# Draft Highway Deficiency Analysis Tool

Tool Summary
And the Implementation Plan

# Objectives for the Meeting

- Inputs/Comments from the attendees
- Provide understanding of how tool relates to planning process
- Provide overview of highway deficiency analysis tool
- Implementation plan
- Next steps

# Agenda

1. Overview – 20

2. Terms, Methodologies, and Components – 20

3. Measures and Scoring Process – 70

4. Tool Demonstration - 20

5. Next Steps and Discussion- 30

**Part 1: Overview**

# Disclaimer

- The tool is under development

- All the data and the result are still pending for final approval

- Once we complete the local inputs process, we will update the tool to the release version

# Improving the System - Introduction

YouTube https://www.youtube.com/watch?v=sJHTH7acDdY

# Part 1

- **Project Funneling Process**
  - General Process
  - MPO/TDOT Process
  - RPO/TDOT Process

- **Improving The system**
  - Introduction
  - Six Planning Goals
  - Funding Sources

- **Highway Deficiency Analysis Tool**
  - Introduction
  - How to
  - Example
  - Comparison

**TN** **TDOT**
Department of
Transportation

# Funneling Process

System Evaluation

Prioritize The Needs and Develop the Projects

Studies/Analyses

Budget, Schedule, Need Filter

Long Term Vision

Budget, Schedule, Need

Program Funding

Project Initiated

**TN**

# Funneling Process – MPO Flow
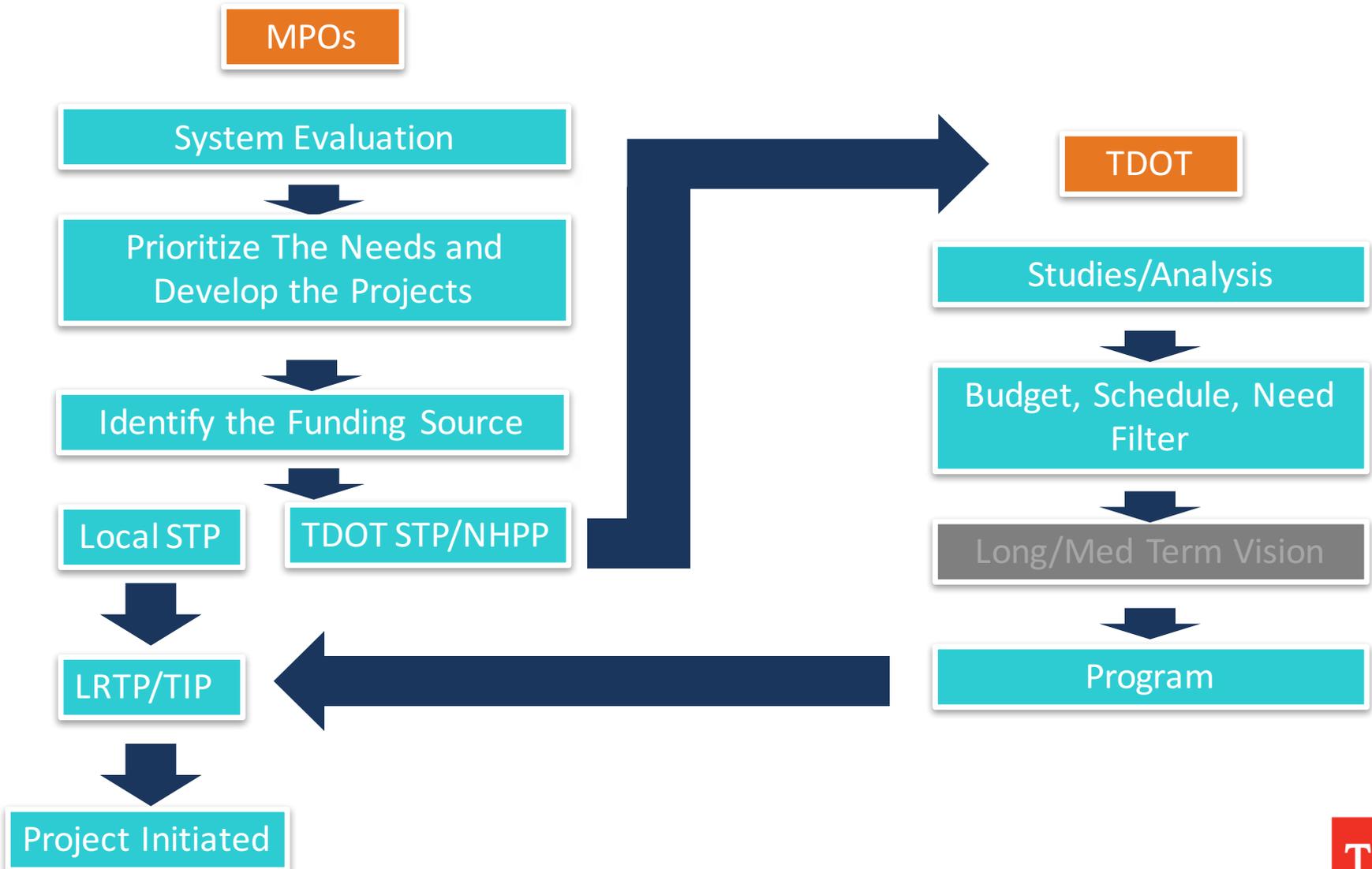
# Funneling Process – RPO Flow

RPOs

↓

System Evaluation

↓

Prioritize the Needs

↓

Submit Potential Improves for Studies

→

TDOT

↓

Needs Assessment /Analysis / Studies

↓

Budget, Schedule Filter

↓

Long/Med Term Vision

↓

Program

↓

Project Initiated
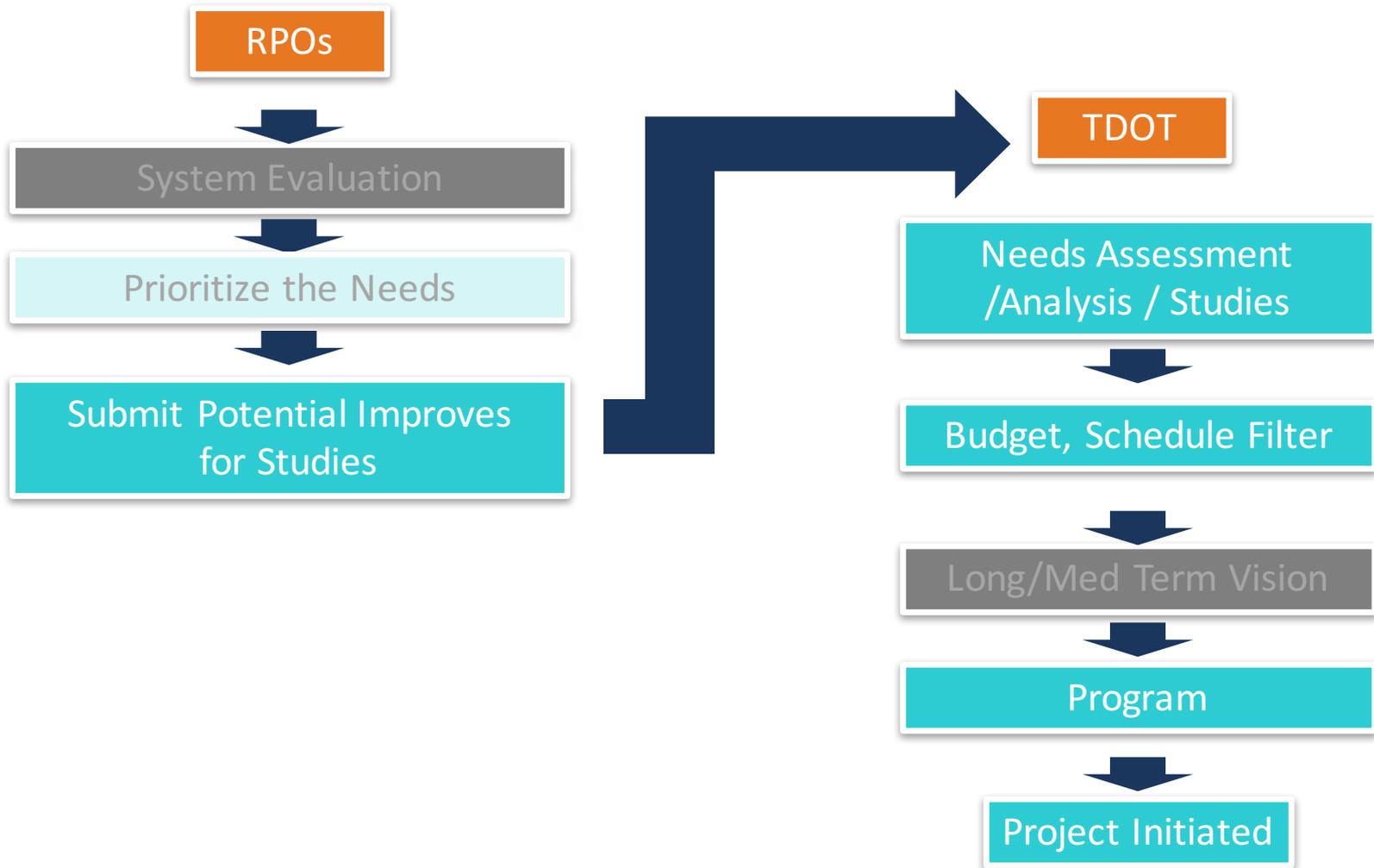
# Improving the System– Six Planning Goals



SAFETY

ECONOMIC DEVELOPMENTS

PRESERVE AND MANAGE EXISTING SYSTEM

ENVIRONMENT

LIVABLE COMMUNITIES

MULTI-MODAL
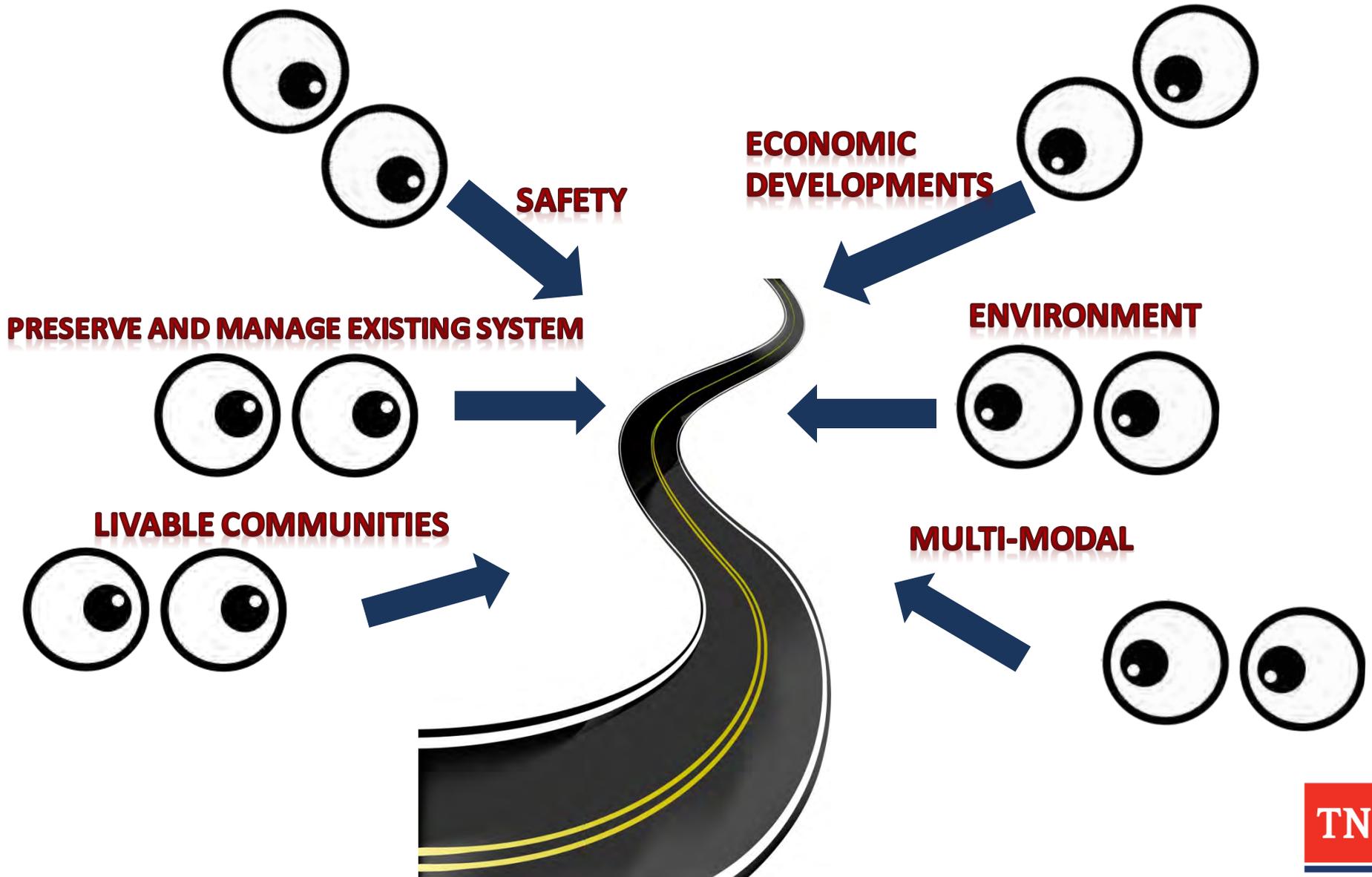
# Improving the System - Federal-aid Highway Program (MAP-21)

- **NHPP:** National Highway Performance Program (NHS, IM, Bridge)

- **STP:** Surface Transportation Program(STP and Bridge)

- HSIP: Highway Safety Improvement Program (including High Risk Rural Roads)

- Railway-Highway Crossings (set aside)

- CMAQ: Congestion Mitigation & Air Quality Improvement Program

- Metropolitan Transportation Planning

- Transportation Alternatives



Pie chart legend:
- National Highway Performance Program — 58%
- Surface Transportation Program — 26%
- Highway Safety Improvement Program — 6%
- Railway-Highway Crossings (setaside) — 1%
- Congestion Mitigation & Air Quality Improvement Progam — 6%
- Metropolitan Transportation Planning — 1%
- Transportation Alternatives 4/ — 2%
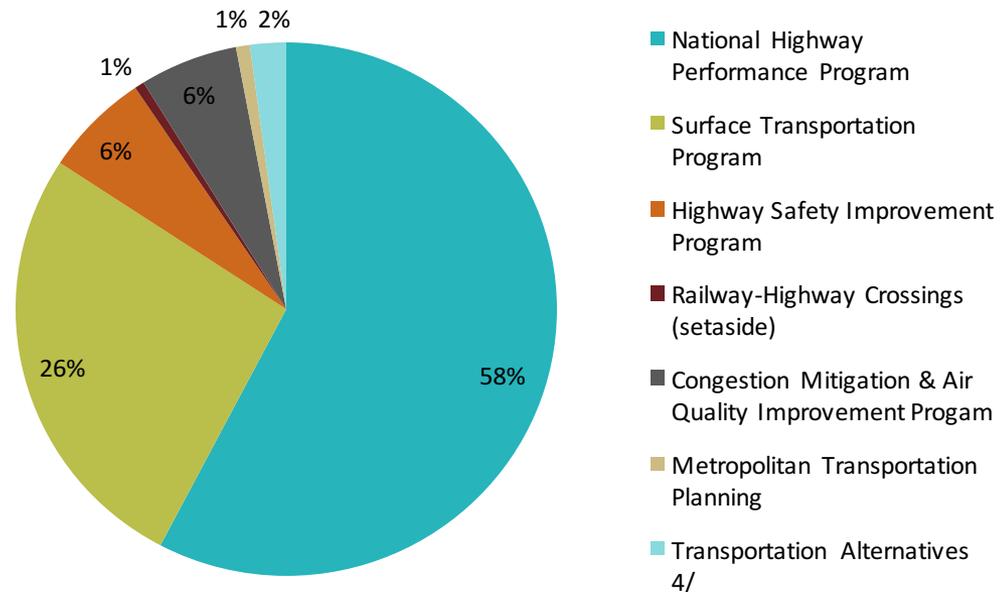
# Highway Deficiency Analysis Tool – Introduction

- System-Wide Highway Deficiency Analysis Tool
  - Not a solution prescriber – Only identifies the deficiencies in the system

- Focuses more on the NHPP, and STP Programs
  - Not for multi-modal planning tool

- Planning Level Analysis Tool
  - Not a project prioritizer (yet)

- Improve the Project Development Process
  - Does not consider cost and schedule for the potential improvements

- Help to justify the needs through the funneling process
  - Top deficiencies locations for the area don't mean projects

- Data driving approach
  - Not a substitute for public involvement

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# Highway Deficiency Analysis Tool – How to

- **Planning Tool for the System Analysis**
  - **System Deficiency Analysis**
    - The Network database contains all the information used in the tool, as well as the scores (comparisons) for all the measures.
  - **Top Deficiency Locations Report**
    - Top-10 Deficiency Mini-Corridors by the 6 facility types for the State, TDOT Regions, TN MPOs, and TN RPOs.

- **Project Information**
  - **Evaluating Existing Projects**
    - Overlapping with the existing projects
      - 3 Year Program Overlay
      - 10 Year Program Overlay
      - Freight Plan Overlay
  - **Develop Potential New Starts**
    - Potential new-start projects can be identified in the system deficiency analysis

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# Highway Deficiency Analysis Tool – Example
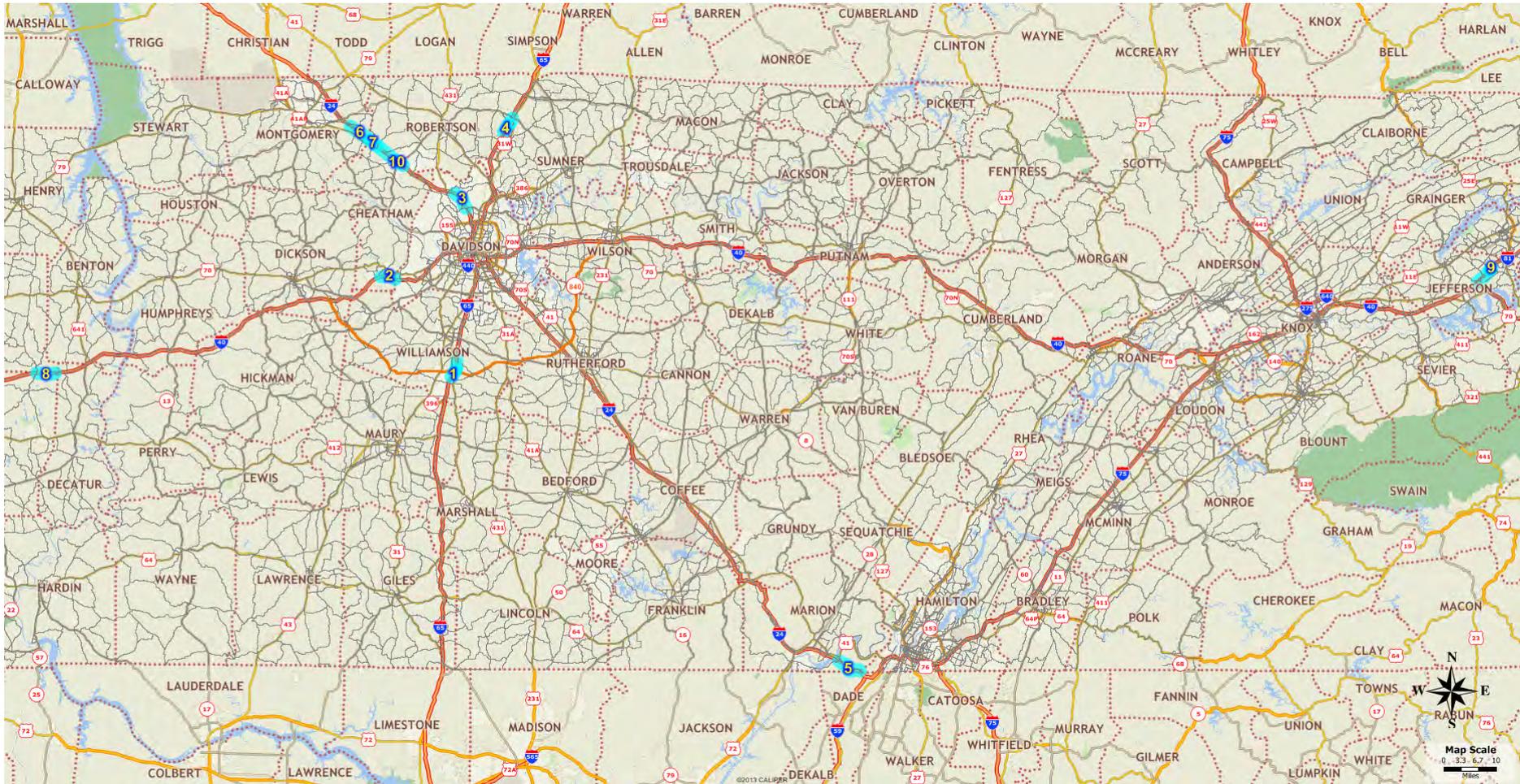
# Highway Deficiency Analysis Tool – Example

| County | Williamson | Cheatham | Davidson | Robertson | Marion | Montgomery | Robertson | Henderson | Jefferson | Robertson |
|---|---|---|---|---|---|---|---|---|---|---|
| Deficiency Ranking - TN | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Deficiency Ranking - Region | 1 | 2 | 3 | 4 | 1 | 5 | 6 | 1 | 1 | 7 |
| Deficiency Ranking - MPO/RPO | 1 | 1 | 2 | 3 | 1 | 1 | 4 | 1 | 1 | 5 |
| Name | I-65 | I-40 | I-24 | I-65 | I-24 | I-24 | I-24 | I-40 | I-81 | I-24 |
| Mini Corridor | 94I0065001_3 | 11I0040001_3 | 19I0024001_3 | 74I0065001_3 | 58I0024001_11 | 63I0024001_6 | 74I0024001_1 | 39I0040001_9 | 45I0081001_2 | 74I0024001_3 |
| Beginning Log Mile | 4.82 | 4.11 | 4.65 | 5.49 | 26.81 | 12.80 | 0.00 | 21.13 | 0.29 | 2.00 |
| End Log Mile | 8.77 | 7.14 | 8.54 | 8.96 | 32.13 | 17.20 | 2.00 | 24.64 | 4.37 | 8.23 |
| Length | 3.95 | 3.03 | 3.89 | 3.47 | 5.32 | 4.40 | 2.00 | 3.51 | 4.08 | 6.23 |
| NHS | | | | | | | | | | |
| AADT | 59,582 | 51,890 | 57,560 | 49,460 | 51,240 | 46,490 | 46,490 | 30,210 | 41,240 | 46,946 |
| Single Unit Truck Percentage | 2.0 | 5.0 | 1.0 | 2.0 | 3.0 | 2.0 | 2.0 | 10.0 | 3.0 | 2.0 |
| Multi-Unit Truck Percentage | 13.3 | 19.0 | 14.0 | 34.0 | 32.0 | 19.0 | 19.0 | 43.0 | 27.0 | 18.7 |
| 2010 V/C | 0.65 | 0.64 | 0.81 | 0.63 | 0.55 | 0.51 | 0.51 | 0.41 | 0.57 | 0.51 |
| 2020 V/C | 0.48 | 0.68 | 0.85 | 0.67 | 0.59 | 0.54 | 0.54 | 0.58 | 0.62 | 0.54 |
| 2030 V/C | 0.55 | 0.76 | 0.90 | 0.73 | 0.62 | 0.58 | 0.58 | 0.69 | 0.67 | 0.55 |
| Crash Severity | 0.70 | 0.62 | 0.52 | 0.75 | 0.56 | 0.90 | 0.81 | 0.60 | 1.60 | 0.69 |
| Crash Score | 2.5 | 1.0 | 1.5 | 0.8 | 1.3 | 1.3 | 1.1 | 0.8 | 1.1 | 2.0 |
| Economic Depressed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Bi-Ped LOS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| A - Preserve and Manage the Existing System | 81 | 83 | 80 | 82 | 76 | 56 | 56 | 47 | 66 | 56 |
| B - Provide for the Efficient Movement of People and Freight | 43 | 0 | 36 | 19 | 29 | 19 | 19 | 0 | 20 | 29 |
| C - Support the State's Economy | 68 | 57 | 53 | 44 | 53 | 72 | 53 | 76 | 41 | 53 |
| D - Maximize Safety and Security | 29 | 44 | 41 | 31 | 51 | 34 | 48 | 44 | 41 | 37 |
| E - Build Partnerships for Sustainable and Livable Communities | 97 | 80 | 48 | 88 | 57 | 92 | 82 | 78 | 85 | 90 |
| F - Protect Natural, Cultural and Environmental Resources | 89 | 80 | 80 | 100 | 0 | 100 | 100 | 80 | 100 | 100 |
| Total Score | 86 | 84 | 80 | 77 | 77 | 77 | 76 | 74 | 74 | 72 |

# Highway Deficiency Analysis Tool – Example

# Highway Deficiency Analysis Tool – Comparison

| | Highway Deficency Tool | DL3/TD1 |
|---|---|---|
| **Main Purpose** | Planning Level Tool to Identify System-Wide Deficiency Locations. Identifying Potential New Start Locations | Prioritizing Legislative Programs |
| **Structure** | Six Planning Goals (Minus the Financial) | Seven Planning Goals |
| **Prioritization** | All Collectors and Above Facilities in Tennessee | Legislative Projects |
| **Public Inputs** | Data Driven | MPO/RPO and Region's Ranking |
| **C/P Value** | No Cost Factor Built In | Project Cost is Considered |
| **Weights** | Same Planning Goal Weights, Different Measures and Individual Weights* | |

*Completed list of measures attached
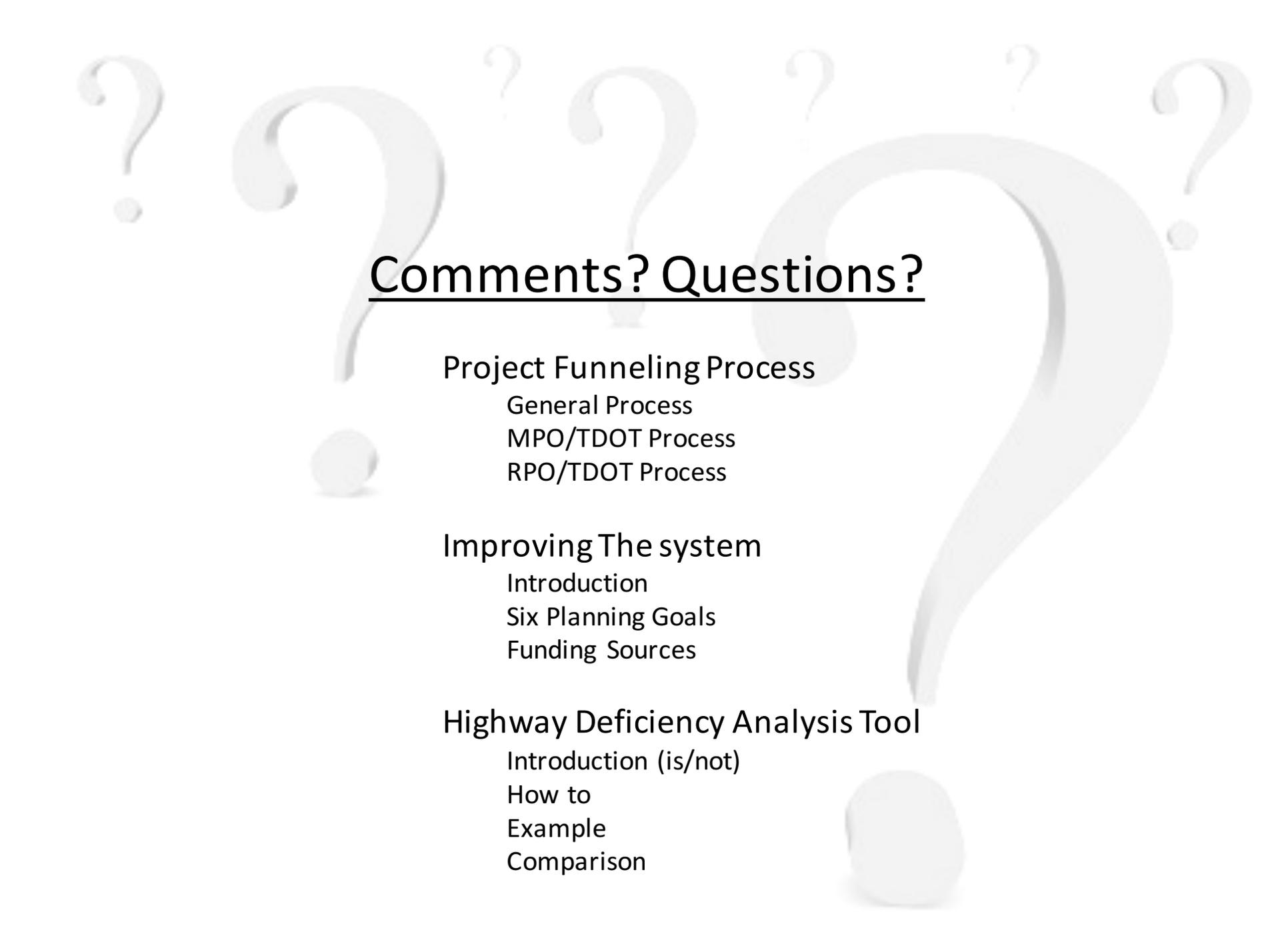
# Comments? Questions?

**Project Funneling Process**
- General Process
- MPO/TDOT Process
- RPO/TDOT Process

**Improving The system**
- Introduction
- Six Planning Goals
- Funding Sources

**Highway Deficiency Analysis Tool**
- Introduction (is/not)
- How to
- Example
- Comparison

# Part 2: Terms and Methodologies

# Part 2

- **Terms**
  - Linear Reference
  - Segments
  - Mini-Corridor
  - Percentile
  - Ratio
  - Grid Cells

- **Tool Components**
- **Work Flow**

# Terms / Methodology

- **Linear Reference System**
  - is a method of spatial referencing, in which the locations of features are described in terms of measurements along a linear element, from a defined starting point, for example a milestone along a road. Each feature is located by either a point (e.g. a signpost) or a line (e.g. a no-passing zone). The system is designed so that if a segment of a route is changed, only those mile points on the changed segment need to be updated.

- **Segments:** The termini of the segments are defined by the physical termini. The physical termini are defined by:
  - Roadway Intersections,
  - Interstate Exits,
  - Functional Class Changes
  - Urban/Rural Boundaries
  - County Boundaries
  - Route Name Changes
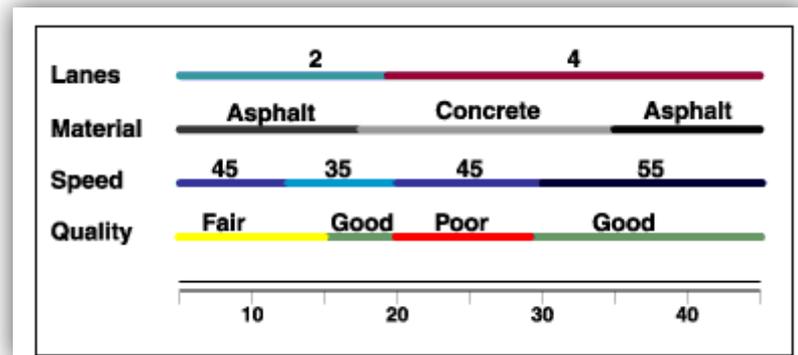
# Terms / Methodology

- **Mini Corridor:** Mini-Corridors are groups of segments, the mini-corridors are about 3 miles long, depends on the length of the segments. The mini-corridors are created to simulate the project locations.

- **Percentile:** is a measure used in statistics indicating the value below which a given percentage of observations in a group of observations fall. For example, the 20th percentile is the value (or score) below which 20 percent of the observations may be found. The approach is intended to rank the segments, and to make the locations with higher needs to stand out.

Scores don't matter in the end

| 50% | 25% | 15% | 10% |
|---|---|---|---|
| Tier4 | Tier3 | Tier2 | Tier1 |
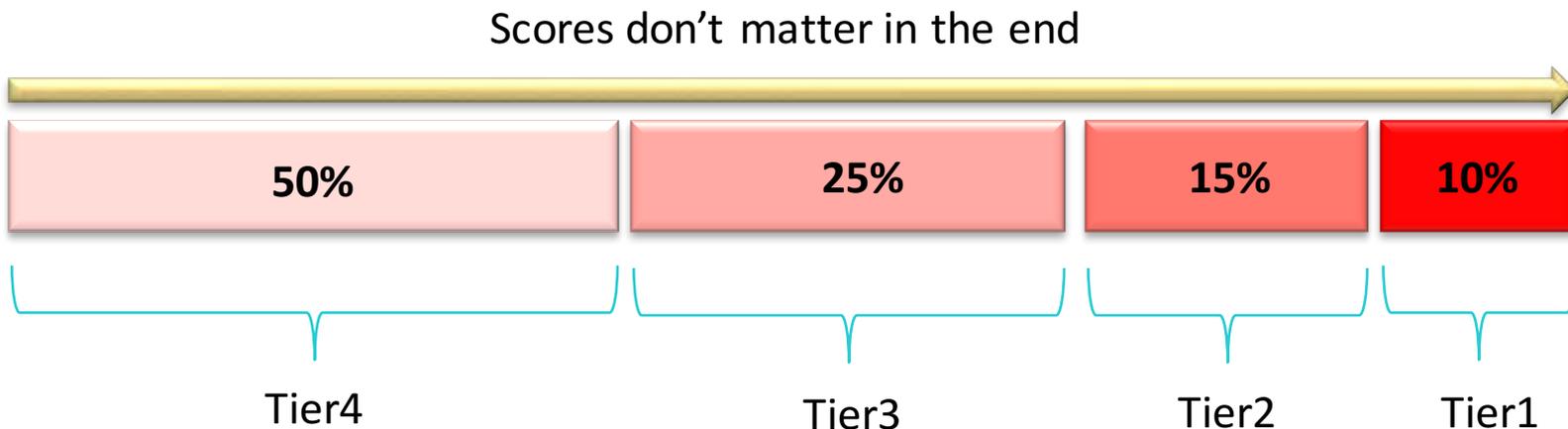
# Terms / Methodology

- **Ratio:** A ratio is created by comparing a small area's rate to a county or state average rate. The ratio can be used to identify the area with higher or lower than county/state average rates. Usually, a score of 100 means the area rate is the same as county or state average.



Ratio > 100% (Above Average)

Average

Ratio < 100% (Below Average)

- **Grid Cell Analysis**: is a method to aggregate the information from different sources/geography into the uniform size cells. The methodology is to evaluate the environmental impacts for the entire states.
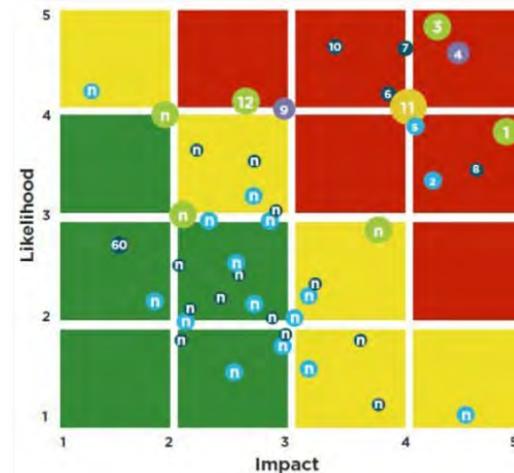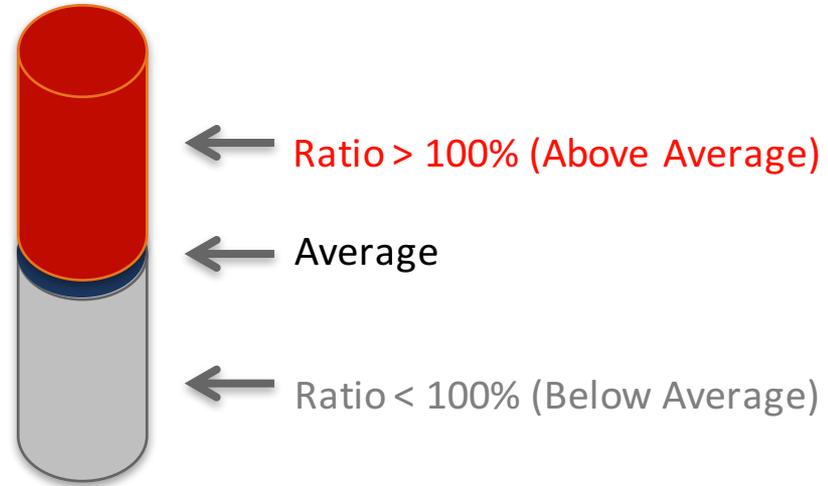
# Components and Flow

1. Data
   - TRIMS, ACS, Travel Demand Model, Environmental GIS files
   - Data Processing/Analyses in SAS, translate to the weights and the look-up tables
2. Main Network
   - A GISDK script aggregates all the information together to the main network file
3. Excel Scoring Engine
   - The weights, look up tables from the analyses are coded in the scoring engine.
   - After the segments and corridors are scored, the result can be joined to the main network for the scores and the ranks.
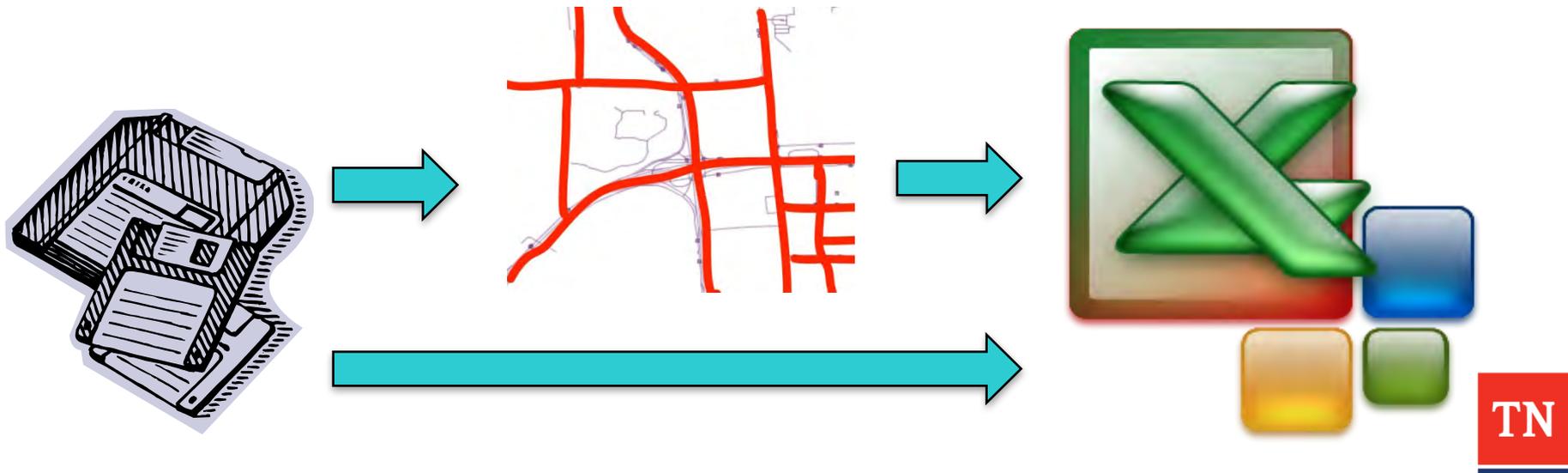
# Comments? Questions?

- **Terms**
  - Linear Reference
  - Segments
  - Mini-Corridor
  - Percentile
  - Ratio
  - Grid Cells

- **Tool Components**
- **Work Flow**

# Part 3: Measures and Scoring Process

# Part 3

- **Seven Guiding Principals**
  - Master Table
  - Interpretations and Measures

- **Maps**

- **Limitations**

# Seven Guiding Principles

1. Preserve and Manage the Existing System
2. Provide for the Efficient Movement of People and Freight
3. Support the State's Economy
4. Maximize Safety and Security
5. Build Partnerships for Sustainable and Livable Communities
6. Protect Natural, Cultural and Environmental Resources
7. Emphasize financial responsibility

TN **25-Year** Long Range Transportation Plan

# List of Measures

| Goals | Percentage | Objectives | Criteria | Descriptions | ID |
|---|---|---|---|---|---|
| **Preserve and Manage the Existing System** | 25.80% | Average Annual Daily Traffic (AADT) | Average Annual Daily Traffic | AADT by Urban/Rural Facility Types | A11 |
| | | | Bridge Condition Rating | Bridge Condition, Vertical Clearance, Weight Limitation | A12 |
| | | Goods/Freight Movement | MU Truck Volume | Truck Volume by Urban/Rural Facility Types | A21 |
| | | | MU Truck Percentage | Truck Percentage by Urban/Rural Facility Types | A22 |
| | | | SU Truck Volume | Truck Volume by Urban/Rural Facility Types | A21a |
| | | | SU Truck Percentage | Truck Percentage by Urban/Rural Facility Types | A22a |
| | | | NHS Routes | National Highway System Route | A23 |
| | | Volume/Capacity Ratio | 2010 Congestion | Volume over Capacity Base Year | A31 |
| | | | 2020 Congestion | Volume over Capacity 2020 | A32 |
| | | | 2030 Congestion | Volume over Capacity 2030 | A33 |
| | | | Bottlenecks | Change in V/C Significantly | A34 |
| | | | Delay | Delay in VHT | A35 |
| **Provide for the Efficient Movement of People and Freight** | 4.20% | Bicycle/Pedestrian/Transit Accommodations | Existing Transit Service | Fix Route Transit Service | B11 |
| | | | Bicycle/Pedestrian LOS | Bike/Ped LOS | B12 |
| | | Freight Facilities | Freight Infrastructure | Near Heavy Freight Facilities/Ag & Farming Industry | B21 |
| **Support the State's Economy** | 16.70% | Community Economic Need | Economical Depressed County | Economical Depressed County | C11 |
| | | Specific Economic Development Opportunity | Workforce Size | Employment Density Measure By State | C21 |
| | | | High Job Growth Areas | High # of Employment Growth By State | C22 |
| | | | Educational Attainment Level | Highly Educated Work Force by Regions | C23 |
| | | | Per Capita Income | High Income/Productivity by Regions | C24 |
| **Maximize Safety and Security** | 26.30% | Crash Rate & Severity | Crash Ratio | Crash Ratio | D11 |
| | | | Serivirity | Severity Index | D12 |
| | | | Fatality | Fatality | D13 |
| | | | State High Crash Corridor | Identified as High Crash Corridor | D14 |
| **Build Partnerships for Sustainable and Livable Communities** | 3.60% | Livable Communities (Accessibility) | Population Density | Population Density Measures by Regions | E31 |
| | | | Population Growth Rate | Population Growth Rate by Regions | E32 |
| | | | EJ - Poverty | Poverty Population Measure by County | E33 |
| | | | EJ -Minority | Minority Population Measure by County | E34 |
| | | | EJ - Elderly | Elderly Population Measure by County | E35 |
| | | | EJ - Disability | Disability Population Measure by County | E36 |
| **Protect Natural, Cultural and Environmental Resources** | 3.40% | Environmental Impact | 1/2 Mile Grid Cell Analysis | Natural Resource/Environmental Constrained Area | F11 |
| | | | | Farmlands | F12 |
| | | | | Geology hazard | F13 |
| | | | | Archeological / Historical Sites | F14 |
| | | | | Conservation and Preservation | F15 |
| | | | | Wildlife and Habitat | F16 |
| | | | | Flood Plains / Flood Control | F17 |
| | | | | Special Designations | F18 |

# 1 - Preserve and Manage the Existing System

| Measure | Data Source | Method |
|---|---|---|
| • Average Annual Daily Traffic | TRIMS | Percentile |
| • Bridge Condition Rating | NBI | Good/OK/Bad |
| • SU/MU Truck Volume | TRIMS | Percentile |
| • SU/MU Truck Percentage | TRIMS | Percentile |
| • NHS Routes | TRIMS | Yes/No |
| • 2010 Congestion | SWM | Level of Service |
| • 2020 Congestion | SWM | Level of Service |
| • 2030 Congestion | SWM | Level of Service |
| • Bottlenecks | Traffic Operation | Tier 1,2,3 |
| • Delay | SWM | Very High/High/Med/Low |

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# 2 - Provide for the Efficient Movement of People and Freight

| Measure | Data Source | Method |
|---|---|---|
| • Existing Transit Service | TN Urban Area Fix Routes | Yes/No |
| • Bicycle/Pedestrian LOS | Bi-Ped Study | Level of Service |
| • Freight Infrastructure | Freight Plan | Close/Med/Far/Too Far |



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# 3 - Support the State's Economy

| Measure | Data Source | Method |
|---|---|---|
| • Economical Depressed County | Commissioner's Office | Yes/No |
| • Workforce Size | 2011 LEHD | Ratio |
| • High Job Growth Areas | 2002/2011 LEHD | Ratio |
| • Educational Attainment Level | 2012 ACS | Ratio |
| • Per Capita Income | 2012 ACS | Ratio |

# 4 - Maximize Safety and Security

| Measure | Data Source | Method |
|---|---|---|
| • Crash Ratio | HSIP | Ratio |
| • Severity Index | HSIP | Ratio |
| • Fatality | HSIP | 0, 1-2, 3 and above |
| • Corridor Crash Index | HSIP | Warning, Watch, Caution, Low |

# 5 - Build Partnerships for Sustainable and Livable Communities

| Measure | Data Source | Method |
|---|---|---|
| • Population Density | 2012 ACS | Simple Ratio |
| • Population Growth Rate | 2000/2010 Census | Simple Ratio |
| • EJ - Poverty | 2012 ACS | Buffer Ratio by Facility |
| • EJ - Minority | 2012 ACS | Buffer Ratio by Facility |
| • EJ - Elderly | 2012 ACS | Buffer Ratio by Facility |
| • EJ - Disability | 2012 ACS | Buffer Ratio by Facility |

# 6 - Protect Natural, Cultural and Environmental Resources

| Measure | Data Source | Method |
|---|---|---|
| • Natural Resource/Environmental Constrained Area | TNMAP | Yes/No |
| • Farmlands | TN Parcel | Yes/No |
| • Geology hazard | Varies | Yes/No |
| • Archeological / Historical Sites | TNMAP | Yes/No |
| • Conservation and Preservation | TNMAP | Yes/No |
| • Wildlife and Habitat | TDEC | Yes/No |
| • Flood Plains / Flood Control | TNMAP | Yes/No |
| • Special Designations | TNMAP | Yes/No |

# Limitations

- It **cannot** evaluate the new build roadway projects
    - Unless a model run is performed, or
    - New-location roadway assumptions are made
- It **cannot** evaluate multi-modal projects
    - We currently don't have a good procedure to do that
- Functional class has to be correct
    - Overly classify a road: Unfair disadvantage
    - Under classify a road: Unfair Advantage
    - We will update the scoring methodology in the next version (eg: using area type and AADT group)
- No on-going project locations
    - We will add this feature in the next version
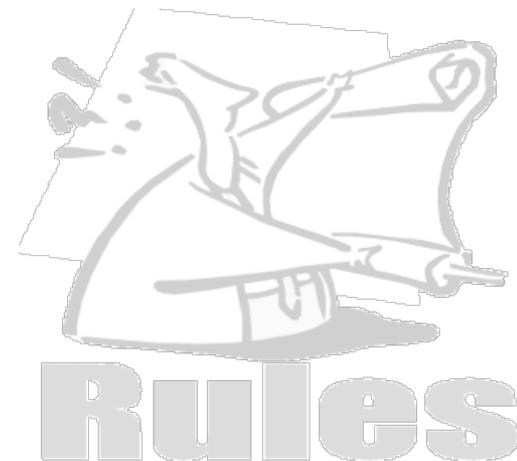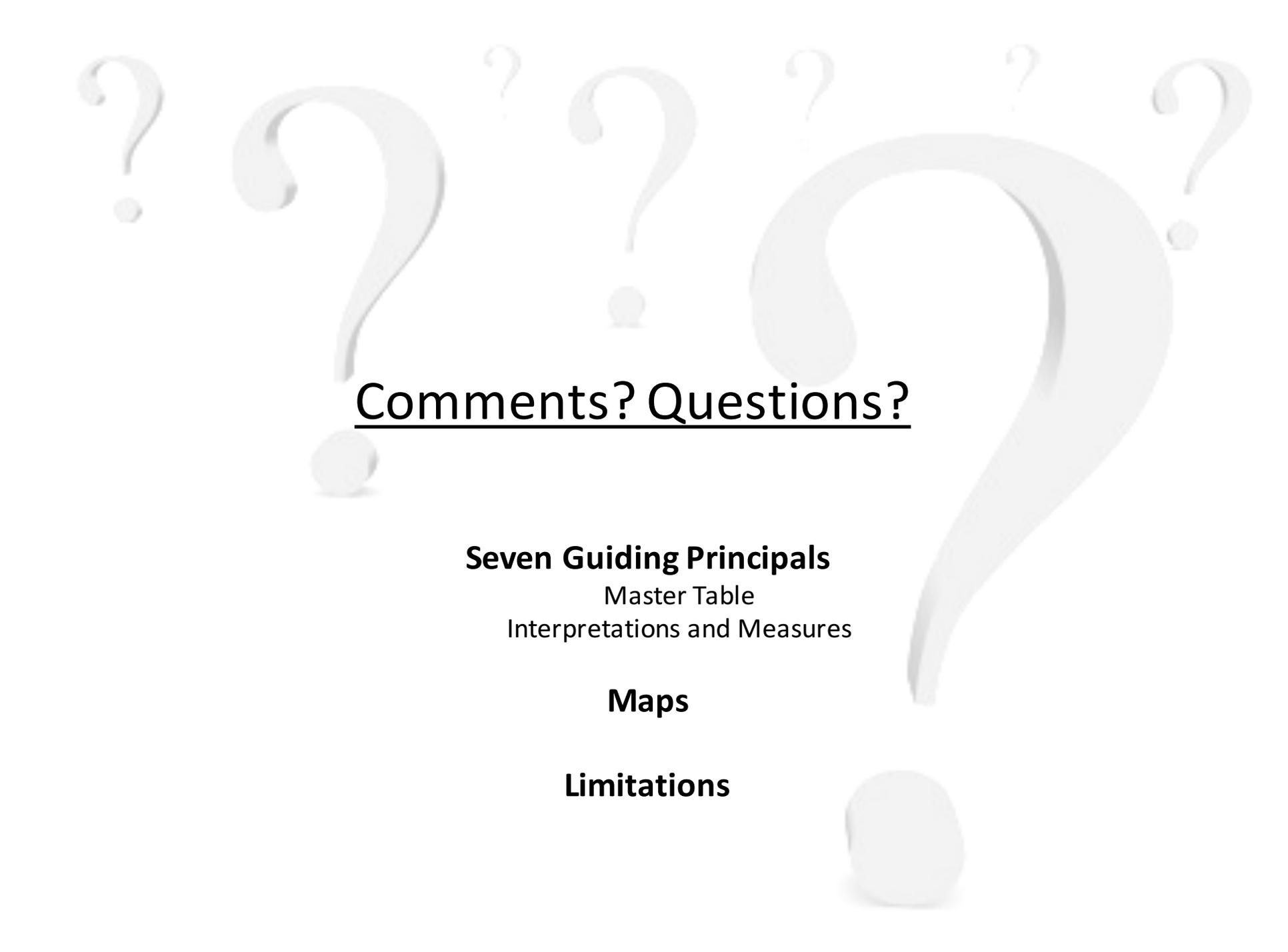
# Comments? Questions?

**Seven Guiding Principals**
Master Table
Interpretations and Measures

**Maps**

**Limitations**

# Part 4: Demonstration

# Demonstration

- Reports (Handout)
  - TN
  - Region
  - MPO
  - RPO
  - RPO – SR only

- KML (Google Earth)
  - All Routes in the Region
  - MPO/RPO Top 10

- Excel Engine
  - Data
  - Weight Tables
  - Segment and Mini-Corridor Scores/Ranks

# Measure Maps



AADT by FCLASS

Multi-Modal Access

Employment Growth

Environment

Score
0
1
3
5

0  5  10  15
Miles
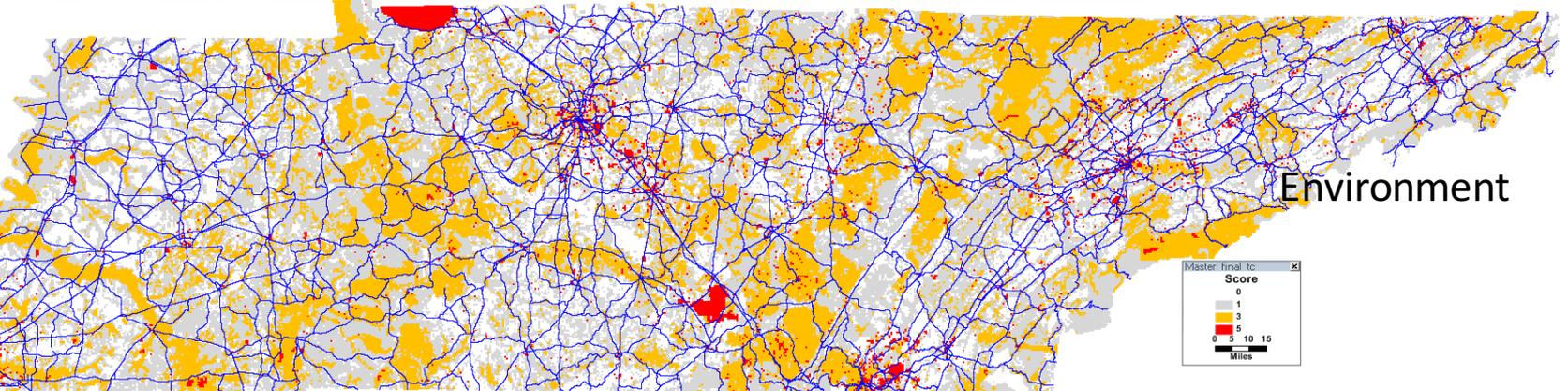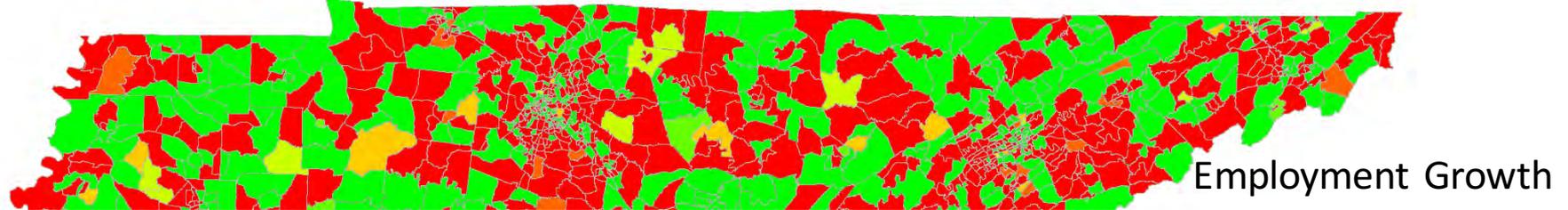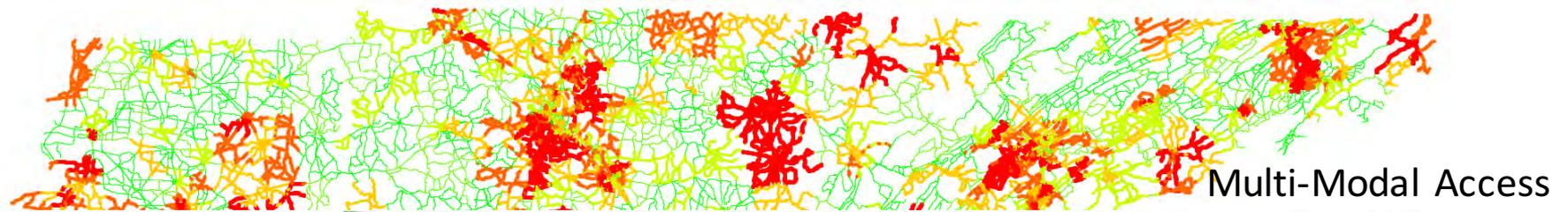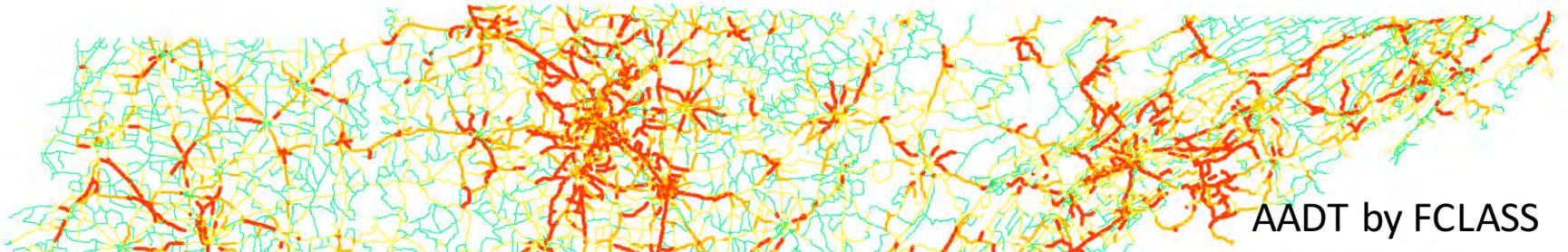
# Part 5: Next Steps and Discussion

# Next Steps - Coordination

- **RPO Coordination/Inputs Meetings**

- MPO Coordination/Inputs (4/28 TN MUG Meeting)

- Initial Tool Package
  - This Presentation File
  - The draft Highway Deficiency Analysis Tool Tech Memo
  - 2015 Top 10 Location Annual Reports
  - Master Network
    - Google Earth KML file – Top 10 Locations
    - Google Earth KML file – System
    - 2015 Master Network in ESRI Shape format
    - 2015 Master Network in TransCAD geographic file format

- Late 2016 ~ 2017
  - E-TRIMS Integration
  - Highway Deficiency Analysis Tool Software

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# Next Steps – Updates and Implementations

- TDOT Divisions
  - **Strategic Investment:** Continue to have a good working relationship (tool update and 3-year program evaluation)
  - **Environmental:** Implement the NEPA process where possible
  - **Traffic Operation:** Updated bottleneck locations
  - **IT:** Continue to work with IT in order to make the data easy to share

- Update the Tool (April 2016 – July 2016)
  - New Data (Slope, Travel Time Data, SWM)
  - Adding Current Project Locations
  - New Measures (eg: MAP-21 safety performance measures)
  - Suggest Project Type
  - Actual Percentile for the score
  - Distance to a intermodal facility (N/A now)
  - Enhance the maps in the report
    - PPRM Project overlay
  - Enhance the comparison methods
    - Using area type and AADT groups instead of functional classes
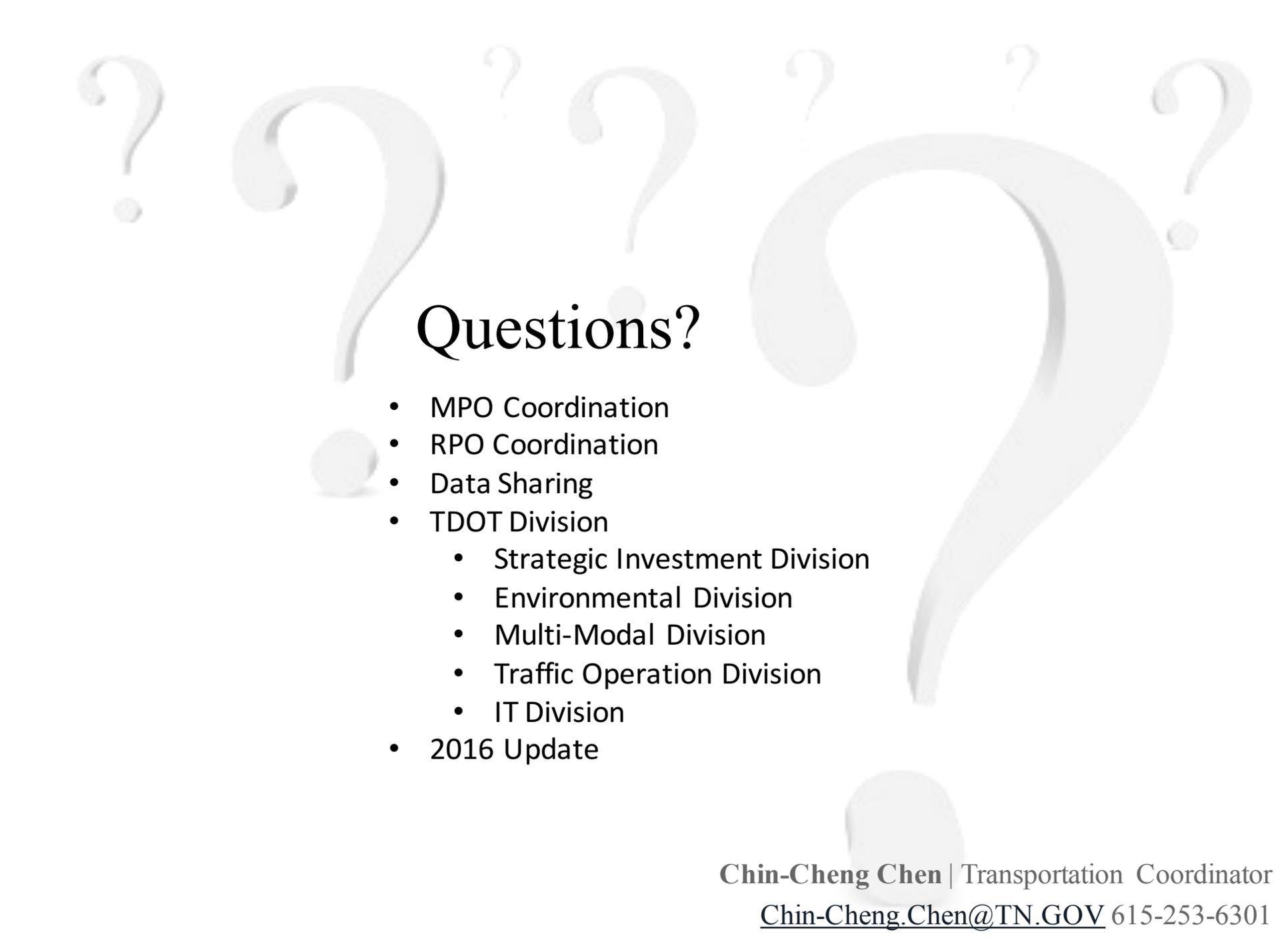
# Questions?

- MPO Coordination
- RPO Coordination
- Data Sharing
- TDOT Division
  - Strategic Investment Division
  - Environmental Division
  - Multi-Modal Division
  - Traffic Operation Division
  - IT Division
- 2016 Update

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# FAQ

- How this tool coincide with the corridor studies?
  - There are a lot more factors go into the corridor studies. The data used in this tool can be part of the inputs for the corridor studies

- How does this tool can be incorporated to the RPO/MPO planning process?
  - This tool helps the MPOs and RPOs to understand their transportation system. Once the deficiencies are identified, then solutions can be developed to address the deficiencies.

- Is this forcing other planning agencies to fit their planning process to TDOT's vision (6 guiding principles and weight). What if the planning agency has different goal in mind?
  - The tool utilized the same weight as TDOT's project prioritization process for the short term program development. The local planning agencies can change the weights or measures based on their own planning goals. This tool is useful to identify the deficiency lactations using local planning agencies' vision.

- How to translate the deficiencies to projects
  - Through the funneling process, this tool will help with the justifications

- How does someone with limited software background use this tool
  - We are providing the google earth files and the top deficiency reports

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# FAQ

- It's too hard to use
  - Report: Please download the report if you haven't already. This is the report created for the RPO area
  - https://www.dropbox.com/s/chkwg2mpadrope6/RPO-SRONLY-Report.pdf?dl=0
  - KML: We will also provide the RPOs/MPOs with the KML file, which can be opened in google earth, hopefully it will be easy enough for them to use.
  - Excel Engine: We will reduce the size of the engine by reduce the records to a smaller MPO area, so you can see how to re-prioritize the weights in the tool.

- It doesn't provide the deficiency locations for bridge, safety, intersection, air quality projects, or multi-modal locations
  - That's absolutely right, this is a highway deficiency analysis tool
  - Please refer to the extra slide page 1, this tool focuses more on the NHPP and STP funding, all other types of projects are evaluated using different mechanisms.

- What does this tool do exactly, and what if MPOs/RPOs think the top-location report means TDOT will have a project there.
  - Page 8 has a simple flow chart for the federal-aid project for the MPOs, this tool helps them with the "system evaluation", and "prioritize the needs and develop the projects" phases. Even if a location is ranked number 1 in the tool, doesn't mean it can bypass all other steps. It simply helps the MPOs to justify their needs, and provide another(similar) angle to look at their area's transportation issues.
  - Page 9 has a similar chart for the RPOs, as you can see, first two steps are grayed out, we are helping the RPOs to establish the planning procedures, and to help them to justify their needs when they submit the "ask for study" proposals to TDOT.

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