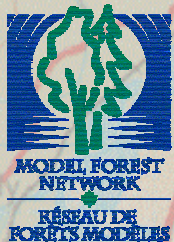


Managing Fish and Aquatics Data Using the ArchHydro Data Model

*Christian Weik
GIS Coordinator, Foothills Model Forest
Hinton, Alberta, Canada*



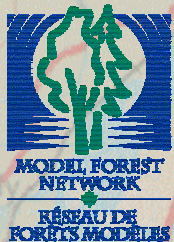
Outline

- /// Foothills Model Forest (FtMF) Overview
- /// Project Background
- /// Approach
- /// Methodology
- /// Results



Foothills Model Forest (FtMF) Overview

- ≡ The FtMF is a not for profit corporation conducting research on the ecological, economic and social values of the forest.
- ≡ One of eleven Model Forests across Canada.
- ≡ 2.75 million hectares (6.75 million acres) in the Rocky Mountains and foothills





**MCGREGOR
Model Forest**

**PRINCE ALBERT
Model Forest**

**MANITOBA
Model Forest**

**WASWANUPI
Model Forest**

**BAS-
SAINT-LAURENT
Model Forest**

**WESTERN
NEWFOUNDLAND
Model Forest**

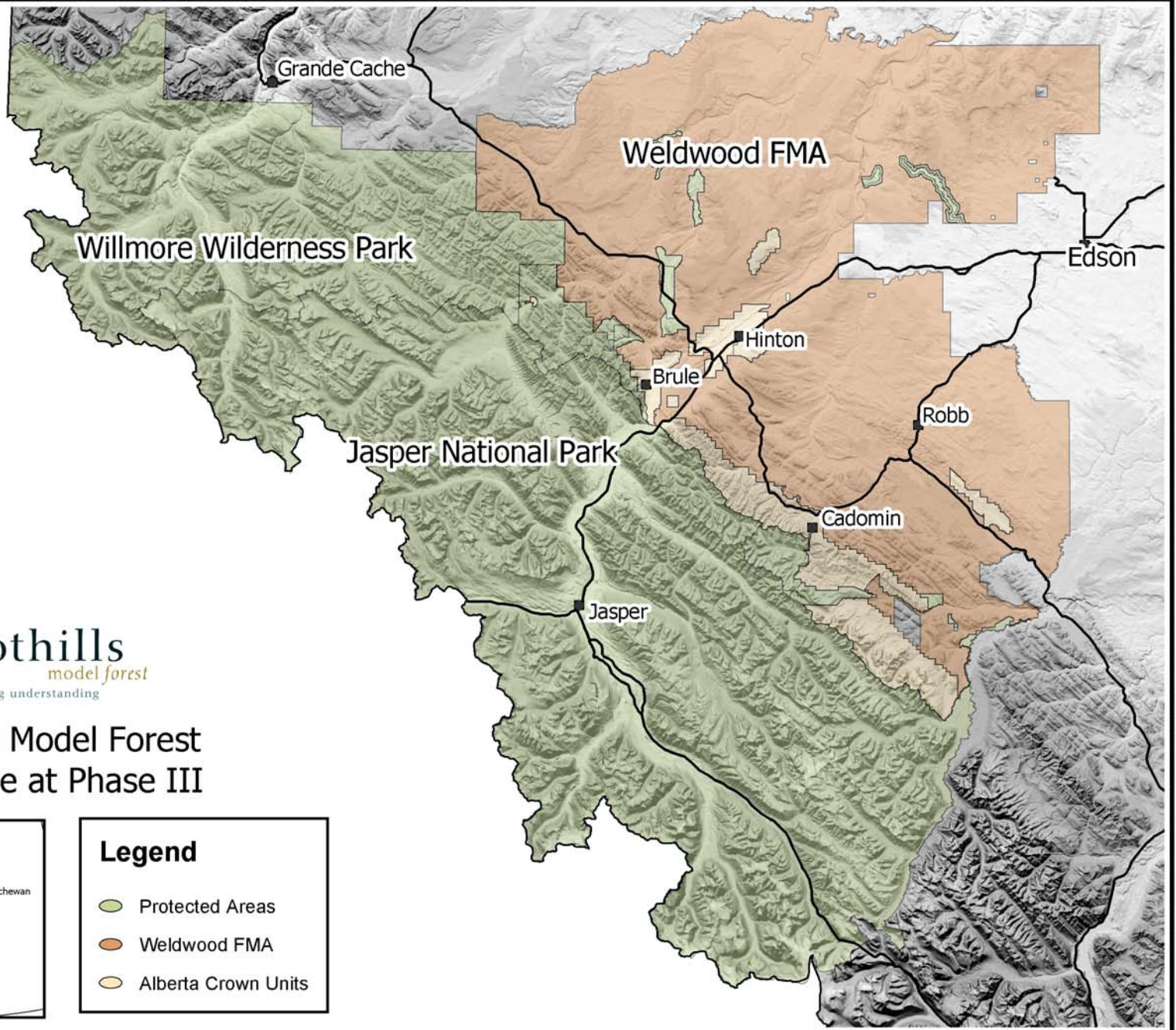
**FOOTHILLS
Model Forest**

**LAKE ABITIBI
Model Forest**

**EASTERN ONTARIO
Model Forest**

**FUNDY
Model Forest**

**NOVA
Forest
Alliance**



Foothills Model Forest Landbase at Phase III

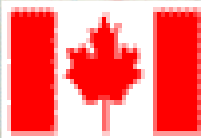


Legend

- Protected Areas
- Weldwood FMA
- Alberta Crown Units

Foothills Model Forest (FtMF) Overview...

≡ Program sponsors



Natural Resources
Canada



Canadian Heritage Patrimoine canadien
Parks Canada Parcs Canada

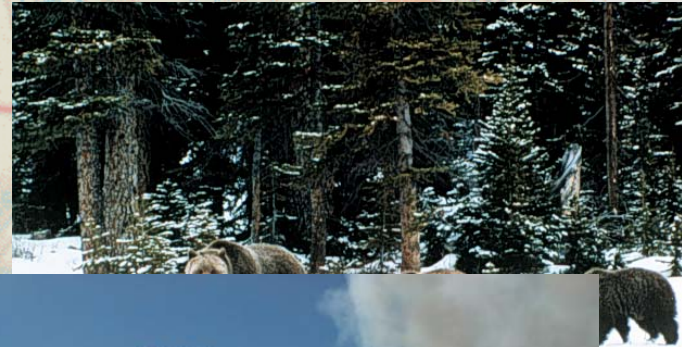
Alberta
SUSTAINABLE RESOURCE
DEVELOPMENT



Foothills Model Forest (FtMF) Overview...

≡ FtMF projects include

- ▶ *Grizzly bear*
- ▶ *Natural disturbance (predominantly fire)*
- ▶ *Aboriginal involvement*
- ▶ *Fish and watershed*



Project Background



≡ The problem

- ▶ *Fish and watershed program spending enormous amounts of time dealing with data issues*
- ▶ *Spent 2 man months in a single year fixing data problems*
- ▶ *Typical problems with aging and expanding database(s)*
 - Non-spatial data stored across several Access databases and Excel workbooks
 - Little or no constraints on data integrity
 - Inability to perform complex queries due to poor database design

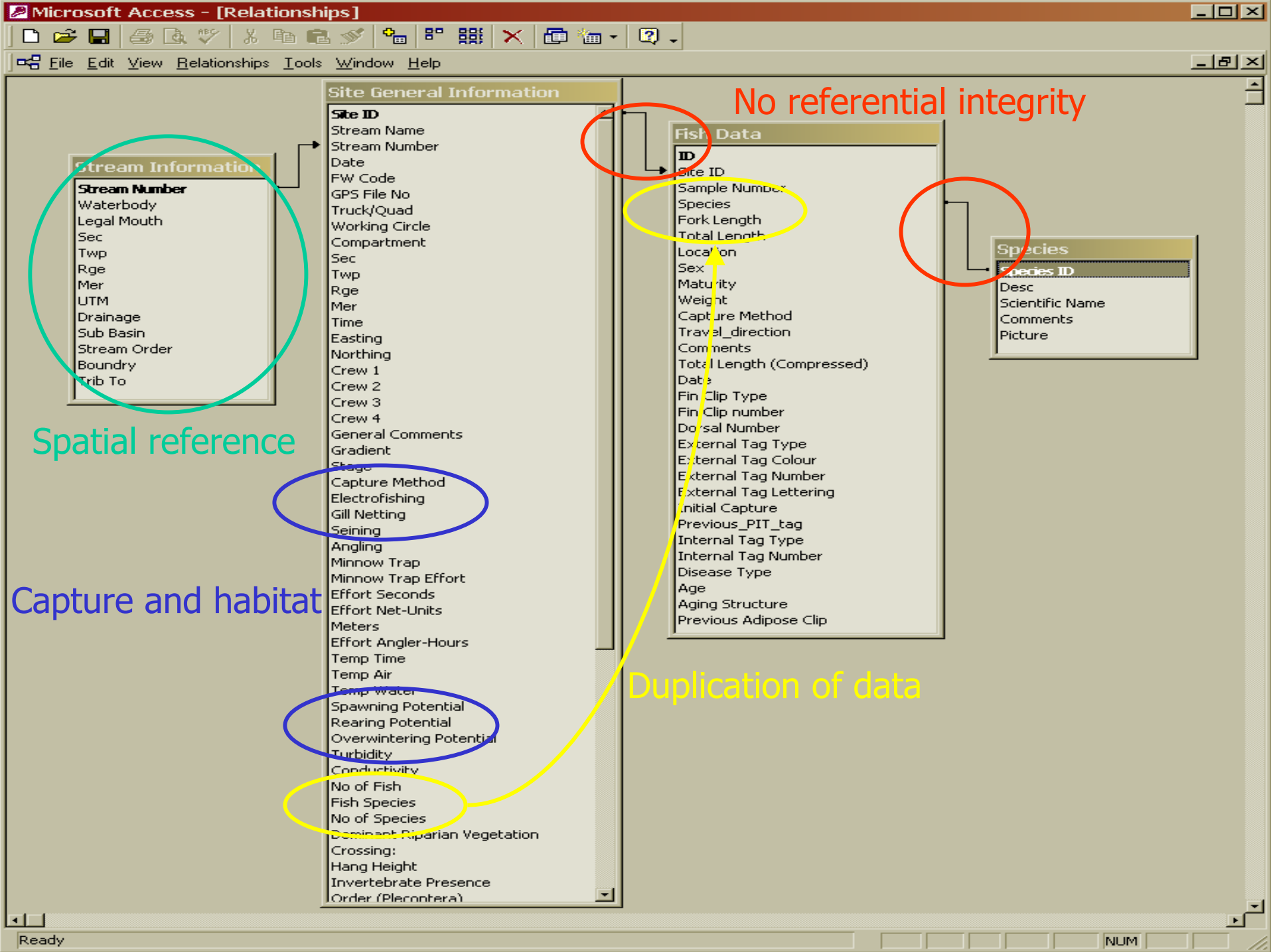
Project Background...



Additional problems with non-spatial database

- ▶ *No integrity of spatial reference columns*
 - UTM point coordinates not falling on hydrographic features
- ▶ *Considerable effort to describe spatial features without GIS*
- ▶ *Inability or difficulty in creating maps of in-stream point or linear survey locations*
- ▶ *Inability or difficulty in building maps representing explicit locations of fish presence or absence*
- ▶ *Added complexity dealing with network features*





No referential integrity

Spatial reference

Capture and habitat

Duplication of data

Stream Information
Stream Number
Waterbody
Legal Mouth
Sec
Twp
Rge
Mer
UTM
Drainage
Sub Basin
Stream Order
Boundry
Trib To

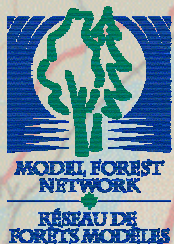
Site General Information
Site ID
Stream Name
Stream Number
Date
FW Code
GPS File No
Truck/Quad
Working Circle
Compartment
Sec
Twp
Rge
Mer
UTM
Drainage
Sub Basin
Time
Easting
Northing
Crew 1
Crew 2
Crew 3
Crew 4
General Comments
Gradient
Stage
Capture Method
Electrofishing
Gill Netting
Seining
Angling
Minnow Trap
Minnow Trap Effort
Effort Seconds
Effort Net-Units
Meters
Effort Angler-Hours
Temp Time
Temp Air
Temp water
Spawning Potential
Rearing Potential
Overwintering Potential
Turbidity
Conductivity
No of Fish
Fish Species
No of Species
Dominant Riparian Vegetation
Crossing:
Hang Height
Invertebrate Presence
Order (Plerontera)

Fish Data
ID
Site ID
Sample Number
Species
Fork Length
Total Length
Location
Sex
Maturity
Weight
Capture Method
Travel_direction
Comments
Total Length (Compressed)
Date
Fin Clip Type
Fin Clip number
Dorsal Number
External Tag Type
External Tag Colour
External Tag Number
External Tag Lettering
Initial Capture
Previous_PIT_tag
Internal Tag Type
Internal Tag Number
Disease Type
Age
Aging Structure
Previous Adipose Clip

Species
Species ID
Desc
Scientific Name
Comments
Picture

Approach

- ≡ Develop database to serve FtMF and two partner organizations
- ≡ Key requirements
 - ▶ *Consolidate databases*
 - ▶ *Better interface for data entry; both spatial and non-spatial*
 - ▶ *Improve model for better storage efficiency, query capability, and expansion potential*
 - ▶ *Ensure correct placement of in-stream surveys*



Approach...



Key requirements...

- ▶ *Enable better map representation of surveys*
- ▶ *Enable fish presence/absence mapping*
- ▶ *Provide access to users without ArcGIS 8.x*
- ▶ *House 100-110k spatial features*

Approach...

Software

- ▶ *Microsoft Access 2000*
 - Cost of full SDE
 - User familiarity, and internal application development skills
- ▶ *Personal Geodatabase*
 - Number of features (100k)
 - Multi-user and versioning not required
 - Proof of concept approach
- ▶ *ArchHydro Data Model*
 - Test concept of standard modeling approach in natural resource management
 - Potential for better data exchange
 - Potential for expansion of features to be managed



Methodology

≡ Non-spatial

- ▶ *Traditional ER data modeling approach*
- ▶ *Needs analysis, database design, database creation, forms development, testing, historical data loading*
- ▶ *Design non-required links to geodatabase*



Tahoma 8 B I U [Text Alignment Icons] [Color Icons] [Font Size Icon] [Zoom Icon] [Print Icon] [Save Icon] [Undo Icon] [Redo Icon] [Copy Icon] [Paste Icon] [Find Icon] [Help Icon]

Location Header

Unique Name: MacKenzie Creek-464 Date established: 01-Jan-1970 Loc description:
 Waterbody: MacKenzie Creek Visit start: 13-Jul-2001 Objective: Visit ID: 3723

- Creel
- Electroshocking
- Fish Trap**
- Netting
- Sample Angling
- Set Line
- Fish Observations
- Snorkel

Fish Survey

Fish Survey Code: Objectives:
 Comments:

Fish Trap

Set Date/Time: (mm/dd/yyyy hour:min:sec in 24 hour clock)
 Lift Date/Time:
 Trap Type Code:
 Trap Dimensions:
 Mesh Size Code:
 Depth of Set: m
 Comments:

Photos

Fish Survey Parameters

Fish Species	Fork Length (mm)	Total Length (mm)	Total Length Method	Sample Number	Sex Code	Maturity Code	Weight (g)	Weight Method	Pass Number	Transect Code	Comments
<input type="text" value="MNWH"/>	<input type="text" value="244"/>	<input type="text"/>	<input type="text"/>	<input type="text" value="1"/>	<input type="text"/>	<input type="text" value="NotSpec"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	
*	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	

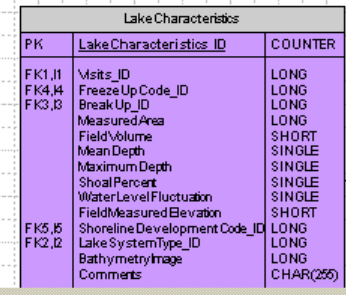
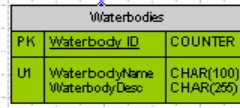
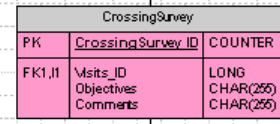
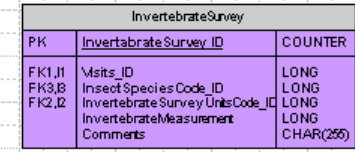
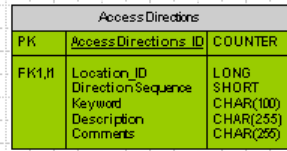
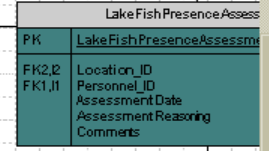
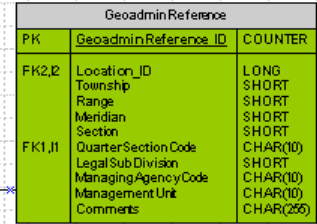
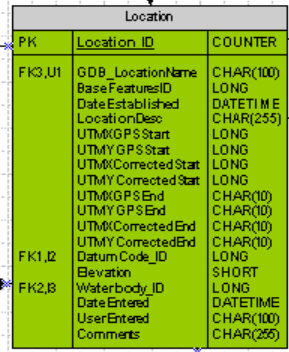
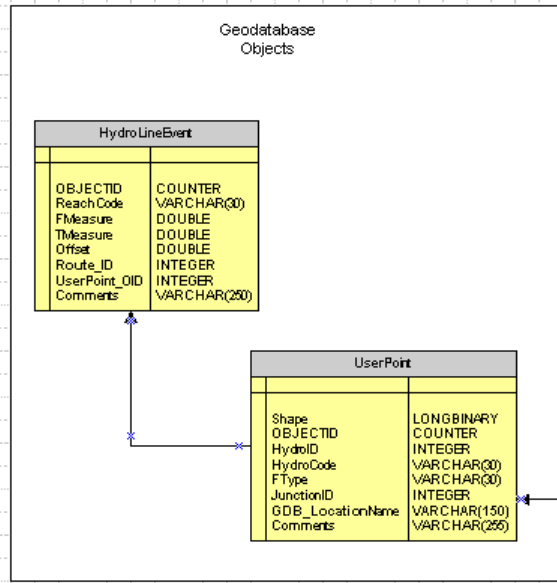
- Details
- Taqs
- Photos

Record: 1 of 1

Close

FMF Fish and Aquatics Database Development

17-Feb-2003



Methodology...

≡ Spatial

- ▶ *Applied tools provided with "ArchHydro – GIS for Water Resources"*
 - UML schema and schema wizard to generate database
 - Populate downstream distances
- ▶ *Loaded spatial layers into new feature classes*
 - HydroEdges (flowlines), HydroJunctions, HydroNetwork
 - Waterbodies (lakes, wetlands etc.)
 - User points (survey locations)
 - HydroLineEvents (linear surveys)

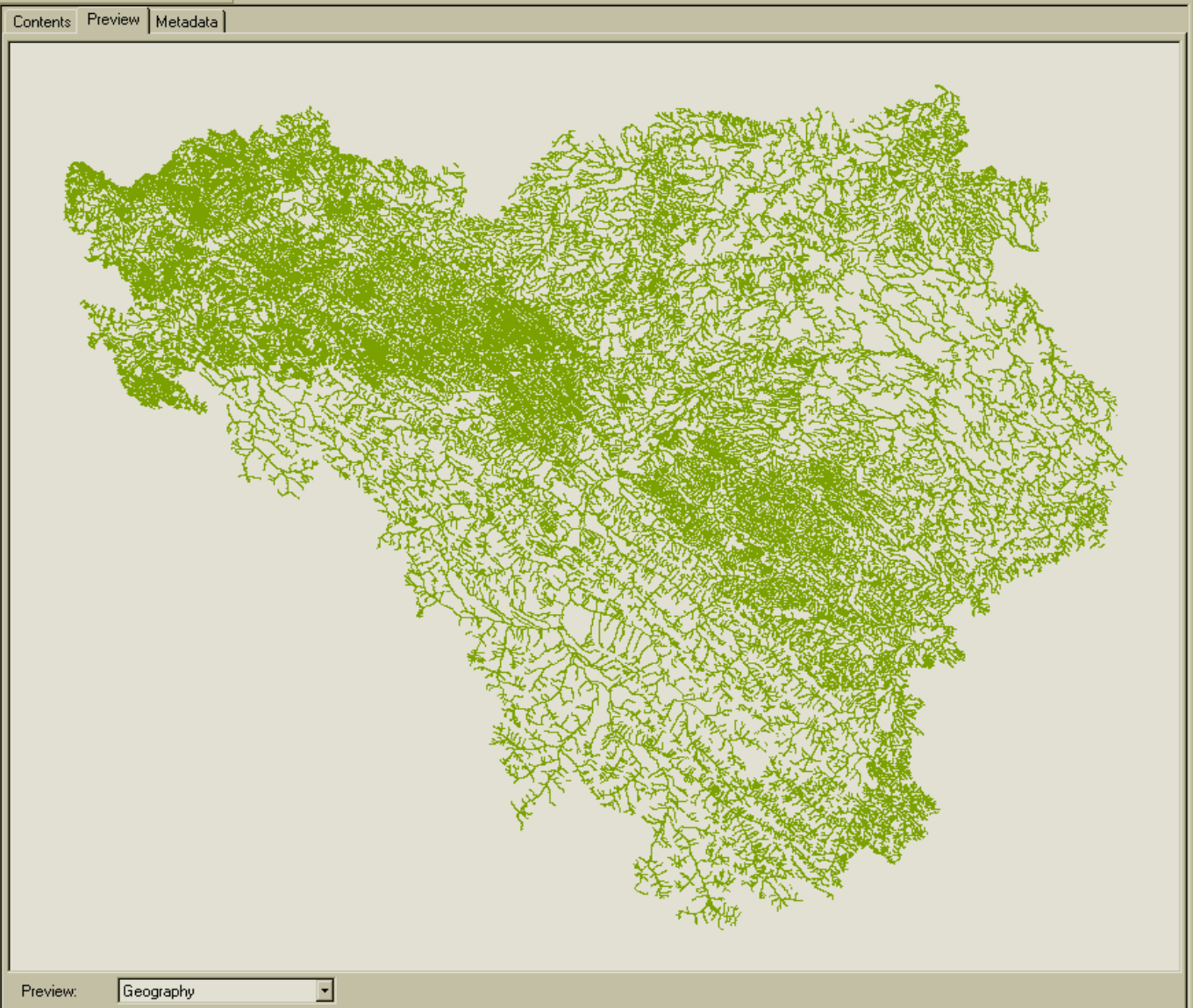
Methodology...

≡ Spatial...

- ▶ *Created feature class HydroRoutes representing path from headwaters to outflow where surveys have occurred*
- ▶ *Created topology to force all surveys to occur on HydroRoutes*
- ▶ *Added columns where necessary*
- ▶ *Retained all ArchHydro columns*
 - Hopefully retain data portability

Location: W:\fish\database\FMFFishWatershed_GDB.mdb\Network\HydroEdge

- FMFFishWatershed_GDB.mdb
 - Channel
 - CrossSection
 - ProfileLine
 - Drainage
 - Basin
 - Catchment
 - DrainageLine
 - DrainagePoint
 - Watershed
 - Hydrography
 - Bridge
 - Dam
 - HydroArea
 - HydroLine
 - HydroPoint
 - HydroResponseUnit
 - HydroRoutes
 - MonitoringPoint
 - Structure
 - UserPoint
 - UserPoints_HydroRoutes1
 - Waterbody
 - WaterDischarge
 - WaterWithdrawal
 - Network
 - HydroEdge
 - HydroJunction
 - HydroNetwork
 - HydroNetwork_Junctions
 - SchematicLink
 - SchematicNode
 - CrossSectionHasPoint
 - CrossSectionPoint
 - HydroJunctionHasWatershed
 - HydroLineEvent
 - HydroPointEvent
 - TimeSeries
 - TSType
 - TSTypeHasTimeSeries
 - UserPointHasHydroLineEvent
- FMFFishWatershed>Loading.mdb
- FMFFishWatershed_Queries.mdb
- FMFFishWatershed_Spatial.mdb
- FMFFishWatershedBACKUP05JUN.mdb
- FMFFishWatershedHOLDForTesting.mdb
- Spatial_Analysis2000.mdb



Results to date

- 85,000 features loaded
- Geometric network representing stream flow lines
- 1,300 surveys and 30,000 fish measurement records loaded
- Route systems built for about 25% of surveyed streams
 - Enable explicit survey locations and presence/absence maps*

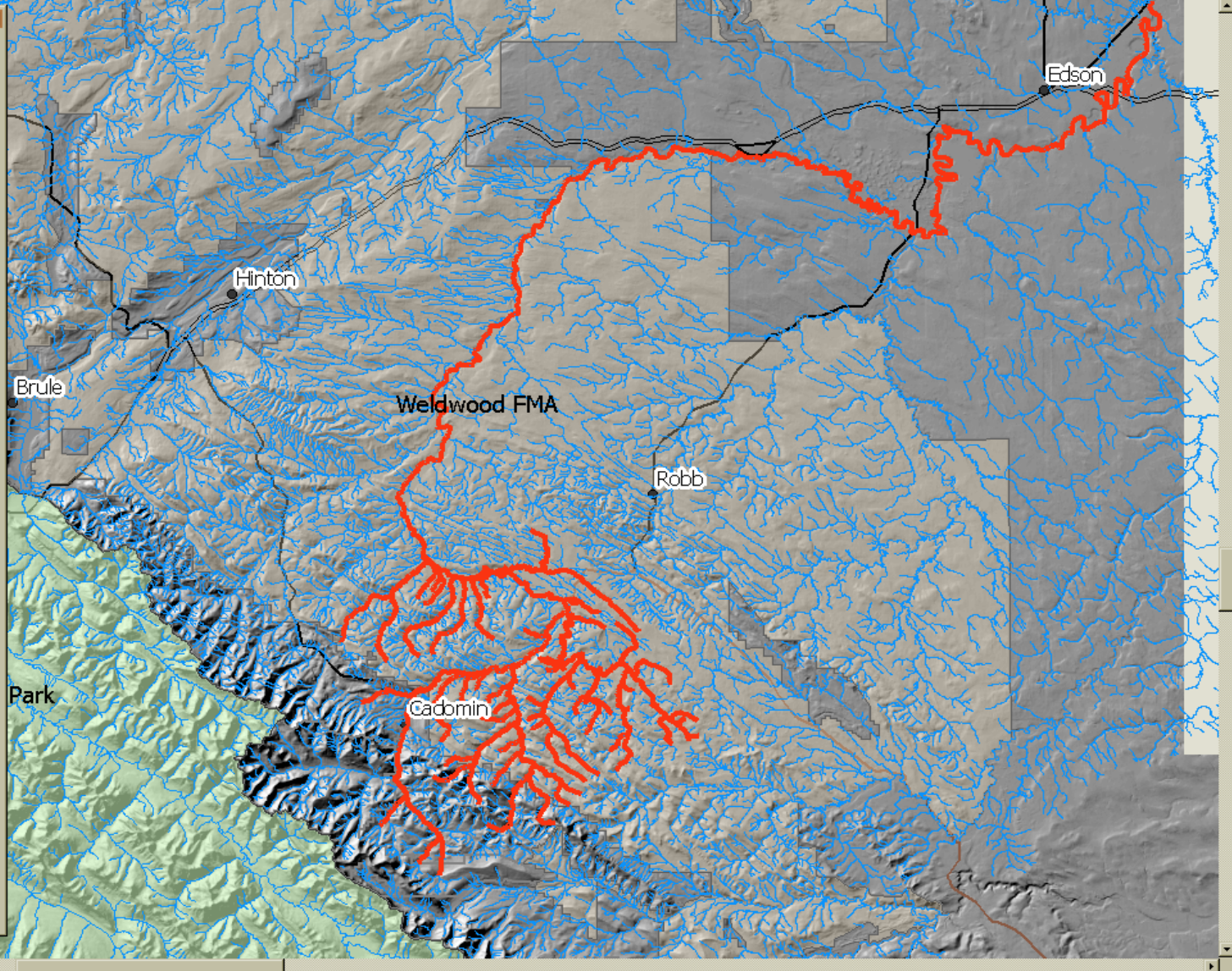


Results to date...

- ≡ Much simpler tools to manage linear referencing
- ≡ Ability to perform trace analysis on geometric network
- ≡ Non-spatial component can be used independently of the geodatabase (ArcMap) for data entry

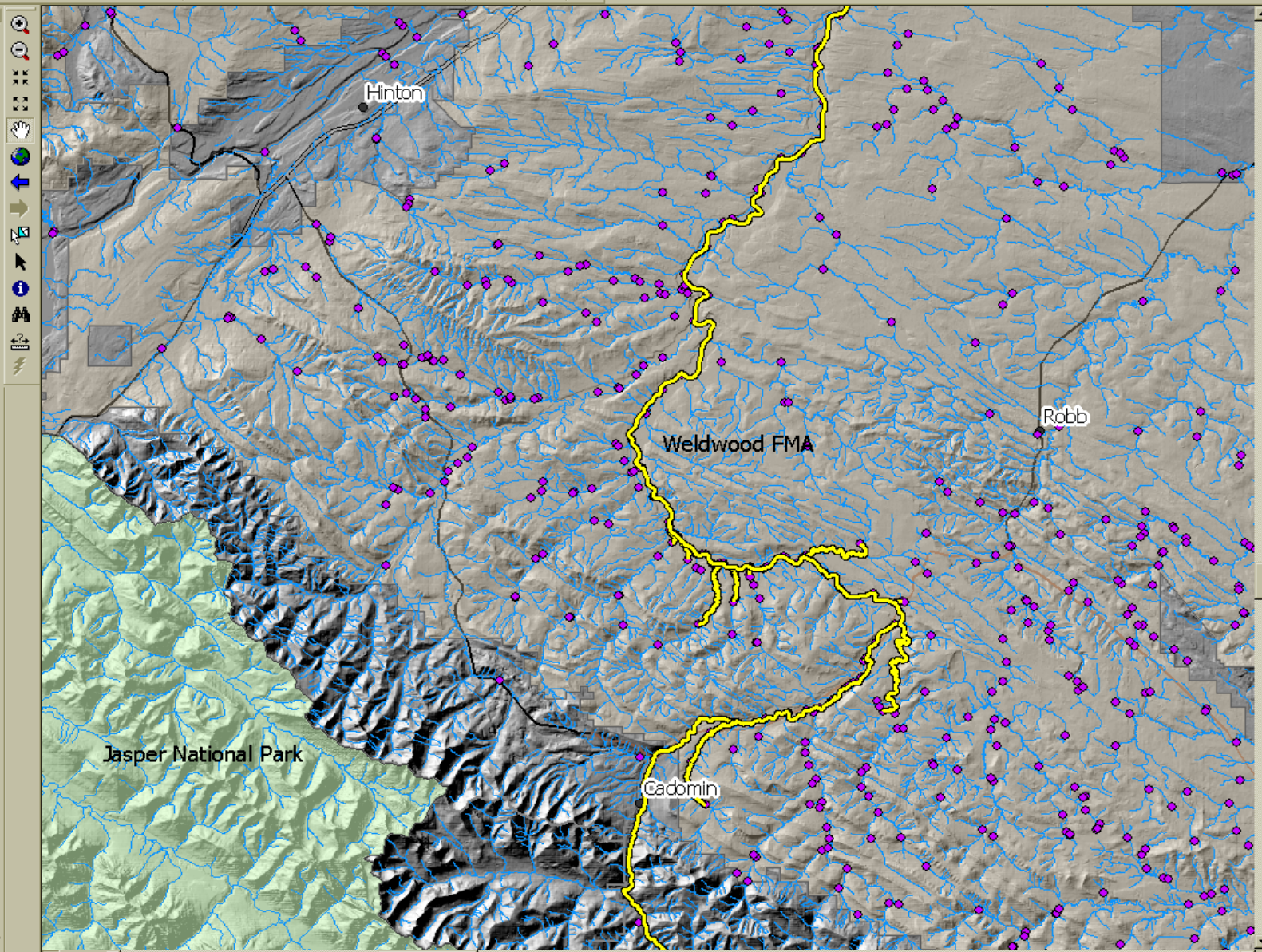
Table of Contents

- Layers
 - UserPoint
 - seismic arc
 - roads_ww arc
 - Bull Trout Present
 - MasterArcHydroGDB
 - Fish Survey Location
 - HydroRoutes
 - HydroEdge
 - <all other values>
 - EdgeType
 - Flowline
 - Shoreline
 - UserPoints_HydroRoutes1
 - Point Errors
 - TestingDatabase
 - FMF Boundary
 - Towns
 - bounds_fmf region.jasper
 - FMF Roads
 - ROAD-PAVED-DIV
 - ROAD-PAVED-UNDIV-2L
 - ROAD-GRAVEL-2L
 - ROAD-GRAVEL-1L
 - bounds_fmf region.crown
 - bounds_fmf region.fma
 - Roads 1:1M
 - MAJOR
 - Highway-Divided
 - Highway
 - Secondary Roads
 - FMF Boundary



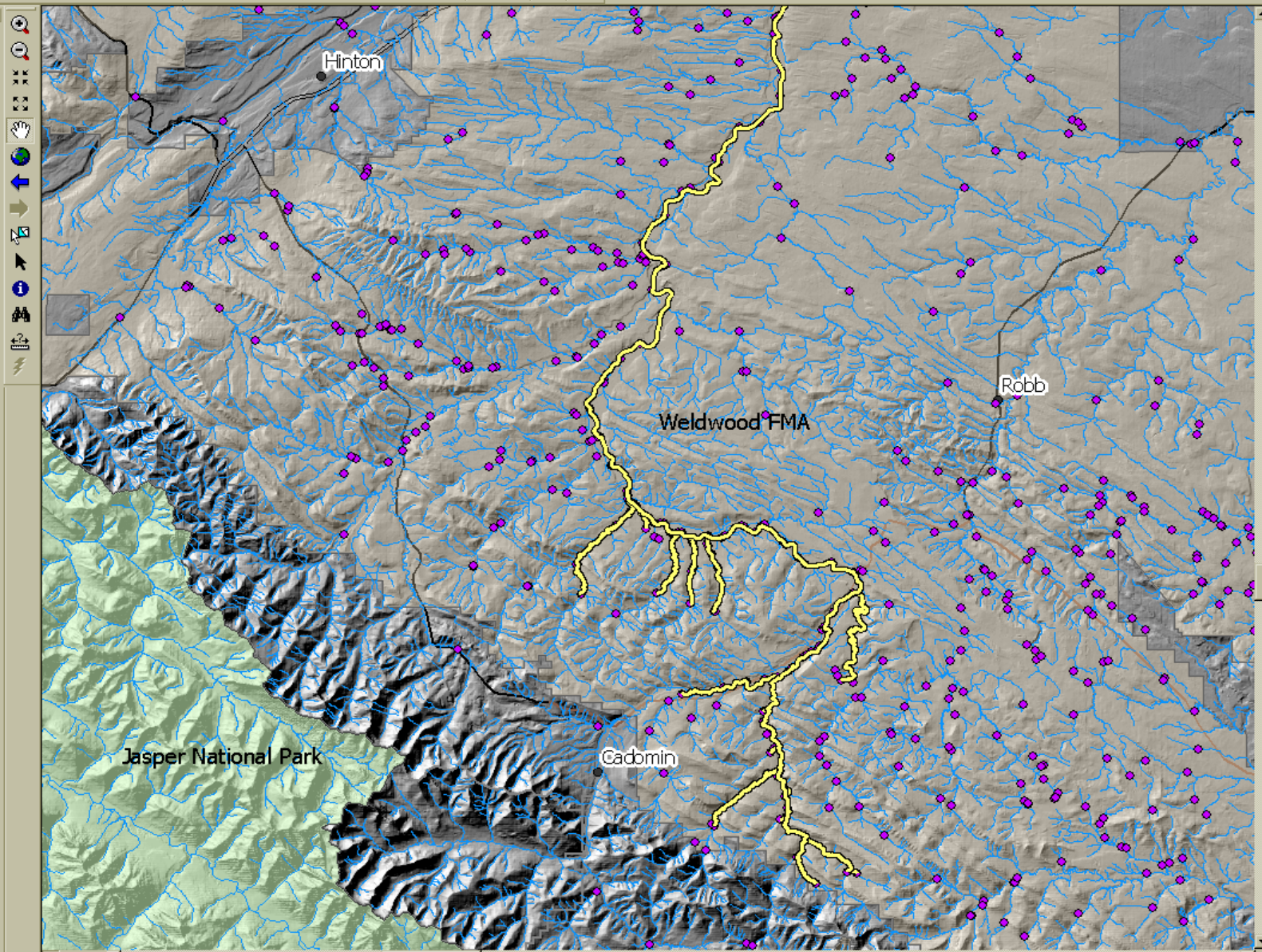
Layers

- Brook Trout Present
- MasterArcHydroGDB
 - Fish Survey Location
 - HydroEdge
 - UserPoints_HydroRoutes1
 - HydroRoutes
- TestingDatabase
- FMF Boundary



Layers

- Bull Trout Present
- MasterArcHydroGDB
 - Fish Survey Location
 - HydroEdge
 - UserPoints_HydroRoutes1
 - HydroRoutes
- TestingDatabase
- FMF Boundary



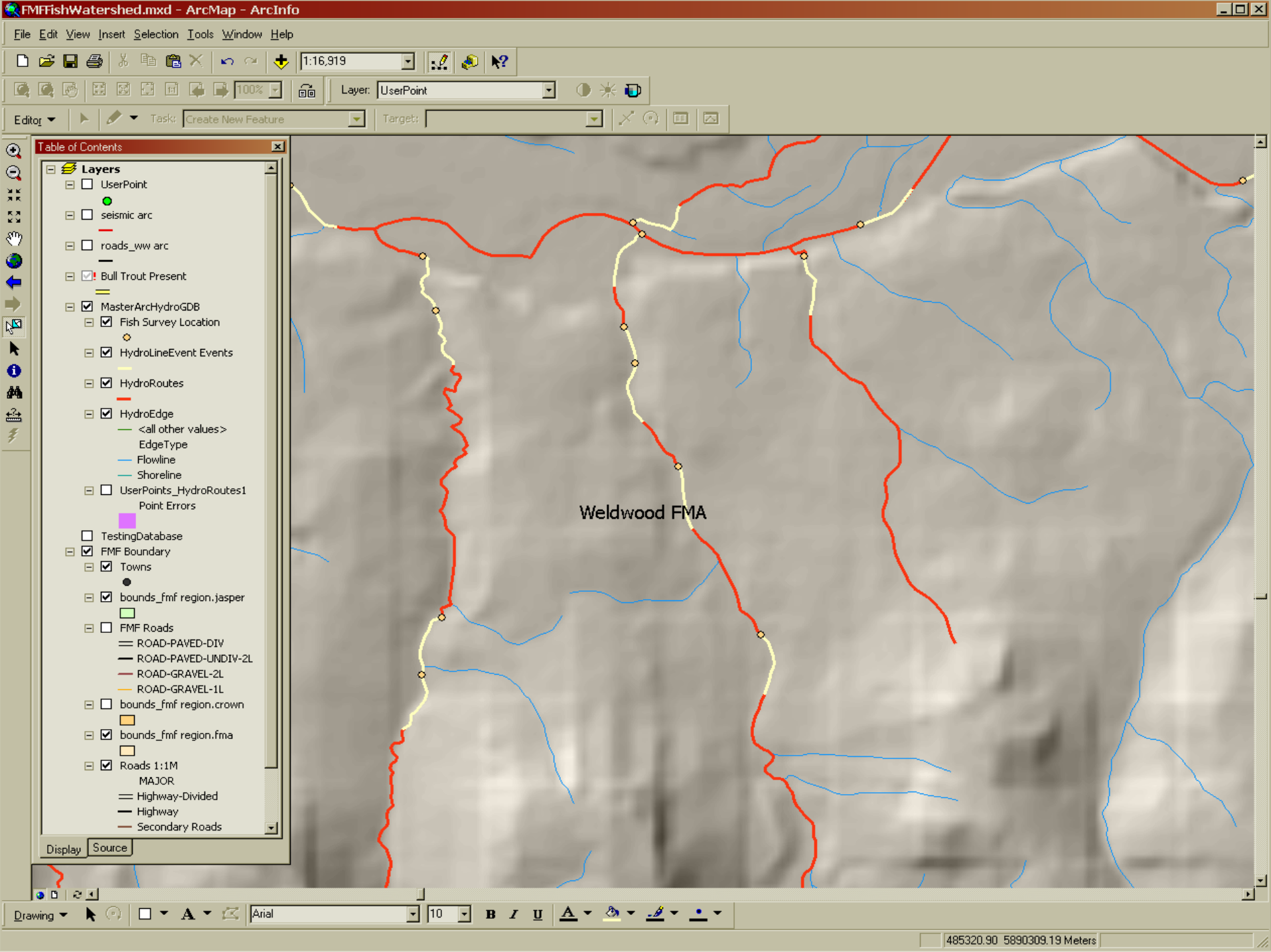


Table of Contents

- Layers
 - UserPoint
 - seismic arc
 - roads_ww arc
 - Bull Trout Present
 - MasterArcHydroGDB
 - Fish Survey Location
 - HydroLineEvent Events
 - HydroRoutes
 - HydroEdge
 - <all other values>
 - EdgeType
 - Flowline
 - Shoreline
 - UserPoints_HydroRoutes1
 - Point Errors
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 - ROAD-GRAVEL-1L
 - bounds_fmf region.crown
 - bounds_fmf region.fma
 - Roads 1:1M
 - MAJOR
 - Highway-Divided
 - Highway
 - Secondary Roads

Display Source

Weldwood FMA

Results to date...



≡ Challenges

- ▶ *Inability to add features with a unique index*
- ▶ *Inability to relate Access views (queries) as objects require a primary key field*
- ▶ *Require patches prior to operational spatial rollout*

≡ The road ahead

- ▶ *Load reach and watershed datasets once complete*
 - Support probability of occurrence models (RSF)
- ▶ *Customize interface to simplify building of survey routes and events*



End



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