

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

Chapter 10: Revenue Generation, Collection Technology and Plans



© Copyright 2010, NTE Mobility Partners Segments 2-4, LLC


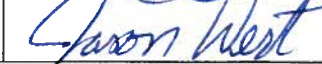
Revision:	0	Revisions	
Effective Date:	12/06/10	Number	Date
Prepared by	NTE Mobility Partners Segments 2-4, LLC	0	12/06/10
Reviewed by			
Approved by			



Table of Contents

10.1.	Tolling Operations	1
10.2.	Tolling Point Devices.....	2
10.3.	Advanced Dynamic Toll Rate Signs (ADTRS).....	4
10.4.	Control Facility	5
10.5.	Transaction Processing.....	5
10.6.	Dynamic Pricing	11
10.7.	Interface to CSC.....	11
10.8.	Control Facility Hardware	12
10.9.	Communications	13
10.10.	The Limits of Proposed Toll Segments	14
10.11.	Locations of Toll Zones and Declaration Lanes	15
10.12.	Enforcement.....	17
10.13.	Performance and Measurement of the Managed Lanes	18
10.14.	Dynamic Toll Rate Process	21
10.15.	Interoperability with Existing and Future Facilities and Transportation Infrastructure	23

List of Figures

Figure 10-1:	Typical Equipment and Wiring Layout.....	4
Figure 10-2:	Toll Zone Transaction Flow Diagram	7
Figure 10-3:	CSC Host Transaction Flow Diagram	10
Figure 10-4:	ETCS Equipment Locations and Communication Interconnects.....	14
Figure 10-5:	Typical HOV Declaration Lane and Enforcement / Maintenance Parking Area.....	18
Figure 10-6:	Segment 2E Stick Diagram – Interim Configuration.....	25
Figure 10-7:	Segment 2E Stick Diagram – Ultimate Configuration.....	26
Figure 10-8:	Stick Diagram – Segments 3A and 3B – Interim Configuration.....	27
Figure 10-9:	Stick Diagram – Segments 3A and 3B – Ultimate Configuration.....	28
Figure 10-10:	Stick Diagram – Segment 3C – Interim Configuration.....	29
Figure 10-11:	Stick Diagram – Segment 3C – Ultimate Configuration	30
Figure 10-12:	Stick Diagram – Segment 4 – Interim Configuration	31
Figure 10-13:	Stick Diagram – Segment 4 – Ultimate Configuration	32



Chapter 10: Revenue Generation,
Collection Technology and Plans

List of Tables

Table 10-1: Limits of Proposed Toll Segments.....	15
Table 10-2: Proposed Locations of Toll Gantries	16
Table 10-3: Size/Occupancy-Based Classification.....	22
Table 10-4: Demand Factors.....	23



10. Revenue Generation, Collection Technology and Plans

10.1. Tolling Operations

The toll collection system on NTE Segments 2-4 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 be based on the vehicle classification and the Toll Zones will not be designed or equipped to accept cash.

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 the standards set for Segments 2-4.

There will be a Toll Zone at every entry to each Segment, as described in Section 10.11 of this document. Each Toll Zone will have at least two lanes and one full shoulder wide enough for a maintenance or enforcement vehicle to safely park and work on the equipment or observe traffic. Additionally, one toll lane at every Toll Zone will be identified as the HOV declaration lane. For an HOV to receive the discounted toll rate they must pass through the HOV declaration lane.

The toll setting mechanism will be dynamic and based on traffic volumes and speeds on the roadway following the spirit of the requirements established in Exhibit 4 to the CDA of NTE for Segments 1 and 2 for dynamic tolling. These comprise changing the tolls as needed but no more often than every five minutes, maintaining a minimum speed of 50 mph and a maintaining a certain maximum traffic volume on the Managed Lanes among others.

10.2. Tolling Point Devices

Components in the ETCS located at the Toll Zones will include:

- 1) **Redundant Toll Zone Controllers** that will record all transactions and forward them to the Host Servers at least once daily or when requested by a Host Server to do so. The Toll Zone Controllers will also have redundant data storage units that will be sized to hold a minimum of 30 days of Transactions for all vehicles traveling through the Toll Zone in the event that communications between the Zone Controllers and Host Servers is lost.
- 2) **Automatic Vehicle Identification (AVI) System** Antennas and Readers integrated into the Zone Controllers for each Toll Zone for identifying and reading all Toll Tags issued by tolling authorities sanctioned by TxDOT.
- 3) **A Video Tolling Video Exception System (VES)** with front and rear license plate cameras with non-obtrusive supplemental lighting and image capture computers that are connected to, and integrated into, the Toll Zone Controllers. The VES will capture multiple images of the front and rear of all vehicles traveling through the Toll Zone. Transaction files will contain the captured digitized front and rear images and digitized text of both the license plate and jurisdiction of issue for all humanly readable license plates.
- 4) A height-, width- and length-based **Vehicle Classification System** with an interface controller that is connected to, and integrated into, the Toll Zone Controllers. The ETCS will use the Vehicle Classification System to determine the applicable toll factor.
- 5) **Speed detectors** that monitor and record vehicle speeds in the Managed Lanes will be used so the Toll Rates in effect on the Managed Lanes can be adjusted based on average speeds in the Managed Lanes.
- 6) The capability and functionality to add and integrate a **Human Occupancy Vehicle Detection System (HOVDS)** into the ETCS to reliably and accurately determine the number of human occupants in each vehicle in the future. Currently these systems are in development and to date, have not been proven accurate or reliable enough for use in an ETCS.
- 7) **Toll Rate Schedules** for each Toll Zone can be generated in two modes, a mandatory pre-defined Schedule mode and an optional dynamic mode. The Schedule mode is mandatory and relies upon pre-defined rate tables

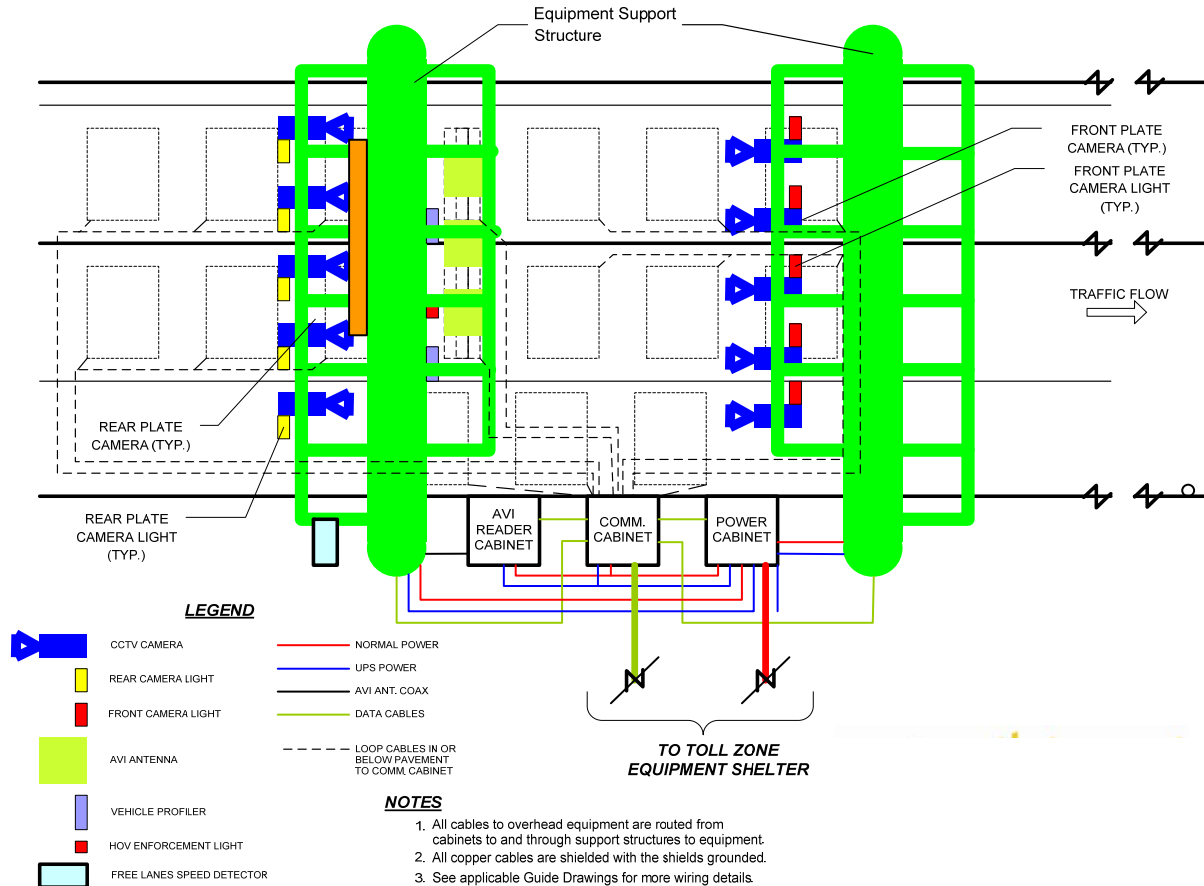
Chapter 10: Revenue Generation,
Collection Technology and Plans

that can be based upon time of day, day of week, holidays, etc. The dynamic mode will use the pre-defined schedule mode tables as a base and dynamically change the toll rate schedule based upon conditions on the roadway. For example, declared emergencies or average vehicle speeds can factor into the dynamic toll adjustments.

- 8) **Toll equipment and support structures** for each toll zone with dedicated utility and personnel access-ways to allow safe and secure access to all overhead components for service, maintenance and replacement without closing the roadway will be a part of the ETCS.
- 9) **Advanced Dynamic Toll Rate Signs (ADTRS)** will be located in advance of all Toll Zone entrances where patrons will have the choice of whether or not to pay the current toll rate advertised in order to use the managed lanes. The ADTRS will be integrated into the overall ETCS to display the current applicable Toll Rates in effect for using the Managed Lanes and/or traveling through the Toll Zone.
- 10) Environmentally controlled, properly grounded **equipment cabinets and/or equipment shelters** with Normal Power and UPS Power backed up with natural gas or diesel generators with automatic transfer switches will be a part of the ETCS.
- 11) **A Maintenance Operations Management System (MOMS)** that continually monitors the ETCS individual components performance and operations and automatically alerts a maintenance technician when a component fails or is about to fail so that the component can be replaced as soon as possible. The MOMS will also maintain an inventory of all ETCS parts, and suppliers of those parts, separated by parts installed in the system and parts in the maintenance inventory. When the quantity of a part in the maintenance inventory reaches a user-defined low level for that part, the MOMS will automatically generate a purchase order to the supplier for a user-defined number of that part. The purchase order then has to be signed by authorized personnel and transmitted to the part supplier for the inventory to be replenished. Additionally, the MOMS will be integrated with an Access Control and Alarm Monitoring System for each Toll Zone and will automatically notify and dispatch the user defined appropriate personnel when there is an unauthorized access or alarm at a Toll Zone.
- 12) **An Access Control and Alarm Monitoring System (ACAMS)** will be installed and integrated into the MOMS at each Toll Zone. The ACAMS will include digital CCTV cameras and a Controller with the ability to store CCTV evidence video.

Figure 10-1 is a high-level block diagram that illustrates the equipment layout and wiring at a typical two lane Toll Zone with a single shoulder.

Figure 10-1: Typical Equipment and Wiring Layout



10.3. Advanced Dynamic Toll Rate Signs (ADTRS)

The ETCS will have Advanced Dynamic Toll Rate Signs (ADTRS) that will be located in advance of all Toll Zones entrances.

In general the ADTRS will be placed one quarter (1/4) of a mile before the start of the gore at an entrance ramp to the managed lanes in accordance with AASTHO guidelines regarding human decision making at highway speeds. Placement of ADTRS on frontage roads will depend upon ramp distance from an intersection and may be placed closer than one quarter mile before the start of a gore, because vehicles will be traveling at slower speeds and intersection layouts vary.

All ADTRS will be integrated into the ETCS to display the current applicable Toll Rates in effect for using the Managed Lanes and/or traveling through the Toll Zone. All ADTRS will be NTCIP compliant, commercially available programmable DMS signs. The ADTRS Controllers will be integrated into the ETCS Zone Controllers and the ETCS Zone Controllers will send to the ADTRS Controllers the current Toll Rate that is to be displayed by the ADTRS. This will occur every time the ETCS changes the Toll Rate and the ADTRS will display the current applicable toll rate. As contractually obligated, the ADTRS will display the toll of the Toll Segment to be entered and a maximum of three Toll Segments. The ETCS Zone Controller will also be integrated into the ITS such that the ITS will be able to post current video toll rates for the tolled lanes on a website to advise motorists of traffic conditions as discussed in further detail within Section 10.14.1.

10.4. Control Facility

The ETCS Control Facility and its redundant backup site. The ETCS Control Facility is the location connected to all Toll Zones and is connected to the CSC. The ETCS Control Facility will receive, validate and format data from the Toll Zones, and transmit and receive transaction and tag files to and from the CSC in accordance with the ICD. The ETCS Control Facility will also Host and Control the ETCS MOMS which includes an Access Control and Alarm Monitoring System. The ETCS Control Facility and its backup site will be the stationary locations where transaction auditing, system performance auditing, maintenance, and required service operations can be performed. Authorized users will be able to print user-configurable reports for the ETCS and/or any of its components.

10.5. Transaction Processing

Initial transaction creation will be done at the Toll Zone by the Zone Controller. The Zone Controller will create and process toll transaction records as follows:

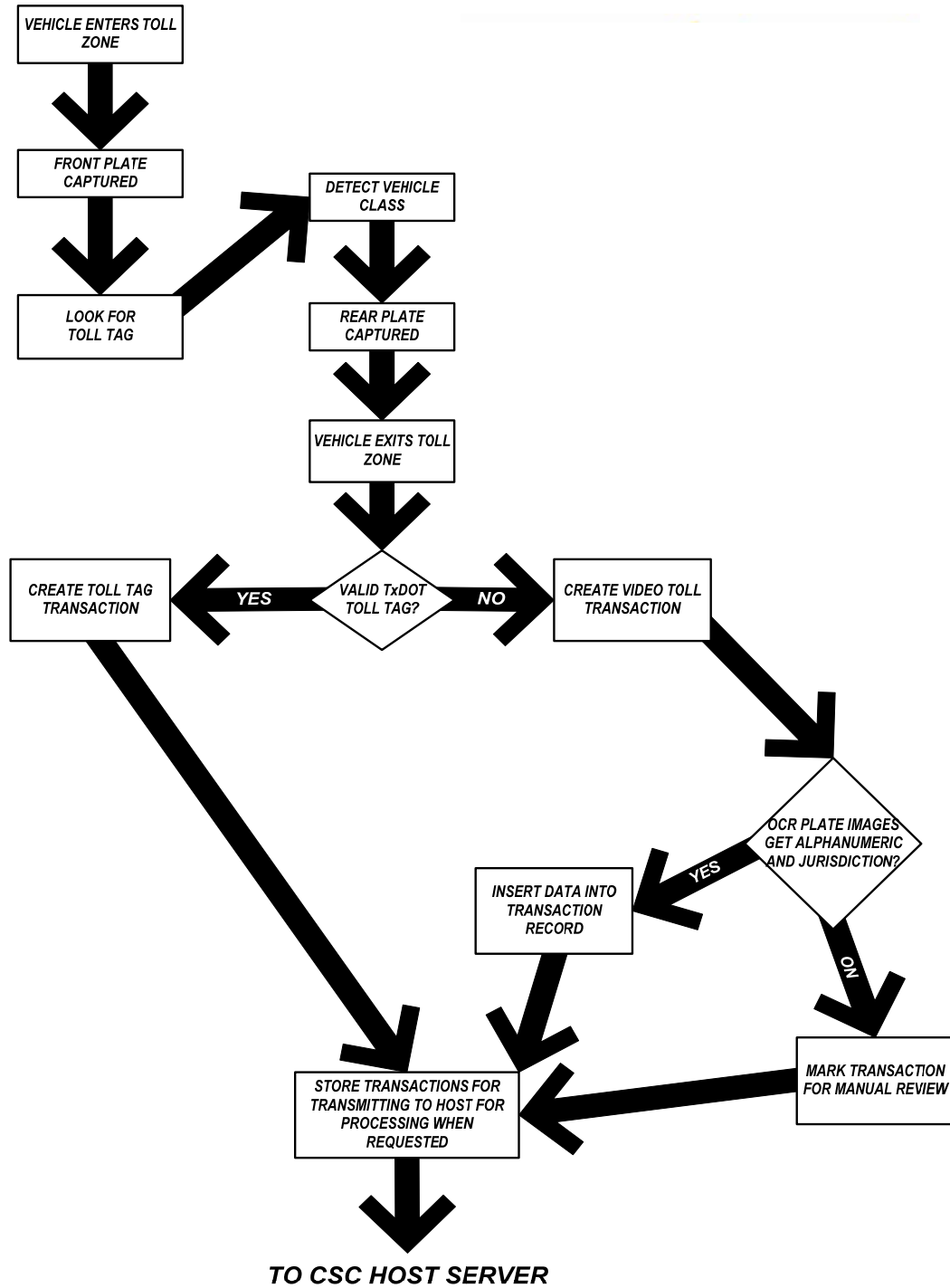
1. When a vehicle enters the toll zone, a transaction record will be opened and images of the front license plate will be captured and linked to the record.
2. As the vehicle continues through the toll zone the ETCS will determine if the vehicle has a transponder or not and add this information to the transaction record for the vehicle.
3. As the vehicle exits the toll zone, images of the rear license plate will be captured and linked to the transaction record.
4. After the vehicle has left the toll zone the Toll Zone Controller will:
 - a) If the transaction record does not contain a transponder, mark it as a Video Toll Transaction.

Chapter 10: Revenue Generation,
Collection Technology and Plans

- b) Determine whether the transponder detected is valid, if it is mark the record as a transponder transaction, and if it is not mark the record as a video transaction.
- c) Assign the applicable toll rate to the transaction based on the detected vehicle classification.
- d) Process the license plate images with Optical Character Recognition software and if possible extract out the license plates alphanumeric characters and jurisdiction of issue and insert this data into the vehicle transaction record. This functionality may be transferred to the ETCS Host for efficiency.
- e) For a Video Toll transaction, determine if the appropriate license plate data is contained in the transaction and if it is not mark the transaction for manual review.
- f) Store the transaction for transmission to the ETCS Host.

Figure 10-2 illustrates how transactions are formed and processed at the Toll Zones.

Figure 10-2: Toll Zone Transaction Flow Diagram



Secondary transaction processing will be done at the ETCS Control Facility. All transactions from the Toll Zones will be reviewed and processed by the ETCS Host Server as follows:

- The ETCS Host will request the toll zone controllers to transmit transaction records to it during user definable times throughout the day. The ETCS Host will process the transactions as follows:
 - All valid non-revenue transponder transactions not marked as unusual occurrences will be sent to storage and not transmitted for payment processing.
 - All remaining transponder transactions not marked as unusual occurrences will be automatically reviewed to ensure that they are in the correct format and contain all information required. They will be automatically reviewed to determine if the user self declared as an HOV user, if so the applicable discounted toll rate will be applied and a copy of the transaction will be sent to storage and transmitted for payment processing. If a transponder transaction is not in the correct format or does not contain all required information it will be marked for Audit review and must be reviewed and adjusted to be in the correct format and contain all required information before a copy is sent to storage and it is forwarded for payment processing.
 - All transponder transactions marked as unusual occurrences will be manually reviewed and adjusted, if necessary, before they are forwarded to the North Texas Tollway Authority (NTTA) for processing and payment. The manual review will include using the license plate images and adjustment of the toll rate if necessary.
 - All Video Transactions that are not marked for manual review will be automatically reviewed to ensure that they are in the correct format and contain all information as required by the Interface Control Document (ICD). If they contain all required information, the license plate data in the transactions will be compared to the license plate data of valid TxDOT Toll Tag accounts. If a Video Transactions license plate data matches the license plate data of a valid transponder account (This list is supplied to the developer from the CSC) then that transaction will be marked and converted to a valid transponder transaction before being sent to storage and payment processing. For all other valid Video Toll Transactions that are not valid transponder accounts a copy of the Video Toll Transaction will be sent to storage and the transaction will be forwarded for processing and payment. If a Video Toll Transaction that is not marked for manual review is found to be in an incorrect

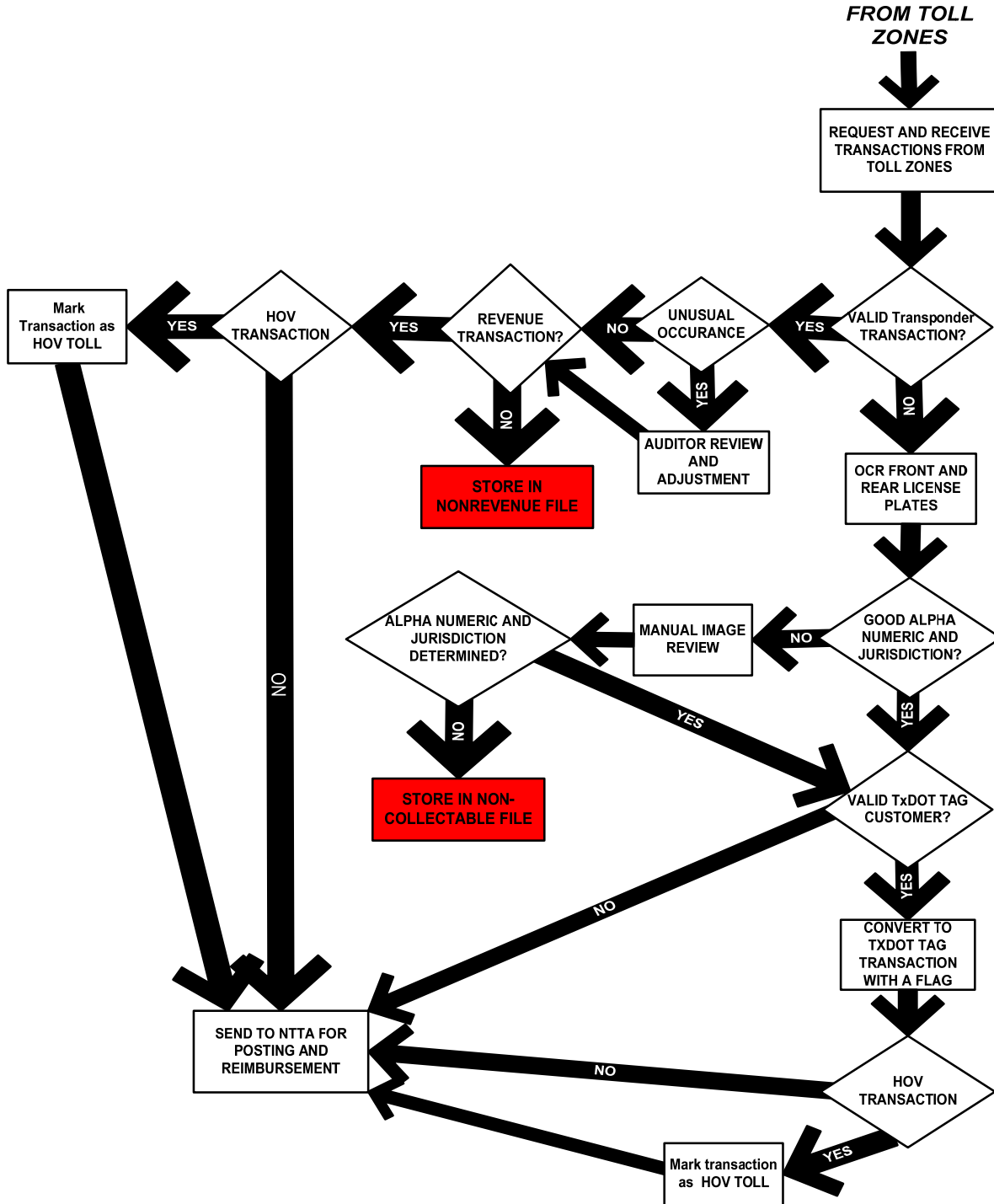
Chapter 10: Revenue Generation,
Collection Technology and Plans

format, or does not contain all of the required information, it will be marked for Audit review. The transaction must be reviewed and adjusted to be in the correct format and contain all required information before a copy is sent to storage and forwarded for processing and payment.

- All Video Toll Transactions that are marked for manual review will be manually reviewed using the license plate images to, if possible, determine the correct license plate alphanumeric characters and issuing jurisdiction. If this information can be visually obtained, it will be input into the Video Toll Transaction, a copy of the transaction will be sent to storage, and the transaction will be forwarded for processing and payment. If this information cannot be determined, the transaction will be marked as a non-collectable transaction and sent to storage.

Figure 10-3 illustrates how transactions are processed by the Host at the Control Facility.

Figure 10-3: CSC Host Transaction Flow Diagram



Chapter 10: Revenue Generation, Collection Technology and Plans

The Customer Service Center (CSC) and Back Office Operations will receive and process all revenue transactions in accordance with the ICD and the Tolling Services Agreement. Services provided by the Tolling Services Agreement include:

- Utilizing and making available existing CSC and handling customer inquiries and complaints.
- Providing account management and other Back Office services.
- Posting Toll Tag Transactions to customer accounts.
- Providing interoperability functions.
- Processing Video Transactions.
- Providing toll collection enforcement services, which shall include transmittal of violation notices, collection efforts (this may include utilization of a third party collection agency) and other actions permitted by applicable Law (including court action) and in accordance with the Performance Standards and the practices and procedures that the CSC follows in respect of its own facilities.
- Making payments to the developer for Video Transactions and Toll Tag Transactions
- All services provided by the CSC shall be in accordance with the Toll Services Agreement between the CSC and the Developer.

10.6. Dynamic Pricing

Dynamic pricing will be implemented where the Tolls on the Managed Lanes can be changed dynamically, based on the average traffic volumes and speeds on the roadway.

Detectors will be integrated into the ETCS that will determine the average traffic volumes and speeds on the roadway, and automatically establish the applicable tolls for each segment and direction based on this data. The procedure whereby tolls are changed dynamically will follow the criteria and performance standards established in Exhibit 4 to the CDA of Segments 1 and 2 for dynamic mode.

10.7. Interface to CSC

All file transfers and communications between the ETCS Host Servers and the CSC Host will be in accordance with the Interface Control Document.

The ETCS Host – to/from – CSC Host Interface will include the following file transfers:

Note: All files exchanged between the CSC and the ETCS Host shall be accomplished using File Transfer Protocol (FTP). All FTP servers will be password protected, and usernames and passwords will be shared at a mutually agreed time between the parties identified in the final agreement.

- Tag Validation List (TVL) File (Pushed from CSC to the ETCS Host)
- Tag / Plate Association Data File (Pushed from the CSC to the ETCS Host)
- Transaction Files (Pushed from the ETCS Host to the CSC)
- Image Files (Pulled from the ETCS Host by the CSC)

Note: Image files are pulled from the ETCS Host FTP Server as needed.

- Disposition Files (Pushed from the CSC to the ETCS Host)
- Violation Status Files (Pushed from the ETCS Host to the CSC)
- Acknowledgement Files

It is recognized that as technology evolves and systems change the ICD will be updated and revised and that the file formats transferred between the ETCS Host Server and how they are transferred could change. Therefore, the ETCS Host Server software will be designed to anticipate, accommodate, and implement these changes as much as possible without any major modifications.

10.8. Control Facility Hardware

The Control Facility and its backup site will include, at a minimum, the following components:

1. Host Servers with a Storage Area Network (SAN) or similar, sized to handle the configuration and interface with the CSC Host in accordance with the ICD. The Host Servers will receive, validate and format data from the Toll Zones and transmit and receive transaction and tag files to and from the CSC in accordance with the ICD and to and from the Toll Zones when required. The SAN will be connected to the Host Servers and will store online three years worth of all the data processed by the ETCS. Data that is older than 36 months will be automatically archived. Archives may be stored in offline formats.
2. Workstation computers and laptop computers can be connected into the ETCS for Auditing Transactions, Auditing the ETCS Performance, performing maintenance, and required service operations. The number of workstations will be estimated based upon the number of Toll Zones and projected traffic volumes. All workstations will be user configurable by

Chapter 10: Revenue Generation, Collection Technology and Plans

authorized users and sized to do transaction auditing, system performance auditing, and/or maintenance, and required service operations. The number of workstations will be increased as needed.

3. A high-speed backup system properly sized for the system automatically backs up the ETCS at least once daily during periods of low communications network traffic.
4. Industry standard commercially available printers will be part of the Control Facility hardware for printing reports generated by authorized users.

10.9. Communications

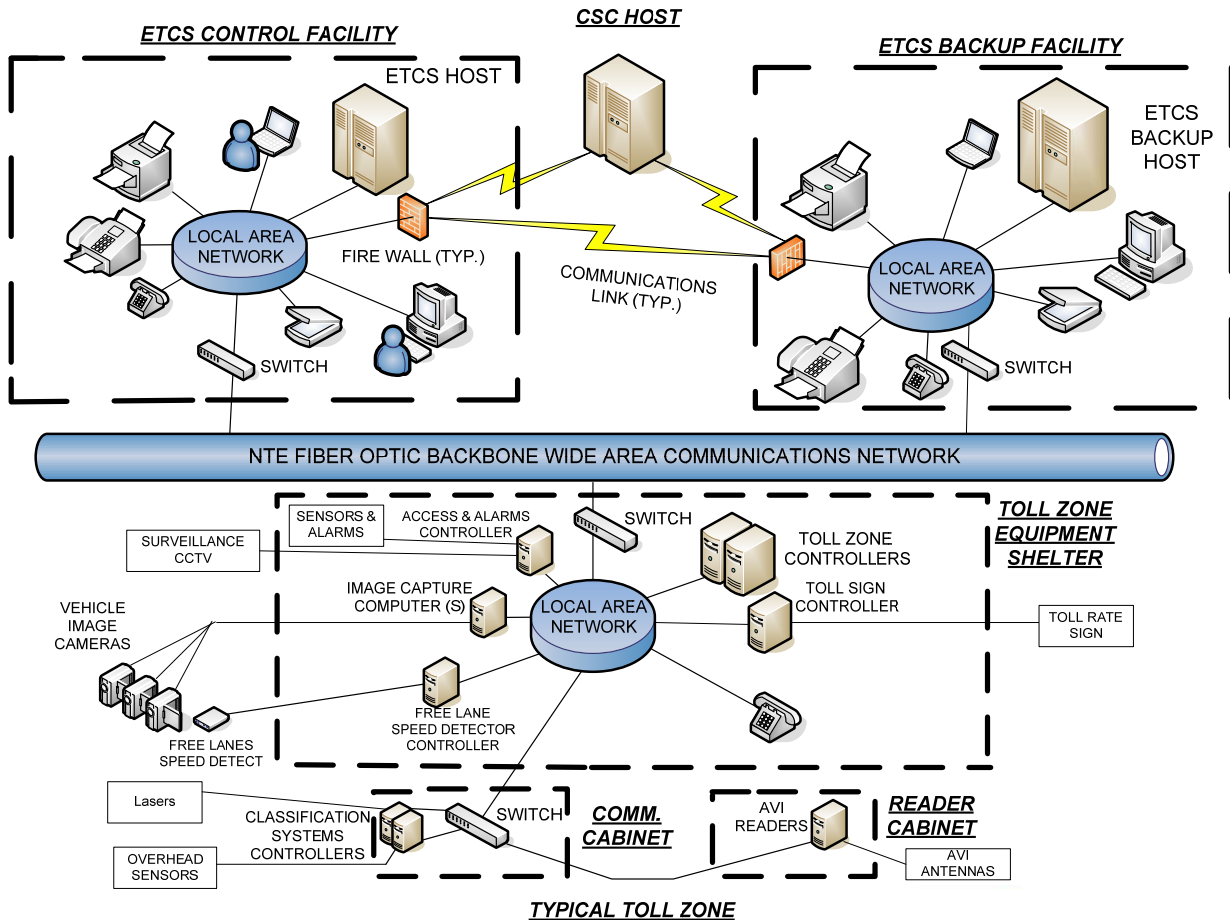
The ETCS Toll Zone Controllers and the Access and Alarm Monitoring System will be connected to the Host Servers located at the Control Facility and the ETCS Backup Host Server at the remote Backup Site.

Communications at the Toll Zones between the Zone Controllers and other components will use standard communication protocols such as RS-232, RS-422, RS-485, and mediums such as fiber optic, copper cables, wirelessly, or a combination of one or more communication mediums.

Communications between the ETCS Host Computers and the CSC Host will be in accordance with the ICD and are anticipated to be on a virtual private network sized to handle all of the estimated data transfers plus 50% to allow for growth.

Figure 10-4 is a high-level block diagram of the ETCS that illustrates the ETCS equipment locations and the communication interconnects between the subsystems.

Figure 10-4: ETCS Equipment Locations and Communication Interconnects



10.10. The Limits of Proposed Toll Segments

The limits of the proposed Toll Segments have been defined geographically based on the original definition of the NTE Segments provided in TxDOT's Request for Proposals for the Project and refined through the schematic design process, which is ongoing. Approximate Toll Segment limits are provided in Table 10-1. The exact Toll Segment limits will be finalized during final design.

Table 10-1: Limits of Proposed Toll Segments

Segment	Road	Configuration	Starting Milepost	Ending Milepost	Total Segment Length (rounded to nearest half-mile)
2E	SH 183	Interim	1313+00	1500+00	3.5
		Ultimate	1313+00	1550+00	4.5
3A	IH 35W	Interim & Ultimate	942+00	615+00	6.0
3B	IH 35W	Interim & Ultimate	615+00	1405+00	4.0
3C	IH 35W	Interim	1143+00	1405+00	5.0
		Ultimate	1063+80	1405+00	6.5
4	SH 121	Interim & Ultimate	337+15	377+70	2.0
	IH 820		790+00	853+50	

10.11. Locations of Toll Zones and Declaration Lanes

The locations of the proposed Toll Gantries and Declaration zones are shown in the stick diagrams provided as Figures 10-6 through 10-13, beginning on page 25 of this document. Table 10-2 provides a brief overview of the tolling point locations. The Segment lengths presented in the stick diagrams are not representative of the interim chargeable lengths, which are shown in Table 10-1 above.

Chapter 10: Revenue Generation,
Collection Technology and Plans

Table 10-2: 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

10.12. Enforcement

An HOV discount can be applied to vehicles that have a valid transponder and declare themselves as HOVs by passing through the designated HOV lanes at the Toll Plazas. The ETCS will assign self-declared HOV vehicles a discounted toll during peak periods of traffic in accordance with Toll Polices, Vehicle Classifications and Toll Rates in effect at the time of the transaction. Transactions will be marked as discounted before the Transaction is sent to the CSC Host Server for processing.

Each Toll Zone on the project will have at least two lanes and one full shoulder wide enough for a maintenance or enforcement vehicle to safely park and work on the equipment or observe traffic. Additionally, one toll lane at every Toll Zone will be identified as the HOV declaration lane and for an HOV to receive the discounted toll rate they must use the HOV declaration lane at the toll zone.

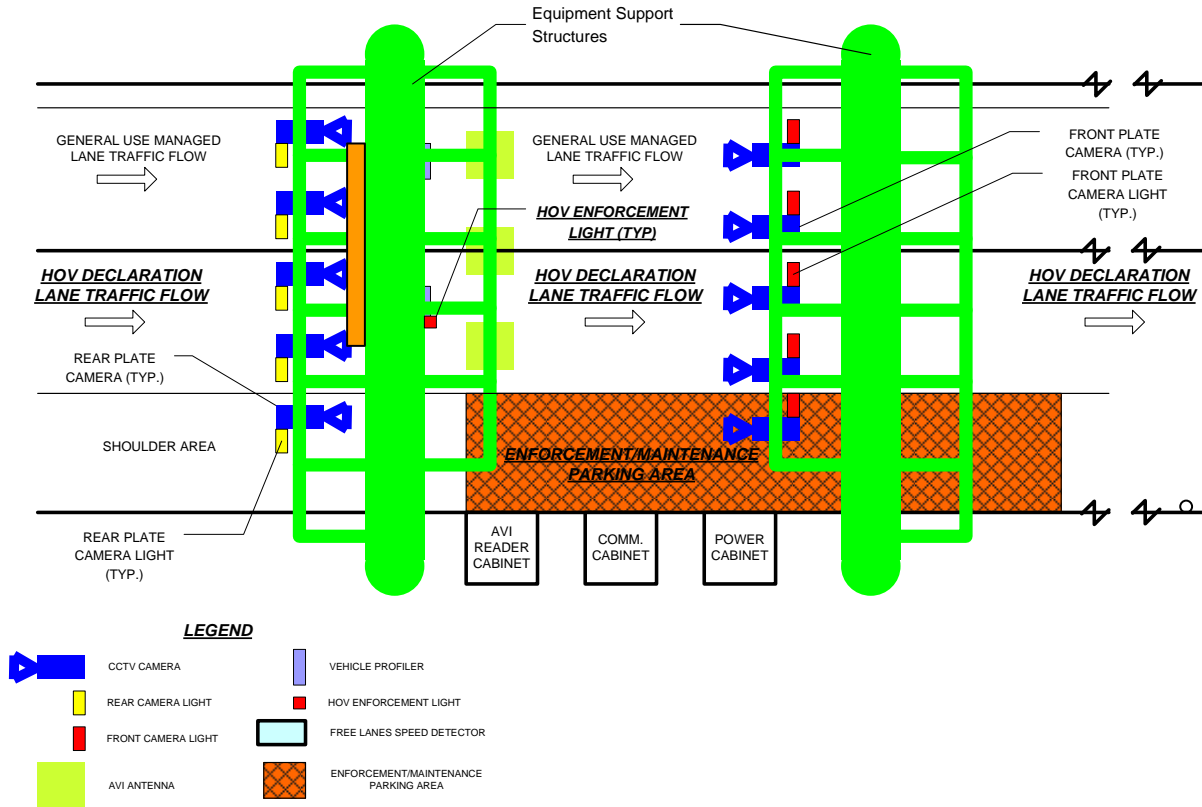
Enforcement signals are installed in each HOV lane, and triggered to turn on when a valid transponder is detected on a passing vehicle. The signal provides a visual flag to a law enforcement officer as to whether the passing vehicle obtained the HOV discount. A visual inspection of the number of vehicle occupants will serve to check whether the vehicle qualifies for the HOV discount.

Enforcement zones are located downstream next to the tolling points. On-site enforcement officers stationed at the enforcement zones visually verify that HOV-declared vehicles have the required number of occupants. The zone provides ready pull-out access if the officer needs to pull over a motorist. Wherever it is not possible to pull over the violator, an officer can note the license plate and radio it to his colleagues on the main-line who shall intercept the violator.

Another HOV enforcement method that will be available is the transmission of the license plates and/or transponder numbers of potential violators to officers who are downstream of the tolling point via Personal Data Assistant (PDA – such as a Palm-Pilot or Blackberry) or through an officer's in-vehicle computer via a secure website. This information can be used by the officer to make an enforcement stop. Once a potential violator is stopped, the law enforcement officer will be able to use a handheld electronic device to determine the vehicle's most recent toll transaction.

Figure 10-5 is a plan view of a typical two lane Toll Zone that illustrates the locations of the HOV declaration lane and enforcement/maintenance parking area.

Figure 10-5: Typical HOV Declaration Lane and Enforcement / Maintenance Parking Area



NOTES

1. Portion of equipment support structures and pavement sensors not shown for clarity.

10.13. Performance and Measurement of the Managed Lanes

Radar Traffic Management Sensors (RTMS's) to monitor and record near real time speeds and traffic volumes in the managed lanes shall be integrated into the ETCS. Using the data from the RTMS's and transaction data from the toll zones the ETCS Host will prepare and submit the following reports:

Weekly reports summarizing:

- The Average Speeds during all time periods where the Average Speed for each Toll Segment was below 50 mph (e.g., Tuesday, 10:14 a.m. to 10:40 a.m. — To Segment 2 — Avg. 48 mph);
- The reason any Average Speeds were below 50 mph (e.g., Incident in Managed Lanes — Stalled Car); and

Chapter 10: Revenue Generation,
Collection Technology and Plans

- Any corrective action taken to raise Average Speeds (e.g., responded to incident and instituted lane recovery procedures within response parameters).

Monthly reports that include:

- traffic volume, classification, Average Speeds, Average Volumes, HOV and average toll data for each Managed Lane every half mile, for each Toll Segment and each direction, including at each entry and exit point to the Managed Lanes, averaged once a minute for each Segment and each direction;
- for each valid transponder tag account holder that declares (or is otherwise identified) as an HOV or Motorcycle during Peak Periods during the HOV Discount Period, the date, time and amount of the undiscounted toll and a unique transaction identifier; and
- the total HOV discount for the month that is potentially eligible for reimbursement to Developer.

The ETCS storage network shall be sized to retain data for a minimum of five years to facilitate periodic auditing purposes. Outdated material shall be disposed of no earlier than December 31 of the year where there is a complete and full record of the preceding five years worth of data. After three years the data may be archived off the system onto an electronic medium and saved for the legally required amount of time after which, it will be permanently destroyed.

The ETCS shall monitor average volumes in the Managed Lanes for each Toll Segment for compliance when Base Toll Rate increases are above the Base Toll Rate Cap as follows:

- On a monthly basis, the ETCS shall measure and report on the following data:
 - Toll Segment traffic volume
 - Vehicle classification
 - Average speeds
 - Average HOV volumes
 - Average toll data
- The above data will be collected for each Managed Lane, for each direction including at each entry point to the Managed Lanes in such a manner that the speed and number of measurements correspond to a volume in total vehicles and passenger car equivalents, per hour, per lane, averaged once a minute.

The ETCS shall prepare and deliver a weekly report for each Toll Segment:

- Summarizing any and all time periods where the speeds were above 50 mph, the Base Toll Rate was at or above the Base Toll Rate Cap and the volume thresholds were exceeded;
- Summarizing volumes in passenger car equivalents per hour per lane of Segments 10 minutes prior to, during and 10 minutes after implementation of a Base Toll Rate above the Base Toll Rate Cap;
- Documenting that the Base Toll Rate Cap was exceeded because Average Volumes Increased or Average Speeds decreased in accordance with the CDA; and
- Documenting that the Base Toll Rate was reduced to values below the Base Toll Rate Cap as Average Volumes decreased or Average Speeds increased.

The ETCS shall maintain Average Speeds in the Managed Lanes of each Segment at or above 50 mph.

The ETCS shall be excused from the Developer's obligation to maintain average speeds in the Managed Lanes at or above 50 mph only if such failure is caused by events that are beyond the Developer's control and are not due to any act, omission, negligence, recklessness, willful misconduct, breach of contract or Law, or violation of a Governmental Approval of any of the Developer-Related Entities, upon providing to TxDOT adequate written evidence thereof. Examples of events that are beyond Developer's control include:

1. An Incident (beyond the control of any Developer-Related Entity) within the Managed Lanes or General Purpose Lanes that is responded to by Developer and measures instituted by Developer to clear the Incident and return lane availability as required under the Incident Management Plan. Documentation of corrective action include ITS still photos and video with time stamps, Courtesy Patrol/Motorist Assistance or Operations Manager records, auditable data records provided from automated ITS dispatch records.
2. An Incident (beyond the control of any Developer-Related Entity) within the Managed Lanes or General Purpose Lanes that is responded to by authorized emergency vehicles, as defined in Section 541.201, Transportation Code. Documentation of corrective action include Official Police Reports showing dates and times dispatched, time arrived, time cleared.
3. Incidents or recurring congestion (beyond the control of any Developer-Related Entity) adjacent to the Project outside the limits of responsibility of

- the Developer. Documentation of corrective action will include ITS still photos and video with time/date stamps.
4. Severe/Inclement weather. Documentation of corrective action will include ITS still photos and video with time/date stamps, Weather Radar Snapshots with time/date stamps, vehicle volumes, etc.
 5. The roadway is declared as an evacuation route.

If at any time the posted speed limit on any portion of the Managed Lanes is less than 60 mph, then (a) the Average Speeds requirement for such portion of the Managed Lanes shall be reduced to the posted speed limit minus 10 mph and (b) the corresponding Noncompliance Point thresholds will each be reduced by the amount of the reduction to the Average Speeds.

The ETCS which is integrated into the Traffic Management Center will automatically generate, print and distribute electronically to, operator defined, authorized recipients, standard audit reports. Additionally, the ETCS will have a report generator that will allow additional and/or custom reports to be created, generated and distributed by trained authorized operators using a user friendly Graphical User Interface (GUI) at anytime a custom report or an additional report is needed.

10.14. Dynamic Toll Rate Process

10.14.1. Tolling Regulation

The tolling setting mechanisms for the dynamic tolling of segments 3A and 3B has been assumed to follow the performance criteria set out by the Texas Department of Transportation, for the North Tarrant Express for Segments 1 and 2, CDA Exhibit 4, for dynamic mode.

Tolls are changed on the Managed Lanes, as needed but not more often than every five minutes, for the use of each Toll Segment as defined in Section 10.10 of this document.

Toll Factor

A Toll Factor is used to assign a greater toll to vehicles larger than standard cars and a lower toll to motorcycles and high occupancy vehicles (HOV). The tables below outline the maximum Toll Factors allowable for each user classification. Vehicles will be classified by size and the initial Maximum Toll Factors outlined in Table 10-3. Classification definitions (sizes) can be found in Exhibit 4 to the CDA for Segments 1 and 2.

Table 10-3: Size/Occupancy-Based Classification

User Classification	Maximum Toll Factor
Exempt Vehicles	0.0
HOV and Motorcycles	Discount Factor/1.0
Single Occupancy Vehicles (SOV)	1.0
Automobiles with one trailer	2.0
Large trucks	3.0
Large trucks with one trailer	4.0
Large trucks with more than one trailer	5.0

If the developer identifies the need to modify these factors, it will seek approval from TxDOT prior to the change. The Discount Factor for HOV and Motorcycles will be determined by TxDOT.

Base Toll Rate Cap

The ‘Base Toll Rate Cap’ will initially be \$0.75 per mile per Toll Segment per direction and shall be adjusted annually every year, beginning January 1, 2010, by a percentage increase in the CPI between the CPU for the second to last December before the date of the increase and the CPI for the last December before the date of the increase¹.

The managed lanes will be operated in **Dynamic Mode**. The Toll Schedule no longer applies and tolls can change as often as needed but no more frequently than once every five minutes.

The Base Toll Rate can be higher than the Base Toll Rate Cap but if so it must then be adjusted using the rules defined in Exhibit 4 to the CDA for Segments 1 and 2.

If the average vehicle volume or average speed is at a level that requires a change in the Base Toll Rate over the Toll Rate Cap, this is achieved by multiplying the existing Base Toll Rate by a “Demand Factor”. The Demand Factor depends on the amount by which the average vehicle volume change is equal to or greater than the lower bound and less than the upper bound as outlined in Table 10-4.

¹ Consumer Price Index or CPI means the Consumer Price Index for All Urban Consumers (CPI-U), All City Average, All Items, as published by the United States Department of Labor, /bureau of Labor Statistics, for which the base year is 1982-84 = 100, or if such publication ceases to be in existence, a comparable index selected by TxDOT and approved by the Developer, acting reasonably.

Table 10-4: Demand Factors

Change in Traffic Volume (lower and upper bound)	Decreasing Demand	Increasing Demand
Between 0 and 50 pce/h/l	0.95	1.05
Between 50 and 100 pce/h/l	0.90	1.10
Between 100 and 150 pce/h/l	0.85	1.15
Between 150 and 200 pce/h/l	0.80	1.20
Greater than 200 pce/h/l	0.75	1.25

Where pce/h/l = passenger car equivalents per hour per lane

If the average speed is less than 50 mph then a demand factor of 1.25 applies to the toll applied in the previous five-minute period, and this takes precedence even if a demand factor outlined in the table above is also relevant.

The Developer must maintain average speed in the Managed Lanes at or above 50 mph once operating in **dynamic mode**. The Developer is excused from its obligation to maintain average speeds in the Managed Lanes above 50 mph for events out of the Developer’s control.

10.15. Interoperability with Existing and Future Facilities and Transportation Infrastructure

In the context of NTE Segments 2-4, interoperability refers to the Electronic Toll Collection System’s ability to:

- recognize and process toll revenue transactions from transponders issued by all tolling authorities sanctioned by TxDOT, currently consisting of:
 - NTTA (TollTag),
 - Texas Tollways (TxTag), and
 - Harris County Toll Road Authority (EZ TAG);
- provide an equal level of service to customers using any of the above transponders; and
- transmit transaction data to the appropriate tolling authority in a manner that requires minimal processing for compatibility.

The proposed ETCS for the Project provides an effective technological solution for maintaining technical, operational and financial interoperability with the TxDOT-sanctioned toll authorities, which currently handle transactions for more than 4.5 million transponders actively registered in Texas.



Chapter 10: Revenue Generation,
Collection Technology and Plans

The ETCS implements multi-protocol radio-frequency identification (RFID) readers and antennas, high-resolution video tolling cameras and an innovative Back Office System that is able to interoperate with Texas toll authorities to provide a secure, seamless and economical transaction processing solution. The ETCS is designed to be flexible enough to incorporate future subsystem integrations for the purpose of providing interoperability with any new toll agency sanctioned by TxDOT.

Figure 10-6: Segment 2E Stick Diagram - Interim Configuration

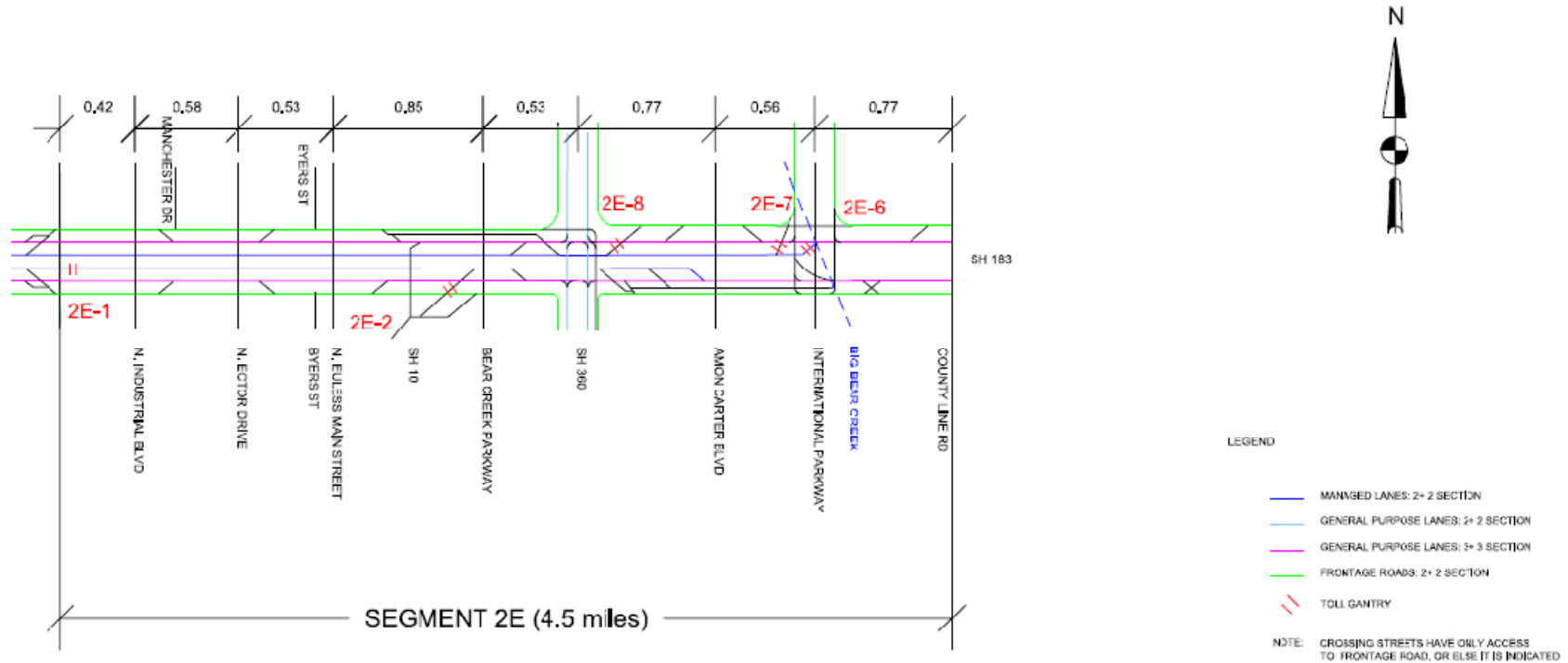


Figure 10-7: Segment 2E Stick Diagram - Ultimate Configuration

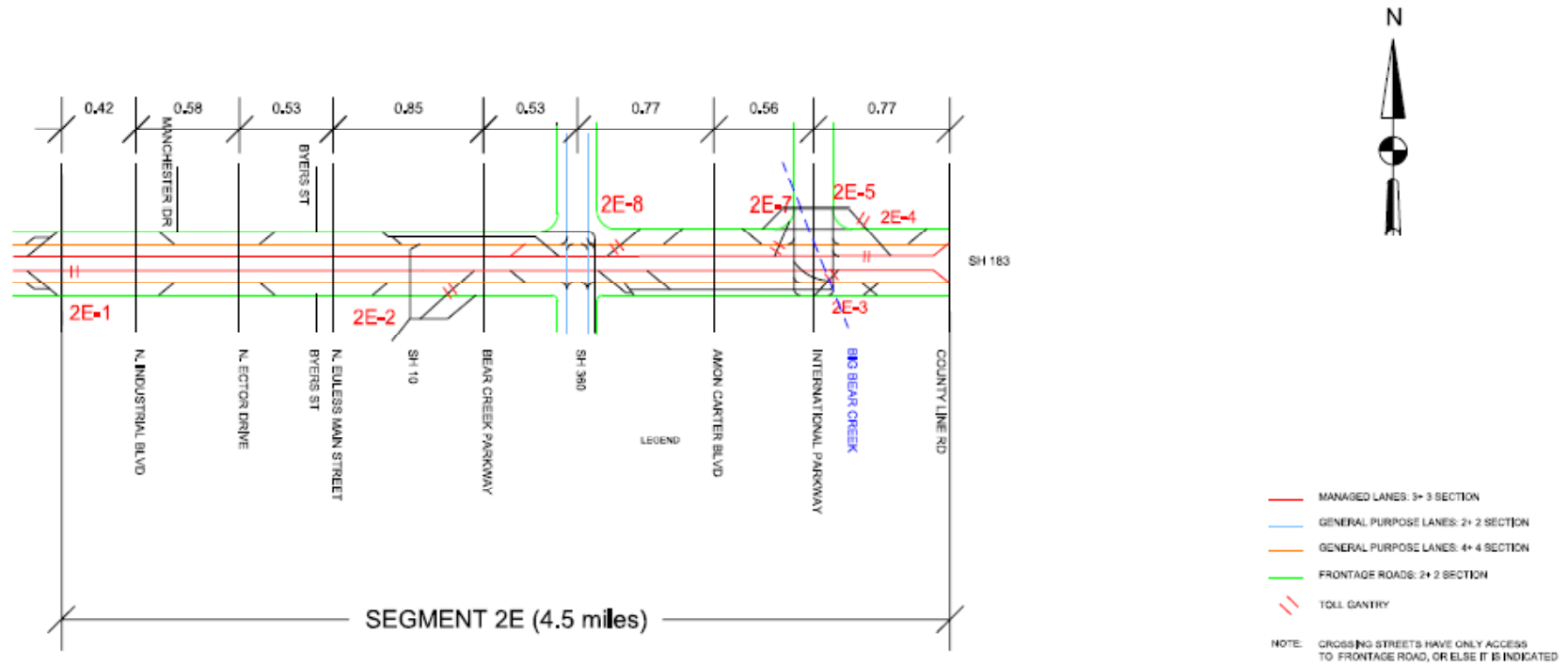


Figure 10-8: Stick Diagram - Segments 3A and 3B - Interim Configuration

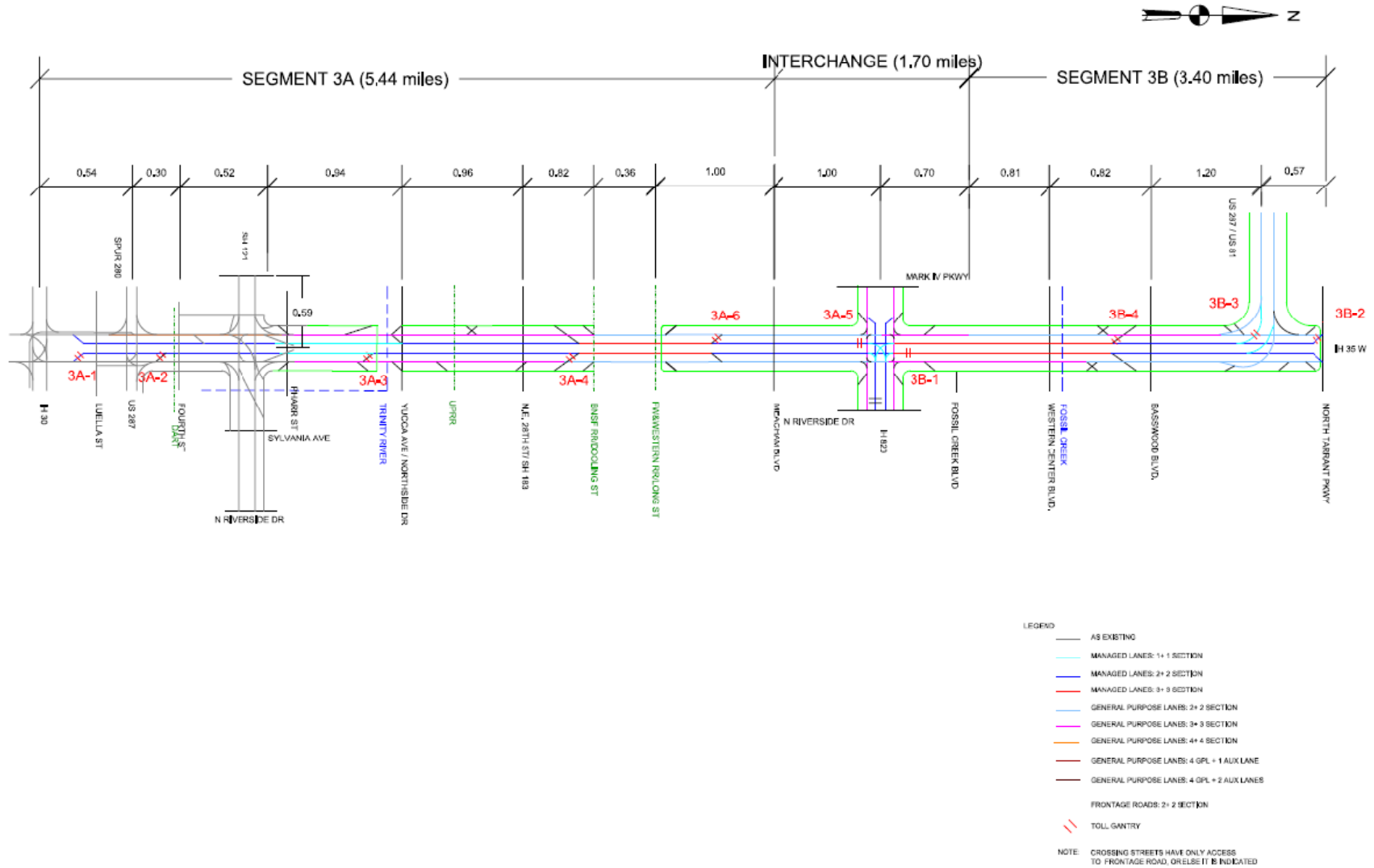


Figure 10-9: Stick Diagram - Segments 3A and 3B - Ultimate Configuration

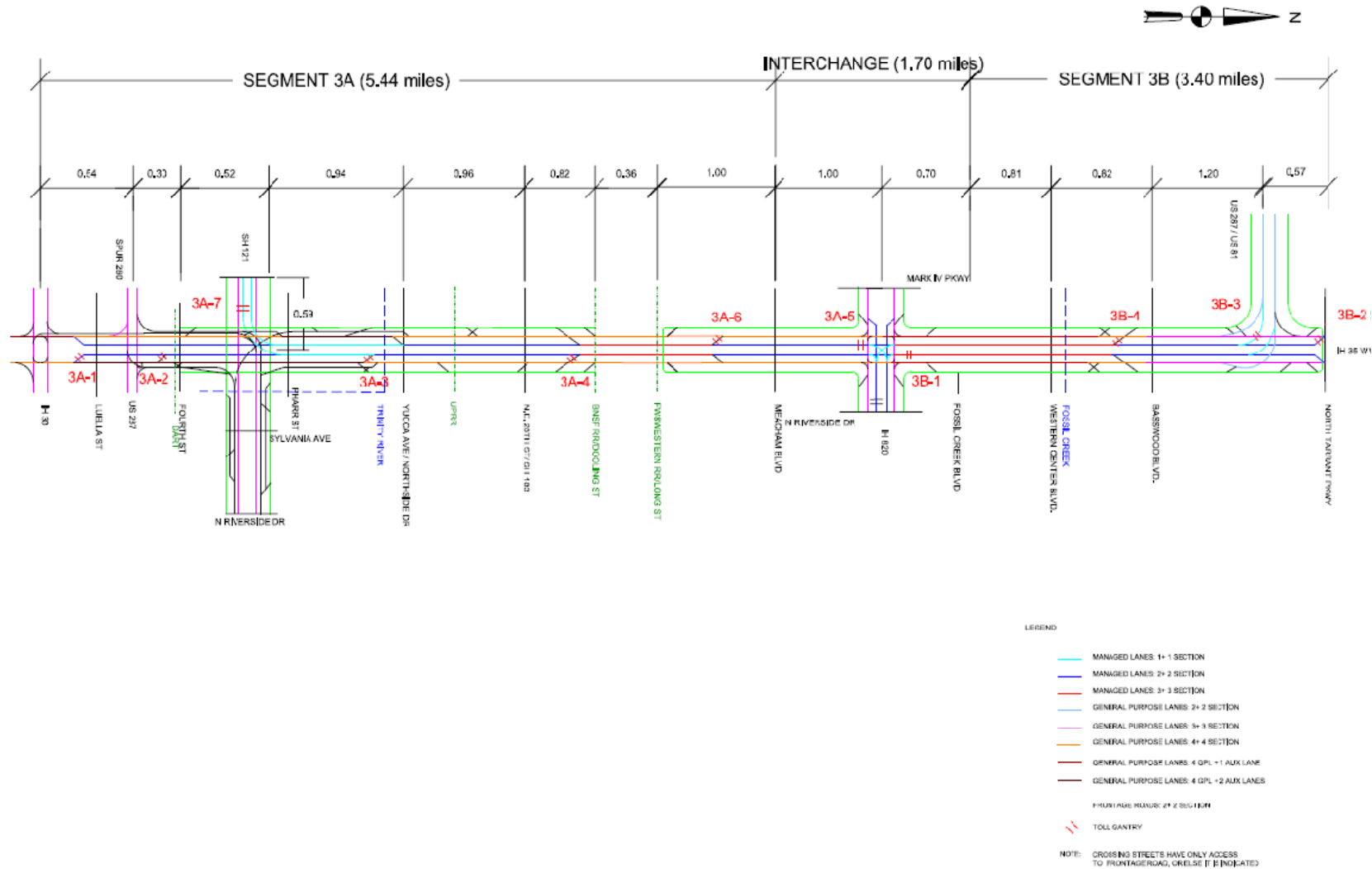


Figure 10-10: Stick Diagram - Segment 3C - Interim Configuration

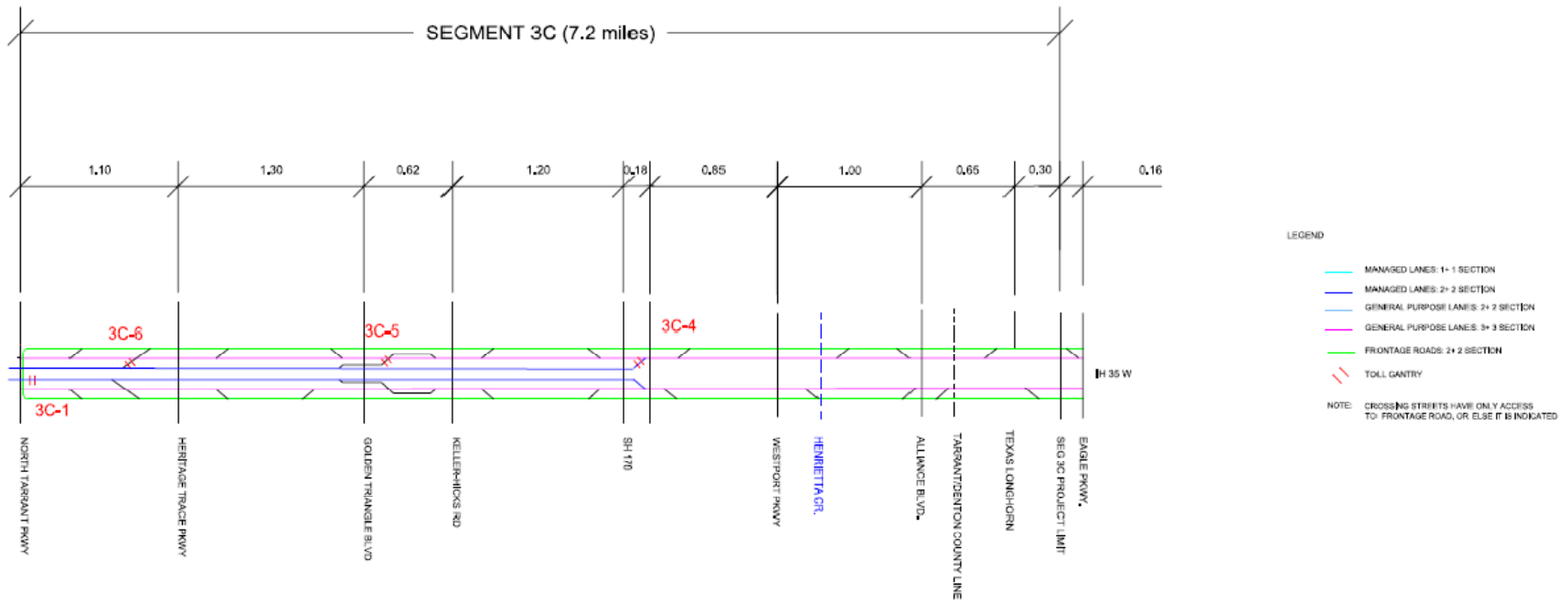


Figure 10-11: Stick Diagram - Segment 3C - Ultimate Configuration

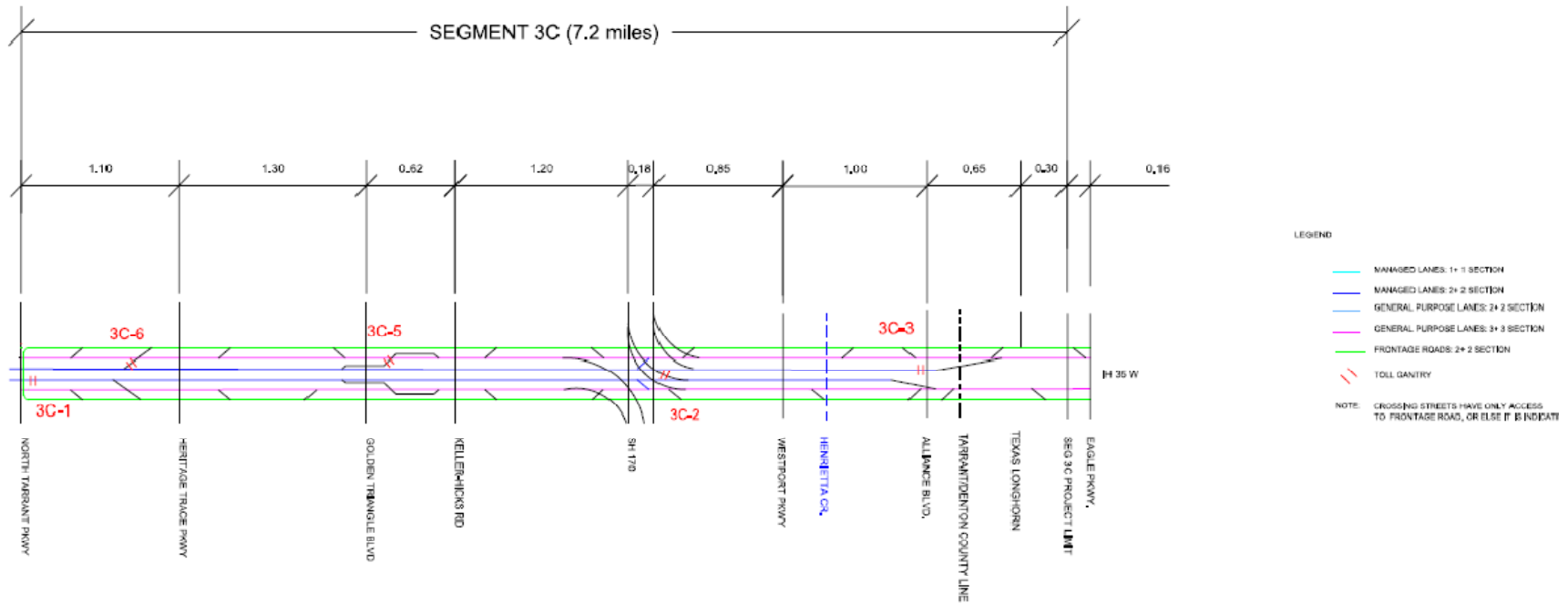


Figure 10-12: Stick Diagram - Segment 4 - Interim Configuration

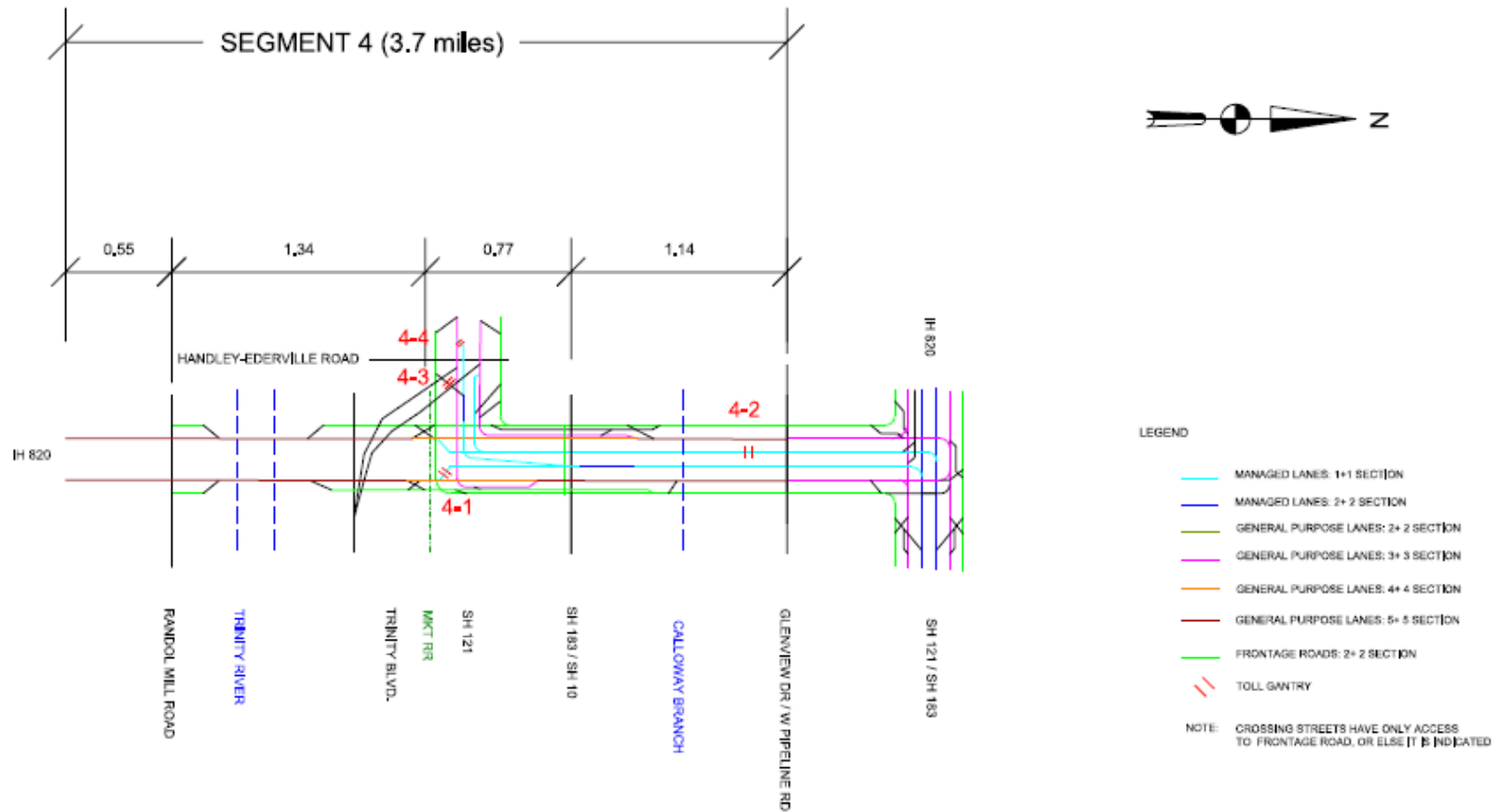


Figure 10-13: Stick Diagram - Segment 4 - Ultimate Configuration

