

*SharedUse Web-Based Tool*  
*Railroad Corridor  
Transportation Planning Tool*

*SCORT Annual Meeting  
Washington DC  
February 18, 2015*



FRA – Office of Railroad Policy and Development

2/23/2015



U.S. Department  
of Transportation  
**Federal Railroad  
Administration**

## ***What are Shared Use Passenger and Freight Corridors?***

- ***Passenger and freight operations co-exist on rail line owned and operated by a Class 1 railroad***
- ***Include Amtrak and most future state-supported lines***
- ***Service plan agreements between the host freight railroad, the state, and Amtrak required for Federal funding.***
  - ***Passenger Rail and American Recovery Investment and Improvement Acts of 2008.***

## ***Service Plan Requirements?***

- ***Adequate rail infrastructure to maintain rail network fluidity (freight) and minimum delay and on time performance (passenger and freight).***
- ***Freight railroads' large-scale simulation models identify rail infrastructure requirements required to support service outcome agreements:***
  - 1. Track***
  - 2. Signal***
  - 3. Structures***

## ***Shared-Use Web-Based Tool?***

- ***Provides State DOTs an alternative to the freight's large scale simulations***
- ***Preliminary evaluation to help states select best candidates for further study among multiple rail alignments.***
- ***Evaluates track infrastructure improvements and changes to operating plans***
- ***Output: useful charts and graphs identify areas of conflict, train delay for each train type and each train***

***Shared Use includes simulation components developed, verified, and validated by FRA:***

***Train Movement –Improves upon Train Performance System***

***calculates acceleration and resistance forces for each car  
recalculates force for each grade/elevation change  
uses 8 throttle positions***

***Node Network***

***supports deadlock free dispatching using “free path” and  
“buffer” concepts developed by UC Berkeley***

***Central Dispatcher***

***Grants train movement authorities, imposes delays to prevent  
deadlock, governs train priorities and meet-pass logic***



## ***Shared-Use Step-By-Step***

***Track Tool*** - develop and visualize detailed rail track infrastructure: speed zones, curvature, and elevation for each track segment on the corridor.

***Operations Planning*** – develop timetable routes, train schedules, and train consists. Option to include track outages, work zones, and crew schedule.

***Simulate Train Movement***- simulate operating plan over well-define track infrastructure to generate minute-by-minute train performance metrics with string line and block authority visualization.

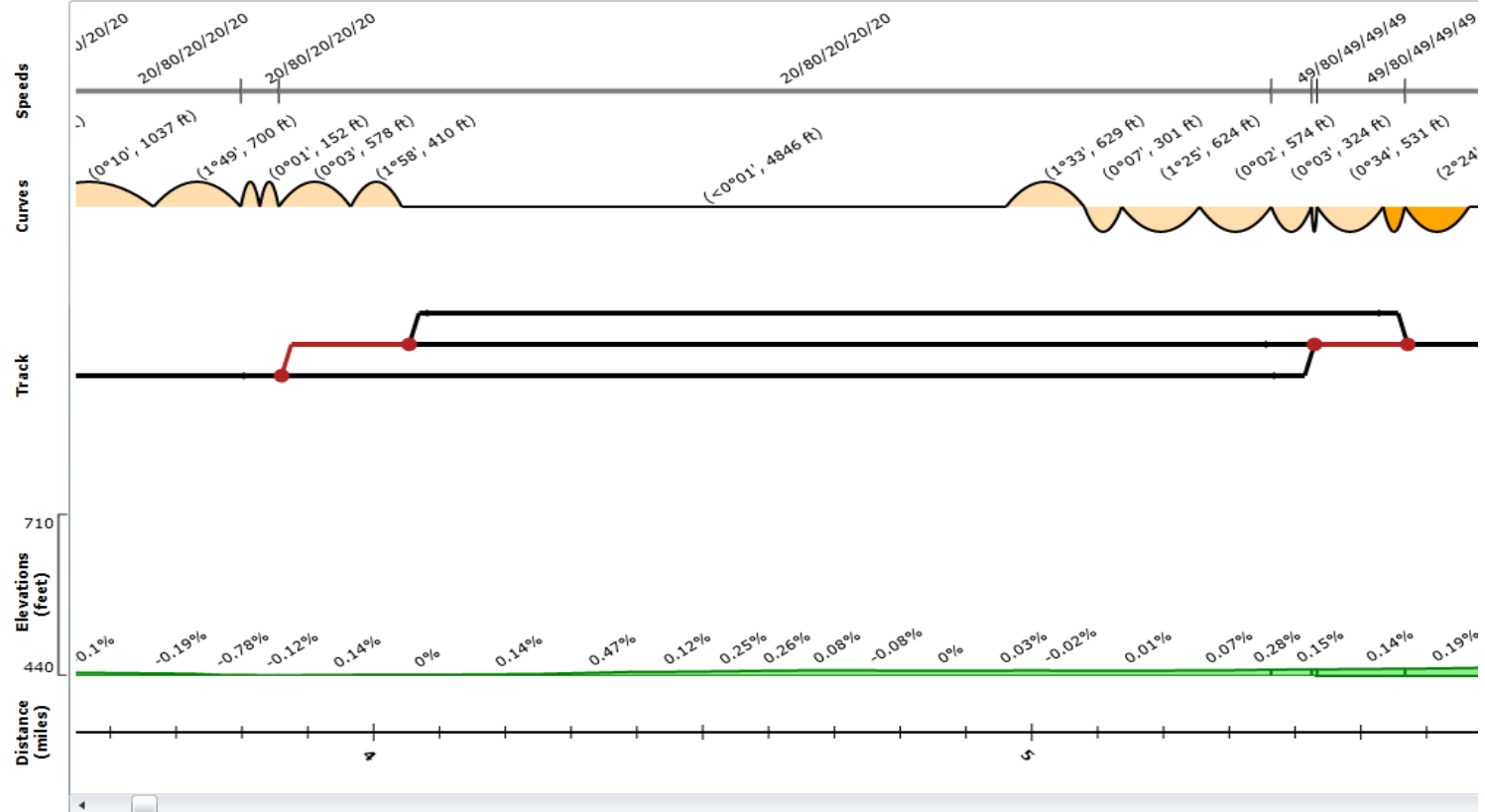
***Return to Track Tool***- Test added infrastructure for resolving conflicts and reducing delay.



# Track Infrastructure: Visualization Tool

## Track Tool

View Manage Options Utilities Help



Start Point: Beardstown Scale: 1:10000 Segment ID: 0 Offset: 0 Direction:



FRA – Office of Railroad Policy and Development

2/23/2015



*User develops track territory using drop-down menus to input track elevation, number of tracks, signals, cross-overs, and sidings. The user also enters track curvature and train speed for each train type.*



## Train Car Data

Image credit: [illegible]

Select Library: ☒ System library ☐ User-defined

Select a Car Category:

Select a Car:

### Car Data

Name:

Description:

AAR Code:

Light Weight (in lbs):

Load Limit (in lbs):

Length (in feet.):

Axles:

Source:

Air Resistance Coefficient:

Last modified: 5/21/2010 12:00:00 AM

*Users can select train cars from an existing library or create their own rail cars. Cars, locomotives, and the track infrastructure are used by the simulation model to determine braking, acceleration, and train speeds.*

## Build Trains

Select Locomotives:

Selected Locomotives	Name	Horsepower	Dead-in-Tow	Quantity
<input checked="" type="checkbox"/>	TALGO_S8_V2	1972	<input type="text" value="0"/>	<input type="text" value="2"/>
<input type="checkbox"/>	AC4400	4400	<input type="text" value="0"/>	<input type="text" value="0"/>
<input type="checkbox"/>	AC6000	6000	<input type="text" value="0"/>	<input type="text" value="0"/>
<input type="checkbox"/>	B18-7	1800	<input type="text" value="0"/>	<input type="text" value="0"/>
<input type="checkbox"/>	B30-7A	3000	<input type="text" value="0"/>	<input type="text" value="0"/>
<input type="checkbox"/>	C30-7A	3000	<input type="text" value="0"/>	<input type="text" value="0"/>
<input type="checkbox"/>	C36-7	3600	<input type="text" value="0"/>	<input type="text" value="0"/>

Select Cars:

Selected Cars	Name	Light Weight	Load Limit	Number of Empty Cars	Number of Half-full Cars	Number of Full Cars
<input checked="" type="checkbox"/>	TALGO_S8V2	34000	6800	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="10"/>
<input type="checkbox"/>	PAX_85.00	135000	30000	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
<input type="checkbox"/>	M500_85.25	112500	60000	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
<input type="checkbox"/>	TALGO_S8V2_TEM	34000	6800	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>

*Train length, weight, horse power, air resistance coefficient, inform the train movement and central dispatcher algorithms.*

## Build Train Schedules

iles

Select Train: T\_KCSt\_E\_550 : PASSENGER - 10 CARS and 2 LOCOMOTIVES

Timetable Route: BA-Kansas City-TALGO\_Express-St Louis

Select Schedules:

Station	Arrival Time	Departure Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun
KANSAS CITY PAS	15:45:00	15:47:00	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Lee's Summit MO	16:15:00	16:17:00	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Jefferson City MO Track 1	18:07:00	18:09:00	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Kirkwood MO Track 1	19:41:00	19:43:00	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
ST LOUIS PAS	20:00:00	20:02:00	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

*Users assign a time table route to each passenger and freight train.*

*A unique time table route is developed for each unique combination of entry, exit, and station stops. The Kansas City-St. Louis rail corridor has 5 separate time table routes.*

## Develop Operating Plan

Save

Save Copy

Set As Current

Delete

Cancel

Description: 522012\_Full\_C - c1

Select Trains:

Selected Train	Description	Timetable Route	Departure	Mean Delay	Delay Std. Dev
<input checked="" type="checkbox"/>	StL_KC_E_1_Fre : BULK - 150 CARS and 2 LOCOMOTIVES	St Louis-Freight-Kansas City	00:22:00	0.0	0.0
<input type="checkbox"/>	JeffStL_F_1Fr : BULK - 150 CARS and 2 LOCOMOTIVES	Jeff-Freight-St Louis	00:22:00	0.0	0.0
<input checked="" type="checkbox"/>	JeffStL_F_AFr : BULK - 150 CARS and 2 LOCOMOTIVES	Jeff-Freight-St Louis	00:22:00	0.0	0.0
<input checked="" type="checkbox"/>	Kan_PH_L_A : BULK - 150 CARS and 2 LOCOMOTIVES	KC-Pleasant Hill	00:22:00	0.0	0.0
<input type="checkbox"/>	KCSTL_F410 : BULK - 150 CARS and 2 LOCOMOTIVES	Jeff-Freight-St Louis	00:49:00	0.0	0.0
<input type="checkbox"/>	PH_KC_Fre_Emp : BULK - 150 CARS and 2 LOCOMOTIVES	Pleasant Hill-KC	01:02:00	0.0	0.0
<input type="checkbox"/>	Test_Fre_412_A : BULK - 150 CARS and 2 LOCOMOTIVES	Test_Fre_Only2	01:02:00	0.0	0.0
<input type="checkbox"/>	StLKc_Fre_Em : BULK - 150 CARS and 2 LOCOMOTIVES	Test_Fre_Only2	01:02:00	0.0	0.0
<input type="checkbox"/>	Test_Jeff_StL : BULK - 150 CARS and 2 LOCOMOTIVES	Test_Fre_Only	01:02:00	0.0	0.0
<input type="checkbox"/>	StL_KC_E_2_Fre	St Louis-Freight-Kansas City	01:46:00	0.0	0.0

Set Delay Mean and St. Dev for all Trains

0

0

*Operating Plan includes train schedules, time table routes, and delay metrics.*



FRA – Office of Railroad Policy and Development

2/23/2015



U.S. Department  
of Transportation  
**Federal Railroad  
Administration**

# FEDERAL RAILROAD ADMINISTRATION

## Operating Plan (continued)

Parameters by Traffic Volume		Low/Moderate Traffic	High Traffic
Time between Dispatcher actions (seconds)		150.00	150.00
Target distance to authorize miles (miles)		1.00	1.00
Distance to end of authority - trigger for new authorities		1.00	1.00
Minimum required clear track of entry (miles)		0.01	0.01
Allow Passing?		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Following distance that triggers passing (miles)		10.00	10.00
Time passed from schedule entry time that elevates train priority (hours)		5.00	5.00

GCOR Forms A: *No GCOR Forms A*

GCOR Forms B: *No GCOR Forms B*

Temporary Node Outages: *No Temporary Node Outages*

Train Crew Availability: ☒ Ignore Train Crew Replacement

Train Crew Time Parameters	Min	Max
----------------------------	-----	-----

Operating plans modify dispatcher activity like “allow passing” on single track and can include Form A & B track outages and train crew



FRA – Office of Railroad Policy and Development

2/23/2015



U.S. Department  
of Transportation  
**Federal Railroad  
Administration**



# FEDERAL RAILROAD ADMINISTRATION

## Shared-Use Web-Based Tool: Model Output

### Train Simulation Output

Select Train:

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 ... >>															
ID	Element ID	Node ID	Offset (ft.)	Time	Next Speed Limit	Target Speed	Current Speed	Speed Limit	Distance Traveled	Elevation (ft.)	Weight (tons)	Length (ft.)	Throttle Position	PSI	Status
0	30668	0	0.0	6/25/2012 6:34:00 AM	0.0	20.0	30.0	30	1.00	13.5	384	578	4	0	8
1	30668	0	5.3	6/25/2012 6:34:00 AM	30.0	30.0	29.0	30	1.00	13.5	384	578	8	0	8
2	30668	0	41.1	6/25/2012 6:34:01 AM	30.0	30.0	30.0	30	1.01	13.8	384	578	8	0	8
3	30668	0	230.7	6/25/2012 6:34:05 AM	30.0	30.0	30.0	30	1.04	15.0	384	578	8	0	8
4	30668	0	240.7	6/25/2012 6:34:05 AM	30.0	30.0	30.0	30	1.05	15.1	384	578	8	0	8
5	30668	0	250.7	6/25/2012 6:34:05 AM	30.0	30.0	30.0	30	1.05	15.1	384	578	8	0	8
6	30668	0	260.7	6/25/2012 6:34:06 AM	30.0	30.0	30.0	30	1.05	15.2	384	578	8	0	8
7	30671	0	6.7	6/25/2012 6:34:06 AM	30.0	30.0	30.0	68	1.05	15.3	384	578	8	0	8
8	30672	0	165.1	6/25/2012 6:34:18 AM	68.0	68.0	30.0	79	1.15	18.8	384	578	8	0	8
9	30672	0	203.9	6/25/2012 6:34:19	79.0	79.0	31.0	79	1.16	19.0	384	578	8	0	8

*Detailed results provide the exact time, train speed and position, throttle position, air brake pressure, and air brake status. There are 9,245 train simulation output records fro this Kansas to St. Louis passenger train (see string chart).*



FRA – Office of Railroad Policy and Development

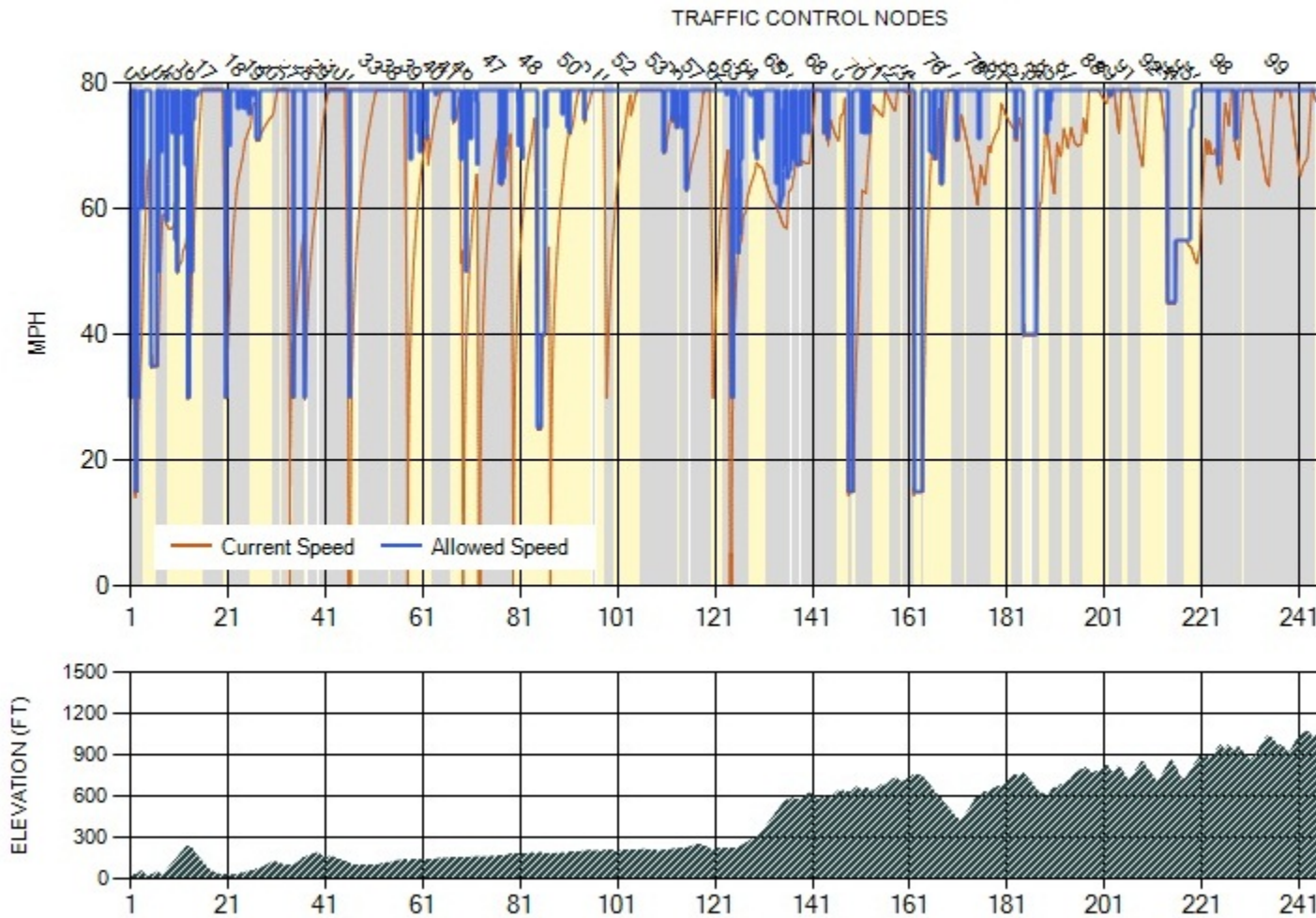
2/23/2015



U.S. Department  
of Transportation  
**Federal Railroad  
Administration**

# FEDERAL RAILROAD ADMINISTRATION

SPEED PROFILE - StL KC Miss R1 : PASSENGER 1 - 6 CARS and 1 LOCOMOTIVES



*Speed profile for entire territory shows passenger train station stops and response to freight interference*

*Evenly spaced sidings or additional track is needed along the entire corridor to add more trains to this territory*



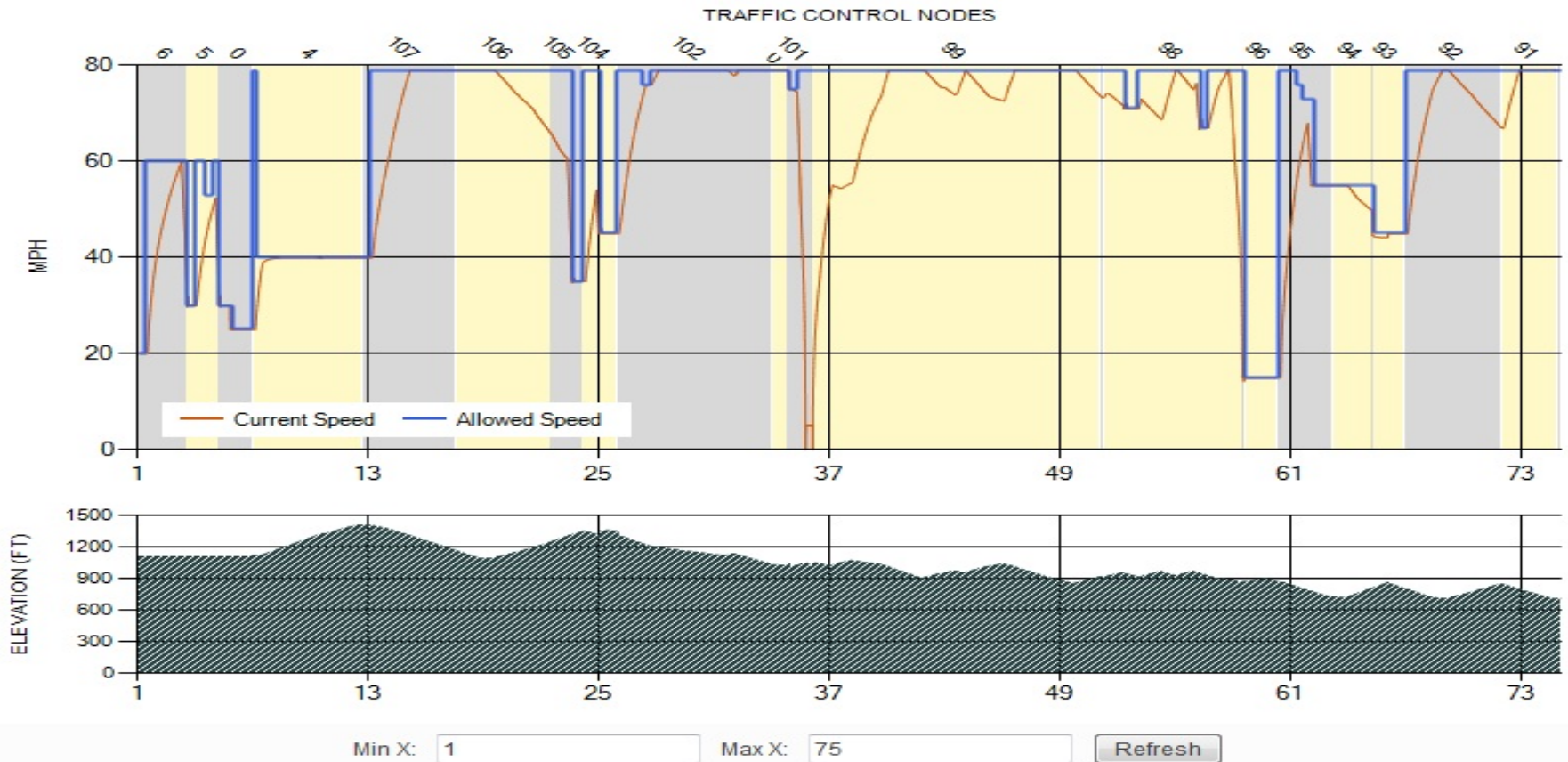
FRA – Office of Railroad Policy and Development

2/23/2015



U.S. Department  
of Transportation  
Federal Railroad  
Administration

SPEED PROFILE - KC StL Miss R1 : PASSENGER - 6 CARS and 1 LOCOMOTIVES

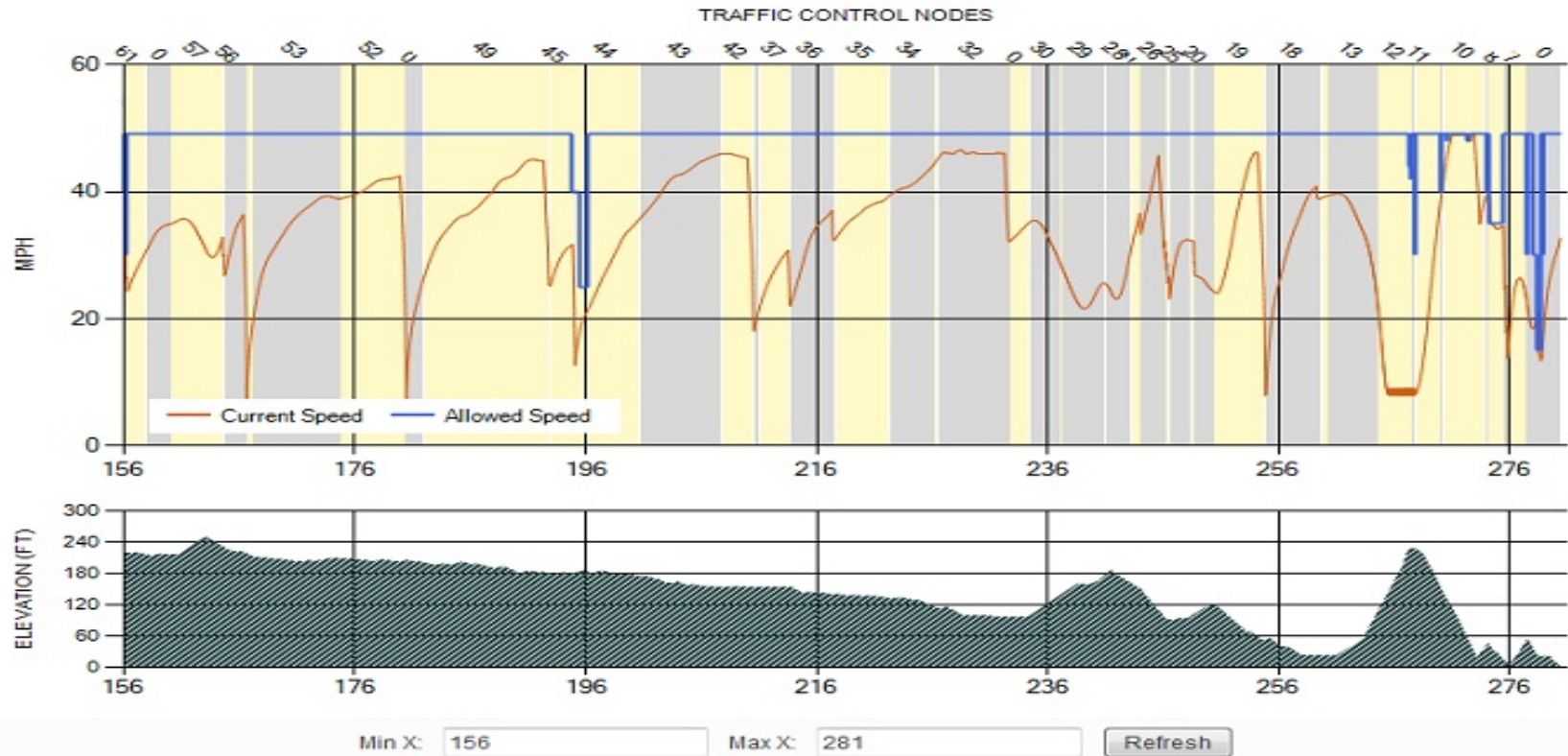


*Speed profile of first 75 miles of double track. Blue line represents the allowed speed and the orange line is the actual speed of the 6 car passenger train. There is a station stop just before milepost 37 in the middle of the chart above.*



Select Train:

SPEED PROFILE - JeffStL F GFr : BULK - 150 CARS and 2 LOCOMOTIVES



*Freight trains incur delay associated with grade and curvature (Chart depicts territory from milepost 156 to 281).*



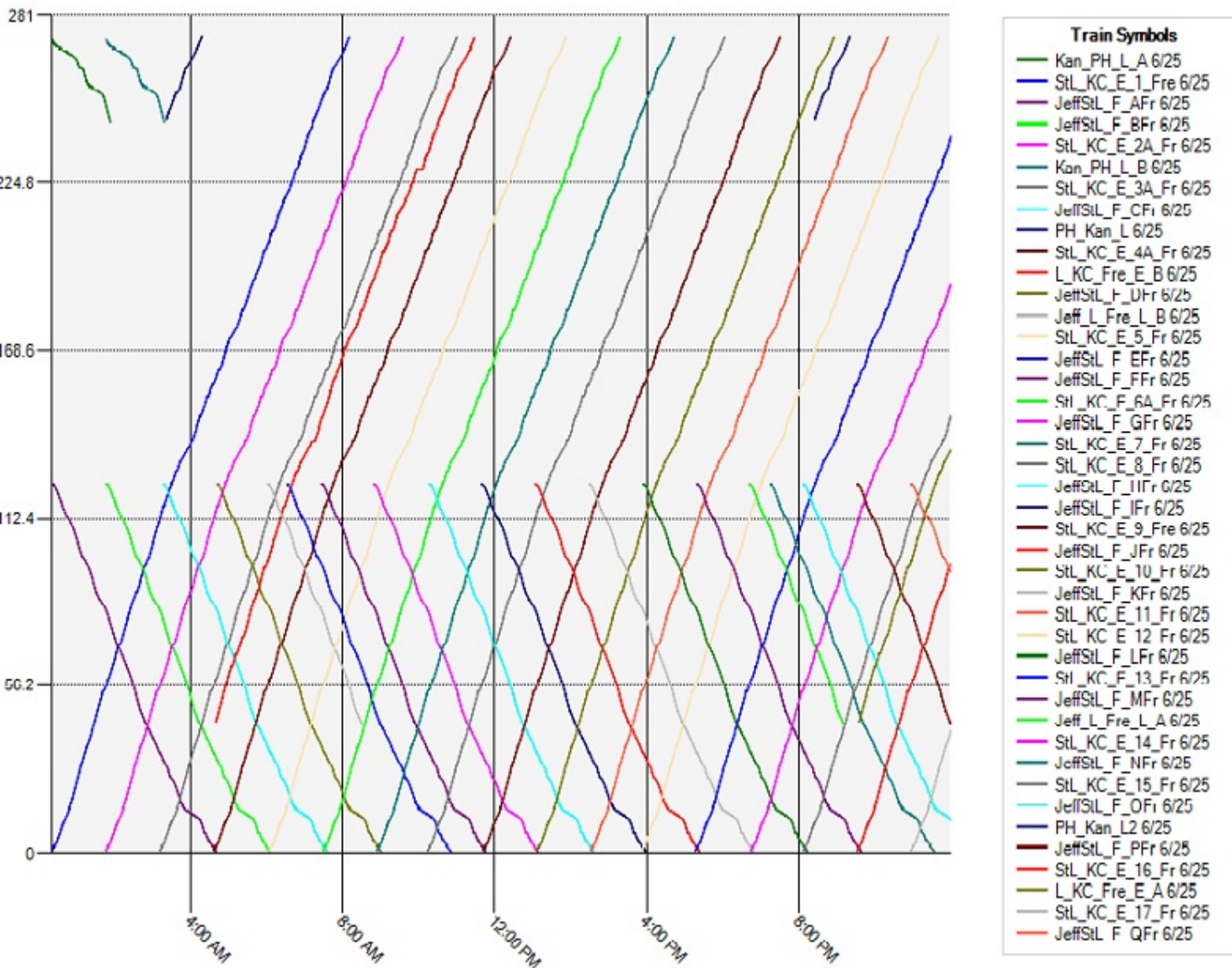
FRA – Office of Railroad Policy and Development

2/23/2015



U.S. Department  
of Transportation  
Federal Railroad  
Administration

## String Chart Kansas City to St. Louis: Current UP Service

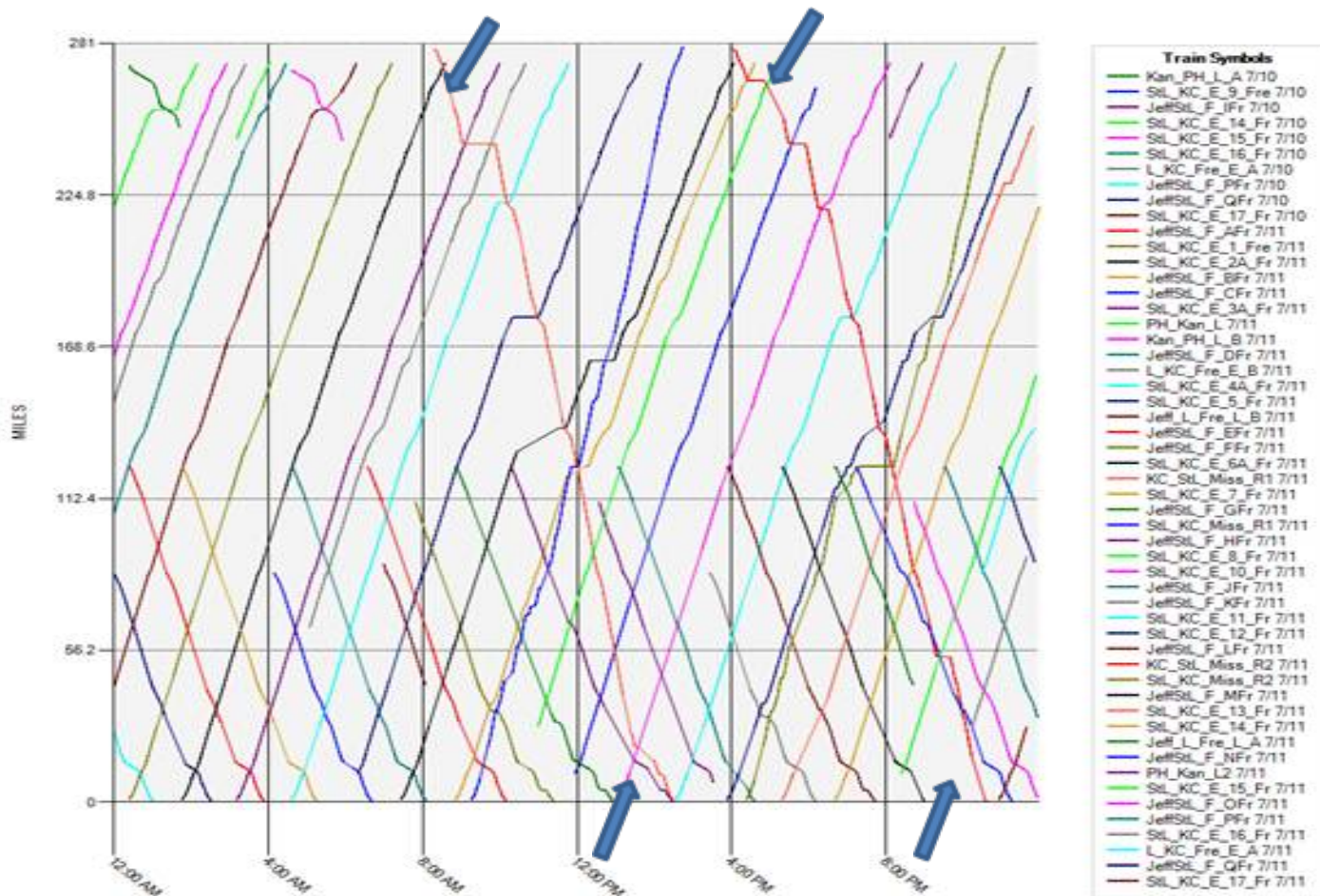


*The first 112 miles of the territory area double track followed by 150 miles of single track.*





# FEDERAL RAILROAD ADMINISTRATION



Two Amtrak trains added to UP schedule (top to bottom).

Passenger trains leave Kansas City at 8:15 am and 4:00 PM with near on-time arrivals.



FRA – Office of Railroad Policy and Development

2/23/2015



U.S. Department of Transportation  
Federal Railroad Administration

## UP Freight with 4 Amtrak Trains

### Operational Results Summary

*Fifty percent of passenger trains experience an average of 24.3 minutes of delay. 6.5 minutes of this delay occur upon entering the territory, the other 17.8 minutes are due to freight train interference on the territory.*

For the following train types, enter the delay tolerance in minutes:

Passenger	<input type="text" value="15"/>	Autotrain	<input type="text" value="120"/>	Bulk	<input type="text" value="600"/>	General	<input type="text" value="120"/>
Intermodal	<input type="text" value="60"/>						

Group Results by Train Type? ☐ No ☒ Yes

#### Operational Metrics

Train Type	Average Speed (in mph)	Percentage with Delay	Delay (in minutes)	Percentage with Delay Net of Departure Delay (in minutes)	Delay Net of Departure Delay (in minutes)
BULK	35.9	0.0	0.0	0.0	0.0
PASSENGER 1	45.0	50.0	24.3	50.0	17.8

## Operational Results Summary

*Two of the passenger trains have no delay but the fourth passenger train is delayed 51 minutes in the station due to freight train interference. On this territory, passenger trains traveling 49 mph are able to meet their time table schedules.*

For the following train types, enter the delay tolerance in minutes:

Passenger	<input type="text" value="15"/>	Autotrain	<input type="text" value="120"/>	Bulk	<input type="text" value="600"/>	General	<input type="text" value="120"/>
Intermodal	<input type="text" value="60"/>						

Group Results by Train Type? ☐ No ☒ Yes

### Passenger Train Metrics

Passenger Train	Total time in system (minutes)	Total time waiting in stations (minutes)	Total average speed (mph)	Avg. speed net of wait time in stations (mph)
KC_StL_Miss_R1 07/11	372.00	0.00	45.11	45.11
KC_StL_Miss_R2 07/11	393.00	0.00	42.70	42.70
StL_KC_Miss_R1 07/11	328.00	4.00	51.16	51.79
StL_KC_Miss_R2 07/11	400.00	51.00	41.95	48.08

# F E D E R A L   R A I L R O A D   A D M I N I S T R A T I O N



FRA – Office of Railroad Policy and Development

2/23/2015



U.S. Department  
of Transportation  
**Federal Railroad  
Administration**

***NCFRP Report 27:***

***Web-Screening Tool for Shared-Use Rail  
Corridors***

***Contact Karen McClure for access to the tool***  
***[karen.mcclure@dot.gov](mailto:karen.mcclure@dot.gov)***

***202-493-6417***



FRA – Office of Railroad Policy and Development

2/23/2015



U.S. Department  
of Transportation  
**Federal Railroad  
Administration**