



# Ohio Rail Development Commission

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## 3C “Quick Start” Train Run Time Analysis and Train Performance Calculations

### **Introduction:**

As part of the on-going Cleveland-Columbus-Dayton-Cincinnati, 3C “Quick Start” service development and planning process, the Ohio Department of Transportation (ODOT) and the Ohio Rail Development Commission (ORDC) have been working with the Woodside Consulting Group to advance the evaluation of the 3C rail corridor. The purpose of this effort is to calculate train run times and to make appropriate adjustments to the proposed train schedule. The train schedule defines a level of 3C service performance that provides a starting point for project negotiations. ODOT and ORDC will work in partnership with the freight railroads to further advance the analysis; but ultimately, the final train schedule will be validated by the railroads and delineated as part of the State’s agreement for access to the privately owned freight railroad tracks and rights-of-way.

Train run time is critical to the development of passenger train schedules. Train run time is defined as the time it takes for a passenger train to run from one point to another along a line. The run time from one station stop to the next is referred to as the *station to station run time*. Total corridor run time for the 3C “Quick Start” Service will be estimated from the terminal station in Cleveland to the terminal station in Cincinnati. Train run times, or trip time predictions for the 3C “Quick Start” also serve as critical inputs into the ridership and revenue forecasting process, the train operations planning process, and fleet sizing requirements.

This paper serves to provide the background to the analytic process used to develop the train run time as an input into the development of the 3C “Quick Start” passenger train schedule.

### **Train Run Time Analysis Process:**

To analyze run time and generate estimates of train trip times, rail planners can use a *train performance calculator*. A train performance calculator (TPC) program simulates the operation of a passenger train over a railroad route. The inputs for the TPC program include track geometry data, civil engineering speed limits, operating characteristics for the line, performance characteristics of the passenger train, and the total weight of the locomotive, cars and passengers. The TPC program analyzes acceleration and braking, and calculates the time needed for a train to

accelerate to full speed, run at full throttle, slow down for speed restrictions, brake and decelerate into a station stop.

ODOT and ORDC requested that the Woodside Consulting Group use the TPC program to determine the 3C train running times to provide the inputs needed to build and refine the 3C passenger train schedule from Cleveland to Cincinnati and between all of the station stops.

### **Train Performance Calculator Output:**

To illustrate the train performance over a line, the TPC program output is a *train/speed profile*. A train/speed profile provides a visual representation of the maximum authorized track speed; the actual speed of the train; reductions in authorized train speeds or slow orders; changes in throttle position; application of brakes; and the elevation of the line. The train run time is usually illustrated along the bottom of a train/speed profile, from left to right, and highlights time-points at key locations. The timelines on train/speed profiles do not include time for station dwells and do not add operating recovery time or other time that may be needed for special operations. (The illustrated time assumes that the train continues to operate, i.e. after it stops at a station, the train will immediately accelerate and run up to speed without delay.) Additional time needed for station dwell time and special operations or recovery time are added to the TPC estimated train run times to create the overall train schedule.

### **3C “Quick Start” Train/Speed Profile:**

The attached train/speed profile, labeled *OH3C083MrTPC093010*, represents the TPC analysis output used to create the 3C schedule. The profile provides a visual illustration of the train performance over the 3C corridor from Cleveland, through Columbus and Dayton to Cincinnati. The 3C train/speed profile was generated by Woodside for ODOT and ORDC and it illustrates the performance of a bi-level Diesel Multiple Unit (DMU), including two power cars and one trailer, running over the entire railroad line from the Cleveland station to the Cincinnati station, with six intermediate station stops between the corridor end-points. The output for this analysis was calibrated for the specific operating characteristics of the DMU, including, the acceleration characteristics which are based on the DMU’s horsepower to weight ratio, and the added weight fully loaded with passengers.

As illustrated on the attached 3C train/speed profile, along on the top of the page labeled *Train and Track Speeds (MPH)*, the train speed is identified in green; the speed goal is identified in red; and the maximum authorized track speed is identified by the areas shaded in grey. The six intermediate station stops are identified at the points where the green line shows the train speeds dropping to 0 MPH along the bottom of the profile. The shaded grey areas that create “valleys” or dips along the profile represent speed restrictions where the train must slow down. The TPC analysis output and the train/speed profile highlight the locations where the maximum 3C train speed is reduced due to civil engineering restrictions. These locations may be identified on the

profile from left to right, and include, but are not limited to: Berea, Grafton, Willington, New London, Greenwich to Shelby, Worthington to Columbus, Buckeye Yard, London, Springfield, Dayton, Miamisburg, Middletown, Sharonville and the IORY line in Cincinnati.

The 3C train run time is calculated across the bottom of the page and is highlighted for various points along the line. The run time from the Cleveland Amtrak Lakefront station to the Cincinnati station at Lunken is indicated as 4:30 (hours: minutes).

### **3C “Quick Start” Train Schedule:**

The original 3C train schedule provided by Amtrak in its December 18, 2009 Feasibility Report advanced a train run time of 6:30 (hours: minutes) over the length of the corridor from the Cleveland station to the Cincinnati station. This schedule served as an initial input into the 3C corridor railroad capacity analysis process, required by the freight railroads.

Over the last few months, ODOT and ORDC have requested that Woodside use the TPC to provide a more precise calculation of the 3C corridor train run times. The goal is to refine the train schedule that will be advanced to the freight railroads (NS, CSX and the IORY) for consideration. Therefore, the refined train schedule will serve as a starting point in the freight railroad negotiation process; however, the final 3C train schedule will be validated by the railroads and delineated as part of the access agreements.

Woodside has used the TPC program to generate train run times as inputs into the most recent 3C train schedule, which is attached and labeled as *Woodside Modification of ORDC Alternative Schedule 3*. The Woodside schedule highlights a total scheduled time from the Cleveland station to the Cincinnati station at 5:14 (hours: minutes).

The 5:14 (hours: minutes) is the total corridor train run time and incorporates station to station train run times, with TPC calculations for train acceleration and speed reductions, and also adds station dwell time along with train recovery time. It is common practice to add train recovery time into a passenger train schedule to account for unforeseen operational delays that invariably occur in passenger train service. In the case of the attached 3C train schedule, 8% recovery time was added to the overall train run time for the corridor. Based on Amtrak experience, the 8% delay time approximates actual train run time, excluding station dwell time and time for special operations. For example, for every 100 minutes of train run time, 8 minutes are added to the schedule for train recovery time.

The chart below identifies the components of time that have been incorporated into the development of most recent 3C train schedule from Cleveland to Cincinnati stations:

<b>Components of Time in the 3C Train Schedule</b>	<b>Time (hours: minutes)</b>
TPC estimated corridor train run time (Cleveland to Cincinnati) based on November 17, 2009 Woodside train/speed profile	4:30
Station dwell time (West 150 <sup>th</sup> Street, Cleveland)	0:03
Station dwell time (Columbus Station)	0:03
Station dwell time (Springfield)	0:05
Station dwell time (U.S. Air Force Museum, Riverside)	0:03
Station dwell time (Dayton)	0:03
Station dwell time (Sharonville)	0:03
Train recovery time based on 8% (270 minutes x 8%)	0:22
<b>TOTAL ESTIMATED SCHEDULED TIME</b>	<b>5:12</b>

With a scheduled time of 5:14 (hours: minutes), the most recent 3C train schedule which is attached is two minutes longer than the TPC output run time of 5:12 (hours: minutes) identified in the chart above. Woodside has suggested that the scheduled time at 5:14 incorporates further analysis and additional refinements into the overall calculations for the corridor train run times.

As ODOT and ORDC prepare to initiate detailed discussions and negotiations with NS and CSX further refinement to the 3C train schedule should be expected.

3C Project: Frt and Locals, 3C Trains, July '09 Infrastructure

OH3C W0647tpc Consist: 1 cars ( 1L + 0E) 274 tons 266 feet 7.65 HP/ton Locos: 1 Opr DMU\_USR 1 Opr DMU\_USR

