"GIS-Based Software for Safety Management of Road Networks

Scott Jones, Utah DOT
Doug Harwood, MRI Global
Reg Soulerette, U of Kentucky
Terry C. Bills, Esri
Safety Management using UPlan and usRAP

W. Scott Jones, P.E., PTOE
Safety Programs Engineer,
Utah DOT
wsjones@utah.gov
801-965-4285
Utah DOT Dream

- All data accessible through one portal
- No duplicating and manipulating data
- Data updates as projects are completed
- All business systems work together seamlessly
Purpose: Obtain data for use in making safety, pavement and roadway asset management decisions

Scope: 5,845 centerline miles (9,400 km), with data collected in both directions, and 310 miles (500 km) of ramps & collectors on state maintained roads
Mobile LiDAR
Work Products

- Right-of-Way Digital Imaging
- Workstation
- LiDAR Point Cloud
Utah Integrated Business Systems (UTIBS)

Knowledge Management

- Data
- Information
- Sustainability
- Wisdom
- Knowledge
UTIBS - Organization

Initial Collaborators
- ESRI
- Deighton
- USU
- GTMA
- Agile Assets
- Virtual Geomatics
- Mandli
- MRI Global
- 3M
- Oracle
- Bentley
- UDOT

Working Subgroups
- Asset Management
- Safety
- Hub
- Roadway Design

Additional Collaborators
- More UDOT
UTIBS Safety Subgroup

Group Leaders
• AAA Foundation/MRI Global
• ESRI
• UDOT

Goals
Combine crash, traffic and roadway data using UPlan/ArcGIS Online for:
• Risk Mapping
• Star Ratings & Safer Roads Investment Plans
• Managing it all online
What is UPlan?

- UPlan is UDOT’s enterprise GIS Portal
- Uses ArcGIS Online as an interactive tool to combine all geospatial data in one place

- Flexible environment makes it easy to share and manage data among various internal and external customers
- The ability to rapidly produce web content has shifted how we combine and present data

uplan.maps.arcgis.com
Combining Data Elements
Conclusion

- Statewide implementation of Risk Mapping, Star Ratings, and Safer Roads Investment Plans using UPlan/ArcGIS Online

- usRAP and ESRI plan to make the GIS-based software developed for UDOT available to other highway agencies

- Incorporation of socio-economic and behavioral analysis elements

- Any highway agency with data in a compatible format will be encouraged to use these software tools
Up Next...

Reg Souleyrette – usRAP Team
  • Risk Mapping

Doug Harwood – usRAP Team
  • Star Ratings & Safer Roads Investment Plans

Terry Bills – ESRI
  • UPlan/ArcGIS Online
  • Behavioral Analysis
Development of a GIS-Based Software Tool for Risk Mapping to be developed by ESRI, usRAP, and UDOT

Reg Souleyrette
usRAP Team
Outline

• Risk Maps
• Making Risk Maps
  - Data
  - Segmentation
  - QA
• Risk Levels
• Risk Map Formats and Outputs
usRAP and Protocols

- usRAP
- The usRAP team
- Pilot studies
- Risk mapping protocol
  - What it is
Types of Risk Maps

- Map 1 – crash density (crashes/mi)
- Map 2 – crash rate (crashes per 100 million veh-mi)
- Map 3 – crash rate ratio (rate compared to avg.)
- Map 4 – potential savings (if we could improve to at least the average)
Supplementary Maps

- bicycle-related crashes
- older-driver crashes
- younger-driver crashes
- lane departure crashes
- failure to yield right of way crashes

- alcohol-related crashes
- unrestrained occupant crashes
- speed-related crashes
- truck-related crashes
- pedestrian-related crashes
Examples of usRAP risk maps
Use in UPLAN/UTIBS
Utility of Risk Maps:

- risk rather than spot maps
- considers users and use
- can see changes over time (performance tracking)
Annual Fatal & Major Injury Crashes per Mile
3 Year Average

2002 - 2004 Rural, Primary Roads

As of 3/1/2005

3 yrs of data

Draft

4/21/2005
Annual Fatal & Major Injury Crashes per Mile
10 Year Average

10 yrs of data
Making Risk Maps

• Fatal and serious injury crashes

• Rural road systems
  ✓ State primary routes
  ✓ County primary roads

• Homogeneous segments

• Length for meaningful results
Risk Map Data Requirements…

Section identifiers
1. Road number and description (to and from)
2. GIS reference for start and end points
3. Jurisdiction (state or local highway agency) identifiers

Section details
1. Length
2. Roadway type
3. Daily traffic flow
4. Speed limit
5. Intersection type (grade separated, at grade)

Crash data
1. Number of fatal crashes, serious crashes, all crashes
2. Number of crashes by crash type
3. Number of crashes by vehicle composition
Section (Roadway) Identifiers

- Route type
- Route number or road name
- County
- Location and basis for dynamic segmentation
Section (Roadway) characteristics data

- AADT
- speed limit
- Area type
- Number of lanes
- Divided/undivided
- Access control

- Roadway type … derived: freeway, multilane divided, multilane undivided, 2 lane
Crash characteristics data

- Location
- Severity
- Year
- Other crash characteristics for supplementary risk maps
Define the Network

- Select roads where reliable crash and roadway data are available ...
- Cartography
- Jurisdictional boundaries
Creating Analysis Segments

• A segment of road:
  o Length
  o Distinct
  o Broadly similar
  o Rural
  o Stable

• These can be competing requirements, so compromises can be required
Typical Approach to Defining Sections

Starting point?

aggregated if same or similar:

- county, route number, and road type
- speed limits
- AADTs
- Crossing town/rural community boundaries
- very short sections >55mph
- extremely short length
Test of segmentation

- Average K+A per 5 years > XX*
- % segments < 3 K+A per 5 years < YY*
- > 1.0 mi in length, except:
  - short routes
  - discontinuous routes
  - county lines

* Relax speed criterion then AADT criterion if not met
Assign Crashes to Segments

- Lat-long or MP
- closest road section with matching road number
- intersections?
  - allocation
Quality Assurance Checks for Crashes

- Gaps
- Missing location but relevant route number
- Miscoded mileposts
- > ZZ ft. from segment
- different route number/road name
- Clusters at beginning or end
- Total number wrong
Sections 148(c)(1)(D) and 148(g)(3)(A), of Title 23, *United States Code*, effective October 1, 2005, required each highway agency to identify each year the five percent of their highway system most in need of safety improvement.
Risk Map Formats

• All roads on the study network
• Color coded risk levels
• No risk rating = grey
• Distinctive Political boundaries
• Legend
• Logos
## Risk Mapping Output Tables

### Crashes by type

<table>
<thead>
<tr>
<th>Roadway type</th>
<th>Number of segments</th>
<th>Total length (mi)</th>
<th>Average length (mi)</th>
<th>Average AADT (veh/day)</th>
<th>Total frequency</th>
<th>Annual frequency (per segment)</th>
<th>Annual density (per mi)</th>
<th>Average rate (per 100 million VMT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural freeway</td>
<td>57</td>
<td>784</td>
<td>13.8</td>
<td>13,107</td>
<td>1,852</td>
<td>6.50</td>
<td>0.47</td>
<td>9.87</td>
</tr>
<tr>
<td>Rural multilane divided</td>
<td>1</td>
<td>3</td>
<td>3.0</td>
<td>12,767</td>
<td>9</td>
<td>1.80</td>
<td>0.60</td>
<td>12.90</td>
</tr>
<tr>
<td>Rural multilane undivided</td>
<td>67</td>
<td>191</td>
<td>2.8</td>
<td>13,324</td>
<td>504</td>
<td>1.50</td>
<td>0.53</td>
<td>10.86</td>
</tr>
<tr>
<td>Rural two-lane undivided</td>
<td>761</td>
<td>4,159</td>
<td>5.5</td>
<td>1,989</td>
<td>2,214</td>
<td>0.58</td>
<td>0.11</td>
<td>14.67</td>
</tr>
<tr>
<td>Urban freeway</td>
<td>41</td>
<td>158</td>
<td>3.9</td>
<td>91,815</td>
<td>1,275</td>
<td>6.22</td>
<td>1.61</td>
<td>4.80</td>
</tr>
<tr>
<td>Urban multilane divided</td>
<td>8</td>
<td>28</td>
<td>3.5</td>
<td>34,961</td>
<td>161</td>
<td>4.03</td>
<td>1.16</td>
<td>9.07</td>
</tr>
<tr>
<td>Urban multilane undivided</td>
<td>159</td>
<td>328</td>
<td>2.1</td>
<td>26,970</td>
<td>3,325</td>
<td>4.18</td>
<td>2.03</td>
<td>20.60</td>
</tr>
<tr>
<td>Urban two-lane undivided</td>
<td>91</td>
<td>192</td>
<td>2.1</td>
<td>12,181</td>
<td>688</td>
<td>3.64</td>
<td>0.72</td>
<td>16.09</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1,185</td>
<td>5,843</td>
<td>4.9</td>
<td>6,598</td>
<td>10,028</td>
<td>1.69</td>
<td>0.34</td>
<td>14.34</td>
</tr>
<tr>
<td>Route</td>
<td>County</td>
<td>Mileposts</td>
<td>Roadway type</td>
<td>AADT (veh/day)</td>
<td>Fatal and serious injury crashes per 100 million VMT</td>
<td>Risk level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>--------</td>
<td>-------------</td>
<td>----------------------------------</td>
<td>----------------</td>
<td>-----------------------------------------------------</td>
<td>------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-98</td>
<td>Smith</td>
<td>27.3 – 29.5</td>
<td>Rural freeway</td>
<td>11,450</td>
<td>3.4</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-98</td>
<td>Jones</td>
<td>0.0 – 4.8</td>
<td>Rural freeway</td>
<td>11,450</td>
<td>18.4</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>US 20</td>
<td>Clay</td>
<td>0.0 – 1.6</td>
<td>Rural two-lane undivided</td>
<td>4,650</td>
<td>20.5</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>US 20</td>
<td>Clay</td>
<td>1.6 – 9.8</td>
<td>Rural two-lane undivided</td>
<td>4,650</td>
<td>8.6</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR 14</td>
<td>Scott</td>
<td>0.0 – 1.6</td>
<td>Urban multilane divided</td>
<td>18,850</td>
<td>9.3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Intellectual Property

- AAA Foundation for Traffic Safety (AAAFTS)
- royalty-free licenses available to create and use
- Memorandum of Understanding
Further Information

• Reg Souleyrette, University of Kentucky
• Souleyrette@uky.edu
• 859-257-5309
• www.usrap.us
Infrastructure Safety Tool: usRAP Safer Roads Investment Plans

Doug Harwood
MRI Global
Infrastructure Safety Planning

• The second module of the new safety analysis tool will use the usRAP safer roads investment plan protocol adapted from current usRAP Tools software.

• Star ratings are assigned to road segments based on data for approximately 40 safety-related roadway characteristics.

• Safer roads investment programs are developed from the same roadway characteristics data.
Intended Application of Software Module

• Apply star rating and safer roads investment plan protocols
• Perform network-level safety planning analyses
• Consider data for over 40 safety-related roadway design and traffic control attributes
• Generate star rating maps and download files with star rating data
• Generate safety roads investment plans
• No detailed site-specific crash data needed
• Network-wide crash data is useful for calibration
usRAP Infrastructure Safety Planning Overview

Road Inspection Data → Road Safety Scores → Star Rating → Safer Roads Investment Plan
Star Ratings

• Star ratings are assigned based on presence or absence of road design and traffic control features related to safety
• 1 to 5 scale
• Key Advantage:
  - site-specific crash data not required
  - limited network-wide crash data can be used for calibration
Star Ratings

• Star ratings are based on data for approximately 40 safety-related roadway design and traffic control attributes
• Previously, coding of data from videos has been a manual process
• Existing UDOT records and Mandli mobile mapping data will provide most of the needed input variables
Key Safety-Related Roadway Characteristics

- No. of lanes
- One-way/two-way
- Roadway width/lane width
- Shoulder width
- Horizontal alignment (esp. curve radius)
- Vertical alignment (esp. grades)
- Delineation
- Road surface condition
- Sidewalks
Key Safety-Related Roadway Characteristics

- Roadside severity
- Shoulder rumble strips
- Access point density
- Median type
- Intersection type
- Pedestrian facilities
- Bike facilities
- Area type (rural/semi-urban/urban)
- Land use (commercial/residential)
Key Safety-Related Roadway Characteristics

- Quality of curve
- Quality of intersection
- Quality of pedestrian crossing
Key Operational and Traffic Control Characteristics

- Traffic volume
- Motorcycle percentage
- Pedestrian flow
- Bicycle flow
- Intersecting road volume
- Speed limit
- 85th percentile traffic speed
Road Safety Scores

Road users
- Vehicle occupants
- Motorcyclists
- Pedestrians
- Bicyclists

Crash types
- Run off road
- Head on
- Intersection
- Along
- Across
- Intersection

Risk factors

Road attributes
- Risk factors
Road Safety Scores

- Road users
  - Pedestrians

- Crash types
  - Along
  - Across

- Road attributes
  - Speed
  - Sidewalk provision – left
  - Sidewalk provision – right
  - Side friction
  - Number of lanes
  - Median type
  - Crossing facilities
  - Crossing facilities quality
Road Safety Scores

Road users
- Bicyclists

Crash types
- Along
- Across
- Intersection

Road attributes
- Speed
- Roadside severity – left
- Roadside severity – right
- Lane width
- Paved shoulder
- Curvature
- Curve quality
- Delineation
- Road condition
- Facilitates for bikes
- Side friction
- Crossing facilities
- Number of lanes
- Median type
- Crossing facilities
- Crossing facilities quality
- Intersection type
- Intersecting road volume
- Intersection quality
- Minor access density
Star Rating/Crash Relationships

All F&S Injury Crashes/100 MVMT for All 2U Roadways
Star Rating Based on Individual Locations

All area types; groups with 10+ mi only

All F&S Injury Crashes/100 MVMT for All 2U Roadways

Star Rating Based on Individual Locations

Car Star Rating for Individual Locations

All area types; groups with 10+ mi only
Safer Roads Investment Plans

- Nearly 70 countermeasures considered
- Each countermeasure is reviewed for each 300-ft (100-m) road segment.
- A countermeasure is “triggered” if it makes engineering sense for the location
- Once a countermeasure is “triggered” economic analysis is performed
Safer Roads Investment Plans

- Countermeasures are retained in plan for a given 300-ft (100–m) road segment if:
  - countermeasure is not already installed
  - BCR exceeds minimum BCR specified by user
  - countermeasure is compatible with other cost-effective countermeasures for the same location
  - countermeasure is not overridden by a mutually exclusive countermeasure for the same location that is more cost-effective
  - countermeasure is consistent with countermeasures recommended for adjacent road segments
What Do Safer Roads Investment Plans Provide?

- Safer roads investment plan for a road network includes:
  - specific countermeasures to be implemented
  - specific implementation locations
  - quantitative cost estimates
  - quantitative safety benefits (in crashes reduced and dollars)
  - cost-effectiveness measures
  - benefit-cost ratios
  - all countermeasures meet a minimum benefit-cost ratio specified by the user
  - output in the form of tables, maps, and Excel spreadsheets
# usRAP Kane County Illinois Road Safety Report

## Kane County Illinois Map

![Map of Kane County, Illinois](image)

## Kane County Illinois Fast Facts

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>525,000</td>
</tr>
<tr>
<td>GDP per Capita</td>
<td>$45,550</td>
</tr>
<tr>
<td>Road Network</td>
<td>443km</td>
</tr>
<tr>
<td>Fatalities (2011)</td>
<td>25</td>
</tr>
<tr>
<td>Serious Injuries (2011)</td>
<td>85</td>
</tr>
<tr>
<td>Est. Crash Cost</td>
<td>$147,445,000</td>
</tr>
<tr>
<td>Traffic Mix</td>
<td>TDB</td>
</tr>
</tbody>
</table>

## STAR RATINGS

<table>
<thead>
<tr>
<th>Star Rating</th>
<th>Length (km's)</th>
<th>%</th>
<th>Motorcyclists</th>
<th>Length (km's)</th>
<th>%</th>
<th>Bicyclists</th>
<th>Length (km's)</th>
<th>%</th>
<th>Pedestrians</th>
<th>Length (km's)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>2km</td>
<td>0%</td>
<td>0km</td>
<td>0%</td>
<td></td>
<td>0km</td>
<td>0%</td>
<td></td>
<td>0km</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td>13km</td>
<td>3%</td>
<td>0km</td>
<td>2%</td>
<td></td>
<td>0km</td>
<td>0%</td>
<td></td>
<td>0km</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td>82km</td>
<td>19%</td>
<td>50km</td>
<td>11%</td>
<td></td>
<td>10km</td>
<td>2%</td>
<td></td>
<td>375km</td>
<td>86%</td>
<td></td>
</tr>
<tr>
<td>Gold</td>
<td>322km</td>
<td>73%</td>
<td>334km</td>
<td>75%</td>
<td></td>
<td>404km</td>
<td>91%</td>
<td></td>
<td>64km</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>Gold</td>
<td>24km</td>
<td>5%</td>
<td>52km</td>
<td>12%</td>
<td></td>
<td>20km</td>
<td>5%</td>
<td></td>
<td>2km</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Gold</td>
<td>0km</td>
<td>0%</td>
<td>0km</td>
<td>0%</td>
<td></td>
<td>0km</td>
<td>0%</td>
<td></td>
<td>0km</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>443km</td>
<td>100%</td>
<td>443km</td>
<td>100%</td>
<td></td>
<td>443km</td>
<td>100%</td>
<td></td>
<td>443km</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>
Example of Star Rating Variation Along a Road Section
## usRAP Kane County Illinois Safer Roads Investment Plan

### ALL ROADS

#### usRAP Kane County Illinois Countermeasure Program based on a minimum benefit-cost ratio of 10

<table>
<thead>
<tr>
<th>Countermeasure Type</th>
<th>Length</th>
<th>KSI's Saved (20 years)</th>
<th>PV of Safety Benefit (20 years)</th>
<th>Estimated Cost (20 years)</th>
<th>Cost per KSI saved</th>
<th>Program BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central median barrier (no duplication)</td>
<td>5.1 km</td>
<td>114.97</td>
<td>$79,251.625</td>
<td>$1,749,364</td>
<td>$15,215</td>
<td>45.31</td>
</tr>
<tr>
<td>Shoulder paving (&gt;1m)</td>
<td>46.8 km</td>
<td>110.58</td>
<td>$76,229.818</td>
<td>$3,735,460</td>
<td>$34,216</td>
<td>20.15</td>
</tr>
<tr>
<td>Roadside barriers - Right</td>
<td>16.8 km</td>
<td>96.36</td>
<td>$66,429.932</td>
<td>$3,825,375</td>
<td>$39,699</td>
<td>17.37</td>
</tr>
<tr>
<td>Signalize intersection (3-leg)</td>
<td>15 sites</td>
<td>70.33</td>
<td>$48,454.644</td>
<td>$1,800,000</td>
<td>$26,448</td>
<td>26.07</td>
</tr>
<tr>
<td>Signalize intersection (4-leg)</td>
<td>5 sites</td>
<td>65.18</td>
<td>$44,933.933</td>
<td>$810,000</td>
<td>$12,427</td>
<td>55.47</td>
</tr>
<tr>
<td>Left turn lane (unsignalized 3 leg)</td>
<td>27 sites</td>
<td>55.99</td>
<td>$38,601.484</td>
<td>$2,402,400</td>
<td>$42,905</td>
<td>16.07</td>
</tr>
<tr>
<td>Roadside barriers - Left</td>
<td>7 km</td>
<td>51.13</td>
<td>$36,250.371</td>
<td>$1,662,325</td>
<td>$32,901</td>
<td>29.96</td>
</tr>
<tr>
<td>Roundabout</td>
<td>2 km</td>
<td>40.25</td>
<td>$27,746.597</td>
<td>$2,000,000</td>
<td>$49,691</td>
<td>13.87</td>
</tr>
<tr>
<td>Duplication with median barrier</td>
<td>0.7 km</td>
<td>38.66</td>
<td>$26,649.424</td>
<td>$1,254,960</td>
<td>$32,464</td>
<td>21.24</td>
</tr>
<tr>
<td>Left turn provision at existing signalized site (4-leg)</td>
<td>5 sites</td>
<td>30.53</td>
<td>$21,047.362</td>
<td>$641,000</td>
<td>$17,746</td>
<td>38.05</td>
</tr>
<tr>
<td>Left turn lane (unsignalized 4 leg)</td>
<td>10 sites</td>
<td>25.65</td>
<td>$18,306.492</td>
<td>$856,000</td>
<td>$32,267</td>
<td>21.36</td>
</tr>
<tr>
<td>Left turn provision at existing signalized site (3-leg)</td>
<td>6 sites</td>
<td>26.26</td>
<td>$18,173.903</td>
<td>$730,000</td>
<td>$27,721</td>
<td>24.85</td>
</tr>
<tr>
<td>Rail crossing upgrade</td>
<td>1 site</td>
<td>15.85</td>
<td>$10,923.321</td>
<td>$78,000</td>
<td>$4,923</td>
<td>140.04</td>
</tr>
<tr>
<td>Lane widening (up to 0.5m)</td>
<td>6.3 km</td>
<td>15.25</td>
<td>$10,514.582</td>
<td>$186,056</td>
<td>$11,018</td>
<td>62.57</td>
</tr>
<tr>
<td>Shoulder paving (&lt;1m)</td>
<td>9.7 km</td>
<td>10.56</td>
<td>$7,281.456</td>
<td>$307,525</td>
<td>$36,687</td>
<td>18.79</td>
</tr>
<tr>
<td>Road resurfacing</td>
<td>0.9 km</td>
<td>9.96</td>
<td>$6,859.668</td>
<td>$421,848</td>
<td>$43,324</td>
<td>16.28</td>
</tr>
<tr>
<td>Delineation and signing (intersection)</td>
<td>5 sites</td>
<td>4.71</td>
<td>$3,246.032</td>
<td>$106,826</td>
<td>$22,668</td>
<td>30.39</td>
</tr>
<tr>
<td>Sidewalk improvement - Right</td>
<td>1.0 km</td>
<td>4.65</td>
<td>$3,207.812</td>
<td>$93,000</td>
<td>$19,987</td>
<td>34.49</td>
</tr>
<tr>
<td>Sidewalk improvement - Left</td>
<td>0.7 km</td>
<td>2.15</td>
<td>$1,481.329</td>
<td>$51,300</td>
<td>$23,875</td>
<td>28.88</td>
</tr>
<tr>
<td>Improve delineation</td>
<td>2.5 km</td>
<td>1.87</td>
<td>$1,250.949</td>
<td>$91,329</td>
<td>$48,776</td>
<td>14.14</td>
</tr>
<tr>
<td>Road surface improvement</td>
<td>0.5 km</td>
<td>1.02</td>
<td>$706.725</td>
<td>$30,040</td>
<td>$25,347</td>
<td>23.49</td>
</tr>
<tr>
<td>Improve curve delineation</td>
<td>0.1 km</td>
<td>0.27</td>
<td>$188.982</td>
<td>$1,784</td>
<td>$6,508</td>
<td>105.93</td>
</tr>
</tbody>
</table>

**TOTAL:** 793 km | $546,824,372 | $22,927,004 | $28,904 | 23.85 |
usrAP / UPLAN and GeoSpatial Statistics

Terry C. Bills
Esri
Utah DOT / usRAP Project

- Risk Maps
- Star Ratings
- Geospatial Statistics
- AASHTO TIG
- Resource Center
Geospatial Statistics
How to Begin to Analyze Large Data Sets?
Exploratory Spatial Data Analysis (ESDA)
Grouping Analysis

• We know a lot more than just where accidents happened
  - Weather condition
  - Lighting
  - Road characteristics

• Find groups of data with similar characteristics.
Spatial Statistics Applied

- Restaurants, bars, nightclubs
- High schools, universities
- Other Human Factors
Continuing the Momentum

- Working with UT DOT
- Tools soon available on Resource Center
- AASHTO TIG grant
- Mobile Runtime licensing
It all starts in the field
AASHTO TIG Project

UPLAN Participants

AASHTO’s TIG supports peer-to-peer outreach to accelerate the advancement of proven transportation technologies. AASHTO has selected UPLAN as a technology to move forward among agencies nationwide.