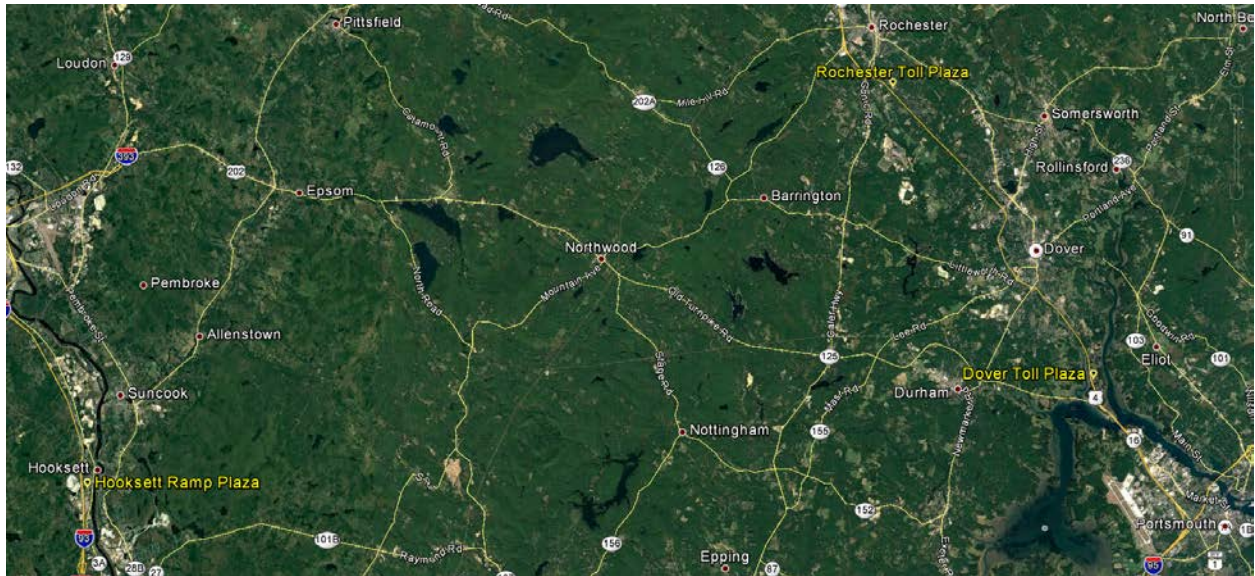


AET Feasibility Analysis and Comparative Assessment of ORT

Follow-up Analysis at the Dover & Rochester Toll Plazas



Comparing the Financial Feasibility of Open Road Tolling vs. All Electronic Tolling

Presented to



Bureau of Turnpikes

Prepared by



28 July 2017

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Executive Summary

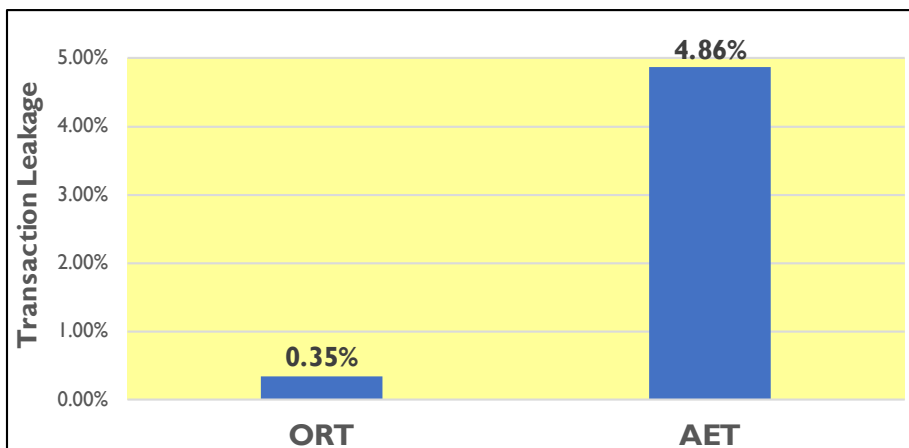
This report updates a comparative evaluation of two different business models for toll collection by the New Hampshire Department of Transportation’s Bureau of Turnpikes, between All-Electronic Tolling (AET) vs. Open Road Tolling (ORT). The report focuses on two mainline locations—the Dover toll plaza and the Rochester toll plaza. The study addressed this fundamental question: Could a realistic AET scenario be developed which was revenue neutral? In addressing this question, the study employed the following definitions:

- *Revenue Neutral* – A scenario in which the net revenue (that is, gross toll revenue less operating costs and capital costs) under AET over a 20-year period is no less than net revenue under ORT.
- *Realistic* – A scenario that can easily be implemented within the context of a larger system that still employs conventional toll collection at most facilities.

The task of achieving “revenue neutrality” under AET can be challenging for two reasons:

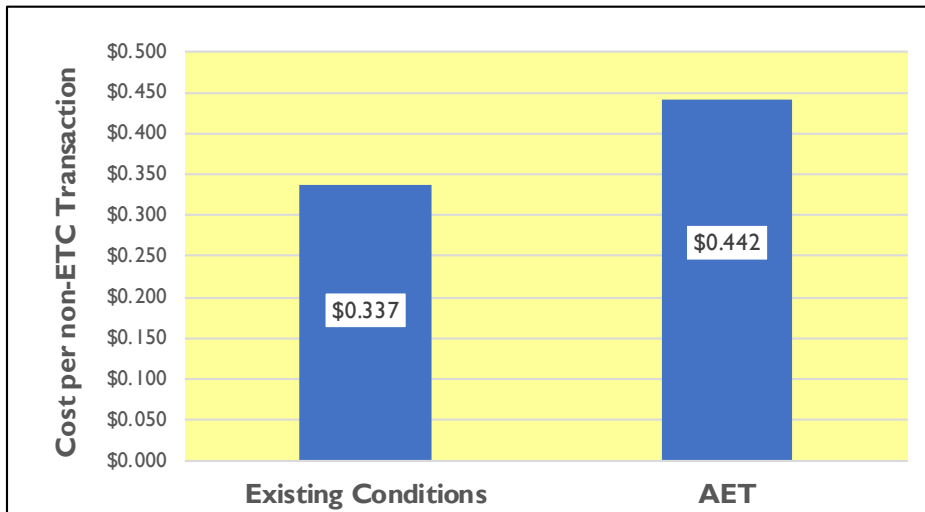
- First, AET has increased leakage compared to ORT, in which “leakage” is defined as revenue that, for various reasons associated with the method of toll collection, is not collected. As Figure ES-1 illustrates, ORT facilities at Dover and Rochester (in the projected opening year of 2020) would be expected to lose revenue from roughly *one-third of one percent* of all transactions. Under AET, this figure would be expected to rise to nearly five percent.

Figure ES-1 – Forecasted Transaction Leakage, ORT vs. AET



- Second, video transactions under an AET scenario generally cost more to process than cash transactions under an ORT scenario. As Figure ES-2 illustrates, the average video transaction under AET is expected to cost about 10¢ more to process than the average cash transaction under ORT.

Figure ES-2 – Projected Cost per Non-ETC Transaction at Dover & Rochester, 2020



For these reasons, HNTB evaluated four scenarios that employed various combinations of fees and/or surcharges to help cover the additional costs and the increased leakage typically associated with AET. The four scenarios evaluated by HNTB are summarized in Table ES-1.

Table ES-1 – Scenarios Evaluated by HNTB

Cost Category	Scenario 1 Existing Business Rules	Scenario 2 Base Case	Scenario 3 Cover Cost of Account Handling	Scenario 4 Add Surcharge
Description	Current pricing framework and invoicing.	Revised pricing and invoicing framework to match minimal industry practice.	Increased pricing (thru higher fees) within base case framework to cover costs only.	Increased pricing (by adding a surcharge) to cover costs as well as revenue leakage.
Video Toll Rate	75¢ per trans. existing cash fare (no surcharge)	75¢ per trans. existing cash fare (no surcharge)	75¢ per trans. existing cash fare (no surcharge)	\$1.30 per trans. 73% surcharge
Level 1 Invoice	\$1.00 fee per transaction	65¢ per invoice = 65¢ mailing fee	\$2.15 per invoice = 65¢ mailing fee + \$1.50 acct. mgt. fee	\$2.15 per invoice = 65¢ mailing fee + \$1.50 acct. mgt. fee
Level 2 Invoice	\$1.50 fee per transaction	\$2.80 per invoice = \$1.30 mailing fee + \$1.50 late fee	\$5.80 per invoice = \$1.30 mailing fee + \$1.50 late fee + \$3.00 acct. mgt. fee	\$5.80 per invoice = \$1.30 mailing fee + \$1.50 late fee + \$3.00 acct. mgt. fee
Level 3 Violations Notice	\$25.00 fee per transaction	\$26.95 per invoice = \$1.95 mailing fee + \$25 admin penalty	\$31.45 per invoice = \$1.95 mailing fee + \$4.50 acct. mgt. fee + \$25 admin penalty	\$31.45 per invoice = \$1.95 mailing fee + \$4.50 acct. mgt. fee + \$25 admin penalty

The key findings of the analysis may be summarized as follows:

- Scenarios 1 and 4 are financially feasible over a wide range of possible influencing factors. These two scenarios generate positive net revenue over a broad spectrum of assumptions and unknowns, and they do so regardless of whether capital cost savings are factored into the calculation in addition to operations and revenue impacts.
- This study recommends that if the Bureau of Turnpikes wishes to move forward with AET implementation, Scenario 1 presents the strongest opportunity based on the following:
 - Scenario 1 yields a higher net present value (NPV) than the next best option (Scenario 4) and therefore provides a larger margin of net revenue to cover inherent uncertainty in key assumptions.
 - Scenario 1 integrates more closely into the Bureau of Turnpikes' existing operations, since it incorporates existing business rules for handling non-payments. All customers that drive through *any* plaza without a valid E-ZPass will be handled the same way. This makes the implementation of AET less complicated from a customer perspective and requires fewer changes from a Bureau of Turnpikes perspective.
- The following three factors contribute to the financial feasibility of AET:
 - **Existing deficiencies.** The Dover and Rochester toll facilities are both in need of capital improvements due to end of life. This enables NHDOT to take advantage of the capital cost savings of AET.
 - **Large capital cost savings relative to revenue at risk.** By building AET facilities at Dover and Rochester in lieu of building ORT facilities, the Bureau of Turnpikes will likely save \$26.4 million. This is a large number when compared to the amount of cash revenue that is projected to be collected at these plazas annually (totaling \$3.9 million in 2020). It would take a significant rate of revenue losses beyond industry experiences under the less efficient AET collection methods over an extended period for the revenue loss to exceed the capital cost savings.
 - **Demonstrated success in video billing.** The Bureau of Turnpikes has demonstrated high success rates at recovering revenue from today's customers that pass through toll facilities without paying. Approximately 80% of all customers that are mailed an invoice ultimately pay (which represents the upper end of the range for comparable facilities), and the fee structure has proven to be effective at covering costs.
- NHDOT should consider the following challenges that will accompany the implementation of AET on the Spaulding Turnpike:
 - Implementation of Scenario 1 will effectively yield a significant toll increase for today's cash customers that choose not to acquire an E-ZPass after conversion to AET. Today's cash trip that costs 75¢ will cost \$1.75 under Scenario 1—an increase of 133%.
 - The fees and fines assessed to video transactions under Scenario 1 will primarily affect *New Hampshire drivers*. Approximately 70-75% of the people whose cost to travel the road will be raised by AET are going to be New Hampshire residents.
 - Qualitatively speaking, the mixing of payment options (AET in some places but not in others within the same trip) could result in higher customer service costs, lower payment rates and lower satisfaction due to increased confusion about available payment options

(quantitatively not part of this study). Customer communication before, during and after implementation, particularly for seasonal variations in customers, will therefore be critical.

- Capital cost considerations will apply differently to different AET implementations, so any results for Dover and Rochester **should not be considered as representative for all NHDOT toll facilities**. For example, consider a potential AET deployment at the Hampton Mainline toll plaza. In that situation, since an ORT facility has already been constructed at Hampton, the advantages of AET avoiding these costs is not available to the same degree as Dover or Rochester.
- As a low-cost, low-risk means of evaluating AET prior to a larger-scale deployment similar to the approach taken by other toll agencies in the region, this study recommends conducting an AET pilot project at a lower risk location, namely the Hooksett Ramp toll plaza. A pilot project provides a valuable opportunity for the following:
 - Gathering data on key variables such as E-ZPass usage, trip frequency, and payment response rates. Better understanding these variables post conversion will better enable the Bureau of Turnpikes to plan for larger-scale deployment in a way that is more certain to achieve revenue neutrality.
 - Providing a better understanding and additional experience regarding back-office operations to handle video tolling. Implementing AET on a small-scale pilot basis will provide a better understanding of the functionality of systems and projection of staffing requirements on a reduced scale that allows for significant variation if risks are realized.

Section 1.0 Introduction

The New Hampshire Department of Transportation’s Bureau of Turnpikes (“the Bureau”) has engaged HNTB to update its comparative evaluation of All-Electronic Tolling (AET) vs. Open Road Tolling (ORT) at two mainline locations—the Dover toll plaza and the Rochester toll plaza. The Bureau has also expanded the AET feasibility analysis to include the Hooksett Ramp toll plaza. This section provides background for this evaluation as well as a roadmap for the rest of the report.

1.1 Background

In January 2015, HNTB produced two reports for the Bureau. These reports focused on four different toll facilities on the New Hampshire Turnpike system—three mainline toll plazas (at Bedford, Dover, and Rochester) and one ramp toll plaza (in Hampton, on the connector between I-95 and NH-101).

- The first report was entitled *AET Feasibility Analysis and Comparative Assessment of ORT*. It concluded that, if the Bureau wished to move forward with modernizing its facilities, then Open Road Tolling (ORT) was most closely aligned with NHDOT goals. The primary factors included (a) prior success with ORT conversion in two previous implementations at the Hampton and Hooksett mainline toll plazas, and (b) the fact that the approach carried less financial risk than AET.
- The second report was entitled *AET Feasibility Analysis and Comparative Assessment of ORT – APPENDIX*. This report focused on comparing ORT with an in-kind plaza rehabilitation at each facility. The purpose of the report was to determine whether the additional capital costs associated ORT (as compared to in-kind rehabilitation) could be offset by public benefits such as travel time savings, fuel consumption savings, and safety improvements. The report concluded that the public benefits at the three facilities would total approximately \$3.6 million per year—a total that more than offset the additional capital cost of ORT conversion.

The findings of the two reports cited above were included in the overall decision by the Bureau to move forward with its plans to implement ORT at Bedford. However, before advancing its implementation plans for Dover and Rochester, the Bureau decided to update the previous AET vs. ORT comparison. The Bureau felt that changes in E-ZPass market share, improvements in violations enforcement, and reductions in operations costs could create a scenario that was more favorable to AET.

1.2 Purpose

This report has two primary purposes.

The first purpose of the report is to update the evaluation of the financial feasibility of AET vs. ORT at Dover and Rochester, incorporating the most recently available data related to traffic, revenue, and violations enforcement. The definition of “financial feasibility” will be evaluated from two perspectives:

- The first perspective uses the “revenue neutrality” test. For AET to be feasible, its net operating revenue—defined in this study as gross revenue less the operations costs required to collect the revenue—must be greater than or equal to the net operating revenue under ORT.

- The second perspective uses the “net revenue” test. This test expands on the “revenue neutrality” test by rolling in capital costs. For AET to be feasible from this perspective, its overall net revenue—defined as gross revenue less the sum of operations costs **and** capital costs—must be greater than or equal to the overall net revenue under ORT.

Numerous agencies that have explored a conversion to AET have used an assessment of revenue neutrality and/or net revenue as key measuring sticks for evaluating feasibility. Although both perspectives will be evaluated, the “net revenue” test is most appropriate for Dover and Rochester. The Bureau of Turnpikes has already determined that capital improvements are essential at these locations, and that these improvements will be funded from their cash on hand. Therefore, the Bureau wishes to identify the most cost-effective use of their resources from both a capital and an operating perspective.

The second purpose of the report will discuss the feasibility of performing an AET pilot project at the Hooksett Ramp toll plaza. If AET at Dover and Rochester is deemed to be financially feasible, then this pilot project would (a) provide an opportunity to test the assumptions behind the financial analysis, and (b) provide a means for testing the back office operations that will be needed for effective AET implementation. A pilot enables these objectives to be pursued at a lower revenue risk location.

1.3 Overview of Report

The report will proceed in the following manner:

- Section 2.0 will provide an overview of All Electronic Tolling in the United States, providing some context for the state of the industry.
- Section 3.0 will review existing conditions at Dover, Rochester, and Hooksett Ramp. It will provide a detailed discussion of traffic transactions, revenue, and violations at each facility.
- Section 4.0 will discuss the assumptions underlying the analysis, including a detailed discussion of the various scenarios evaluated by HNTB.
- Section 5.0 will provide an overview of the results of HNTB’s financial feasibility analysis of ORT vs. AET, evaluating feasibility from both a *revenue neutrality* and a *net revenue* perspective.
- Section 6.0 will summarize HNTB’s findings and present HNTB’s recommendations for moving forward with appropriate toll facility upgrades at Dover and Rochester.
- Section 7.0 will discuss a scenario for a proposed pilot project to test AET implementation and to further inform future decisions.
- Appendix A will present the detailed results of a financial feasibility analysis at the Hooksett Ramp toll plaza.
- The report will conclude with Appendix B, which will provide an overview of the issues that the Bureau of Turnpikes will need to consider if it implements AET on a corridor-wide (as opposed to a systemwide) basis.

Section 2.0 Overview of Existing AET Facilities

All Electronic Tolling, or AET, is a general term used to categorize toll facilities that do not involve any cash toll collection on the roadway. All transactions are electronic, requiring no human intervention in the toll lanes themselves. In broad terms, there are two general approaches to AET in the United States from a payment option standpoint:

- *Transponder Only.* These facilities require all users to have a transponder. Any driver that uses the facility without a valid transponder account is considered a violator. License plate images of violators are prepared for invoicing using DMV data, and violation notices are sent out per agency business rules. Examples would include agencies with interchanges classified as transponder only and entire roadways. The Pennsylvania Turnpike, Florida's Turnpike and others have select interchanges that are designated as transponder only; cash payments are not available at these sites. The Harris County Toll Road Authority (HCTRA) in Houston also has entire facilities that require transponders.
- *Transponder and Video Tolling.* This approach, employed by MassDOT in its recent systemwide conversion to AET, is the most common approach to payment options under AET. In these facilities, as with "Transponder Only" facilities, a license plate image is taken of all vehicles that pass through the facility without a valid transponder detected. The biggest difference is that, in "Transponder plus Video" facilities, all drivers are considered "customers."
 - Transponder payment options are similar to standard programs. For video tolling, there are a wide range of pre- and post-pay products offered by agencies based on customer needs and cost efficiencies of offering.
 - Most agencies are solely or primarily handling video tolling as a post payment process in which drivers are sent a bill in the mail for video transactions. Drivers are not considered "violators," although most agencies do apply additional fees and surcharges on the video transactions. More aggressive collection or enforcement practices (involving the assessment of "fines" or "penalties") are typically employed when bills are not paid in a timely manner, similar to how violators are handled.
 - However, some agencies (such as the Transportation Corridor Agencies in southern California) place the responsibility on the drivers to contact the agency and pay the toll either before or soon after traveling the road. Drivers becomes "violators" if they fail to contact the agency and pay the bill within a specified period, typically 5-7 days.

In this report, the term "AET" will be assumed to refer to the "Transponder plus Video" approach.

2.1 Locations

Numerous agencies throughout the United States have implemented AET in recent years, either through conversion or the opening of new facilities as AET. The stars in Figure 2-1 identify the general locations of various AET facilities in operation as of March 2017.

Figure 2-1 – AET Location Overview



Higher concentrations of AET facilities are found in the northeast (from Virginia to Massachusetts), Florida, and Texas. However, major AET facilities can also be found in North Carolina, Colorado, California, and Washington State. The E-470 Public Highway Authority in suburban Denver was one of the first facilities to convert to AET in 2008. Numerous facilities are currently in the planning stages for further or new conversion to AET, including Virginia (I-66), Pennsylvania (portions of the Pennsylvania Turnpike), and several agencies in New York, among others around the country.

2.2 Fare Structures

Most agencies that deploy AET with both transponder and video products have two rate structures—one for ETC customers and one for video customers.

- The ETC customers typically pay the lowest fare. This may be referred to as the ETC rate or the base rate.
- Video customers typically pay the ETC rate *plus* a video surcharge. In some cases, the surcharge is a fixed amount (e.g. 30¢ above the ETC rate), and in other cases the surcharge is a fixed percentage (e.g. 30% above the ETC rate).

Agencies typically set the ETC rate lower, given the higher efficiency of collection and to incentivize customer usage in order to improve traffic operations. While the methods for calculation vary widely, typical ETC operating costs range from about 8¢ to 13¢ per transaction. Most of these costs are associated with staffing costs (specifically, customer service representatives that are available to handle customer requests) and with credit card fees. Video-based transactions have higher operating costs per transaction, in addition to experiencing more significant leakage.

To account for lower efficiency in collecting the toll via video tolling compared to transponder tolling, a surcharge is typically assessed to video customers. The surcharge generally has two purposes:

- First and foremost, the surcharge helps to offset *revenue leakage*. Leakage may be defined as revenue that, for various reasons associated with the method of toll collection, is not collected. Video fare collection involves much higher levels of leakage than ETC fare collection. Consequently, if the agency targets preservation of revenue levels, a higher level of revenue must be collected from paying customers to offset the revenue that is not collected due to leakage. Sources of revenue leakage under video tolling include the following:
 - Some video images do not provide enough information to identify a license plate, due to customer, weather or system factors, some of which the agency has limited ability to influence cost effectively if at all.
 - The DMV's of some states are not willing to provide addresses of video customers from their state
 - Some DMV data is incomplete, not available or inaccurate. As a result, either (a) the customer cannot be identified for an invoice to be sent, or (b) when the invoice is sent, the address is returned as undeliverable.
 - Some invoices are never returned with payment.
- Secondly, the surcharge provides an incentive for customers to shift to transponder based toll collection, which is both cheaper to collect and has much lower levels of leakage.

In addition to assessing surcharges, most agencies assess additional fees as well. The purpose of these fees is primarily to offset the higher processing costs associated with video transactions. Average video costs can range from 30¢ to over \$1.00 per transaction. The costs entail processes such as image review, DMV lookup, payment processing, and customer service, in addition to credit card fees, all of which are higher than the corresponding activities associated with transponder or cash fare collection. A secondary purpose of fees and fines is to encourage earlier payment of initial invoices rather than waiting for subsequent past due invoices.

Table 2-1 below provides a summary of the fare structures adopted by various agencies. The toll rates in the table apply to passenger cars; commercial vehicle toll rates will differ.

Table 2-1 – AET Rate Structure Summary, Selected Agencies

Agency / Facility	Video Surcharge	Fees & Fines
<i>MassDOT – Tobin Bridge / Sumner Tunnel / Ted Williams Tunnel</i>	30¢ above the ETC toll rate for out-of-state customers	<ul style="list-style-type: none"> • No fee on 1st invoice • \$1 fee per toll charge after 30 days • \$2 fee per toll charge after 60 days • \$3 fee per toll charge + \$20 fine after 90 days
<i>Pennsylvania Turnpike – Delaware River Bridge</i>	\$1.75 (35%) above the ETC toll rate	<ul style="list-style-type: none"> • No fee on 1st invoice • \$5 fee per invoice (or 1.5% of total amount owed, whichever is higher) after 20 days • Tolls and fees referred to Collections, w/ additional fees if 2nd invoice unpaid
<i>North Texas Turnpike Authority – Various Facilities</i>	24¢ or 50% above the ETC toll rate, whichever is greater	<ul style="list-style-type: none"> • No fee on 1st invoice • \$10 fee per invoice after 25 days • \$35 fee per invoice after 50 days • \$35 fee plus collections fees after 75 days
<i>Northwest Parkway</i>	45¢ per transaction above the ETC toll rate (12% surcharge for mainline plazas & 36% for ramp plazas)	<ul style="list-style-type: none"> • 65¢ handling fee on 1st invoice • 65¢ handling fee plus \$2.50 fine per transaction after 20 days • 65¢ handling fee plus \$25.00 fine per transaction after 40 days
<i>Central Texas Regional Mobility Authority – Various Facilities</i>	33% surcharge above the ETC toll rate	<ul style="list-style-type: none"> • \$1.15 handling fee on 1st invoice • \$1.15 handling fee plus \$15 administrative penalty after 30 days • \$1.15 handling fee plus \$30 administrative penalty after 60 days

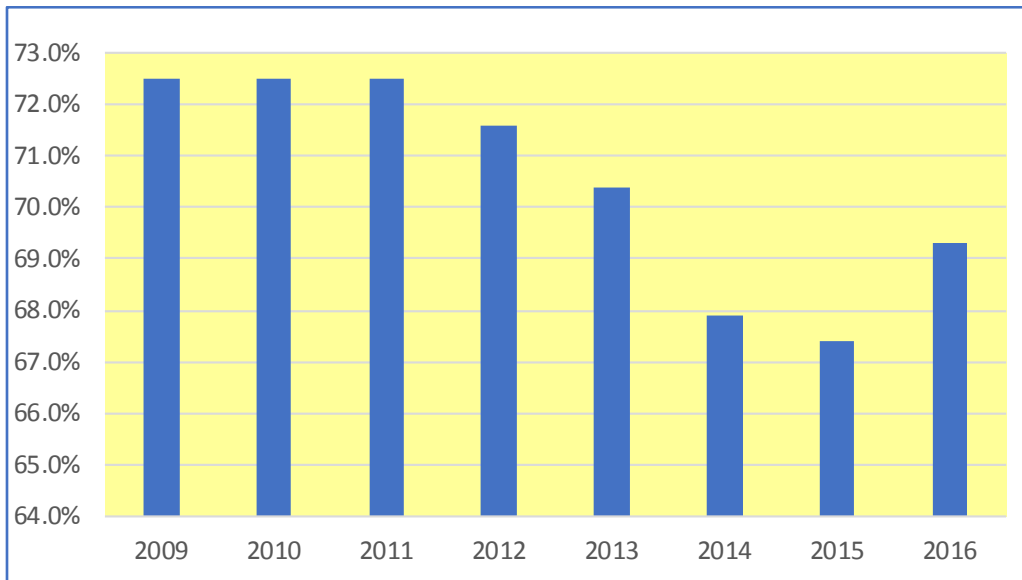
2.3 Impact of AET on Transponder Market Share

Since the advent of electronic toll collection, virtually all toll agencies in the northeast have experienced a steady increase in ETC market share. This growth has provided a twofold benefit. First, it has improved operations at toll facilities, since transponder-equipped vehicles can pass through a plaza more rapidly than vehicles that must stop and pay cash. Second, it has restrained operating costs, since transponder transactions are almost always cheaper to process than cash transactions.

However, some agencies have found that AET puts a distinct damper on ETC market share growth. Experience for these agencies has shown that, after conversion to AET, the share of transactions attributable to transponders tends to stay static. Even though the raw number of transponder transactions may jump, their share of total transactions does not.

HNTB reviewed ETC market share data from two agencies for which data was readily available. Figure 2-2 shows how the ETC market share on E-470 in suburban Denver has evolved since the facility converted to AET in 2009.

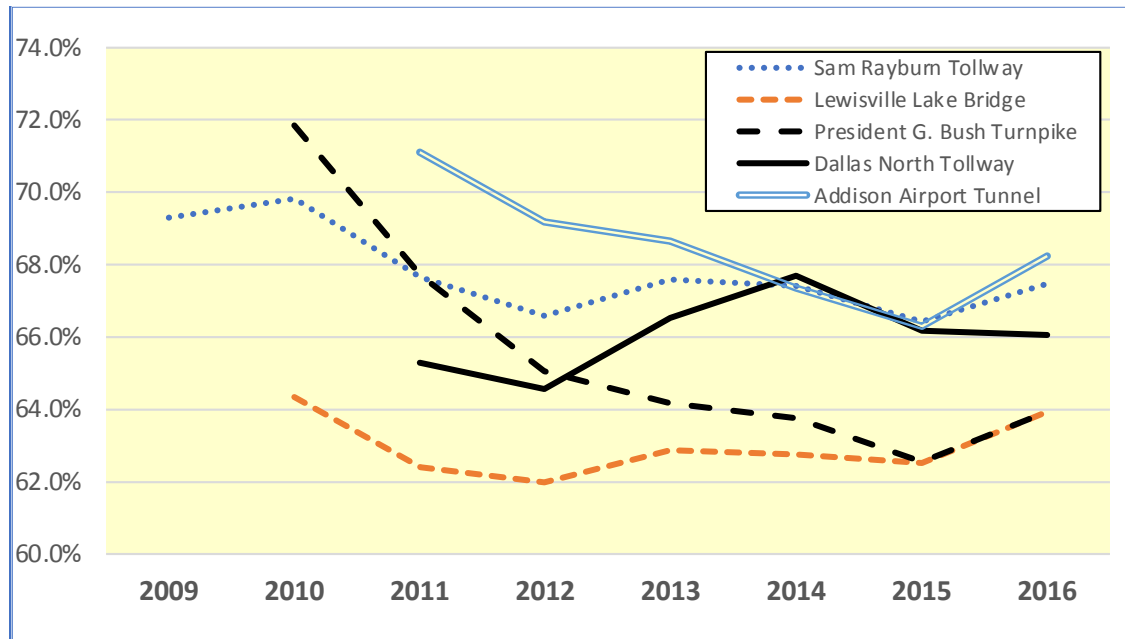
Figure 2-2 – ETC Market Share on E-470, 2009 thru 2016



As Figure 2-2 illustrates, the transponder market share declined slightly in the years following AET conversion, falling from over 72% in 2009 to about 67% in 2015. Transponder market share rebounded somewhat in 2016; this potentially could be attributable to the recent opening of neighboring other agency interoperable toll facilities (namely, the CDOT US-36 Express Lanes) that have promoted the acquisition of transponders presumably by former video users on E-470 that now have decided that a transponder makes sense for them given the new facilities.

The North Texas Toll Authority (NTTA) is another agency that observed little-to-no growth in transponder market share following conversion to AET. This is illustrated in Figure 2-3, which summarizes the transponder market share observed at multiple NTTA facilities in the years following conversion to AET.

Figure 2-3 – Transponder Market Share for Various NTTA Facilities, 2009 thru 2016



As Figure 2-3 illustrates, the transponder market share has hovered between 62% and 72% at five different NTTA toll facilities following conversion to AET. Only the Dallas North Tollway experienced an increase in market share between the time the facility converted (65.3% in 2011) and the present (66.1% in 2016). The transponder market share held steady or declined at the other four facilities. The reason for the stagnation in transponder market share following conversion to AET is not clear. Perhaps it is because the perceived biggest advantage of having a transponder—namely, to avoid toll plaza congestion—goes away with the advent of AET. Customers with no transponder can travel just as swiftly through the toll point as customers with a transponder, albeit at a higher fare.

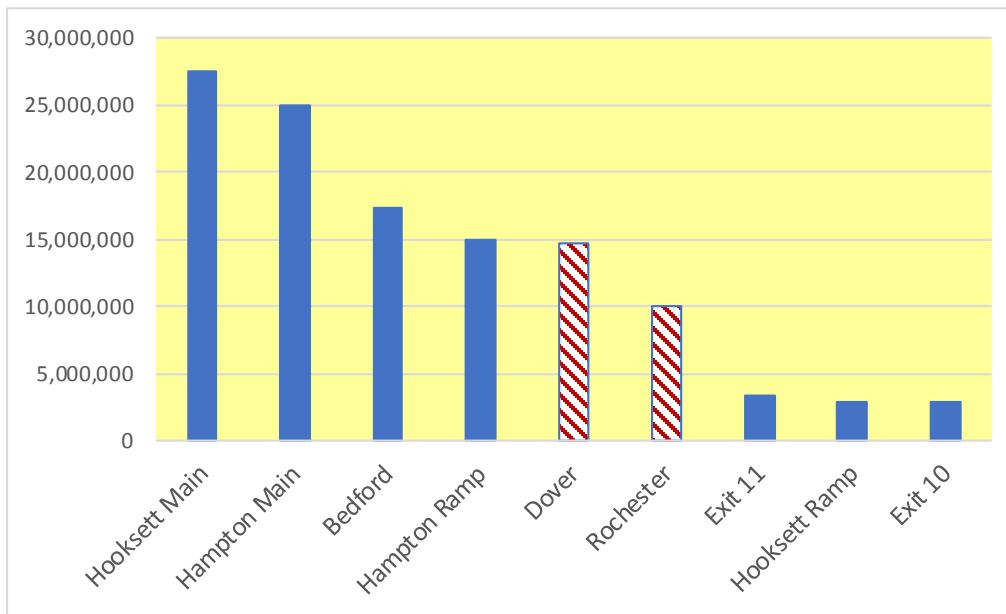
The phenomenon noted in the examples above is in marked contrast to the experience of agencies that employ the more traditional toll collection methods of either conventional toll plazas or ORT. For example, the conventional toll plazas at both Dover and Rochester have experienced steady, consistent growth in E-ZPass market share over the years. This will be discussed in more detail in Section 3.5.

The key issue is this: If transponder market share *does not* grow after conversion to AET, then the volume of video transactions *will* grow. This means that, over time, increasing levels of revenue will be at risk through the invoicing process. Any AET implementation must therefore include (a) a good understanding of the response rates to invoices if AET were to be implemented, and (b) a set of properly-calibrated video toll rates that will provide sufficient coverage for likely leakage.

Section 3.0 Existing Conditions Overview

The Dover and Rochester mainline toll plazas are both located on New Hampshire Route 16 in southeastern New Hampshire. In Fiscal Year (FY) 2016, the Dover plaza served a total of about 15 million vehicle transactions, while the Rochester plaza served about 10 million transactions. They are ranked 5th and 6th (respectively) out of the nine New Hampshire plazas in terms of annual traffic volumes. Figure 3-1 provides a graphical summary of how Dover and Rochester relate to the other 7 facilities in the New Hampshire Turnpike system.

Figure 3-1 – FY16 Traffic Volumes at each New Hampshire Toll Plaza

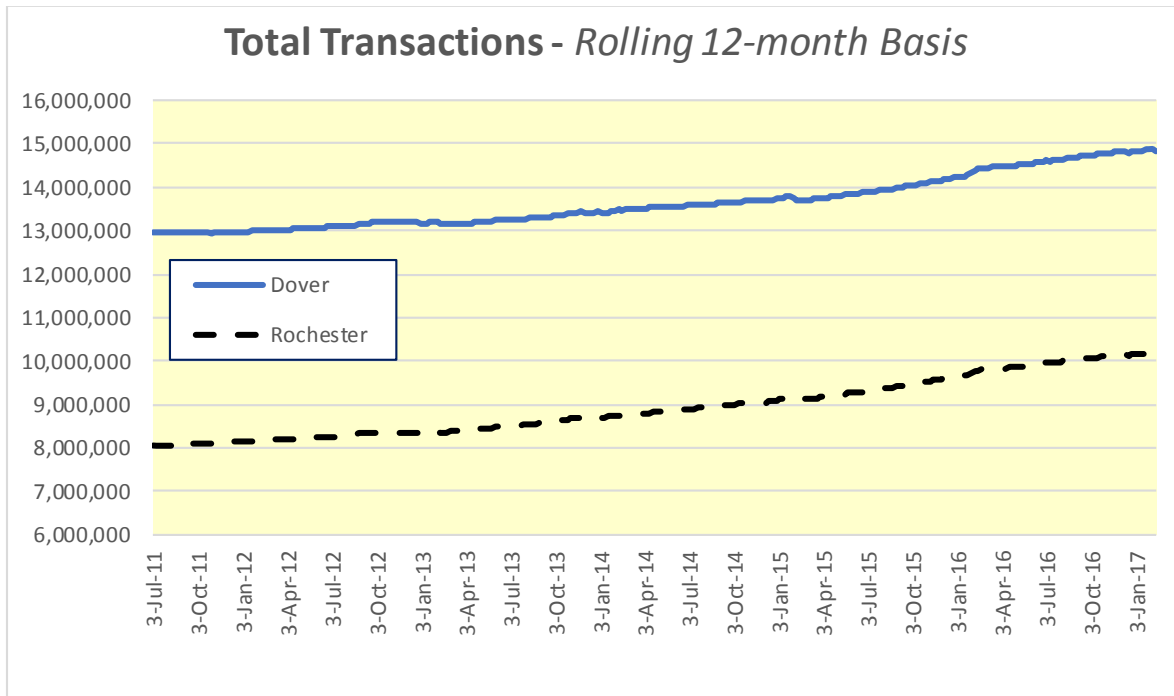


Combined, Dover and Rochester accounted for 21% of the transactions and 13% of the revenue generated by the New Hampshire Turnpike system. This section will provide a detailed overview of existing conditions with respect to transactions and revenue at these two mainline toll plazas.

3.1 Traffic Trends

As noted above, a total of approximately 25 million vehicles passed through the Dover and Rochester toll plazas in FY16. Total traffic at both Dover and Rochester has grown gradually and steadily over the past 5+ years. Figure 3-2 illustrates the growth trend at both facilities since June 2011. The graph presents data on a rolling 12-month basis.

Figure 3-2 – Total Transactions at Dover & Rochester (rolling 12-month basis, June 2011 thru February 2017)



Traffic at both facilities has grown by about two million vehicles annually over the past five-and-a-half years. Dover traffic has grown at an average rate of 2.5% per year, while Rochester traffic has grown at a rate of 4.4% per year. The growth rate at both locations has accelerated slightly since early 2015, consistent with traffic growth on other roadways in the region.

3.2 Toll Rate Structure

The toll rates at Dover and Rochester are identical. Passenger cars—which make up approximately 95% of the traffic at both plazas—pay 53¢ if they have a New Hampshire-based E-ZPass, and 75¢ if they either pay with cash or pay with an E-ZPass based elsewhere. Toll rates for the other 11 classes of vehicles are multiples of the passenger car rate.

As at all New Hampshire toll plazas, there are two sets of rates. The highest rates are for cash-paying customers and for customers with an E-ZPass based outside of New Hampshire. The lowest rates are for customers with an E-ZPass based in New Hampshire.

- For vehicles with single tires on the rear axle, the NH E-ZPass rates are 30% lower than the cash rates.
- For vehicles with dual rear tires, the NH E-ZPass rates are 10% lower than the cash rates.

The rates for all 12 classes of vehicles are summarized in Table 3-1.

Table 3-1 – Existing Toll Rates at Dover & Rochester

Vehicle Type	NH-based E-ZPass Rate	Out-of-State E-ZPass / Cash Rate
Class 1 – 2 axles, single rear tire	\$0.53	\$0.75
Class 2 – 3 axles, single rear tire	\$0.70	\$1.00
Class 3 – 4 axles, single rear tire	\$0.88	\$1.25
Class 4 – 5 axles, single rear tire	\$1.05	\$1.50
Class 5 – 2 axles, dual rear tires	\$1.35	\$1.50
Class 6 – 3 axles, dual rear tires	\$1.80	\$2.00
Class 7 – 4 axles, dual rear tires	\$2.25	\$2.50
Class 8 – 5 axles, dual rear tires	\$2.70	\$3.00
Class 9 – 6 axles, dual rear tires	\$3.15	\$3.50
Class 10 – 7 axles, dual rear tires	\$3.60	\$4.00
Class 11 – 8 axles, dual rear tires	\$4.05	\$4.50
Class 12 – 9 axles, dual rear tires	\$4.50	\$5.00

At both Dover and Rochester, roughly 80% of all E-ZPass transactions are from NH-based transponders. This is considerably higher than at the Hampton Main toll plaza, where the most recently-available data indicates that less than 40% of all E-ZPass transactions are from NH-based transponders.¹

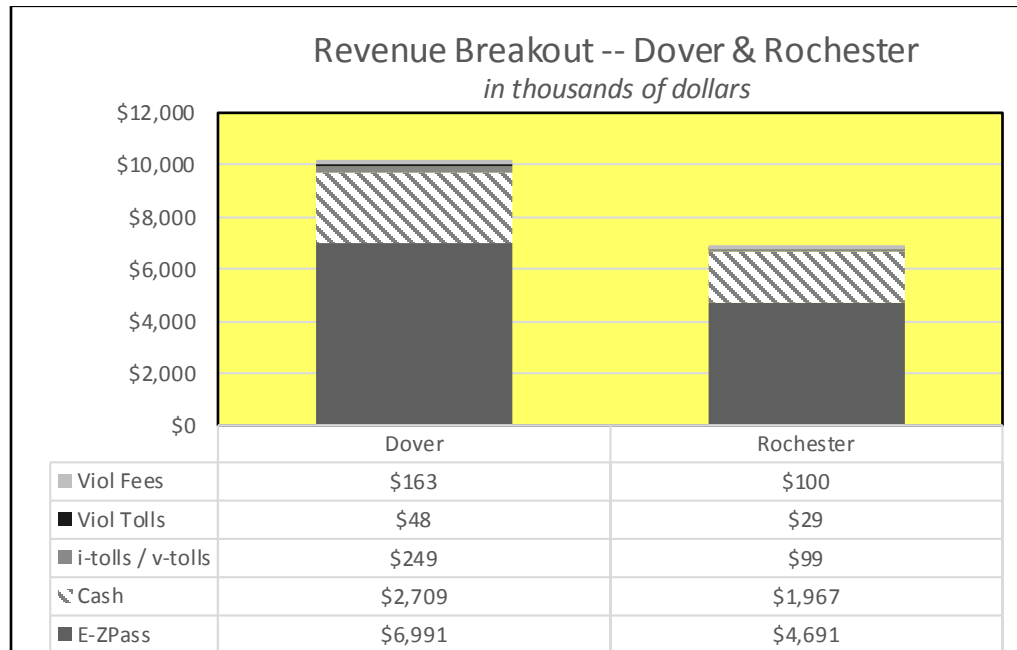
3.3 Revenue Summary

The New Hampshire Turnpike system collected over \$127.5 million in revenue in FY2016. About \$17 million of that was collected from Dover and Rochester. Figure 3-3 summarizes how this revenue breaks out into the following 5 categories:

- Valid E-ZPass transactions
- Cash transactions
- L-tolls (in which a license plate trace links the driver to an existing valid E-ZPass account, which is subsequently debited) and v-tolls (in which an E-ZPass account that was not in good standing at the time of the transaction was subsequently replenished such that the toll could be collected)
- Violations toll revenue (that is, toll revenue collected from violators that were identified and subsequently invoiced via capture of their license plate images)
- Violations fee revenue (that is, fees incurred as part of the violation-related toll transactions to cover the additional costs associated with pursue violators)

¹ See Table 5 from Jacobs' memorandum entitled *New Hampshire Turnpike System Traffic and Toll Revenue Forecast Update*, dated December 20, 2013.

Figure 3-3 – Gross Revenue Breakout from Dover & Rochester (in thousands of dollars)



The following observations may be drawn from Figure 3-3:

- At both locations, E-ZPass transactions account for **over 68%** of the total revenue collected.
- Cash and E-ZPass combined (which represent the valid transactions that occur in the lane at the time the vehicle passes through the toll plaza) account for **96%** of the revenue collected.
- The remaining 4% of revenue is evenly split between i-tolls and v-tolls (2%) and the recovery of revenue through the violations process (2%).

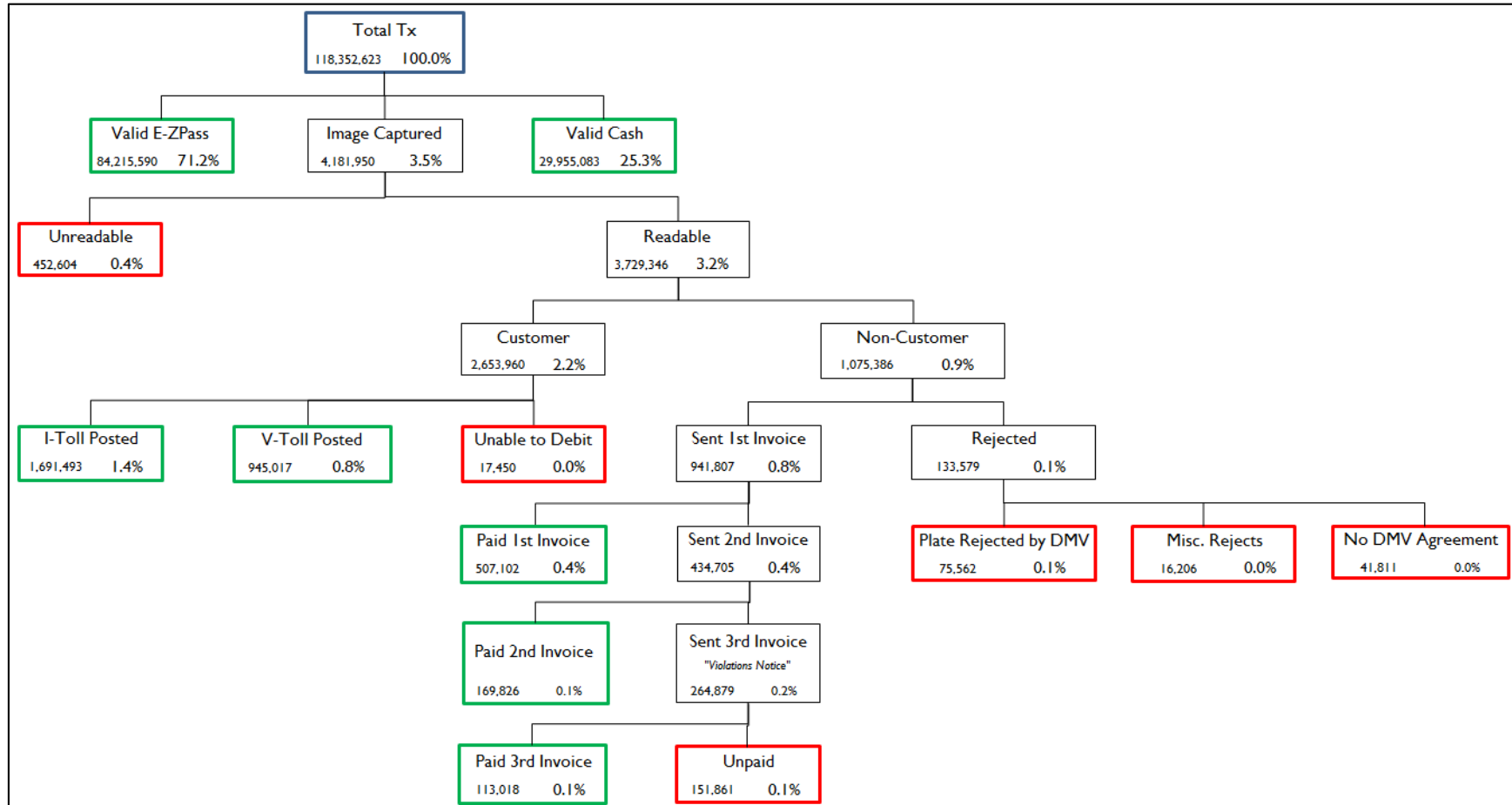
3.4 Transaction Flowchart & Violations Recovery

Based on data from the entire Turnpike system, New Hampshire collects revenue from about 99% of all transactions. New Hampshire has a low percentage of gross violations, with only 3.5% of its transactions being unpaid at the toll point. Of those unpaid transactions:

- Nearly two-thirds are recovered as i-tolls and v-tolls (as defined in Section 3.3)
- Of the remaining one-third of unpaid toll transactions, over 80% are collected through the invoicing process.

Figure 3-4 presents a transaction flowchart for the New Hampshire Turnpike system. Starting with a total of 118.4 million transactions, the diagram shows how these volumes break down into either paid transactions (boxes with a green outline) or unpaid transactions (boxes with a red outline).

Figure 3-4 – New Hampshire Turnpike System Transaction Flowchart – 2016



The following observations may be drawn from Figure 3-4:

- A total of 4.2 million license plate images of non-paying vehicles were captured. Of those, roughly 453k were unreadable. This means that **10.8%** of all image-based transactions are lost due to unreadability.
- A total of 1,075,386 “non-customers” were identified. Of these, a total of 789,946 transactions were ultimately paid over three levels of invoicing. This represents an overall recovery rate of **73.5%**.
- The response rates to the invoices sent to non-customers were relatively high.
 - 54% of those who received the first invoice responded with payment (507,102 of 941,807)
 - 39% of those who received a second invoice responded with payment (169,826 of 434,705)
 - 43% of those who received a third invoice (also known as a “violations notice”) responded with payment (113,018 of 264,879)²
 - Overall, of the 941,807 transactions that were invoiced, 789,946 were paid. This means that approximately 83% of the non-customer transactions that were invoiced were ultimately paid.
- The losses (identified in the boxes outlined in red) totaled approximately 755k transactions for 2016, accounting for a mere 0.6% of all systemwide transactions. In other words, the *New Hampshire Turnpike system collected 99.4% of all possible revenue* in 2016.

The overall recovery rate of 73.5% is very high, and has positive implications for AET. It means that the Bureau of Turnpikes can expect to collect revenue from about three-fourths of all identified image-based transactions. An important contributor to this high recovery rate is the *toll enforcement reciprocity agreement* that exists among the states of New Hampshire, Massachusetts, and Maine. This agreement, signed in August 2011, provides two important enforcement mechanisms:

- The first mechanism is *information sharing*. The Motor Vehicle departments for each state agree to provide addresses to the other states to support the sending of invoices for unpaid tolls. For example, if a vehicle from Maine owes unpaid tolls to the NH Bureau of Turnpikes, then Maine agrees to provide the address of the observed violator to New Hampshire.
- The second mechanism is *penalty enforcement*. Each state agrees to let the reciprocal states impose penalties to collect unpaid tolls. Following the example above, if the Maine driver repeatedly fails to render payment to New Hampshire, then the Bureau of Turnpikes can petition Maine to impose its penalties (e.g. deny registration) until the driver pays his unpaid tolls to New Hampshire.

The reciprocity agreement has been very effective in enabling agencies to collect unpaid tolls. From the perspective of Dover and Rochester, a key reason for the agreement’s effectiveness is that *the vast majority of drivers at these plazas are from reciprocal states*. This is highlighted by Table 3-2, which was derived from data collected from the Dover and Rochester plazas in May 2014.³ The chart summarizes license plate data for cash-paying customers observed at these plazas.

² Drivers who do not pay when passing through toll facilities on the New Hampshire Turnpike are not formally considered “violators” until they fail to pay the 2nd invoice.

³ The data was collected as part of the previous AET feasibility study entitled *AET Feasibility Analysis and Comparative Assessment of ORT*, completed for the NH Bureau of Turnpikes in January 2015.

Table 3-2 – License Plate Registration Summary for Cash-Paying Customers at Dover & Rochester

LICENSE PLATE REGISTRATION	DOVER	ROCHESTER
NH	70.3%	75.1%
MA	11.7%	9.5%
ME	12.1%	11.3%
REST OF NEW ENGLAND	1.8%	1.5%
CANADA	0.7%	0.2%
OTHER	3.5%	2.3%

As Table 3-2 indicates, **approximately 95% of all cash-paying traffic at Dover and Rochester is from one of the reciprocal states.** This means that—for all but 5% of likely drivers—the Bureau of Turnpikes can aggressively pursue (through acquiring addresses and implementing enforcement measures) people who pass through the Dover or Rochester toll plazas without paying. This is a key contributor to the high recovery rate of nearly 75%.

3.5 E-ZPass Market Share Growth

As noted in Section 2.3, the E-ZPass market share at Dover and Rochester has grown consistently. This is illustrated in Figure 3-5, which depicts E-ZPass market share at both facilities on a rolling 12-month basis since mid-2011.

Figure 3-5 – E-ZPass Market Share Growth at Dover & Rochester, June 2011 through February 2017

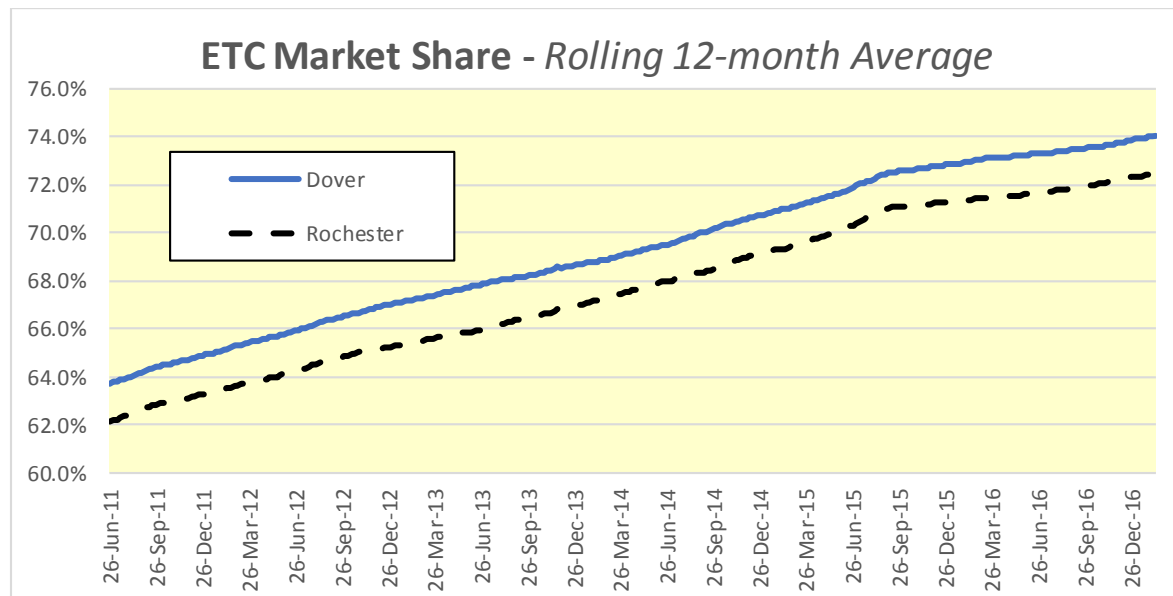
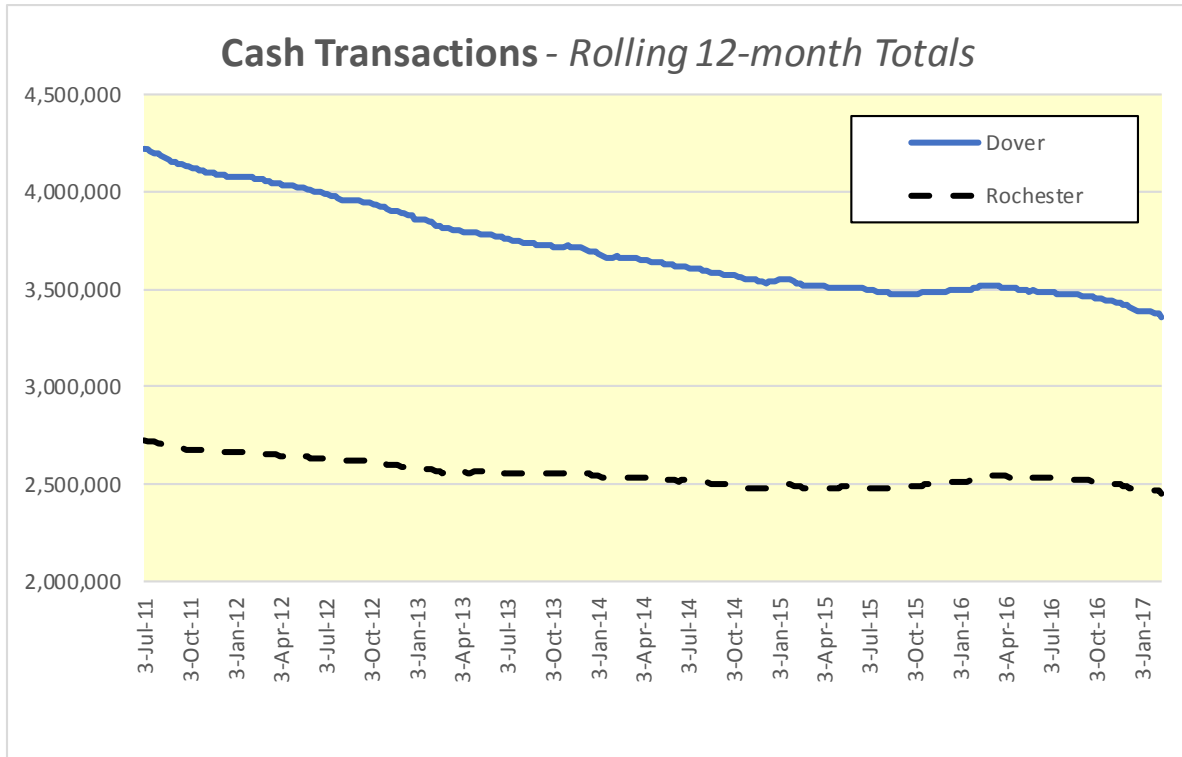


Figure 3-5 indicates that E-ZPass market share has grown by an average of about 1.9% per year since mid-2011, although the rate of growth has tapered off to about 1% annually since September 2015.

One implication of the rapid growth in ETC market share is that cash volumes have declined over time. This has been the case at both Dover and Rochester, as illustrated in Figure 3-6.

Figure 3-6 – Annual Cash Transactions at Dover & Rochester, June 2011 thru February 2017



In short, E-ZPass transactions at Dover and Rochester have been on the rise while cash volumes have been in decline. This is consistent with trends in E-ZPass usage throughout the northeast.

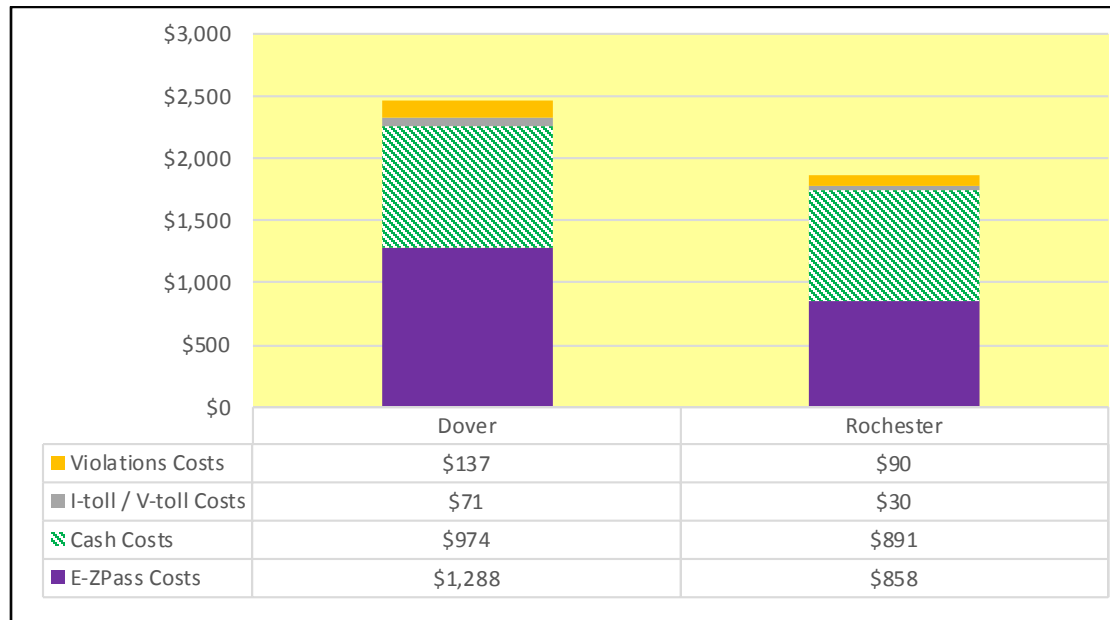
3.6 Fare Collection Costs

The existing fare collection costs at Dover and Rochester can be broken down into four basic categories:

- **Cash costs.** These are the costs associated with handling the cash payments. About 95% of these costs are related to staffing the attended toll plaza lanes. Cash handling costs and banking costs make up the remaining 5% of cash-related costs.
- **E-ZPass costs.** These are the costs associated with managing E-ZPass accounts and processing electronic toll payments. These costs include toll system maintenance costs, the facility and labor costs associated with operating a customer service center, and banking fees for all toll transactions paid via credit card.
- **I-toll / v-toll costs.** These are the costs associated with handling license plate images that can be traced to E-ZPass customer accounts. It covers the cost of reviewing the image, processing the payments, and handling customer questions.
- **Violations costs.** These are the costs associated with reviewing images, performing DMV lookups, mailing invoices, and processing payments.

Figure 3-7 summarizes the fare collection costs associated with each of the categories listed above.

Figure 3-7 – Fare Collection Cost Summary at Dover & Rochester (in thousands of dollars)



As Figure 3-7 illustrates, the overall cash costs are similar in magnitude to the E-ZPass costs. However, E-ZPass transactions outnumber cash transactions by approximately three-to-one. Clearly, E-ZPass is a more cost-effective means of collecting tolls.

In comparing Figure 3-7 with Figure 3-3, one can conclude the following:

- At Dover, the fare collection costs totaled \$2.47 million in 2016. The total revenue collected was \$10.16 million. Therefore, approximately 24% of the revenue was spent in the process of collecting the revenue.
- At Rochester, the fare collection costs totaled \$1.87 million in 2016. The total revenue collected was \$6.89 million. Similar to Dover, approximately 27% of gross toll revenue was spent in the process of collecting the revenue.

Figure 3-8 summarizes the existing unit costs for each of the four basic types of transactions.

Figure 3-8 – Unit Costs for Fare Collection in 2016

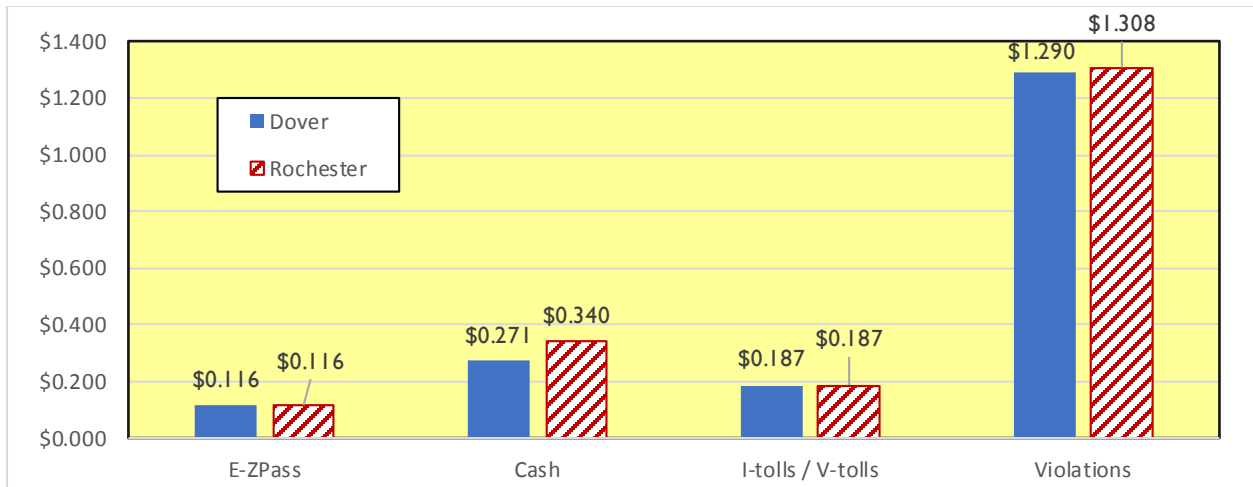


Figure 3-8 illustrates the following:

- E-ZPass transactions are clearly the most cost-effective to handle.
- The unit cost for handling violations, on the other hand, is about 10 times the unit cost of handling E-ZPass transactions. Fees and fines are essential to offset the costs of handling such transactions.
- I-toll and v-toll transactions are costlier to process than E-ZPass transactions. For this reason, the Bureau of Turnpikes does *not* extend the 30% discount to i-toll and v-toll transactions, even if they can be traced to customers with a New Hampshire-based E-ZPass account.

This observation has implications for All Electronic Tolling. Video billing is an essential component of AET. Non-transponder transactions will need to undergo image review, DMV lookup, and invoicing similar to violations processing. To cover the expected additional costs of handling video transactions (compared to the cost of handling as a cash transaction prior to AET), some measures such as invoicing fees and administrative penalties may be needed. These will be addressed in more detail in Section 4.4.

Section 4.0 Key Assumptions and Analytical Framework

To assess the relative feasibility of AET vs. ORT, it is necessary to make some assumptions regarding how transactions, costs, and revenue streams will change when the method of toll collection changes. This section will summarize the key assumptions underlying these projected changes. It will also lay out the analysis framework upon which AET and ORT will be compared.

One overarching assumption for this section is that *either ORT or AET will be deployed at Dover and Rochester in 2020*. There is no “replace in-kind” or “do nothing” option as part of the requested analysis. Any volumes or revenue totals reported in this section will be predicated upon this assumption.

4.1 ORT Assumptions

The conversion to Open Road Tolling, or ORT, involves one fundamental change in the method of toll collection. Under ORT, vehicles equipped with a transponder no longer need to slow down as they pass through a toll plaza. Instead, such vehicles pass underneath a toll gantry at highway speeds via a physically separated and appropriately safety-designed set of lanes, similar to the designs at the Hampton and Hooksett mainline toll plazas today. Cash-paying vehicles continue to pass through conventional portions of the toll plazas and stop to render payment before passing through.

The provision of ORT has implications for traffic composition, for capital costs, and—to a lesser extent—for fare collection costs. These will be discussed in the following subsections.

4.1.1 Traffic Composition

Experience has shown that the conversion of a conventional toll plaza to an ORT plaza has two key impacts on the composition of toll transactions:

- First, it tends to lead to a jump in ETC market share. It appears that the ability to pay tolls at highway speeds provides an incentive for some reluctant customers to acquire a transponder.
- Second, it tends to yield a modest increase in “undefined transactions.” An undefined transaction is any transaction for which a valid transponder transaction is not recorded. Consequently, a license plate image is taken of the vehicle involved in the transaction, thus initiating a collection operation.⁴

The Hampton toll plaza was converted to ORT in 2010, while the Hooksett toll plaza was converted to ORT in 2013. Based on HNTB’s observations of these toll plazas, the following assumptions were made regarding the composition of traffic after conversion to ORT:

- ETC market share will increase by an additional 2.1% over the normal rate of E-ZPass growth.
- The number of undefined transactions will increase by 26.6%.
 - For Dover, this means that the share of undefined transactions is expected to increase from 3.19% of all transactions to 4.04% of all transactions.

⁴ Please see the flowchart in Figure 3-4. An “undefined transaction” will show up in the “Image Captured” block. This triggers the image review process, with all “readable” images being pursued for revenue recovery.

- For Rochester, this means that the share of undefined transactions is expected to increase from 2.24% of all transactions to 2.84% of all transactions.
- The total volume of transactions would not change, assuming that the overall toll rates won't change.

Table 4-1 shows how the baseline projected volumes in 2020 at Dover and Rochester (combined) would be expected to change if ORT were implemented. The total volumes do not change, reflecting the assumption that an ORT conversion will result in little-to-no diversion. Because ORT leaves the existing rate structure intact, ORT should not cause any existing drivers to divert to local roads. This assumption has been borne out by NHDOT's experiences at Hampton and Hooksett, in which no discernible diversion to local roads was observed following conversion to ORT.

Table 4-1 – Projected Changes in Volumes at Dover & Rochester Following Conversion to ORT, 2020

	Existing	ORT	ORT minus Existing	%Change
ETC	21,414,780	21,988,224	573,443	2.7% ⁵
Cash	5,098,793	4,320,328	-778,465	-15.3%
i-tolls / v-tolls	627,925	795,208	167,283	26.6%
Paid Violations	66,594	84,336	17,741	26.6%
Leakage ⁶	75,064	95,062	19,998	26.6%
Total	27,283,157	27,283,157	0	0.0%

In short, the growth in ETC market share results in an increase in ETC volumes, while the anticipated jump in “undefined” transactions leads to a collective increase in i-tolls, v-tolls, violations and leakage. Meanwhile, cash volumes are expected to drop by over 15%. This means that a conversion to ORT would result in roughly 2,000 fewer cash-paying vehicles passing through Dover and Rochester per average day.

4.1.2 ORT Capital Costs

HNTB developed capital cost estimates for implementation of ORT at Dover and Rochester. The estimate involves the demolition of the existing facilities and the construction of a new ORT facility at each location. Both Dover and Rochester will be outfitted with 2 highway-speed lanes and 2 conventional toll collection lanes in each direction. The estimated costs are summarized in Table 4-2.

⁵ It is important to distinguish between changes in ETC market share and changes in ETC volumes. An increase in ETC market share of 2.1% (as noted in the text) yields an increase in ETC volumes of 2.7% (as noted in the table).

⁶ “Leakage” is defined as the volume of traffic passing through a toll facility that does not ultimately pay the toll that is due. Vehicles that pass through as violators, but that eventually pay when issued an invoice, are not counted as “leakage.”

Table 4-2 – ORT Capital Cost Estimates for Dover & Rochester

Cost Category	Dover Cost	Rochester Cost
Roadway Construction	\$3,164,800	\$3,365,350
Maintenance of Traffic	\$474,720	\$504,803
Median Concrete Barrier	\$867,000	\$785,000
Miscellaneous Items	\$474,720	\$504,803
Drainage and Water Pollution Control	\$632,960	\$673,070
Sign Structures	\$750,000	\$750,000
Signing and Pavement Markings	\$158,240	\$168,268
ORT Civil Installation (concrete roadway, gantry, conduits, etc.)	\$1,115,000	\$1,115,000
Tunnel*	\$844,000	\$885,000
Demolition: Toll Booth & Roadway Approaches**	\$600,000	\$455,000
Cash Toll Booth Construction	\$1,000,000	\$1,000,000
Mobilization	\$1,008,144	\$1,020,629
Contingency	\$1,008,144	\$1,020,629
Construction Subtotal	\$12,097,728	\$12,247,551
Engineering (Pre-Construction & Construction) (12%)	\$1,451,727	\$1,469,706
Tebbetts Road Bridge Replacement	n/a	\$2,800,000
Utility Building Construction	\$600,000	\$600,000
ORT Equipment***	\$2,000,000	\$2,000,000
Total Project Cost (unrounded--2017)	\$16,149,455	\$19,117,258
Assumed Annual Inflation Rate:	2.00%	2.00%
Total Project Cost (in ORT Yr1 (2020) -- Rounded)	\$17,138,000	\$20,287,000

* Tunnel will accommodate ORT and side cash power, communications, and portions of equipment. An overhead gantry/walkway could be considered; however, industry experience suggests this structure type is generally costlier.

** The existing toll plaza location in Dover cannot be utilized for an ORT facility. Rather, it requires relocating 1.25 miles to the north for a new ORT facility. This necessitates a complete demolition of the existing facility and a retrofitting of the roadway at the current location.

*** Costs encompass design, equipment, and testing for the ORT and cash lanes.

As Table 4-2 illustrates, the anticipated cost at Rochester is roughly \$3M greater than the anticipated cost at Dover. Most of this cost difference can be attributed to the cost of replacing the Tebbetts Rd. bridge, located roughly one-half mile south of the existing Rochester toll plaza. The bridge would need to be widened to provide the required distance for southbound cash-paying traffic to merge back into the highway-speed lanes.

4.1.3 Fare Collection Costs

The unit costs associated with fare collection under ORT are summarized in Table 4-3. All costs have been projected forward to 2020, which is the first year in which ORT is expected to be operational. For all instances except cash fare collection, the unit costs are the same for Dover and Rochester. The costs are derived from the following:

- Existing cash collection unit costs as calculated by NHDOT for 2016, escalated over 4 years at 2.25% annually
- Existing E-ZPass unit costs as calculated by NHDOT for 2016, escalated over 4 years at 1.50% annually

- Postage costs assume existing unit cost of 37¢ per mailing in 2016, escalated over 4 years at a rate of 2.00% annually
- All other costs provided per contract with existing vendor

Table 4-3 – ORT Fare Collection Unit Costs, 2020 (ORT Year 1)

Fare Collection Category	Unit Cost
Cash collection	\$0.297 per transaction (Dover) \$0.372 per transaction (Rochester)
E-ZPass collection	\$0.123 per transaction
I-toll processing with OCR (including payment processing & posting)	\$960.47 per month for the first 20,000 transactions \$240.12 per batch of 5,000 transactions after the initial 20,000 [equivalent to 4.8¢ per transaction]
I-toll processing without OCR (including payment processing & posting)	\$2,521.77 per month for the first 20,000 transactions \$631.19 per month for each subsequent batch of 5,000 transactions [equivalent to 12.6¢ per transaction]
Violations processing (not including postage)	\$67,787.84 per month for the first 20,000 invoices [equivalent to \$3.39 per invoice] \$12,285.82 per month for each subsequent batch of 5,000 invoices [equivalent to \$2.46 per invoice]
Violations processing – postage	39.3¢ per mailing

Beyond 2020, unit costs were projected forward at the following annual rates:

- Cash collection – 2.25%
- E-ZPass collection – 1.50%
- All other unit costs – 2.00%

In short, fare collection under ORT entails the same basic types of costs as fare collection under existing conditions. The only difference concerns the mix of payment types. Under ORT, we expect fewer cash transactions and more of every other type of transaction (E-ZPass, i-tolls, and violations).

4.2 AET Assumptions

The conversion to AET involves the adoption of one key assumption: *everyone is a customer*. There are no toll evaders in the lanes. Drivers that pass through with a valid transponder are E-ZPass customers. All others are considered video customers whose license plate will be photographed and who will be pursued through the video billing process.

This assumption means that, under AET, *cash customers* become *video customers*. This fundamental change has the following ramifications:

- First, it means that there will be an increase in revenue leakage. If a license plate image cannot be identified, or if no valid address can be found for the identified license plate, or if the customer refuses to pay the invoice, then toll revenue will be lost.

- Second, it means that the cost structure must be modified. Although both E-ZPass collection and i-toll processing continue as cost categories, *cash fare collection* is eliminated as a category. It is replaced by the category of *video account management*, which entails the costs associated with identifying license plates, assigning license plates to video accounts, pursuing addresses via DMV lookup, compiling bills, distributing invoices, processing payments, and fielding questions from video customers.

Changing the collection method from cash toll collection to video toll collection will eliminate the need for personnel in toll booths (since cash tolls are no longer collected) while simultaneously increasing the need for staff in the back office. The net effect is generally an increase in toll collection costs. This is because the unit cost of collecting a video toll is generally higher than the unit cost of collecting a cash toll. At Dover and Rochester, HNTB estimates that the effective cost to handle each video transaction will be roughly 44¢, compared to an average of 34¢ per cash transaction under existing conditions.⁷

- Third, it means a likely change to the toll rate and fee structures. As noted above, AET yields greater revenue leakage and higher toll collection costs that are not offset by savings in cash collection costs. The result is a decline in net operating revenue.⁸ In order to meet either the *revenue neutrality test* (which focuses on operations costs) or the *net revenue test* (which includes capital costs) for financial feasibility, most agencies converting to AET have found it necessary to implement a combination of toll rate surcharges and fees for video transactions.
- Fourth, it means that capital costs can potentially be reduced. No longer will costlier conventional toll plazas be required to provide a place for toll attendants to stand and process payments. Instead, all toll equipment can be situated on lower cost overhead gantries and supporting facilities that will allow vehicles of all payment types to pass through the facility without stopping. This reduces the construction costs of the facility as well as the physical number of lanes required.

The subsections that follow will discuss these ramifications in more detail.

4.2.1 Traffic Composition and Revenue Leakage

To estimate how the composition of traffic would change under a conversion to AET, HNTB made the following assumptions:

- A video toll surcharge will be calculated based on the need to achieve revenue neutrality. The surcharge will be applied at a fixed amount higher than existing toll fare charged to cash-paying customers. The fixed amount may be on either a *fixed percentage* basis or on a *fixed price* basis. This will be necessary to offset the expected revenue leakage.
- Appropriate fees and fines may be assessed to cover the increased costs related to managing video accounts that are not countered by savings in removing cash collection.

⁷ The video rate of 44¢ per transaction assumes a low frequency of travel. The unit cost will decline if the actual frequency of travel is greater. This topic is discussed in more detail in the text accompanying Figure 6-2 (see Section 6.1).

⁸ As noted in Section 1.2, net operating revenue is defined as gross toll revenue less the costs associated with collecting the toll revenue.

- Because of the rate increase related to the video toll surcharge, a percentage of existing cash customers will divert off the roadway to avoid the toll. Based on HNTB’s knowledge of New Hampshire Turnpike traffic and revenue trends, coupled with consultation with the Bureau of Turnpikes, HNTB assumed a toll elasticity of demand of **-0.075**. To illustrate its impact, consider a situation in which a 75¢ cash toll is increased to \$1.30. This represents an increase of 73%. To estimate the resulting diversion, the elasticity is multiplied by the percentage toll increase. Thus, the resulting change in cash-paying demand would be $(-0.075 * 73\%)$, or -5.5%. In other words, a 73% toll increase would yield a 5.5% reduction in cash-paying volume, based on this assumed rate of elasticity.
- Immediately following conversion to AET, the analysis assumes the overall market share of ETC customers will increase by an additional **4.0%** over the normal rate of E-ZPass growth. Part of this growth in market share will be a result of some drivers shifting to ETC to avoid the surcharge, and part will be a consequence of having fewer cash-paying customers due to diversion.⁹
- Of all transactions that are *not* valid ETC transactions in the lane:
 - Approximately **25%** will be i-toll and v-toll transactions. This is consistent with experience at other AET facilities with which HNTB has direct experience.
 - Approximately **14%** of the transactions will yield license plate images that cannot be invoiced, consistent with current experience on the New Hampshire Turnpike. Most of the lost transactions (approximately 11% out of 14%) are attributable to unreadable images. Other contributors to lost transactions include plates that are rejected by DMVs and plates that belong to states whose DMVs have not agreed to share data with New Hampshire.
 - The remaining **61%** of transactions are invoiced to the video customers. Most of these transactions (**80%**) will ultimately be paid, consistent with the response rate observed today in NHDOT’s violations enforcement system.

Table 4-4 summarizes the projected changes in volumes that would likely follow a conversion to AET in 2020, assuming a surcharge of 73% (which equates to 55¢ for passenger cars) per transaction.

Table 4-4 – Projected Changes in Volumes at Dover & Rochester Following Conversion to AET, 2020

	Existing	AET	AET minus Existing	%Change
ETC	21,414,780	22,282,324	867,544	4.1%
Cash (Ex) / Paid Video (AET)	5,157,757	2,187,491	-2,970,266	-57.6%
i-tolls & v-tolls	627,925	1,171,721	543,796	86.6%
Paid Violations*	7,630	33,357	25,727	337.2%
Leakage	75,064	1,329,416	1,254,352	1671.0%
Total	27,283,157	27,004,309	-278,848	-1.0%

* “Paid Violations” entails payments that are rendered following the sending of a “violations notice.” Under both existing conditions and AET, a “violations notice” is only sent if the preceding two invoices were ignored.

A key observation from Table 4-4 is that AET may lead to both **diversion** (expected to be about 279k transactions at Dover and Rochester combined) and **increased leakage** (expected to be about 1.3

⁹ However, as will be subsequently discussed in Section 4.6, the annual growth in E-ZPass market share in all subsequent years after conversion to AET will diminish.

million transactions) in Year 1. Leakage at Dover and Rochester, which comprises a mere 0.3% of all transactions under existing conditions, is expected to comprise **nearly 5%** of all transactions under AET. As mentioned earlier, this large jump in transactions that don't yield revenue will necessitate the imposition of a higher tolls (through the incorporation of a video surcharge) and/or other fees to achieve revenue neutrality.

4.2.2 Fare Collection Costs

Under AET, all transactions that cannot be traced to an E-ZPass account will be assigned to a video account. The handling of these transactions yields a cost structure that differs from the existing framework. Although the costs per E-ZPass transaction and per i-toll transaction are not expected to change, the costs associated with all other transactions are likely to change significantly.

Table 4-5 summarizes the unit costs assumed in HNTB's analysis. The costs associated with video transactions are representative of costs incurred in the industry.

Table 4-5 – AET Fare Collection Unit Costs, 2020 (AET Year 1)

Fare Collection Category	Unit Cost
E-ZPass collection	\$0.123 per transaction
I-toll processing with OCR (including payment processing & posting)	\$960.47 per month for the first 20,000 transactions \$240.12 per batch of 5,000 transactions after the initial 20,000 [equivalent to 4.8¢ per transaction]
I-toll processing without OCR (including payment processing & posting)	\$2,521.77 per month for the first 20,000 transactions \$631.19 per month for each subsequent batch of 5,000 transactions [equivalent to 12.6¢ per transaction]
Video account management (not including postage)	\$1.62 per account-month. [This includes all costs related to account management, including image review, DMV lookup, invoicing, payment processing, and customer service.]
Video invoice	39.3¢ per mailing
Credit Card Fees	2.1% of all video tolls, fees, and fines paid via credit card.

Beyond 2020, unit costs were projected forward at the following annual rates:

- E-ZPass collection – 1.50%
- Credit Card Fees – The percentage of 2.1% was held steady throughout the analysis period
- All other unit costs – 2.00%

4.2.3 Fare Structure

To develop valid assumptions regarding the fare structure that would likely be employed by NHDOT if it were to deploy AET, HNTB performed a survey of various agencies that have already deployed AET. The purpose of the survey was to evaluate whether there were any generally-accepted approaches to imposing surcharges, fees, and/or fines as a means of covering the likely leakage associated with AET.

The results of this survey were provided earlier in this report in Table 2-1. A detailed review of this table indicates the following three general approaches that agencies have adopted in developing a fare structure supportive of AET:

- First, all agencies charge video customers a higher toll rate than is charged to ETC customers. In some cases, the surcharge is a fixed dollar amount; in other cases, it is a fixed percentage. The purpose of the surcharge is to help cover the revenue loss associated with increased leakage under AET.
- Second, agencies tend to incorporate fees into the invoicing process. In some cases, the fees are incorporated into the first invoice; in other cases, the fees aren't added until the second notice. The purpose of these fees is to cover the additional handling costs associated with processing video tolls.
- Finally, agencies tend to add stiffer penalties if customers fail to respond to the first couple of invoices. In some cases, the penalties are a fixed amount per invoice; in other cases, the penalties are applied on a per-transaction basis. The purpose of these penalties is to compel payment of outstanding tolls and to recover the sunk costs of pursuing the delinquent payments.

Considering these findings, HNTB identified five different tools that could be employed by NHDOT to facilitate additional revenue collection to offset the revenue loss. These tools include the following:

- A surcharge of a fixed percentage (or, alternatively, a fixed amount) to be applied to the existing cash rate.
- A mailing fee of 65¢ to cover the cost of mailing the invoice.
- An account management fee of \$1.50 per month to help cover NHDOT's costs of maintaining the video accounts.
- A late fee of \$1.50 to be imposed if the first invoice isn't paid.
- An administrative penalty of \$25 to be imposed if both the first and second invoices were ignored by the customer.

Section 4.4 will identify four different AET scenarios in which these tools are employed in various combinations to support the financial feasibility of AET.

4.2.4 AET Capital Costs

HNTB developed capital cost estimates for implementing AET at both Dover and Rochester. The cost estimates encompassed the cost of demolishing the existing facilities and replacing them with new AET facilities, including the cost of the toll system itself. The cost estimates are summarized in Table 4-6.

Table 4-6 – AET Capital Cost Estimates for Dover & Rochester

Cost Category	Dover	Rochester
Cash Toll Booth Demolition	\$600,000	\$455,000
AET Civil Installation (concrete roadway, gantry, conduits, etc.)	\$1,115,000	\$1,115,000
Toll Equipment	\$2,000,000	\$2,000,000
Administrative Building Upgrade	\$200,000	\$200,000
Maintenance of Traffic Control	\$191,500	\$177,000
Mobilization	\$114,900	\$106,200
Contingency	\$191,500	\$177,000
Construction Subtotal	\$4,412,900	\$4,230,200
Pre-Construction Engineering (10%)	\$441,290	\$423,020
Construction Engineering (10%)	\$441,290	\$423,020
Total Project Cost (unrounded – 2017)	\$5,295,480	\$5,076,240
	<i>Assumed Annual Inflation Rate:</i> 2.00%	2.00%
Total Project Cost (in AET Yr 1 – rounded)	\$5,620,000	\$5,387,000

In comparing Table 4-6 with Table 4-2, one sees that the capital costs for AET are considerably lower than the capital costs for ORT. At Dover, the difference is about \$11.5 million; at Rochester, the difference is nearly \$15 million.

4.3 Evaluation Framework

As noted in Section 1.2, HNTB evaluated financial feasibility from two perspectives. The first employed a “revenue neutrality” test, while the second employed a “net revenue” test.

HNTB’s evaluation of the financial feasibility of AET from the “revenue neutrality” perspective involved the following steps.

- **Step 1.** At each toll plaza (Dover and Rochester), HNTB calculated the net operating revenue under ORT for each year from 2020 through 2040. “Net operating revenue” was defined as gross toll revenue (including toll revenue, as well as fees and fines from violators) less the costs associated with collecting the tolls.
- **Step 2.** In similar fashion, HNTB calculated the net operating revenue under AET.
- **Step 3.** HNTB calculated the “change in net operating revenue” for each year from 2020 through 2040. This was calculated by taking the net operating revenue under AET and subtracting the net operating revenue under ORT. A positive number indicated that net operating revenue under AET was greater than net operating revenue under ORT.
- **Step 4.** The “change in net operating revenue” for each year was discounted back to 2020 dollars by applying a discount rate of 3.0%. For example, if the value of the “change in net operating revenue” was \$1,000,000 in 2027, this value was discounted back to 2020 dollars by applying the following formula:

$$\text{Discounted change in net operating revenue} = \frac{\$1,000,000}{(1+0.03)^{2027-2020}} = \$813,092$$

- **Step 5.** The discounted values for each year were summed for the entire period from 2020 through 2040.
- **Step 6.** The total discounted value for Dover was added to the total discounted value for Rochester. The sum represented the “Net Present Value” (NPV) of AET.

If the NPV was greater than 0, then AET was considered financially feasible.

HNTB’s evaluation of the financial feasibility of AET from the “net revenue” perspective involved the same six steps. The only difference was that, instead of basing the calculations on net operating revenue, the calculations were based on “overall net revenue.” For purposes of this study, “overall net revenue” is defined as gross toll revenue less the operations costs **plus** capital costs.

Sections 5.1 through 5.4 will provide detailed results of the feasibility analysis from the “revenue neutrality” perspective. Section 5.5 will summarize the “net revenue” analysis, providing a detailed discussion of the implications of capital cost impacts on AET feasibility.

4.4 Scenarios for Evaluation

The purpose of HNTB’s analysis was to evaluate a range of scenarios to test whether AET would be financially feasible compared to ORT. Therefore, four unique AET scenarios were defined and evaluated for their revenue-generating potential. Each scenario was characterized by defining the costs associated with four different elements:

- **Video Toll Rate.** This represents the toll rate assessed to video customers (that is, customers whose vehicle is not equipped with a valid E-ZPass transponder) passing through either the Dover or the Rochester toll plazas. For discussion purposes, only the rates for passenger cars will be highlighted.
- **Level 1 Invoice.** This includes fees associated with the initial invoices sent to video customers.
- **Level 2 Invoice.** This includes fees associated with a follow-up invoice sent to customers who failed to respond to the Level 1 invoice. These invoices are typically sent 30 days after the initial invoice. Additional fees are typically incorporated into these invoices to cover the additional costs associated with multiple mailings.
- **Level 3 Violations Notice.** This represents any fees and fines associated with a third invoice sent to customers who failed to respond to both the Level 1 and the Level 2 invoice. These invoices, whose fees are more punitive than the previous two invoices, are typically sent about 60 days after the initial invoice.

Table 4-7 summarizes the four scenarios defined by HNTB for its feasibility analysis.

Table 4-7 – Evaluation Scenarios

Cost Category	Scenario 1 <i>Existing Business Rules</i>	Scenario 2 <i>Base Case</i>	Scenario 3 <i>Cover Cost of Account Handling</i>	Scenario 4 <i>Add Surcharge</i>
Video Toll Rate	75¢ per trans. <i>existing cash fare (no surcharge)</i>	75¢ per trans. <i>existing cash fare (no surcharge)</i>	75¢ per trans. <i>existing cash fare (no surcharge)</i>	\$1.30 per trans. <i>73% surcharge</i>
Level 1 Invoice	\$1.00 fee per transaction	65¢ per invoice <i>= 65¢ mailing fee</i>	\$2.15 per invoice <i>= 65¢ mailing fee + \$1.50 acct. mgt. fee</i>	\$2.15 per invoice <i>= 65¢ mailing fee + \$1.50 acct. mgt. fee</i>
Level 2 Invoice	\$1.50 fee per transaction	\$2.80 per invoice <i>= \$1.30 mailing fee + \$1.50 late fee</i>	\$5.80 per invoice <i>= \$1.30 mailing fee + \$1.50 late fee + \$3.00 acct. mgt. fee</i>	\$5.80 per invoice <i>= \$1.30 mailing fee + \$1.50 late fee + \$3.00 acct. mgt. fee</i>
Level 3 Violations Notice	\$25.00 fee per transaction	\$26.95 per invoice <i>= \$1.95 mailing fee + \$25 admin penalty</i>	\$31.45 per invoice <i>= \$1.95 mailing fee + \$4.50 acct. mgt. fee + \$25 admin penalty</i>	\$31.45 per invoice <i>= \$1.95 mailing fee + \$4.50 acct. mgt. fee + \$25 admin penalty</i>

In reviewing Table 4-7, please note the following:

- Scenario 1 represents NHDOT’s existing business rules for dealing with non-payments. This scenario does not employ a surcharge, but instead applies a per-transaction fee that escalates with each successive level of notice that is distributed. The differences between this scenario and Scenarios 2 through 4 is discussed in more detail in Section 4.5.
- Scenarios 2 through 4 represent a revised pricing framework for handling non-ETC transactions. The revised framework is consistent with approaches taken by other agencies that have implemented AET (as documented in Table 2-1).
- Of the scenarios that adopt the revised pricing framework, Scenario 2 is the least aggressive in terms of its revenue-generating potential, while Scenario 4 is the most aggressive.
- The term “Base Case” (applied to Scenario 2) is not meant to suggest that it represents the same processes that NHDOT employs today in its pursuit of non-payments through current violations processing. Rather, it simply represents a “minimalist” approach that includes no surcharge and only very modest fees to cover the cost of mailing the invoice.
- The video toll rate—that is, the toll rate assessed to customers who do not possess an E-ZPass transponder—represents the current cash toll rate plus a video surcharge. A 73% video surcharge on a 75¢ toll rate would therefore present an additional charge of 55¢. Thus, a 73% surcharge scenario would yield a video toll rate of 75¢ (the base toll rate) plus 55¢ (the video surcharge) equaling **\$1.30**.
- Mailing fees (as employed in Scenarios 2 through 4) escalate over time to cover the cumulative cost of the mailings. An initial invoice costs roughly 65¢ to mail, and it is therefore recovered through a mailing fee of 65¢. If the customer fails to respond to the initial invoice, then a second invoice is distributed with a mailing fee of \$1.30. The higher mailing fee is designed to ensure that the customer covers the cost of both mailings.

- Similar to the manner in which mailing fees are handled, Account Management fees (as employed in Scenarios 3 and 4) escalate over time. This fee is intended to cover the costs associated with maintaining an account. It primarily includes the labor costs associated with opening and closing accounts, handling customer questions and disputes, and processing payments. Account Management fees are typically assessed on a monthly basis for active accounts. Every month that transpires in which an account has an unpaid balance, the Bureau of Turnpikes is assessed an Account Management fee. Therefore, if a customer doesn't respond to a first invoice, then he must be assessed an Account Management fee covering the two-month period in which the account had an unpaid balance.

4.5 Comparison of Scenarios 1 (Existing Processes) with Scenarios 2 through 4 (Revised Pricing Framework)

Scenarios 2 through 4 (as summarized in Table 4-7) represent a change from the current way in which NHDOT charges customers who are billed via mail.

- Today, when NHDOT sends an initial invoice to a driver who failed to pay in the lane, the invoice includes a \$1.00 processing fee per unpaid transaction.¹⁰ For example, consider a customer who is being billed for 4 transactions through a plaza (e.g. Dover) that assesses a 75¢ toll. That customer would be charged \$1.75 per transaction—75¢ for the toll and \$1.00 for the processing fee. The bill would therefore be \$7.00.
- The proposed scenarios assess fees on a per invoice basis. Therefore, the fee is the same regardless of whether the invoice is for a single transaction or multiple transactions.

In other words, Scenarios 2 through 4 distinguish “surcharges” (which are applied on a per-transaction basis) from “fees” (which apply on a per-invoice basis). Many agencies have found this distinction to be helpful for the following reasons:

- First, this distinction makes the invoicing process consistent with processes employed by various agencies that have already implemented AET.
- Second, the distinction is helpful because surcharges serve a different function from fees.
 - Surcharges are generally designed to help cover revenue loss due to leakage. HNTB's analysis indicates that the Bureau of Turnpikes experiences a systemwide leakage rate of about 0.6% under existing conditions. This is expected to jump to nearly 5% upon conversion to AET. The purpose of the surcharge is to compensate for the revenue loss associated with this increased leakage.
 - Fees, on the other hand, are designed primarily to help cover the additional costs associated with processing video tolls. Additionally, they provide a mechanism for encouraging prompt payment of the invoices and a financial incentive for customers to shift to electronic toll collection. They are *not* intended as a tool for generating significant revenue.

¹⁰ This fee escalates to \$1.50 per transaction if 30 days passes without the initial invoice being paid.

- Third, the distinction provides more flexibility to respond to future net revenue needs. If fare collection costs escalate, then the fees could increase without touching the surcharge. On the other hand, if the Bureau of Turnpikes needs a revenue adjustment, it could increase the surcharge without touching the fees.

To illustrate the impact of transitioning from the current fee-based structure to the proposed “surcharge plus fee” structure, consider a scenario in which a driver records four video transactions at Dover in the month of January. Table 4-8 illustrates the charges that would be posted on the invoices that would be sent to this driver. The charges at each level assume that the driver did not pay the preceding invoice and did not record any additional transactions

Table 4-8 – Invoice Comparison for Typical Turnpike Usage

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
	<i>Existing Business Rules</i>	<i>Base Case</i>	<i>Cover Account Handling Costs</i>	<i>Add Surcharge</i>
Level 1 Invoice <i>sent in February</i>	\$ 7.00	\$ 3.65	\$ 5.15	\$ 7.35
Level 2 Invoice <i>sent in March</i>	\$ 9.00	\$ 5.80	\$ 8.80	\$ 11.00
Level 3 Viol. Notice <i>sent in April</i>	\$ 103.00	\$ 29.95	\$ 34.45	\$ 36.65

As Table 4-8 illustrates, the charges associated with “Level 1” and “Level 2” of the existing violations policy (Scenario 1) are comparable to the charges for the four scenarios under consideration. However, the charges associated with Level 3 are *approximately three times higher* under Scenario 1. This is because the \$25 administrative penalty is applied on a *per transaction* basis under the existing violations policy, whereas it would be applied on a *per invoice* basis in Scenarios 2 through 4. Most agencies have chosen to avoid this tremendous jump from “Level 2” billing amounts to “violations” billing amounts by applying administrative penalties on a per-invoice basis.¹¹

4.6 AET Conditions of Analysis

HNTB’s experience with AET assessments at other facilities has revealed that feasibility is closely related to the following two variables:

Key feasibility variable #1 – Trip frequency. This variable refers to the frequency with which video customers travel on a given facility. For a given number of transactions in a month, it is cheaper for an agency to send invoices to a smaller number of customers with more transactions per invoice, as compared to sending invoices to a greater number of customers with fewer transactions per invoices. In other words, a facility characterized by frequent travelers will tend to be more cost-

¹¹ This is illustrated in Table 2-1, in which—of the five agencies listed—only the Northwest Parkway chose to apply its administrative penalty on a per-transaction basis.

effective than a facility characterized by infrequent travelers because it involves less labor associated with mailing and processing invoices.

HNTB considered two alternative possibilities for trip frequency associated with video customers:

- A lower-end frequency alternative in which video customers average **14 trips per year**. This is comparable to the trip frequency observed on the Henry Hudson Bridge.
- A higher-end frequency alternative in which video customers average **27 trips per year**. This is comparable to the trip frequency observed on various NTTA facilities.

Key feasibility variable #2 – E-ZPass growth after AET. This variable refers to the rate at which E-ZPass usage grows after conversion to AET. As Section 2.3 noted, some facilities have experienced a slowing of ETC market share growth once AET is implemented. All else being equal, a facility that has a higher rate of E-ZPass growth will be more cost-effective over time than a facility that has a lower rate of E-ZPass growth.

HNTB considered two alternative possibilities with respect to growth in E-ZPass transactions:

- A lower-end growth alternative in which E-ZPass transactions grow at a rate of 2.2% to 2.4% annually. This corresponds to a minimal growth in E-ZPass market share (approximately 0.1%) from year to year. This is consistent with observations drawn from existing AET facilities observed by HNTB in Colorado and Texas (see Figure 2-2 and Figure 2-3).
- A higher-end growth alternative in which E-ZPass transactions grow at a rate of 2.7% to 3.0% annually. This corresponds to a small but consistent growth in E-ZPass market share (approximately 0.5%) from year to year.

Therefore, to evaluate the impact of these two variables on AET feasibility, HNTB evaluated four different conditions within each of the five scenarios identified in Table 4-7. These four conditions of analysis represent the four unique combinations of trip frequency and E-ZPass growth. They include:

- Condition #1 – Lower-end frequency of travel & lower-end E-ZPass growth
- Condition #2 – Lower-end frequency of travel & higher-end E-ZPass growth
- Condition #3 – Higher-end frequency of travel & lower-end E-ZPass growth
- Condition #4 – Higher-end frequency of travel & higher-end E-ZPass growth

4.7 Simulation of Results

One characteristic of any AET conversion is uncertainty. The results of the analysis are closely related to the assumptions, and the assumptions cannot be confirmed until the facility has been operational.

To help understand the impact of uncertainty, HNTB performed a simulation in its assessment of feasibility. Simulation involves the following:

- Assigning *ranges* of values to key variables.
- Running several (i.e. 2000) iterations of each scenario of the net revenue model, with each iteration calculating a unique net revenue result by randomly selecting unique combinations of values for the selected variables.

- Calculating the 20th, 50th, and 80th percentile outputs for net revenue to establish a reasonable range of likely outcomes.

HNTB utilizes a special software package to perform the simulation. In doing so, the results of the analysis are expressed as ranges. The low end of the range represents the 20th percentile output, meaning that the only 20 percent of the net revenue outputs generated during the simulation process were lower than it. The high end of the range represents the 80th percentile output, meaning that 80 percent of the outputs generated during the simulation process were lower than it. The 20th percentile output represents a lower-end (or “conservative”) outcome, whereas the 80th percentile output represent an upper-end (or “optimistic”) outcome.

The following variables were assigned ranges of values as part of the simulation process:

- **AET Fee Forgiveness.** This value represents the percentage of fees and fines (assessed to video customers under AET) that are expected to get waived. A range of between 10% and 30% was assumed, with a likely value of 20%.¹²
- **Year 1 Jump in E-ZPass Market Share under ORT.** Experience at Hampton and Hooksett has demonstrated that E-ZPass market share will increase after conversion to ORT. It was assumed that this value would range from between 1% and 3%, with an expected value of 2.1% (the value most recently observed at Hooksett after its conversion to ORT in 2013).
- **Year 1 Jump in E-ZPass Market Share under AET.** As noted in Section 4.2.1, HNTB assumed that E-ZPass market share after conversion to AET would jump by 4%. However, in its simulations, HNTB assumed that this increase could vary from between 3% and 5%, with a likely value of 4%.
- **Customer Percentage of non E-ZPass Transactions after Conversion to AET.** Section 4.2.1 also noted that, after conversion to AET, 25% of all transactions that are *not* valid E-ZPass transactions are expected to be either i-toll or v-toll transactions. Experience at other facilities has shown this figure to be somewhat variable. Therefore, HNTB assumed that this share would range from 20% to 33%, with a likely value of 25%.
- **Toll Elasticity of Demand.** Toll elasticity of demand can experience considerable variability. Its value depends on trip purpose (e.g. recreational trips tend to have lower elasticities than work trips), the value of the toll rate itself (lower tolls tend to be associated with lower elasticities), and the prevailing wage rate (drivers with higher wage rates tend to be less sensitive to toll rates). For this reason, HNTB evaluate the impact of a range of toll elasticities of demand, varying from -0.025 to -0.125, with a likely value of -0.075.¹³
- **Unreadable Share of Video Transactions.** An analysis of NHDOT’s current image review process found that 10.8% of all images taken were not readable, either because the plate was obscured (e.g. through mud or snow) or because the quality of the image was poor. HNTB’s simulation evaluated the impact of a range of values from 7% to 15%, with a likely value of 10.8%.

¹² Currently, as part of its violations enforcement process, NHDOT waives 17% of fees and fines at Dover and 21% of fees and fines at Rochester.

¹³ As a point of reference, HNTB tracked volumes at the Hampton Toll Plaza back in the summer and fall of 2003, when the Bureau of Turnpikes performed a one-way tolling trial. This involved doubling the toll in the northbound direction and eliminating the toll in the southbound direction. HNTB’s analysis found that diversion around the northbound toll varied from 3% to 12%, depending on the week. This variation corresponds almost exactly with the assumed range of diversion used in this study.

- **7 Days to Pay Program.** The Bureau of Turnpikes has a program today by which customers that drive through the toll facility without paying can go on-line after the trip and render payment.¹⁴ If they do so within 7 days, they can avoid the \$1.00 fee that is attached to all transactions billed through the mail. Current data suggests that approximately 2.5% of all non-payments in the lane are ultimately paid through this program. HNTB assumed that, under AET, the “7 Days to Pay” market share would increase slightly, up to a level ranging from 5% to 10%, with a likely value of **7.5%**.

4.8 Analysis Approach Summary

HNTB’s approach to assessing AET feasibility may be summed up as follows:

- HNTB analyzed four different scenarios, with each scenario representing a distinct approach to assessing fares, fees, and fines to video customers.
- Within each scenario, four different conditions were evaluated, with each condition representing a unique combination of frequency of travel (lower-end and higher-end) and E-ZPass transaction growth (lower-end and higher-end).
- For each scenario, in each condition, a range of net present values (NPV) was generated. The net present value represented the total net revenue generated in AET, less the total net revenue generated in ORT. A positive value would indicate that AET is expected to generate greater net revenue than ORT and is therefore feasible. The calculation of total net revenue encompassed the period from 2020 (the projected opening year for AET, if it were to be implemented) through 2040. All values were discounted back to 2020 dollars using a discount rate of 3% annually.
- NPV calculations were performed for both the *revenue neutrality test* (which incorporated operations costs only) and the *net revenue test* (which incorporated by operations costs and capital costs).

¹⁴ More details about this program can be seen at <https://www.ezpassnh.com/postpay-trip>.

Section 5.0 Analysis Results

This section presents the results of HNTB’s analysis of AET financial feasibility. It will summarize the results by scenario, starting with Scenario 1 (which employs current business rules) and running through Scenario 4 (the most aggressive of the scenarios that assume a revised pricing framework).

Sections 5.1 through 5.4 will focus on the **revenue neutrality test**, which calculates the net present value for each of the four scenarios **without consideration of capital costs**. Section 5.5 will focus on how each scenario performs under the *net revenue test*, which accounts for the differences in capital costs between ORT and AET.

5.1 Scenario 1 – Existing Business Rules

As noted earlier, Scenario 1 replicates NHDOT’s existing business rules for handling non-payments in the lanes. Of all the scenarios evaluated as part of this study, Scenario 1 employs the highest per-transaction charges. However, it does not include any invoice-level fees (e.g. mailing fees).

Table 5-1 summarizes the results of HNTB’s net present value analysis for Scenario 1. As noted above, the NPV figures in Table 5-1 are calculated on a revenue neutrality basis, which does not factor in capital costs.

Table 5-1 – NPV Results for Scenario 1, 2020 thru 2040 (in millions of dollars)

	Dover	Rochester	Combined
Condition #1: <i>Low Frequency of Travel – Low E-ZPass Growth</i>	-\$1.11 to \$1.03	\$1.22 to \$2.89	\$0.10 to \$3.94
Condition #2: <i>Low Frequency of Travel – High E-ZPass Growth</i>	-\$0.48 to \$1.05	\$1.62 to \$2.89	\$1.15 to \$3.95
Condition #3: <i>High Frequency of Travel – Low E-ZPass Growth</i>	\$8.74 to \$11.75	\$8.54 to \$10.91	\$17.26 to \$22.69
Condition #4: <i>High Frequency of Travel – High E-ZPass Growth</i>	\$5.44 to \$8.02	\$6.11 to \$8.23	\$11.53 to \$16.24

The key result documented in Table 5-1 is that **the Combined change in net present value associated with Scenario 1 is expected to be positive.**

- Even in the most pessimistic of conditions (Condition #1), AET is expected to generate positive net revenue compared to ORT. The net present value under AET in Condition 1 is expected to generate somewhere between \$0.1M and \$3.9M more than ORT over the 20-year period from 2020 through 2040.

- Moreover, if “Condition #3” were to be most reflective of future conditions (in which AET is characterized by video customers that travel with higher-end frequency and by low growth in E-ZPass market share), then AET could yield an increase in net revenue of ±\$20 million. This equates to a net revenue increase of *approximately \$1 million per year* throughout the analysis period (relative to ORT).

5.2 Scenario 2 – Base Case

As noted in Table 4-7, Scenario 2 (as applied to Dover and Rochester) involves the following measures:

- *Video Toll Rate* – Video customers will be charged the same toll rate as existing cash customers. For passenger cars, this would be 75¢.
- *Level 1 Invoicing* – In addition to the outstanding tolls, customers would be assessed a 65¢ fee to cover the cost of mailing the initial invoice (i.e. the envelope plus postage).
- *Level 2 Invoicing* – In addition to the outstanding tolls, customers would be assessed a \$1.30 mailing fee as well as a \$1.50 late fee.
- *Level 3 Violations Notice* – This would be similar to Level 2, except that (a) the mailing fee would be increased to \$1.95, and (b) the \$1.50 late fee would be replaced with a more punitive \$25 administrative penalty.

In short, Scenario 2 represents a very basic approach to pricing that attempts to achieve two goals—maintain the existing toll rates and minimize fees. It pursues these goals in such a way that it still provides an incentive to pay promptly. In doing so, Scenario 2 adopts a fee structure that is more consistent with approaches adopted by other agencies that have converted to AET.

As with all scenarios, a \$25 administrative penalty is appended to the third invoicing level. The purpose of this more punitive measure—a measure consistent with actions taken by virtually every other agency that has implemented AET—is to deter excessive delays in the payment of overdue tolls.

Table 5-2 summarizes the Net Present Value results for Scenario 2. Keep in mind that a negative number suggests that ORT is more advantageous from the perspective of net revenue.

Table 5-2 – Net Present Value Results for Scenario 2 (Base Case), 2020 thru 2040 (in millions of dollars)

	Dover	Rochester	Combined
Condition #1: Low Frequency of Travel – Low E-ZPass Growth	-\$21.68 to -\$19.47	-\$14.21 to -\$12.71	-\$35.89 to -\$32.19
Condition #2: Low Frequency of Travel – High E-ZPass Growth	-\$14.21 to -\$11.94	-\$8.86 to -\$7.31	-\$23.06 to -\$19.24
Condition #3: High Frequency of Travel – Low E-ZPass Growth	-\$13.00 to -\$11.80	-\$7.76 to -\$6.95	-\$20.76 to -\$18.77
Condition #4: High Frequency of Travel – High E-ZPass Growth	-\$8.55 to -\$7.46	-\$4.57 to -\$3.87	-\$13.11 to -\$11.34

The following observations may be drawn from Table 5-2:

- All conditions in Scenario 2 yield negative net revenue. In other words, AET in Scenario 2 yields a lower net present value than ORT in all four conditions. This suggests that a “surcharge-free” scenario with minimal fees is NOT adequate to enable AET to pass the revenue neutrality test.
- In reviewing the “Combined” totals, the NPV for Condition #3 was about \$15 million higher than the NPV for Condition #1. Similarly, the NPV for Condition #4 was about \$10 million higher than the NPV for Condition #2. Taken together, these observations suggest that, under Scenario 2, having a high frequency of travel is more favorable to AET feasibility than having a low frequency of travel. This is primarily because Scenario 2 has no mechanism for recovering revenue lost through leakage. As a result, the “high frequency” options perform better because they reduce costs (relative to the “low frequency” options) by yielding fewer accounts to manage and fewer invoices to mail.
- The NPV for Condition #2 was about \$13 million higher than the NPV for Condition #1. Similarly, the NPV for Condition #4 was about \$7 million higher than the NPV for Condition #3. These two observations reveal that, under Scenario 2, having a higher rate of E-ZPass growth is more favorable to AET feasibility than having a lower rate of E-ZPass growth. The reason is that having a higher rate of E-ZPass growth yields a condition where, over time, there are fewer video customers. In a condition in which video customers do not pay a surcharge, the most effective way to minimize revenue loss is to minimize the number of video customers.

5.3 Scenario 3 – Cover Cost of Account Handling

Scenario 3 builds on Scenario 2 by adding an account management fee, whose purpose is intended to defray the monthly cost paid by NHDOT to maintain each video account. The account management fee is \$1.50 on the first invoice, corresponding to the cost of maintaining the video account over the preceding month. The fee increases to \$3.00 on the second invoice, since the video account (because of the failure to pay) had to be maintained for two months. The third invoice adds a \$4.50 account management fee, corresponding to three months of account management costs incurred due to delayed toll payments.

Table 5-3 summarizes the results of HNTB’s Net Present Value calculations for Scenario 3.

Table 5-3 – NPV Results for Scenario 3, 2020 thru 2040 (in millions of dollars)

	Dover	Rochester	Combined
Condition #1: <i>Low Frequency of Travel – Low E-ZPass Growth</i>	-\$14.31 to -\$12.72	-\$8.67 to -\$7.58	-\$22.97 to -\$20.30
Condition #2: <i>Low Frequency of Travel – High E-ZPass Growth</i>	-\$9.17 to -\$7.83	-\$5.02 to -\$4.10	-\$14.16 to -\$11.96
Condition #3: <i>High Frequency of Travel – Low E-ZPass Growth</i>	-\$8.90 to -\$7.89	-\$4.71 to -\$3.95	-\$13.59 to -\$11.82
Condition #4: <i>High Frequency of Travel – High E-ZPass Growth</i>	-\$5.80 to -\$5.04	-\$2.5 to -\$1.93	-\$8.29 to -\$6.98

A review of Table 5-3 and a comparison to Table 5-2 indicates the following:

- The additional account management fees improve net revenue from an AET perspective. For example, the NPV for Condition #1 in Scenario 3 is approximately \$7 million higher than the NPV for Condition #1 in Scenario 2. For Condition #4 (which assumes a higher frequency of travel and a higher rate of E-ZPass growth), the difference between Scenario 3 and Scenario 2 is roughly \$2.5 million.
- However, the account management fees are *not* sufficient to make AET “net revenue neutral.” The account management fees help to cover the additional costs associated with handling video payments, but they do **not** help cover the lost revenue associated with leakage (as discussed in Section 4.2.1).

5.4 Scenario 4 – Add Surcharge

Scenario 4 introduces the concept of a “video surcharge” for customers that do not complete the toll transaction with a valid E-ZPass transponder. Rather than simply charging video customers the same toll rate as today’s cash customers, Scenario 4 adds a 73% surcharge to today’s cash toll rate. In the context of Dover and Rochester, this increases the passenger car rate (currently set at 75¢) to \$1.30 per transaction. The goal of adding the surcharge is to make up for revenue lost due to leakage. In doing so, HNTB aims to identify a more aggressive approach to pricing that passes the revenue neutrality test under even the most pessimistic conditions.

The results of HNTB’s net present value analysis for Scenario 4 is summarized in Table 5-4.

Table 5-4 – NPV Results for Scenario 4, 2020 thru 2040 (in millions of dollars)

	Dover	Rochester	Combined
Condition #1: <i>Low Frequency of Travel – Low E-ZPass Growth</i>	-\$1.93 to -\$0.21	\$0.44 to \$1.80	-\$1.48 to \$1.60
Condition #2: <i>Low Frequency of Travel – High E-ZPass Growth</i>	-\$2.04 to -\$0.76	\$0.30 to \$1.40	-\$1.74 to \$0.66
Condition #3: <i>High Frequency of Travel – Low E-ZPass Growth</i>	\$3.03 to \$5.09	\$4.09 to \$5.75	\$7.13 to \$10.83
Condition #4: <i>High Frequency of Travel – High E-ZPass Growth</i>	\$0.64 to \$2.57	\$2.31 to \$3.94	\$2.93 to \$6.50

Based on the results in the “Combined” column, Scenario 4 essentially achieves revenue neutrality. In the critical “low frequency of travel” conditions, Scenario 4 yields a range of net present values that hover around \$0. This suggests that, if Scenario 4 is implemented, AET is feasible under the most “reasonably pessimistic” conditions evaluated by HNTB.

On the other hand, if video customers are characterized by “high frequency of travel” (i.e. Conditions 3 or 4), then AET is expected to generate as much as \$10.8M in NPV above what would be expected from ORT.

5.5 Net Revenue Analysis for Scenarios 1 thru 4

It is important to remember that the NPV ranges provided in Sections 5.1 through 5.4 did **not** include the impact of capital costs. As noted in Section 4.2.4, AET saves roughly \$11.5 million in construction costs at Dover and \$14.9 million at Rochester. Thus, construction of AET facilities at Dover and Rochester save a combined **\$26.4 million** compared to construction of ORT facilities. These savings can mitigate potential losses in net operating revenue. In other words, even if a particular scenario doesn’t pass the revenue neutrality test, it may be feasible if the capital cost savings are also considered.

To better understand the impact of capital cost savings under AET, HNTB performed an NPV calculation that incorporated capital costs. These revised calculations followed the same methodology described in Section 4.3, except that the cost calculations also included capital costs (in addition to the operational costs associated with collecting the tolls). The analysis assumed that NHDOT will pay for the construction out of their cash flow in year 1 (2020). Thus, year 1 of the calculation is “net revenue negative” for both

the AET and ORT scenarios, since the capital costs are much higher than the average annual toll revenue (which currently totals about \$17 million at Dover and Rochester combined).¹⁵

Table 5-5 summarizes the NPV calculations for all four scenarios as they apply to the *net revenue test*, which assumes that capital costs are rolled into the net revenue calculation for both ORT and AET.

Table 5-5 – NPV Results for Scenarios 1 through 4 (in millions of dollars), **including Capital Cost Impacts**

	Scenario 1 <i>Existing Business Rules</i>	Scenario 2 <i>Base Case</i>	Scenario 3 <i>Cover Account Handling Costs</i>	Scenario 4 <i>Add Surcharge</i>
Condition #1: <i>Low Frequency of Travel – Low E-ZPass Growth</i>	\$26.57 to \$30.27	-\$9.46 to -\$5.82	\$3.52 to \$6.07	\$25.04 to \$28.04
Condition #2: <i>Low Frequency of Travel – High E-ZPass Growth</i>	\$27.62 to \$30.34	\$3.39 to \$7.14	\$12.35 to \$14.51	\$24.73 to \$27.17
Condition #3: <i>High Frequency of Travel – Low E-ZPass Growth</i>	\$43.98 to \$49.34	\$5.69 to \$7.66	\$12.84 to \$14.57	\$33.55 to \$37.22
Condition #4: <i>High Frequency of Travel – High E-ZPass Growth</i>	\$37.91 to \$42.7	\$13.25 to \$15.04	\$18.12 to \$19.43	\$29.39 to \$32.97

A review of the results in Table 5-5 suggests the following:

- As the net revenue test reveals, when capital costs are rolled into the net revenue calculation, **AET yields positive net revenue compared to ORT in virtually every scenario.** The only exception was Scenario 2 in the most pessimistic condition (low frequency of travel and low E-ZPass market share growth).
- Scenarios 2 through 4 employ a revised pricing framework, and the scenarios represent increasingly aggressive approaches to maintaining an appropriate revenue stream after conversion to AET. The NPV results for Scenarios 2 through 4 therefore increase with each successive scenario.
- The relatively high numbers in Table 5-5 suggest why Dover and Rochester are good candidates for conversion to AET. These plazas meet three important criteria:
 - They represent locations which need a toll facility upgrade anyway, so AET presents an opportunity for significant savings in capital costs.
 - The capital cost savings of AET relative to the non-AET alternative (in this case, ORT) is very high relative to the amount of cash revenue at risk. In the case of Rochester, the capital cost savings in 2020 (\$14.9 million) is over eight times as great as the cash revenue at risk (\$1.7 million in 2020, declining to \$1.2 million in 2040). In such cases, it would take

¹⁵ For a review of capital costs, go to Table 4-2 (for ORT costs) and Table 4-6 (AET costs). For a review of gross revenue, see Figure 3-3.

a tremendous amount of leakage for the revenue loss under AET to exceed the capital cost savings of AET.

- The agency has demonstrated an ability to collect a high percentage of transactions captured through video.

However, when considering the results of the net revenue test and the implications of factoring capital costs into the NPV analysis, it is important to note the following:

- The high positive numbers in Table 5-5 don't necessarily suggest that AET is a method for generating surplus revenue. A significant portion is attributable to the \$26.5 million in cost savings associated with building an AET facility compared to an ORT facility. In other words, the large increases in NPV under the net revenue test are only possible if the funding is available for construction. If no construction funds were available, no relative benefit from AET would be possible.
- The analysis summarized in Table 5-5 assumes that capital costs are paid up front; they are *not* financed through issuing debt (e.g. bonds). The results would likely differ if the capital costs were spread out over a 20- or 30-year period.
- The NPV must be evaluated over a period that is consistent with the expected life expectancy of the facility. If a particular facility has a 30-year design life, then the NPV would need to be calculated over a 30-year span.
- Capital cost considerations will apply differently to different AET implementations, so any results for Dover and Rochester **should not be considered as normative for all deployments**. For example, consider a potential AET deployment at the Hampton Mainline toll plaza. In that situation, the capital costs associated with AET at Hampton would likely be *higher* than the capital costs associated with ORT, since an ORT facility has already been constructed at Hampton. Since AET would likely *not* yield capital cost savings in this instance, its potential for feasibility would be diminished.

Section 6.0 Findings and Recommendations

The overarching purpose of this study was to perform an updated and more detailed assessment of the relative feasibility of ORT vs. AET at Dover and Rochester. The intent of this assessment was to provide updated information and thereby help the Bureau of Turnpikes identify a course of action for the coming years as it seeks to address end-of-life needs for toll collection infrastructure on the Spaulding Turnpike. This section will summarize the key findings of the study and will recommend a path forward for NHDOT's consideration.

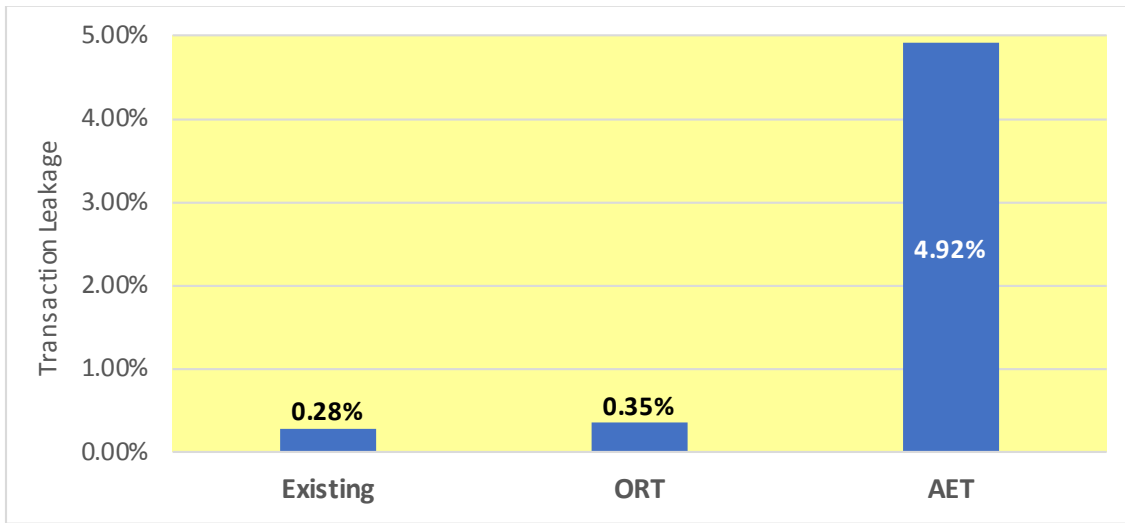
6.1 Findings

HNTB's analysis of AET feasibility at Dover and Rochester has revealed the following:

- The NHDOT Bureau of Turnpikes loses very little money due to leakage under current conditions. On a systemwide basis, it collects revenue from over 99% of all vehicles that pass through the toll lanes. About 96.5% of all vehicles generate revenue as they pass through the lanes; another 2.9% generate revenue after the fact, as a result of either license plates matched to E-ZPass customers or the violations process. The resulting current revenue leakage is roughly 0.6%.
- Historical revenue leakage rates for NHDOT tend to increase slightly after conversion to ORT, but remain less than 1%. The same would be anticipated for future conversions of Dover and/or Rochester to ORT.
- In contrast, AET is projected to result in a significant increase in leakage. Several factors contribute to the increase in leakage, including:
 - Technical factors (e.g. some images are not sufficient to identify a license plate, either due to customer, environmental or system factors);
 - Third party limitations (e.g. some DMV data is insufficient to bill a customer, and some agencies do not share data with New Hampshire); and,
 - Customer behavior (e.g. some customers refuse to pay their invoices).

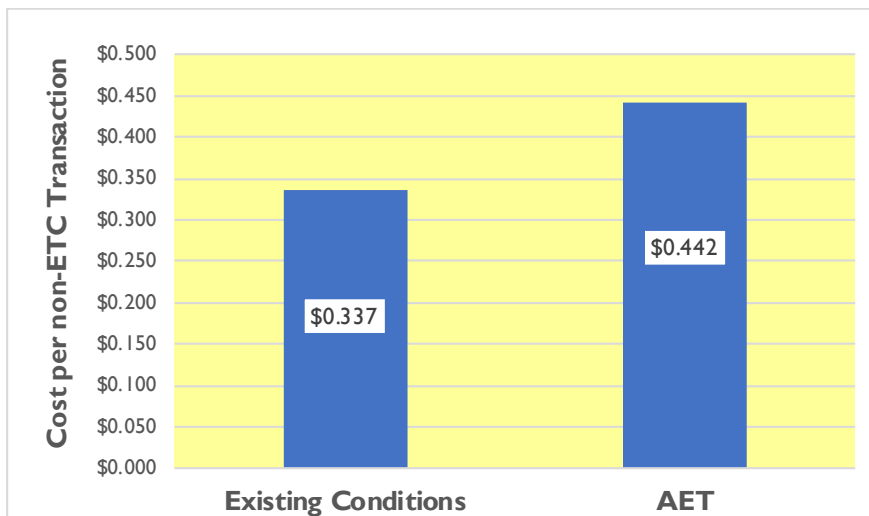
Figure 6-1 illustrates how leakage (measured in terms of the percentage of total transactions that *should* generate revenue but do not) increases dramatically under AET.

Figure 6-1 – Projected Leakage at Dover & Rochester in 2020, Existing vs. ORT vs. AET



- In general, a video transaction under AET is costlier to handle than a cash transaction under existing conditions. The video collections process involves numerous steps, including identifying license plates, assigning license plates to video accounts, pursuing addresses via DMV lookup, compiling bills, distributing invoices, processing payments, and fielding questions from video customers. Figure 6-2 illustrates how the cost per non-ETC transaction at Dover and Rochester would be expected to increase in 2020 under AET.

Figure 6-2 – Projected Cost per Non-ETC Transaction at Dover & Rochester, 2020



- These two impacts of AET—increased leakage and increased costs—have generally been approached by the industry with two measures to achieve feasibility:

- A video surcharge must be added to the existing cash toll rate. In this way, the customers that pay the tolls make up for the toll revenue lost through leakage.
- A series of fees must be added to the billing process to help cover the additional costs associated with handling and processing video transactions.
- HNTB's analysis identified two possible paths to achieving financial feasibility under AET:
 - **Path #1 – Implement current business rules.** This would be the simplest and most straightforward approach, since it would alleviate the need for NHDOT to develop a new set of business rules for handling non-payments at AET plazas. Video transactions at AET plazas could be handled in the same manner as non-payments at all other toll facilities on the NH Turnpike system. This approach would entail assessing video customers a \$1.00 fee per video transaction. According to the current business rules, this fee would escalate to \$1.50 on the second notice (i.e. if the first notice is not paid within 30 days) and to \$25.00 on the third notice. This path is somewhat unconventional in that—unlike most agencies that have implemented AET—it doesn't provide a mix of per-transaction surcharges (to cover leakage) and per-invoice fees (to cover handling costs).
 - **Path #2 – Implement a surcharge.** This approach would involve the imposition of a video surcharge of 73% on top of the current cash toll to establish the video toll rate. The surcharge would be supplemented by an escalating series of fees associated with successive invoices that can be used to cover the additional handling costs associated with processing video transactions. In doing so, this path would be most consistent with general industry practice for agencies that have implemented AET.
- The combined effect of the surcharges and fees can significantly increase the effective per-transaction payment made by video customers. For example, under Scenario 4 (as the example in Table 4-8 illustrated), a video customer who makes four trips through Dover in a given month would receive an invoice for \$7.35 the following month. This equates to an effective rate of \$1.84 per transaction—an increase of 145% compared to the existing cash rate of 75¢.
- It is worth noting that the surcharges, fees, and fines that will be assessed to video transactions will primarily affect *New Hampshire drivers*. HNTB conducted a license plate survey of cash-paying customers as part of the 2015 study. As Table 3-2 illustrated, the survey found that 70% of these customers at Dover were from New Hampshire. The share at Rochester was even higher, at 75%. In other words, most of the people whose cost to travel the road will be raised by AET are going to be New Hampshire residents.
- Based on the license plate survey cited above, it is expected that over 90% of the video drivers at Dover and Rochester will be from one of the three states (Maine, New Hampshire, and Massachusetts) covered by the reciprocity agreement. Therefore, there is very little to be gained by extending this agreement to neighboring regions. HNTB's financial analysis indicated that, even if the agreement were extended to the remaining New England states (RI, CT, and VT) as well as Canada, the net benefit would only be in the range of \$5,000 to \$15,000 per year.

- HNTB’s analysis suggests that financial feasibility is loosely connected to the year of implementation. An appropriately-calibrated AET fare structure will be revenue neutral regardless of when it is implemented. However, the amount of revenue at risk will change over time. In other words, as ETC market share continues to grow, the amount of cash revenue—that is, the amount of revenue that would be at risk upon conversion to AET—will likely decline from year to year. Therefore, if the Bureau of Turnpikes is uncomfortable with the amount of cash revenue at risk in a given year, then waiting will likely reduce the revenue at risk.

6.2 Conclusions and Recommendations

In light of the findings summarized above, HNTB concludes the following:

- This study defined an AET scenario as financially feasible when tolls and fees are increased enough such that the net present value over the period from 2020 through 2040 is greater than or equal to the net present value for a comparable ORT scenario over the same time period. HNTB evaluated the net present value (or NPV) from two different perspectives:
 - *Revenue neutrality test.* From this perspective, the “net present value” for each scenario is calculated on an annual basis by forecasting the gross toll revenue (including revenue from fees and fines) and subtracting all operations costs associated with collecting the revenue. The annual values of net present value are discounted back to “opening year” dollars by applying a discount rate of 3% per year.
 - *Net revenue test.* This test is almost identical to the “net revenue neutral” test, except that capital costs are also subtracted from gross toll revenue (in addition to all operations costs associated with collecting the revenue).
- In HNTB’s opinion, the net revenue test is the most appropriate for Dover and Rochester. This is because, given the existing conditions at these facilities, capital expenditures are inevitable. Therefore, when calculating net revenue, it is important to understand how differences in capital costs can impact the bottom line.
- HNTB’s analysis of the net revenue test suggests that all four scenarios are financially feasible for AET. The toll rates, surcharges, fees and fines associated with each scenario—originally presented in Table 4-7—are summarized again in Table 6-1. Recall that Scenario 1 involves a direct application of current business rules for non-payments to an AET context, whereas Scenarios 2 thru 4 represent a new pricing framework that is more reflective of approaches taken by other agencies that have implemented AET.

Table 6-1 – Summary Definitions of Scenarios 1 thru 4

Cost Category	Scenario 1 <i>Existing Business Rules</i>	Scenario 2 <i>Base Case</i>	Scenario 3 <i>Cover Cost of Account Handling</i>	Scenario 4 <i>Add Surcharge</i>
Video Toll Rate	75¢ per trans. <i>existing cash fare (no surcharge)</i>	75¢ per trans. <i>existing cash fare (no surcharge)</i>	75¢ per trans. <i>existing cash fare (no surcharge)</i>	\$1.30 per trans. <i>73% surcharge</i>
Level 1 Invoice	\$1.00 fee per transaction	65¢ per invoice <i>= 65¢ mailing fee</i>	\$2.15 per invoice <i>= 65¢ mailing fee + \$1.50 acct. mgt. fee</i>	\$2.15 per invoice <i>= 65¢ mailing fee + \$1.50 acct. mgt. fee</i>
Level 2 Invoice	\$1.50 fee per transaction	\$2.80 per invoice <i>= \$1.30 mailing fee + \$1.50 late fee</i>	\$5.80 per invoice <i>= \$1.30 mailing fee + \$1.50 late fee + \$3.00 acct. mgt. fee</i>	\$5.80 per invoice <i>= \$1.30 mailing fee + \$1.50 late fee + \$3.00 acct. mgt. fee</i>
Level 3 Violations Notice	\$25.00 fee per transaction	\$26.95 per invoice <i>= \$1.95 mailing fee + \$25 admin penalty</i>	\$31.45 per invoice <i>= \$1.95 mailing fee + \$4.50 acct. mgt. fee + \$25 admin penalty</i>	\$31.45 per invoice <i>= \$1.95 mailing fee + \$4.50 acct. mgt. fee + \$25 admin penalty</i>

- HNTB recommends that if the Bureau of Turnpikes wishes to move forward with AET implementation, it should implement Scenario 1. There are three primary reasons for this recommendation:
 - HNTB’s analysis has been built upon numerous assumptions; the key assumptions have been documented in this report. Any significant deviation from these assumptions could impact feasibility. Scenario 1 yields a higher NPV than the other scenarios and therefore provides a solid margin of net revenue that should cover for uncertainty in these assumptions.
 - Scenario 1 smoothly integrates into the Bureau of Turnpikes’ existing operations. All customers that drive through *any* plaza without a valid E-ZPass will be handled the same way. Their identity will be captured via license plate image; they will be sent a bill (unless they proactively pay through either the pre-pay program or the “7 Days to Pay” program); and the bill will include an escalating series of per-transaction fees. This makes the implementation of AET seamless from a customer perspective and relatively simple from a Bureau of Turnpikes perspective.
 - Scenario 1 has the potential to both save costs and to generate additional revenue (compared to ORT). This provides opportunities for alternative programming of these funds for NHDOT to support other financial needs where permitted.

- The following three factors contribute to the financial feasibility of AET over a wide range of scenarios:
 - **Existing deficiencies.** The Dover and Rochester toll facilities are both in need of being upgraded. This opens the door to being able to realize the capital costs saving potential afforded by AET.
 - **Large capital cost savings relative to cash revenue at risk.** By building AET facilities at Dover and Rochester in lieu of building ORT facilities, the Bureau of Turnpikes will likely save \$26.4 million. This is large compared to the projected cash revenue at these plazas (totaling \$3.9 million in 2020). It would take a significant rate of leakage over an extended period of time in order for the revenue loss to exceed the capital cost savings.
 - **Demonstrated efficiency at video billing.** The Bureau of Turnpikes has demonstrated high efficiency at recovering revenue from today's customers that pass through toll facilities without paying. Approximately 80% of all customers that are mailed an invoice ultimately pay, and the fee structure has proven to be effective at covering costs. It is reasonable to expect that this operation will remain efficient when it is deployed on a larger scale in the context of AET.

- All scenarios will effectively result in a toll increase for cash customers compared to existing cash toll rates. By comparison, a conversion to ORT would *not* entail a comparable toll increase for cash customers.

- Given the high range of financial, customer and public perception uncertainties remaining, HNTB recommends that any AET implementation be preceded by a pilot project. Many agencies have adopted this approach to better understand the impact of AET on their business and customers prior to proceeding with a larger-scale implementation. Pilot projects can provide an agency with a low-risk opportunity to validate key assumptions and parameters and thereby provide a clearer understanding of what is required to achieve financial feasibility. They can also provide valuable feedback regarding customer and stakeholder acceptance for a broader deployment.

- HNTB notes that these conclusions differ from those that were drawn from our 2015 study for NHDOT. The primary factors contributing to the change include the following:
 - *Lower video costs.* The Bureau of Turnpikes now has a better understanding of the costs it would incur in the process of handling video transactions. These costs are lower than the costs that were assumed in the previous study.
 - *Higher E-ZPass market share.* The revenue risk of converting to AET has decreased over time as the E-ZPass market share has continued to climb.
 - *Better response rates.* When HNTB reviewed response rates to invoicing under the current violations process, it found that the rates had improved since the previous study. This may be attributed to stricter enforcement on the part of NHDOT.
 - *Improved understanding of traffic composition.* Since the previous study, additional information has been made available from further peer agency experience with AET conversions, removing some of the uncertainty (and subsequent risk) within the analysis.

- *More detailed cost estimates.* HNTB, in consultation with NHDOT, performed a detailed revision of the capital cost estimates originally presented in the 2015 study. These revisions reduced the AET estimates by roughly 10% while simultaneously increasing the ORT estimates. As a result, the AET-related capital cost savings increased from approximately \$13 million in the 2015 study to over \$26 million in the current study.
- If NHDOT chooses to move forward with AET, it would be prudent for Dover and Rochester to be implemented together. The plazas are separated by only 12 miles, and it is likely that thousands of vehicles each day travel through both plazas on the same trip. Therefore, to avoid confusion to customers, both facilities should employ the same method of toll collection.
- Extending reciprocity to neighboring regions (such as the rest of New England and Canada) is expected to yield very little financial benefit. Therefore, extending reciprocity should only be pursued if it can be done cost-effectively, or if it can be demonstrated to produce other benefits that extend beyond the realm of toll collection at Dover and Rochester.
- NHDOT should be mindful of the following challenges that will accompany the implementation of AET on the Spaulding Turnpike:
 - Implementation of Scenario 1 will effectively yield a significant toll increase for today's cash customers that choose not to acquire an E-ZPass after conversion to AET. Today's cash trip that costs 75¢ will cost \$1.75 under Scenario 5—an increase of 133%. However, this toll increase can be avoided if drivers take advantage of either (a) the Prepaid License Plate Toll program, or (b) the “7 Days to Pay” program offered by the Bureau of Turnpikes.¹⁶ These programs reward customers for taking the initiative to pay the license plate (or “video”) toll by foregoing the \$1.00 per-transaction fee.
 - Customers that drive on multiple corridors (e.g. both the Spaulding Turnpike and the Blue Star Turnpike) could be confused about the mixing of collection methods. Customer communication will be critical. Future implementations should therefore be considered on a corridor-by-corridor basis, with specific customer outreach planning and programs to match.

¹⁶ Details on the Prepaid License Plate Toll program can be found at <https://www.ezpassnh.com/account/signup/lp>. Details on the “7 Days to Pay” program can be found at <https://www.ezpassnh.com/postpay-trip>.

Section 7.0 Pilot Program

A potential candidate for an AET pilot would be the Hooksett Ramp toll plaza. An AET pilot at this location is similar to other agency approaches to pilots for the following reasons:

- Introducing AET via a pilot project is a proven approach prior to implementing AET more broadly. Most recently, the Pennsylvania Turnpike Commission implemented AET at the Delaware River Bridge. The Commission monitored back office operations and revenue collection for over a year and opened the second pilot facility in May 2017. MassDOT piloted AET on the Tobin Bridge prior to system-wide rollout later and after monitoring the pilot. MTA TBTA started with the Henry Hudson Bridge. Similarly, the North Texas Tollway Authority has phased in implementation of AET over several years, with early sites serving as pilot projects.¹⁷
- In selecting a pilot site, agencies often select lower-revenue locations to confine revenue risk relative to overall system revenues. A similar condition exists at the Hooksett Ramp. When a facility converts to AET, its collection of revenue from cash customers is most at-risk. This is because most cash customers become video customers, and it is the video customers that are the source of virtually all revenue leakage under AET. At Hooksett Ramp, only \$400,000 in cash revenue is expected to be collected in 2017. If fully 25% of this revenue were lost to leakage, the resultant loss of \$100,000 would comprise *less than 0.1%* of the Bureau of Turnpike's annual revenue stream. This is a relatively small potential price to pay to acquire a better understanding of the likely impacts of AET.
- The existing toll plaza at the Hooksett Ramp is at the end of useful life and in need of replacement. Therefore, a pilot project at this location would serve a secondary role of providing a much-needed and lower cost toll facility replacement.
- A pilot project provides a good opportunity to gather data on key variables such as E-ZPass growth, trip frequency, and response rates. Better understanding these variables will better enable the Bureau of Turnpikes to implement a larger-scale deployment in a way that is more certain to achieve revenue neutrality. Note that some limitations in the transfer of experience will exist given that customer patterns are different.
- A pilot project can provide the Bureau of Turnpikes with a better understanding and additional experience regarding back-office operations to handle video tolling. For example, the functionality of systems and projection of staffing requirements will therefore be better understood prior to broader implementation, allowing for improved customer service needs and cost forecasting.
- The proximity of the pilot project to the mainline Hooksett toll plaza will require significant customer education and outreach to explain an AET facility adjacent to a cash facility. While not

¹⁷ See Figure 2-3, which illustrates how 5 different NTTA facilities were phased into operations starting in 2009, with each year seeing additional facilities converted.

ideal, the lower revenue risk and other factors would outweigh the potential for confusion. In terms of industry precedence, the PTC and MassDOT pilots were also relatively close to remaining active cash facilities.

Appendix A will provide a brief financial analysis of the Hooksett Ramp, to provide insight regarding the potential risks associated with an AET pilot at that location.

Appendix A Hooksett Ramp Analysis

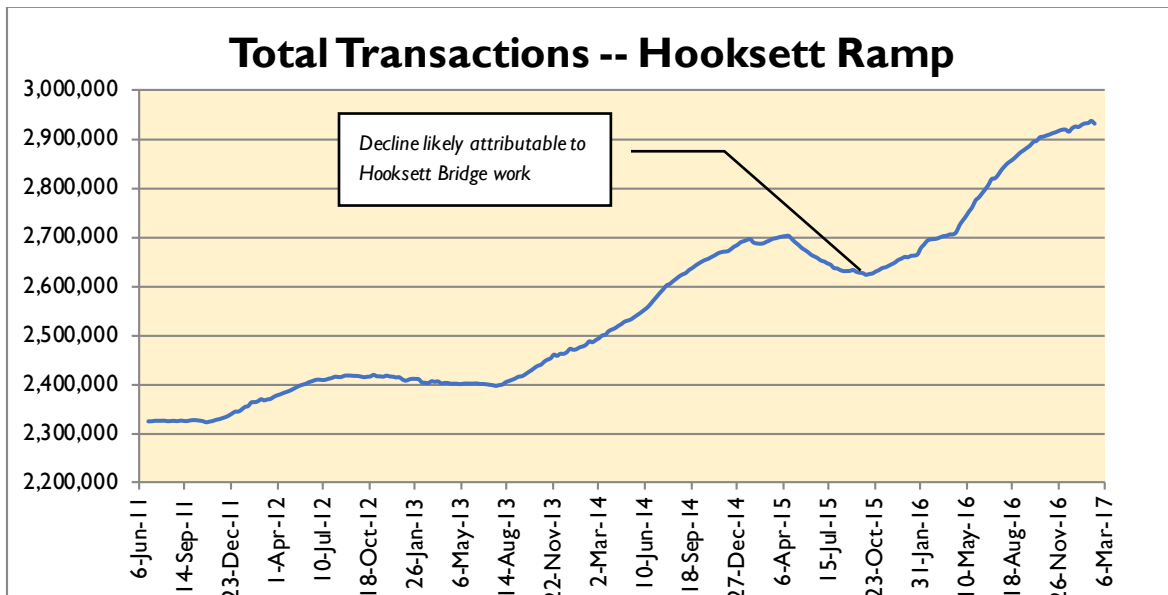
The purpose of this appendix is to provide insight regarding the likely financial implications of conducting an AET pilot project at the Hooksett Ramp. This project provides an opportunity for the Bureau of Turnpikes to acquire important insight regarding the financial and operational parameters that are necessary for AET to succeed in New Hampshire. However, the project comes with some financial costs and financial risks that need to be understood prior to moving forward.

A.1 Existing Conditions Review

Total transactions at the Hooksett Ramp toll plaza have fluctuated somewhat, but the trend over the past six years has been generally upward. On an average basis, traffic has grown by about 4% annually. But the percentage has varied (sometimes dramatically) from year to year.

The Hooksett Ramp toll plaza processes just under 3 million transactions annually. This is considerably lower than both Dover (15 million annually) and Rochester (10 million). Figure A-1 illustrates how total transactions have grown since mid-2011.

Figure A-1 – Total Transactions at Hooksett Ramp (rolling 12-month basis, June 2011 thru February 2017)



The toll rates at Hooksett Ramp are consistent with the rates charged at other ramp facilities on the New Hampshire Turnpike System. As at Dover and Rochester, customers with a NH-based E-ZPass receive a 30% discount off the cash rate if they are driving a vehicle with single rear tires, and a 10% discount off the cash rate if they are driving with dual rear tires. The rates at Hooksett Ramp are summarized in Table A-1.

Table A-1 – Toll Rates at Hooksett Ramp Toll Plaza

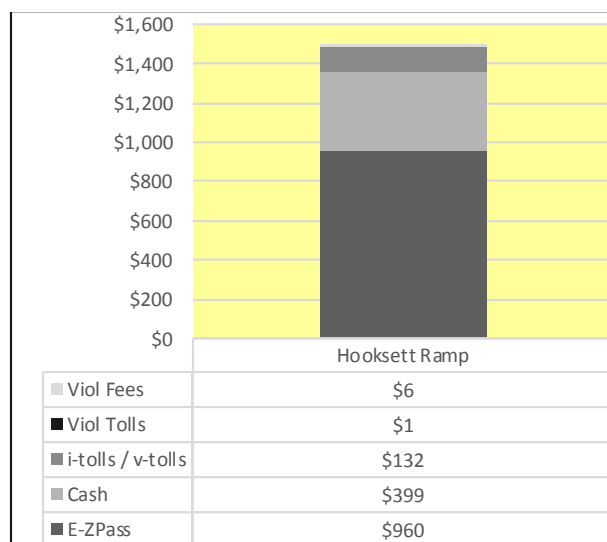
Vehicle Type	NH-based E-ZPass Rate	Out-of-State E-ZPass / Cash Rate
Class 1 – 2 axles, single rear tire	\$0.35	\$0.50
Class 2 – 3 axles, single rear tire	\$0.53	\$0.75
Class 3 – 4 axles, single rear tire	\$0.70	\$1.00
Class 4 – 5 axles, single rear tire	\$0.88	\$1.25
Class 5 – 2 axles, dual rear tires	\$0.90	\$1.50
Class 6 – 3 axles, dual rear tires	\$1.35	\$1.50
Class 7 – 4 axles, dual rear tires	\$1.80	\$2.00
Class 8 – 5 axles, dual rear tires	\$2.25	\$2.50
Class 9 – 6 axles, dual rear tires	\$2.70	\$3.00
Class 10 – 7 axles, dual rear tires	\$3.15	\$3.50
Class 11 – 8 axles, dual rear tires	\$3.60	\$4.00
Class 12 – 9 axles, dual rear tires	\$4.05	\$4.50

At the Hooksett Ramp, nearly 60% of all transactions are NH-based E-ZPass customers.

In terms of overall revenue collection, the Hooksett Ramp is project to bring in roughly \$1.5 million in revenue in 2017. Approximately 64% of this revenue comes from valid E-ZPass transactions. Interestingly, another 9% of revenue comes from i-tolls and v-tolls, which represent transactions that are initially invalid (i.e. they are not recorded either as a valid cash or a valid E-ZPass transaction) but are subsequently tied to existing E-ZPass accounts. The share of i-tolls and v-tolls at Hooksett Ramp is much higher than the shares observed at Dover (2.4%) and Rochester (1.4%).

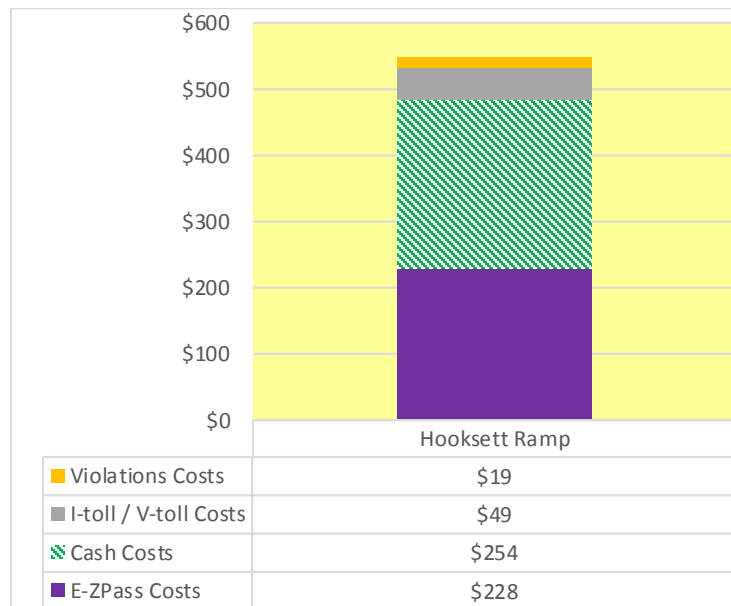
Figure A-2 illustrates the projected revenue breakout for 2017 at the Hooksett Ramp toll plaza.

Figure A-2 – Projected 2017 Revenue Breakout from Hooksett Ramp (in thousands of dollars)



Based on current and projected trends, HNTB estimates that the Bureau of Turnpikes will spend approximately \$0.55 million in 2017 to collect the projected \$1.5 million in revenue at the Hooksett Ramp. Thus, the Hooksett Ramp is expected to generate roughly \$950k in net revenue in 2017. Figure A-3 illustrates the various cost components involved in collecting revenue at Hooksett Ramp.

Figure A-3 – 2017 Operating Cost Breakout from Hooksett Ramp (in thousands of dollars)



A comparison of the preceding two figures reveals the following:

- The Bureau of Turnpikes currently spends \$19,000 to pursue violators at the Hooksett Ramp. This expenditure yields only about \$7,000 in tolls and fees.
- Cash fare collection is not particularly cost-effective at Hooksett Ramp. In 2017, it is expected that the Bureau of Turnpikes will spend \$254,000 to collect \$399,000 in cash revenue. In other words, about 64% of cash revenue is consumed by the cost to collect. This is much higher than at Dover and Rochester, where the ratio was closer to 40%.
- Overall, approximately 37% of the revenue was spent in the process of collecting the revenue. This is higher than the overall ratios observed at Dover (24%) and Rochester (27%).

In sum, a review of existing conditions at Hooksett Ramp indicates the following:

- The Hooksett Ramp toll plaza is expected to collect about \$400,000 in cash revenue in 2017. This is the upper limit of the amount of revenue that would be at risk during an AET trial—and it is an amount that is expected to decline over time. As such, Hooksett Ramp provides a low-risk venue for evaluating AET.
- The process of cash collection at Hooksett Ramp is not particularly cost-effective. An AET pilot may help indicate whether alternative approaches could be more cost-effective.
- The toll rates at Hooksett Ramp are low, with cash customers only paying 50¢ for a passenger car. This means that even the addition of a reasonable video surcharge would keep the passenger car fare under a dollar, which would not be too onerous for the Bureau’s customers.

In short, Hooksett Ramp appears to be a good site for an AET pilot. The next section will build on this foundation by identifying the underlying assumptions for an AET financial analysis at Hooksett Ramp.

A.2 AET Assumptions

With respect to changes in traffic composition, HNTB employed the same assumptions that were applied to the analysis for Dover and Rochester. A detailed explanation of these assumptions may be found in Section 4.2.1. The results of these assumptions are summarized in Table A-2. The analysis assumes that Scenario I (Existing Business Rules) is implemented in 2018.

Table A-2 – Projected Changes in Volumes at Hooksett Ramp Following Conversion to AET, 2018

	<i>Existing</i>	<i>AET</i>	<i>AET minus Existing</i>	<i>%Change</i>
<i>ETC</i>	2,023,078	2,151,315	128,238	6.34%
<i>Cash (Ex) / Paid Video (AET)</i>	871,344	463,754	-407,590	-46.78%
<i>i-tolls & v-tolls</i>	258,461	252,391	-6,070	-2.35%
<i>Paid Violations</i>	4,458	7495.475061	3,038	68.15%
<i>Leakage</i>	5,176	287,561	282,385	5455.61%
Total	3,162,516	3,162,516	0	0.00%

As Table A-2 indicates, the leakage under existing conditions (roughly 5,000 transactions out of a total of 3.2 million) is extremely low—less than 0.2%. This level is expected to jump to about 9% under AET. This is the central challenge of AET: to get more revenue from the customers that pay to cover the lost revenue from the customers that do not pay.

In building on the analysis described in Section 4.0, HNTB evaluated Scenarios I thru 4 for AET feasibility. These scenarios, initially presented in Table 4-7, are summarized again below.

Table A-3 – Evaluation Scenarios for Hooksett Ramp

Cost Category	Scenario 1 <i>Existing Business Rules</i>	Scenario 2 <i>Base Case</i>	Scenario 3 <i>Cover Cost of Account Handling</i>	Scenario 4 <i>Add Surcharge</i>
Video Toll Rate	75¢ per trans. <i>existing cash fare (no surcharge)</i>	75¢ per trans. <i>existing cash fare (no surcharge)</i>	75¢ per trans. <i>existing cash fare (no surcharge)</i>	\$1.30 per trans. <i>73% surcharge</i>
Level 1 Invoice	\$1.00 fee per transaction	65¢ per invoice <i>= 65¢ mailing fee</i>	\$2.15 per invoice <i>= 65¢ mailing fee + \$1.50 acct. mgt. fee</i>	\$2.15 per invoice <i>= 65¢ mailing fee + \$1.50 acct. mgt. fee</i>
Level 2 Invoice	\$1.50 fee per transaction	\$2.80 per invoice <i>= \$1.30 mailing fee + \$1.50 late fee</i>	\$5.80 per invoice <i>= \$1.30 mailing fee + \$1.50 late fee + \$3.00 acct. mgt. fee</i>	\$5.80 per invoice <i>= \$1.30 mailing fee + \$1.50 late fee + \$3.00 acct. mgt. fee</i>
Level 3 Violations Notice	\$25.00 fee per transaction	\$26.95 per invoice <i>= \$1.95 mailing fee + \$25 admin penalty</i>	\$31.45 per invoice <i>= \$1.95 mailing fee + \$4.50 acct. mgt. fee + \$25 admin penalty</i>	\$31.45 per invoice <i>= \$1.95 mailing fee + \$4.50 acct. mgt. fee + \$25 admin penalty</i>

As with the analysis at Dover and Rochester, HNTB evaluated four conditions within each of the scenarios outlined in Table A-3. These conditions represent the four unique combinations of trip frequency and E-ZPass growth. They include:

- Condition #1 – Lower-end frequency of travel & lower-end E-ZPass growth
- Condition #2 – Lower-end frequency of travel & higher-end E-ZPass growth
- Condition #3 – Higher-end frequency of travel & lower-end E-ZPass growth
- Condition #4 – Higher-end frequency of travel & higher-end E-ZPass growth

One important difference with respect to the analysis at Hooksett Ramp is that net revenue under AET was *not* compared to net revenue under ORT. Rather, it was compared to net revenue under existing conditions, with a three-lane conventional toll plaza. The toll facility at Hooksett Ramp is not configured such that it could accommodate ORT, given the short distance (less than 500 feet) between Hackett Hill Rd. and the I-93 access ramps. Therefore, ORT is not a feasible alternative for comparison purposes.

A.3 AET Net Revenue Analysis

Table A-4 summarizes the results of HNTB’s net present value analysis for the Hooksett Ramp. Rather than evaluating 2020 through 2040, the Hooksett Ramp analysis evaluated 2018 through 2038. This approach evaluates the same duration (21 years) as the Dover and Hooksett analysis while reflecting the fact that, as a pilot project, it will be deployed earlier. HNTB’s analysis focused on the *net revenue test*, which accounts for both operations costs and capital costs. The analysis assumed the following capital costs:

- *Existing conditions:* The existing plaza would undergo a rehabilitation at a cost of **\$1.27 million**.

- *AET conditions:* The existing plaza would be demolished and replaced with a new AET facility at a cost of **\$4.69 million**.
- Capital costs will be paid in year 1 (2018) out of cash reserves.

Table A-4 summarizes the net present value results for Hooksett Ramp, **based on the net revenue test** (which includes capital costs). A positive number indicates that AET generates greater net revenue than existing conditions.

Table A-4 – Net Present Value Results for Hooksett Ramp, 2018 thru 2038 (in millions of 2018 dollars)

	Scenario 1 <i>Existing Business Rules</i>	Scenario 2 <i>Base Case</i>	Scenario 3 <i>Cover Account Handling Costs</i>	Scenario 4 <i>Add Surcharge</i>
Condition #1: <i>Low Frequency of Travel – Low E-ZPass Growth</i>	-\$3.06 to -\$2.38	-\$10.79 to -\$9.82	-\$8.01 to -\$7.36	-\$5.00 to -\$4.60
Condition #2: <i>Low Frequency of Travel – High E-ZPass Growth</i>	-\$2.32 to -\$1.89	-\$7.28 to -\$6.19	-\$5.48 to -\$4.80	-\$3.78 to -\$3.48
Condition #3: <i>High Frequency of Travel – Low E-ZPass Growth</i>	\$0.54 to \$1.46	-\$7.70 to -\$7.12	-\$6.12 to -\$5.73	-\$3.22 to -\$2.88
Condition #4: <i>High Frequency of Travel – High E-ZPass Growth</i>	-\$0.38 to \$0.42	-\$5.42 to -\$4.79	-\$4.39 to -\$3.99	-\$2.82 to -\$2.57

The following conclusions may be drawn from Table A-4:

- Scenario 1 provides the most favorable conditions for AET. In the low-frequency conditions (#1 and #2), the NPV results are only slightly negative, meaning that AET loses minimal net revenue compared to rehabilitating the existing plaza. In the high-frequency conditions (#3 and #4), the NPV results tend to be near zero or slightly positive.
- In short, the results for Scenario 1 suggest *little-to-no decline in net revenue over time*, despite the fact that capital costs under AET are actually higher than the rehabilitation costs.
- All other scenarios project a decline in net revenue under AET compared to the rehabilitation option.
- HNTB therefore recommends implementing Scenario 1 at Hooksett Ramp as part of an AET pilot. It provides an opportunity to test the revenue-generating potential of applying the current business rules in an AET context, and it has the greatest likelihood of generating positive net revenue.

A.4 Conclusions

HNTB recommends proceeding with an AET pilot at Hooksett Ramp. An AET pilot based on the implementation of Scenario I would pursue the following objectives:

- Testing the revenue-generating potential of the current business rules in an AET context.
- Assessing whether the proposed fee structure for Scenario I (as highlighted in Table A-3) is adequate to cover the costs associated with handling video transactions.
- Evaluating back office operations to be better prepared for a broader deployment of AET.
- Testing public reaction to video tolling and the invoicing process.
- Evaluating the impacts of AET on growth in E-ZPass market share.
- Identifying whether the response rate to invoices under AET is consistent with the existing response rate to the violations process.
- Identifying the frequency with which video customers travel.

Appendix B Corridor-wide vs. Systemwide Deployment

This report has focused on the potential implementation of AET on one portion of the New Hampshire Turnpikes system—namely, the Spaulding Turnpike. This will create a condition in which drivers could encounter two different types of fare collection (AET and conventional) during the same trip in New Hampshire. This appendix will qualitatively discuss some of the potential challenges that the Bureau of Turnpikes should consider when deploying AET on a corridor-wide basis as opposed to a systemwide basis.

- **Customer expectations.** Greater customer awareness is required if ways to pay the toll are not consistent within a single trip or travel in general across the systems. If a customer is allowed to pay cash at the start of a trip but not at the end—as would be the case for a non E-ZPass customer making the trip from Seabrook to Rochester, for example—then greater communication will be required to define expectations to avoid impacts to customer service costs, revenue collection and customer satisfaction.
- **Legislation.** If legislation defines how invoices or notices are sent to customers without differentiation between ORT and AET, then the agency may be forced to handle all customers in a way that focuses more on one than the other, risking revenue and/or customer experience. For example, approaches for violations under ORT may help to recover revenue for true violations but be seen as heavy-handed for AET customers. Less heavy-handed approaches for AET customers may result in not enough penalties to compel violators under ORT. Solutions by other states have included allowing flexibility in business rules within legislation by avoiding overly prescriptive language.
- **System design and maintenance complexity.** Operating both ORT and AET in different portions of a system requires multiple versions of systems both at the roadside and back office, increasing complexity of operations. On the roadside, maintenance of AET systems is more complex given fewer options for lane closures to maintain equipment. Back office systems must account for both violations operations in ORT and video tolling in AET and manage customers accordingly, thus creating greater complexity for customer and violation account management and invoicing.
- **Transition.** – agencies recognize that a complete conversion at one time to minimize issues with running two systems is often not practical due to capital costs, construction window limitations and the need to deploy AET as a pilot in limited locations to tune the program before risking larger revenues. However once the business model has been confirmed through pilots and if sufficient funding is available, rapid conversion of remaining sites is the approach to minimize inconsistency in collection methods and transition-related issues.