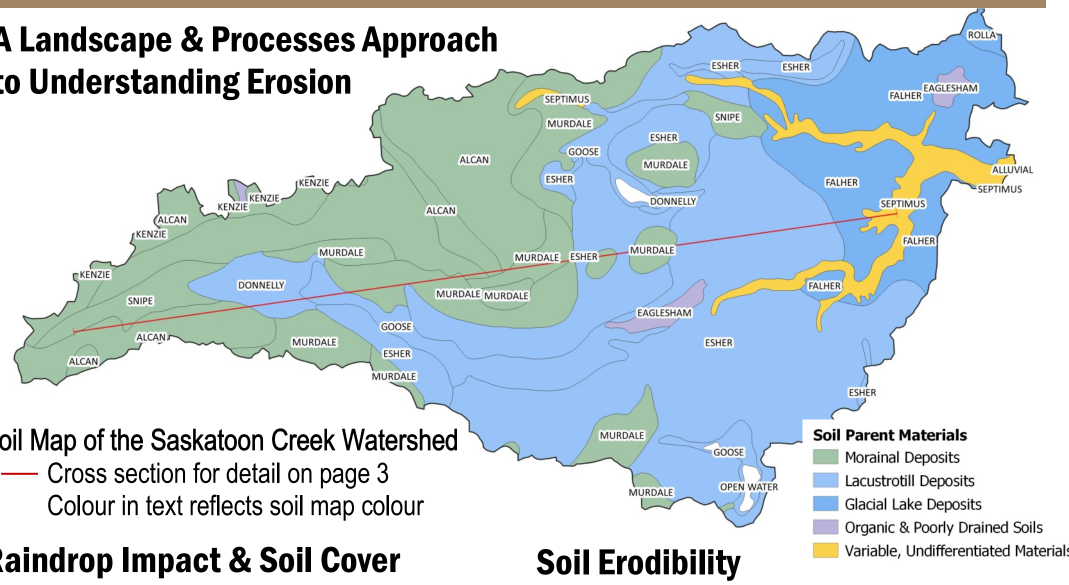
C = cover & management

Cropping systems, vegetative cover & surface management dramatically influence the amount of erosion & runoff. Perennial forage crops are as effective as undisturbed forests and grasslands in protecting soil from erosion. This factor also considers tillage scheme, residue & surface roughness.

P = practice for erosion control

A practice or physical structure may be needed to guide or slow the flow of runoff water. If no support practices or structures are in place P=1.0.

A Landscape & Processes Approach to Understanding Erosion



Soil Map of the Saskatoon Creek Watershed

— Cross section for detail on page 3

Colour in text reflects soil map colour

Raindrop Impact & Soil Cover

Soil erosion actually begins in the **upper watershed** and on the knolls, not the sensational, eye catching **gullies**. When raindrops strike bare soil, the particles explode, bouncing water and soil particles in all directions (up to 60 cm high & 150 cm horizontally!). When rainfall intensity is more than the soil's infiltration capacity (i.e. how rapidly water enters the soil profile) these dislodged particles move with the flowing water. When thin layers of topsoil start to move, this process is called sheet erosion. Finer textured, fertile topsoil is often eroded from the knolls and midslopes to be deposited in depression areas and ditches or moved offsite within rills and gullies. (A rill is a small channel up to 0.3m deep while a gully is a channel deeper than 0.3m)

Soil Erodibility

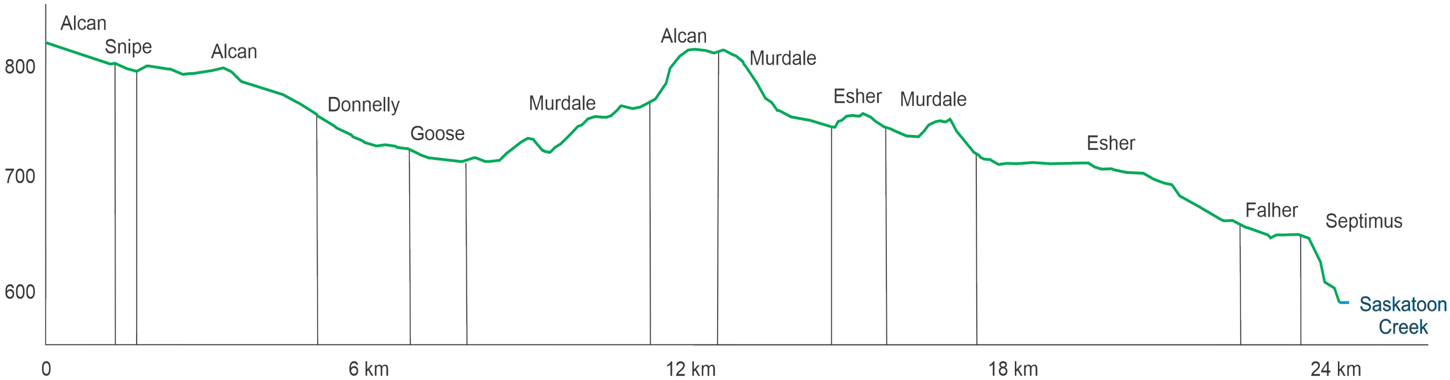
The soils ability to absorb raindrops or meltwater is what is important here. Both soil **texture** and **organic matter** percentage affect the ease and rate of **infiltration** into the profile below. The stability of **structures** and **aggregates** is critical as well. If the structure has broken down into a crust, this will prevent water from getting into the soil quickly, as will impermeable layers below. Soil maps *(see example above)* can be used to predict erodibility.

Some parts of soil quality are a given, but there are still properties that can be managed and improved. Focussing on seedbed conditions, lessening crusting, increasing root penetration, establishing good plant cover can all reduce the erodibility of the surface.

On the upper slopes in the landscapes, cropping/ tillage systems can reduce raindrop erosivity & slow down sheet erosion.

As soil particles move faster & if there is no resistance from the soil/ cropping surface, sheet erosion progresses quickly to rill erosion.

A Landscape & Processes Approach to Understanding Erosion *continued*



Cross Section from West to East of the Saskatoon Creek Watershed (see red line — across soils map on page 2). This illustrates how LS or topographic factors and glacial landscapes interact with soil types and K or soil erodibility factors.

Slope Length & Steepness

Slope steepness (gradient) affects soil erosion, but slope length is equally critical. With overland flow, rills coalesce concentrating water flow / speed. The Peace is known for long, highly erodible slopes.

Slope length & erodibility (AB Ag, 1985)

Slope length	Least erodible	Moderately erodible	Highly erodible
(m)	(% slope)	(% slope)	(% slope)
100	< 3	3 - 8	> 8
200	< 2	2 - 5	> 5
600	< 1.5	1.5 - 3	> 3
1000	< 0.7	0.7 - 2	> 2
1600	< 0.5	0.5 - 0.7	> 0.7

At this point in the watersheds, rills are joining into small gullies. If there is no choice but fall tilling a field, tilling across the slope & leaving the surface rough can slow the speed of water moving & detaching soil particles. Anything that creates a "speed bump" in the landscape here will reduce downstream effects.

Saturation & Ponding

The dominant processes in the lower portions of the landscapes or depressions will be **water ponding**, sorting and re-deposition of soil particles. **Snipe** and **Goose** are poorly drained soils where this process is occurring.

This same water sorting happened historically with glacial melt so that the soils in the lower portions of the watershed have finer clay textures. **Falher** *(lower or eastern watershed)* is a soil that are prone to ponding and drainage issues. As part of this project, a pilot drainage plan illustrating the tools available for producers was compiled.

Creek channels & culverts often cannot handle the increased water /soil flow. Many of the lower positions in the land-scapes & watersheds suffer from drainage & ponding issues.

Gully Erosion & Slumping

Gully erosion and **slumping** are the dominant processes in the lower portions of the watershed (and on a smaller scale in the lower landscape positions next to creeks and waterways). At this point, the water and soil moving from above is overwhelming the land's ability to absorb and contain it. *(see eastern portion of Saskatoon Creek watershed on page 2).*

When steep and gully slopes are on a large enough scale to map, these are noted within **Septimus** soils along the margins of creek banks in the lower portions of the watersheds.

Slow moving creeks in upper watersheds become raging torrents in the lower parts of the watersheds, causing massive gully erosion & huge soil losses.

References:

Alberta Agriculture, Soils Branch. 1985. Chapter 9, Soil Conservation. Alberta Soils Course. pg 901-931.

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Lord, TM. & Green, AJ. 1986. Soils of the Fort St John - Dawson Creek area, BC.130 pg. & 4 maps 93P/NE, 93P/NW, 94A/SE, 94A/SW.

Weil, RR & Brady, NC. 2016. The Nature & Properties of Soils. 15th ed. pg. 819-877.

Van Vliet, LJP, Sanborn, P, Kline,R, & Carroll, KM. 1991. Soil conservation under three tillage systems. In: Proceedings of 14th Annual BC Soil Science Workshop. Feb. 1991, UBC, Vancouver, BC.

More Information

BC Soil Maps:
https:catalog.data.gov.bc.ca/dataset/soil-survey-spatial-view

To view in google earth:
Scroll down & click EXPLORE next to "kml network link"

Which Processes & Factors of Erosion Can We Manage?

Soil Loss Factor	Description	Key Process	Management Options
R	rainfall erosivity	raindrop impact & intercepting	Maintain soil cover with residues or plant stubble to intercept raindrop energy or slow down snowmelt.
K	soil erodibility	infiltration & aggregation	Establish healthy plant cover & roots; Improve seedbed; Decrease surface crusting; Increase root penetration; Increase organic matter.
LS	topography length & steepness	overland water flow & speed	Create "speed bumps" to slow water flow with grassed waterways, tillage direction, or surface roughness.
C	cropping & tillage	all the processes above	Consider perennial or continuous cropping; reduce tillage passes or plan tillage to protect soil during vulnerable seasons.
P	practice or physical structure	gully erosion, slumping & undercutting	Construct physical structures such as contour strip cropping, terraces, grassed waterways, channel structures to slow speed of water; Design appropriate drainage system.

Key Messages

Erosion is complex and varies considerably over different regions and seasons. By knowing where we are in the watershed and the landscape position, we can understand the key processes and factors of erosion at that site. This enables us to focus on appropriate management options that can have the most impact. *(see table above).* In summary, the key is cropping and tillage practices that intercept raindrops, improve soil quality (infiltration & aggregation), slow the speed of water flow across slopes, keep crop or residue cover during vulnerable times, or create surface roughness. A key tool for this, conservation or reduced tillage, will be explored in a separate factsheet *(see Factsheet #4)*.

Remote sensing techniques help plan for controlling runoff, erosion risk mapping or designing drainage systems. Other factsheets or components of the Runoff, Drainage & Erosion Project explore the potential of these methods.

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