

A network diagram with various sized nodes (circles) in shades of blue and green, connected by thin lines. The nodes are distributed across the top half of the slide, with a denser cluster on the left and more sparse connections towards the right. The background transitions from a dark blue on the left to a lighter blue on the right.

Freight Analysis Framework, Version 5 (FAF5): Overview of Highway Network Assignment Model and Visualization Tool Demonstration

October 2022



U.S. Department of Transportation
Federal Highway Administration

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Agenda

- Overview of FAF5
- Overview of FAF5 Highway Network Assignment Model
- FAF5 Visualization Tool Demonstration
- Q&A

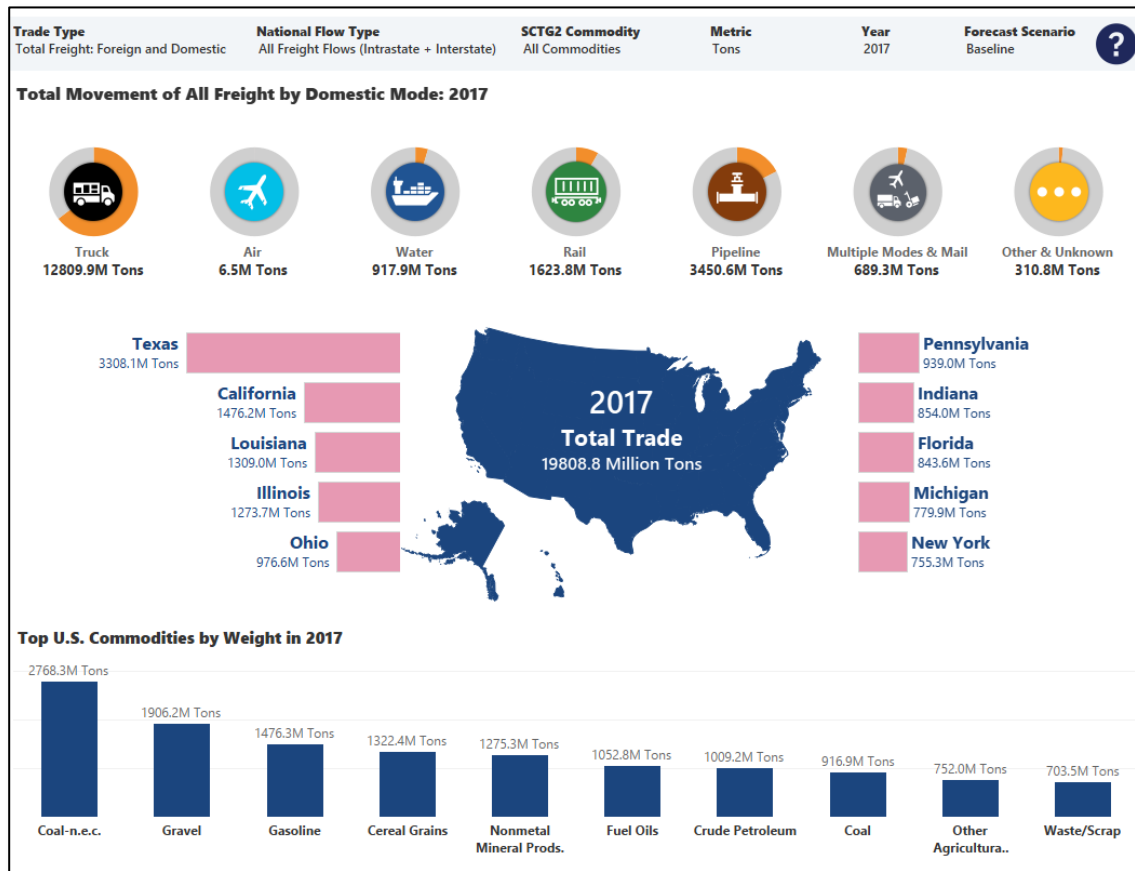
Expected Learning Outcomes

- ✓ Improved understanding of FAF5 updates
- ✓ Enhanced ability to use FAF5 for freight analysis
- ✓ Increased knowledge of FAF5 visualization tool



What is FAF?

FAF5 Webpage: https://ops.fhwa.dot.gov/freight/freight_analysis/faf/



FAF Provides a Comprehensive Picture of Freight Movement in the U.S.

- Includes information on:
 - Weight and value of freight transported
 - Types of commodities and transport mode
 - Freight truck routings
- Offers tools to obtain customized data for analysis
- Updated every 5 years in conjunction with economic census

Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.



What is New in FAF5?

Origin-Destination Flows

- New data base year (2017)
- Updated data to horizon 2050 with 5-year increments
- New short-term forecasts for 2020, 2022, and 2023
- Revised annual estimates for 2018 and 2019
- Updated base year data and forecast data development processes

Highway Network Flows

- Updated model highway network (dualized Interstates and included ramps)
- Added new truck flows by commodity groups
- Added new truck flows (domestic, imports, and exports)
- Overhauled highway network model and routing algorithms
- Added new customized model software and analysis capability

Special Products and Data Tools

- Updated features for web-based data products
- Added new FAF data visualization tools
- Added new national truck flow maps
- Added new State-level truck flow maps
- Added new summary tables by FAF zones
- Added a new special tabulation of CFS 2017 for small areas



What Can FAF Help Me Do?

FAF can help:

- Inform freight analysis and decision-making
- Improve understanding of current and projected future freight needs
- Enhance understanding of current and projected future freight movement
- Illuminate links between freight and economic activity
- Improve freight performance monitoring and management
- Better visualize freight flows and other freight data

Examples of FAF Use Cases:

- ✓ Support development of or updates to the State Freight Plan
- ✓ Help identify commodity corridors and trade lanes
- ✓ Provide control totals for modeling needs to understand State/regional freight connectivity
- ✓ Help conduct macro-level analysis for drafting grant applications



FAF5 User Resources and Tools

Pre-Populated Resources

- Summary tables and key statistics
- Freight truck flow maps

Web-Based Tools for Customized Analysis

- FAF5 Visualization Tool and dashboards
(covered in this webinar)
- Data tabulation tool
(covered in July 28 FHWA FAF5 webinar)



FHWA Investments in Freight Data Tools and Resources

In addition to the FAF5 Visualization Tool and dashboards, FHWA has invested in other freight data tools and resources to support FAF5 users in improved freight analysis and decision making.

Examples of FHWA Investment in Improved Freight Data Tools and Resources:

Freight Mobility Trends Tool

- Dashboard providing national freight performance statistics and information on freight mobility and highway bottlenecks, based on an analysis of National Performance Management Research Data Set (NPMRDS)
- Available at: https://ops.fhwa.dot.gov/freight/freight_analysis/mobility_trends/index.htm

Vehicle Inventory and Use Survey Update

- Principal data source on the physical and operational characteristics of the U.S. truck population.
- Partnership between FHWA, the Bureau of Transportation Statistics, and the U.S. Department of Energy.
- The survey is conducted by the U.S. Census Bureau.
- Additional information available at: <https://www.bts.gov/vius>
- Expected update in 2023.





FAF5 Highway Network Assignment Model



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What is the FAF5 Highway Network Assignment Model?

- Produces data for identifying freight truck corridors (e.g., heavily used routes)
- Produces data for understanding commodity flows and the associated truck trips on a national model highway network
- Entails a multi-step process to disaggregate FAF commodity flows to a more detailed zone system, convert commodity flows to truck trips, and assign those truck trips to a national level model highway network



Why is the FAF5 Highway Network Assignment Model Important?

- Supports improved freight analysis
- Enhances transportation planning, management, and decision-making
- Provides an improved, flexible, and transparent methodology for estimating freight truck flows on national highway systems

Model Applications (Examples):

- Identify major trucking corridors
- Query originations and destinations of truck flows on road links
- Estimate State through-truck traffic volumes



What Products Result from the FAF5 Highway Network Assignment Model?

✓ **County FAF5 commodity flows:**

- Commodities carried by trucks
- Truck trips

✓ **Nationwide FAF5 freight truck volumes:**

- Estimates for 2017
- Projections for 2022 and 2050

✓ **Maps of FAF5 freight truck flows:**

- National level maps by commodity groups
- State level maps

✓ **FAF5 Highway Model Network**

✓ **FAF5 Network Analysis Tool**

✓ **Technical report**



What is the FAF5 Highway Network?

A new FAF model highway network that includes the:

- National Highway System
- Strategic Highway Network
- National Highway Freight Network

Key network features:

- 480,000 links; 342,000 nodes
- Directional links coded for Interstates and ramps connections
- Includes centroid connectors for counties, ports, airports, and border crossings
- Congested speeds from National Performance Management Research Data Set (NPMRDS) and truck tolls compiled for 2017



Example of FAF5 Highway Network Attributes

Selected Inputs

Field	Value
Road_Name	I 80
LENGTH	8.47
Class	11
Class_Description	Interstate Highway
Road_Type	11
Sign_Rte	I 80
Facility_Type	2
NHS	1
STRAHNET	1
NHFN	1
AB_Lanes	3
BA_Lanes	--
Speed_Limit	70
AB_FinalSpeed	70.00
BA_FinalSpeed	70.00
AB_FreeFlowTime	7.26
BA_FreeFlowTime	7.26

Selected Outputs

Field	Value
AB ALL-TotalTons Flow	48527.76
BA ALL-TotalTons Flow	0.00
AB ALL-TotalTrips Flow	5811.33
BA ALL-TotalTrips Flow	0.00
TOT ALL-TotalTons Flow	48527.76
TOT ALL-TotalTrips Flow	5811.33
AB Farm Products-TotalTons Flow	17532.30
BA Farm Products-TotalTons Flow	0.00
AB Farm Products-TotalTrips Flow	1856.00
BA Farm Products-TotalTrips Flow	0.00
TOT Farm Products-TotalTons Flow	17532.30
TOT Farm Products-TotalTrips Flow	1856.00
AB Food, Beverage and Tobacco-TotalTons Flow	7637.58
BA Food, Beverage and Tobacco-TotalTons Flow	0.00
AB Food, Beverage and Tobacco-TotalTrips Flow	1052.58
BA Food, Beverage and Tobacco-TotalTrips Flow	0.00
TOT Food, Beverage and Tobacco-TotalTons Flow	7637.58
TOT Food, Beverage and Tobacco-TotalTrips Flow	1052.58

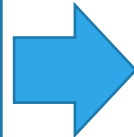
Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.1.



How was the FAF5 Highway Network Assignment Model Developed?

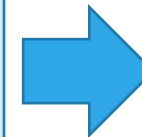
Step 1. Commodity Flow Disaggregation

FAF5 commodity flows disaggregated from FAF zones to a more granular and suitable geography



Step 2. Truck Trip Estimation

Disaggregated commodity flows converted to truck trips by applying payload factors



Step 3. Truck Flow Assignment

Estimated truck trips carrying FAF commodities assigned to the FAF5 model highway network by applying a path choice model



What is Step 1? (Commodity Flow Disaggregation)

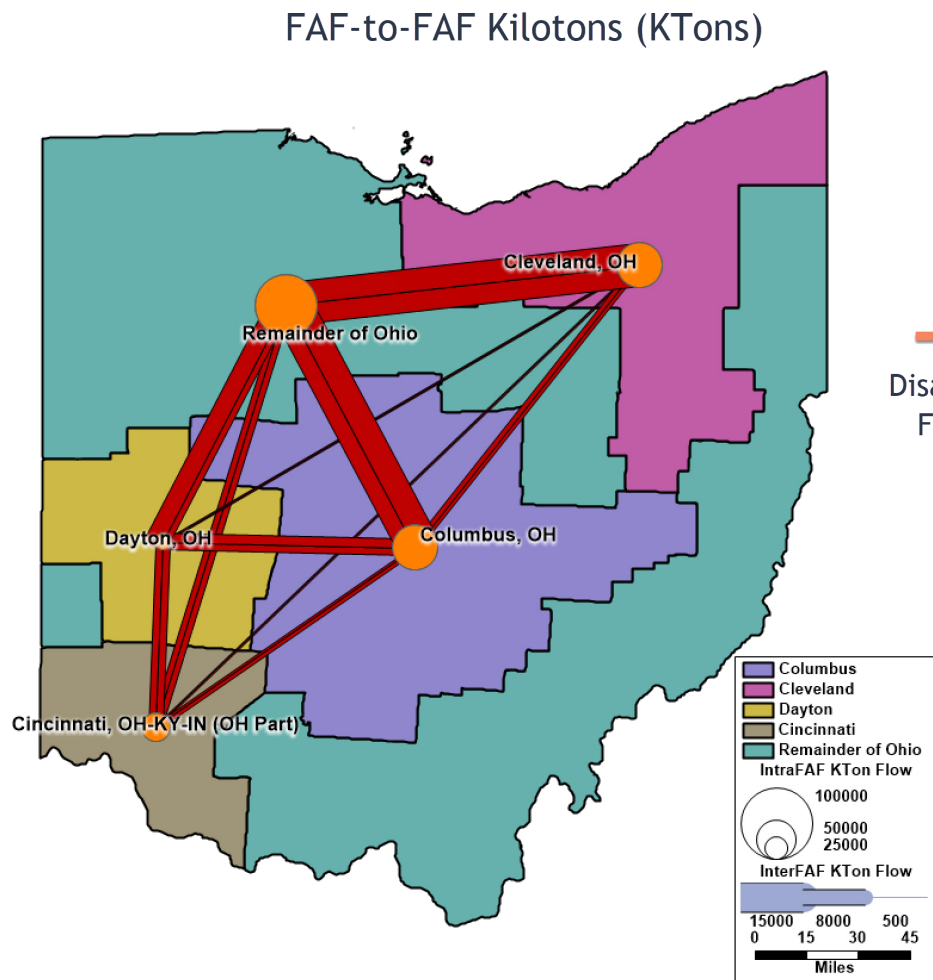
- Disaggregates FAF5 commodity flows from between 132 FAF zones to between 3,497 counties, sub-county areas, ports, airports and border crossings so these flows can be routed to estimate truck volumes (in Step 3)

Disaggregation Method Details:

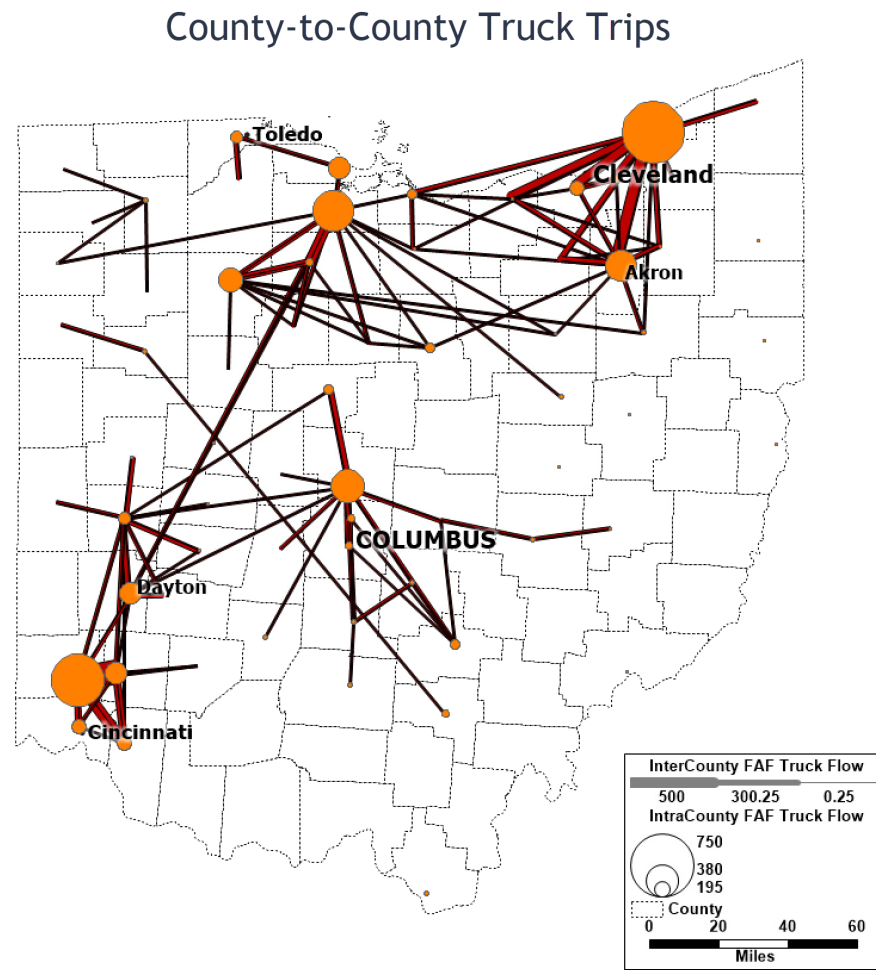
- Production and attraction regression equations developed and applied for commodity flows by commodity group as a function of industry employment, population, and other variables
- Tri-proportional gravity model applied to preserve FAF totals and mean flow length distributions



Example of Disaggregation: FAF-to-FAF Commodity Flows Converted to County-to-County Truck Trips in Ohio



Disaggregate from FAF to County



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.1.



What is Step 2? (Truck Trip Estimation)

- For each O-D pair, the tonnage of commodity flows by commodity group is converted to estimated truck trips by type of truck

Truck Trip Estimation Details:

- Payload factors applied to estimated number of truck trips
- Different payload factors used by commodity group, length of haul, and truck type



What are Average Payload Factors?

Average Payload Factors (Tons/Truck)

Commodity	Truck Type	
	Single Unit Trucks	Combination Unit Trucks
Meat/seafood	11.37	20.17
Pharmaceuticals	8.51	21.03
Wood products	15.45	22.12
Electronics	9.12	14.74
Mixed freight	10.21	19.21



What is Step 3? (Truck Flow Assignment)

- Assigns O-D flows of estimated truck trips (produced in Steps 1 and 2) to specific routes on the FAF5 national model highway network

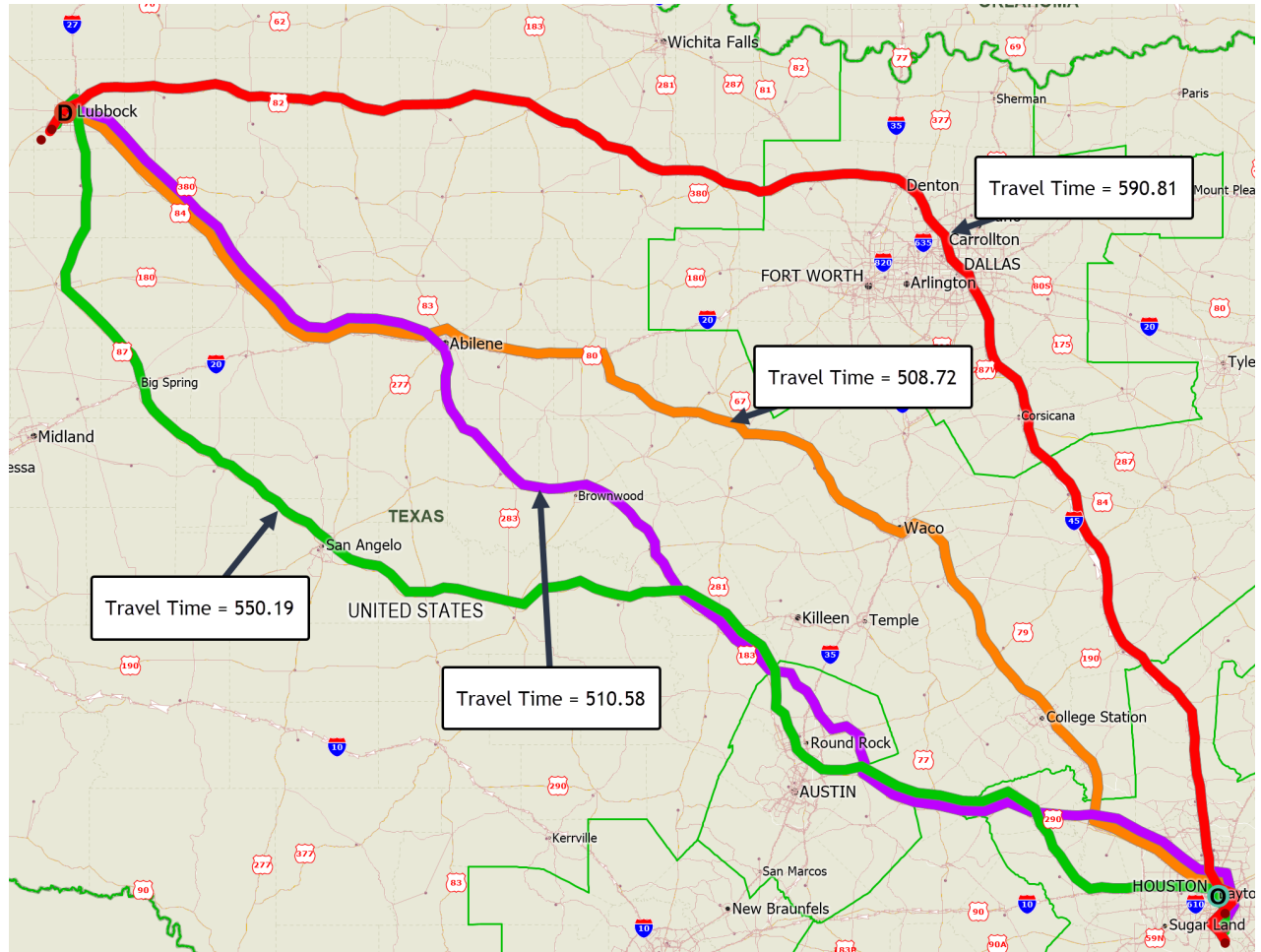
Truck Flows Assignment Details:

- Assignment of truck to specific routes based on congested travel times and tolls
- Application of an improved assignment methodology
- Use of a heuristic for path enumeration
- Use of a discrete choice model to estimate route shares on enumerated routes
- Use of a path-size logit model to correct for overlapping routes



Example of Path Enumeration: Alternative Routes between Lubbock and Houston, Texas

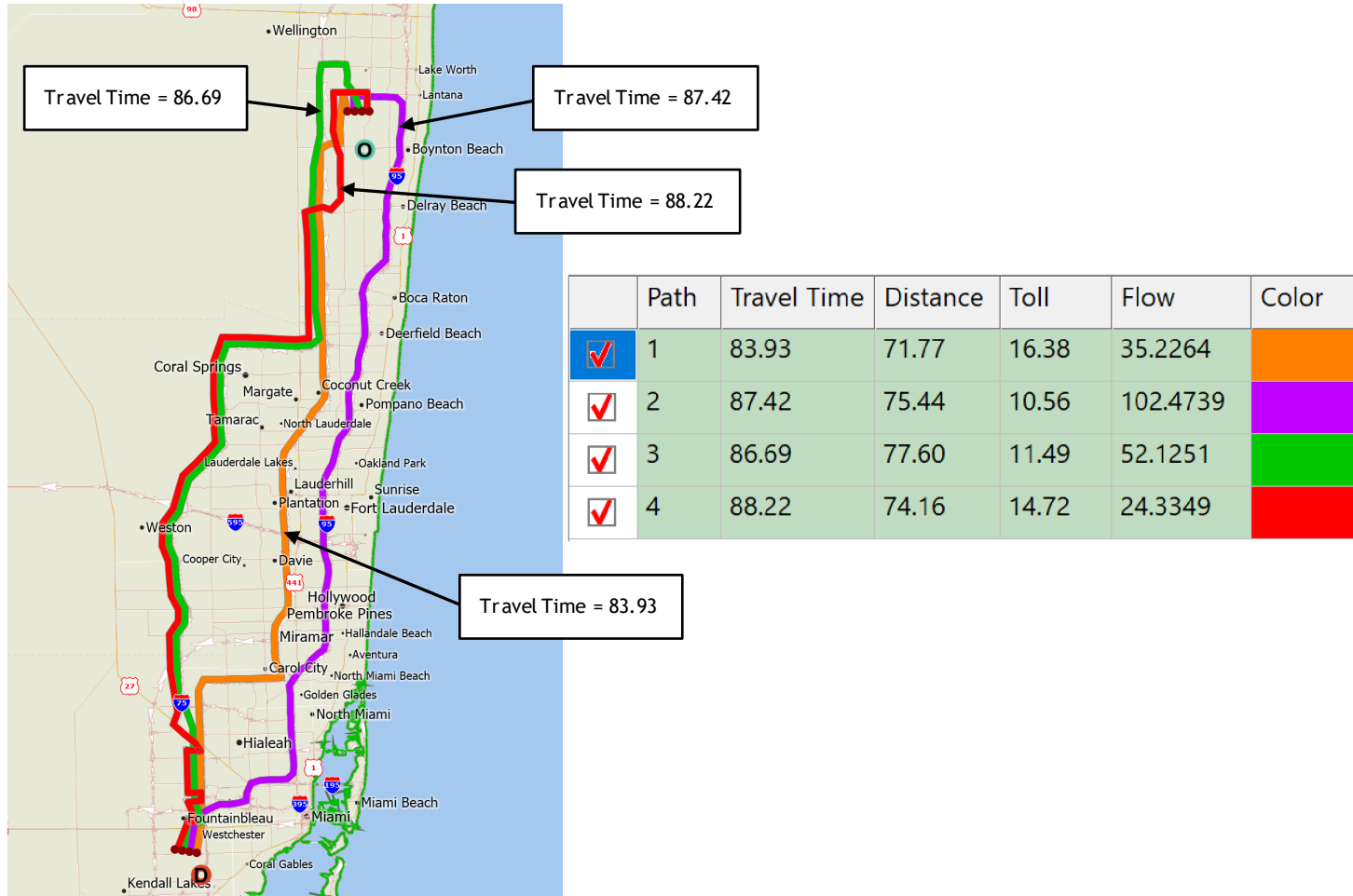
- Paths are enumerated between all 3,497 origins and destinations based on congested travel times
- Multiple paths are identified when they are competitive



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.1.



Flows Are Assigned with the Route Choice Model for Each O-D Pair



- Trip volumes calculated for each route for each O-D pair
- Link volumes summed to produce an overall national flow map

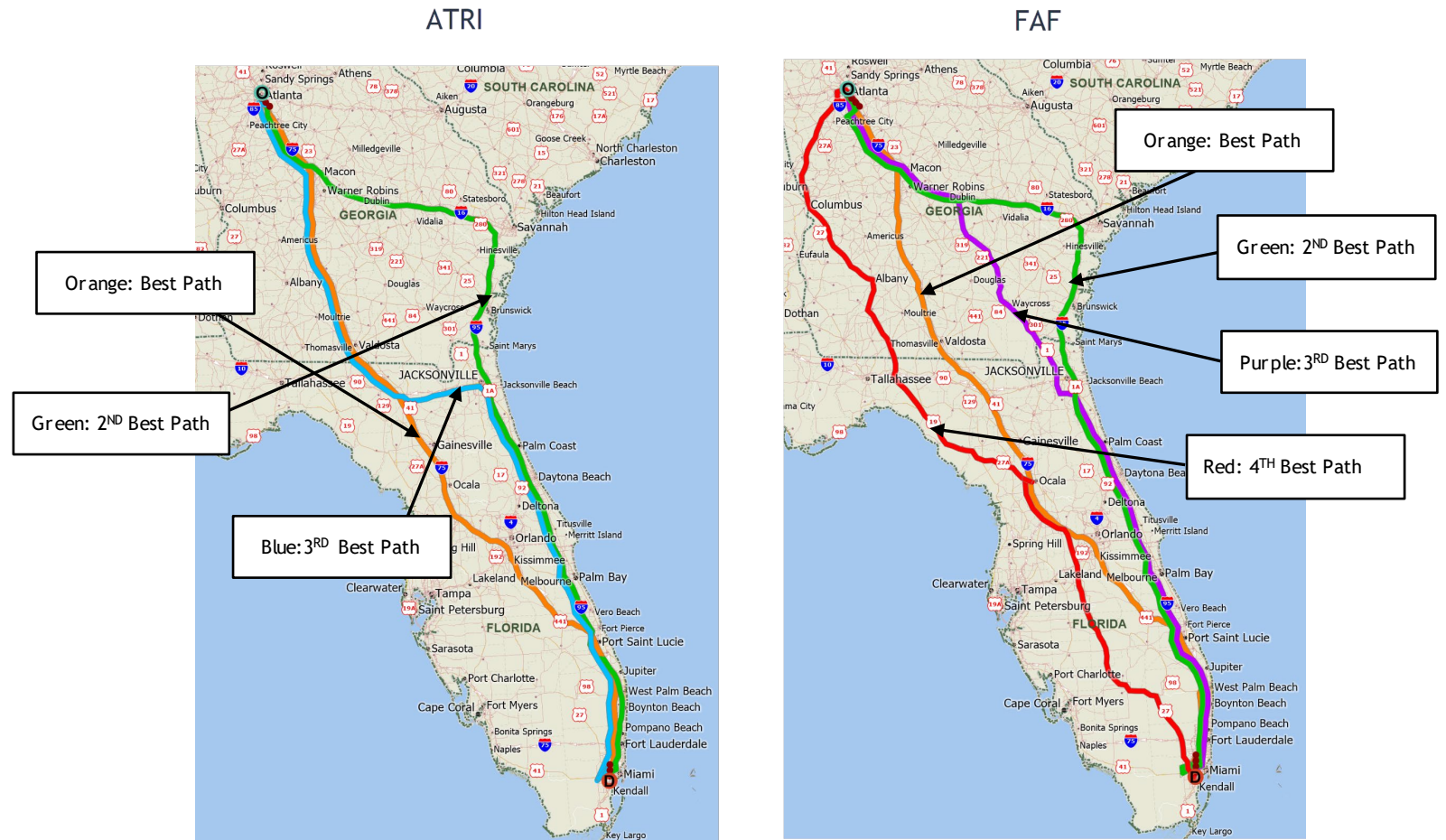
Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.1.



How Was the Assignment Process Checked?

- Reasonable correspondence found when comparing enumerated routes with used truck routes identified in ATRI data
- Over 50 city-to-city used truck routes were compared
- In general, the route with the greatest share of freight trucks was the same as in American Transportation Research Institute (ATRI) data

ATLANTA/MIAMI ROUTING



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.1.



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Example of FAF5 Network Flow Map: Average Estimated Total Daily Truck Volumes (2017)



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.1.



Example of FAF5 Network Flow Map: Estimated Daily Volumes for Trucks Carrying Chemicals (2017)

Estimated Average Daily FAF Volumes for Trucks Carrying Chemicals Commodities on National Highway System 2017



Note: Major flows include domestic and international freight moving by truck on highway segments with more than twenty five FAF trucks per day and between places typically more than fifty miles apart.
 Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.1.
 Flows include Basic chemicals (SCTG20), Pharmaceuticals (SCTG21), and Fertilizers (SCTG22) commodities represented in FAF.



Example of FAF5 Network Flow Map: Freight Flows Passing Through Missouri (2017)

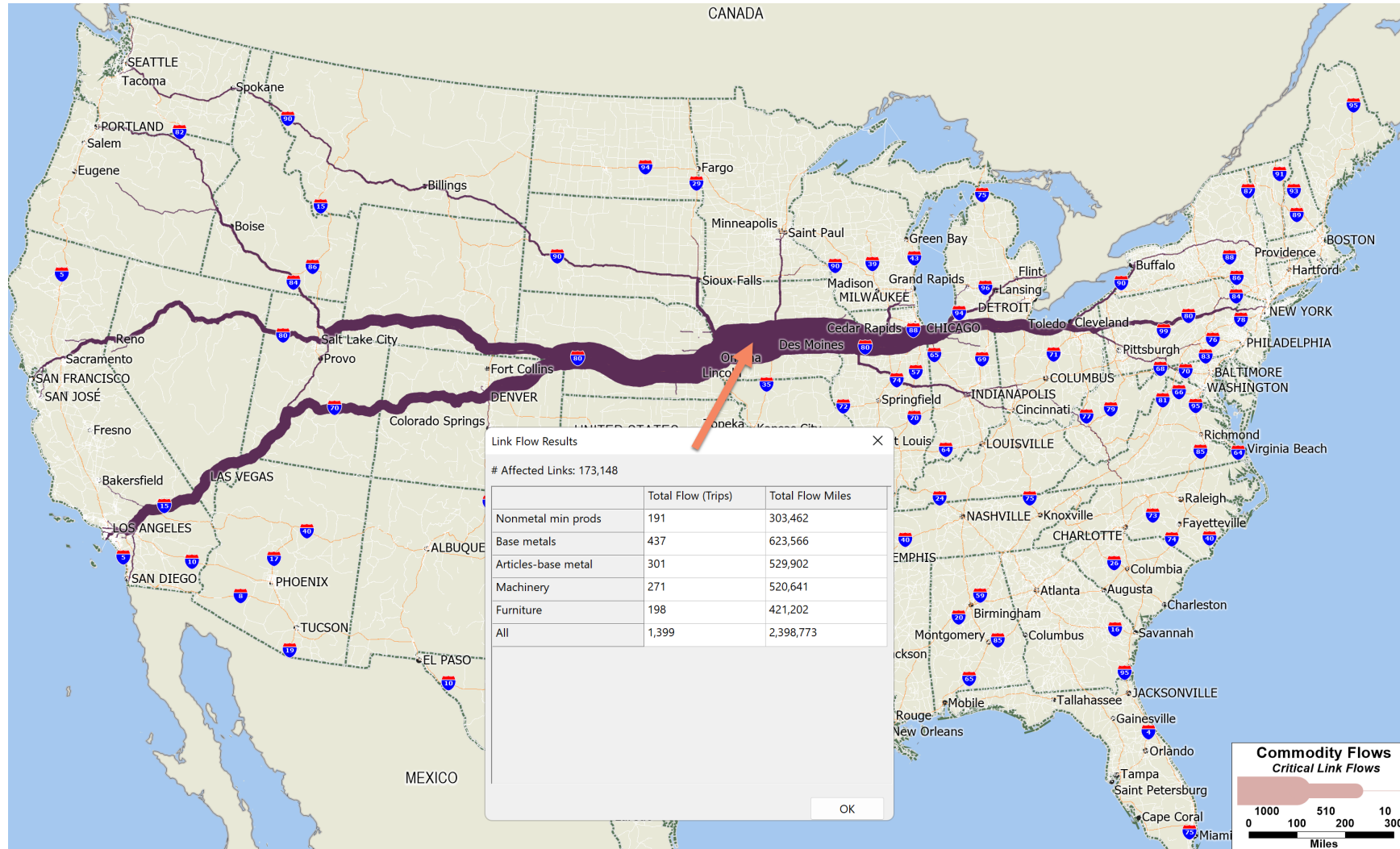
Estimated FAF Flow for Trucks Passing Through Missouri on National Highway System: Year 2017



Note: Major flows include domestic and international freight moving by truck on highway segments with more than twenty five FAF trucks per day and between places typically more than fifty miles apart.
 Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.1. Flows include 42 different commodities represented in FAF.
 * State to State flows represent annual KTons of freight transported by trucks that pass through Missouri including imports and exports that use Missouri as the gateway port.



Example of FAF5 Network Flow Map: Truck Trips Carrying Durable Goods through Iowa on I-80 (2017)



What is the FAF5 Network Analysis Tool?

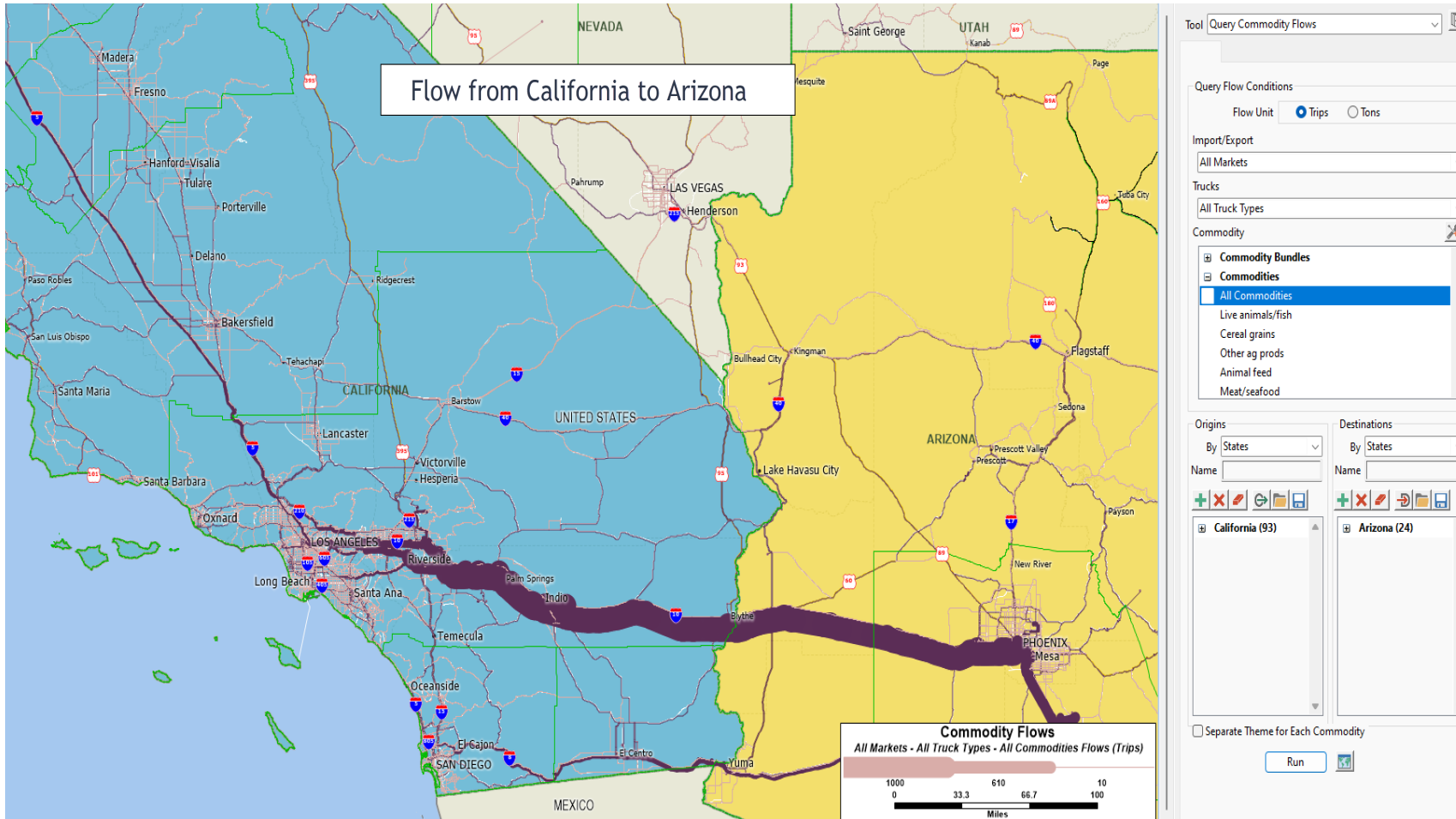
- New software tool developed to perform FAF5 highway network modeling and support improved freight analysis
- Software tool is modular, flexible, and transparent
- Includes features for network management, querying data, and visualization of results

Tool Overview:

- Software application built on TransCAD Version 9
- Supports data querying of the nearly 13 million origin-destination pairs, 40+ million routes, and almost 500,000 network links represented in the FAF5 model highway network
- Allows users to edit, add, or delete routes and recalculate flows



Example of FAF5 Network Analysis Tool Capability: Select Area Analysis

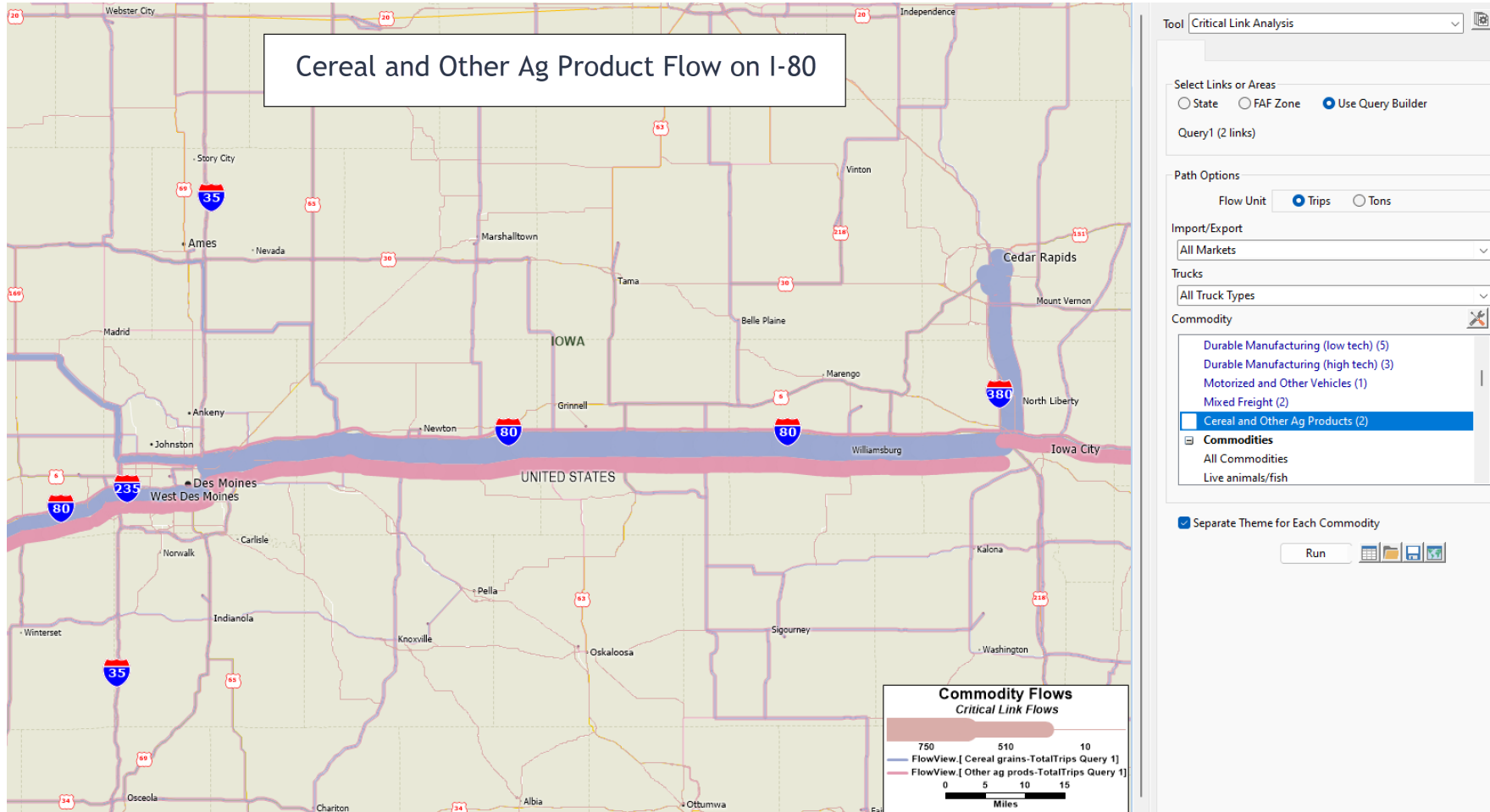


- Provides capability to select flows between States of interest and display additional details and visuals

Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.1.



Example of FAF5 Network Analysis Tool: Select Link Analysis



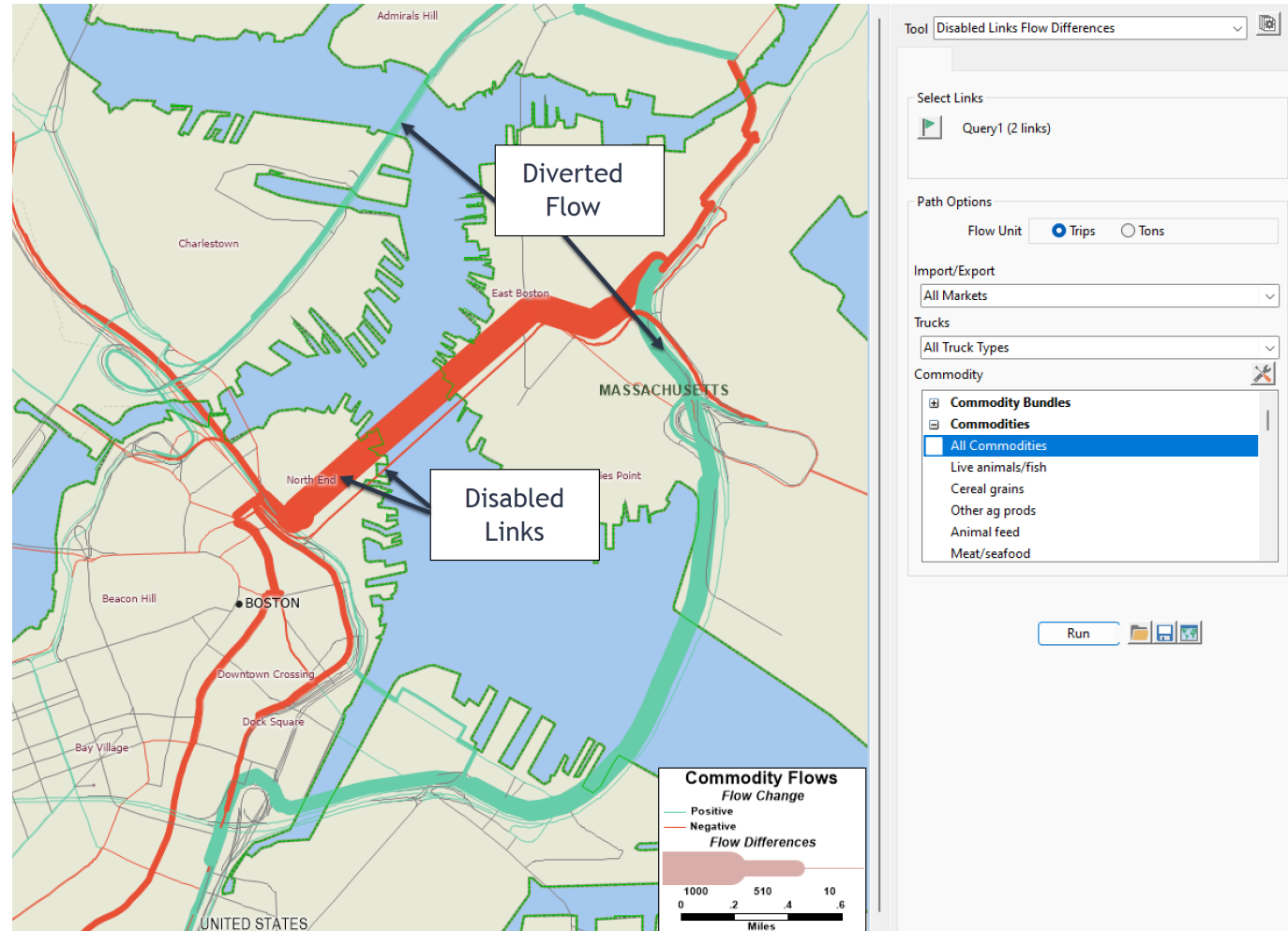
- Provides capability to select flows associated with road segments of interest and view additional details

Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.1.



Example of FAF5 Network Analysis Tool Capability: Diversion Analysis

- If some roadway links are not available due to events such as weather, etc., the FAF5 highway network model will divert trips to alternative routes



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.1.





FAF5 Visualization Tool Demonstration



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What is the Purpose of the FAF5 Visualization Tool?

- Visualize FAF5 data
- Allow for a more dynamic and interactive user experience
- Animate data to help tell the freight story
- Provide a user-friendly tool to access freight flows data
- Support development of materials for improved freight analysis, decision making, and other activities



What can Users do with the FAF5 Visualization Tool?

- Visualization tool users may:
 - Select preferred options for FAF5 data display at various geographic level such as international, national, and top origin and destination pairs (State and FAF5 zones)
 - Create dashboards to more easily visualize and export information allowing for different scales of geographic analysis

FAF5 Visualization Tool:

- Provides flexibility for different types of users to visualize FAF5 data
- Focused on ease of use; does not require extensive training



Questions?

To ask a question, you may:

- Type into the chat pod
- Choose the “raise hand” feature if you wish to ask a question by computer audio; facilitator will cue you to ask a question and then unmute your line
- After the webinar:
 - Email Birat.Pandey@dot.gov

**FAF5 and detailed data documentation is available at:
https://ops.fhwa.dot.gov/freight/freight_analysis/faf/**



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