

Predicting the Cost of Fiber to the Premise

Stone Environmental worked with the Nebraska Rural Independent Company and Consortia Consulting to develop a cost model for connecting rural communities to fiber broadband networks based on national geospatial data inputs.

Fiber to Premise

Connecting communities with a high-capacity fiber broadband network is a national initiative accompanied by federal funding programs and subsidies. To date, there is no standard to determine how to value these investments on a consistent basis. Rural telephone exchanges are looking for a level playing field in the competition for limited investment dollars. Multiple environmental and social factors can impact the cost of any one project, particularly in rural areas. Better tools to estimate the cost of running fiber are expected to improve targeting and distribution of funding throughout the country.

The goal of the *Fiber to the Premise* project was to develop an economic model that could accurately predict the cost of running fiber in rural areas and that was repeatable throughout the United States. A number of geospatial variables were expected to impact the cost of running fiber to premises in rural areas. These variables were extracted and compiled from nationwide geospatial datasets and tested against actual cost data to develop the cost model.

Geospatial Model Inputs

Ten geospatial variables were expected to impact the cost of running fiber. These include: number of households, road mileage soil texture road miles of bedrock, number of road intersections, number of stream intersections, percent of wetlands, frost index, rain frequency, and railroad crossing frequency (see the table on page 2). These variables were extracted by telephone exchange areas to test for significance. All variables were derived from datasets with national sources and coverage

including the Soil Survey Geographic (SSURGO) Database, the National Hydrography Dataset (NHDPlus), US Census Bureau Database, TeleAtlas, and NOAA National Climate Center Database.

Each of the variables was tested against actual engineering cost data for 168 telephone exchanges in 18 states to construct the cost model developed by Consortia Consulting and Rolka, Loube, Saltzer Associates. Six of the ten variables were statistically significant and included in the final cost model. These six variables are marked with a star in the table on the following page.

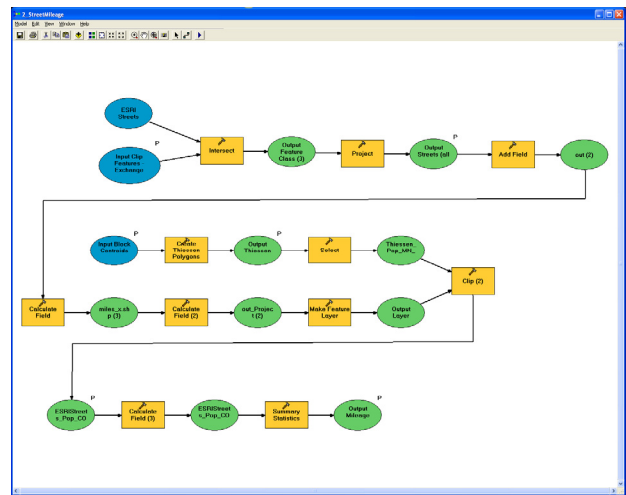


Figure 1: A screenshot of the process followed by the ModelBuilder model when extracting route miles.

Automation of Variable Extraction

The extraction of the geospatial variables from nationwide datasets was automated through a series of ArcGIS ModelBuilder models. A ModelBuilder model was developed for each variable to create a repeatable process reducing time and possible computational errors.

Variable	Description	Source
Households*	Number of households by census block summarized by telephone exchange	US Census Bureau Block Centroids (ESRI 2010)
Road Mileage*	Road miles summarized by telephone exchange, not including roads with zero population based on US Census Blocks.	Tele Atlas (ESRI 2010)
Soil Texture*	Dominant soil texture by road mile	Soil Survey Geographic (SSURGO) Database (NRCS)
Bedrock Percentage	Road miles with bedrock within 36" of surface	Soil Survey Geographic (SSURGO) Database (NRCS)
Road Intersection Frequency*	Number of road intersections summarized by exchange	Tele Atlas (ESRI 2010)
Stream Crossing Frequency	Number of road and stream intersections summarized by exchange	Tele Atlas (ESRI 2010) and NHDPlus (USGS)
Wetlands Percentage*	Percentage of road miles intersecting wetlands	Tele Atlas (ESRI 2010) and US Fish and Wildlife Service
Frost Index*	Average number of frost free days	Soil Survey Geographic (SSURGO) Database (NRCS)
Rain Frequency	Average number of days with > 5 inches precipitation	NOAA National Climate Data Center (1975 - 2000)
Railroad Crossing Frequency	Number of road and railroad intersections summarized by exchange	Tele Atlas (ESRI 2010)

The model combines many steps that would be used to extract any one of the variables from the source datasets. For example, when extracting route miles, the model steps through the following processes (See Figure 1 for a screenshot of the ModelBuilder model used to execute the following steps):

- 1) Clip TeleAtlas streets (from ESRI Streetmap) to telephone exchange boundaries.
- 2) Assign telephone exchange identification numbers to road segments.
- 3) Develop Thiessen polygons for US Census Blocks from centroids to determine areas with zero population.

- 4) Extract streets for areas with greater than zero population.
- 5) Summarize road miles by FCC road class within each exchange.

The execution of the ModelBuilder models is similar to executing any tool within the ArcMap Toolbox with an easy-to-follow user interface (Figure 2). The models are also easily adaptable if workflows change over time.

Use of the Fiber-to-Premise Cost Model

The Nebraska Rural Independent Company filed the paper and model with the FCC in January 2011. The FCC will consider this filing as part of their deliberations in the replacement of the Universal Service Fund that is expected in the next year.

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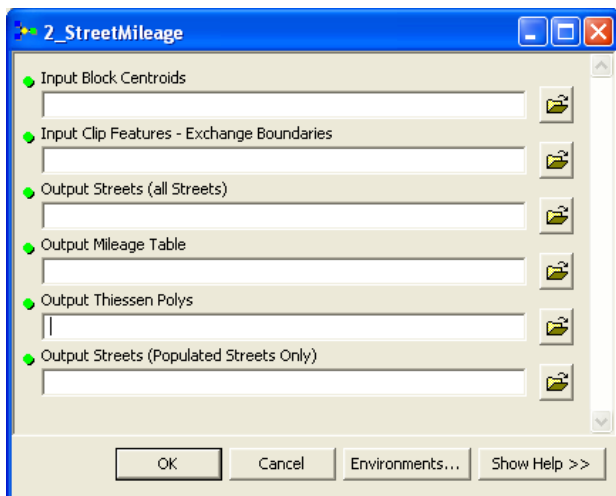


Figure 2: An easy-to-follow user interface simplifies tool execution in ModelBuilder.



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