

Objective: Users will step through the model, format input data layers from multiple sources, and create five raster layers that can be summed to create the UTRI. The final UTRI is then assigned back to the street segment layer for field verification, urban forest risk management, disaster planning, debris stratification, and/or response prioritization.

UTRI GIS Model Worksheet & Tool Description

Project Name: _____ Folder: _____
 Geodatabase: _____ Coordinate System: _____ Resolution: _____ meters

Process Step	Data Source	GIS ³ /Model Processing ⁴	Model Tools	Data Layer(s) ⁵	Input Attribute	Output Attribute	Assignment or Reclass	Model Notes	GIS Processing Notes (As Built)
1 Assemble data layers needed (see Data Source column for steps 1-10). Create a folder & subfolders for the project; for example: ...\\UTRI2012Elmore ...\\UTRI2012Elmore\\SourceData ...\\UTRI2012Elmore\\Maps ...\\UTRI2012Elmore\\Documents).	See below in this column and Notes column links.	NA	NA	NA	NA	NA	NA	http://www.census.gov http://www.mrlc.gov https://www.hifldwg.org Other local/regional/state sources	Input Layers: Output Layers: Other Comments:
2 Create an ArcMap personal/file geodatabase and map document (i.e. project) in the project "root" folder from the previous step. Set the default geodatabase.	NA	<u>ArcCatalog</u> ▪ Create/select folder File=>New Personal Geodatabase <i>ProjectNameDate</i> <u>ArcMap</u> File New... Dialog=>Default geodatabase	NA	NA	NA	NA	NA	The geodatabase is an excellent file/layer organizational tool and may also function as process documentation. It should hold all intermediate layers used in the processing as well as the final vector and raster layers. An example <i>ProjectNameDate</i> might be: <i>UTRI2012Elmore.mdb</i> The original supporting data (e.g. NLCD or Census) does not have to be placed into the geodatabase. Set projection and datum for the geodatabase and then make it the 'default' geodatabase when you create your map document (i.e. the mxd; the 'project'). Note: Users may opt to use ArcGIS shapefiles and stand-alone raster files if desired. Layer name may be used as the shapefile and raster file names.	Input Layers: Output Layers: Other Comments:
3 Create project boundary; i.e. the area of interest (AOI)	2010 Census TIGER Lines - Geographic Areas=>Counties (and equivalent)	<u>Data Download</u> ▪ Census data or other <u>UTRI Model</u> ▪ Select feature (AOI) ▪ Extract AOI feature ▪ Buffer to 1k or desired distance ▪ Project to project coordinates <u>ArcMap</u> TB=>Select Feature (e.g. County) RC=>Data=>Export Data <u>ArcToolbox</u> Analysis Tools=>Proximity=>Buffer	02_UTRI-AOI	AOI_Region AOI_County AOI_City AOI_Other	NA	NA	NA	Source: http://www.census.gov/cgi-bin/geo/shapefiles2010/main . Use UTRI model tool or ArcToolbox. This step may include multiple levels (e.g. county, municipality, neighborhood). Intermediate layer names should lead to or reflect the final layer to be used by UTRI; e.g. <i>AOI_CountyCensus (i.e. first data export layer)</i> <i>AOI_County (i.e. after projection and datum set)</i> <i>AOI_County1k (e.g. 1 kilometer buffer)</i>	Input Layers: Output Layers: Other Comments:
4 Process streets (Targets)	2010 Census TIGER Lines - Features => All Lines (i.e. "edges") or... Features => Roads =>All	<u>Data Download</u> ▪ Census data or other <u>UTRI Model</u> ▪ Add UTRI_T (set to 0) ▪ Clip with AOI ▪ Project to project coordinates ▪ Classify ▪ Buffer to right-of-way (ROW) extent <u>ArcToolbox</u> ▪ Convert to raster at project resolution ATB=>Conversion Tools=>To Raster=>Feature to Raster	03_UTRI-Street 03_UTRI-Blocks	AOI_Street vStreet rStreet	MTFCC	UTRI_S to raster cell	UTRI_S & Cell: S1100 = 4 S1200 = 3 S1300/S1400 = 2 Others important to your community = 1 All else = 0	Source: http://www.census.gov/cgi-bin/geo/shapefiles2010/main . UTRI_S is an integer value. (STREET) Use 50' buffer from centerline or appropriate width based on street type for the segment or other local knowledge to create the polygon vector layer of street segments. Trees within the street buffer represent the area of concern for disaster planning if they can adversely affect people, facilities, or transportation.	Input Layers: Output Layers: Other Comments:
4a Process facilities (Targets)	Local or HSIP Gold	<u>Data Download</u> ▪ Data as available <u>UTRI Model</u> ▪ Add UTRI_F (set to zero) ▪ Clip with AOI ▪ Project to project coordinates ▪ Classify ▪ Buffer facility vicinity <u>ArcToolbox</u> ▪ Convert to raster at project resolution	04_UTRI-Facility	AOI_Facility vFacility rFacility	Name or description	UTRI_F to raster cell	UTRI_F & Cell: Hospitals=5 Fire, Police, Emergency Management Center = 4 Communication Towers, Water Treatment Plants, Water Towers, Waste Water Treatment Plants = 3 Schools, Parks, and	Source: Local or HSIP CD. UTRI_F is an integer value. (FACILITY) Buffer the facilities with a 100 meter or 200 meter radius. This represents the "immediate area" of risk for each critical facility.	Input Layers: Output Layers: Other Comments:

³ ArcGIS is ArcCatalog, ArcMap, ArcToolbox, and ArcGIS Extensions; **TB** refers to ArcMap menu tools & toolbars; **ATB** refers to the ArcToolbox, **TOC** is the ArcMap table of contents, **RC** is 'right-mouse click'; **Dialog** is the input dialog window from a menu selection (e.g. *New...*).

⁴ "=>" Indicates ArcGIS menu selections.

⁵ Suggested layer names; AOI is **area of interest** and used for clipping. Some steps will have multiple layers; use **v** prefix for vector and **r** prefix for raster in those cases (e.g. vStreet and rStreet represent the same data).

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Process Step	Data Source	GIS ³ /Model Processing ⁴	Model Tools	Data Layer(s) ⁵	Input Attribute	Output Attribute	Assignment or Reclass	Model Notes	GIS Processing Notes (As Built)
Process facilities (for Step 4b that follows)		<p>ATB=>Conversion Tools=>To Raster=>Feature to Raster</p> <p><u>Data Download</u></p> <ul style="list-style-type: none"> Data as available <p><u>UTRI Model</u></p> <ul style="list-style-type: none"> NA <p><u>ArcToolbox</u></p> <p>ATB=>Analysis Tools=>Proximity=>Buffer</p>		vFacilityZone		UTRI_F	<p>other locations where people congregate = 2</p> <p>Others important to your community = 1</p> <p>All else = 0</p>	<p>UTRI_F is an integer value as assigned in vFacility.</p> <p>Selected critical facilities (e.g. use two highest UTRI_F levels) should be buffered to a distance of 3000 meters to 5000 meters and used in the next step that identifies critical routes for these facilities in the AOI.</p>	
4b Process streets (Access to Facilities)	2010 Census TIGER Lines - Features => Roads => Primary/Secondary vFacilityZone	<p><u>Data Download</u></p> <ul style="list-style-type: none"> Data as available <p><u>UTRI Model</u></p> <ul style="list-style-type: none"> Add UTRI_C (set to zero) <p><u>ArcMap Tools</u></p> <ul style="list-style-type: none"> Cumulative UTRI_F into UTRI_C <p>RC=>[TOC Layer] Open Attribute Table</p> <p>TB=>Selection=>Select by attribute</p> <p>TB=>Selection=>Select by location</p> <p>RC=>[Attribute Name] Field Calculator</p> <p><u>ArcToolbox</u></p> <ul style="list-style-type: none"> Convert to raster at project resolution <p>ATB=>Conversion Tools=>To Raster=>Feature to Raster</p>	NA	vCFstreet rCFstreet	UTRI_F	UTRI_A to raster cell	<p>Cumulative UTRI_A from the critical facility zones layer.</p>	<p>UTRI_A is an integer value. (Access)</p> <p>This will be the GIS layer of primary roads in the AOI; assigned the risk ratings for all facilities that depend on that particular street or street segment; segment risk is cumulative for all critical facilities (CF) in vFacilityZone.</p> <p>When making calculations for street segment rating for facility access:</p> <p><i>work alternatively in two layers: vFacilityZones, vCF_Streets</i></p> <p><i>set all UTRI_C to one (1) in v_CF_Streets</i></p> <p><i>use a "Select by Attributes..." for UTRI_F > x (rating desired)</i></p> <p><i>calculate UTRI_C = UTRI_C + x</i></p>	<p>Input Layers:</p> <p>Output Layers:</p> <p>Other Comments:</p>
5 Process population (Targets)	2010 Census or HSIP LANDSCAN	<p><u>Data Download</u></p> <ul style="list-style-type: none"> Census data or other <p><u>UTRI Model</u></p> <ul style="list-style-type: none"> Extract population in AOI Convert to vector (polygon) Project to project coordinates Calculate square miles (=acres/640; =square feet/27878400; =square meters/2589988) Calculate population/square mile Reclassify <p><u>ArcToolbox</u></p> <ul style="list-style-type: none"> Convert to raster at project resolution <p>ATB=>Conversion Tools=>To Raster=>Feature to Raster</p>	05_UTRI-Census	vCensus rCensus		SqMiles Pop_SqMile UTRI_P to raster cell	<p>Classification- Try Quantile, Natural Breaks (Jenks) or other symbol classification technique with four or five classes.</p> <p>UTRI_P & Cell:</p> <p>Class 5 = 4</p> <p>Class 4 = 3</p> <p>Class 3 = 2</p> <p>Class 2 = 1</p> <p>Class 1 = 0</p>	<p>Source: http://www.census.gov/cgi-bin/geo/shapefiles2010/main.</p> <p>Source: Local or HSIP CD.</p> <p>UTRI_P is an integer value. (POPULATION)</p> <p>When making calculations for population density:</p> <p><i>set all Pop_SqMile to zero (0)</i></p> <p><i>use a "Select by Attributes..." for areas > 0 (square miles)</i></p> <p><i>calculate Pop_SqMile = Population/SqMiles</i></p> <p>Areas with zero population / square mile should be set to UTRI_P = 0.</p>	<p>Input Layers:</p> <p>Output Layers:</p> <p>Other Comments:</p>
6 Process tree canopy (Potential Tree Failure)	NLCD (USGS) NAIP (FSA)	<p><u>Data Download</u></p> <ul style="list-style-type: none"> Most current NLCD tree canopy Or, local tree canopy Or, classify most recent NAIP <p>UTRI Model (NLCD)</p> <ul style="list-style-type: none"> Clip to buffered AOI Reclassify (raster operation) Project to project coordinates <p><u>ArcToolbox</u></p> <p>ATB=>Data Management Tools=>Raster=>Raster Processing=>Clip</p> <p>ATB=>Data Management Tools=>Projections and Transformations=>Raster=>Project Raster</p> <p>ATB=>Spatial Analyst Tools=>Reclass=>Reclassify</p>	06_UTRI-Canopy	AOI_Canopy rCanopy	Cell Value	Cell value (UTRI_T)	<p>Classification- Try Quantile, Natural Breaks (Jenks) or other symbol classification technique to create from five or eleven classes.</p> <p>Cell (UTRI_T):</p> <p>91-100 = 10</p> <p>81-90 = 9</p> <p>71-80 = 8</p> <p>61-70 = 7</p> <p>51-60 = 6</p> <p>41-50 = 5</p> <p>31-40 = 4</p> <p>21-30 = 3</p> <p>11-20 = 2</p> <p>1-10 = 1</p> <p>0 = 0</p>	<p>Tree canopy is available from the MRLC: http://www.mrlc.gov/index.php</p> <p>The National Land Cover Database (NLCD 2001) tree canopy layer is downloaded as a raster and the cell value represents percent of tree canopy (from 0 to 100%) for the 30 meter pixel.</p> <p>This is a single file for the entire coterminous US and is in the Albers projection and in meters, WGS84.</p> <p>The MRLC Consortium Viewer at: http://gisdata.usgs.gov/website/mrlc/viewer.htm can be used to download an area that includes a single or multiple counties (not by county boundary but by rectangular selection area that you estimate will include your AOI). This raster file can then be clipped with the AOI.</p> <p>When downloading from the viewer the default is to get the landcover dataset. To specify tree canopy, click on the download tab (in the right panel), and uncheck landcover and select tree (forest) canopy.</p> <p>Then make your download area with the selection box tool (in the left panel near the bottom).</p> <p>ArcGIS Spatial Analyst Extension is required for most of the operations in this and the following steps.</p>	<p>Input Layers:</p> <p>Output Layers:</p> <p>Other Comments:</p>
6a Area of Interest Mask	vStreet	<p><u>Data Download</u></p> <ul style="list-style-type: none"> Streets from Step 6 		vAOImask rAOImask	Select any integer attribute with a value of 1	Cell	<p>Assign value of 1 to the areas within the AOI that should have a risk index</p>	<p>Use approximately 3x the distance used in Step 3; 150' buffer from centerline or appropriate width based on street type for the segment or other local knowledge to create the polygon</p>	<p>Input Layers:</p>

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		<u>UTRI Model</u> <ul style="list-style-type: none"> Buffer to a distance that exceeds right-of-way (ROW) extent <u>ArcToolbox</u> <ul style="list-style-type: none"> Convert to raster at project resolution ATB=>Conversion Tools=>To Raster=>Feature to Raster			(or due field calculator to set it)		calculated; otherwise NoDATA .	vector layer of street segments. When buffering, select "merge polygons". This raster layer will be used to mask OUT all areas that are beyond the buffer.	Output Layers: Other Comments:
7 Create UTRI (Raster)	rStreet rFacility rCFstreet rCensus rCanopy rAOImask	<u>Data Download</u> <ul style="list-style-type: none"> NA <u>UTRI Model</u> <ul style="list-style-type: none"> Run model to sum individual layer cell values <u>ArcToolbox</u> ATB=>Spatial Analyst Tools=>Map Algebra=>Raster Calculator ATB=>Spatial Analyst Tools=>Reclass=>Reclassify	07_UTRI-Index	rUTRIsum rUTRI	UTRI_S (cell) UTRI_F (cell) UTRI_A (cell) UTRI_P (cell) UTRI_T (cell)	Cell Value	Classification- Try Quantile, Natural Breaks (Jenks) or other symbol classification technique to create four or five classes. Once break points are determined use the raster reclassify tool to create a final reclassified raster layer.	Reclassification of input layers may be performed to create more suitable risk index upon summation. Use ArcMap RC=>Properties->Symbology dialog to view the Jenks Natural Breaks to set and test breaks in the data prior to reclassification. The final rUTRI layer is created from the reclassification of this rUTRIsum into four classes: 1:Low, 2:Moderate, 3:High, and 4:Very High. See Appendix D for Raster Calculator details for syntax and weighting of layers.	Input Layers: Output Layers: Other Comments:
8 Create UTRI (Vector)	rUTRI	<u>Data Download</u> <ul style="list-style-type: none"> NA <u>UTRI Model</u> <ul style="list-style-type: none"> NA <u>ArcToolbox</u> <ul style="list-style-type: none"> Convert UTRI raster to vector and assign UTRI risk rating to street segments for field verification and stratification components. ATB=>Conversion Tools=>From Raster=>Raster to Polygon and... ATB=>Analysis Tools=>Overlay=>Spatial Join or possibly... ATB=>Analysis Tools=>Overlay=>Identify or possibly... ATB=>Analysis Tools=>Overlay=>Union	08_UTRI-R2V	vUTRI	NA	Cell values summed to UTRI (grid_code)	NA	After conversion to a polygon layer, the original street layer (AOI_Street) is assigned the corresponding UTRI value (obtained in the conversion from raster). A street segment may intersect from 1 to n raster cells that are summed into the final UTRI and assigned to the street layer. Note: Only integer raster layers can be converted to polygon features. If you create a floating point raster in step 7 you will need to convert it to integer for this step (see Appendix D).	Input Layers: Output Layers: Other Comments:
9 Create field verification report	NA	<u>UTRI Model</u> <ul style="list-style-type: none"> NA <u>ArcToolbox</u> <ul style="list-style-type: none"> Can use Crystal Reports, or read DBF in Excel or other spreadsheet to generate report 	NA		NA	NA	NA	Generates street segment field verification form from street layer for urban forester. Includes a color coded map(s) and corresponding list(s) of street segments keyed to map. Generates standard UTRI map from an ArcMap template. Updated street segment map (and list) after verification is used for: 1. Comprehensive risk management (risk zones) 2. Tree risk assessment and rating 3. Pre-disaster mitigation 4. Urban forest management (planting)	Input Layers: Output Layers: Other Comments:
10 Produce a stratified random sample (street segments) for debris estimation in i-Tree Eco or i-Tree Streets. Produce UTRI street segment map.	NA	<u>UTRI Model</u> <ul style="list-style-type: none"> NA <u>ArcToolbox</u> <ul style="list-style-type: none"> NA <u>Other Tools</u> <ul style="list-style-type: none"> Stratified Sampling Tools 	NA		NA	NA	NA	Biogeography Branch's Sampling Design Tool for ArcGIS http://ccma.nos.noaa.gov/products/biogeography/sampling/ or Hawth's Analysis Tools for ArcGIS v9.3 http://www.spatial ecology.com/htools/overview.php or the Geospatial Modeling Environment http://www.spatial ecology.com/gme/ or Iowa State PM2082-09n Using Field Calculator: Create Random Values. www.extension.iastate.edu/Publications/PM2082-09N.pdf	Input Layers: Output Layers: Other Comments: