Master Development Plan for the TxDOT North Tarrant Express Project Segments 2-4

Chapter 4: Traffic and Revenue Forecasts

MOBILITY PARTNERS 2-4

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4. Traffic and Revenue Forecasts

4.1. Purpose and Scope

This chapter contains preliminary travel demand and toll revenue forecasts prepared in response to the requirements for the Master Development Plan for NTE Segments 2-4. The primary purpose of the traffic modeling and forecasting exercise was to develop a quantitative understanding of future travel demands under various assumptions of Facility alignment and phasing, tolling strategies, and socioeconomic conditions. This information serves as a key input into the development of staging/project phasing plans and the assessment of feasibility for the Facilities as proposed.

The preliminary traffic and revenue forecasts in this chapter will be supplemented with detailed, investment grade, Facility-specific forecasts of travel demands and revenue projections prior to securing the final approval to proceed with implementation of a Facility.

4.2 Overview of Methodology

The methodology used to undertake the traffic and revenue forecast was designed to produce a revenue case that represents the most likely revenue forecast to be achieved. The methodology includes the following tasks:

- establishing the project and its context;
- traffic data review;
- socioeconomic data review;
- road user choice assessment;
- traffic modeling;
- analysis of results; and
- risk and opportunity analysis.

The DFW Regional Transportation Model (DFWRTM), developed by the North Central Texas Council of Governments (NCTCOG), was used as the primary basis for the travel demand forecasting analysis, and then refined into a sub-area model, as detailed in Section 4.2.1. The DFWRTM includes more than 4,800 traffic survey zones and encompasses the entirety of Collin, Dallas, Denton, Rockwall and Tarrant counties, as well as portions of Kaufman, Ellis, Johnson and Parker counties. It is a four-step model comprising trip generation, roadway skim and trip distribution, mode choice, and roadway traffic assignment and transit assignment.

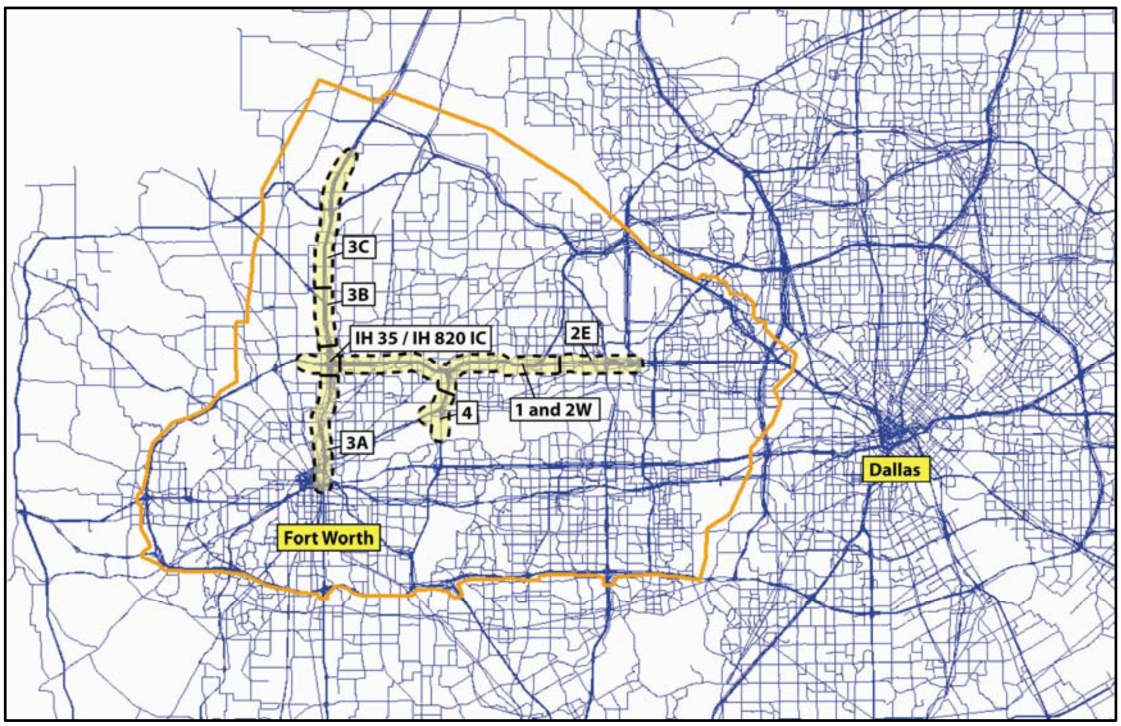
Details of the model development are provided in “Dallas-Fort Worth Regional Travel Model (DFWRTM): Model Description October 2007” produced by NCTCOG Transportation Department, Model Development Group.

The traffic and revenue forecasts have been based upon traffic modeling undertaken for base year (2006), and forecast years 2015, 2025 and 2030. The traffic modeling was split into seven time periods to represent the different congestion levels experienced throughout the day, which are critical to achieving the desired speeds in the Managed Lanes and optimizing toll revenue. Intermediate year forecasts were interpolated, and forecasts post 2030 were extrapolated based on long-term growth rates with capacity constraints applied.

4.2.1 Sub-Area Model

A sub-area model (including road network and car and truck matrices) was extracted from the DFWRTM, relevant to the study area. The sub-area is shown in Figure 4-1, and contains approximately 1,500 zones.

Figure 4-1: Modeled Sub-Area



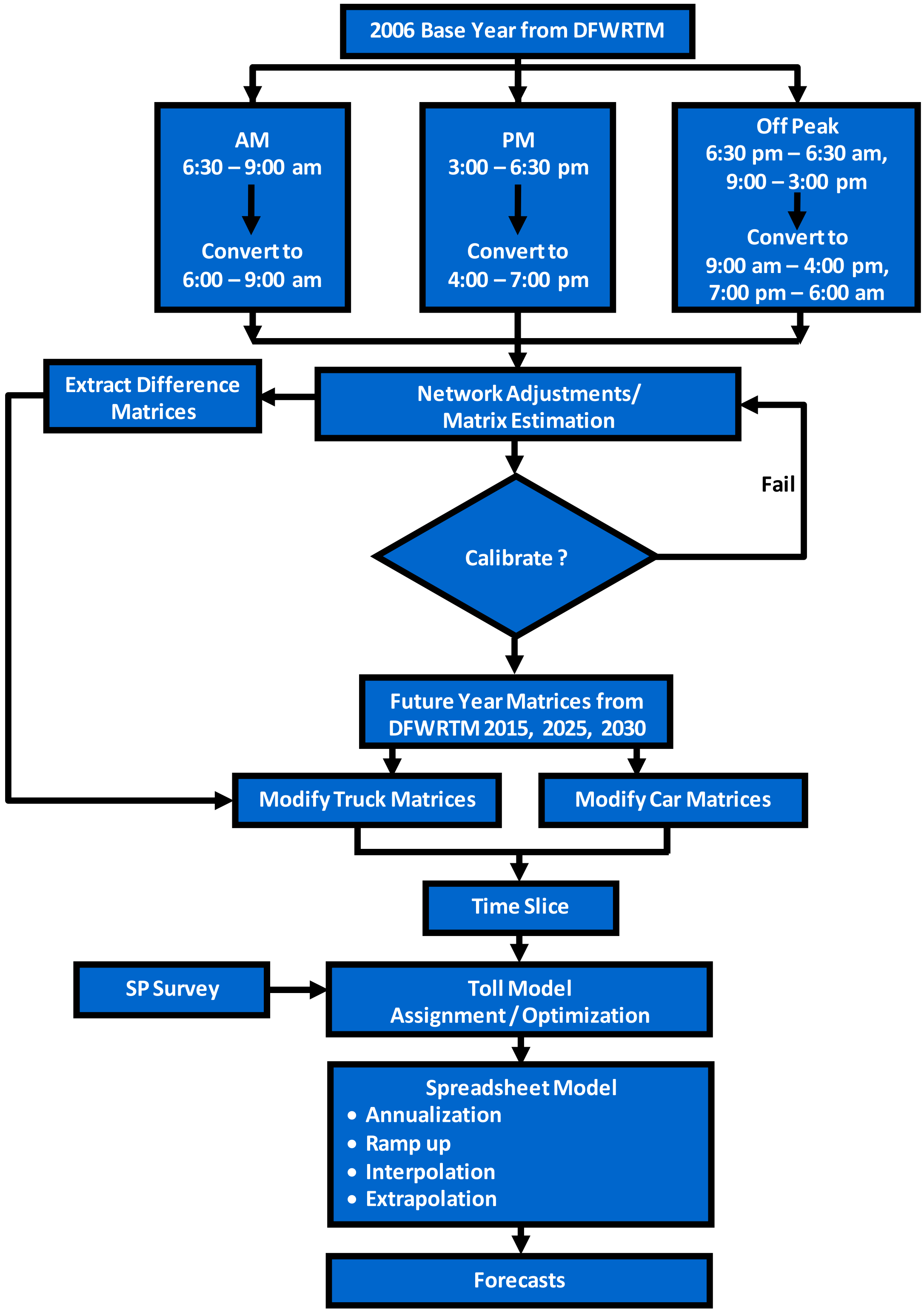
4.2.2 Model Calibration and Validation – Current Year Trip Tables

NCTCOG matrices for AM (6:30-9:00 am), PM (3:00-6:30 pm) and OP (off-peak period 9:00 am-3:00 pm, 6:30 pm – 6:30 am) were extracted (for the relevant sub-area) for 2006. These matrices were then converted into time periods relevant to the NTE project, namely AM (6:00 am -9:00 am – three hours), PM (4:00 pm -7:00 pm – three hours), and OP (remaining 18 hours) using factors derived from 2006 hourly count data.

The NCTCOG matrices include three user classes, Single Occupant Vehicle (SOV), High Occupancy Vehicle (HOV) and Trucks (3 or more axles).

An overview of the process used to calibrate the model and prepare the traffic and revenue forecasts is shown schematically in Figure 4-2.

Figure 4-2: Modeling Methodology Flow Chart



4.3 Traffic Forecasts

4.3.1 List of Facilities and Development Milestones

The traffic forecasts presented in this chapter cover Segments 2E, 3A, 3B, 3C and 4. Segments 3A, 3B and the IH 35W / IH 820 Interchange are currently being considered as a combined Facility. The remaining Segments have been considered as stand-alone Facilities for the purposes of Traffic and Revenue forecasting.

Development Milestones

The anticipated Service Commencement Dates and other key development milestones for each Facility are provided in Table 4-1.

Table 4-1: Facility Configurations and Development Milestones

<table>
<tr><th colspan="2">Segment / Facility</th><th>Number of Lanes</th><th>Timeline</th></tr>
<tr><td colspan="2">Segment 2E</td><td>Interim: GPL: 3 / ML: 2 / FR: 2
Ultimate: GPL: 3 / ML: 3 / FR: 2</td><td>Pre-Development: 2014-2015
D&C Period: 2016-2020
Service Commencement: 2020</td></tr>
<tr><td rowspan="3">Potential Facility 3A/3B</td><td>Seg. 3A</td><td>Interim: GPL: 2-3 / ML: 2 / FR: 2
Ultimate: GPL: 4 / ML: 3 / FR: 2-3</td><td rowspan="3">Pre-Development: 2010-2011
D&C Period: 2012-2017
Service Commencement: 2017</td></tr>
<tr><td>IH 35W / IH 820 Interchange</td><td>Interim: GPL: 2-3 / ML on IH 35W: 2 / ML on IH 820:1- 2 / FR: 2 / DC: 1
Ultimate: GPL: 3 / ML on IH 35W: 2 / ML on IH 820: 2 / FR: 2 / DC: as shown on schematics for environmental approval</td></tr>
<tr><td>Seg. 3B</td><td>Interim: GPL: 2-3 / ML: 2-3 / FR: 2-3
Ultimate: GPL: 4-5 / ML: 2-3 / FR: 2-3</td></tr>
<tr><td colspan="2">Segment 3C</td><td>Interim: GPL: 2 / ML: 2 / FR: 2
Ultimate: GPL: 3 / ML: 2 / FR: 2
plus connections to SH 170 and extension to south of Eagle Parkway</td><td>Pre-Development: 2014-2015
D&C Period: 2016–2020
Service Commencement: 2020</td></tr>
<tr><td colspan="2">Segment 4</td><td>Interim: GPL: 3-5 / ML: 1-2 / FR: 2-3
Ultimate: GPL: 3-5 / ML: 1-2 / FR: 2-3</td><td>Pre-Development: 2019-2020
D&C Period: 2021-2025
Service Commencement: 2025</td></tr>
</table>

In addition, Segments 1 and 2W are expected open in 2015.

Optimized Scenario for IH 35W / IH 820 Interchange

The traffic and revenue forecasts in this chapter assume the "Optimized" scenario for development of the IH 35W / IH 820 Interchange. The Optimized scenario consists of the following:

Work to be performed by the Developer:

- Constructing the Managed Lanes on NB and SB IH 35W and EB and WB IH 820
- Constructing Managed Lane-to-Managed Lane Direct Connectors from IH 820 WB to IH 35W SB and NB
- Constructing all remaining GPL connectors (one lane only) to and from IH 35W.
- Constructing IH 35W and IH 820 GPLs (existing capacity to be matched)

Work to be deferred to Ultimate configuration:

- SB to WB FR from Sta. 401 to Mark IV Parkway and associated entrance ramp
    - North of Sta. 401+00 will be part of Segment 3B
    - TxDOT shall construct the interim SB GPL ramp from Western Center Blvd. on Segment 3B
- Reconstruction of EB to SB FR from Mark IV Parkway to Sta. 395+00
- Reconstruction of Mark IV Parkway and associated u-turns
- Reconstruction of the IH 820 EB and WB GPL west of approximately Sta. 648+00

Work to be procured separately by TxDOT:

- All Work between IH35W Sta. 581+00 and 590+00 (to be included as part of Segment 3B)

4.3.2 Passenger Auto and Truck Traffic Forecasts

Table 4-2 summarizes forecasted transactions by Segment. Table 4-3 provides the anticipated traffic volumes on the General Purpose Lanes for modeled years 2025 and 2030 as a point of comparison with the forecasted transactions in **Error! Not a valid bookmark self-reference.**. Table 4-4 summarizes forecasted transactions by vehicle class and time period.

Table 4-2: Average Annual Daily Transactions by Segment

Year	Segment					Total
	2E	3A	3B	3C	4	
2017	0	37,600	31,400	0	0	69,000
2018	0	38,800	32,900	0	0	71,700
2019	0	40,100	34,500	0	0	74,600
2020	46,100	44,000	40,700	19,600	0	150,400
2025	49,300	48,100	45,700	19,300	8,300	170,700
2030	55,100	55,000	53,600	23,600	8,700	196,000
2035	65,800	57,900	61,100	28,100	11,600	224,500
2040	70,600	63,000	68,200	32,500	12,800	247,100
2045	76,600	67,300	74,300	36,900	14,100	269,200
2050	80,900	71,200	81,500	41,200	15,200	290,000
2055	86,700	75,900	82,100	45,600	16,600	306,900
2060	88,600	79,400	87,300	50,000	17,700	323,000
2065	92,600	84,600	86,200	54,200	18,900	336,500

Excludes ramp-up effects. Assumes Optimized solution for IH-35 interchange. Assumes Ultimate Configuration for Segment 1 and 2W in 2031.

Table 4-3: Traffic Volumes on General Purpose Lanes for Modeled Years

Year	Segment					Total
	2E	3A	3B	3C	4	
2025	176,310	149,097	164,425	143,699	238,806	872,336
2030	181,534	154,572	174,031	150,762	247,419	908,318

Traffic volumes have been extracted from approximately the midpoint of each toll segment. The volumes vary along the segment.

Table 4-4: Average Annual Daily Transactions by Vehicle Class and Time Period for Segments 2E, 3 and 4

Year	Vehicle Class				Time Period			
	SOV	HOV	Truck	Total	AM	PM	OP	Total
2017	33,500	19,900	15,600	69,000	10,900	12,800	45,300	69,000
2018	35,000	20,500	16,200	71,700	11,300	13,200	47,200	71,700
2019	36,400	21,200	17,000	74,600	11,600	13,800	49,100	74,500
2020	73,600	46,600	30,300	150,500	22,700	34,700	93,000	150,400
2025	94,000	38,500	38,300	170,800	24,500	31,300	114,800	170,600
2030	106,300	43,800	45,700	195,800	28,200	34,400	133,400	196,000
2035	120,900	50,300	53,300	224,500	31,900	39,000	153,500	224,400
2040	131,500	55,400	60,200	247,100	33,800	41,700	171,400	246,900
2045	141,800	60,400	66,900	269,100	35,800	43,700	189,700	269,200
2050	151,300	65,100	73,700	290,100	36,600	45,700	207,700	290,000
2055	159,100	69,100	78,700	306,900	39,100	47,000	220,700	306,800
2060	166,100	72,600	84,300	323,000	39,100	48,300	235,600	323,000
2065	172,300	75,500	88,700	336,500	41,700	49,600	245,200	336,500

Excludes ramp-up effects. Differences between vehicle class total and time period total due to rounding. Assumes Optimized solution for IH-35 interchange. Assumes Ultimate Configuration for Segment 1 and 2W in 2031.

4.3.3 Toll Regulation

The demand factor calculates how the toll rates may be adjusted according to previous traffic volumes and speeds on the Managed Lanes, as shown in Table 4-5.

Table 4-5: Determination of Demand Factor

Action	Average Volume		Demand Factor
	2 Lanes	3 Lanes	
Decrease			
0	2,500	4,000	0.95
50	2,400	3,850	0.9
100	2,300	3,700	0.85
150	2,200	3,550	0.8
200	2,100	3,400	0.75
Increase			
0	3,300	5,100	1.05
50	3,400	5,250	1.1
100	3,500	5,400	1.15
150	3,600	5,550	1.2
200	3,700	5,700	1.25

Within the traffic model, the demand factor for each toll segment is calculated by direction for seven time periods, resulting in 14 factors per segment per year. The demand factor is typically higher for peak periods and lower for off-peak periods.

Considering only the maximum demand factor (of the 14) for each year, Table 4-6 shows when each of the demand factors is first applied.

Table 4-6: Application of Demand Factor

Demand Factor	Anticipated First Application of Demand Factor (Year)		
	Segment 3A	Segment 3B	Segment 2E
0.75	2017	2017	#N/A
0.8	2024	#N/A	#N/A
0.85	2027	2020	#N/A
0.9	2028	2022	#N/A
0.95	2029	#N/A	#N/A
1	2030	2023	2020
1.05	2037	2037	2042
1.1	2039	2032	2033
1.15	2042	2034	2034
1.2	2048	2036	2036
1.25	#N/A	2042	2037

In most cases, a "high" demand factor is followed by a lower demand factor in the next year. This is due to the traffic being diverted by the higher toll. In some cases, a multiple step in the demand factor occurs between years rather than a single-step change.

4.3.4 Methodology and Assumptions for User Charges and Diversion Rates

User Charges

These forecasts have been prepared based on an Optimum Tolling Scenario that meets the requirements of the CDA. Revenue optimization was carried out using a two-step process. Step one involved running the initial base toll rates and incrementally changing these rates to develop a series of revenue curves. From these curves, the optimal toll rate in terms of revenue for the toll segments was derived. A final run was then undertaken applying in combination the optimized toll rates for each of the toll segments by time period.

Toll Diversion Methodology

The traffic demand forecasts are based on an analysis of the effect of tolling on route choice, recognizing the payment of the toll as a purchase of a range of road travel benefits, including reduced travel times and increased certainty around the travel times.

There is particular complexity in the toll diversion in this study as the model must be able to evaluate between the tolled and free route choice alternatives and over a number of different toll road combinations. The Project contains six independent sections and it is possible to use part of a section, an entire section or multiple sections. The toll model must therefore be flexible to deal with drivers traveling on different lengths of the toll road and alternating between the tolled and free alternative.

The approach adopted in this study assumes that individuals will choose a route by considering the inherent "utility" they will derive from travelling via each alternative route, and will accordingly choose the best path to maximize this utility. With respect to toll roads, there are many factors affecting the individual's judgment of the "utility" or benefit to be derived from its use compared to using the "free" road network, including:

- the magnitude of the toll cost (c) – (see sample toll rates in Table 4-10, page 17);
- the value (VOT) placed on travel time (t);
- other non-tangible factors represented by the motorway bonus (ε), including:
    - reliability of travel time;
    - perceptions of driving comfort offered by a high standard road; and
    - the benefit of electronic tolling.

These factors are converted into a common value (in this study, cents/minute) by multiplying time and the motorway bonus by the Value of Time (VOT).

This is represented mathematically by the following equation:

$$U_{Max} = \sum_{i=1-Zones} c + \left(\sum_{i=1-Zones} t + \varepsilon \right) * VOT$$

In application, a different best path is created for each zone within a network based on a randomly distributed value of time. This approach was first developed by the French research institute INRETS and has been used for numerous toll road studies in France and throughout the world. AECOM conducted a review of distributed value of time studies to determine the most appropriate methodology to estimate the key variables, including the following studies:

- Barbier-Saint-Hilaire, Friedrich, Hofsäss and Scherr; “TRIBUT – A Bicriterion Approach for Equilibrium Assignment“, 2000
- Hensher, Greene and Rose; “Deriving willingness-to-pay estimates of travel-time savings from individual-based parameters”; 2006
- Fosgerau; “Investigating the Distribution of Travel Time Savings”; Danish Transport Research Institute; 2004
- Leurent; “Cost Versus Time Equilibrium over a Network”, Transportation Research Board, 1994
- Mahmassani, Zhou and Lu; “Toll Pricing and Heterogeneous Users”, Transportation Research Board, 1998

These studies provided the basis for applying the toll diversion methodology:

1. In applying the toll diversion model, paths are built on the network based on a generalised cost of travel times and tolls, whereby time and costs are converted to a common value using VOT.

2. Road users are assigned to these network paths using an equilibrium assignment.

3. a. Travel speeds are then updated depending on the traffic volume using a speed flow curve.

   b The value of time is also updated by randomly choosing another value within the log normal distribution.

$$\text{Log (VOT)} \sim \text{N} (\mathrm{M}\Sigma)$$

Where

M = average Value of Time

Σ = standard deviation of the Value of time

Within each iteration of the assignment process, each origin zone is assigned a VOT randomly chosen from the log normal distribution. The process uses the following algorithm.

1. Generate a random number, X1, between 0 and 1

2. Determine the inverse normal, Y, of the random number.

3. Calculate Log (VOT) = $M + \Sigma * Y$

4. Take the exponent to give a randomly generated Value of Time

5. This procedure continues iteratively, with paths now built on the loaded network to update the travel times input into the generalized costs. This process continues until convergence occurs.

4.3.5 Revenue Stream Analyses

The forecast revenue by Segment is summarized in Table 4-7. The forecast revenue by vehicle type is summarized in Table 4-8, based on the optimized tolling scenario. Table 4-9 summarizes annual toll revenue by vehicle class and time period.

Table 4-7: Annual Revenue by Segment (000's $2008 Dollars)

Year	Segment					Total
	2E	3A	3B	3C	4	
2017	0	30,886	17,696	0	0	48,582
2018	0	34,410	19,857	0	0	54,267
2019	0	38,056	22,125	0	0	60,181
2020	25,439	44,313	26,795	11,794	0	108,342
2025	31,078	61,937	38,475	18,787	5,269	155,547
2030	40,650	89,587	54,288	28,153	6,847	219,525
2035	56,292	108,124	69,500	38,072	9,312	281,300
2040	70,136	118,980	83,061	47,746	11,210	331,133
2045	84,504	129,724	94,819	57,420	13,108	379,576
2050	95,794	140,264	106,848	67,095	15,007	425,007
2055	104,904	150,267	119,281	76,769	16,905	468,127
2060	113,996	161,167	131,119	86,443	18,803	511,528
2065	122,782	171,947	143,641	96,117	20,701	555,189

Excludes ramp-up effects. Assumes 'Optimised solution' for IH-35 interchange. Assumes Ultimate Configuration for Segment 1 and 2W in 2031.

Table 4-8: Revenue by Vehicle Class and Time Period
for Segments 2E, 3 and 4 (000's $2008 Dollars)

Year	Vehicle Class				Time Period			
	SOV	HOV	Truck	Total	AM	PM	OP	Total
2017	17,451	10,931	20,200	48,582	8,249	9,770	30,563	48,582
2018	19,558	12,146	22,562	54,267	9,322	11,004	33,941	54,267
2019	21,754	13,404	25,023	60,181	10,444	12,303	37,433	60,181
2020	41,255	25,453	41,634	108,342	18,511	25,059	64,772	108,342
2025	65,415	25,260	64,871	155,547	25,594	33,347	96,605	155,547
2030	90,049	35,154	94,323	219,525	35,711	46,532	137,283	219,525
2035	112,973	44,759	123,568	281,300	45,881	56,236	179,183	281,300
2040	131,152	52,639	147,343	331,133	53,643	64,316	213,174	331,133
2045	148,473	60,341	170,762	379,576	60,571	71,953	247,051	379,576
2050	164,340	67,281	193,387	425,007	67,593	79,110	278,304	425,007
2055	179,597	73,832	214,697	468,127	74,908	86,496	306,723	468,127
2060	195,182	80,432	235,914	511,528	83,060	93,607	334,862	511,528
2065	210,744	87,050	257,395	555,189	90,638	100,673	363,878	555,189

Excludes ramp-up effects. Assumes Optimized solution for IH-35 interchange. Assumes Ultimate Configuration for Segment 1 and 2W in 2031.

Table 4-9: Annual Revenue by Vehicle Class and Time Period
for Segments 2E, 3 and 4 (000's $2008 Dollars)

Year	Vehicle Class				Time Period			
	SOV	HOV	Truck	Total	AM	PM	OP	Total
2017	17,451	10,931	20,200	48,582	8,249	9,770	30,563	48,582
2018	19,558	12,146	22,562	54,267	9,322	11,004	33,941	54,267
2019	21,754	13,404	25,023	60,181	10,444	12,303	37,433	60,181
2020	41,255	25,453	41,634	108,342	18,511	25,059	64,772	108,342
2025	65,415	25,260	64,871	155,547	25,594	33,347	96,605	155,547
2030	90,049	35,154	94,323	219,525	35,711	46,532	137,283	219,525
2035	112,973	44,759	123,568	281,300	45,881	56,236	179,183	281,300
2040	131,152	52,639	147,343	331,133	53,643	64,316	213,174	331,133
2045	148,473	60,341	170,762	379,576	60,571	71,953	247,051	379,576
2050	164,340	67,281	193,387	425,007	67,593	79,110	278,304	425,007
2055	179,597	73,832	214,697	468,127	74,908	86,496	306,723	468,127
2060	195,182	80,432	235,914	511,528	83,060	93,607	334,862	511,528
2065	210,744	87,050	257,395	555,189	90,638	100,673	363,878	555,189

Excludes ramp-up effects. Assumes Optimized solution for IH-35 interchange. Assumes Ultimate Configuration for Segment 1 and 2W in 2031.

4.4 Tolling Plan

4.4.1 Toll Rates

Toll rates will be defined following the principles set out in an exhibit to each Facility Agreement, which specifies requirements for user classifications, toll segments, toll operations, toll schedules, toll calculation and performance and measurement requirements.

Travel time savings and revealed values of time will be determined in five-minute intervals throughout the day to determine the revenue maximizing rate for each segment and direction that complies with the toll rate cap and the two thresholds defined in Exhibit 4:

- Speeds on the Managed Lanes consistently over 50 mph

- Volumes on the Managed Lanes consistently under 3,300pce/h (two-lane sections) or 5,100pce/h (three-lane sections)

If one of the two thresholds is met, toll rates will increase as necessary (even over the toll rate cap if needed) to restore speeds and volumes within the performance thresholds.

Rates may change during the day in five-minute intervals and are expected to have variations depending on the day of the week and month of the year. Annual variations will be driven by changes in congestion in the network further to regional growth. The toll rate cap will be subject to escalation in accordance with the Facility Agreement.

The Concessionaire may utilize Toll Segment Tolls, defined in Exhibit 4 to the Concession CDA the the product of the Base Toll multiplied by the Toll Factor, rounded to the nearest five cents ($0.05). Toll Segment Tolls will depend solely on the toll rate for the segment and the segment length, and this toll will therefore be the same at all tolling points irrespective of the point of entry or exit. The Concessionaire, however, may charge differential tolls at different tolling points at any time during the concession, subject to the maximum tolls applicable by segment.

For an initial period to be specified in each Facility Agreement, the Managed Lanes will operate in Schedule Mode. Under this mode, tolls will be static and will only be adjusted once per month in response to changes in demand on the Managed Lanes. After the initial period, congestion pricing will be implemented where the tolls on the Managed Lanes will be changed dynamically, based on demand patterns.

Toll rates for sample years 2025, 2045 and 2065 are provided in Table 4-10.

Table 4-10: Optimized Toll Rates for Sample Years ($/mile), (2008 USD)

Segment & Direction	Forecasted Toll Rates ($ US)						
	6-7 am	7-9 am	9 am-4 pm, 7-8 pm	4-5 pm	5-7 pm	8 pm-10 pm	10 pm-6 am
2025							
2E NB	0.33	0.56	0.27	0.36	0.24	0.10	0.07
2E SB	0.15	0.27	0.36	0.62	0.47	0.13	0.07
3A NB	0.36	0.46	0.46	0.60	0.46	0.20	0.09
3A SB	0.46	0.67	0.46	0.57	0.43	0.20	0.09
3B NB	0.32	0.46	0.43	0.60	0.46	0.18	0.09
3B SB	0.43	0.64	0.46	0.53	0.43	0.20	0.09
3C NB	0.39	0.50	0.46	0.53	0.46	0.18	0.09
3C SB	0.32	0.57	0.39	0.50	0.43	0.18	0.09
4 NB	0.25	0.41	0.28	0.31	0.22	0.13	0.08
4 SB	0.13	0.19	0.25	0.44	0.34	0.09	0.08
2045							
2E NB	0.56	0.75	0.50	0.71	0.47	0.16	0.07
2E SB	0.38	0.62	0.71	0.86	0.71	0.25	0.07
3A NB	0.71	0.71	0.71	0.82	0.71	0.34	0.09
3A SB	0.71	0.99	0.71	0.75	0.71	0.62	0.09
3B NB	0.71	0.71	0.71	0.85	0.78	0.39	0.09
3B SB	0.71	1.15	0.71	0.71	0.71	0.62	0.09
3C NB	0.71	0.71	0.71	0.71	0.71	0.39	0.09
3C SB	0.60	0.71	0.67	0.75	0.71	0.18	0.09
4 NB	0.50	0.63	0.41	0.56	0.59	0.19	0.08
4 SB	0.38	0.56	0.63	0.63	0.59	0.16	0.08
2065							
2E NB	0.71	0.82	0.71	0.71	0.71	0.22	0.07
2E SB	0.62	0.71	0.71	1.45	0.71	0.37	0.07
3A NB	0.71	0.71	0.71	0.82	0.82	0.48	0.09
3A SB	0.71	2.15	0.71	0.75	0.71	0.71	0.09
3B NB	0.71	0.71	0.71	0.85	0.82	0.60	0.09
3B SB	0.82	2.37	0.82	0.78	0.78	0.71	0.09
3C NB	0.71	0.71	0.71	0.71	0.71	0.60	0.09
3C SB	0.71	0.71	0.71	0.75	0.71	0.18	0.09
4 NB	0.63	0.63	0.53	0.63	0.63	0.25	0.08
4 SB	0.63	0.63	0.63	0.63	0.63	0.22	0.08

4.5 Tolling Technologies

The toll collection system on the Project will be an Electronic Toll Collection System (ETCS) that generates accurate toll transactions from either Transponder or Video Transactions for all vehicles traveling through the toll segments. The ETCS will charge tolls based on the vehicle classification. The ETCS hardware and software utilized at each toll zone will be the same regardless of the location. The only difference between toll zone locations will be the configurations of the hardware and software to meet site-specific conditions such as the number of lanes and shoulders.

The ETCS will be modular with an open architecture, composed of commercially available hardware components, so that as new technologies emerge, and improved components come to market they can be easily added and/or integrated into the system to improve performance and/or reliability. The ETCS will be designed with redundant components to minimize the risks of lost revenues due to system degradations and/or malfunctions and to meet or exceed industry, National, TxDOT and North Texas Tollway Authority (NTTA) standards and to meet or exceed all of the requirements contained in the Facility Agreement for a given Facility.

The ETCS shall be interoperable with all transponders issued by tolling authorities sanctioned by TxDOT. The ETCS Host will be connected to and will interface with the NTTA CSC Host through the Concessionaire’s Back Office System, in accordance with the NTTA Interface Control Document (NTTA ICD).

4.6 Toll Collection Locations

The analysis of the ultimate configuration of each Segment assumes the toll collection locations described in Table 4-11 and depicted in the stick diagrams in Figures 4-4 through 4-10. One HOV declaration lane will be provided for each entry point onto the Managed Lanes. The Segment lengths presented in the stick diagrams are not representative of the interim chargeable lengths, which are presented in Chapter 10.

Table 4-11: Proposed Locations of Toll Gantries

No.	Type	Interim	Ultimate	Road	Direction	Milepost
Segment 2E						
2E-1	Mainline	✓	✓	SH 183	EB	1313+00
2E-2	On-Ramp	✓	✓	SH 10	EB	1411+00
2E-3	On-Ramp		✓	SH 183 FR	EB	1525+00
2E-4	Mainline		✓	SH 183	WB	2537+00
2E-5	On-Ramp		✓	SH 183	WB	2540+00
2E-6	On-Ramp	✓		SH 183	WB	2510+00
2E-7	On-Ramp	✓	✓	Intl Pkwy	WB	2508+00
2E-8	On-Ramp	✓	✓	SH 183 FR	WB	2466+00
Segment 3A						
3A-1	Transition On-Ramp	✓	✓	IH 35W	NB	925+00
3A-2	Connector	✓	✓	IH 35W	NB	925+00
3A-3	On-Ramp	✓	✓	IH 35W	NB	809+00
3A-4	On-Ramp	✓	✓	IH 35W	NB	767+00
3A-5	Mainline	✓	✓	IH 35W	SB	650+00
3A-6	On-Ramp	✓	✓	IH 35W	SB	703+00
3A-7	Connector		✓	SH 121	NB	923+00
Segment 3B						
3B-1	Mainline	✓	✓	IH 35W	NB	1582+00
3B-2	Transition On-Ramp	✓	✓	IH 35W	SB	1403+00
3B-3	Connector	✓	✓	IH 35W	SB	1453+00
3B-4	On-Ramp	✓	✓	IH 35W	SB	1510+00
Segment 3C						
3C-1	Mainline	✓	✓	IH 35W	NB	1400+00
3C-2	Connector		✓	SH 170	NB	1155+00
3C-3	On-Ramp		✓	IH 35W	SB	1070+00
3C-4	On-Ramp	✓		IH 35W	SB	1145+00
3C-5	On-Ramp	✓	✓	IH 35W	SB	1258+00
3C-6	On-Ramp	✓	✓	IH 35W FR	SB	1360+00
Segment 4						
4-1	On-Ramp	✓	✓	IH 820	NB	770+00
4-2	Mainline	✓	✓	IH 820	SB	850+00
4-3	On-Ramp	✓	✓	SH 121 FR	NB	330+00
4-4	On-Ramp	✓	✓	SH 121	NB	352+00

Figure 4-3: Segment 2E Stick Diagram – Interim Configuration

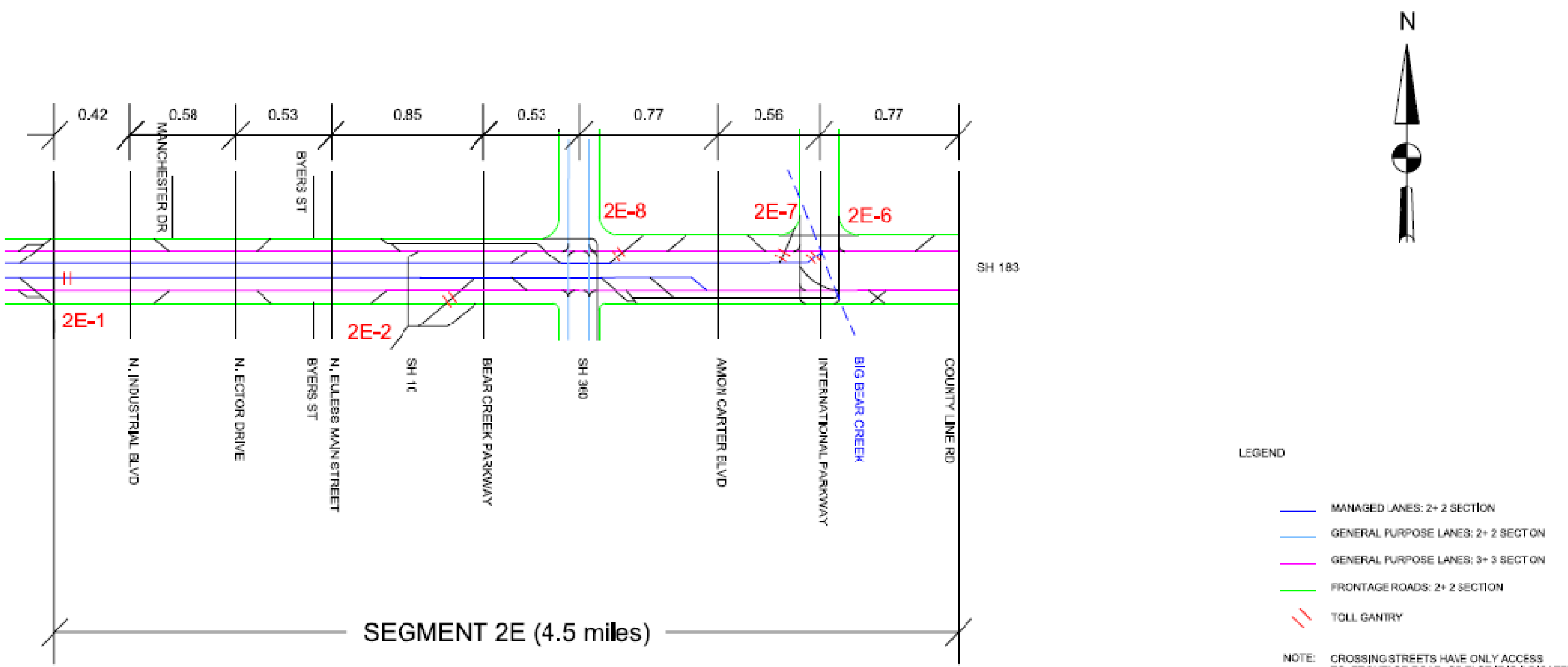


Figure 4-4: Segment 2E Stick Diagram – Ultimate Configuration

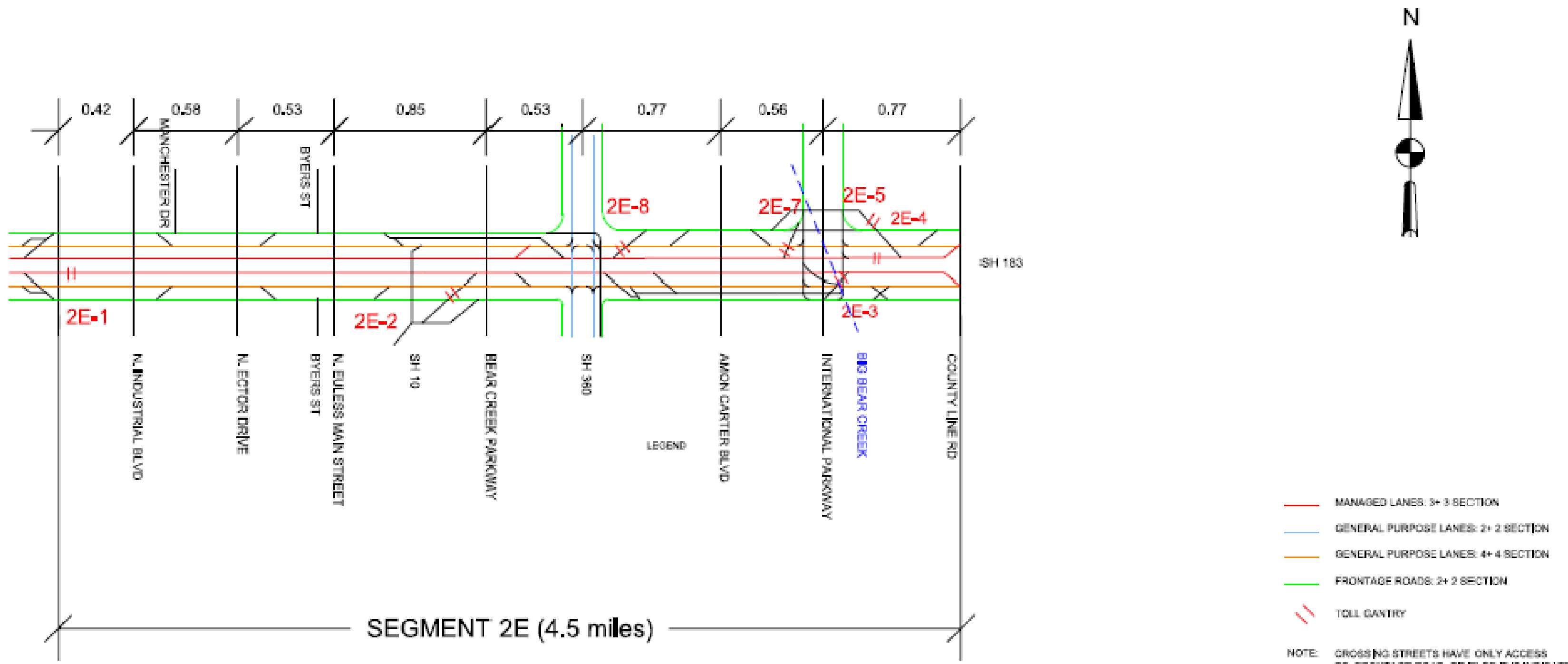


Figure 4-5: Stick Diagram – Segments 3A and 3B – Interim Configuration

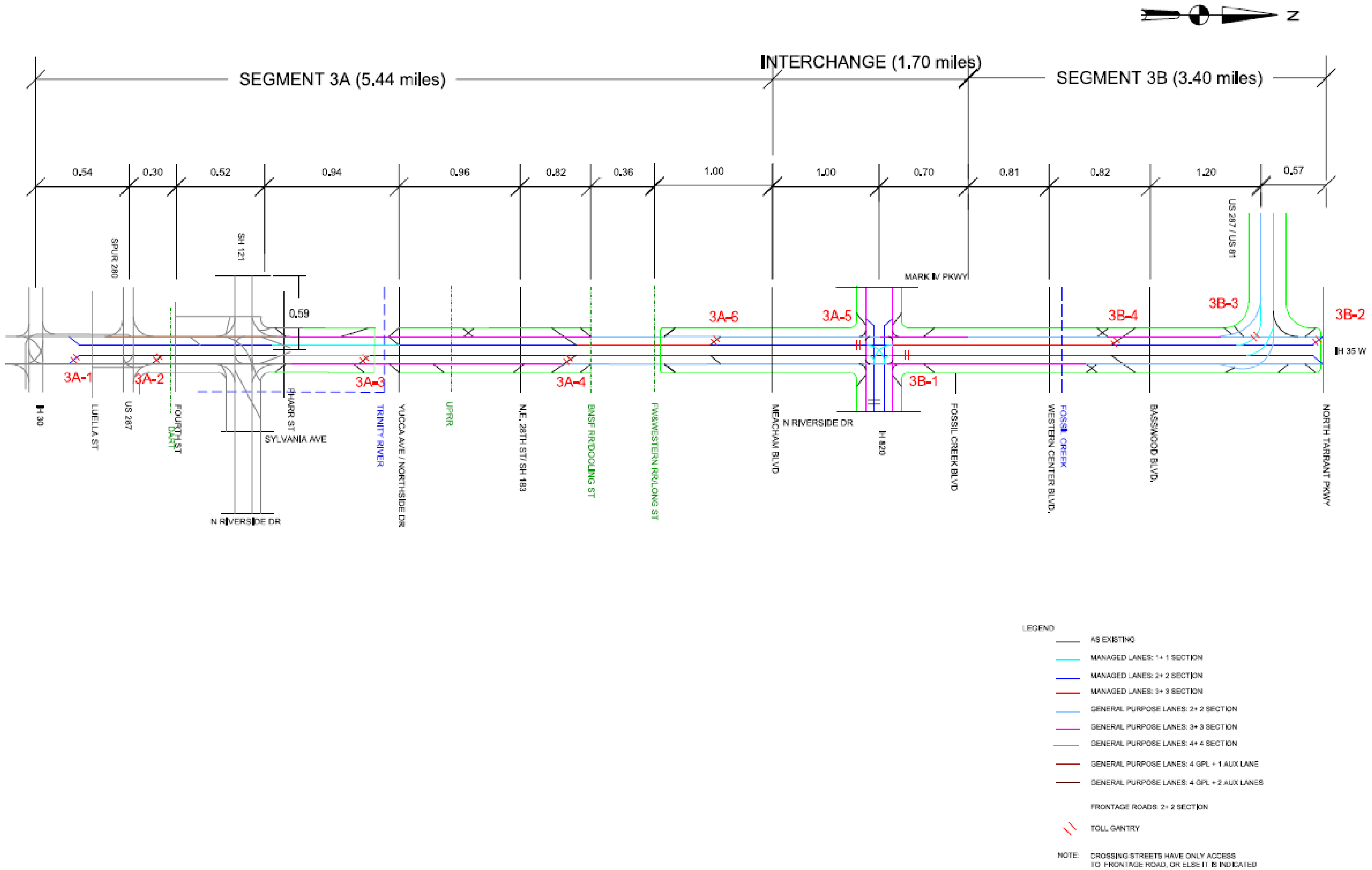


Figure 4-6: Stick Diagram – Segments 3A and 3B – Ultimate Configuration

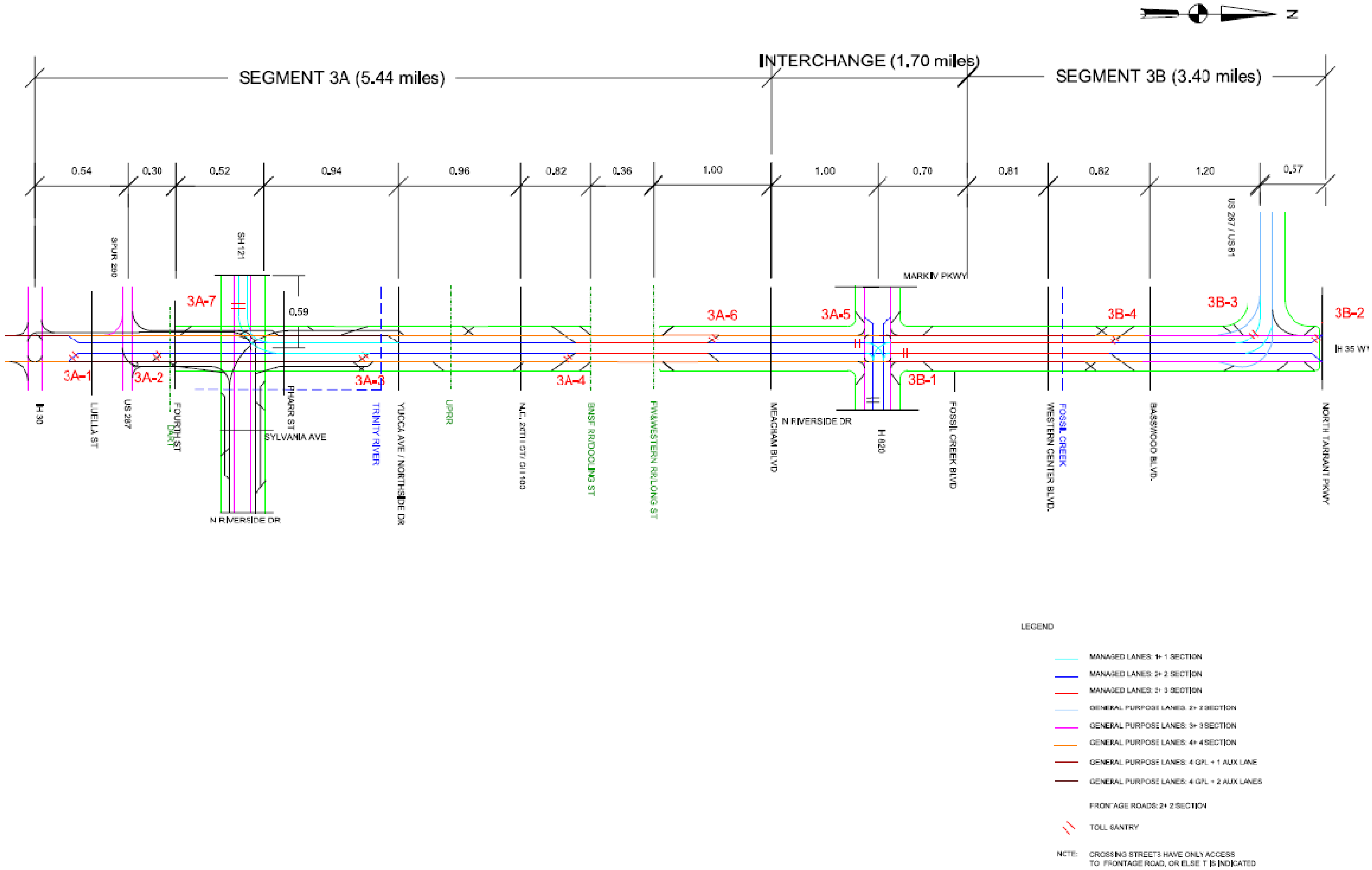


Figure 4-7: Stick Diagram – Segment 3C – Interim Configuration

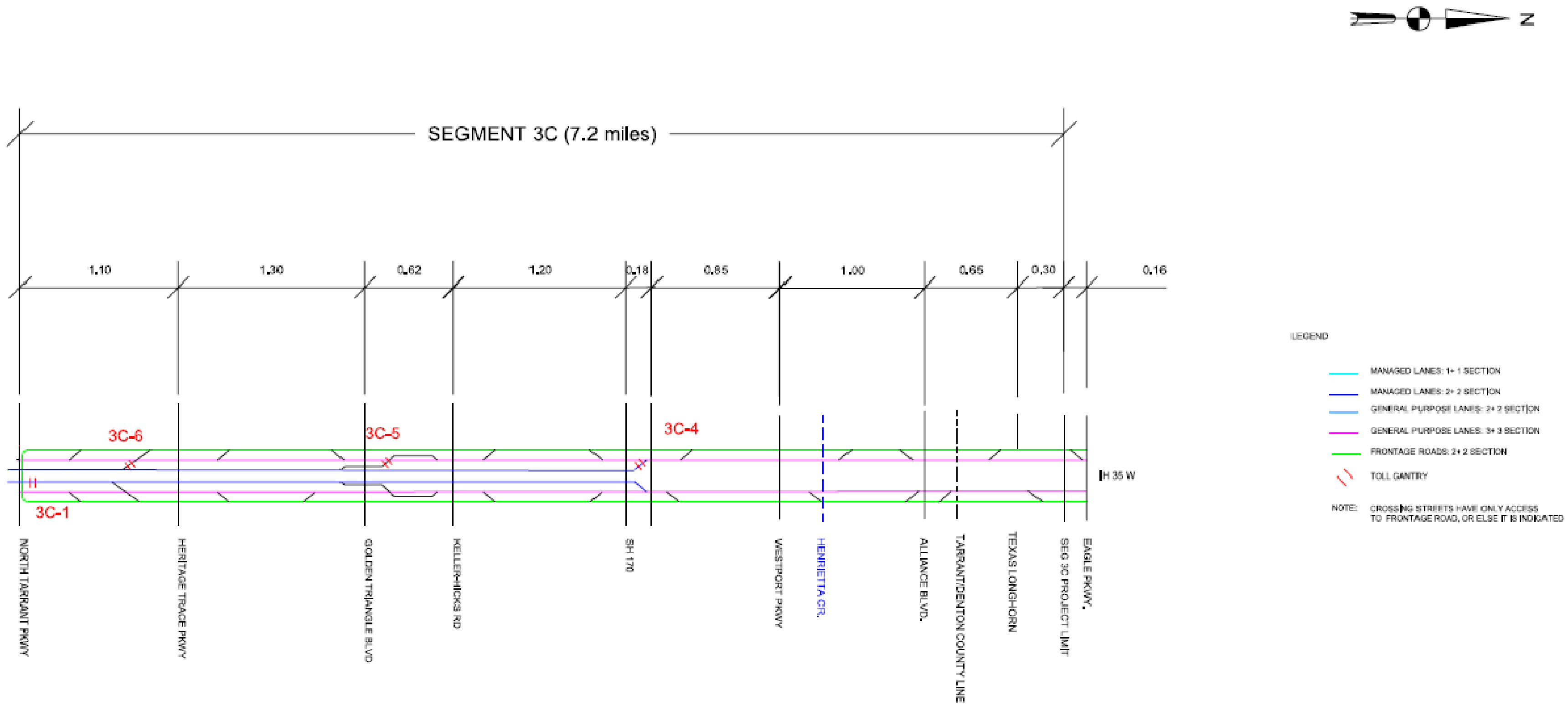


Figure 4-8: Stick Diagram – Segment 3C – Ultimate Configuration

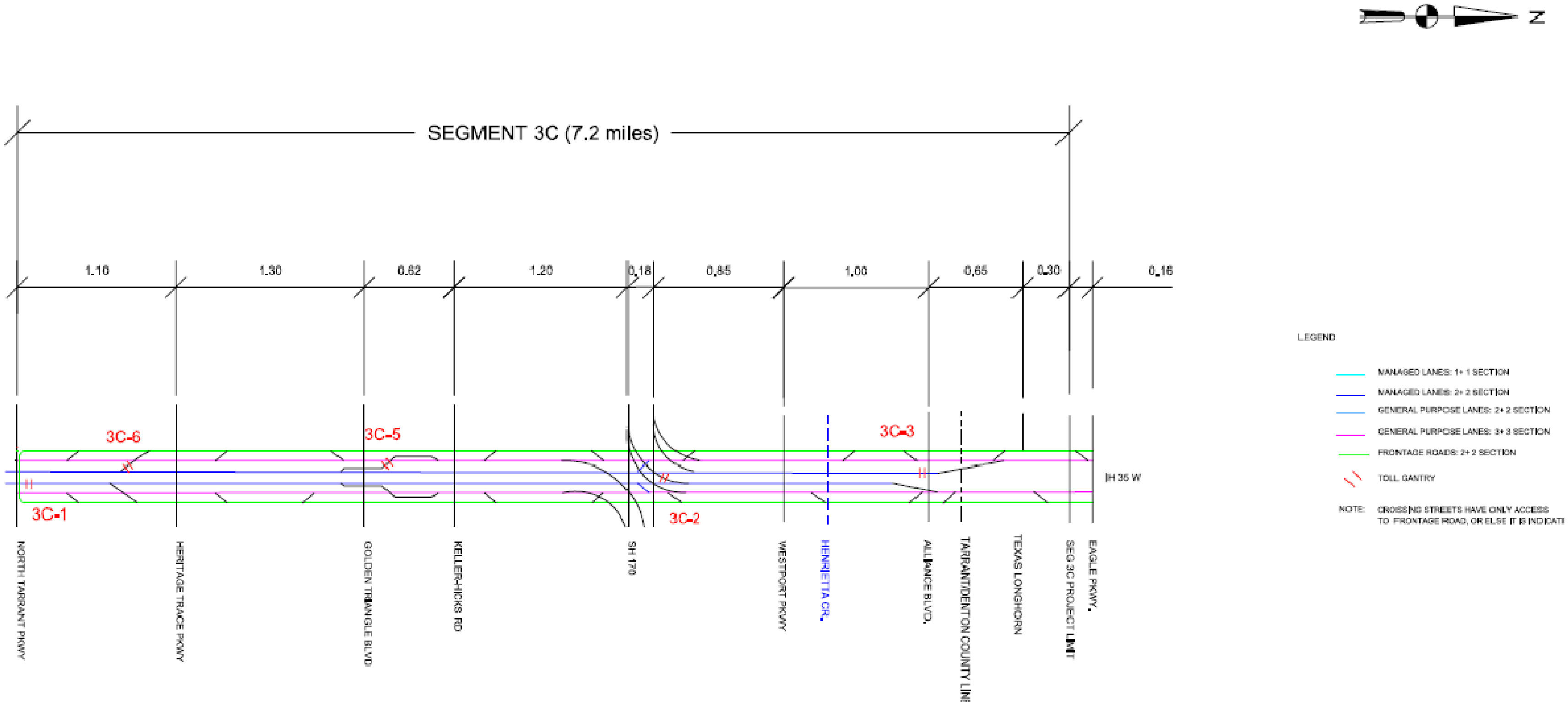


Figure 4-9: Stick Diagram – Segment 4 – Interim Configuration

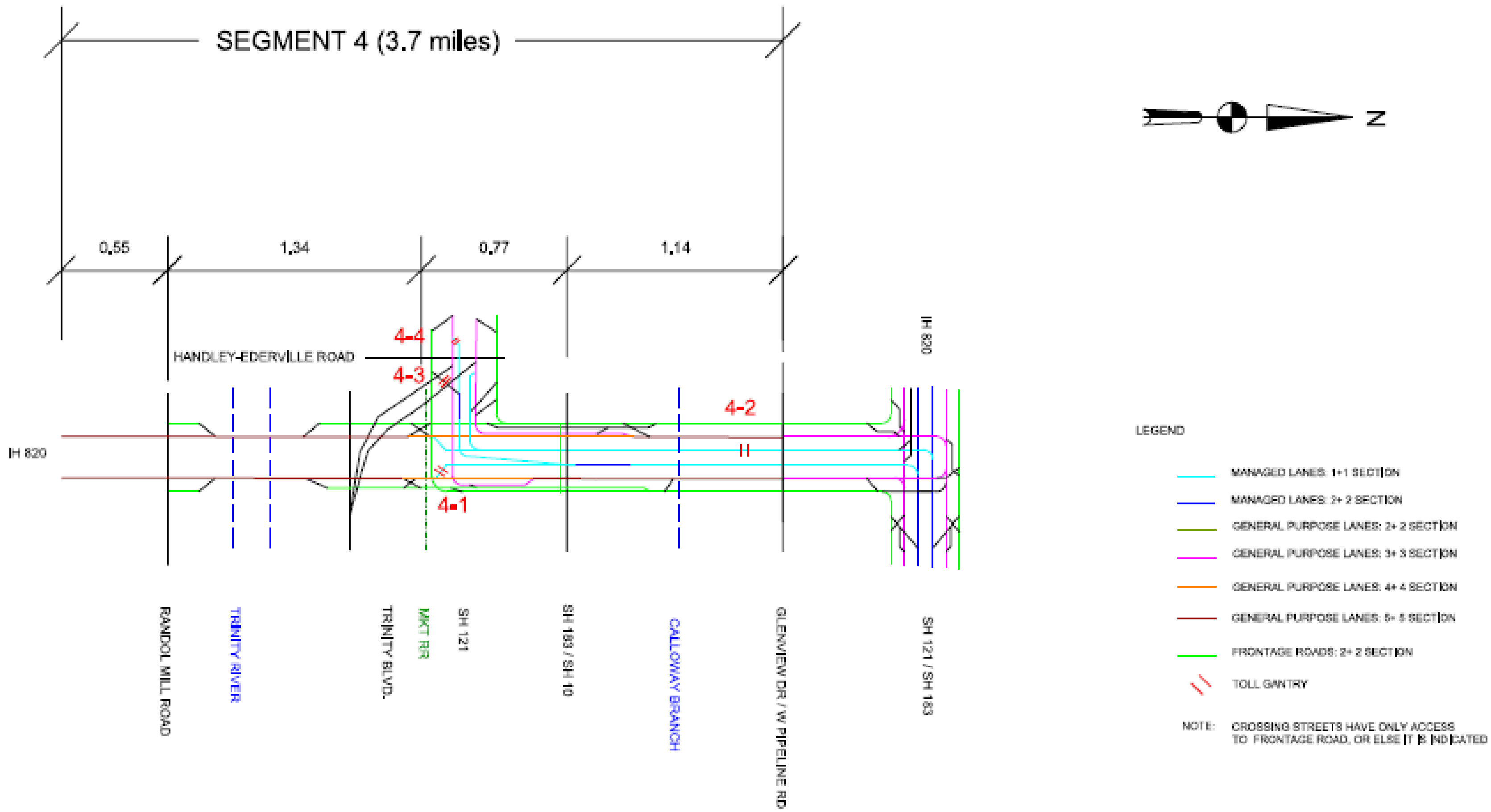


Figure 4-10: Stick Diagram – Segment 4 – Ultimate Configuration