Digital Mapping Techniques '10

Association of American State Geologists

United States Geological Survey

The following was presented at DMT'10
(May 16-19, 2010).

The contents are provisional and will be
superseded by a paper in the
DMT'10 Proceedings.

See also earlier Proceedings (1997-2009)
http://ngmdb.usgs.gov/info/dmt/

Building a surficial geology data model for mapping projects

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Ressources naturelles Canada

Canada

Outline

- Context
- Mapped features
- Geodatabase
- Next steps
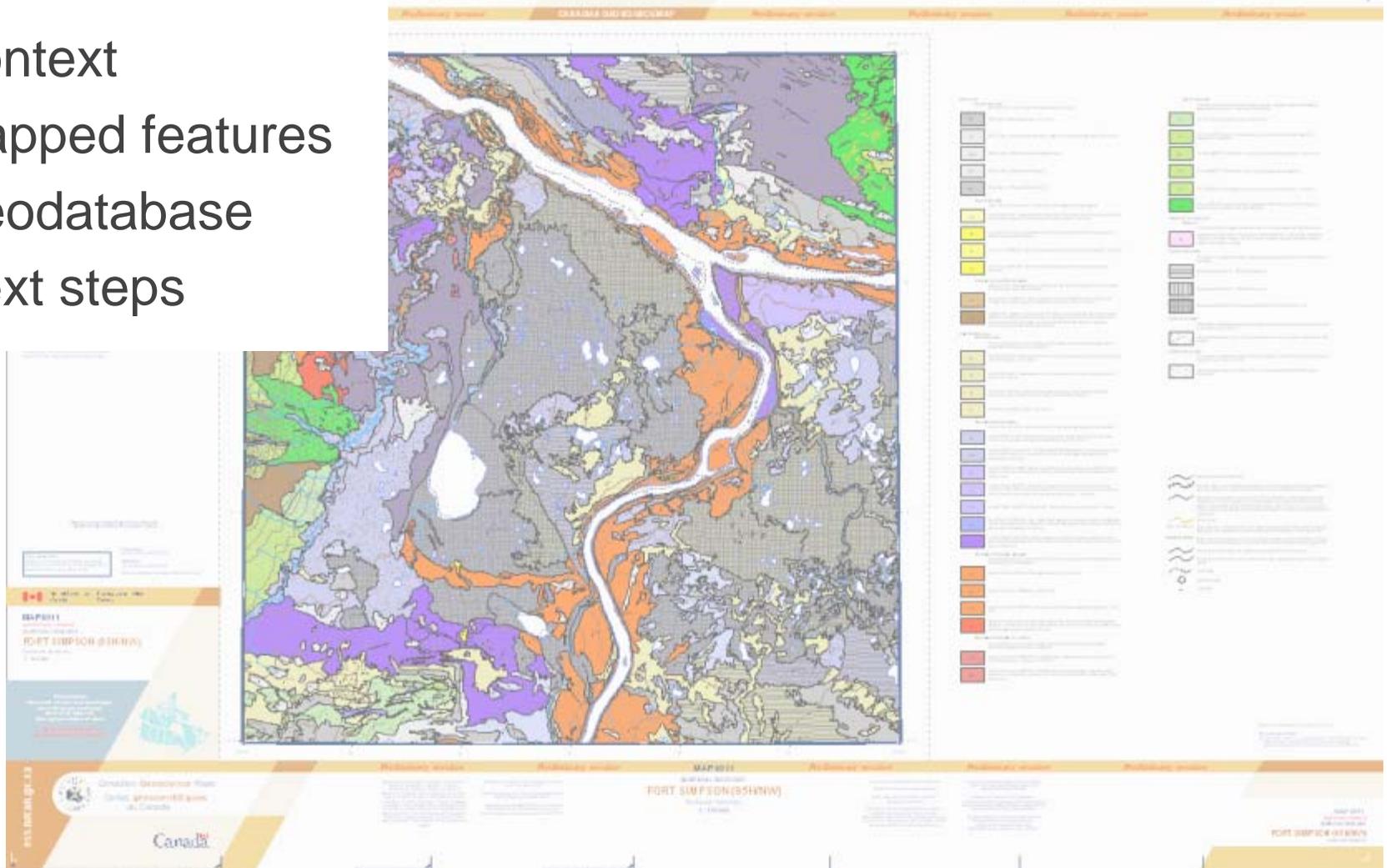
Context

- Geological Map Flow Project

- Compilation, interpretation, management and dissemination of geologic map information

- Data collection –> **Data management** -> Data dissemination

- Surficial geology data

- Data model is implemented as an ESRI™ ArcGIS geodatabase

Mapped features

- **What is being mapped**?
- **How is it described?**
- **How is it implemented?**

Mapped features

- **What is being mapped**?
  - Map units
  - Landforms and geomorphologic features
  - Field observations and measurements
- **How is it described?**
  - Science language, symbol, legend
- **How is it implemented?**
  - Data structure

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Esker (direction of flow indicated) . . . .
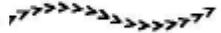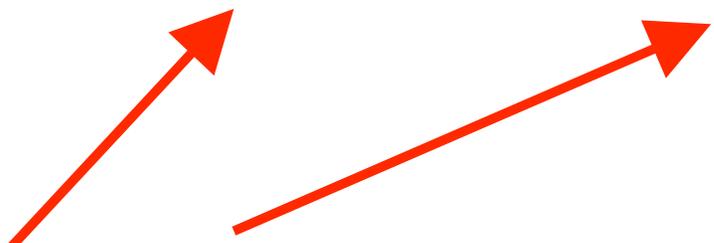
subtype	subfeature	sense
esker ridge	none	known

Mapped features

> **Science language development**
> - Review of existing data models and mapping products
> - 2 science champions
> - Small working group
> - Iterative consultations with surficial geology mapping experts
> - Developed for mapped features and field data collection

- **How is it described?**
  - Science language, symbol, legend
- **How is it implemented?**
  - Data structure

Mapped features

- **What is being mapped?**
  - Map units
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  - Field observations and measurements
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  - **Science language**, symbol, legend
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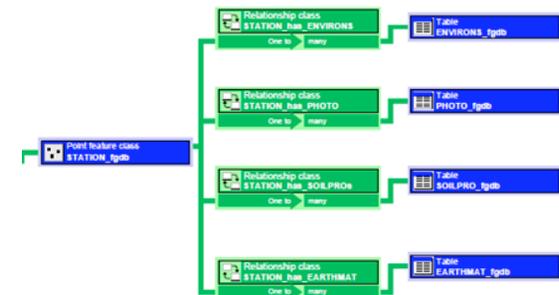
Mapped features
Map units

Compilation of surficial legends (by H. Thorleifson and M. Pyne (2002)

- 1578 maps;
- Map units: 2431 different codes
- Symbols: 5423 different definitions

Mapped features
Map units

Mapped features
Map units

Genesis:
process and environment of depostion

C	Colluvial deposits
O	Organic deposits
E	Eolian sediments
A	Alluvial sediments
L	Lacustrine sediments
M	Marine sediments
GM	Glaciomarine sediments
GL	Glaciolacustrine sediments
GF	Glaciofluvial sediments
T	Glacial sediments
W	Weathering deposits
U	Undifferentiated deposits
R	Bedrock
H	Anthropogenic
I	Glacier - Icefield - Icecap

Category:
Morphology, stratigraphy, thickness, secondary process

Ap	Floodplain sediments
Af	Fan sediments
Ae	Estuarine sediments
At	Terraced sediments
A	Undifferentiated sediments

Legend

grain size, structure, colour, thickness (minimum and maximum), morphology, stratigraphic relationships, depositional environment and other characteristic features.

Geologic event

Neoglacial
Holocene
Pleistocene
Wisconsin(an)
Late Wisconsin(an)
Middle Wisconsin(an)
Early Wisconsin(an)
Sangamon(ian) (interglacial)
Illinoian glaciation

Meleb   Dra

T

Mapped features
Map units

- Points – labels
- Lines – boundaries

Polygons – map units

- Feature linked annotations
- Table – map unit legend description

Mapped features
Landforms and geomorphologic features

- Compilation of surficial legends (by H. Thorleifson and M. Pyne (2002)

  - 1578 maps;
  - Map units: 2431 different codes
  - Symbols: 5423 different definitions
    - e.g. Esker - more than 50 different ways to describe the direction of flow

Legend items shown in figure:

- Geological boundary (approximate) — **Map unit boundary**
- Unmapped built-up area (map GSC 2055A / MGS MAP2003-7 only)
- Mine waste — **features as zones**
- Peat-extraction area
- Gravel pit — **features as points**
- Mine or bedrock quarry
- Stabilized dunes
- Abandoned channel
- Minor beach ridge
- Wave-cut scarp — **features as lines**
- Groundwater sapping channel
- Piping depression
- Iceberg scour
- Tunnel valley
- Esker (direction of flow indicated)
- Streamlined landform
- Glacial striae
- Crossed striae (numbers indicate relative age, 1 being the oldest)
- Small bedrock outcrop

Mapped features
Landforms and geomorphologic features

What features (concepts) are portrayed?

Subtypes
cirque headwall
crevasse ridge (crevasse filling, ice fracture filling)
iceberg scour (includes iceberg pit, furrows)
kettle
moraine - major
moraine - minor
moraine, disintegration
…

Mapped features
Landforms and geomorphologic features

What geometry?

Subtypes
cirque headwall
crevasse ridge (crevasse fil
iceberg scour (includes ice
kettle
moraine - major
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moraine, disintegration
…

polygons	lines	points
	cirque headwall	
	crevasse ridge	
	iceberg scour - includes iceberg pit, furrows	
kettle		kettle
	moraine ridge - major	
	moraine ridge - minor	
moraine, disintegration		

Mapped features
Landforms and geomorphologic features

- What is the most significant attribute? subfeatures
- What other fields do we need? and what goes in them?

subtype	subfeature	sense	notes
moraine ridge - major	lateral	known	ornamented on glacier side

- How is it symbolized?
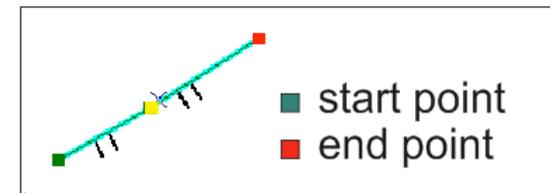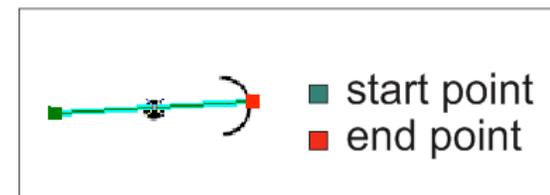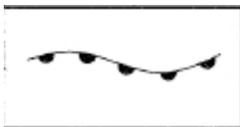
Mapped features
Field data

Geological boundary (approximate)	
Unmapped built-up area (map GSC 2055A / MGS MAP2003-7 only)	
Mine waste	
Peat-extraction area	
Gravel pit	
Mine or bedrock quarry	
Stabilized dunes	
Abandoned channel	
Minor beach ridge	
Wave-cut scarp	
Groundwater sapping channel	
Piping depression	
Iceberg scour	
Tunnel valley	
Esker (direction of flow indicated)	
Streamlined landform	
Glacial striae	
Crossed striae (numbers indicate relative age, 1 being the oldest)	
Small bedrock outcrop	

Field observations and measurements →

Mapped features
Field data

- Field observations and measurements
  - Traverse
  - Station - Station environment
    - Photo
    - Earth material description
      - Samples
      - Paleoflow measurements
      - Structural measurements
  - Preliminary linework

GanFeld application

Mapped features
Field data

Field observations and measurements

- Points (station)
- Lines (traverse, preliminary linework)
- Tables
- Relationship classes
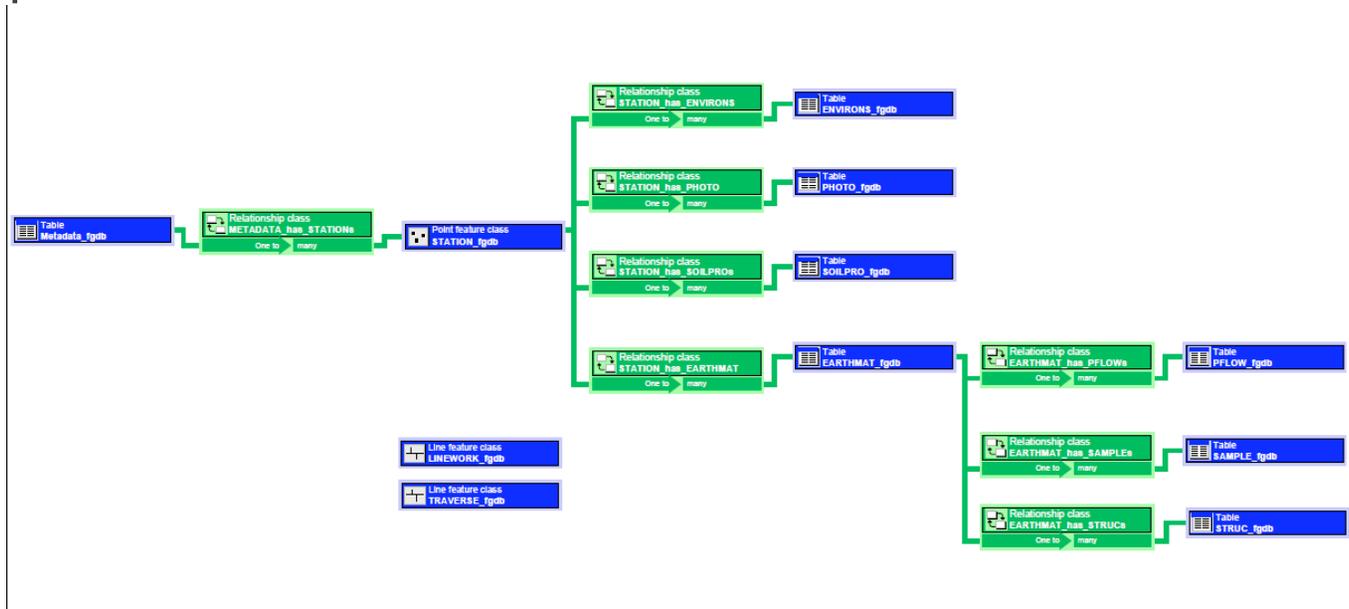
Geodatabase

- Mapped features
  - Feature classes
  - Data tables
- Metadata tables

- **Relationship Classes**

- Controls
  - Domains
  - Subtypes
  - Rules
- Tools
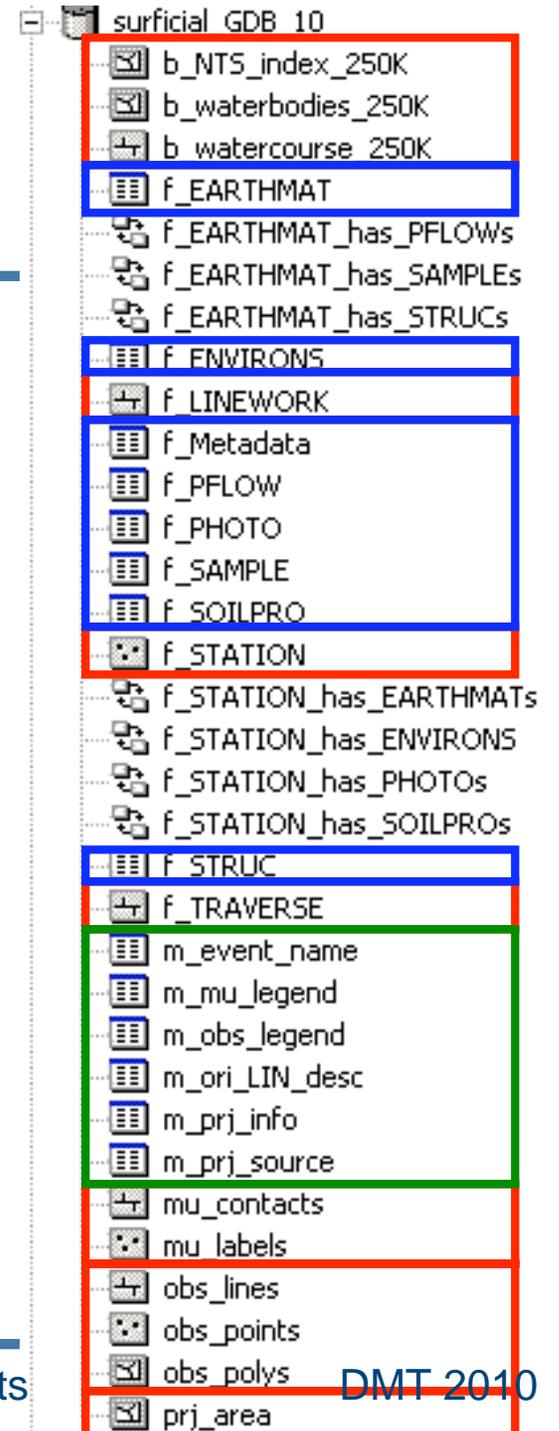
Building a surficial geology data model for mapping projects

DMT 2010

Geodatabase

- Mapped features
  - Feature classes
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- Metadata tables
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  - Domains
  - Rules
- Tools

- Science language is maintained in a separate database
  - Unique sequential number for subtype and domain values
  - Some domains are project specific

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Topology Properties

General | Feature Classes | Rules | Errors

Feature Class	Rule	Feature Class
mu_units	Contains Point	mu_labels
mu_units	Boundary Must Be Covered By	mu_contacts
mu_contacts	Must Not Overlap	
mu_contacts	Must Not Intersect	
mu_contacts	Must Not Self-Overlap	
mu_contacts	Must Not Self-Intersect	
mu_contacts	Must Be Covered By Boundary Of	mu_units
mu_contacts	Must Not Have Dangles	
mu_contacts	Must Not Have Pseudos	
mu_contacts	Must Be Single Part	
mu_units	Must Not Have Gaps	

Description...
Add Rule...
Remove
Remove All
Load Rules...
Save Rules...

OK | Cancel | Apply

Geodatabase

- Mapped features
  - Feature classes
  - Data tables
- Metadata tables
- Relationship Classes
- Controls
  - Subtypes
  - Domains
  - Rules
- **Tools**


```
Ganfeld Data Management Tools
  BEDROCK
  SURFICIAL
    1 - Project Setup
      000 Environment Settings Surficial
      001 Import New Project S
      002 Edit PickLists S
      003 Copy Edited PickLists to HH S
      004 Copy Background Data to HH S
    2 - Field operations
      01 BackUp Handheld to Computer S
      02 Backup_Photo to Computer S
      03_Import Ganfeld Shapefiles to FGDB S
      04 Create AXF S
      05 Copy AXF to handheld S
  GFM_Tools
    Check map unit labels
    Legend generator
```
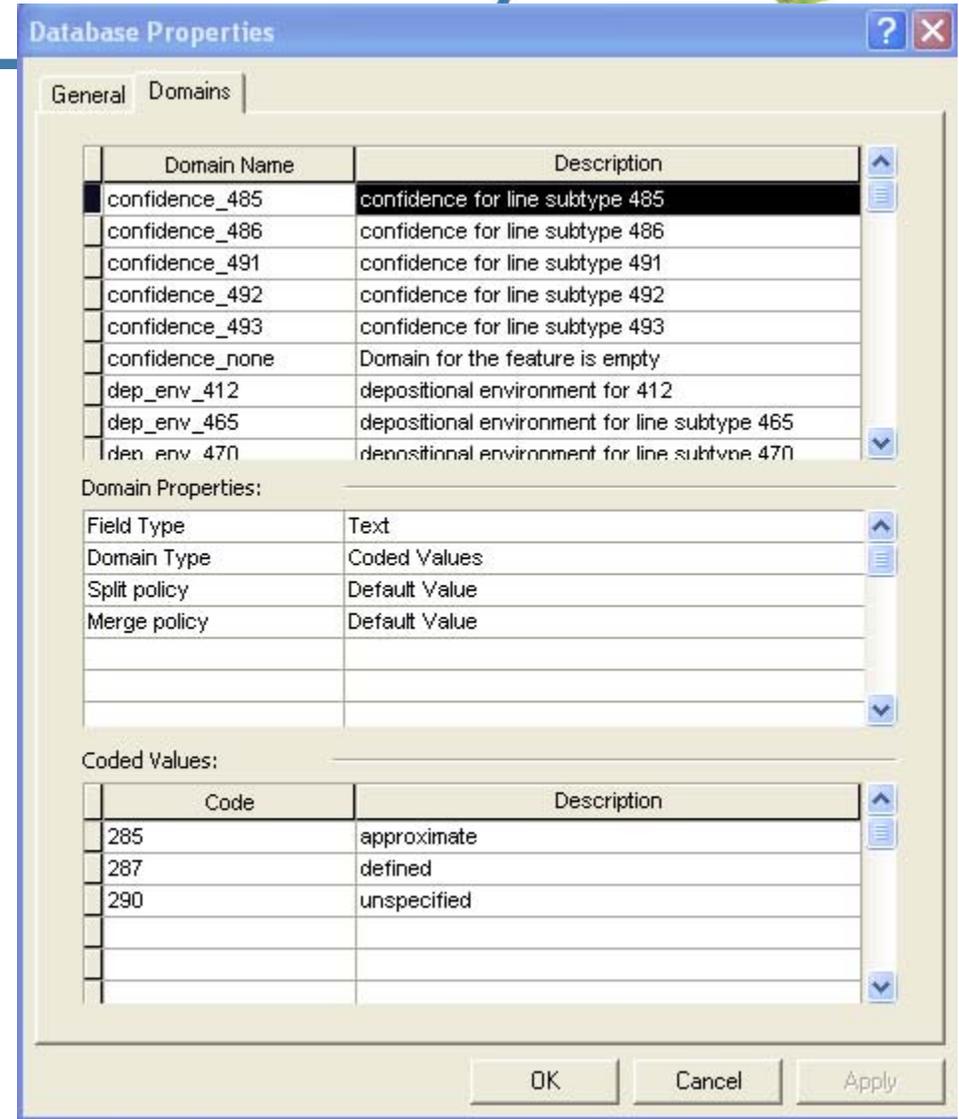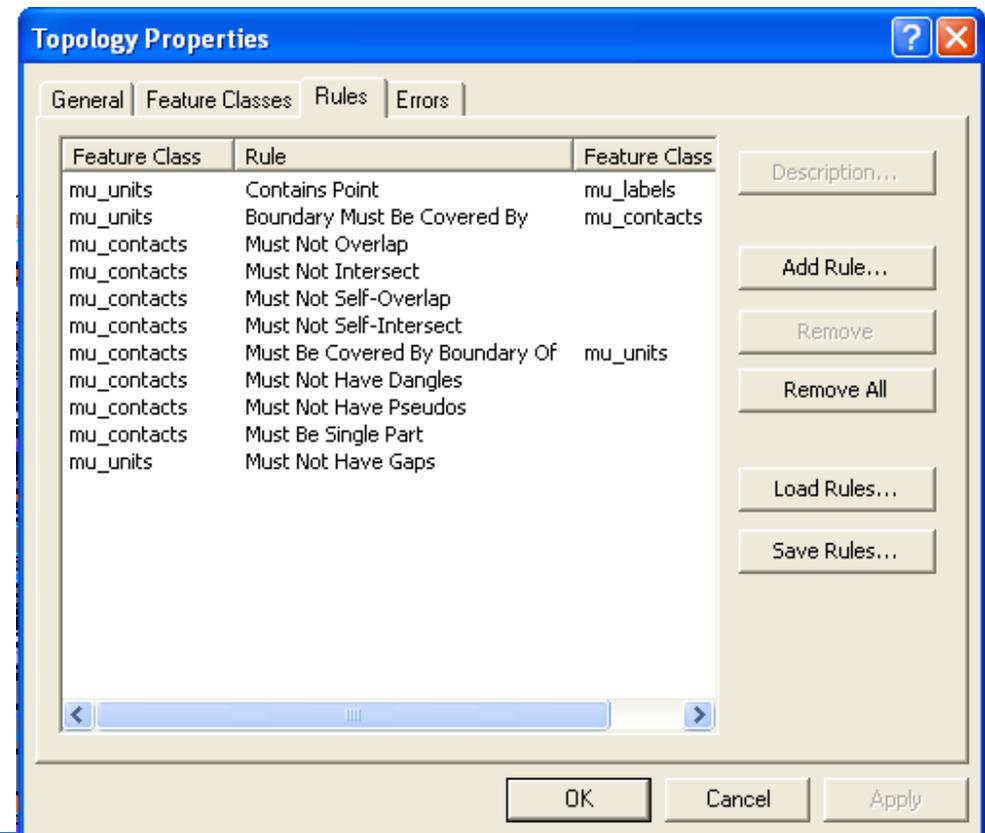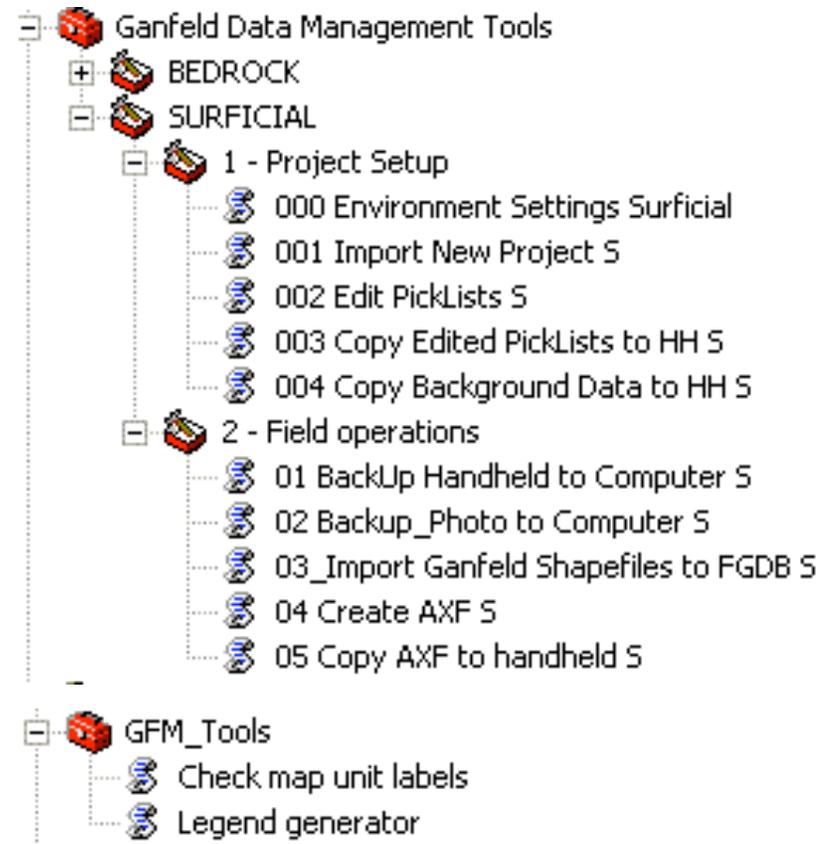
Next steps

- Science language review committee
- Tools, rules (topology, tolerance)
- Publication of science language and geodatabase schema
- Cookbook and training
- Testing Science language by loading maps from:
    - A preliminary version in a personal GDB
    - Coverages
    - Compilations
- ArcSDE implementation

Participants

Science language working group

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GanFeld application and tool development team

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Questions?

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