Improvements to soil data resulting from FFESC

C Bulmer FLNRO
Margaret Schmidt, Brandon Heung (SFU)
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Scott Smith, Grace Frank (Agric. AgriFood Canada)
Eve Flager (NewView GIS Consulting)
Mike Neal (Insight Geomatics)
Laurie Donovan (Okanagan College)

Outline

- Soil information in BC
  - past, present, and future
- Improvements resulting from FFESC
  - Landscape classification
  - Predictive mapping with ArcSIE and other methods
  - Better input datasets
- Current and Future work
  - Predictive mapping with ArcSIE, R, randomForest, ?
  - Field checking for reliability

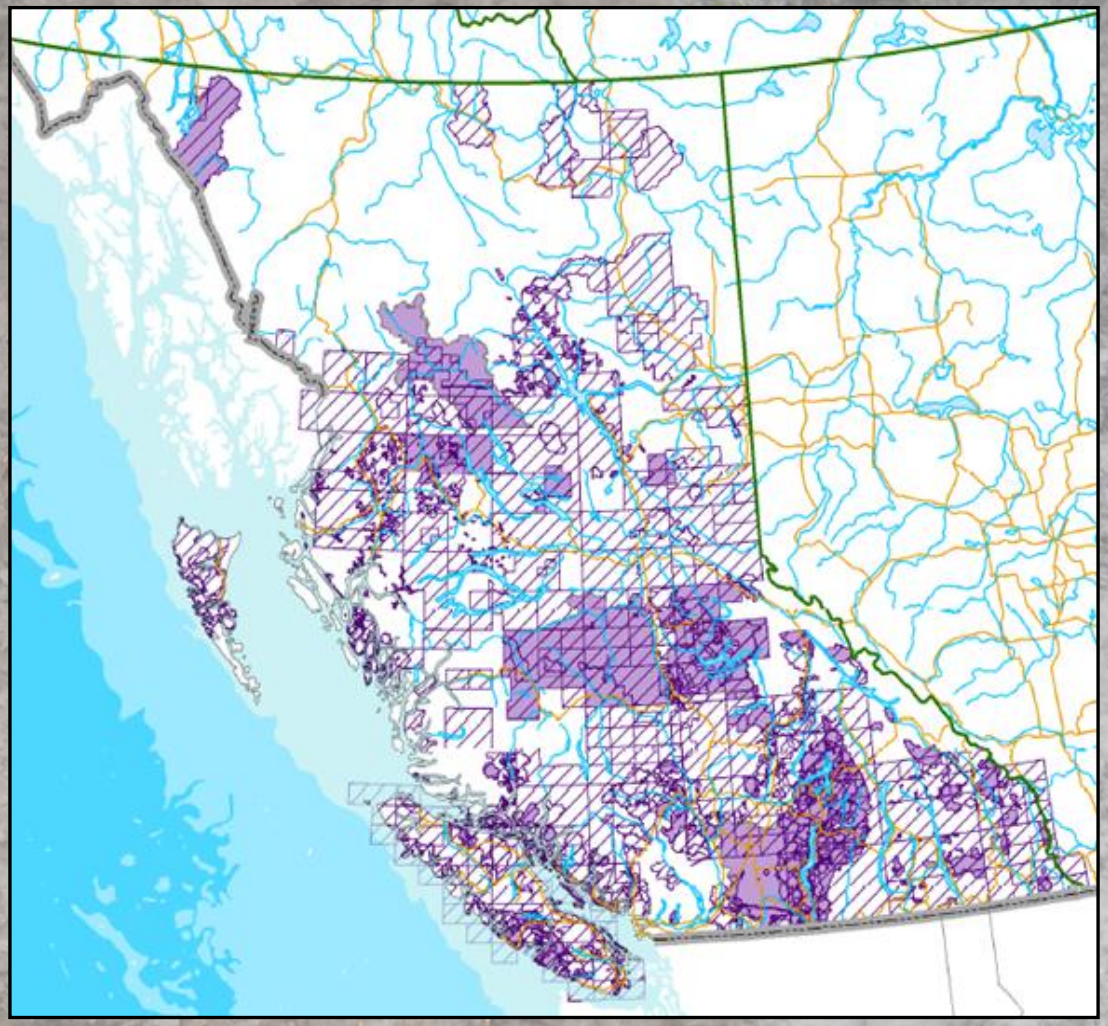
Background (SLC)

- Soil Landscapes
  - all of BC (most of Canada)
  - 1:1,000,000
  - 2000 +/- polygons
  - 2000 +/- components
- Linked attribute & information tables
- Broad interpretations
  - Modeling
    - carbon,
    - climate change,
    - productivity,
    - species suitability.

http://sis.agr.gc.ca/cansis/nsdb/slc/intro.html

Background (BC)

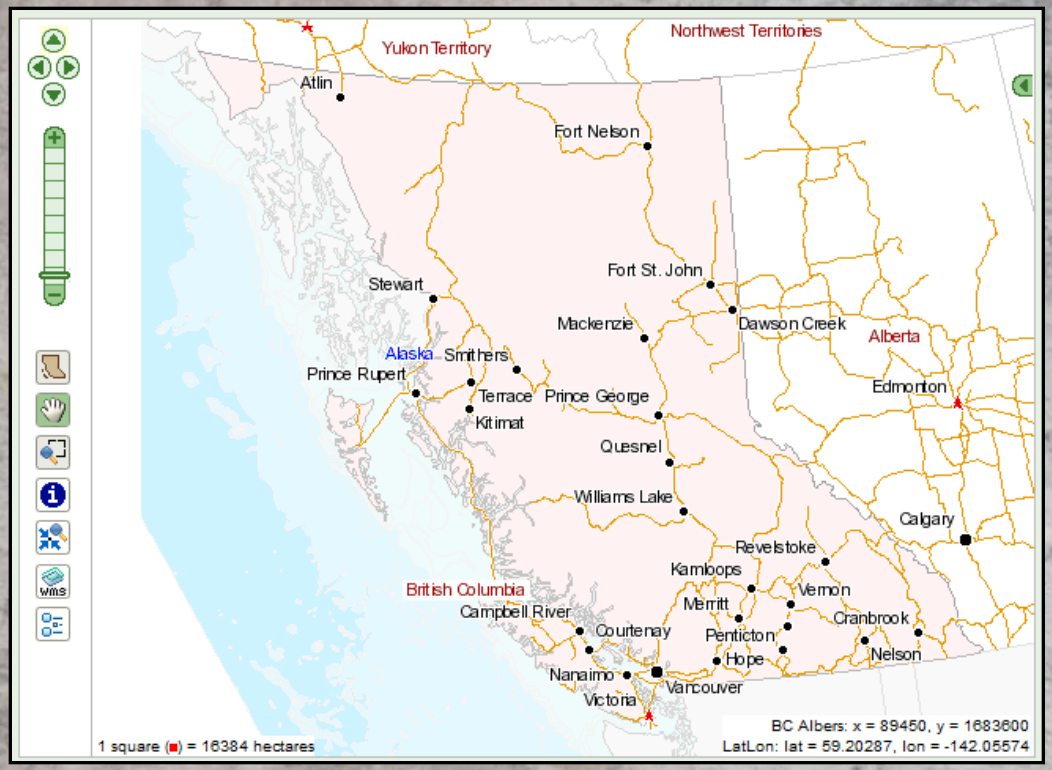
- Soil and Terrain
  - 1:20,000, 1:50,000
  - 1:100,000
- TEIS
  - Terrestrial Ecosystem Information System
- more detailed than SLC, but
  - Databases need work
  - Correlation
  - Linked attributes
  - Full coverage for BC..



D. Filatow and M. Finvers, BC Min of Environment

Background (HaBC)

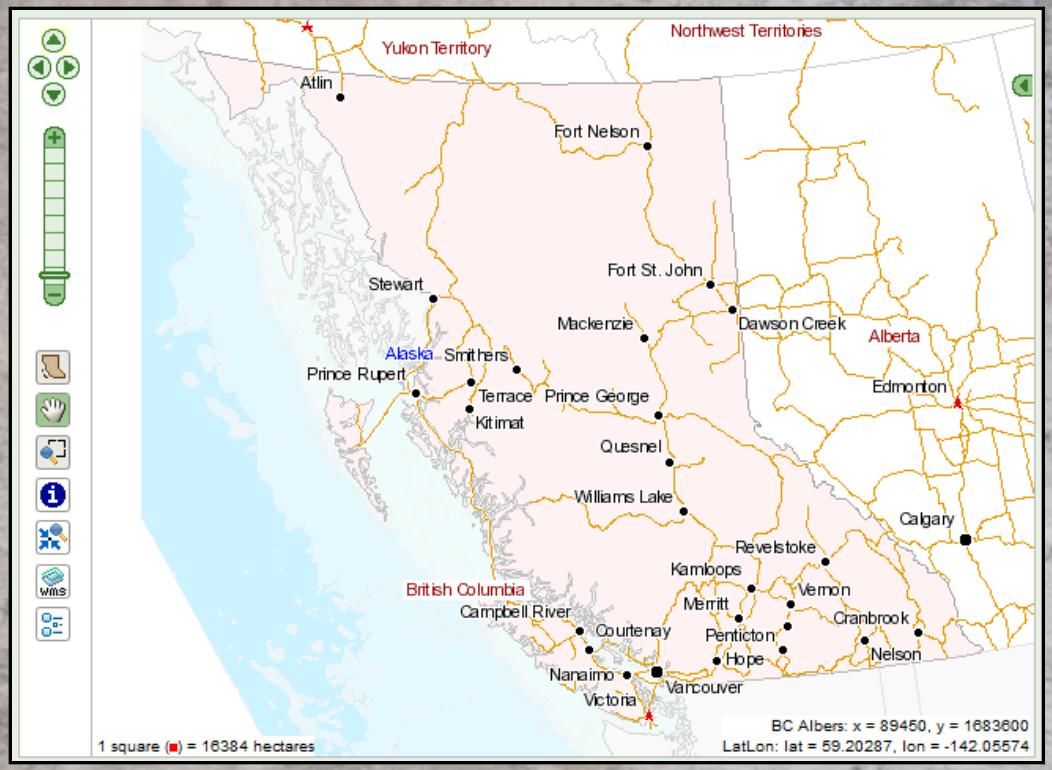
- public access to data
- raster data base (1ha)
  - “Where”
  - “How much”
  - Download raw data..
- Includes:
  - DEM, climate, hydrology, vegetation
  - SLC soils coverage
  - topography



www.hectaresBC.org

Background (HaBC)...

- public access to data
- raster data base (1ha)
  - "Where"
  - "How much"
  - Download raw data..
- Includes:
  - DEM, climate, hydrology, vegetation
  - SLC soils coverage
  - topography
- A natural destination for new soils data



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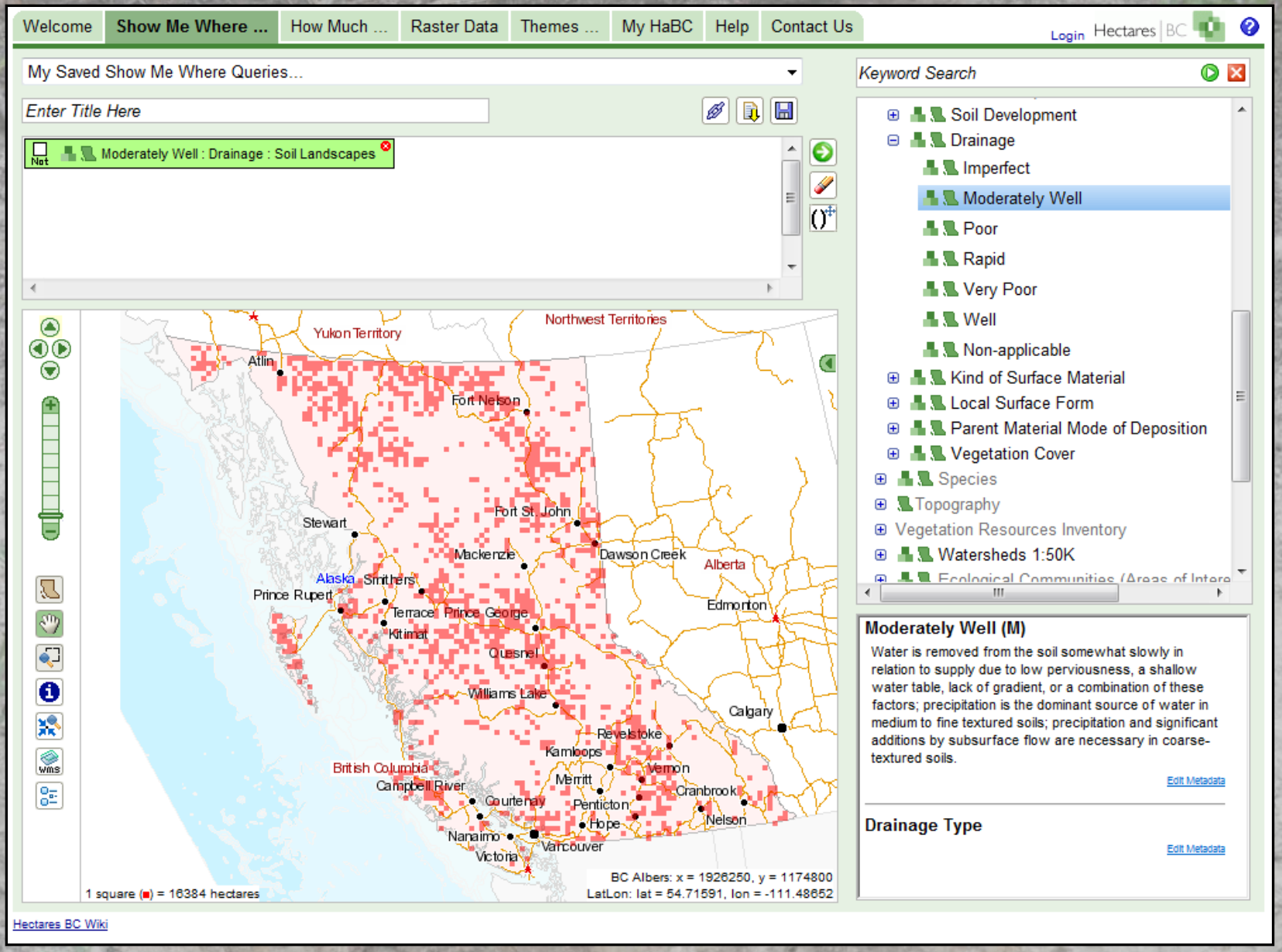
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Show Me Where ...
How Much ...
Raster Data
Themes ...
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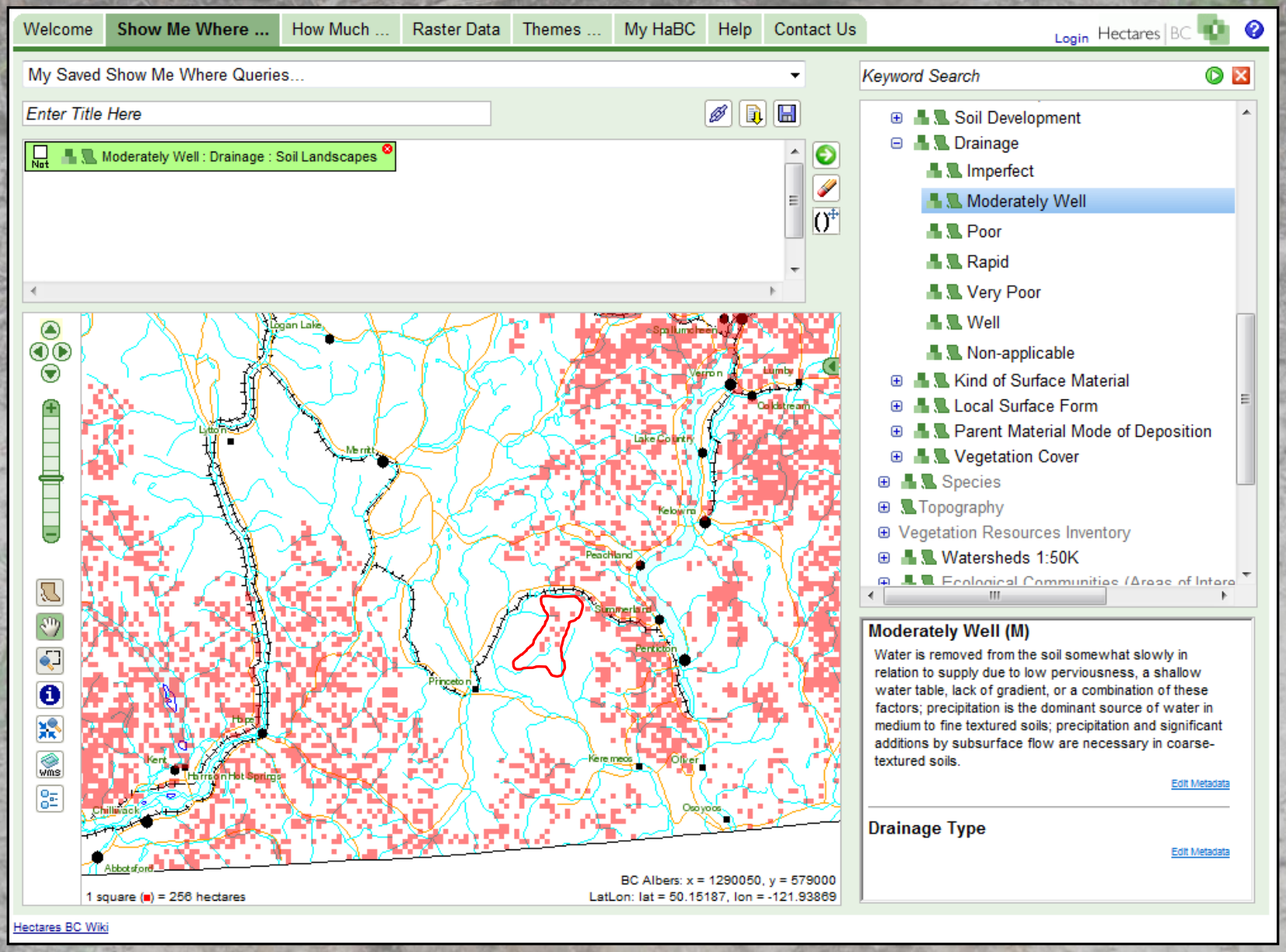
Contact Us
Login
Hectares BC
My Saved Show Me Where Queries...
Keyword Search
Enter Title Here
Not
Moderately Well : Drainage : Soil Landscapes
Soil Development
Drainage
Imperfect
Moderately Well
Poor
Rapid
Very Poor
Well
Non-applicable
Kind of Surface Material
Local Surface Form
Parent Material Mode of Deposition
Vegetation Cover
Species
Topography
Vegetation Resources Inventory
Watersheds 1:50K
Yukon Territory
Northwest Territories
Atlin
Fort Nelson
Fort St. John
Stewart
Mackenzie
Dawson Creek
Alberta
Alaska
Smithers
Prince Rupert
Terrace
Prince George
Kitimat
Quesnel
Edmonton
Williams Lake
Calgary
Revelstoke
Kamloops
British Columbia
Vernon
Merritt
Campbell River
Courtenay
Penticton
Cranbrook
Hope
Nelson
Nanaimo
Vancouver
Victoria
1 square (■) = 16384 hectares
BC Albers: x = 1926250, y = 1174800
LatLon: lat = 54.71591, lon = -111.48652
Moderately Well (M)
Water is removed from the soil somewhat slowly in relation to supply due to low perviousness, a shallow water table, lack of gradient, or a combination of these factors; precipitation is the dominant source of water in medium to fine textured soils; precipitation and significant additions by subsurface flow are necessary in coarse-textured soils.
Edit Metadata
Drainage Type
Edit Metadata
Hectares BC Wiki

7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Edit Metadata
Drainage Type
Edit Metadata
Logan Lake
Lytton
Merritt
Princeton
Hope
Kent
Harrison Hot Springs
Chilliwack
Abbotsford
Vernon
Lumby
Lake Country
Kelowna
Peachland
Summerland
Penticton
Keremeos
Oliver
Osoyoos
wms
1 square (■) = 256 hectares
BC Albers: x = 1290050, y = 579000
LatLon: lat = 50.15187, lon = -121.93869
Hectares BC Wiki

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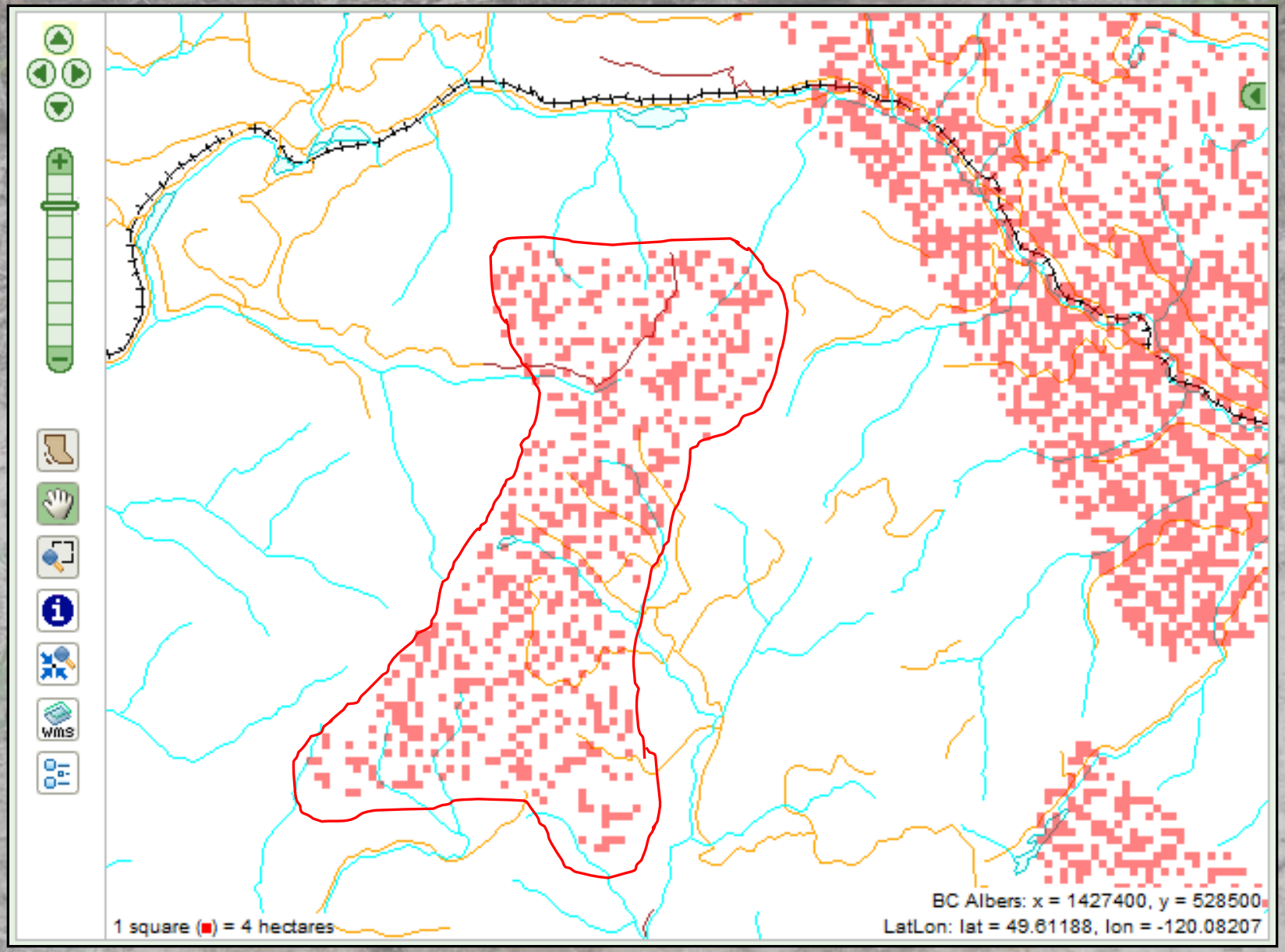
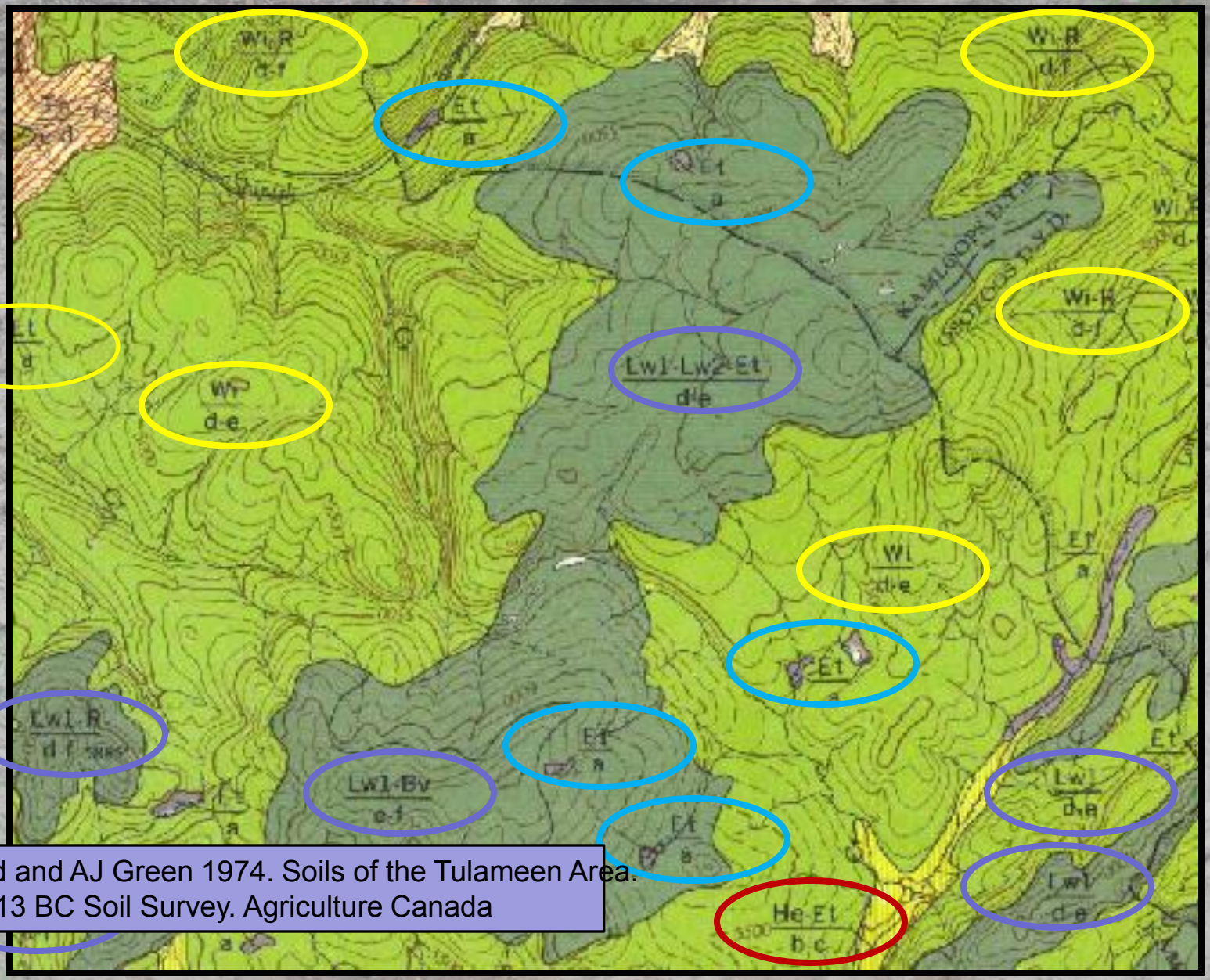

wms
1 square (■) = 4 hectares
BC Albers: x = 1427400, y = 528500
LatLon: lat = 49.61188, lon = -120.08207

9



TM Lord and AJ Green 1974. Soils of the Tulameen Area. Report 13 BC Soil Survey. Agriculture Canada

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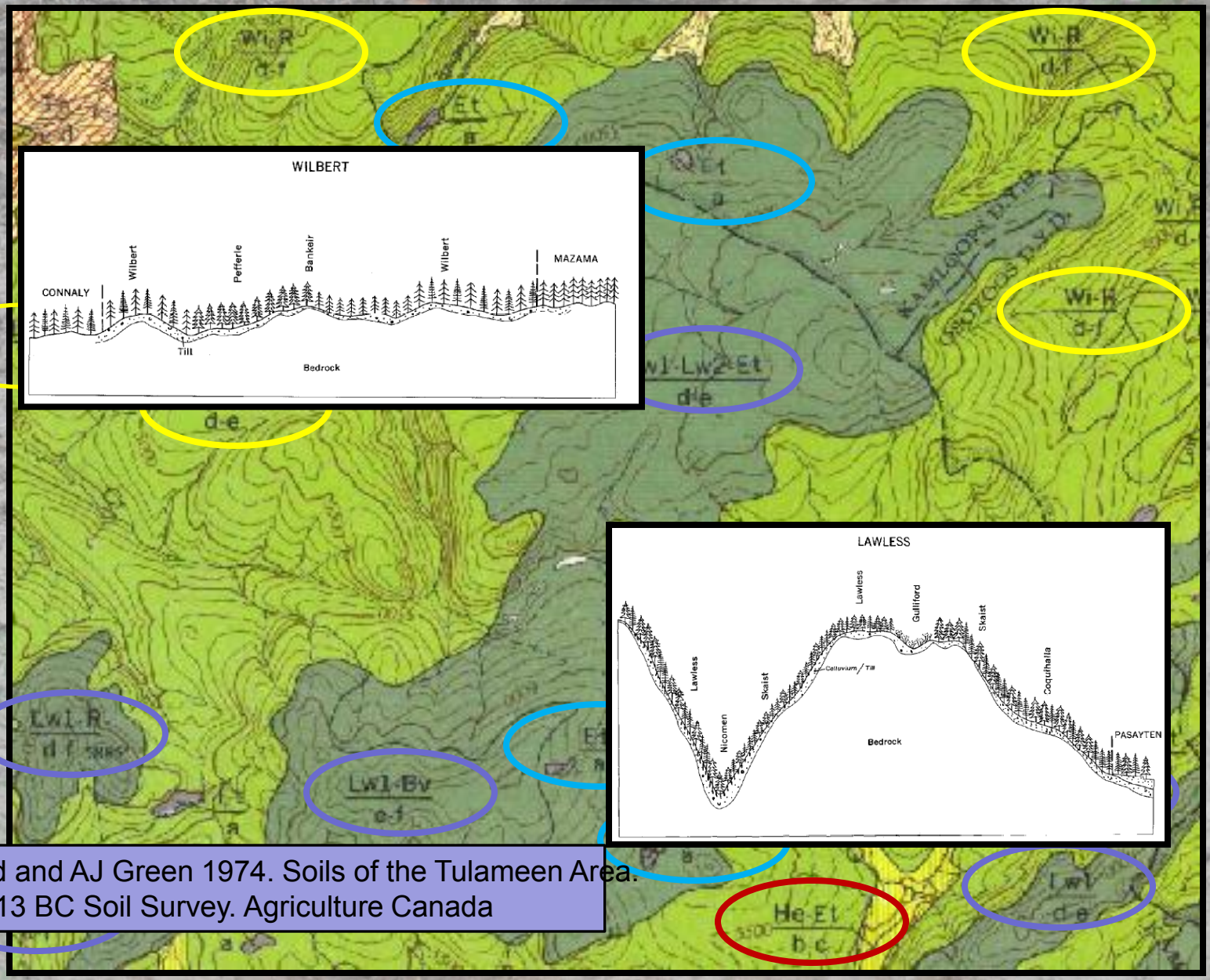
Our approach:



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11

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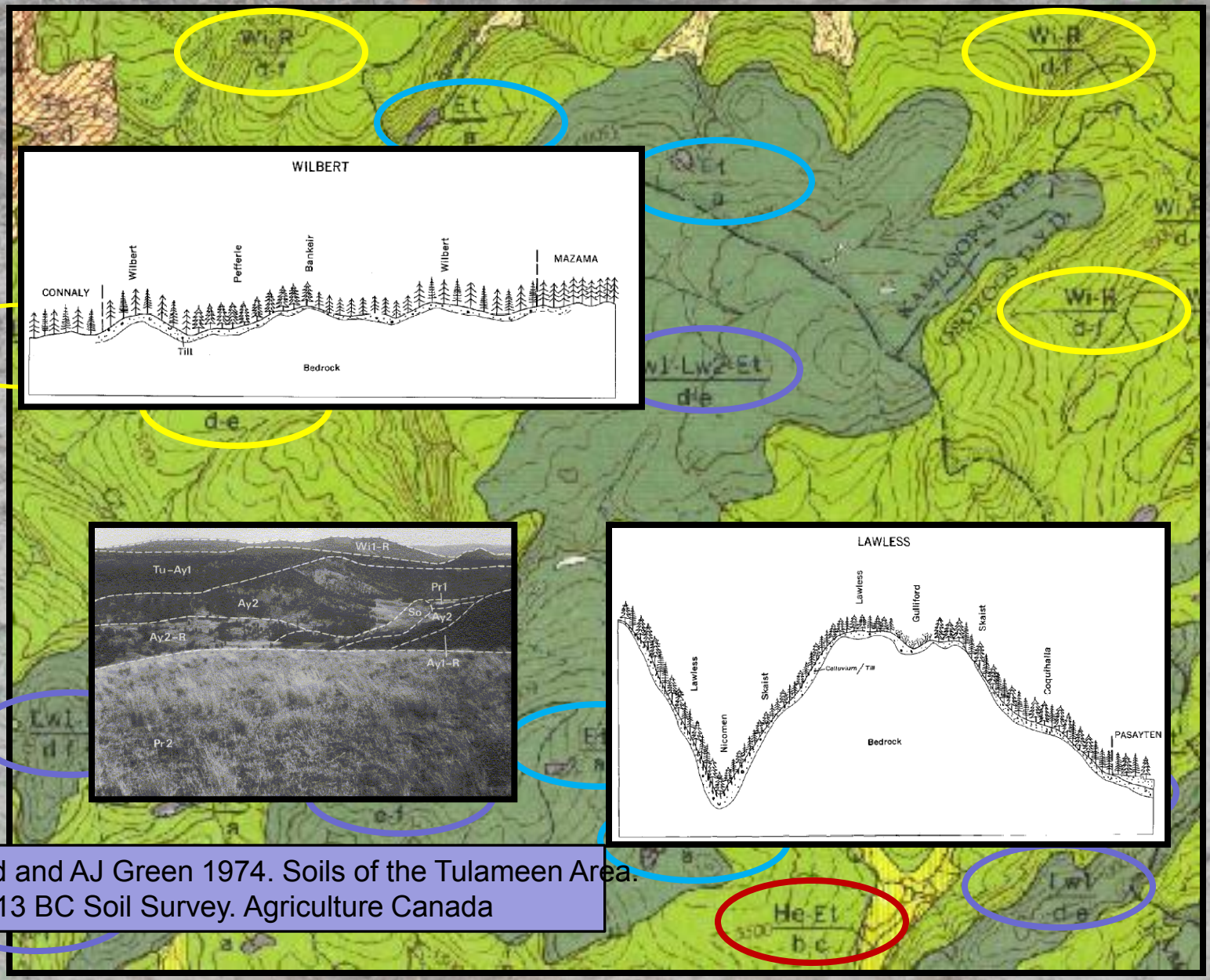

TM Lord and AJ Green 1974. Soils of the Tulameen Area. Report 13 BC Soil Survey. Agriculture Canada

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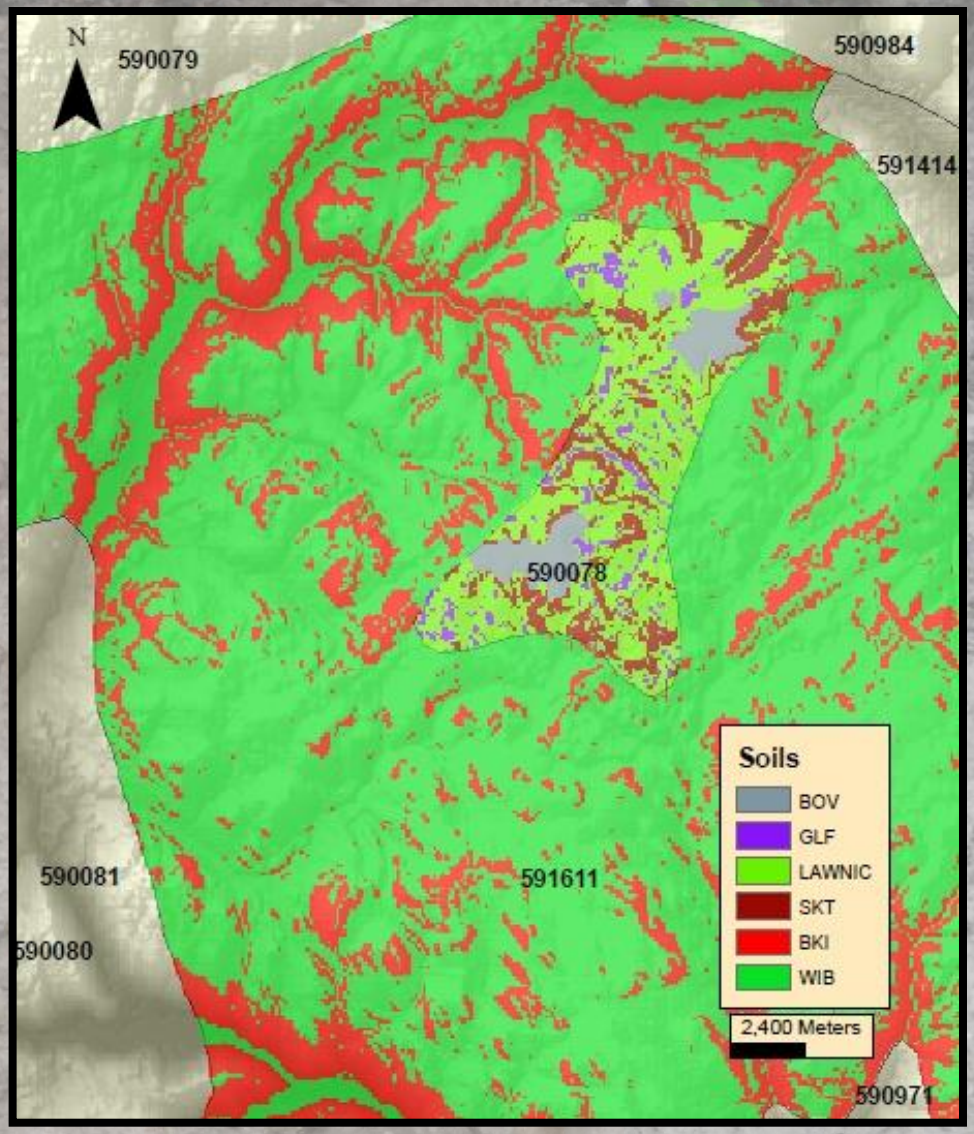
The original concept…

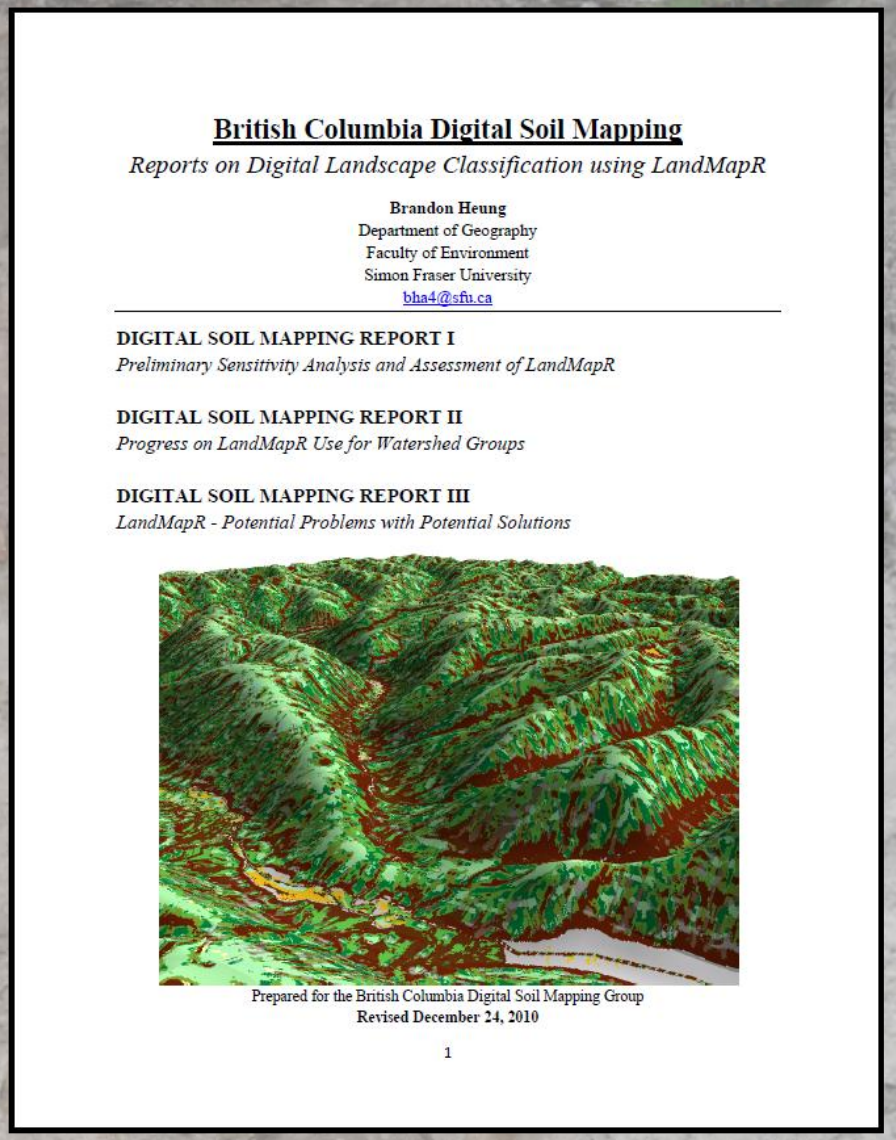
Spatial disaggregation

- For each polygon
  - Extract slope, elev, wetness, etc from DEM
  - Assign a range of attribute values for each component
- Landscape classification



Landscape classification

- Several methods
  - 15 class (MacMillan et al. 2000)
  - TPI (Jenness)
  - Relative Topographic Position
- Optimization based on
  - Landscape character
  - Program parameters
- Evaluate the effects of
  - DEM resolution,
  - threshold settings for pit removal,
  - upslope area threshold for stream initiation



British Columbia Digital Soil Mapping

Reports on Digital Landscape Classification using LandMapR

Brandon Heung
Department of Geography
Faculty of Environment
Simon Fraser University
bha4@sfu.ca

DIGITAL SOIL MAPPING REPORT I
Preliminary Sensitivity Analysis and Assessment of LandMapR

DIGITAL SOIL MAPPING REPORT II
Progress on LandMapR Use for Watershed Groups

DIGITAL SOIL MAPPING REPORT III
LandMapR - Potential Problems with Potential Solutions

Landscape classification

- Evaluate the effects of
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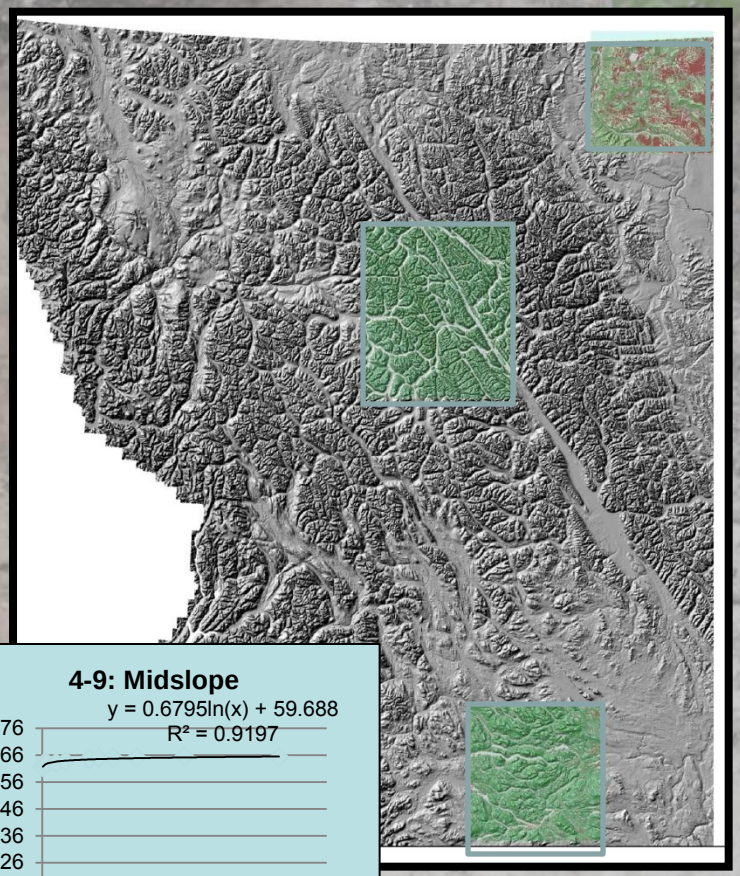
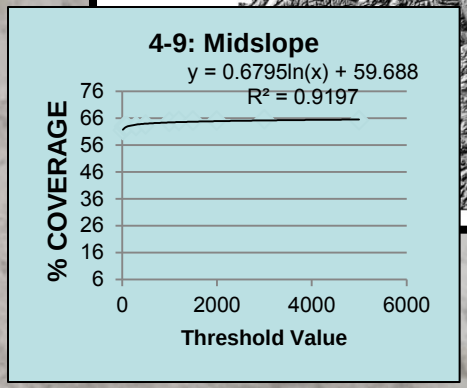
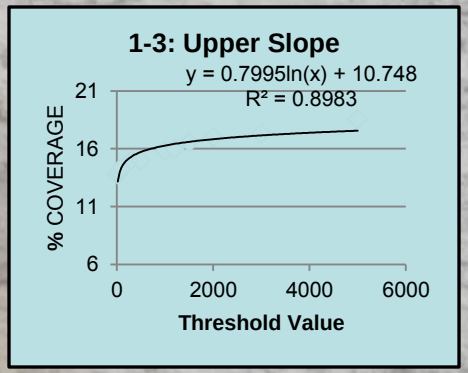
  - threshold settings for pit removal,
  - upslope area threshold for stream initiation

… on outputs from LandMapR (MacMillan et al)







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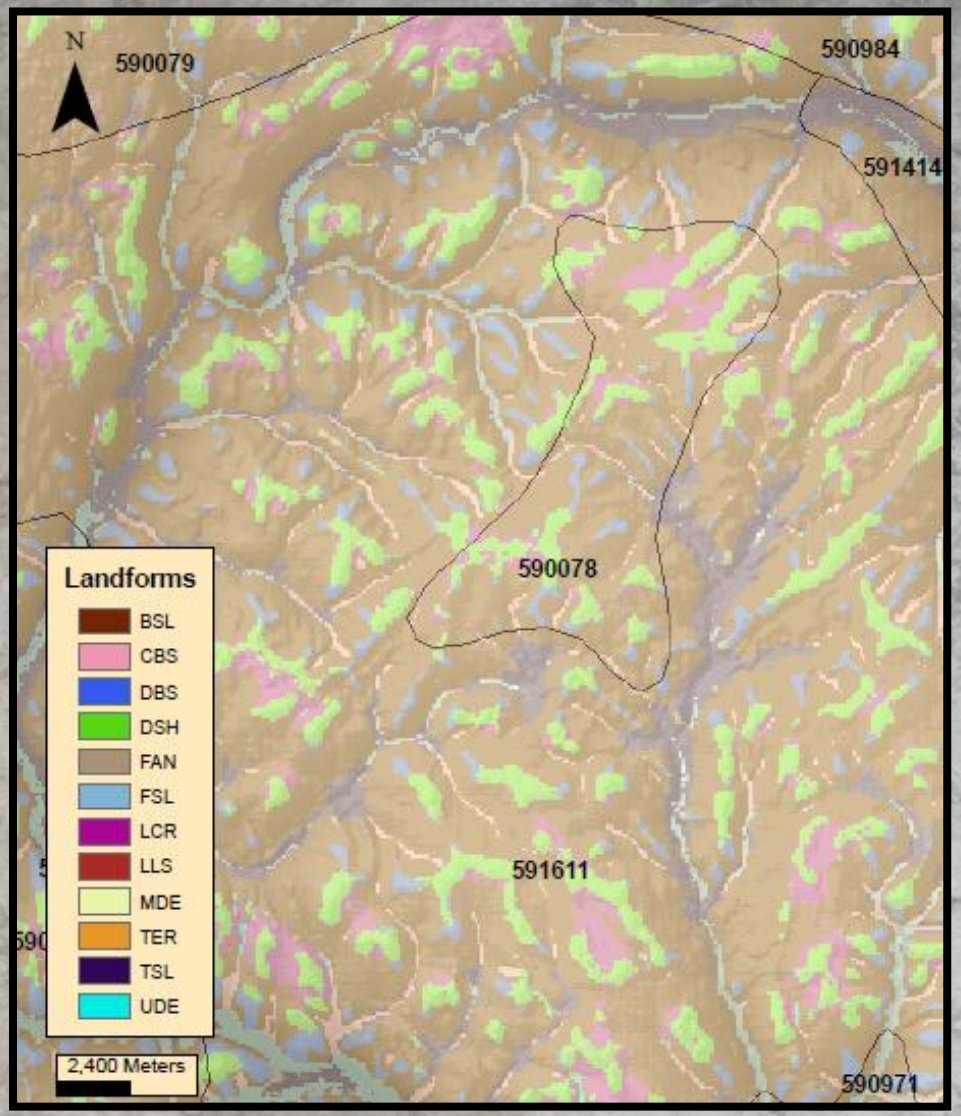


Landscape classification

- LandMapR workflow
  - File conversion
  - FlowMapR
  - FormMapR
  - FacetMapR
  - File conversion

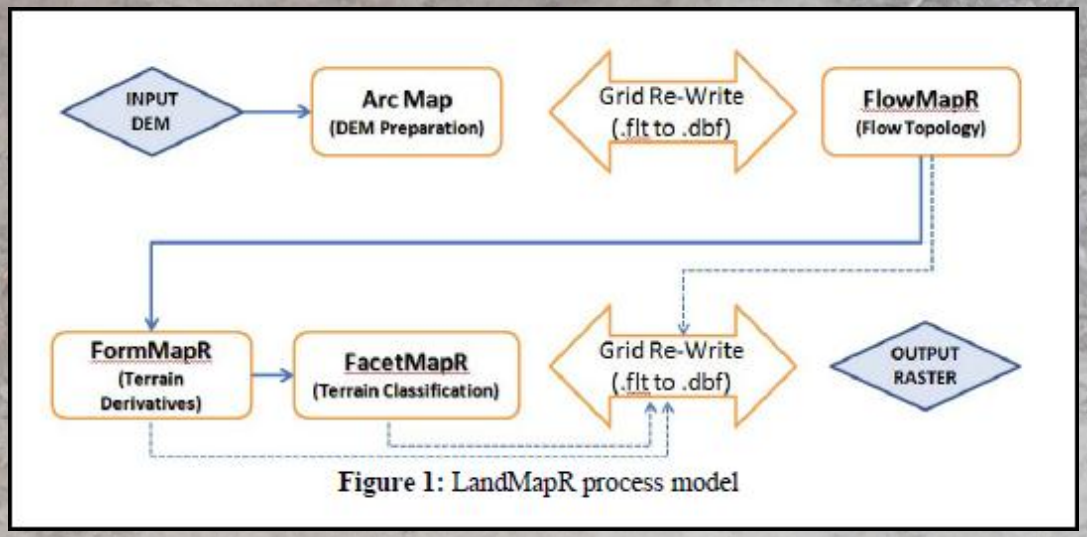
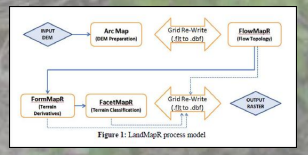


Figure 1: LandMapR process model



Landscape classification

- LandMapR workflow
- DEM preparation
  - Burn stream network
  - Filter 3x3
  - Filter 3x3
  - Burn stream network
  - Filter 5x5

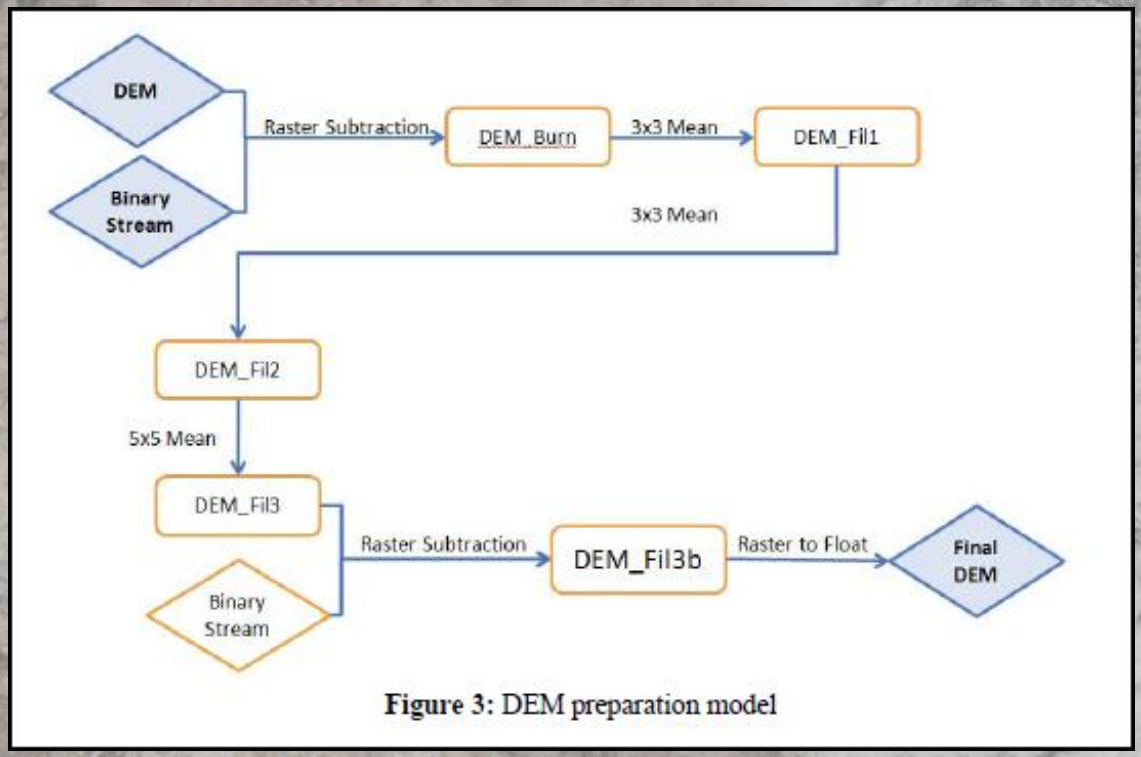
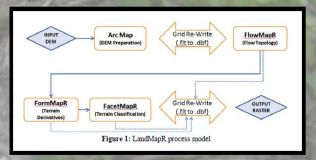


Figure 3: DEM preparation model



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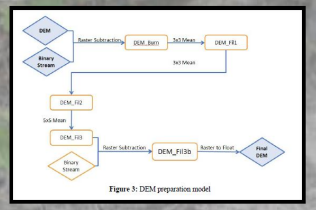
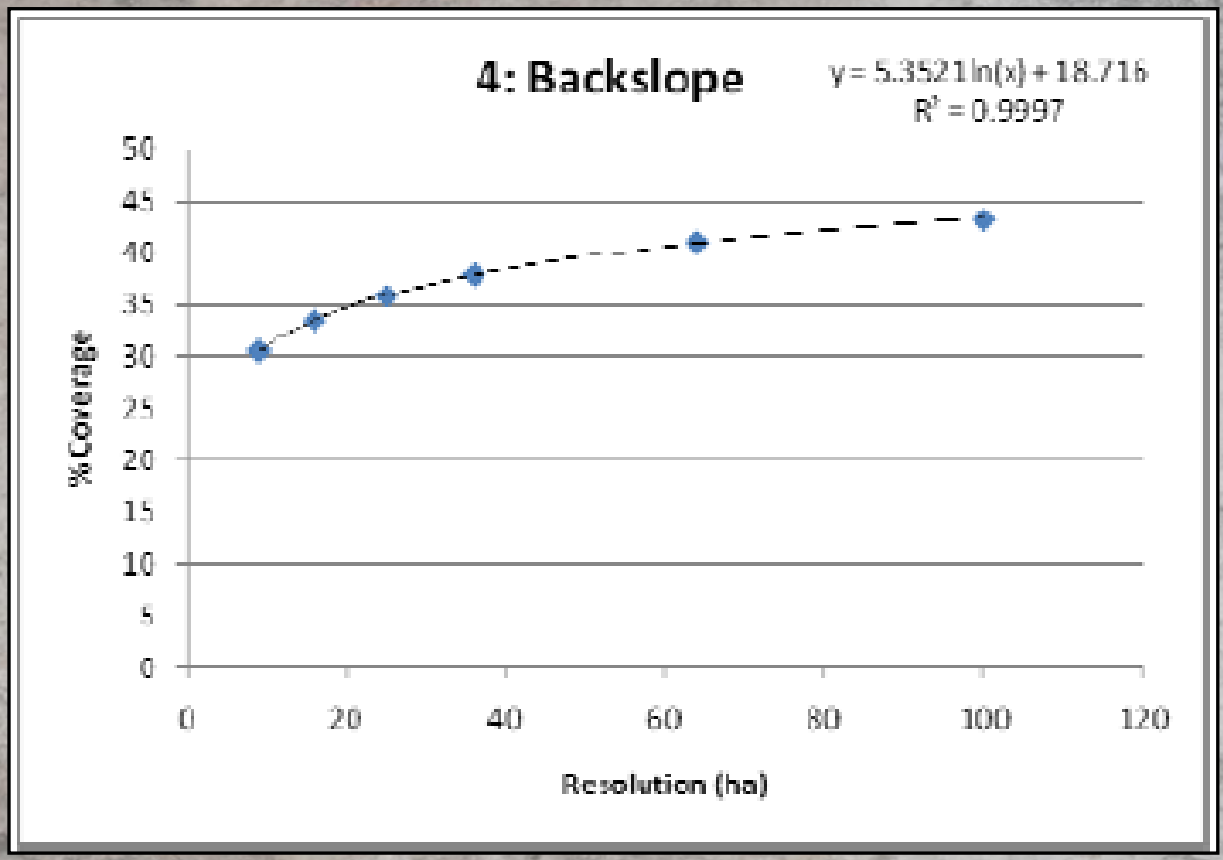


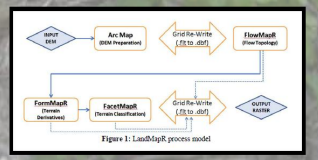
Figure 3: DEM preparation model

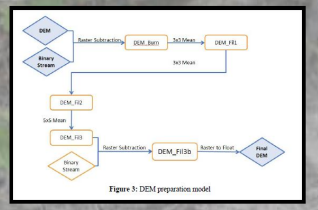
Landscape classification

- LandMapR workflow
- DEM preparation
- Results

  <resolution leads to more backslopes





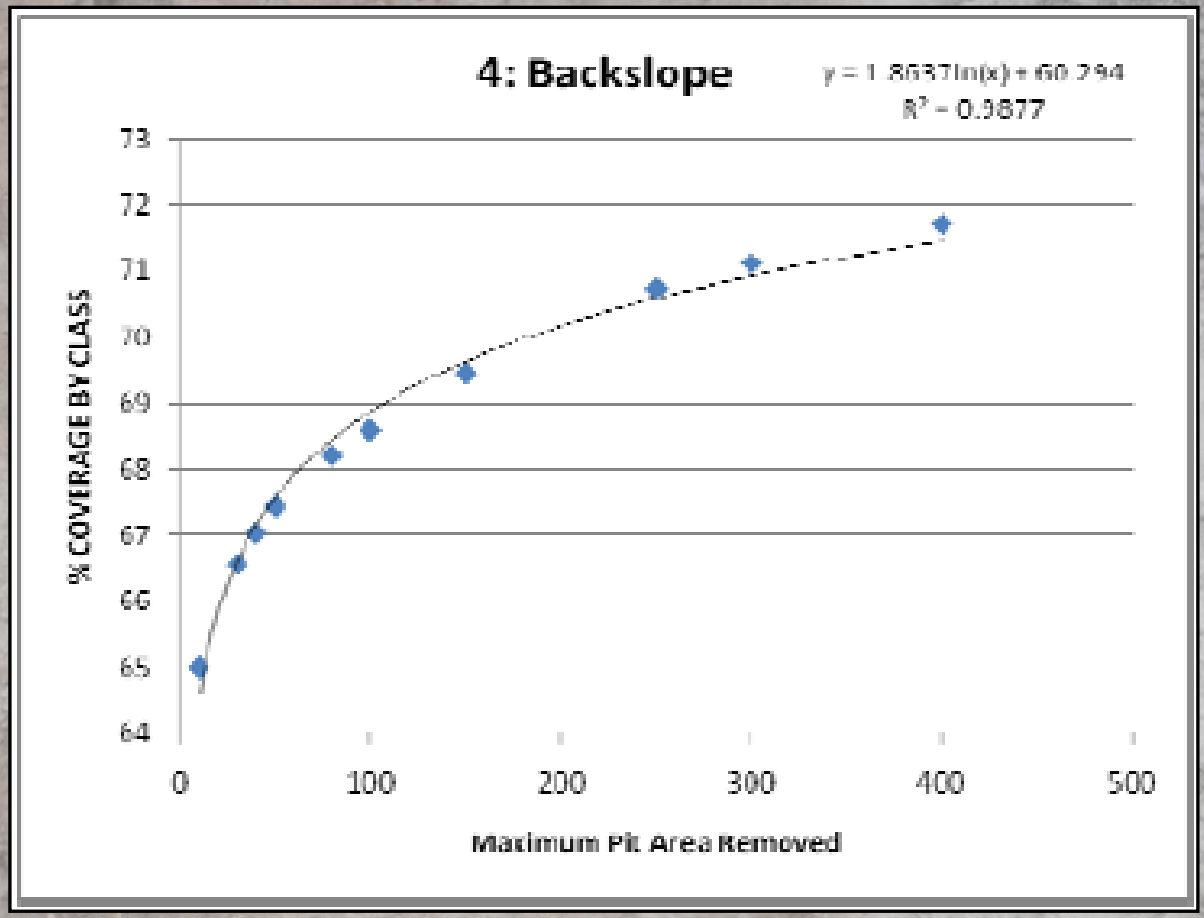


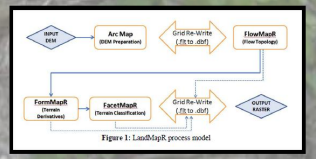
Landscape classification

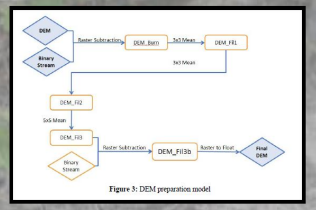
- LandMapR workflow
- DEM preparation
- Results

  < resolution leads to … more backslopes

  Remove bigger pits … more backslopes







Landscape classification

- LandMapR workflow
- DEM preparation
- Results

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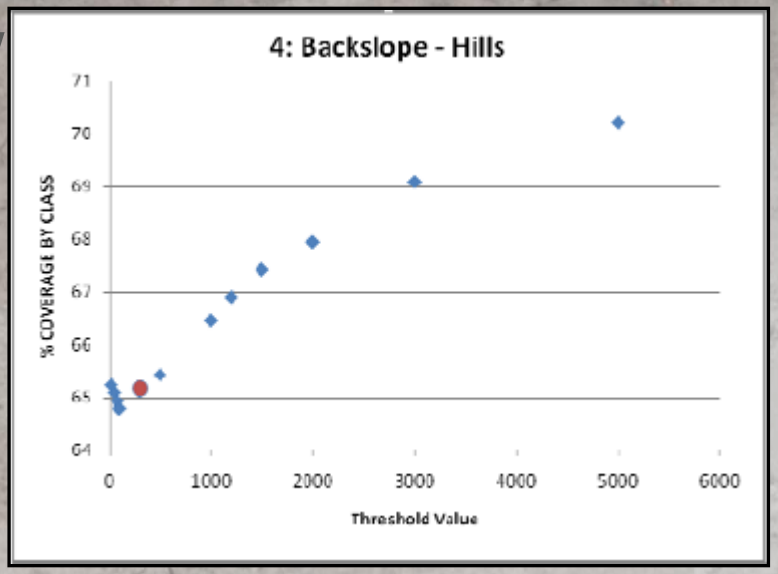
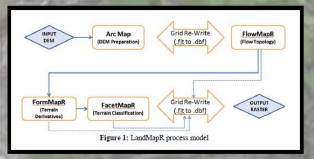
  Remove bigger pits … more backslopes

  Higher threshold area … more backslopes





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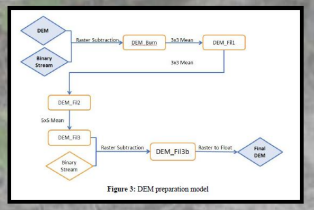

Figure 3: DEM preparation model

Landscape classification

- LandMapR workflow
- DEM preparation
- Results

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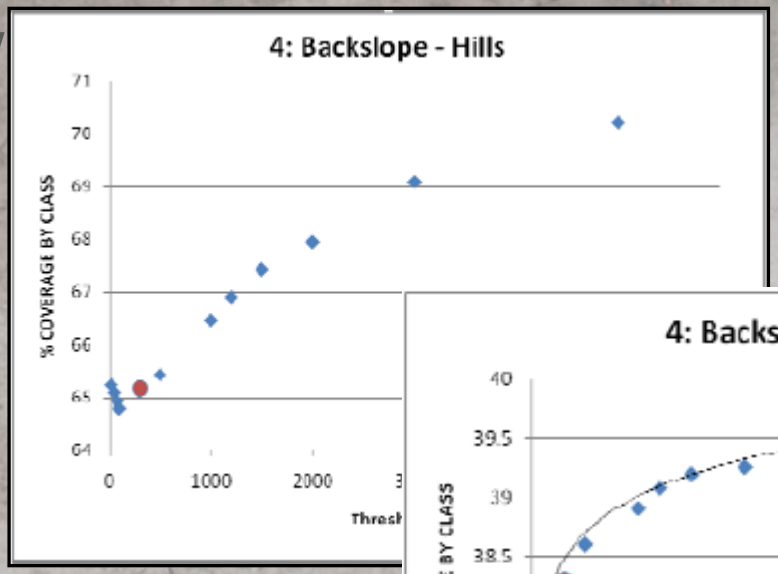

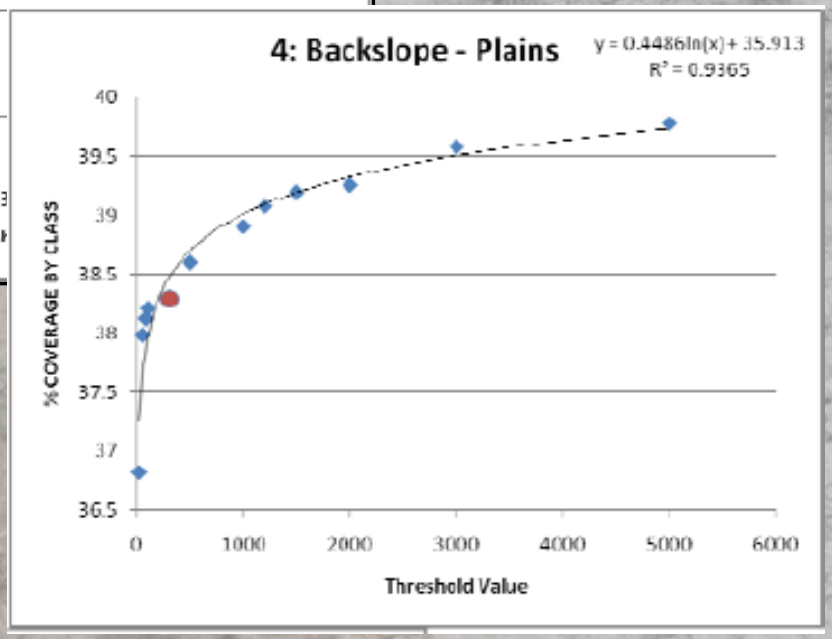

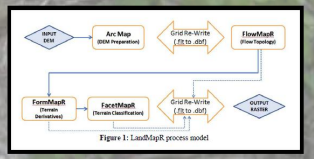

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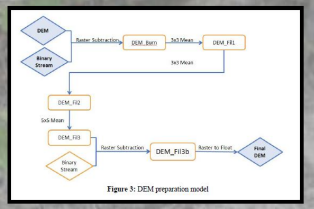

Figure 3: DEM preparation model

Landscape classification

- LandMapR workflow
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- Results

  < resolution leads to
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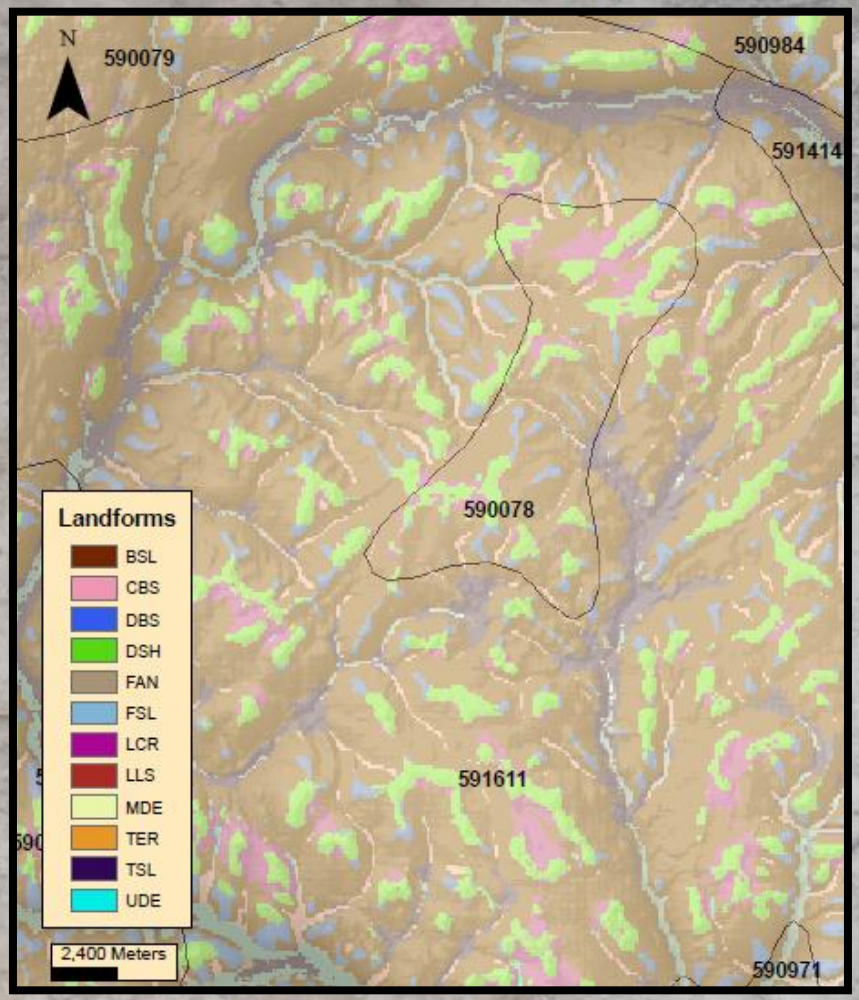
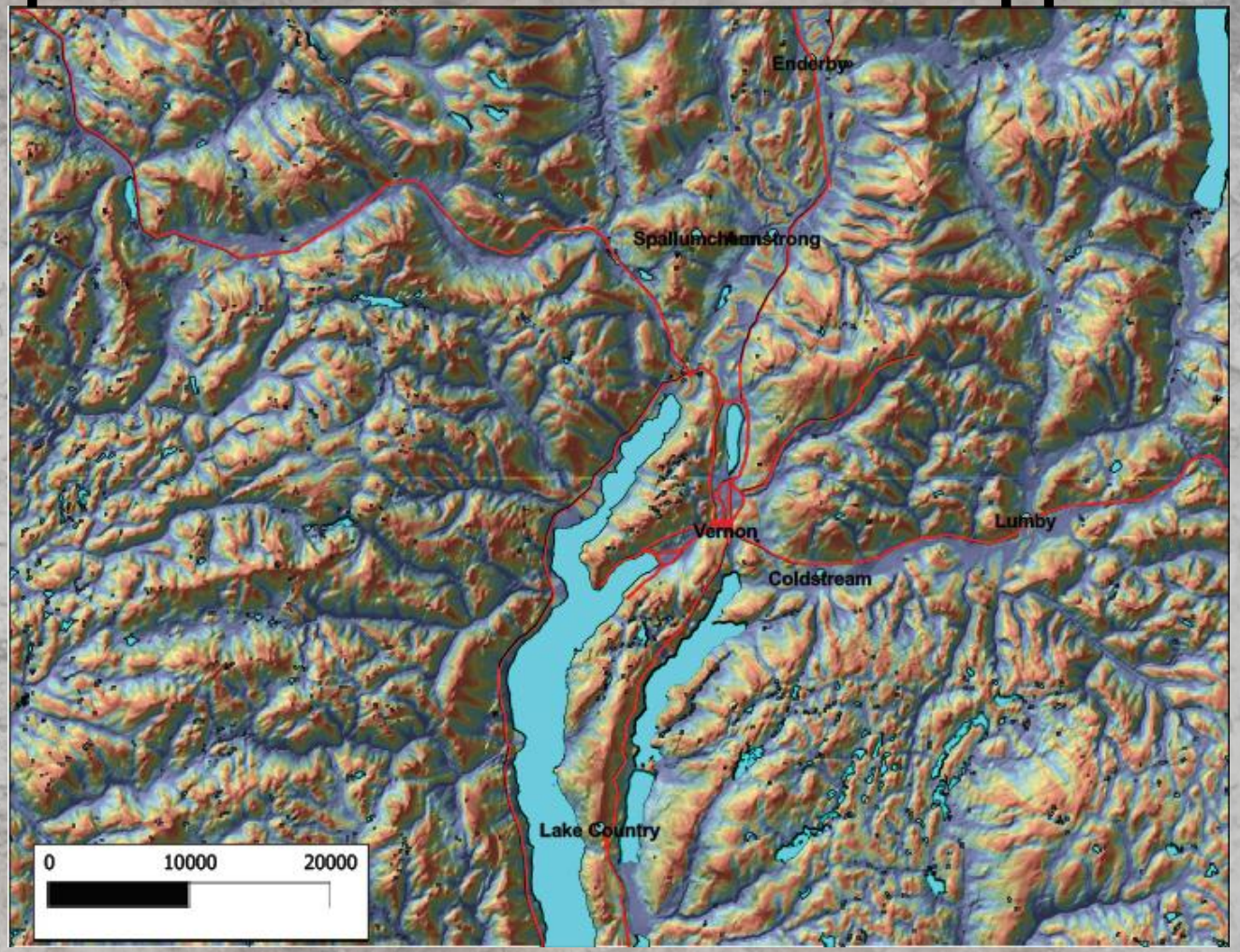
  … more backslopes



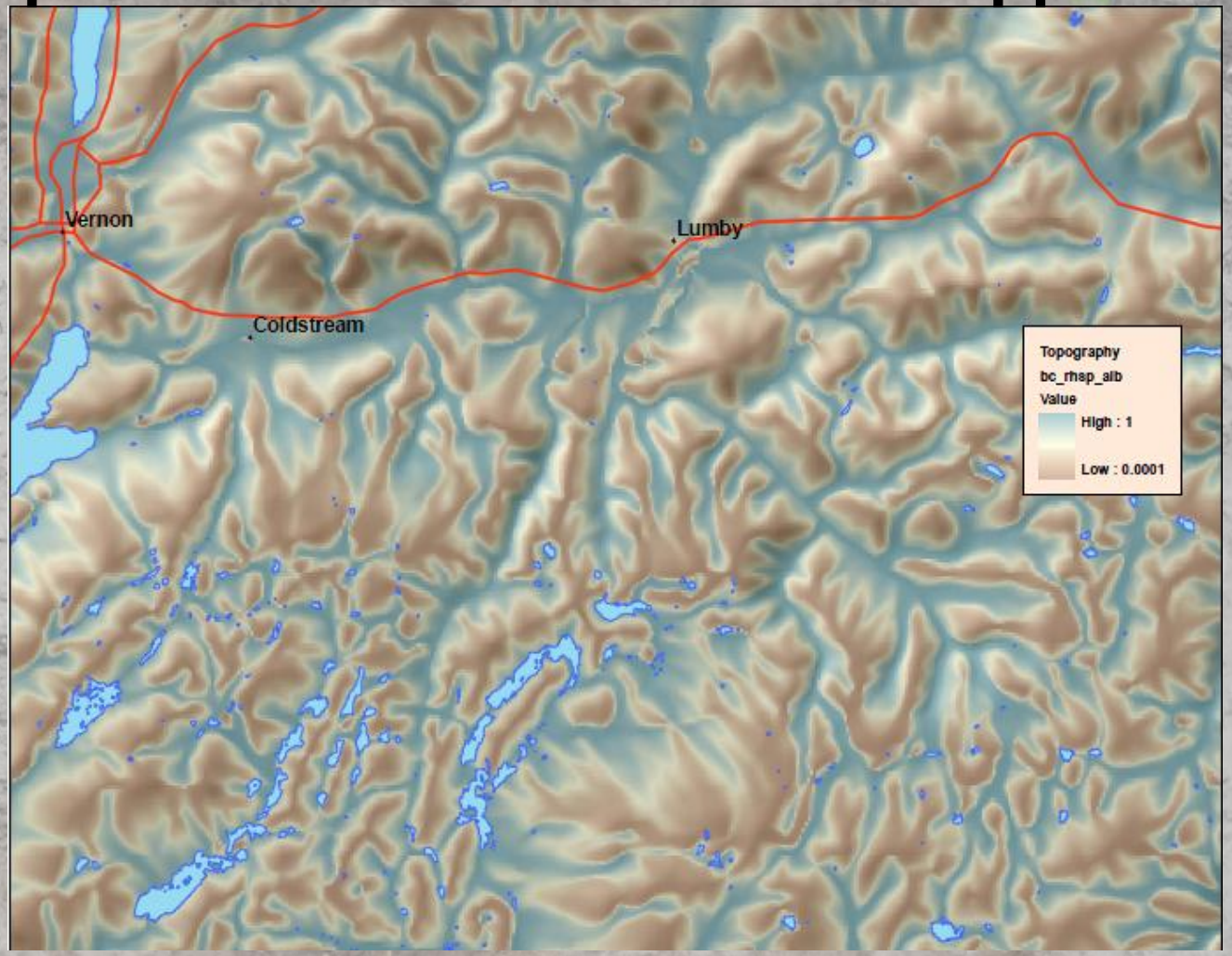
Landscape classification alternative approach

RHSP



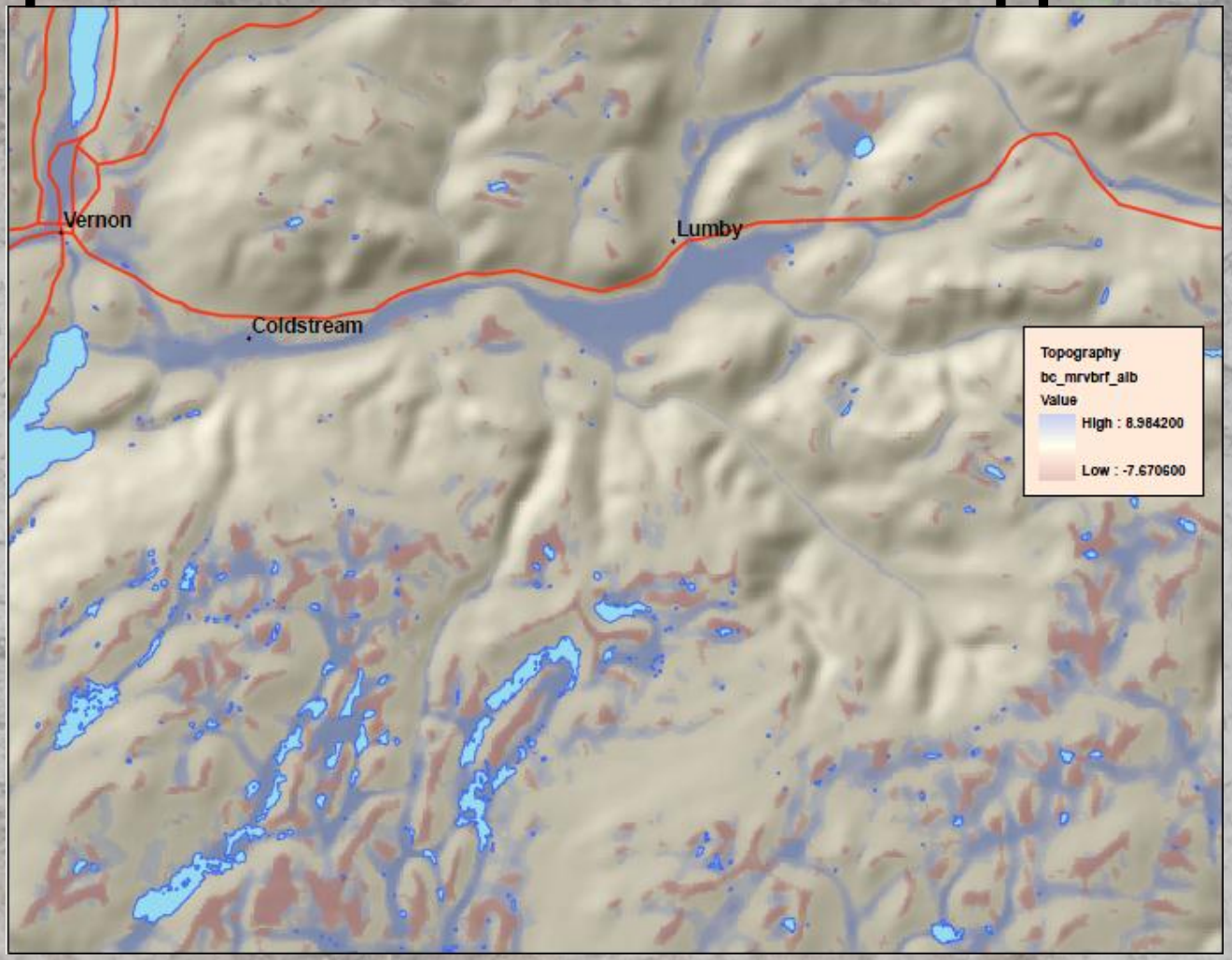
Landscape classification alternative approach

RHSP



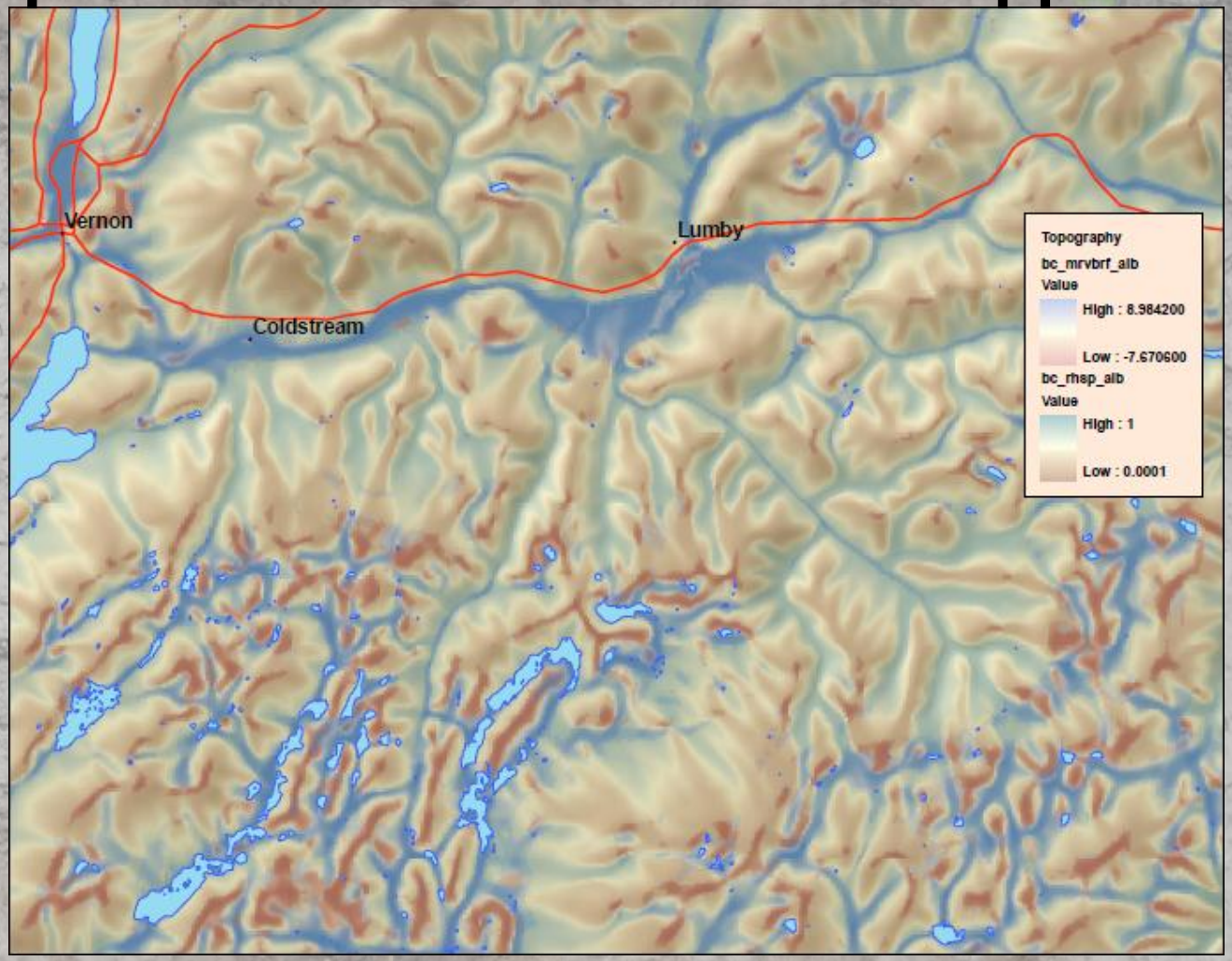
Landscape classification alternative approach

MRVBF

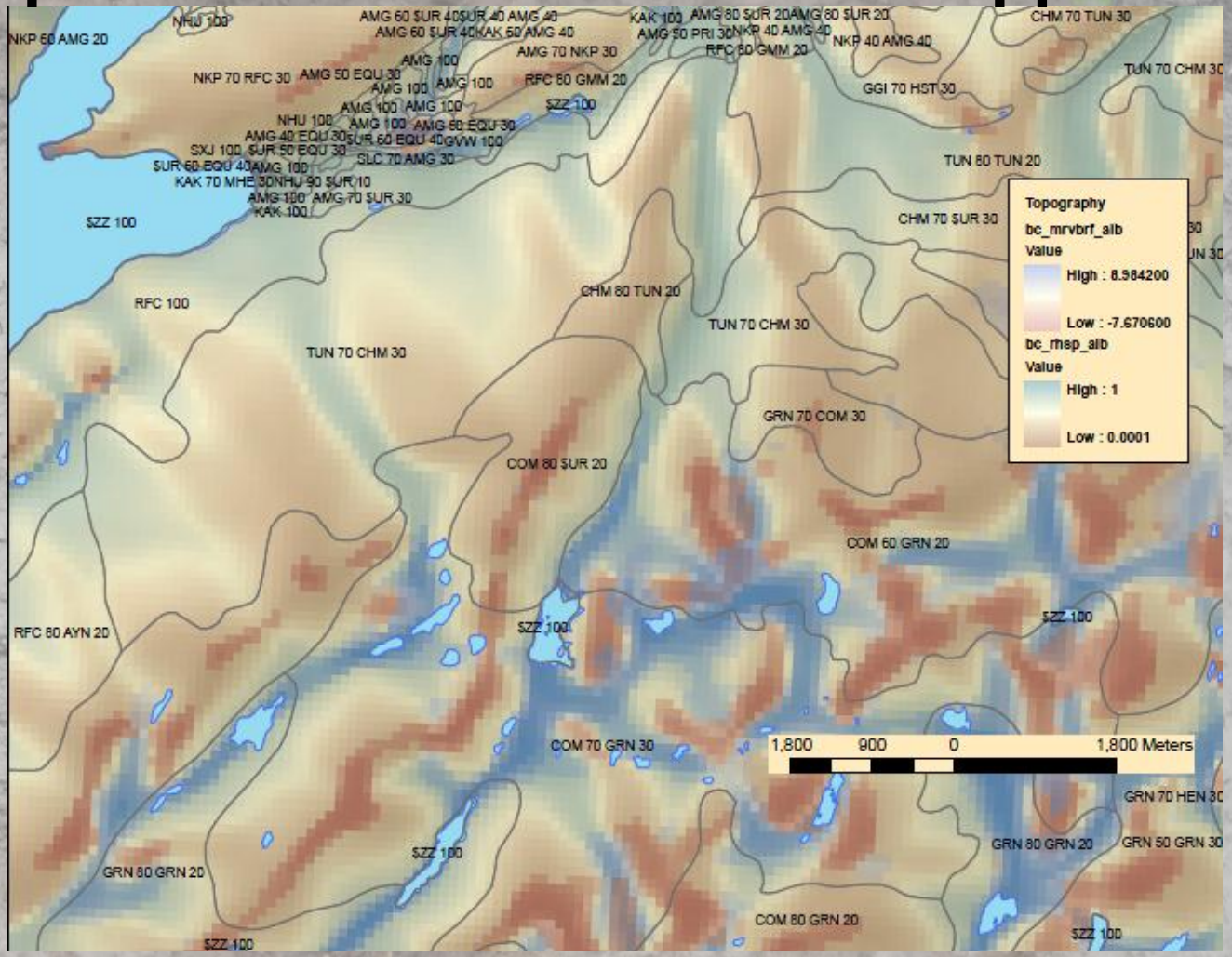


Landscape classification alternative approach

MRVBF+
RHSP

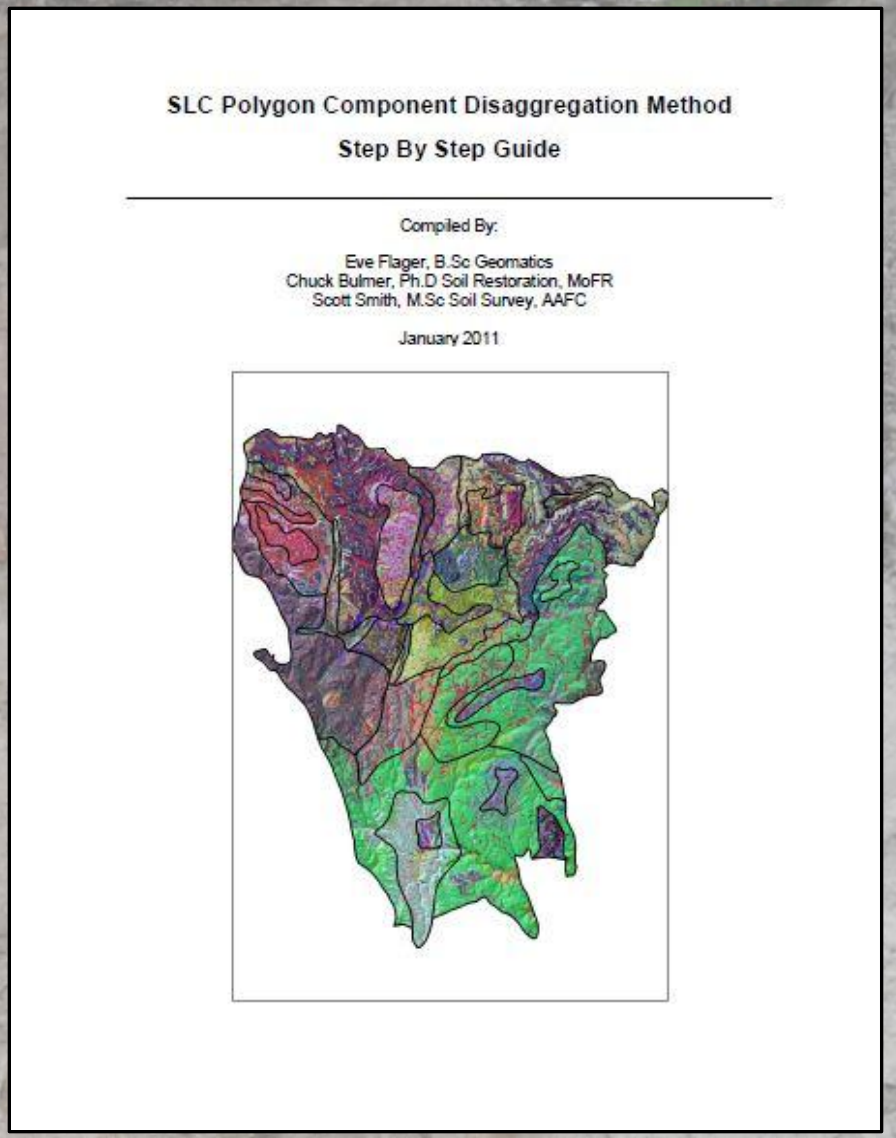


Landscape classification alternative approach



Predictive mapping

- Various methods…
  - Fuzzy logic (ArcSIE)
    - Component disaggregation
    - Expert knowledge ecodistrict
  - (Cluster analysis)
  - (randomForest)
- All methods rely on good input data

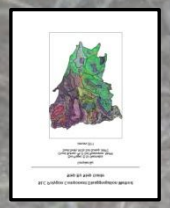

SLC Polygon Component Disaggregation Method

Step By Step Guide

Compiled By:

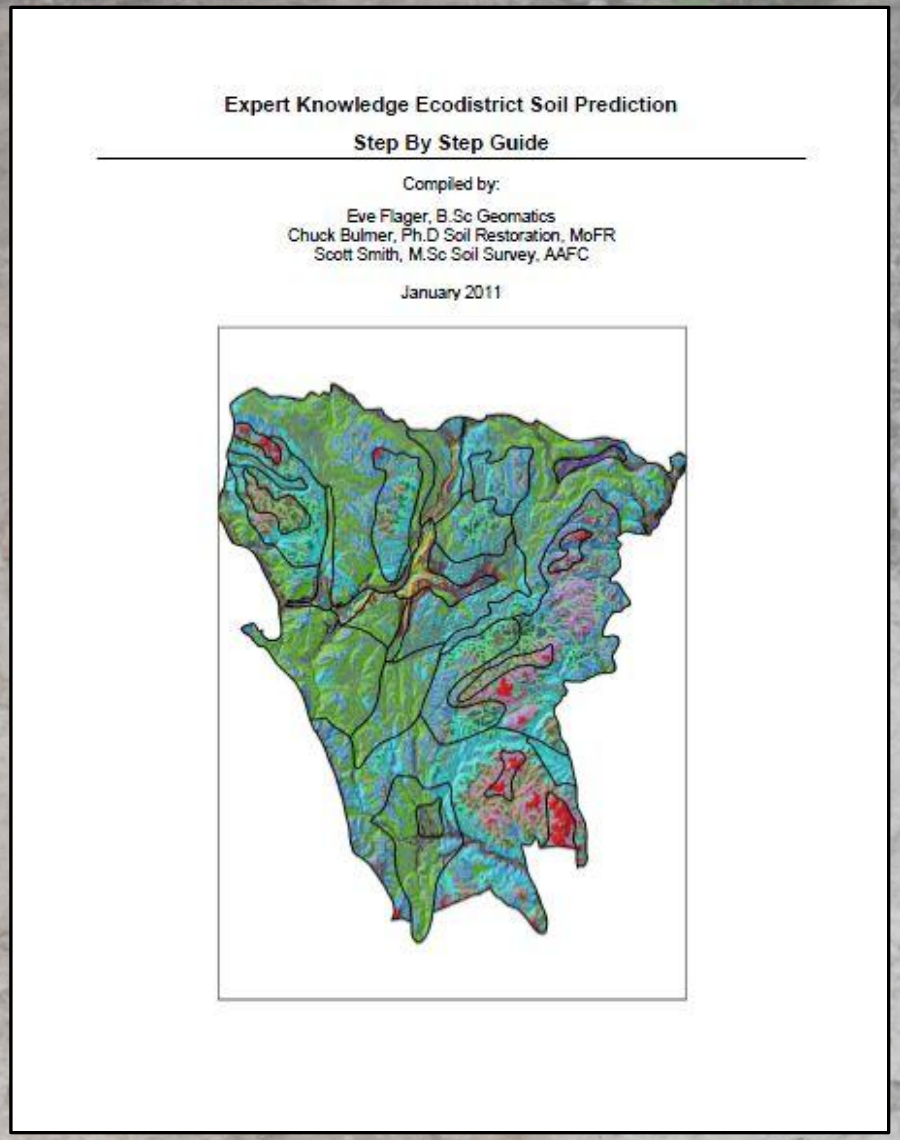
Eve Flager, B.Sc Geomatics
Chuck Bulmer, Ph.D Soil Restoration, MoFR
Scott Smith, M.Sc Soil Survey, AAFC

January 2011



Predictive mapping

- Various methods:
  - Fuzzy logic (ArcSIE)
    - Component disaggregation
    - Expert knowledge ecodistrict
  - Cluster analysis
  - Weights of Evidence
  - randomForest
- All methods rely on good input data



Expert Knowledge Ecodistrict Soil Prediction

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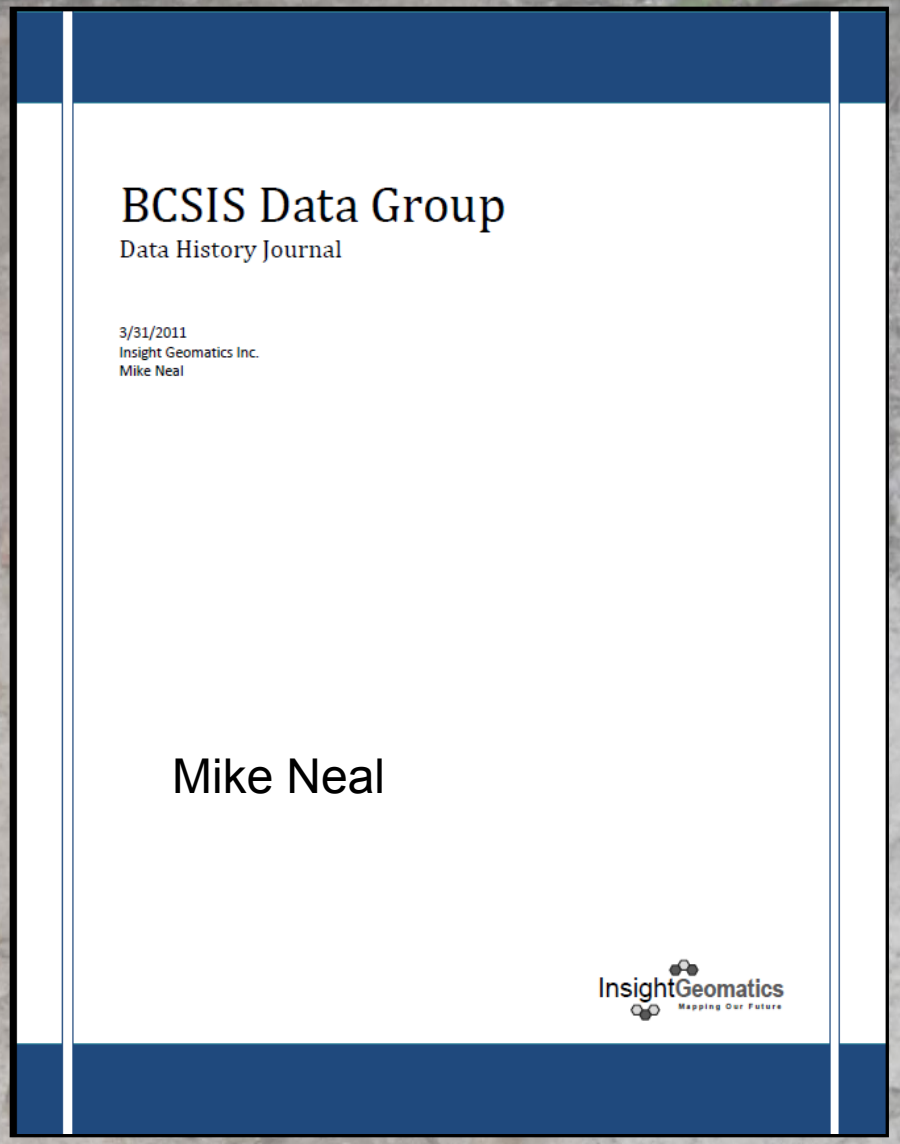
Improving datasets

- Sources of soil information
  - BCSIS
  - CANSIS
  - CAPAMP
  - Soils of BC
  - Seamless
- Dataset standardization
  - Projection
  - Data model and linking
  - Error checking
- Create a “Provincial dataset”



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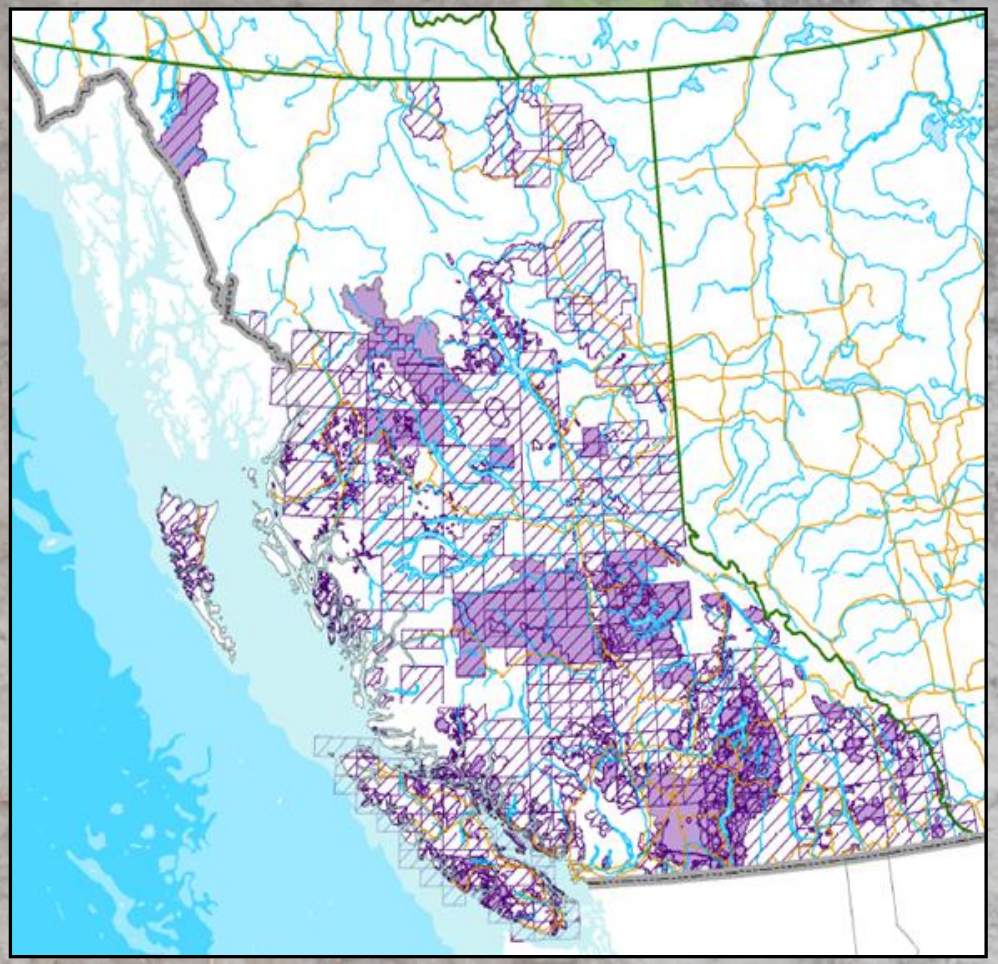

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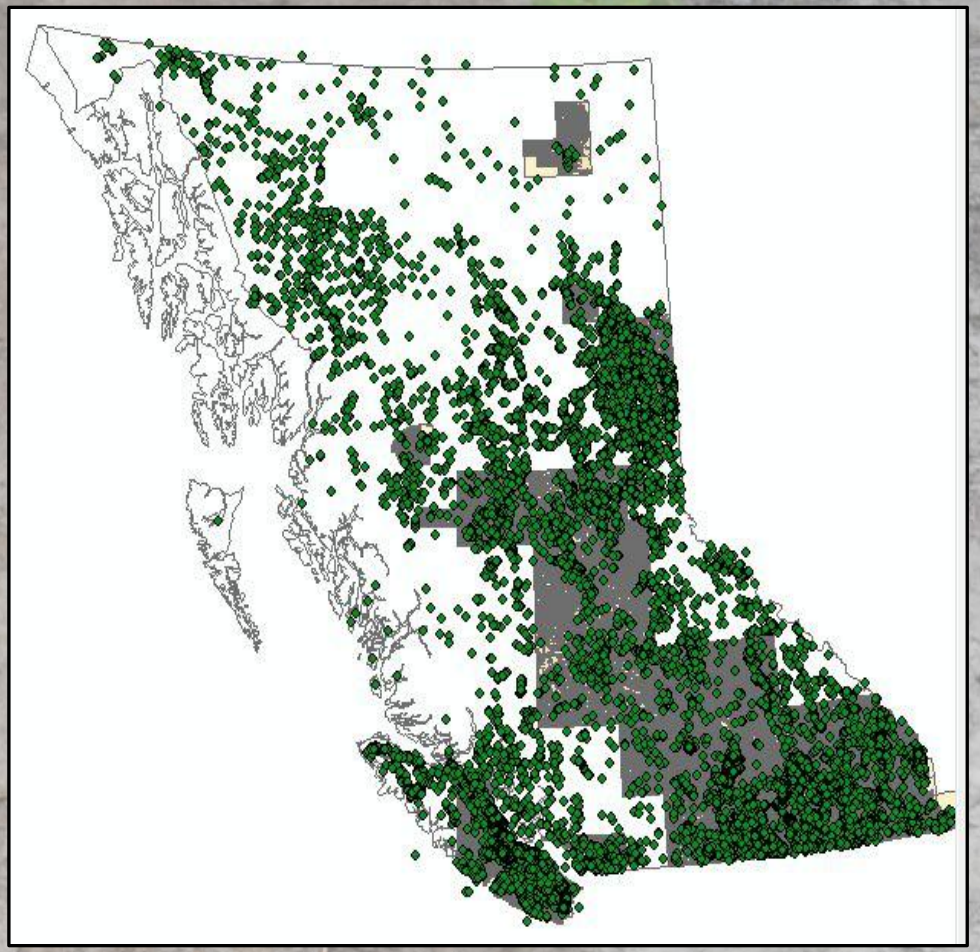
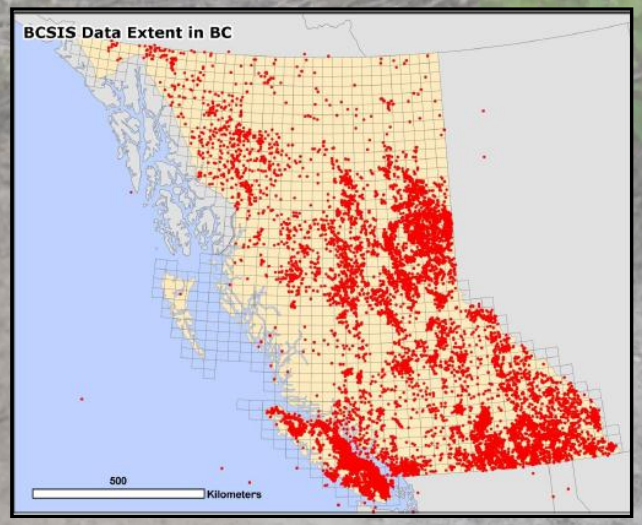
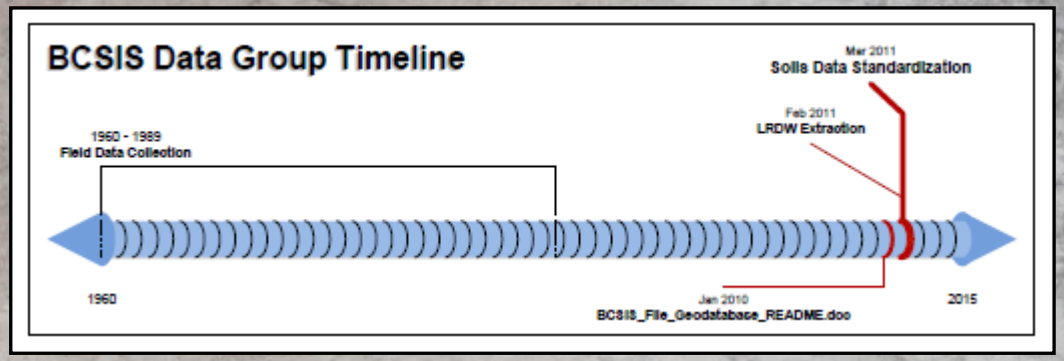


Improving datasets

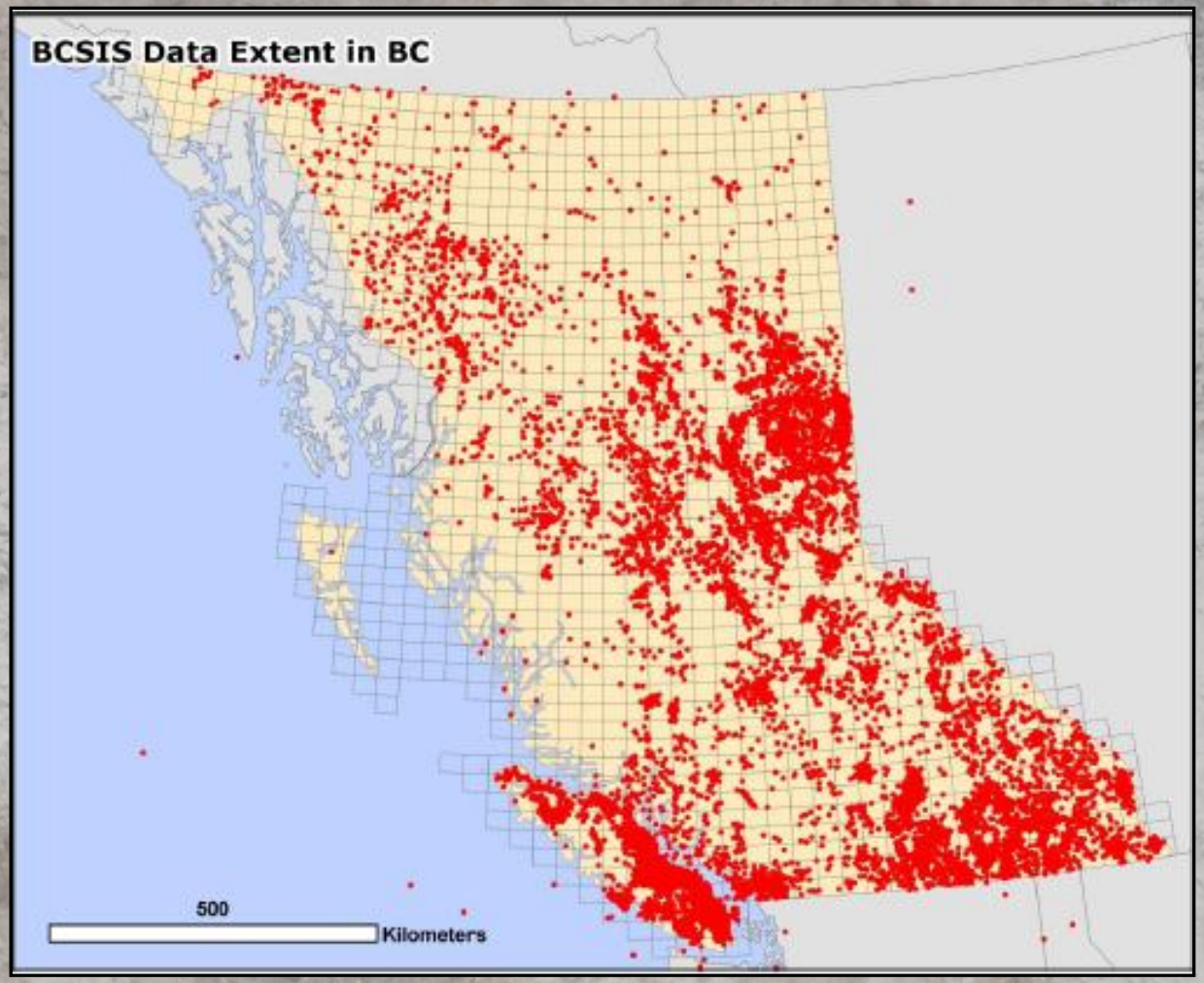
- BCSIS example
  - Point dataset 1980's
  - Mostly before the days of GPS
  - ca. 20,000 points
  - Profile and lab data for ca. 6000 soil profiles





March 2011 - Soils Data Standardization 9
Stage 1 – Standardize Formats 9
Stage 2 – Standardize Geometry 9
Stage 3 – Standardize Attribution (Within) 11
Stage 4 – Merge All Parts 14
Stage 5 – Standardize Attributes (Without) 15

Improving datasets: BCSIS



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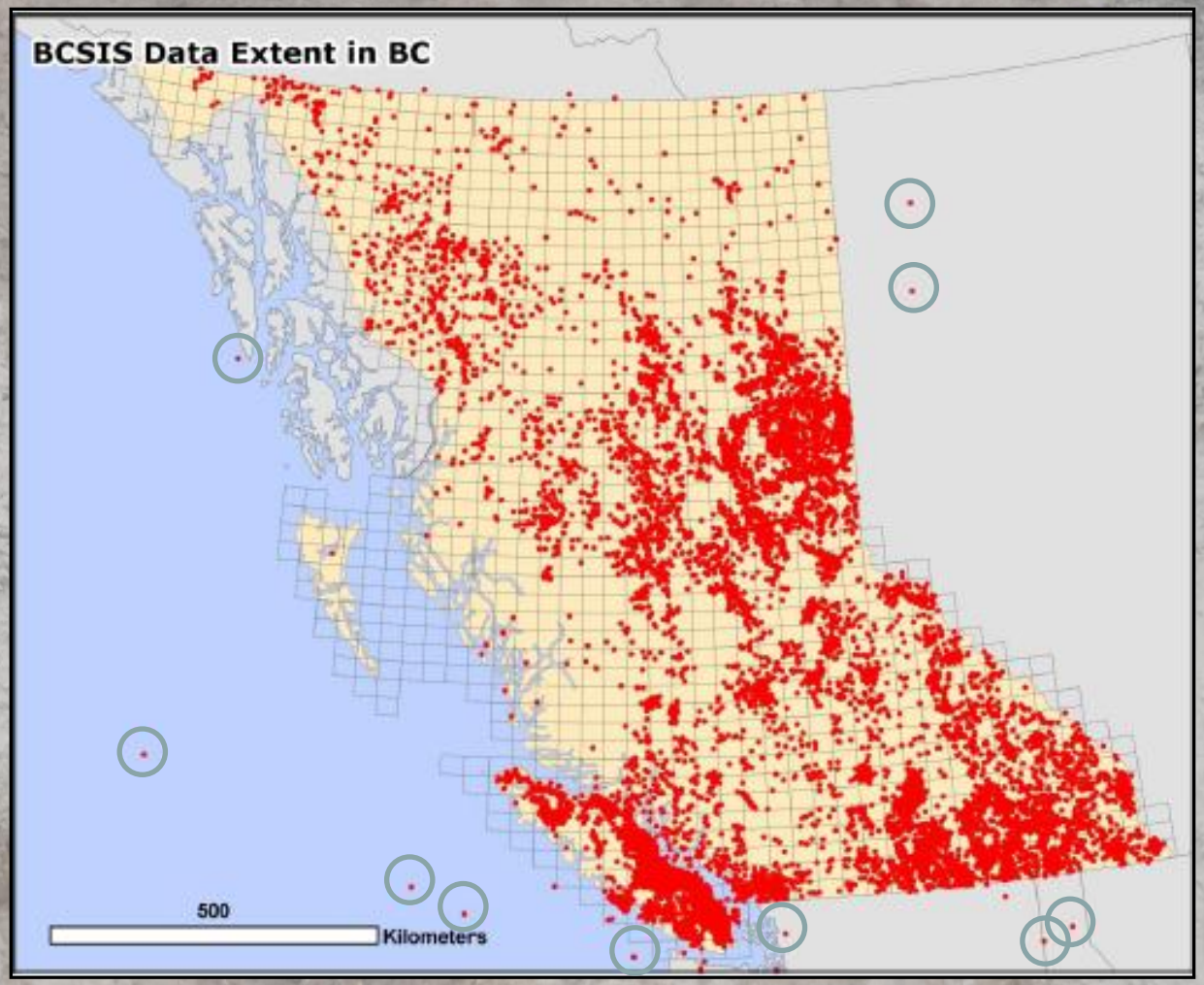

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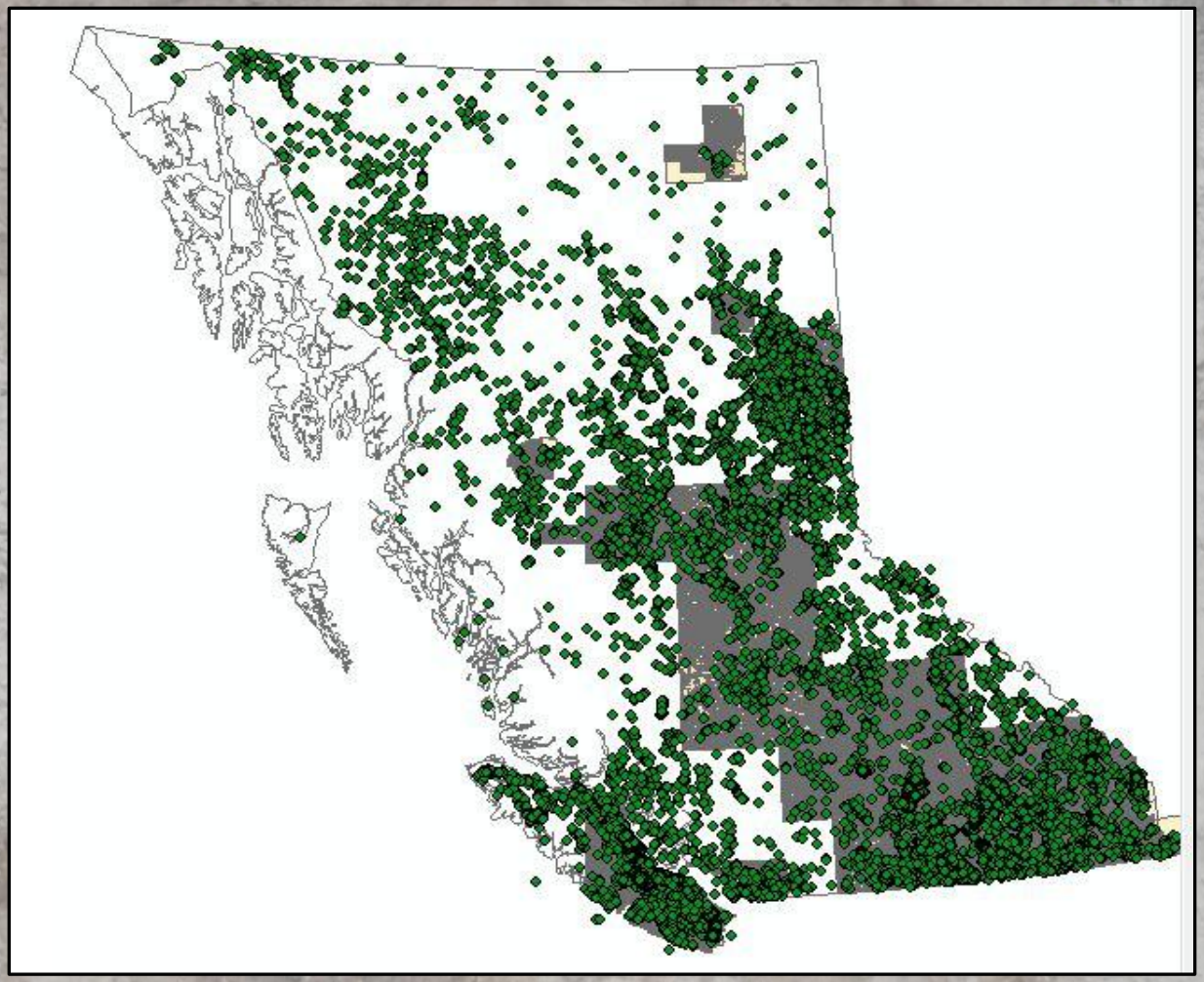
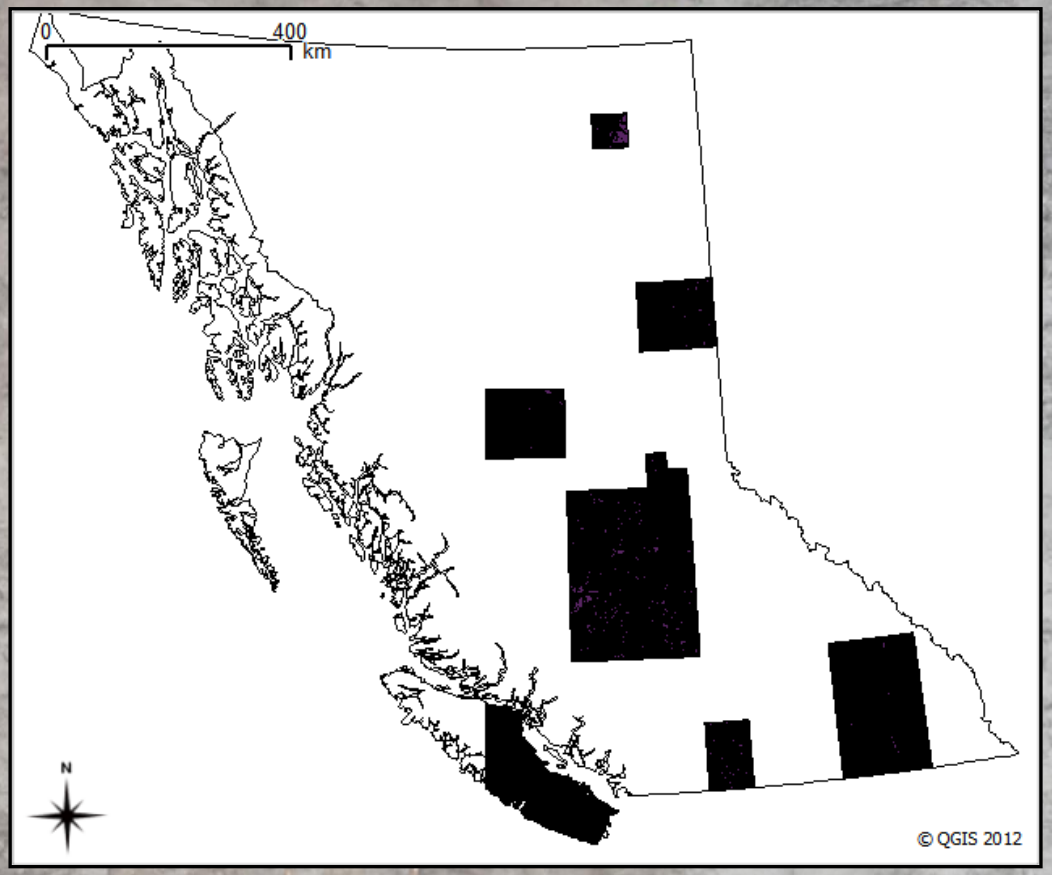


Improving datasets

- CANSIS example
  - Federal gov't soil surveys
  - Soil survey reports
    - eg Tullameen, LacLaHache, Ft St John
  - Geometry issues
    - Nechako Francois Lake
    - Clinton
  - Database issues



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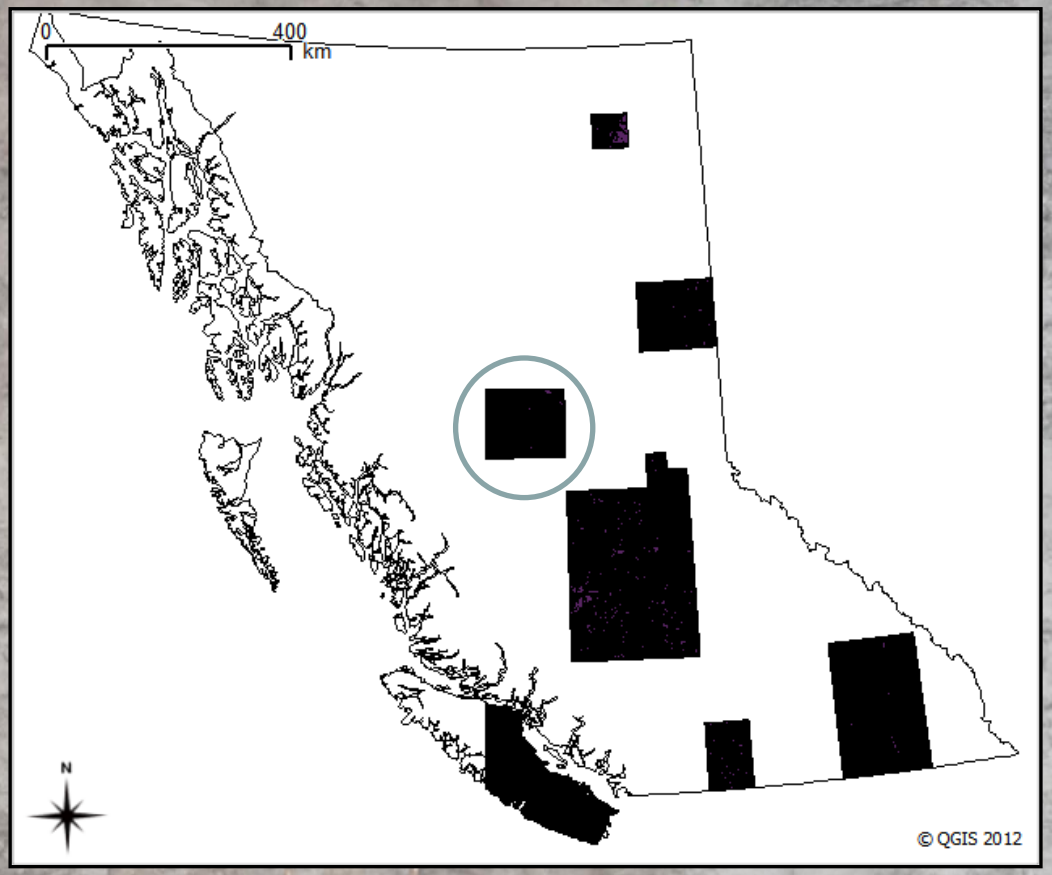

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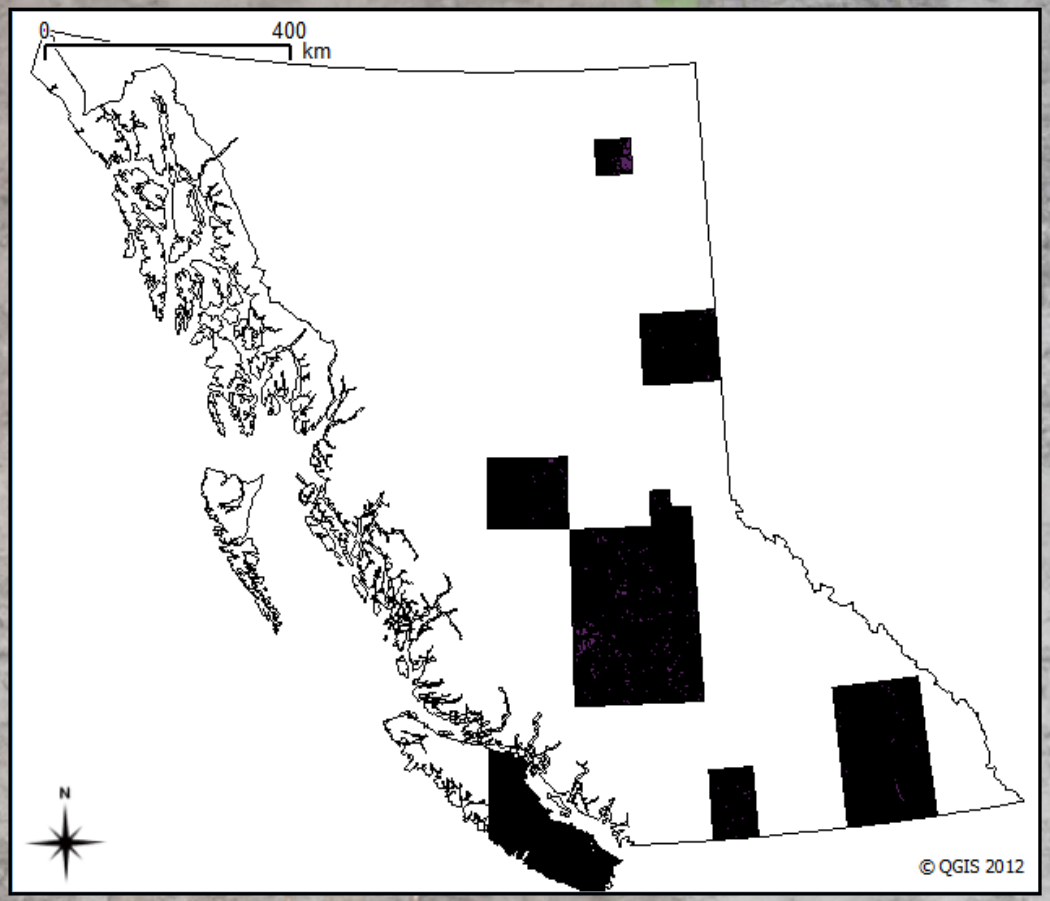

A soil dataset for BC

- Consistent data structure
- Correlate soil concepts

Attribute table - CANSIS100K :: 0 / 38773 feature(s) selected

	OBJECTID	AREA	PERIMETER	LAND_AREA	WATER_AREA	POLYGON_AR	MAPUNIT	BAPID	PROJ_NAME	DataGroup	DataSource
0	1	580559	4393.89	58	0	58	BCBCD036DZ-Y...	4530	Soils of the Bar...	CANSIS100K	barker
1	2	1120850	5958.27	112	0	112	BCBCD036DZ-R...	4530	Soils of the Bar...	CANSIS100K	barker
2	3	3366720	9087.79	336	0	336	BCBCD036BR-C...	4530	Soils of the Bar...	CANSIS100K	barker
3	4	1338620	5544.48	134	0	134	BCBCD036TP/6	4530	Soils of the Bar...	CANSIS100K	barker
4	5	1958790	8307.2	196	0	196	BCBCD036BR/5	4530	Soils of the Bar...	CANSIS100K	barker
5	6	3666770	14949.8	366	0	366	BCBCD036BR-T...	4530	Soils of the Bar...	CANSIS100K	barker
6	7	4740550	14196	474	0	474	BCBCD036TP-L...	4530	Soils of the Bar...	CANSIS100K	barker
7	8	6928240	14507.8	692	0	692	BCBCD036P-B/...	4530	Soils of the Bar...	CANSIS100K	barker
8	9	2591590	10187.8	259	0	259	BCBCD036TP/7	4530	Soils of the Bar...	CANSIS100K	barker
9	10	14211900	27797.4	1420	0	1420	BCBCD036AZ-...	4530	Soils of the Bar...	CANSIS100K	barker
10	11	547651	4684.59	55	0	55	BCBCD036GF/2	4530	Soils of the Bar...	CANSIS100K	barker
11	12	6301370	61590.1	0	630	630	BCBCD036ZZ	4530	Soils of the Bar...	CANSIS100K	barker
12	13	3053120	10336.4	305	0	305	BCBCD036CC/2	4530	Soils of the Bar...	CANSIS100K	barker
13	14	306204	4596.75	31	0	31	BCBCD036GF/2	4530	Soils of the Bar...	CANSIS100K	barker
14	15	1581850	9036.43	158	0	158	BCBCD036GF/4	4530	Soils of the Bar...	CANSIS100K	barker
15	16	3295360	9455.74	329	0	329	BCBCD036B/5-6	4530	Soils of the Bar...	CANSIS100K	barker
16	17	29566500	38615.8	2954	0	2954	BCBCD036P-B/3	4530	Soils of the Bar...	CANSIS100K	barker
17	18	26536200	42865.7	2652	0	2652	BCBCD036LZ-...	4530	Soils of the Bar...	CANSIS100K	barker
18	19	12046300	17370.8	1204	0	1204	BCBCD036P-B/...	4530	Soils of the Bar...	CANSIS100K	barker
19	20	5996410	17411.4	599	0	599	BCBCD036TO4-...	4530	Soils of the Bar...	CANSIS100K	barker
20	21	553580	2883.17	55	0	55	BCBCD036GF/2	4530	Soils of the Bar...	CANSIS100K	barker
21	22	330304	6295.94	0	33	33	BCBCD036ZZ	4530	Soils of the Bar...	CANSIS100K	barker
22	23	1405610	6078.17	140	0	140	BCBCD036P-B/3	4530	Soils of the Bar...	CANSIS100K	barker
23	24	20026400	64499.9	2001	0	2001	BCBCD036DO-...	4530	Soils of the Bar...	CANSIS100K	barker
24	25	2299310	8825.95	230	0	230	BCBCD036GF/2	4530	Soils of the Bar...	CANSIS100K	barker

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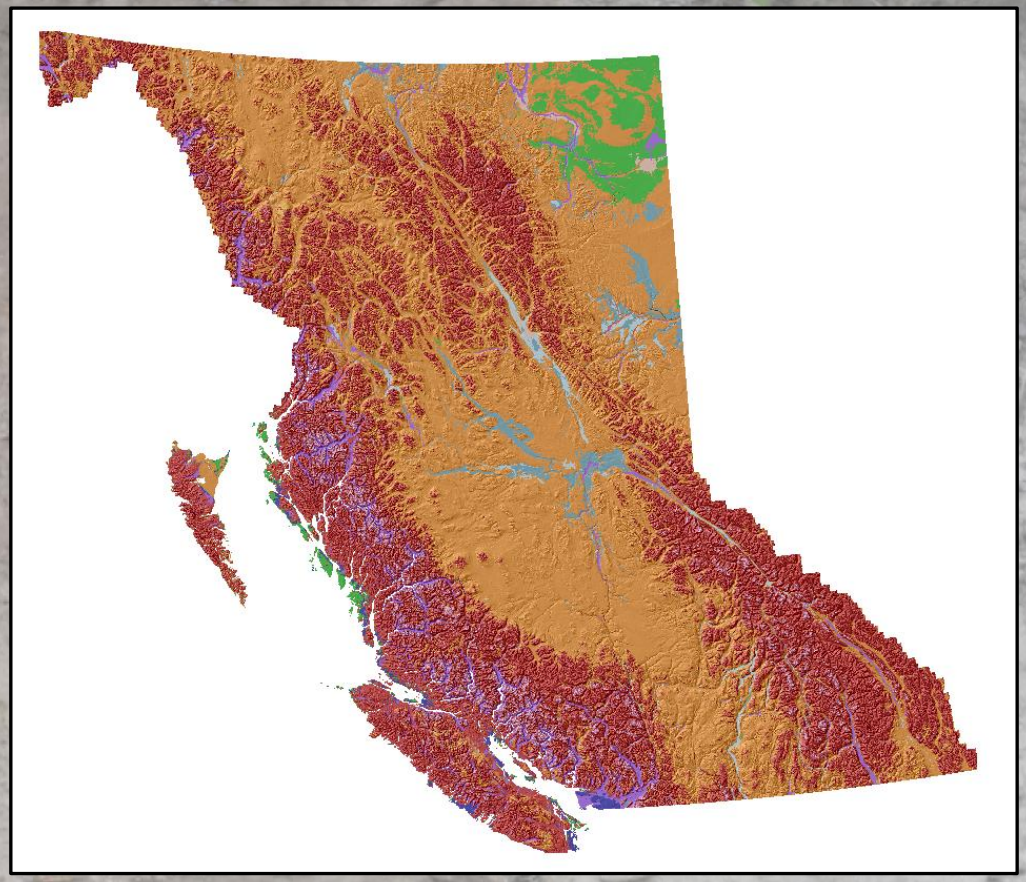
Show selected only | Search selected only | Case sensitive | Advanced search | ?

Conclusions

- A work in progress..
  - Ongoing improvements to datasets
  - Better understanding
  - Active team
- Datasets on haBC
- Actively investigating DSM
- Detailed and small scale approach worked well
- FFESC support…
  - encouraged contributions from multiple partners
    - Provincial national scale / modeling
    - Okanagan Watershed study (regional)
    - FLNRO research

Proof of concept, parent material 9h randomForest