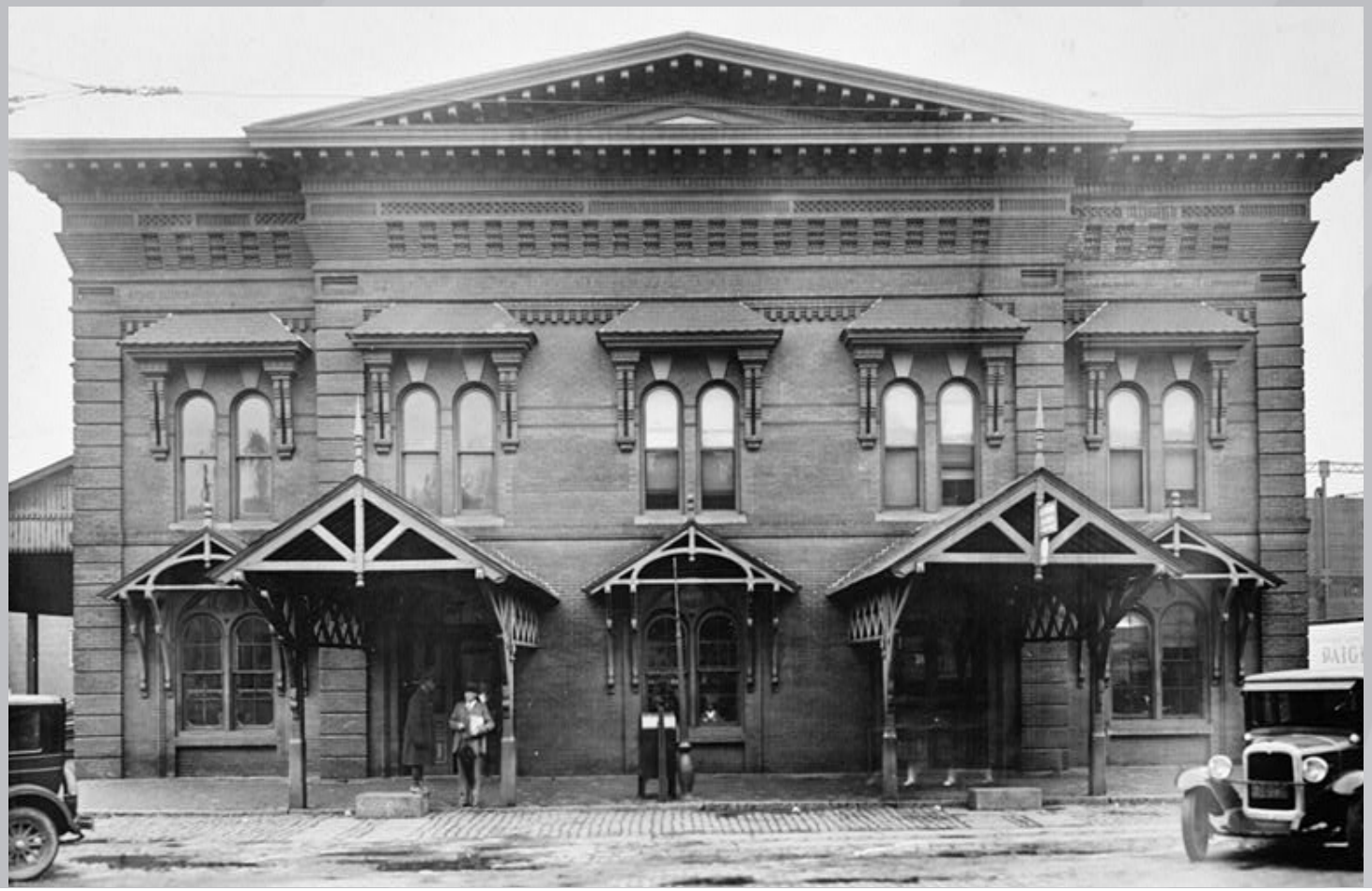
Wawa to West Chester Regional Rail Extension – Ridership Forecast



November 2011

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

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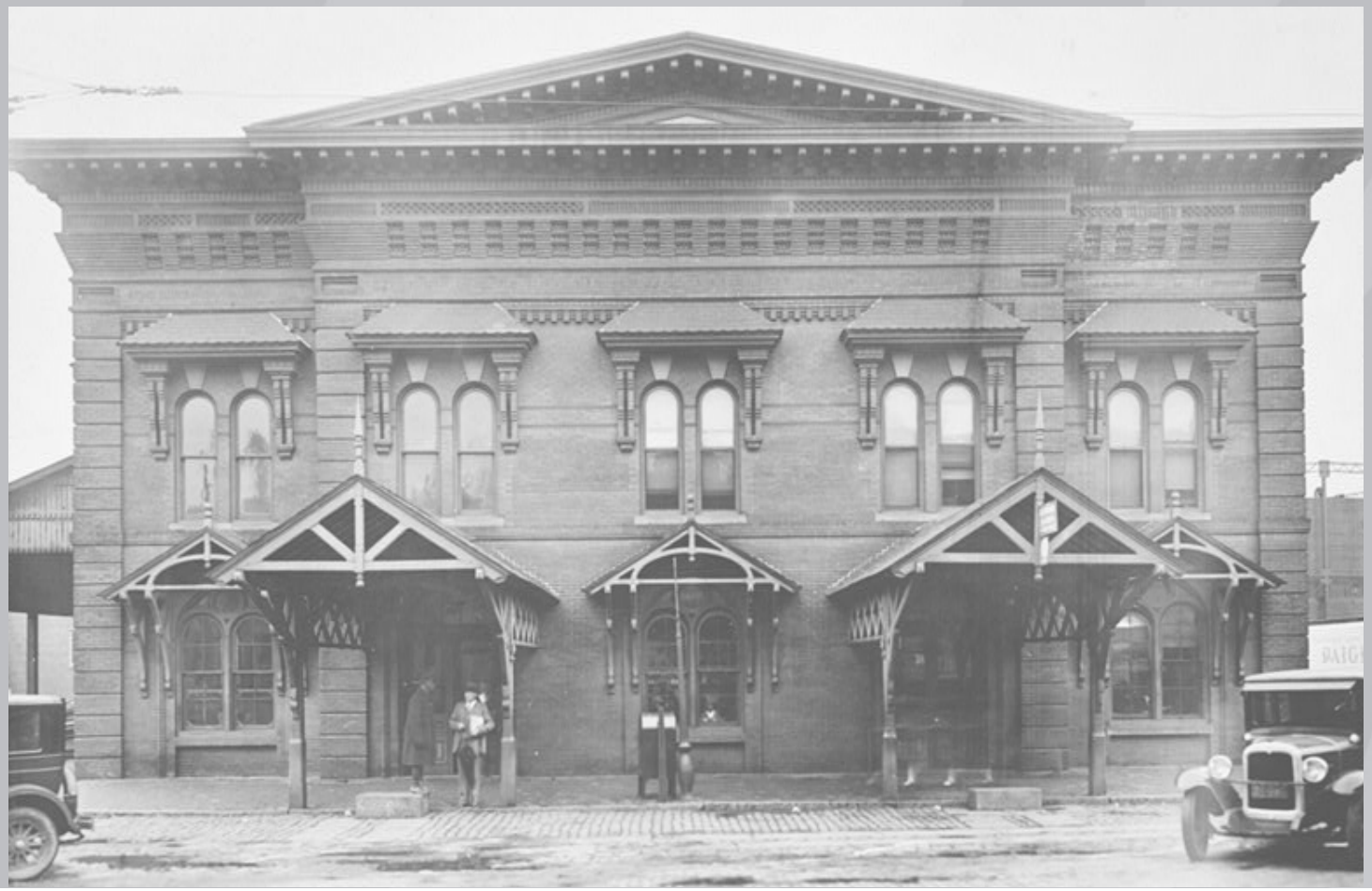

November 2011

DELAWARE VALLEY
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The Delaware Valley Regional Planning Commission is dedicated to uniting the region's elected officials, planning professionals, and the public with a common vision of making a great region even greater. Shaping the way we live, work, and play, DVRPC builds consensus on improving transportation, promoting smart growth, protecting the environment, and enhancing the economy. We serve a diverse region of nine counties: Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer in New Jersey. DVRPC is the federally designated Metropolitan Planning Organization for the Greater Philadelphia Region – leading the way to a better future.

The symbol in our logo is adapted from the official DVRPC seal and is designed as a stylized image of the Delaware Valley. The outer ring symbolizes the region as a whole while the diagonal bar signifies the Delaware River. The two adjoining crescents represent the Commonwealth of Pennsylvania and the State of New Jersey.

DVRPC is funded by a variety of funding sources including federal grants from the U.S. Department of Transportation's Federal Highway Administration (FHWA) and Federal Transit Administration (FTA), the Pennsylvania and New Jersey departments of transportation, as well as by DVRPC's state and local member governments. The authors, however, are solely responsible for the findings and conclusions herein, which may not represent the official views or policies of the funding agencies.

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On the cover: historical photograph of the West Chester Pennsylvania Railroad Station, Market Street, West Chester Borough, Chester County, PA (1930). Source: Historic American Buildings Survey from Library of Congress collection. Photocopy taken by Ned Goode, 1961. Accessed: http://www.loc.gov/pictures/item/PA0335/

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Executive Summary

This project, requested by Chester County and the Southeastern Pennsylvania Transportation Authority (SEPTA) under the Delaware Valley Regional Planning Commission (DVRPC) Fiscal Year 2011 Unified Planning Work Program, forecasts the number of trips that would result from an extension of SEPTA's Elwyn line from the planned Wawa Station to the Borough of West Chester with three intermediate stations. It compares year 2035 forecasts under a No-build scenario, an electrified extension alternative (one-seat ride), and a diesel extension alternative (requiring a transfer at Wawa). The study is meant to be a rigorous evaluation of ridership potential on the West Chester line under certain constraints and assumptions, with additional examination of diversion effects from existing SEPTA services. This study does not examine capital and operating costs, station location and design, or operational details.

The findings of this study may be summarized as follows:

- The electrified one-seat ride alternative is forecast to attract 1,910 additional daily rides on the line between West Chester, Elwyn, and Philadelphia in 2035.
- The diesel two-seat ride alternative is forecast to attract about 1,350 additional daily rides on the line between West Chester, Elwyn, and Philadelphia, which is about 30 percent less than the electric alternative in 2035.
- A portion of the new West Chester line trips are forecast to be diverted from existing Thorndale line ridership at Exton, Malvern, and Paoli. The electric alternatives show an approximate net SEPTA system gain of 1,400 trips per day, while the diesel alternatives show an approximate net gain of 1,000 trips per day in 2035. This is a conservative estimate of the diversion effect on net ridership, as some back filling will occur at Thorndale line stations due to a relaxation of parking constraints. While the Thorndale line has a higher frequency of service and faster travel times on average to Center City Philadelphia, individuals in certain locations in the study area will find travel via a West Chester extension more advantageous.
- Bus trips are forecast to be relatively flat under any alternative.
- There is little difference in forecast daily trips using the historic West Chester station versus a proposed new downtown station. This may be partly explained by the relative proximity between the two stations, and the fact that the West Chester station serves both walk and auto access markets.

The West Chester terminus and the West Chester University stations each attract about 30 percent of ridership on the extension, regardless of build alternative. The Cheyney University and Westtown stations each attract about 20 percent of ridership on the extension. The No-build alternative includes all projects in DVRPC's Transportation Improvement Program (TIP) and Long-Range Plan (LRP) and uses Board adopted 2035 demographic forecasts for the study area. The report contains details on the alternatives and analyzes study area trends. The forecasts were prepared using DVRPC's Travel Improvement Model (TIM) 1.0. Details on the forecasting model are presented in Appendix A.

CHAPTER 1

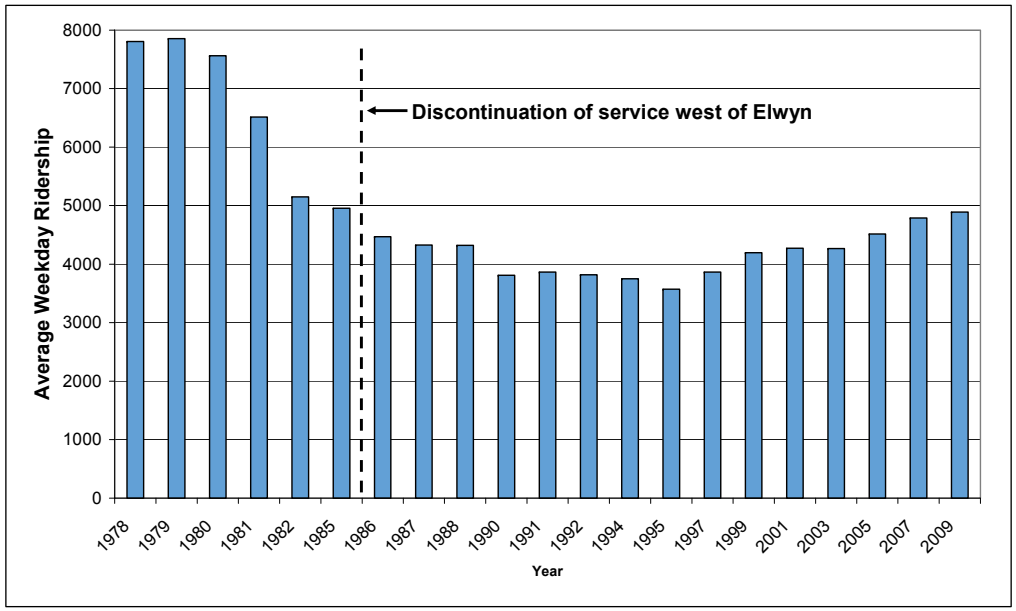
Introduction

SEPTA currently operates Regional Rail (RR) service to Elwyn and Media, from Center City Philadelphia. This service operates at roughly hourly service on weekdays with extra peak-period trains. As seen in Figure 1, ridership on the line has increased moderately over the last 15 years after a long period of decline. Fast travel times to Center City Philadelphia, large park-and-ride lots at the two most westerly stations, and station locations in older, established boroughs and towns give the Elwyn line a strong image and presence.

The Elwyn line is the remnant of a more extensive passenger rail system in Delaware and Chester counties. Service had previously been offered by the Pennsylvania Railroad, Penn Central, Conrail, and SEPTA to West Chester and other locations. Passenger rail service was discontinued to many locations during the decline of transit in the United States in the approximate time period 1960–1990. This culminated in cutting service to West Chester in 1986 due to low ridership and deteriorating track conditions.

Population in the area of the line has grown in the 25 years since service has been cut. Extension of service to Wawa is currently planned to commence by 2015. It is under these circumstances that **the present study investigates the ridership implications of a full-scale extension of service to West Chester.** A computer simulation model that predicts people's travel behavior is used to develop year 2035 forecasts of ridership. Ridership is estimated on the extended RR line to West Chester and on study area bus routes. The effect of extending RR service to West Chester on the existing RR service to Thorndale is also predicted. Chapter 2 of this report describes the study area which the potentially restored service would pass through. Chapter 3 describes the possible options for restoring RR service to West Chester. Chapter 4 presents the ridership forecasts and discusses elements of uncertainty in the forecasts. Appendix A discusses the preparation, calibration, and validation of the travel forecasting model used to produce the ridership forecasts.

Figure 1. West Chester/Elwyn Line Historic Ridership Trends



Source: SEPTA Fall 2008 Survey Data

CHAPTER 2

Description of Study Area

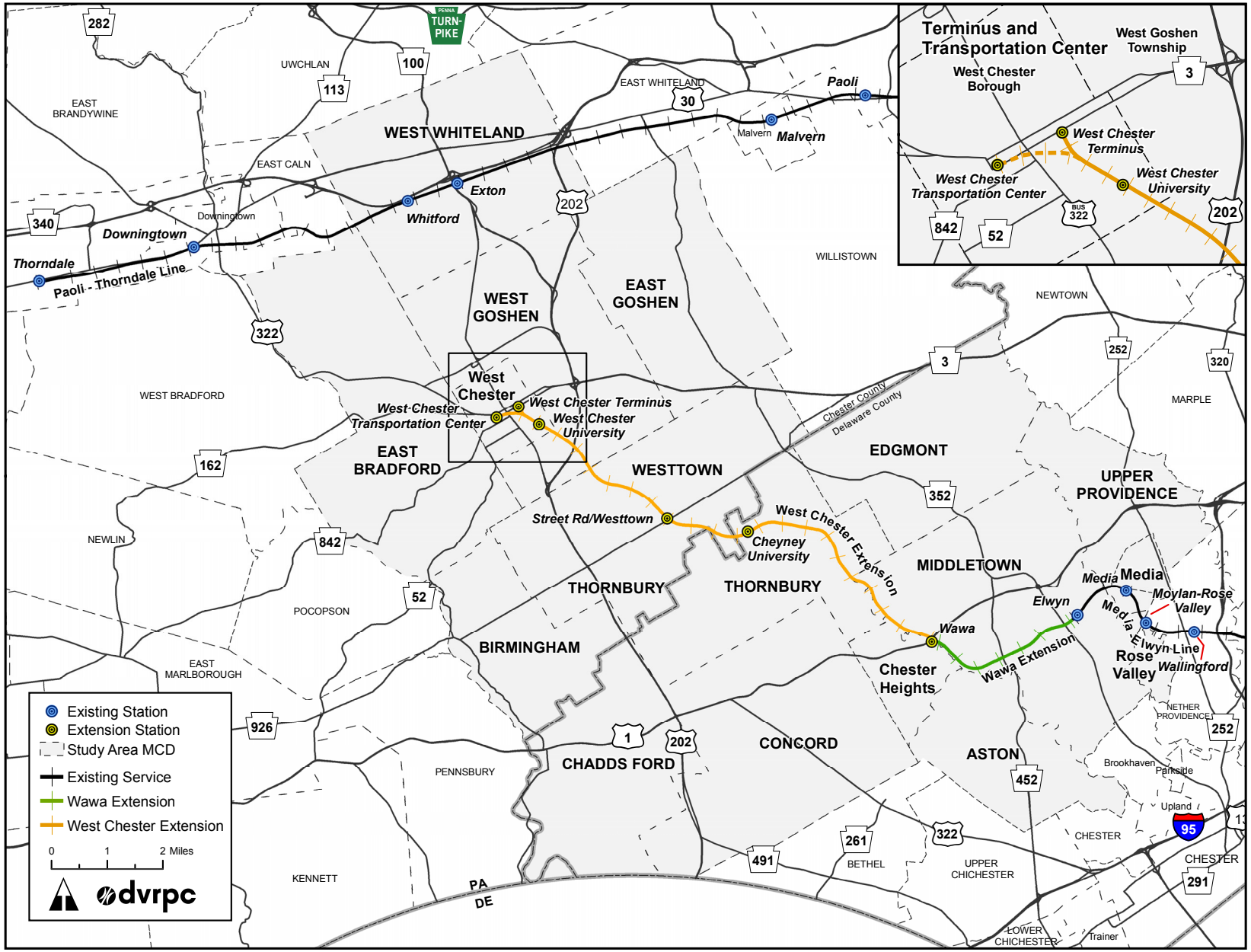
The study area comprises sections of western Delaware County and central and eastern Chester County. Table 1 lists the Minor Civil Divisions (MCD) included in the study area. Figure 2 shows a map of the study area.

Table 1. Study Area MCDs

Delaware County	Chester County
Middletown Township	West Chester Borough
Thornbury Township	West Goshen Township
Edgmont Township	East Bradford Township
Upper Providence Township	West Whiteland Township
Media Borough	East Goshen Township
Rose Valley Borough	Westtown Township
Chester Heights Borough	Thornbury Township
Aston Township	Birmingham Township
Concord Township	
Chadds Ford Township	

Source: DVRPC 2011

Figure 2. Map of Study Area



Source: DVRPC 2011

Existing Highway Facilities and Volumes

Several major highway facilities exist between the current terminus of Elwyn in Middletown Township, Delaware County, and West Chester Borough, Chester County, that would either feed park-and-ride stations for any extended transit service or compete with such transit service. Major highway facilities include US 202 (West Chester Bypass), US 322, US 1 (Baltimore Pike), PA 926 (Street Road), PA 452 (Pennell Road), PA 352 (New Middletown Road/Chester Road), PA 3 (Market Street/West Chester Pike), and PA 100 (Pottstown Pike). While not in the study area, portions of I-76, I-95, and I-476 would all provide part of likely routes for trips between the study area and the more densely populated regional core, including the Philadelphia Central Business District (CBD). Table 2 contains recently counted traffic volumes on some of the significant facilities in the study area.

Table 2. Volumes on Study Area Highway Facilities

Facility	Extent	Bi-directional Average Annual Daily Traffic (AADT)
US 202	Cheyney Dr to Old Wilmington Pk	62,200
US 1	Valley Rd to US 452	32,200
PA 926	Shiloh Rd to Westtown Rd	12,100
PA 352	Glen Riddle Rd to Elwyn Rd	28,700
PA 100	North of US 202	42,400

Source: DVRPC 2011

Existing Transit Facilities and Volumes

The study area is currently sparsely serviced by SEPTA. Table 3 lists current SEPTA bus service in the study area and ridership, while Figure 3 shows the area bus routes. There are several bus lines in the study area; the 92, 104, 111, 119, and 120 are examined in detail. The 92 begins in West Chester and provides service north to the Exton station, and then east to Valley Forge. The route 104 provides trunk service along West Chester Pike from West Chester to 69th Street Terminal in Upper Darby. The 111 runs from 69th Street Terminal, north of Media, to the Penn State Brandywine campus, with peak hour service to Concord Township. The 119 begins service at Cheyney University running south and east through the middle of the study area to Chester City. The 120 has a route along West Chester Pike similar to the 104, but on the western end detours south to terminate at Cheyney University. Several other study area bus routes are examined,

but are found to have no significant impact on or from the proposed extension. The 314 bus runs from West Chester to several business parks northeast of West Chester. The 314 provides peak and limited midday service. The 306 bus provides service from West Chester to Great Valley with six vehicle trips to Great Valley in the morning peak and seven vehicle trips to West Chester in the evening peak. Service between West Chester, Exton, and Coatesville is provided by Krapf's Coach's Route A.

Table 3. Study Area Transit Routes

Transit Route	2009 Average Weekday Ridership[1]
92	432
104	3,082
111	1,445
119	711
120	468
306	79
314	86
Krapf's "A"	759[2]

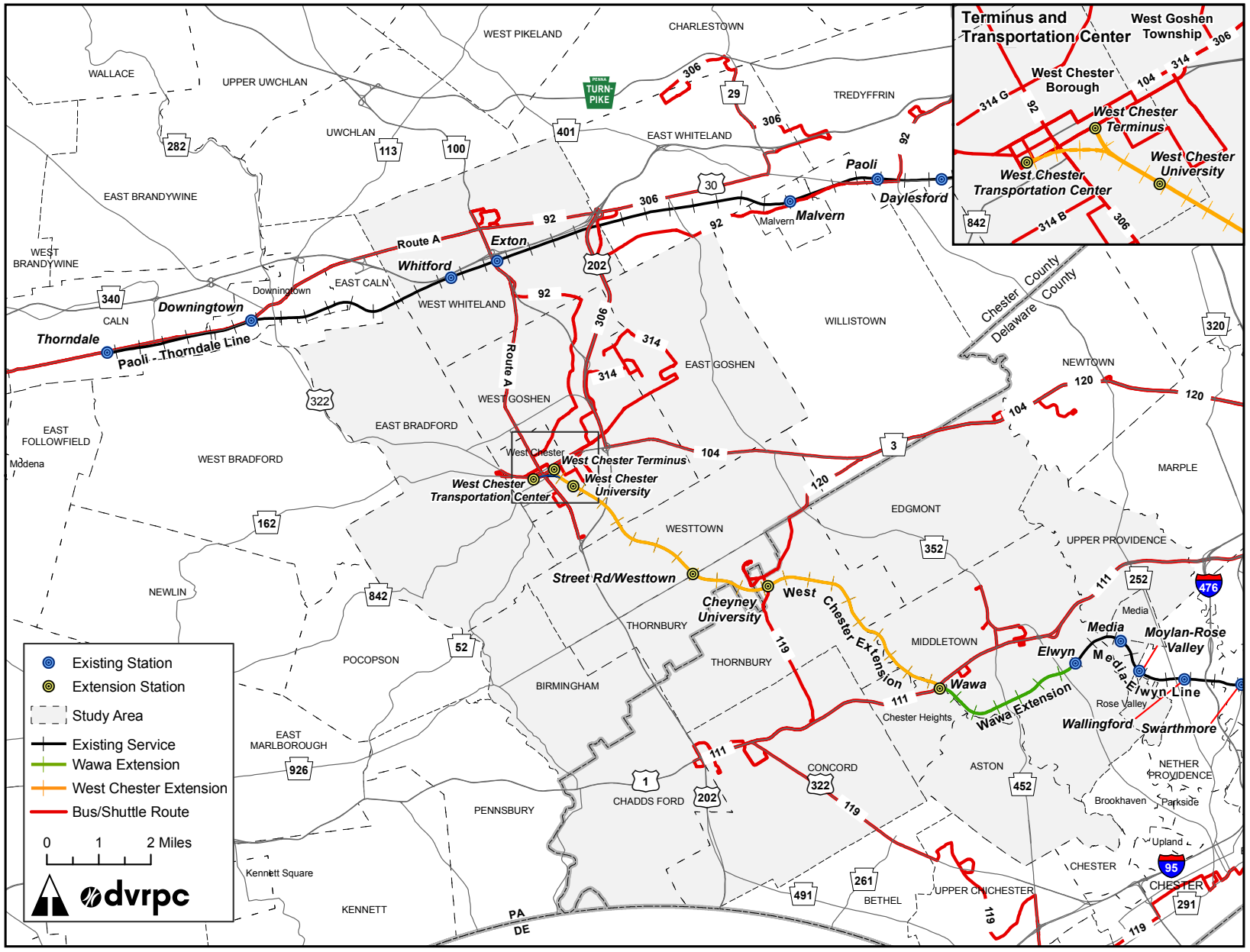
1. From SEPTA Route Operating Report
2. From Krapf's invoice via Chester County

Sources: SEPTA and Krapf's

Rail service in the study area is mostly provided via park-and-ride to stations on the study area periphery; walk access to rail service is mostly non-existent in the study area. License plate surveys at RR stations reveal that the Delaware County portion of the study area tends to access the Elwyn station, while the Chester County portion of the population accesses the Thorndale line, especially at the Exton station. Townships in the middle, such as Thornbury and Westtown Township, have low transit usage because of the long driving distance to RR service. The license plate surveys also reveal that there is an overlap in sheds between the Thorndale and Elwyn line stations (see Appendix A for more details).

A list of stations, parking capacity, and daily average use is shown in Table 4. The data demonstrates that both the Elwyn and Thorndale lines in the study area suffer from a lack of parking. Both lines are likely parking constrained, in that current ridership is constrained by available parking. It should be noted that the figures in Table 4 are only "designated" off-street parking spaces. There is significant undesignated, on-street, and sometimes illegal parking by passengers at several stations.

Figure 3. Study Area Bus Routes



Source: DVRPC 2011

Table 4. 2009 Regional Rail Parking Availability

Station	Parking Spaces	Daily Availability
Elwyn Line		
Elwyn	233	0
Media	250	11
Moylan–Rose Valley	149	0
Wallingford	80	0
Swarthmore	250	12
Thorndale Line		
Whitford	278	66
Exton	642	82
Malvern	284	0

Source: SEPTA Fall 2008 Survey Data

Wawa Extension and Other Planned Transportation Improvements

The most significant transportation improvement in the study area for purposes of this investigation is the extension of RR service to Wawa. The new terminus at Wawa represents an approximate 3-mile extension of service from the current Elwyn terminus. New track, catenary, and other facilities are being constructed to restore service. The new station at Wawa will contain a large park-and-ride lot with 600 spaces. Scheduled opening date is 2015.

Various highway improvements are also being made in the study area within the timeline of any extension to West Chester. A partial list appears in Table 5. The most significant are the capacity expansions on US 202 and US 322. These are in response to current and projected congestion on these facilities. All of these system changes are factored into the ridership forecasting method.

Table 5. Study Area Highway Improvements

Description	County	Opening Year
US1/US322, US 202 to US 322; widen to 6 lanes	Delaware	2013
I-76 PA Tpke, Downingtown to Valley Forge; widen to 6 lanes	Chester	2020
PA 100, Shoen Rd to Gordon Dr; provide additional travel lane in each direction	Chester	2020
US 1 Baltimore Pk, Kennett Sq Bypass to Bayard Rd; widen to 3 lanes by direction; left-turn lane at Schoolhouse Rd	Chester	2020
PA 252, Providence Rd, Palmer Mill to Kirk Lane; widen to 4 lanes; all left turn lanes and interconnect signals	Delaware	2020
US 30 Bypass, Exton Bypass to PA 10; rebuild interchanges - Also widen 4 to 6 lanes: Reeceville to Exton Bypass only	Chester	2030
US 202 (Section 100), Matlack St to DE state line; widen to 6 lanes	Chester	2030
US 202 (Section 300), US 30 to Swedesford Rd; widen to 6 lanes	Chester	2030
US 30 Bus., Exton Mall to US 202; add through lane in each direction	Chester	2030
US 322, US 1 to I-95; widen to 4 lanes	Delaware	2030

Source: DVRPC 2011

CHAPTER 3

Transit Alternatives

This study **estimates the ridership impact of five different future scenarios** or alternatives. One is the "No-build" alternative, which includes probable system changes, but does not have the RR extension to West Chester. The No-build alternative is compared to four different build alternatives, each of which contains a different vision for extending RR service to West Chester. 2035 is used as the evaluation year.

No-Build Alternative

It is standard practice in transportation planning to compare any possible transportation system improvements with a No-build alternative. The No-build alternative is not a "build-nothing" scenario, as it has the most likely set of future transportation system changes, excluding the project being evaluated. The DVRPC LRP is the regionally agreed upon, financially constrained vision of future transportation system improvements in the Delaware Valley. The 2035 LRP plus the current three-year TIP constitute the set of future improvements that were included in all evaluation year modeling for the No-build alternative. The same improvements were also included in all of the build alternatives. Significant for this study, the **No-build alternative contains the RR extension to Wawa**.

The future year scenarios, both No-build and build, assume that current operating condition will continue unless otherwise planned. This means that future year transit schedules are assumed to be identical to current year schedules. Possible future schedule changes, such as increases to Thorndale line departures due to the Exton interlocking, were not used in this study.

Build Alternative

Four alternatives for extending service to West Chester were tested. They consisted of a matrix of two possible service types and two possible West Chester terminal station locations. The four alternatives are shown in Table 6. The **electric service alternatives** would run through-service from Center City Philadelphia to Wawa and on to West Chester; although not all Wawa trains would go all the way to West Chester. The entire portion of the line would be electrified to allow

SEPTA's current fleet of Electric Multiple Unit (EMU) trains to operate on the line. For the **diesel shuttle alternatives**, a diesel powered consist would travel between West Chester and Wawa. The schedule for the shuttle service would be constructed so that convenient transfers are available to the electric service from Wawa to Center City, although not every train has a meet due to scheduling constraints. The need for a transfer at Wawa adds extra travel time and also requires some layover time for crews.

The schedule assumes single-track operations between Wawa and West Chester, with two tracks for passing at these locations and Westtown. The diesel alternatives save on the capital cost of having to electrify the section of the line between Wawa and West Chester. While diesel locomotive service and diesel multiple unit (DMU) consists do have slightly different performance characteristics, the present analysis would be valid for either one. Schedules for both the electric and diesel alternatives are shown in Tables 14-17 in Appendix B. Travel times between Suburban Station and West Chester terminal range from 49–71 minutes for electric service, with 60 minutes typical, and 64–76 minutes for diesel service, with 71 minutes typical. The journey from Exton to Suburban Station, by comparison, takes between 41– 57 minutes. The Thorndale line has better service because of more express trains, higher speeds on the Thorndale line alignment versus the West Chester alignment, and less delay in the schedule because the four-track Main Line right of way eliminates delays due to single-track scheduling constraints.

Table 6. Build Alternatives

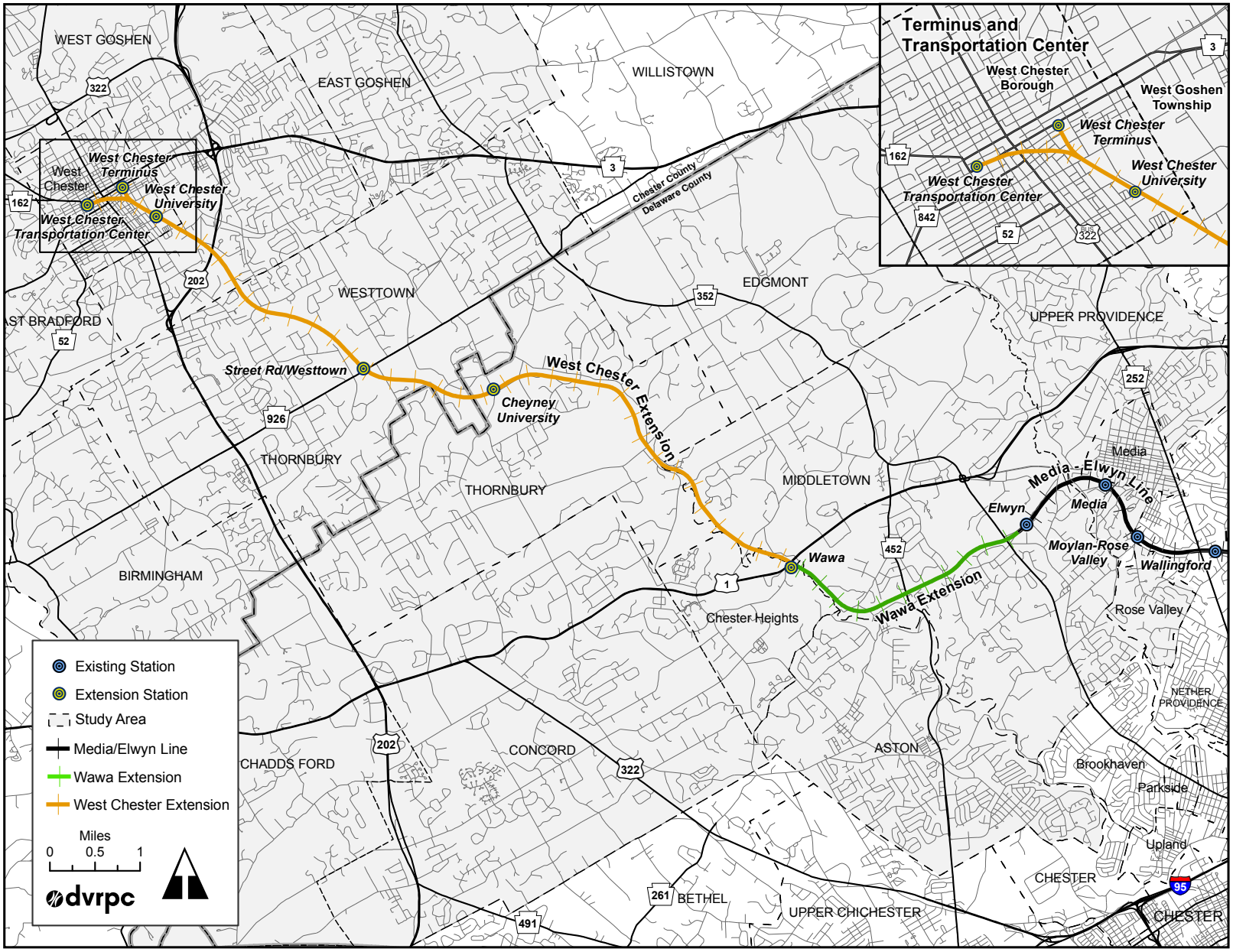
Terminus Location	Direct Electric Service	Diesel Shuttle Service
Traditional West Chester Terminal	Standard Electric	Standard Diesel
Downtown West Chester Terminal	Downtown Electric	Downtown Diesel

Source: DVRPC 2011

Two different locations are considered for the terminal in West Chester. The **standard alternatives** restore service to the traditional terminal where the historic West Chester Line had formerly terminated – at Market Street/US 322 and Railroad Street, just east of Matlack Street in West Chester. The **downtown alternatives** place the final station approximately 0.5 miles west of the traditional station, near the West Chester Transit Center at Market and New Street. The downtown alternatives attempt to provide a more centrally located station in West Chester than the location of the traditional terminal station.

All of the build alternatives share a common alignment between West Chester and Wawa, as shown in Figure 4. Intermediate stations would be located at West Chester University, Westtown/Street Road, and Cheyney University, as seen in Figure 4. Other former historic stations along the line would not be reactivated. The railroad between West Chester and Wawa would remain single tracked. Each of the three intermediate stations would have 200-space parking lots.

Figure 4. Map of Build Alternatives



Source: DVRPC 2011

CHAPTER 4

Forecasted Transit Ridership

This section presents forecast transit ridership. Forecasts are produced using a state-of-the-practice four-step travel forecasting model. Details on the methodology are presented in Appendix A. No-build results are compared against base-year results in order to analyze background changes in transit ridership. Build results are then compared against No-build results in order to ascertain the impacts of the four extension alternatives.

No-Build Alternative

The 2035 No-build forecast is shown in Table 7. The results are compared to the 2009 counted volumes. Most transit facilities in the study area show growth during the 25-year forecasting horizon, mainly due to increases in population and employment. The major exception to this is the Elwyn station, which experiences a decrease of 261 passengers or -26.3 percent. This is due to the opening of the Wawa extension. The Wawa station has a ridership of 930 in the 2035 No-build alternative. The new Wawa station intercepts many of the drive-to-transit trips that would have utilized the Elwyn station. Taken together they show a major increase in ridership of 669 rides between the two stations. Notable in the forecast is that the Exton station on the Thorndale line has a smaller increase in ridership than either the Malvern or Whitford stations on either side. Part of this lower than otherwise expected increase could be due to the opening of the Wawa extension, which draws some passengers who live south and east of West Chester, and for whom the drive to Wawa trip is more convenient than the drive to Exton trip.

The *Elwyn to Wawa Service Restoration Feasibility Study* from June 2000, produced by Vollmer and Associates, provides an estimate of 719 additional trips originating at Wawa versus a No-build for a 2020 planning horizon. This number is reasonably consistent with the forecast numbers above, acknowledging the difference in methods, planning horizon, and alternatives.

Table 7. 2035 No-Build Study Area Forecast

Lines / Stops	2009 Count	2035 No-Build Forecast	09 Counts vs. 35 No-Build Forecast	
			Difference	% Difference
Bus Ridership				
92	432	490	58	13.4%
104	3,082	3,490	408	13.2%
111	1,445	1,450	5	0.3%
119	711	680	-31	-4.4%
120	468	490	22	4.7%
Total Study Area Bus	**6,138**	**6,600**	**462**	**7.5%**
Regional Rail				
Elwyn Line				
Wawa	-	930	-	-
Elwyn	991	730	-261	-26.3%
Media	1,143	1,660	517	45.2%
Moylan – Rose Valley	488	550	62	12.7%
Wallingford	589	700	111	18.8%
Swarthmore	1,430	1,730	300	21.0%
Total Elwyn Line (original study area stations)	**4,641**	**5,370**	**729**	**15.7%**
Total West Chester Line (all study area stations)	**4,641**	**6,300**	**1,659**	**35.7%**
Thorndale Line				
Downingtown	674	780	106	15.7%
Whitford	638	770	132	20.7%
Exton	1,155	1,310	155	13.4%
Malvern	1,075	1,350	275	25.6%
Paoli	2,648	2,860	212	8.0%
Total Thorndale Line (study area stations)	**6,190**	**7,070**	**880**	**14.2%**
Total Study Area transit ridership	***16,969***	***19,970***	***3,001***	***17.7%***

Source: DVRPC 2011

Build Alternatives

Ridership for the diesel and electric build alternatives with the traditional station location are shown in Table 8. Station ridership for study area stations on the Elwyn and Thorndale lines is shown, as is total ridership on each of these lines. Ridership for each of the build alternatives is compared with the No-build alternative. **The diesel alternative adds 1,350 trips to the Elwyn/Wawa line, and the electric alternative adds 1,910 daily trips.** That is, the electrified alternative with its one-seat ride is forecast to provide 589 additional trips relative to the diesel alternative. These numbers are for new trips on the Elwyn (Wawa) line.

Table 8. 2035 Build Alternative Forecasts

Lines / Stops	2035 No-Build Forecast	2035 Diesel Standard	vs. No-Build		2035 Electric Standard	vs. No-Build	
			Difference	% Difference		Difference	% Difference
Bus Ridership							
92	490	490	0	0%	500	10	2.0%
104	3,490	3,490	0	0%	3,420	-70	-2.0%
111	1,450	1,460	10	0.7%	1,450	0	0%
119	680	690	10	1.5%	690	10	1.5%
120	490	500	10	2.0%	490	0	0%
Total Study Area Bus	**6,600**	**6,630**	**30**	**0.5%**	**6,550**	**-50**	**-0.8%**
Regional Rail							
Elwyn Line							
West Chester (downtown)	-	-	-	-	-	-	-
West Chester (original)	-	400	-	-	530	-	-
West Chester University	-	440	-	-	590	-	-
Westtown	-	270	-	-	290	-	-
Cheyney	-	260	-	-	330	-	-
Wawa	930	750	-180	-19.4%	750	-180	-19.4%
Elwyn	730	740	10	1.4%	760	30	4.1%
Media	1,660	1,730	70	4.2%	1,900	240	14.5%
Moylan – Rose Valley	550	560	10	1.8%	540	-10	-1.8%
Wallingford	700	710	10	1.4%	710	10	1.4%
Swarthmore	1,730	1,790	60	3.5%	1,810	80	4.6%
Total Elwyn Line (original study area stations)	**5,370**	**5,530**	**160**	**3.0%**	**5,720**	**350**	**6.5%**
Total West Chester Line (all study area stations)	**6,300**	**7,650**	**1,350**	**21.4%**	**8,210**	**1,910**	**30.3%**
Thorndale Line							
Downingtown	780	770	-10	-1.3%	760	-20	-2.6%
Whitford	770	770	0	0%	770	0	0%
Exton	1,310	1,050	-260	-19.8%	1,020	-290	-22.1%
Malvern	1,350	1,300	-50	-3.7%	1,300	-50	-3.7%
Paoli	2,860	2,790	-70	-2.4%	2,770	-90	-3.1%
Total Thorndale Line (study area stations)	**7,070**	**6,680**	**-390**	**-5.5%**	**6,620**	**-450**	**-6.4%**
Total Study Area transit ridership	***19,970***	***20,960***	***990***	***5.0%***	***21,380***	***1,410***	***7.1%***

Source: DVRPC 2011

The majority of new ridership occurs at the additional stations. However, most of the existing stations (those existing in the 2035 No-build alternative) have slight gains in ridership due to accessibility added by the extension to West Chester. The one exception to this is the Wawa station. The planned new station at Wawa is forecasted to have 930 daily trips in 2035 under the No-build alternative; however, this forecast is reduced to 750 daily trips under both the diesel and electrified alternatives. This suggests that forecast increases would be logically spread to stations closer to the rider origins along the line, rather than strictly concentrated at the Wawa terminus as they are under the No-build alternative. Just as the addition of the Wawa station in the No-build alternative intercepted previous Elwyn station riders, new stations along the West Chester extension will intercept some Wawa riders.

Effect of the West Chester Extension on Bus Ridership

Not all of the increased ridership on the Elwyn line in the diesel and electric alternatives in Table 8 is due to new ridership. Some is due to diversion of existing SEPTA riders to the new service. A new rail line may attract significant ridership, but this benefit is lessened if many of these riders are diverted from existing lines. Generally speaking, **neither build alternative has a significant effect on daily bus ridership**. Compared to the No-build, both diesel (30 daily trip increase) and electric (50 daily trip decrease) alternatives affect negligible changes in the study area bus ridership. The change on any given line is within modeling error. The one exception is the Route 104 bus in the electric alternative, which experiences a 70 rider or two percent decrease. The 104, as seen in Figure 3, competes the most directly with a RR line between West Chester and Philadelphia, with connecting service via 69th Street Terminal. Electric RR service to West Chester is competitive enough that some 104 bus riders will switch to the new rail service. In general, as rail service becomes more attractive, it will tend to siphon off more would-be bus passengers. Taken as a whole, the alternatives affect the forecast daily bus trips by less than 1 percent and, given a 25-year time horizon and modeling error, may be viewed as flat.

Effect of the West Chester Extension on the Thorndale Line

Unlike bus service, **the introduction of the West Chester extension has a noticeable impact on the Thorndale line,** which shares a catchment area with the Elwyn line as shown through license plate surveys. This survey work suggests that riders might naturally be diverted from the Thorndale line to a closer station on the Elwyn line if there were a new station available. This method accounts for trip increases on one line linked to losses on other lines, thereby assessing net gains or losses to the system.

Total trips on the Elwyn line are forecast to increase by 1,350 trips (about 21 percent) in the diesel alternative or by 1,910 trips (about 30 percent) in the electrified alternative compared to the No-build alternative. In contrast, Thorndale trips are forecast to decrease by 390 (about six percent) in the diesel alternative or decrease by 450 trips (about six percent) in the more attractive electrified alternative. The greatest changes occur at the Exton, Malvern, and Paoli stations, particularly Exton, which is forecasted to lose roughly 20 percent of its trips (260 diesel and 290 electric) under either alternative. Exton station is forecasted to have the largest drop in ridership because many individuals living in West Chester would find the West Chester line more convenient for transit trips into the region's core. Malvern and Paoli would also each see decreases of between 50 and 90 daily trips.

These diversions from the Thorndale line are forecast to be redistributed to new West Chester line stations. This forecasted reduction in riders potentially frees parking at Thorndale line stations that are currently at full capacity. One question is to what extent latent demand might be spurred by the emergence of parking capacity at the Thorndale line stations. While this was not part of the simulation, it is worth considering that Exton, with higher automobile accessibility than the other two stations, might attract more riders. **In general, it is fair to assume that some of the forecast Thorndale line diversions would be replaced by new riders who previously could not park at the stations, raising the net system boards. Therefore, the ridership loss at Exton and other Thorndale line stations is likely over estimated and can be viewed as a conservative estimate of the effects of the West Chester extension on total SEPTA system ridership**.

Effect of West Chester Terminus Location on Ridership

The diesel and electrified alternatives were simulated using two terminuses: the original West Chester Station and a proposed downtown station proximate to the current court house and transportation center locations. The effect of a downtown station on ridership can be seen in Table 9. **There is little difference in the total number of forecast trips between the original West Chester Station and a proposed downtown station.** Comparing the station alternatives, it was found that forecasts for the original and proposed station differed by 40 trips in the diesel alternative, 7,650, versus 7,690 and 40 trips in the electrified alternative, 8,210 versus 8,250. The downtown station increases accessibility to both attractions (businesses, cultural amenities, and government buildings) and residences in and around downtown West Chester. However, a downtown terminal station is slightly less accessible for riders who drive, due to extra travel time through the denser parts of West Chester Borough.

Table 9. Effect of Downtown West Chester Station versus Traditional Station Location

	2035 Diesel				2035 Electric			
			Standard vs. Downtown				Standard vs. Downtown	
Lines / Stops	Standard	Downtown	Difference	% Difference	Standard	Downtown	Difference	% Difference
Bus Ridership								
92	490	490	0	0%	500	500	0	0%
104	3,490	3,480	-10	-0.3%	3,420	3,430	10	0.3%
111	1,460	1,460	0	0%	1,450	1,450	0	0%
119	690	690	0	0%	690	690	0	0%
120	500	500	0	0%	490	490	0	0%
Total Study Area Bus	**6,630**	**6,620**	**-10**	**-0.2%**	**6,550**	**6,560**	**10**	**0.2%**
Regional Rail								
Elwyn Line								
West Chester (downtown)	-	350	350	-	-	460	460	-
West Chester (original)	400	-	-400	-	530	-	-530	-
West Chester University	440	520	80	18.2%	590	690	100	16.9%
Westtown	270	270	0	0%	290	290	0	0%
Cheyney	260	260	0	0%	330	330	0	0%
Wawa	750	750	0	0%	750	750	0	0%
Elwyn	740	740	0	0%	760	760	0	0%
Media	1,730	1,740	10	0.6%	1,900	1,910	10	0.5%
Moylan – Rose Valley	560	560	0	0%	540	540	0	0%
Wallingford	710	710	0	0%	710	710	0	0%
Swarthmore	1,790	1,790	0	0%	1,810	1,810	0	0%
Total Elwyn Line (original study area stations)	**5,530**	**5,540**	**10**	**0.2%**	**5,720**	**5,730**	**10**	**0.2%**
Total West Chester Line (all study area stations)	**7,650**	**7,690**	**40**	**0.5%**	**8,210**	**8,250**	**40**	**0.5%**
Thorndale Line								
Downingtown	770	770	0	0%	760	760	0	0%
Whitford	770	770	0	0%	770	770	0	0%
Exton	1,050	1,060	10	1.0%	1,020	1,020	0	0%
Malvern	1,300	1,300	0	0%	1,300	1,300	0	0%
Paoli	2,790	2,790	0	0%	2,770	2,770	0	0%
Total Thorndale Line (study area stations)	**6,680**	**6,690**	**10**	**0.1%**	**6,620**	**6,620**	**0**	**0%**
Total Study Area transit ridership	***20,960***	***21,000***	***40***	***0.2%***	***21,380***	***21,430***	***50***	***0.2%***

Source: DVRPC 2011

Considering the additional costs required to build a new right of way into downtown West Chester, the few additional trips would not appear to justify the proposed downtown alternative. This option, however, might become more justifiable in the future if mitigating factors such as development proposals or plans emerge.

Summary

The electric alternatives show an approximate net SEPTA system gain of 1,410 trips per day or about seven percent of the total for the study area, while the diesel alternatives show an approximate net gain of 990 trips per day or five percent of the total for the study area. This is the number of one-way trips, as is standard in reporting transit ridership. If one assumes that most people will take two one-way trips, then this number of trips is twice the number of actual riders. **Thus, the total riders attracted to the system are about 700 new riders in the electrified alternative and about 500 new riders in the diesel scenario.** The West Chester terminus station location has no significant effect on ridership. The West Chester Extension has negligible effect on most bus routes, but a significant effect on ridership at several Thorndale line stations.

Uncertainty Analysis

There are several factors that affect future ridership but that are either not represented or are underrepresented in the travel model. This section lists several areas of uncertainty in the forecast that are particular to this study. It is worth noting that the biggest source of error in general in travel forecasting is uncertainty in the inputs-both the future year population and employment forecasts as well as the predicted transportation system changes.

Special Student Model

TIM 1.0, used as the forecasting model, contains demographic data on individuals living in group quarters. This includes students living in dormitories. More details can be found in *2000 & 2005 Validation of the DVRPC Regional Simulation Model*, DVRPC Pub. # 08095. Significant for this study is the group quarters populations at West Chester University and Cheyney University. Trips made by these individuals are included in the forecast. Special factors are used to generate trips made by individuals in group quarters, as students have a different frequency of making various types of trips than the non-group quarter's population.

What is not included in the model, however, is the special trip-making characteristics of these individuals in terms of where they travel (trip distribution) or by which mode they travel (mode choice). Students are well known to favor transit modes, often due to the lack of an automobile at their place of residence. While not a large factor, this limitation of TIM 1.0 will tend to modestly underestimate the transit mode share from/to these locations and hence the total number of trips on the extension.

Parking Capacity

Many of the stations in the study area are currently at or over parking capacity. This restricts potential ridership; this element was reflected in the base-year calibration. Many other factors affect station level ridership, however, and the ridership constraining effect of parking undersupply cannot be positively isolated from the other elements. Minor adjustments were made to future year access costs to reflect the large increase of parking capacity in both the No-build case (Wawa) and build cases (Westtown, Cheyney University). These adjustments may, however, over or under represent the ridership restraining effects of parking undersupply. No adjustments were made, however, to dampen additional demand at stations where currently parking is constrained. Additionally, the Elwyn station was modeled so as to correspond to the 2009 ridership data, before the most recent expansion of parking at Elwyn in 2009.

Determination of Park-and-Ride Station Sheds

A careful process is used to determine the ridership sheds of stations. The effect of new stations is carefully estimated– both the shed area of new stations and the loss of any shed areas from existing stations. The primary drivers are examination of current sheds, current station ridership, and future year congested travel times. However, this method does not use a sophisticated discrete choice model to weigh all the factors used to determine to which particular station a person will decide to drive. While the results presented are estimated to be the most reasonable and likely future outcome, other reasonable estimates of both future station sheds and shed boundaries would have a moderate effect on the ridership numbers presented in Tables 7-9.

APPENDIX A

Travel Forecasting Procedures

Travel Forecasting Procedures

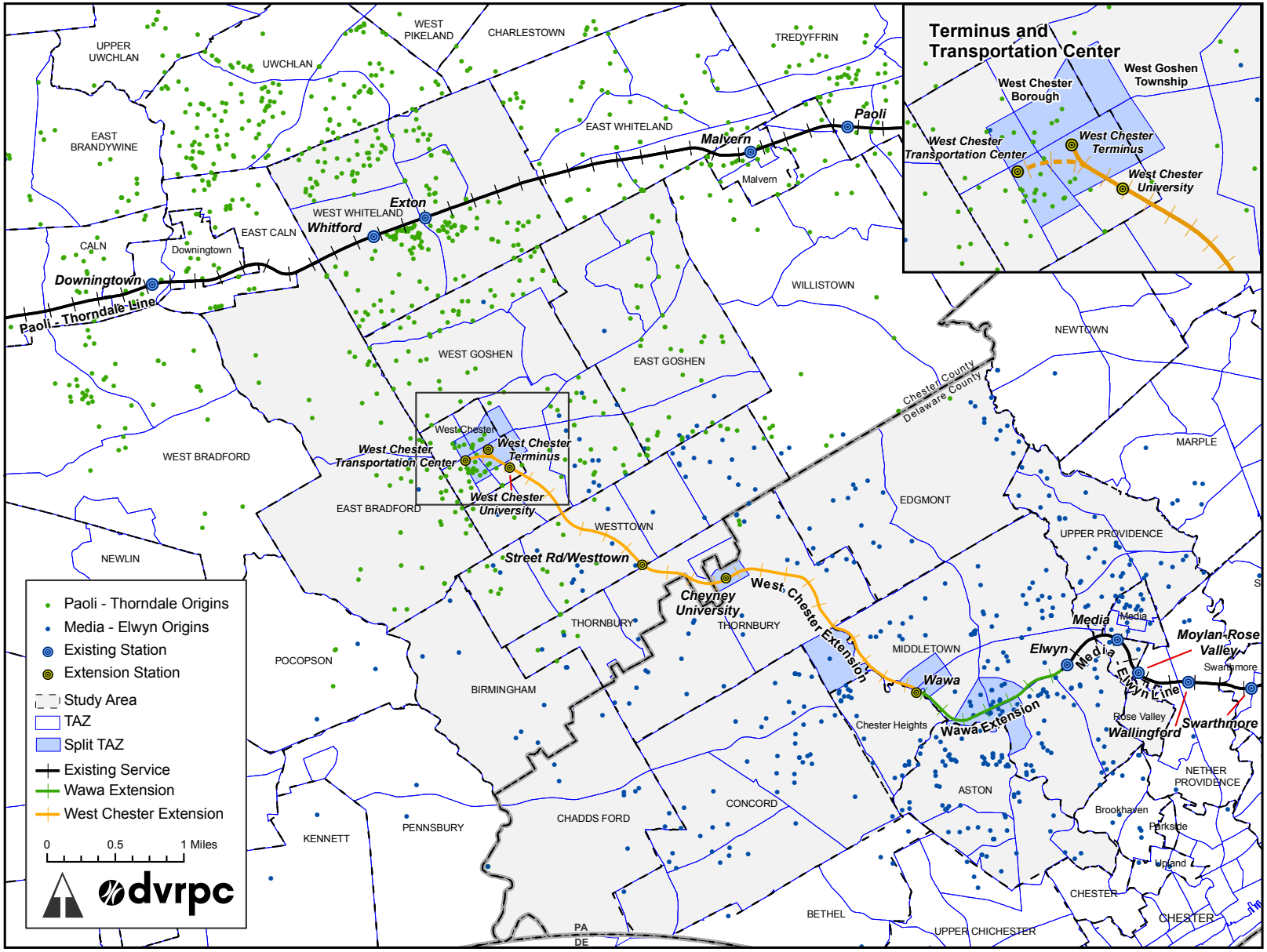
A computerized model of individual's travel behavior, TIM 1.0 (Travel Improvement Model), is used to estimate the future ridership and mode share impact of extending RR service to West Chester. This computerized model system and its application to the present study is explained in brief here, including input data, methods, and model quality. A more detailed explanation of the methods and inputs to TIM 1.0 can be found in DVRPC Report TR10006, *DVRPC Travel Demand Model Upgrade – Travel Improvement Model (TIM) 1.0* published in January 2011, documentation of TIM 1.0.

Regional travel simulation models are used to forecast future travel patterns. They utilize a system of traffic zones that follow census tract and block group boundaries and rely on demographic and employment data, land use, and transportation network characteristics to simulate travel behavior throughout the region. The travel models used for this study include the entire nine-county DVRPC region, with special attention focused on the study area.

For this study, a focused simulation process is employed. A focused simulation process allows the use of DVRPC's regional simulation model, TIM 1.0, but includes a more detailed representation of the study area. Traffic zones inside the study area are subdivided so that traffic from existing and proposed land use developments may be loaded more precisely on transit routes and individual stations. The system of split zones developed for the West Chester RR extension is shown in Figure 5. The primary motivation for zone splitting is to be able to accurately delineate the service areas of existing and proposed rail stations and to differentiate between walk and auto approaches for the nested modal split and transit assignment. Thirteen traffic zones were added within the study area as a result of the zone splitting process.

The focusing process increases the accuracy of the travel forecasts within the detailed study area. At the same time, all existing and proposed transportation projects throughout the region, their impact on the study area, and regional and interregional travel patterns, are retained as an integral part of the simulation process.

Figure 5. Split TAZs and License Plate Surveys Data



Source: DVRPC 2011

Socioeconomic Projections

DVRPC's long-range population and employment forecasts are revised periodically to reflect changing market trends, development patterns, local and national economic conditions, and other available data. The completed forecasts reflect all reasonably known current information and the best professional judgment of predicted future conditions.

DVRPC uses a multi-step, multi-source methodology to produce its population and employment forecasts at the county level. County forecasts serve as control totals for municipal forecasts, which are disaggregated from county totals. Municipal forecasts are based on an analysis of historical data trends adjusted to account for infrastructure availability, environmental constraints to development, local zoning policy, and development proposals. Municipal forecasts are constrained using density ceilings and floors. County and municipal input is used throughout the process to derive the most likely population and employment forecasts for all geographic levels.

Population Forecasting

Population forecasting at the regional level involves review and analysis of six major components: births, deaths, domestic in-migration, domestic out-migration, international immigration, and changes in group quarters populations (e.g., dormitories, military barracks, prisons, and nursing homes). DVRPC uses both the cohort survival concept to age individuals from one age group to the next, and a modified Markov transition probability model based on the most recent census and the U.S. Census Bureau's recent population estimates program to determine the flow of individuals between the Delaware Valley and neighboring regions. For movement within the region, census and Internal Revenue Service migration data coupled with population estimates data are used to determine migration rates between counties. DVRPC relies on county planning offices to provide information on any known, expected, or forecasted changes in group quarters populations. These major population components are then aggregated and the resulting population forecasts are reviewed by member counties for final adjustments based on local knowledge.

Employment Forecasting

Employment is influenced by local, national, and global political and socioeconomic factors. The Bureau of Economic Analysis provides the most complete and consistent time series data on county employment by sector, and serves as DVRPC's primary data source for employment forecasting. Employment sectors include mining, agriculture, construction, manufacturing, transportation, wholesale, retail, finance/insurance, service, government, and military. Other supplemental

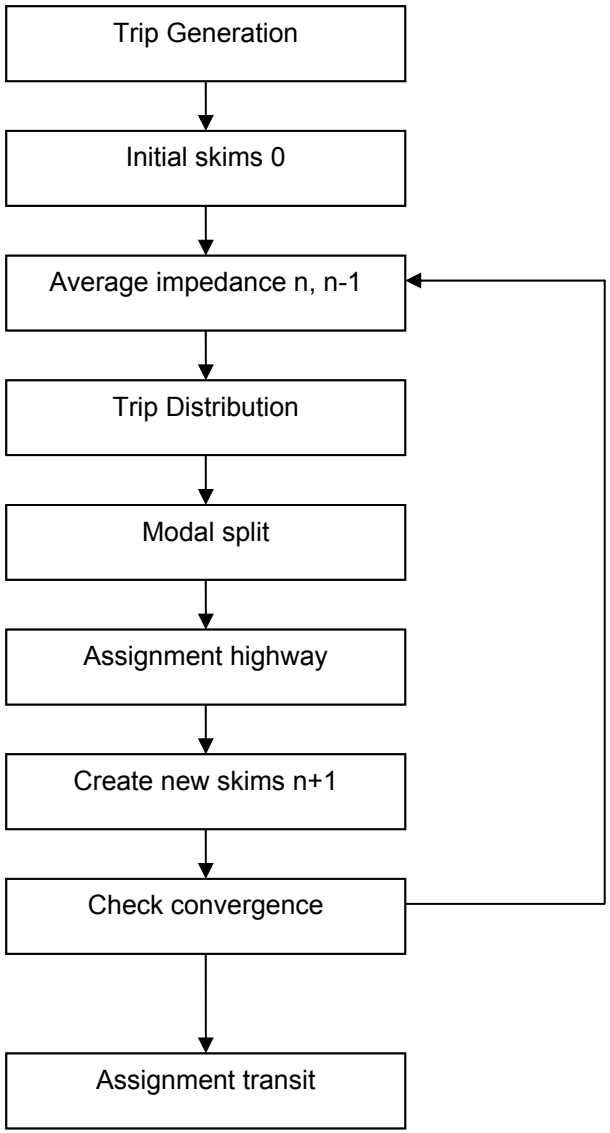
sources of data include the U.S. Census, Dun & Bradstreet; Bureau of Labor Statistics' unemployment insurance covered employment (ES 202), Occupational Privilege Tax data, and other public-and-private sector forecasts. As in the population forecasts, county level total employment is used as a control total for sector distribution and municipal-level forecasts. Forecasts are then reviewed by member counties for final adjustments based on local knowledge.

Transit Ridership Forecasting Model

TIM 1.0 is a conventional four-step travel demand model implemented in the VISUM software package. Figure 6 contains a schematic of the process. The first step in the process involves generating the number of trips that are produced by and destined for each traffic zone and cordon station throughout the nine-county region. Origin-destination patterns are then established and trips are proportioned between highway and transit modes. Finally, the most appropriate route for each trip is determined, and traffic volumes are assigned to individual facilities. These steps are more formally called trip generation, trip distribution, mode choice, and assignment.

Both trip distribution and mode choice require some estimate of travel times, which are produced by highway assignment. The model is iterated several times to insure consistency between the inputs to the trip distribution and mode choice steps and the output of highway assignment. At each iteration, travel impedance (a combination of travel times and out-of-pocket expenses) from the previous iteration is averaged with that from the current iteration. All alternatives are run using the full model chain. This is somewhat different from the procedure required by the Federal Transit Administration (FTA) for New Starts analysis in a formal Alternatives Analysis, which requires the full model chain for the No-build. The build alternatives are then evaluated using the No-build trip table and the mode choice and assignment steps only.

Figure 6. DVRPC Four-step Model Process



Source: DVRPC 2011

Trip Generation

Both internal trips (those made within the DVRPC region) and external trips (those that cross the boundary of the region) must be considered in the simulation of regional travel. Internal trip generation is based on zonal forecasts of population and employment. External trips are extrapolated from cordon line traffic counts and other sources. The latter also include trips which pass through the Delaware Valley region. Estimates of internal trip productions and attractions by zone are established on the basis of trip rates applied to the zonal estimates of demographic and employment data. Estimates of daily trips generated in each zone are calculated and then disaggregated into peak, midday, and evening time periods. The remaining steps are then run separately for each time of day. This is done in order to appropriately model the different levels of transit service and highway congestion in the different time periods. The peak time period is a combination of the AM and PM peaks, from 7:00 AM to 9:00 AM and from 3:00 PM to 6:00 PM. The midday period is from 9:00 AM to 3:00 PM and the evening period lasts from 6:00 PM to 7:00 AM.

Trip Distribution

Trip distribution is the process whereby the zonal trip ends established in the trip generation step are linked together to form origin-destination travel patterns. For example, how many of the work trip productions in West Chester go to Center City zones, and how many are attracted to work trip attractions in other places in the region are determined in trip distribution. These travel patterns are represented by trip tables. Peak, midday, and evening trip ends are distributed separately with each time period. A series of ten gravity-type distribution models are applied at the zonal level. These models follow trip purpose and vehicle type stratifications established in trip generation.

Mode Choice

Mode choice determines how many of the trips from West Chester to Center City, for example, use auto and how many use transit. The model uses various trip attributes that trip-makers use when making these decisions – such as access time, egress time, wait time, in-vehicle time, transit fares, tolls, and other out-of-pocket expenses. A nested logit type model is used, where the transit mode is nested by mode of access (walk or drive to transit). Separate models are used depending on whether the trip is made by a person whose household owns or does not own an automobile. Captive trips, those which must be made by either auto or transit for a particular reason, are considered. Mode choice produces separate auto and transit trip tables. The auto trip table, in terms of persons, is converted to vehicle trips with an auto occupancy model in preparation for highway assignment.

Highway Assignment

Auto vehicle trips are assigned to the highway network to produce link volumes, link travel times, and zone-to-zone travel times. This is done using VISUM's iterative path-based assignment algorithm. The assignment model predicts which routes auto users will take between their origin and destination so as to minimize a weighted average of travel time and out-of-pocket expenses. Since highway travel times are dependent on highway volumes, highway assignment is performed at each iteration of the mode chain.

Transit Assignment

Similar to highway assignment, transit assignment predicts which transit line or sequence of lines a passenger will take between their origin and destination. This is done so that passengers minimize a combination of access times, wait times, in-vehicle times, and fare. TIM 1.0 uses VISUM's multi-path timetable-based transit assignment algorithm. A Box-Cox choice model is used to apportion transit riders between lines with similar characteristics. Because travel times do not depend on volumes in TIM 1.0, transit assignment is only performed once at the end of the model process.

Model Calibration

Several steps were taken to improve the results of the DVRPC regional travel model for use in the study area. This process is called focusing. This consists of improving the zonal structure and network, checking the model performance for specific indicators, and adjusting model parameters and network coding as required. Several zones were split, primarily to provide better definition of walk-to-transit buffers and times. Zonal population and employment was split using Census block population, aerial imagery, and other data sources.

Station access was carefully considered and revised in the model. This was done using a number of inputs. Recent license plate surveys, as shown in Figure 5, were used to determine station access buffers by auto for current, existing stations. Similarly sized buffers were used for new stations in the No-build (Wawa) and build scenarios. Some zones fell within the likely buffer of more than one station. VISUM was used to create travel time comparisons to various stations in order to determine the most likely rail station that a traveler might drive to. Both the license plate survey data and the simulated travel times were used to construct transit station drive sheds.

TIM 1.0 has been validated on a regional level to insure that it properly replicates current travel conditions. The ability of a model to replicate current transportation system behavior is an important factor in demonstrating its ability to forecast future system behavior. A higher level of validation than that done for the regional model is required for specific project-level forecasting. The focused model was validated on transit system ridership, corridor bus-route ridership, Elwyn and Thorndale line study-area station volumes, and Elwyn line transit trip length. While 2010 is the base year for the model, 2009 transit data was used to validate the model, as 2010 data is not yet available.

Total system ridership is shown in Table 10. Most significant for the purposes of this study is the improvement of SEPTA RR ridership error from –7 percent to –1 percent versus 2009 counts. City Transit and Frontier division bus ridership forecasting was also improved overall. While Victory division bus ridership worsened slightly overall, individual study area bus line forecasting was improved, as seen in Table 10. The base year model error on all of the lines was reduced to seven percent or less. The total study area bus ridership error was four percent. This was improved from the regional model, which had a total error of 71 percent when compared with counts. Several steps were taken in order to improve model results. A penalty was added to several lines to address unreliability of service. Walk access times were estimated, as some had been unrealistically low. The amount of transit captives was also reduced in the area, which had been unrealistically high. Table 11 shows 2005 counts as a point of comparison to 2009. Two of the transit lines, the 92 and the 111, showed significant growth in the four year period between 2005 and 2009. Only the 104 route bus showed a decline of ridership during this time period 14 percent.

Table 10. SEPTA System Ridership Calibration

Total Ridership	2009 Counts	2010 Regional Model	09 Counts vs. 10 Regional		2010 Focused Model	09 Counts vs. 10 Focused	
			Difference	% Difference		Difference	% Difference
CTD Bus	515,498	377,197	-138,301	-27%	435,468	-80,030	-16%
CTD Light Rail	91,986	82,464	-9,522	-10%	87,324	-4,662	-5%
CTD Heavy Rail	316,710	313,984	-2,726	-1%	312,399	-4,311	-1%
Victory Bus	35,948	34,084	-1,864	-5%	29,727	-6,221	-17%
Victory LRT	7,707	5,475	-2,232	-29%	5,374	-2,333	-30%
Victory Heavy Rail	8,929	5,889	-3,040	-34%	6,391	-2,538	-28%
Frontier Bus	13,898	32,719	18,821	135%	18,273	4,375	31%
SEPTA RR	123,740	114,683	-9,057	-7%	122,542	-1,198	-1%
Total SEPTA	**1,114,416**	**966,495**	**-147,921**	**-13%**	**1,017,498**	**-96,918**	**-9%**

1. CTD = City Transit Division
2. LRT = Light Rail Transit
3. RR = Regional Rail

Source: DVRPC 2011

Table 11. Study Area Bus Ridership Calibration

Bus Ridership	2005 Counts	2009 Counts	2010 Regional Model	09 Counts vs. 10 Regional		2010 Focused Model	09 Counts vs. 10 Focused	
				Difference	% Difference		Difference	% Difference
92	185	432	786	354	82%	423	-9	-2%
104	3,512	3,082	5,742	2,660	86%	3,125	43	1%
111	1,077	1,445	1,987	542	38%	1,552	107	7%
119	641	711	923	212	30%	761	50	7%
120	354	468	1,054	586	125%	500	32	7%
Total	**5,769**	**6,138**	**10,493**	**4,355**	**71%**	**6,362**	**224**	**4%**

Source: DVRPC 2011

Table 12 shows ridership at RR stations in and near the study area. Parts of the West Chester area are currently in the catchment area of the Thorndale line. Thorndale line ridership, therefore, is forecast in addition to the Elwyn line, as any potential extension from Wawa to West Chester would presumably draw some riders away from the Thorndale line. Ignoring the effects of a RR extension on existing transit services would exaggerate the benefits of the extension. The focused simulation model predicts total ridership on the Elwyn line (all stations, not just those in the study area) within 1 percent of counts. This is slightly worse than the regional model on an aggregate basis; this is more than made up for by the improvement on the disaggregate station-level ridership forecast. The two Elwyn line stations closest to the extension and most similar in urban form, Elwyn and Media, have base year predicted ridership errors of four percent and zero percent, respectively.

The calibration process improved the results of the Thorndale line aggregate ridership from a –27 percent error to –6 percent. Individual station volumes were also drastically improved. The most important stations for the purpose of this study are Whitford, Exton, and Malvern. Whitford and Exton ridership are overestimated by 8 and 11 percent, respectively. Malvern ridership is underestimated by two percent.

Several model items were adjusted in order to improve station-level ridership estimation. The most significant was proper modeling of auto access to transit. One element is proper definition of the drive access sheds, as discussed previously. Proper estimation of auto access times is also important. Lack of parking at certain RR stations is currently a deterrent to ridership. It was therefore necessary to add a penalty to auto access to certain rail stations to reflect this undersupply or under capacity of RR parking.

Table 12. Study Area Regional Rail Ridership – Daily Boardings plus Alightings

Study Area Station Ridership	2005 Counts	2009 Counts	2010 Regional Model	09 Counts vs. 10 Regional		2010 Focused Model	09 Counts vs. 10 Focused	
				Difference	% Difference		Difference	% Difference
Elwyn Line								
Elwyn	882	991	1,255	264	27%	1,029	38	4%
Media	1,049	1,143	825	-318	-28%	1,140	-3	0%
Moylan – Rose Valley	490	488	155	-333	-68%	448	-40	-8%
Wallingford	601	589	752	163	28%	596	7	1%
Swarthmore	1,418	1,430	823	-607	-42%	1,161	-269	-19%
Total Elwyn Line	**9,818**	**9,952**	**9,948**	**-4**	**0%**	**9,865**	**-87**	**-1%**
Thorndale Line								
Downingtown	620	674	283	-391	-58%	682	8	1%
Whitford	630	638	407	-231	-36%	687	49	8%
Exton	1,240	1,155	318	-837	-72%	1,284	129	11%
Malvern	1,236	1,075	293	-782	-73%	1,052	-23	-2%
Paoli	2,696	2,648	1,654	-994	-38%	2,773	125	5%
Total Thorndale Line	**25,993**	**24,260**	**17,809**	**-6,451**	**-27%**	**22,833**	**-1427**	**-6%**

Source: DVRPC 2011

Table 13 contains the transit trip length validation data. The calibrated model replicates both the inbound and outbound Elwyn line transit trip length very closely. The inbound direction has an error of –1.7 percent, while the outbound direction has an error of less than one percent. No additional calibration was needed to achieve these results, other than that done to improve the station-level ridership estimation.

Table 13.Transit Trip Length Validation

Line and Direction	2009 RR Census	2010 Focused Model	Difference	% Difference
Elwyn Inbound	9.3	9.15	0.15	1.7%
Elwyn Outbound	9.5	9.53	-0.03	-0.3%

Source: DVRPC 2011

Model Runs and Ridership Evaluation

Both the No-build model and the four build alternatives were run once the base model was sufficiently calibrated. The same changes made to affect the base-year-focused model were made to the future year alternatives. All data was stored in VISUM's version (ver) file. Each model was run and the results extracted from the ver file. Model runs were checked to ensure that no errors were present. The No-build model results were compared against the base year model to check the effects of 25 years of predicted demographic changes and the transportation system improvements that are a part of the No-build scenario. The build results were then compared against the No-build results. In this way the effects of the extension to West Chester are separated from the other changes that will take place in the study area in the 25 years between the base year and the 2035 evaluation year. The error present in the base year calibration is corrected when making forecasts. For example, since Elwyn station ridership is four percent high in the base year calibration, all future year Elwyn ridership forecasts are corrected by multiplying by a 0.96 correction factor. All forecasts shown in Tables 7-9 are the error-corrected values. Correction factors are not used for facilities not present in the current year, such as the Westtown station.

APPENDIX B

Build Alternative Schedules

Build Alternative Schedules

Table 14. Westbound Diesel Build Alternative Schedule to West Chester

Station											
Temple University	University City	Secane	Morton	Media	Elwyn	Wawa Arrive	Wawa Depart	Cheyney	Westtown	West Chester University	West Chester Terminal
6:06 AM	6:23 AM	6:39 AM	6:42 AM	6:54 AM	6:58 AM	7:03 AM					
6:59 AM	7:16 AM	7:32 AM	7:35 AM	7:45 AM	7:49 AM	7:54 AM	8:05 AM	8:11 AM	8:14 AM	8:18 AM	8:20 AM
7:41 AM	7:58 AM	8:14 AM	8:17 AM	8:27 AM	8:31 AM	8:36 AM	8:45 AM	8:51 AM	8:54 AM	8:58 AM	9:00 AM
8:04 AM	8:22 AM	8:37 AM	8:40 AM	8:50 AM	8:54 AM	8:59 AM	9:15 AM	9:21 AM	9:24 AM	9:28 AM	9:30 AM
8:34 AM	8:51 AM	9:09 AM	9:12 AM	9:21 AM	9:25 AM	9:30 AM	10:15 AM	10:21 AM	10:24 AM	10:28 AM	10:30 AM
9:23 AM	9:40 AM	10:03 AM	10:09 AM	10:18 AM	10:22 AM	10:27 AM					
10:28 AM	10:45 AM	11:08 AM	11:14 AM	11:23 AM	11:27 AM	11:32 AM					
11:33 AM	11:50 AM	12:13 PM	12:19 PM	12:28 PM	12:32 PM	12:37 PM					
12:38 PM	12:55 PM	1:18 PM	1:24 PM	1:33 PM	1:37 PM	1:42 PM					
1:43 PM	2:00 PM	2:23 PM	2:29 PM	2:38 PM	2:42 PM	2:47 PM	3:45 PM	3:51 PM	3:54 PM	3:58 PM	4:00 PM
2:52 PM	3:09 PM	3:32 PM	3:37 PM	3:46 PM	3:50 PM	3:55 PM					
3:16 PM	3:34 PM	3:52 PM	3:55 PM	4:05 PM	4:09 PM	4:14 PM	4:15 PM	4:21 PM	4:24 PM	4:28 PM	4:30 PM
3:55 PM	4:12 PM	4:28 PM	4:31 PM	4:41 PM	4:45 PM	4:50 PM	5:00 PM	5:06 PM	5:09 PM	5:13 PM	5:15 PM
4:23 PM	4:40 PM	4:58 PM	5:01 PM	5:12 PM	5:16 PM	5:21 PM					
4:41 PM	***4:59 PM***	***5:10 PM***	***5:13 PM***	***5:24 PM***	***5:28 PM***	***5:33 PM***	***5:40 PM***	***5:46 PM***	***5:49 PM***	***5:53 PM***	***5:55 PM***
4:53 PM	***5:11 PM***	***5:29 PM***	***5:32 PM***	***5:40 PM***							
5:10 PM	***5:28 PM***	***5:39 PM***	***5:42 PM***	***5:53 PM***	***5:57 PM***	***6:02 PM***	***6:07 PM***	***6:13 PM***	***6:16 PM***	***6:20 PM***	***6:22 PM***
5:14 PM	***5:33 PM***	***5:51 PM***	***5:54 PM***	***6:00 PM***	***6:04 PM***						
5:39 PM	5:56 PM	6:14 PM	6:17 PM	6:28 PM	6:32 PM	6:37 PM	6:47 PM	6:53 PM	6:56 PM	7:00 PM	7:02 PM
6:09 PM	6:26 PM	6:44 PM	6:47 PM	6:58 PM	7:02 PM	7:07 PM					
6:54 PM	7:11 PM	7:27 PM	7:30 PM	7:40 PM	7:44 PM	7:49 PM	8:00 PM	8:06 PM	8:09 PM	8:13 PM	8:15 PM
7:54 PM	8:11 PM	8:27 PM	8:30 PM	8:40 PM	8:44 PM	8:49 PM					
8:44 PM	9:01 PM	9:17 PM	9:20 PM	9:30 PM	9:34 PM	9:39 PM	9:49 PM	9:55 PM	9:58 PM	10:02 PM	10:04 PM
9:44 PM	10:01 PM	10:17 PM	10:20 PM	10:30 PM	10:34 PM	10:39 PM	10:49 PM	10:55 PM	10:58 PM	11:02 PM	11:04 PM
10:54 PM	11:11 PM	11:27 PM	11:30 PM	11:40 PM	11:44 PM	11:49 PM					
11:54 PM	12:11 AM	12:27 AM	12:30 AM	12:40 AM	12:44 AM	12:49 AM					

***Exp Secane to University City**

***Exp Morton to Media**

Source: DVRPC 2011

Table 15. Eastbound Diesel Build Alternative Schedule from West Chester

Station											
West Chester Terminal	West Chester University	Westtown	Cheyney	Wawa Arrive	Wawa Depart	Elwyn	Media	Morton	Secane	University City	Temple University
					5:30 AM	5:35 AM	5:39 AM	5:49 AM	5:52 AM	6:12 AM	6:31 AM
5:40 AM	5:42 AM	5:46 AM	5:49 AM	5:55 AM	6:02 AM	6:07 AM	6:11 AM	6:21 AM	6:24 AM	6:44 AM	7:03 AM
6:05 AM	6:07 AM	6:11 AM	6:14 AM	6:20 AM	6:30 AM	6:35 AM	6:39 AM	6:49 AM	6:52 AM	7:12 AM	7:31 AM
6:30 AM	*6:32 AM*	*6:36 AM*	*6:39 AM*	*6:45 AM*	*6:55 AM*	*7:00 AM*	*7:04 AM*	*7:10 AM*	*7:13 AM*	*7:33 AM*	*7:52 AM*
6:53 AM	*6:55 AM*	*6:59 AM*	*7:02 AM*	*7:08 AM*	*7:13 AM*	*7:18 AM*	*7:22 AM*	*7:28 AM*	*7:31 AM*	*7:52 AM*	*8:09 AM*
							7:13 AM	*7:23 AM*	*7:26 AM*	*7:38 AM*	*7:55 AM*
7:15 AM	*7:17 AM*	*7:21 AM*	*7:24 AM*	*7:30 AM*	*7:35 AM*	*7:40 AM*	*7:44 AM*	*7:59 AM*	*8:03 AM*	*8:15 AM*	*8:32 AM*
									7:47 AM	8:09 AM	8:28 AM
									8:10 AM	8:31 AM	8:47 AM
7:50 AM	*7:52 AM*	*7:56 AM*	*7:59 AM*	*8:05 AM*	*8:12 AM*	*8:17 AM*	*8:21 AM*	*8:31 AM*	*8:34 AM*	*8:44 AM*	*9:03 AM*
					8:24 AM	8:29 AM	8:33 AM	8:43 AM	8:46 AM	9:06 AM	9:23 AM
8:30 AM	8:32 AM	8:36 AM	8:39 AM	8:45 AM	8:53 AM	8:58 AM	9:02 AM	9:11 AM	9:14 AM	9:33 AM	9:50 AM
9:36 AM	9:38 AM	9:42 AM	9:45 AM	9:51 AM	9:56 AM	9:59 AM	10:03 AM	10:12 AM	10:19 AM	10:45 AM	11:02 AM
					10:53 AM	10:58 AM	11:02 AM	11:11 AM	11:18 AM	11:45 AM	12:02 PM
					11:58 AM	12:03 PM	12:07 PM	12:16 PM	12:23 PM	12:50 PM	1:07 PM
					1:03 PM	1:08 PM	1:12 PM	1:21 PM	1:28 PM	1:55 PM	2:12 PM
					2:11 PM	2:16 PM	2:20 PM	2:29 PM	2:36 PM	3:03 PM	3:20 PM
					2:58 PM	3:03 PM	3:07 PM	3:16 PM	3:21 PM	3:47 PM	4:06 PM
3:20 PM	3:22 PM	3:26 PM	3:29 PM	3:35 PM	3:46 PM	3:51 PM	3:55 PM	4:03 PM	4:06 PM	4:24 PM	4:43 PM
3:30 PM	3:32 PM	3:36 PM	3:39 PM	3:45 PM	4:05 PM	4:10 PM	4:14 PM	4:24 PM	4:27 PM	4:47 PM	5:06 PM
					4:30 PM	4:35 PM	4:39 PM	4:49 PM	4:52 PM	5:11 PM	5:30 PM
4:30 PM	4:32 PM	4:36 PM	4:39 PM	4:45 PM	4:59 PM	5:04 PM	5:08 PM	5:18 PM	5:21 PM	5:41 PM	6:00 PM
5:15 PM	5:17 PM	5:21 PM	5:24 PM	5:30 PM	5:38 PM	5:43 PM	5:47 PM	5:57 PM	6:00 PM	6:20 PM	6:39 PM
5:25 PM	5:27 PM	5:31 PM	5:34 PM	5:40 PM	6:30 PM	6:35 PM	6:39 PM	6:49 PM	6:52 PM	7:09 PM	7:28 PM
6:25 PM	6:27 PM	6:31 PM	6:34 PM	6:40 PM	7:12 PM	7:17 PM	7:21 PM	7:31 PM	7:34 PM	7:51 PM	8:10 PM
7:35 PM	7:37 PM	7:41 PM	7:44 PM	7:50 PM	7:59 PM	8:04 PM	8:08 PM	8:18 PM	8:21 PM	8:38 PM	8:57 PM
					8:59 PM	9:04 PM	9:08 PM	9:18 PM	9:21 PM	9:38 PM	9:57 PM
9:15 PM	9:17 PM	9:21 PM	9:24 PM	9:30 PM	9:59 PM	10:04 PM	10:08 PM	10:18 PM	10:21 PM	10:38 PM	10:57 PM
10:15 PM	10:17 PM	10:21 PM	10:24 PM	10:30 PM	10:59 PM	11:04 PM	11:08 PM	11:18 PM	11:21 PM	11:38 PM	11:57 PM

**Exp Secane to University City*

**Exp Media to Morton*

Source: DVRPC 2011

Table 16. Westbound Electric Build Alternative Schedule to West Chester

Station										
Temple University	University City	Secane	Morton	Media	Elwyn	Wawa	Cheyney	Westtown	West Chester University	West Chester Terminal
6:06 AM	6:23 AM	6:39 AM	6:42 AM	6:54 AM	6:58 AM	7:03 AM				
6:59 AM	7:16 AM	7:32 AM	7:35 AM	7:45 AM	7:49 AM	7:54 AM				
7:41 AM	7:58 AM	8:14 AM	8:17 AM	8:27 AM	8:31 AM	8:48 AM	8:54 AM	8:57 AM	9:01 AM	9:03 AM
8:04 AM	8:22 AM	8:37 AM	8:40 AM	8:50 AM	8:54 AM	8:59 AM				
8:34 AM	8:51 AM	9:09 AM	9:12 AM	9:21 AM	9:25 AM	9:30 AM				
9:23 AM	9:40 AM	10:03 AM	10:09 AM	10:18 AM	10:22 AM	10:27 AM				
10:28 AM	10:45 AM	11:08 AM	11:14 AM	11:23 AM	11:27 AM	11:32 AM				
11:33 AM	11:50 AM	12:13 PM	12:19 PM	12:28 PM	12:32 PM	12:37 PM				
12:38 PM	12:55 PM	1:18 PM	1:24 PM	1:33 PM	1:37 PM	1:42 PM				
1:43 PM	2:00 PM	2:23 PM	2:29 PM	2:38 PM	2:42 PM	2:47 PM				
2:39 PM	2:56 PM	3:12 PM	3:15 PM	3:27 PM	3:31 PM	3:36 PM	3:42 PM	3:45 PM	3:49 PM	3:51 PM
2:52 PM	3:09 PM	3:32 PM	3:37 PM	3:46 PM	3:50 PM	3:55 PM				
3:16 PM	3:34 PM	3:52 PM	3:55 PM	4:05 PM	4:09 PM	4:14 PM				
3:55 PM	4:12 PM	4:28 PM	4:31 PM	4:41 PM	4:45 PM	4:51 PM	4:57 PM	5:00 PM	5:04 PM	5:06 PM
4:23 PM	4:40 PM	4:58 PM	5:01 PM	5:12 PM	5:16 PM	5:21 PM				
4:41 PM	***4:59 PM***	***5:10 PM***	***5:13 PM***	***5:17 PM***	***5:21 PM***	***5:27 PM***	***5:33 PM***	***5:36 PM***	***5:40 PM***	***5:42 PM***
4:53 PM	***5:11 PM***	***5:29 PM***	***5:32 PM***	***5:40 PM***						
5:10 PM	***5:28 PM***	***5:39 PM***	***5:42 PM***	***5:46 PM***	***5:50 PM***	***5:56 PM***	***6:02 PM***	***6:05 PM***	***6:09 PM***	***6:11 PM***
5:14 PM	***5:33 PM***	***5:51 PM***	***5:54 PM***	***6:00 PM***	***6:04 PM***					
5:39 PM	5:56 PM	6:14 PM	6:17 PM	6:28 PM	6:32 PM	6:38 PM	6:44 PM	6:47 PM	6:51 PM	6:53 PM
6:09 PM	6:26 PM	6:44 PM	6:47 PM	6:58 PM	7:02 PM	7:14 PM	7:20 PM	7:23 PM	7:27 PM	7:29 PM
6:54 PM	7:11 PM	7:27 PM	7:30 PM	7:40 PM	7:44 PM	7:50 PM	7:56 PM	7:59 PM	8:03 PM	8:05 PM
7:54 PM	8:11 PM	8:27 PM	8:30 PM	8:40 PM	8:44 PM	8:49 PM				
8:44 PM	9:01 PM	9:17 PM	9:20 PM	9:30 PM	9:34 PM	9:40 PM	9:46 PM	9:49 PM	9:53 PM	9:55 PM
9:44 PM	10:01 PM	10:17 PM	10:20 PM	10:30 PM	10:34 PM	10:40 PM	10:46 PM	10:49 PM	10:53 PM	10:55 PM
10:54 PM	11:11 PM	11:27 PM	11:30 PM	11:40 PM	11:44 PM	11:49 PM				
11:54 PM	12:11 AM	12:27 AM	12:30 AM	12:40 AM	12:44 AM	12:49 AM				

**Exp Secane to University City & Morton to Media*

**Exp Media to Morton*

Source: DVRPC 2011

Table 17. Eastbound Electric Build Alternative Schedule from West Chester

Station										
West Chester Terminal	West Chester University	Westtown	Cheyney	Wawa	Elwyn	Media	Morton	Secane	University City	Temple University
				5:30 AM	5:35 AM	5:39 AM	5:49 AM	5:52 AM	6:12 AM	6:31 AM
5:39 AM	5:41 AM	5:45 AM	5:48 AM	6:02 AM	6:07 AM	6:11 AM	6:21 AM	6:24 AM	6:44 AM	7:03 AM
6:10 AM	6:12 AM	6:16 AM	6:19 AM	6:30 AM	6:35 AM	6:39 AM	6:49 AM	6:52 AM	7:12 AM	7:31 AM
6:39 AM	*6:41 AM*	*6:45 AM*	*6:48 AM*	*6:57 AM*	*7:02 AM*	*7:06 AM*	*7:12 AM*	*7:15 AM*	*7:33 AM*	*7:52 AM*
6:57 AM	*6:59 AM*	*7:03 AM*	*7:06 AM*	*7:13 AM*	*7:18 AM*	*7:22 AM*	*7:28 AM*	*7:31 AM*	*7:52 AM*	*8:09 AM*
						7:13 AM	7:23 AM	7:26 AM	7:38 AM	7:55 AM
7:32 AM	*7:34 AM*	*7:38 AM*	*7:41 AM*	*7:48 AM*	*7:53 AM*	*7:57 AM*	*8:01 AM*	*8:04 AM*	*8:15 AM*	*8:34 AM*
								7:47 AM	8:09 AM	8:28 AM
7:54 AM	*7:56 AM*	*8:00 AM*	*8:03 AM*	*8:10 AM*	*8:15 AM*	*8:19 AM*	*8:29 AM*	*8:32 AM*	*8:43 AM*	*9:02 AM*
								8:10 AM	8:31 AM	8:47 AM
				8:24 AM	8:29 AM	8:33 AM	8:43 AM	8:46 AM	9:06 AM	9:23 AM
8:30 AM	8:32 AM	8:36 AM	8:39 AM	8:53 AM	8:58 AM	9:02 AM	9:11 AM	9:14 AM	9:33 AM	9:50 AM
9:36 AM	9:38 AM	9:42 AM	9:45 AM	9:56 AM	10:01 AM	10:05 AM	10:14 AM	10:17 AM	10:36 AM	10:53 AM
				10:53 AM	10:58 AM	11:02 AM	11:11 AM	11:18 AM	11:45 AM	12:02 PM
				11:58 AM	12:03 PM	12:07 PM	12:16 PM	12:23 PM	12:50 PM	1:07 PM
				1:03 PM	1:08 PM	1:12 PM	1:21 PM	1:28 PM	1:55 PM	2:12 PM
				2:11 PM	2:16 PM	2:20 PM	2:29 PM	2:36 PM	3:03 PM	3:20 PM
				2:58 PM	3:03 PM	3:07 PM	3:16 PM	3:21 PM	3:47 PM	4:06 PM
3:41 PM	3:43 PM	3:47 PM	3:50 PM	4:05 PM	4:10 PM	4:14 PM	4:24 PM	4:27 PM	4:47 PM	5:06 PM
				3:46 PM	3:51 PM	3:55 PM	4:03 PM	4:06 PM	4:24 PM	4:43 PM
4:33 PM	4:35 PM	4:39 PM	4:42 PM	4:58 PM	5:03 PM	5:07 PM	5:17 PM	5:20 PM	5:40 PM	5:59 PM
					4:35 PM	4:39 PM	4:49 PM	4:52 PM	5:11 PM	5:30 PM
				5:38 PM	5:43 PM	5:47 PM	5:57 PM	6:00 PM	6:20 PM	6:39 PM
6:14 PM	6:16 PM	6:20 PM	6:23 PM	6:29 PM	6:34 PM	6:38 PM	6:48 PM	6:51 PM	7:08 PM	7:27 PM
6:56 PM	6:58 PM	7:02 PM	7:05 PM	7:11 PM	7:16 PM	7:20 PM	7:30 PM	7:33 PM	7:50 PM	8:09 PM
7:55 PM	7:57 PM	8:01 PM	8:04 PM	8:10 PM	8:15 PM	8:19 PM	8:29 PM	8:32 PM	8:49 PM	9:08 PM
				7:59 PM	8:04 PM	8:08 PM	8:18 PM	8:21 PM	8:38 PM	8:57 PM
8:43 PM	8:45 PM	8:49 PM	8:52 PM	8:58 PM	9:03 PM	9:07 PM	9:17 PM	9:20 PM	9:37 PM	9:56 PM
				9:59 PM	10:04 PM	10:08 PM	10:18 PM	10:21 PM	10:38 PM	10:57 PM
10:20 PM	10:22 PM	10:26 PM	10:29 PM	10:35 PM	10:40 PM	10:44 PM	10:54 PM	10:57 PM	11:14 PM	11:33 PM
				10:59 PM	11:04 PM	11:08 PM	11:18 PM	11:21 PM	11:38 PM	11:57 PM

**Exp Secane to University City*

**Exp Media to Morton*

**Exp Media to Morton & Secane to University City*

Source: DVRPC 2011

Publication Title: Wawa to West Chester Regional Rail Extension – Ridership Forecast

Publication Number: 10036

Date Published: November 2011

Geographic Area Covered: The municipalities of Chadds Ford Township, Concord Township, Aston Township, Thornbury Township, Middletown Township, Upper Providence Township, Edgmont Township, Rose Valley Borough, and Media Borough in Delaware County, and Westtown Township, Thornbury Township, East Goshen Township, West Goshen Township, Birmingham Township, West Whiteland Township, East Bradford Township, and West Chester Borough in Chester County, Pennsylvania

Key Words: Transit Ridership Forecast, West Chester, Elwyn, Wawa, SEPTA, Travel Demand Modeling, Travel Improvement Model, TIM 1.0, VISUM

Abstract: This report documents forecasts of the number of trips that would result from an extension of SEPTA's Elwyn line from the planned Wawa station to West Chester. It compares year 2035 forecasts under a No-build scenario, an electrified extension alternative (one-seat ride), and a diesel extension alternative (requiring a transfer at Wawa). The line between West Chester, Elwyn, and Philadelphia is forecast to attract 1,910 and 1,350 additional daily rides due to the extension of service for the electric and diesel alternatives, respectively. A portion of trips on the extension is due to diversion from other SEPTA services. Total SEPTA system-wide net ridership gains are forecast to be about 1,410 and 990 trips in the electric and diesel alternatives, respectively. Area bus service is not significantly impacted by the extension; the location of the West Chester terminus location, either traditional location or a location at the West Chester Transportation Center, does not meaningfully affect the forecast. The report contains details on study area trends, the alternatives analyzed, and the forecasting methodology.

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