Gravina Access Project
Supplemental Environmental Impact Statement
Traffic Forecast

Agreement 36893013

DOT&PF Project 67698

Federal Project ACHP-0922(5)

Prepared for:

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and Public Facilities
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Executive Summary

HDR Alaska, Inc. has been contracted by the State of Alaska to prepare a supplemental environmental impact statement (SEIS) to evaluate alternatives to access Gravina Island from Revilla Island in the Ketchikan Gateway Borough. A cost-benefit analysis, which includes this Updated Traffic Forecast, is being conducted in support of the SEIS.

A traffic model updated for 2011 results in a forecast of the average daily number of passengers and vehicles crossing in either direction between Gravina Island and the City of Ketchikan on Revillagigedo Island. Results are provided for the following ten access scenarios:

1. Existing Airport Ferry (no action) (includes SEIS Alternative G4v)
2. Improved Ferry (SEIS Alternatives G2, G3, and G4)
3. Airport Bridge, no toll (SEIS Alternative C3-4)
4. Pennock Bridge, no toll (SEIS Alternative F3)
5. Airport Bridge Toll Option 1, $16 round trip
6. Pennock Bridge Toll Option 1, $16 round trip
7. Airport Bridge Toll Option 2, $5 round trip
8. Pennock Bridge Toll Option 2, $5 round trip
9. Airport Bridge Toll Option 3, $2 round trip
10. Pennock Bridge Toll Option 3, $2 round trip

The forecast daily crossings for passengers and vehicles in the year 2033 are summarized in Table E-1. The daily passenger and vehicle crossings from 2005 to 2033 under each access scenario are illustrated in Figure ES-1 and Figure ES-2 respectively. This traffic forecast effort was an update to traffic projections made in 2002 for the original EIS. For easy reference, the exhibits also show the results of the forecast completed as part of the 2002 Gravina Access Project traffic projections.[1]

Table E-1. Updated 2012 Traffic Model - Total Daily Crossings in 2033

	Passengers	Vehicles
Existing Airport Ferry (no action)	865	208
Improved Ferry	1,060	282
Airport Bridge (no toll)	3,930	2,611
Pennock Bridge (no toll)	4,092	2,730
Airport Bridge - Toll Option 1 ($16) [2]	2,190	1,369
Pennock Bridge - Toll Option 1 ($16) [2]	2,323	1,471
Airport Bridge - Toll Option 2 ($5)	2,514	1,606
Pennock Bridge - Toll Option 2 ($5)	2,699	1,749
Airport Bridge - Toll Option 3 ($2)	3,618	2,388
Pennock Bridge - Toll Option 3 ($2)	3,756	2,495

[1] As documented in the *Gravina Access Project Traffic Projections Technical Memorandum* (2002)

[2] Based on double occupancy at the current ferry rates of $5 per person and $6 per vehicle, round trip.

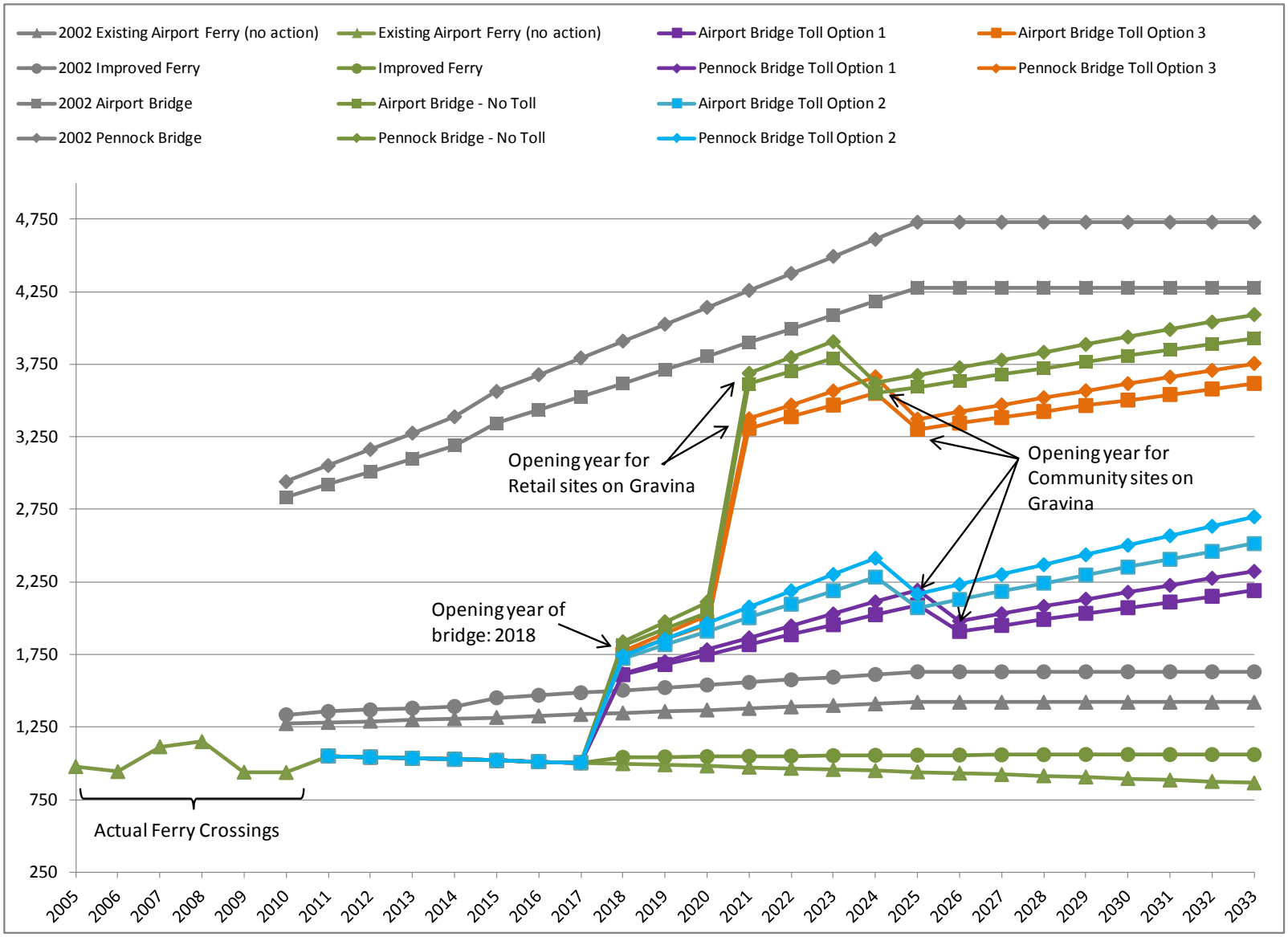

Figure ES-1 : Daily Passenger Crossings by Year

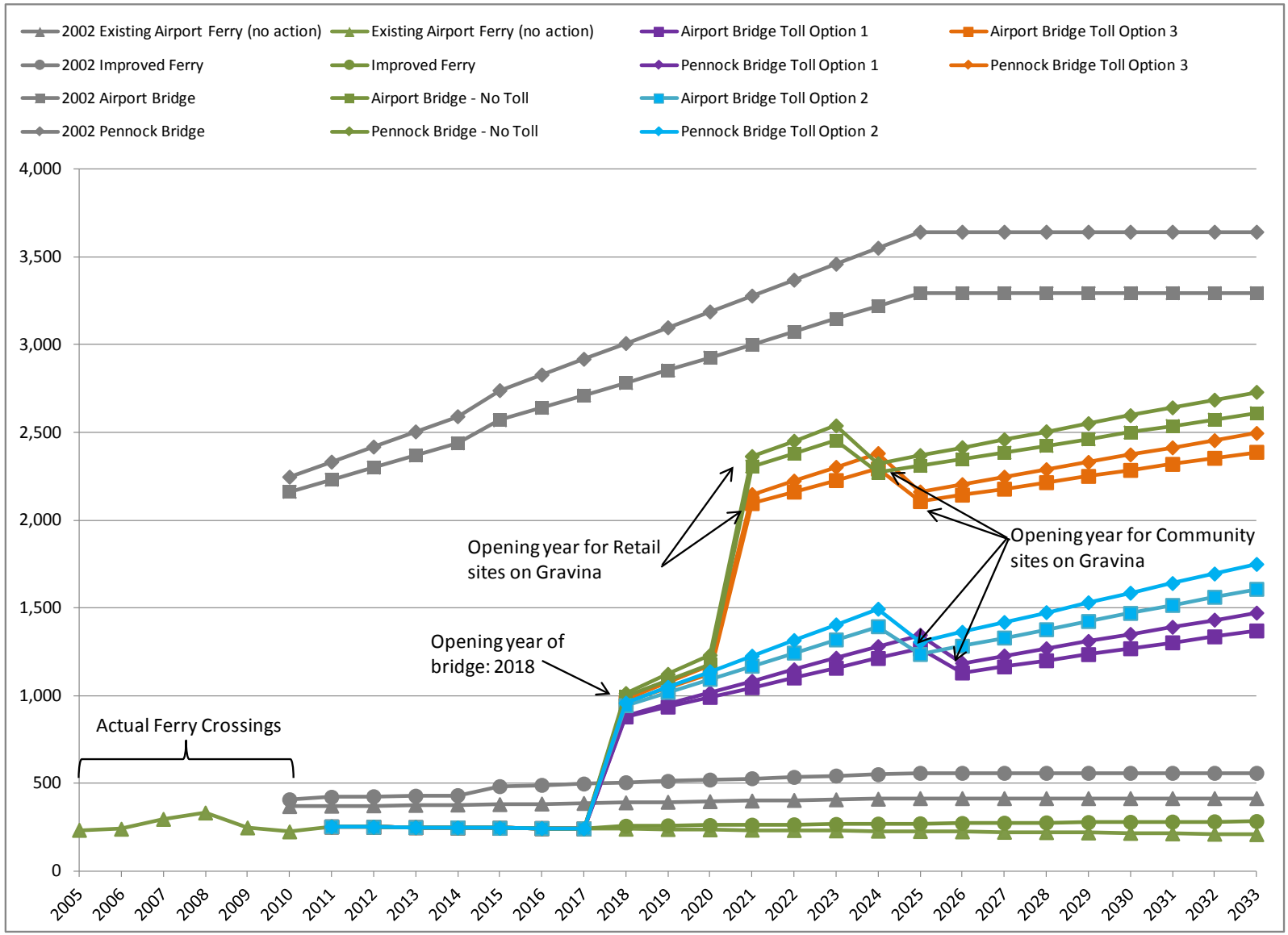

Figure ES-2: Daily Vehicle Crossings by Year

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1 Introduction

In 2004, the Federal Highway Administration (FHWA) and the Alaska Department of Transportation and Public Facilities (DOT&PF) released the *Gravina Access Project Final Environmental Impact Statement* (EIS). The EIS considered three ferry and six bridge alternatives linking Gravina Island and Revillagigedo (Revilla) Island. The final EIS identified alternative F1—a fixed bridge connection crossing Tongass Narrows via Pennock Island—as the FHWA and DOT&PF preferred alternative. The EIS was supported by the *Gravina Access Project Traffic Projections Technical Memorandum* (2002; 2002 Traffic Memo). The 2002 Traffic Memo described the development of traffic projections for the crossing using a Microsoft Excel-based traffic model (2002 Traffic Model).

In 2007, Governor Palin determined Alternative F1 was not financially feasible and directed the DOT&PF to re-examine the project and identify the most fiscally responsible alternative for access to Gravina Island. HDR is preparing a supplemental EIS (SEIS) which will incorporate a Cost-Benefit Analysis. The Cost-Benefit Analysis includes a 22-year traffic forecast being generated using an updated traffic model (2011 Updated Traffic Model). The 2011 Updated Traffic Model and resulting forecast are the subject of this report.

Project Area Background. The Ketchikan Gateway Borough (Borough) is a community of approximately 13,000 residents on and around Revilla Island in southeast Alaska. The Borough includes the cities of Ketchikan and Saxman on Revilla Island, as well as small populations on Gravina Island and Pennock Island.

Ketchikan International Airport is located on Gravina Island, which is separated from the City of Ketchikan by the Tongass Narrows. The airport served approximately 189,000 passengers (enplanements and deplanements) in 2009 (approximately 500 per day).[3] Employment at the airport varies from approximately 180 people to 205 people throughout the year; this level of employment has been stable over the past 10 years.[4]

Access between the two islands is currently provided primarily by ferry. In 2009, approximately 343,000 passengers and 90,000 vehicles used the ferry (averaging approximately 950 passengers and 250 vehicles per day). In addition to the airport, there are approximately ten households on Gravina Island and two small industrial businesses. The few residents and industries based on the island access the island by private boat and use the ferry only occasionally.

1.1 Report Organization

The report is organized into the following sections:

- **Introduction**: presents the project background and organization of the report.
- **Project Approach**: includes technical information on the scope and general assumptions included in the 2011 Updated Traffic Model, as well as an introduction to HDR's risk analysis method.

[3] Complete airport and ferry data for 2010 was not available at the time of analysis.

[4] Employee estimates provided by Ketchikan Gateway Borough, May 19, 2010.

- **Variables Forecast Method**: the first of two chapters describing the method used to complete the traffic forecasts. The 2011 Updated Traffic Model uses variables for seven different trip sources to develop the final traffic forecast. This section describes how these variables were forecast over the study period.
- **Traffic Forecast Method**: the second chapter describing the method used to complete the traffic forecasts. This section presents the factors used to transform the variables into trips in the 2011 Updated Traffic Model.
- **Traffic Forecast Results**: presents the results of the traffic forecast as generated by the 2011 Updated Traffic Model.
- **Summary and Conclusion**: concludes the report.

2 Project Approach

This section presents the general project approach, including the scope and general assumptions and an explanation of HDR's risk analysis method. This section lays the basis for the technical discussion that follows in the remainder of the report.

2.1 Primer on Trip Generation

A trip is a one-way movement by a person from an origin to a destination. The origin is said to have produced the trip, while the destination attracts the trip. The origin and the destination each have a trip end. Trip generation by land use estimates the number of trip ends at a particular land use. In other words, it is an estimate of the number of trips a land use produces (outbound trips) and attracts (inbound trips).

An imaginary 'typical' household provides a useful example. In the morning, two adults leave the house. One is going to work at an office, the other takes a child to school. That is two trip ends: two adults leaving the house. The school-bound parent drops the child off at school. This is two trip ends for the school – one for the adult arriving, and another as they leave. The same parent goes to the grocery store, producing two trips ends for the grocery store. Note that the number of trips for the household is still only two, since neither of the parents have returned home. After spending the day running errands, the parent picks up the child from school (two more trip ends for the school), bringing the number of trip ends for the household to three. The other parent returns from work and the total trip ends is now four. Both parents, together, go out for dinner, making six trip ends for the household and two for the restaurant. They return home, making eight trip ends for the household. This is the end of travel for the day. In total, the household has produced four trips and attracted four trips, for a total of eight trip ends.

The 2011 Traffic Model is only concerned with trips that cross the Tongass Narrows. If the example household above is on Gravina Island, the model must only count the trips where the non-household trip end is on Revilla Island. Assuming that the school and grocery store are on Gravina Island and that the office and the restaurant are on Revilla Island, this household produced six trips that crossed Tongass Narrows and are counted in the 2011 Traffic Model and two trips that stayed on Gravina Island and are not counted.

This report documents how the forecast number of trips across the Tongass Narrows was estimated for different scenarios. Throughout this report, trip ends attracted and produced by a land use are referred to simply as trips with the understanding that the trips generated by a land use are always either inbound or outbound, and are therefore only one end of a trip.

2.2 Scope and General Assumptions

The 2011 Updated Traffic Model estimates the number of passengers and vehicles crossing the Tongass Narrows via a public crossing alternative. Each one-way crossing by a passenger is called a passenger trip; each one-way crossing by a vehicle is called a vehicle trip. The traffic model is not intended to estimate the total number of trips within Gravina Island; it also does not represent economic activity on Gravina Island generated by improved access. The forecast generated by the 2011 Updated Traffic Model was used as input into the Cost-Benefit Analysis, the results of which are incorporated into the SEIS.

The SEIS analyzes six Gravina Island access alternatives and a no action alternative. The six SEIS action alternatives include a bridge alternative near the airport (C3-4), a bridge alterative crossing via Pennock Island (F3), and four ferry alternatives (G2, G3, G4, G4v). The traffic forecast assumes there is negligible difference in traffic flow between ferry access scenarios, and therefore analyzes one general "improved ferry alternative." The following four crossing scenarios were assessed in the 2011 Updated Traffic Model:

1. **Existing Airport Ferry (no action)**—maintain existing ferry service, as is, with no improvements. This is the baseline case for model calibration and was also used to represent SEIS alternative G4v.[5]
2. **Improved Ferry**—improve ferry service with better facilities, new ferries, and greater frequency (G2, G3, and G4).
3. **C3-4 Airport Bridge**—construct a bridge connecting Revilla Island to Gravina Island near the airport.
4. **F3 Pennock Bridge**—construct two bridges connecting Revilla Island to Gravina Island via Pennock Island. The Pennock Bridge alternative touches down on Pennock Island and would enable the Borough to connect residents and businesses on Pennock Island, as well as Gravina Island, to Revilla Island.

DOT&PF requested that the bridge alternatives be evaluated with tolls to offset, in part, the construction and operating costs of the bridges. The two bridge alternatives were each examined with no toll (as described above) and with three different toll options. The six tolled bridge access scenarios are listed below. Toll fees listed are for two-way crossings. This brings the total number of scenarios in the 2011 Updated Traffic Model to 10.

1. **Airport Bridge Toll Option 1—**Airport bridge connection with a $16 return toll that approximates the existing ferry fee.[6]
2. **Pennock Bridge Toll Option 1—**Pennock bridge connection with a $16 return toll that approximates the existing ferry fee.
3. **Airport Bridge Toll Option 2—**Airport bridge connection with a lower toll of $5 per vehicle, return.
4. **Pennock Bridge Toll Option 2—**Pennock bridge connection with a lower toll of to $5 per vehicle, return.
5. **Airport Bridge Toll Option 3—**Airport bridge connection with a toll of $2 per vehicle, **return.** This toll rate is the 'break even toll' where the operations and maintenance of the

[5] In both ferry options there was assumed to be no change from the existing ferry fee.

[6] Based on crossing of one vehicle ($6) containing two adults ($5 per person), round trip.

bridge and tolling infrastructure can be funded completely by toll revenues on an on-going basis starting shortly after the opening of the bridge.

6. **Pennock Bridge Toll Option 3—**Pennock bridge connection with a break even toll of $2 per vehicle, return.

The forecast was completed for two population scenarios. The base scenario uses HDR's risk analysis method along with high, medium, and low population forecasts to develop a population forecast. This process of developing the base population forecast is described later in the report. This base forecast is considered to be the most likely. In the base population forecast, the population of Ketchikan decreases over time. The second population forecast developed was a more optimistic sensitivity analysis using a 1% cumulative annual population growth. This scenario represents the maximum possible development on Gravina Island. The results of the optimistic population growth scenario are included in Appendix A**.**

The 2011 Updated Traffic Model used the 2002 Traffic Model as a base. The 2002 Traffic Model is described in detail in the 2002 Traffic Memo. The 2002 Traffic Model analysis timeline was 2003 to 2025, with an annual traffic forecast developed for each year; this timeline was revised to 2011 to 2033 in the 2011 Updated Traffic Model. Forecasts for all action alternatives are dependent on the opening year of the new infrastructure. For all improved ferry and bridge access scenarios, the opening year is assumed to be 2018.

Assumptions for development, trip generation, and trip reductions were derived using the following sources:

- Information gathered during a Ketchikan site visit and meetings with representatives of the Borough and of the City of Ketchikan.
- Assumptions given in the 2002 Traffic Memo.
- Assumptions given in the *Gravina Access Project Ketchikan Gateway Borough Economic Forecasts* (2002).
- Borough population projections (2010-2034) provided by the Alaska Department of Labor and Workforce Development.
- Airport data (enplanements and deplanements, approximate construction dates, approximate number of employees, approximate delivery information, and anecdotal information) provided by the Borough.[7]
- Ferry passenger data provided by the Borough.
- Institute of Transportation Engineers (ITE), *Trip Generation***,** 8th Edition (2008).
- Survey of a remote northern community with similar population and economic factors conducted by HDR.[8]

These sources are referenced throughout this report.

To estimate trips, it is important to understand the local land use that is generating those trips. The 2011 Updated Traffic Model groups existing and future land uses on Gravina Island into five general categories: airport, non-airport industrial, non-airport retail, residential, and recreational. These categories are further divided into trip sources for the purposes of trip

[7] Provided by the Borough, May, 2010.

[8] The source of this data is confidential at the request of staff representing the community.

generation. Each source has a dependent variable that is multiplied by a factor to estimate the number of trips from that source. Examples of dependent variables are households (for residential), and employees (for industrial). Trips were generated based on the following sources:

- **Airport:**
  - **Airline passengers and accompanying persons—**commercial airline passengers arriving and leaving Ketchikan via the airport and people who come to pick up or drop off airline passengers. With the existing ferry service, some accompanying persons do not cross Tongass Narrows; these people drop-off or meet airline passengers on the Revilla Island side of the ferry crossing.
  - **Airport employees and deliveries**—people working at the airport and making deliveries between the airport and Revilla Island. Deliveries include outbound from the airport (goods arriving by air destined for Revilla Island) and inbound (goods from Revilla Island destined for airport businesses or to be shipped by air to other destinations).
- **Non-airport industrial land on Gravina Island**—local non-airport industries such as forestry, construction fill and riprap material sources, fisheries or related business, and other light industries generate trips by employees, deliveries, and other business functions. The Borough reported that existing non-airport industrial employment on Gravina Island is approximately three people and that these employees do not use the existing ferry service.
- **Non-airport retail/commercial land on Gravina Island**—retail and commercial developments on Gravina Island may include some combination of shops and services. These businesses generate trips by customers, employees, and deliveries. There are no existing non-airport retail developments on Gravina Island.
- **Residential land on Gravina Island and Pennock Island—**population living on Gravina Island travelling to Revilla Island for goods, services, employment, etc. According to the Borough, there are currently about ten households on Gravina Island. The Borough reports that the existing households rarely use the ferry and rely on private boats. In the F3 Pennock Bridge scenario, this category also includes residential land on Pennock Island. The Borough reports that there are approximately 50 households on Pennock Island, all of which use boats to access Revilla Island.
- **Recreation:**
  - **Local recreational travelers**—residents of Revilla Island visiting Gravina Island for recreational purposes.[9]
  - **Tourists—**tourists to Revilla Island visiting Gravina Island for recreational purposes.[10]

Trip sources were grouped together based on mutual factors controlling their numbers. Airline passengers, accompanying persons, employees, and recreation were assumed to be a function of the population of the Ketchikan Gateway Borough. Population changes were considered in the generation of development estimates and non-airport industrial, residential, and retail/commercial sources were assumed to be a function of development on Gravina Island.

[9] Residents from Gravina Island and / or Pennock Island travelling to Revilla Island for recreational purposes are included in the trip generation from residential land. Trip generation rates per household include all trips, for all purposes, by that household.

[10] The land use assumptions do not include the presence of a hotel on Gravina Island. Because the 2011 Traffic Model does not include any hotels on Gravina Island, tourism trips are limited to trips by tourists staying on the mainland and visiting Gravina Island. All tourist trips are two-way.

In the 2002 Traffic Model, trips were generated based on user group. Table 1 compares the user groups from the 2002 Traffic Model with the trip sources from the 2011 Updated Traffic Model. User groups removed from the analysis or combined with other sources are italicized.

Table 1. Comparison of Trip Sources in 2002 Traffic Model and 2011 Updated Traffic Model

2002 Traffic Model User Groups	2011 Updated Traffic Model Trip Sources
Air/Ferry Passengers	Airline passengers and accompanying persons
Accompanying Persons	*Combined with airline passengers*
Airport Businesses	Airport employees and deliveries
General Aviation	*Negligible Impact—Removed from analysis* [11]
Airport-Related Business	*Combined with airport employees and deliveries*
Recreation/Tourism	Recreation/Tourism
Residential	Residential on Gravina Island and Pennock Island
Non-Airport Commercial	Non-airport retail/commercial on Gravina Island
Non-Airport Industrial	Non-airport industrial on Gravina Island
Community Development*	*Assumed to generate local (Gravina Island) trips only. Taken as a reduction in residential trips leaving the island.*[12]

*Includes community infrastructure, such as schools, libraries, local parks, etc. Not described as a user group in the 2002 Traffic Memo, but included as a separate source of trips in the 2002 Traffic Model.

A discussion of the assumptions used for development on Gravina Island is included in Section 3.3; more information on trip generation is presented in Section 0.

2.3 HDR Risk Analysis Method

In addition to giving a single expected result in its forecasts, HDR quantifies the uncertainty associated with this value by using its risk analysis process (RAP©) to produce an expected result called the 'realized' estimate. It is superior to 'traditional' methods for coping with uncertainty such as sensitivity analysis[13] and the scenario approach,[14] which ignore interactions among variables, assume that all underlying factors shift in the same direction, or require arbitrary decisions. Risk analysis attaches ranges to the forecasts of each input variable, allowing them to be varied simultaneously within their distributions and circumventing the problems with 'traditional' methods.

[11] Based on input from the Borough, General Aviation trips were assumed to be negligible. The few private planes at the airport do not make daily trips. For purposes of the model, the owners of private planes and their mechanics were assumed to access Gravina Island by boat.

[12] Typically, municipalities and developers plan for facilities to serve the local community when building a residential development. In the 2011 Traffic Model, it was assumed that the construction of 135 households triggered the opening of infrastructure, such as schools and parks, intended to serve the local community. Before the opening of these facilities, residents of Gravina Island would be required to travel to Revilla Island for children to attend school or visit the library. After the opening of local community facilities, these trips are no longer necessary, and the number of trips crossing the bridge made by Gravina Island residents decreases.

[13] Sensitivity analysis is a method of estimating how responsive the output of a model is to changes in single inputs.

[14] Scenario approach is a method of estimating risk by examining a high, low and middle case where all the inputs are shifted in one direction simultaneously.

There are four steps in this process:

First, develop a structure and logic model diagram. A structure and logic model diagram identifies the cause and effect relationships among variables. The models are depicted mathematically to facilitate analysis and diagrammatically to permit stakeholder scrutiny and modification (in the third step, see below).

Second, assign estimates and probability distributions to each variable. The estimates are based on a predicted low input estimate (10^{th} percentile) and high input estimate (90^{th} percentile) and a medium between these extremes, which are generated from statistical analysis and subjective probability. These ranges are then transformed into different probability distributions through HDR's risk analysis process.

Third, experts and stakeholders discuss the preliminary model in RAP© sessions.[15] They are invited to add variables and hypothesized causal relationships as well as to reassess the ranges and probability distributions assigned to the different variables.

Fourth, risk analysts synthesize the results from the RAP© sessions and simultaneously vary all the inputs along their probability distribution in thousands of simulation model runs. The result is a realized forecast together with estimates of the probability of achieving alternative outcomes given the uncertainty in underlying variables and coefficients.

The HDR risk analysis method was applied to the following variables in the 2011 Updated Traffic Model:

- Population forecast
- Airport enplanement and deplanement forecasts
- Gravina Island development forecasts

3 Variables Forecast Method

The forecast volume of trips in the future depends on the variable identified for each trip source. As discussed, there are seven trips sources included in the 2011 Updated Traffic Model: airline passengers and accompanying persons; airport employees and deliveries; non-airport industrial land; non-airport retail and commercial land; residential land; recreational travel; and tourism travel. The variables for these sources depend on changes in the Borough's population and development on Gravina Island.

This section is divided into three subsections:

- Borough Population Projections: population projections for the Borough influence every part of the traffic model either directly (e.g. trips are related to population through a factor), or indirectly (e.g. trips are estimated using development estimates, which are influenced by population). Population was used directly as a variable for two trip sources: recreation and tourism.

[15] Borough experts and DOT&PF representatives were interviewed during different RAP© sessions conducted in Ketchikan in May 2010.

- Airline Passenger Forecasts: the number of airline passengers is the variable used to forecast two sources: airline passengers and accompanying persons; and airport employees and deliveries.
- Gravina Island Development Forecasts: the population, economy, and access type were used to develop forecasts for the number of households, industrial employees, and gross floor area (GFA) of retail and commercial buildings. Gravina Island Development was used to develop forecasts for the following three trip sources: residential land, non-airport industrial land, and non-airport retail/commercial land.

3.1 Ketchikan Gateway Borough Population Projections

The State of Alaska projects that the population of the Borough will most likely decrease over the projection period, from the estimated population of 12,984 in 2009 to 9,878 people in 2034.[16] Population forecasts were developed using information released by the Borough in 2011 and displayed in Table 2. The projections shown here have an estimated 90% confidence interval. The population estimates developed by the State using 2009 population estimates as a base values were updated by HDR based on the 2010 Census, which recorded the Borough's population at 13,508 people. The updated population forecasts are shown in Table 3.

[16] Alaska Department of Labor and Workforce Development, Research and Analysis Section (February 2011). *Alaska Population Projections 2010 – 2034.* The Borough's population projections were based on historical data regarding the Borough's population size, and rates of fertility, mortality and migration. The projection began with the Borough's 2009 population estimates and ended with the 2034 population projections. The projections represent an annual average population for each year. To create this set of population projections, the Department used a "cohort component" technique. Under this approach, the population of each sex is separated into age groups and aged forward in time, with projected births and immigrants added and projected deaths and out-migrants subtracted. The Department acknowledges that:

> [P]rojections use expected or extrapolated data to make statements about the future. There is much uncertainty in population projections, as it is not possible to predict future events, but projections based on reasoned assumptions are an important tool for planners and policy makers.

Table 2. Population Projections for Ketchikan Gateway Borough (2009-2034)*

	1-Jul-09	1-Jul-14	1-Jul-19	1-Jul-24	1-Jul-29	1-Jul-34
Low*		11,875	10,767	9,764	8,783	7,827
Median	12,984	12,464	11,934	11,339	10,633	9,878
High*		13,046	13,051	12,865	12,512	11,969

* "High" and "Low" are the 90% confidence bounds. The level of variance in the total population projections is slightly overestimated. Further explanation is found in Appendix A, Alaska Population Projections Report.

Source: Alaska Department of Labor and Workforce Development, Research and Analysis Section, *Alaska Population Projections 2010 – 2034 (2011).*

Table 3. HDR Adjusted Population Projections based on 2010 Census (2009 – 2033)*

	1-Jul-10	1-Jul-14	1-Jul-19	1-Jul-24	1-Jul-29	1-Jul-34
Low*		12,354	11,202	10,158	9,137	8,143
Median	13,508	12,967	12,416	11,797	11,062	10,277
High*		13,573	13,578	13,384	13,017	12,452

* "High" and "Low" are the 90% confidence bounds.

The HDR risk analysis method was applied to the low, median, and high population projections. The resulting realized population forecast was used in the 2011 Updated Traffic Model. The population forecasts are illustrated in Figure 1.

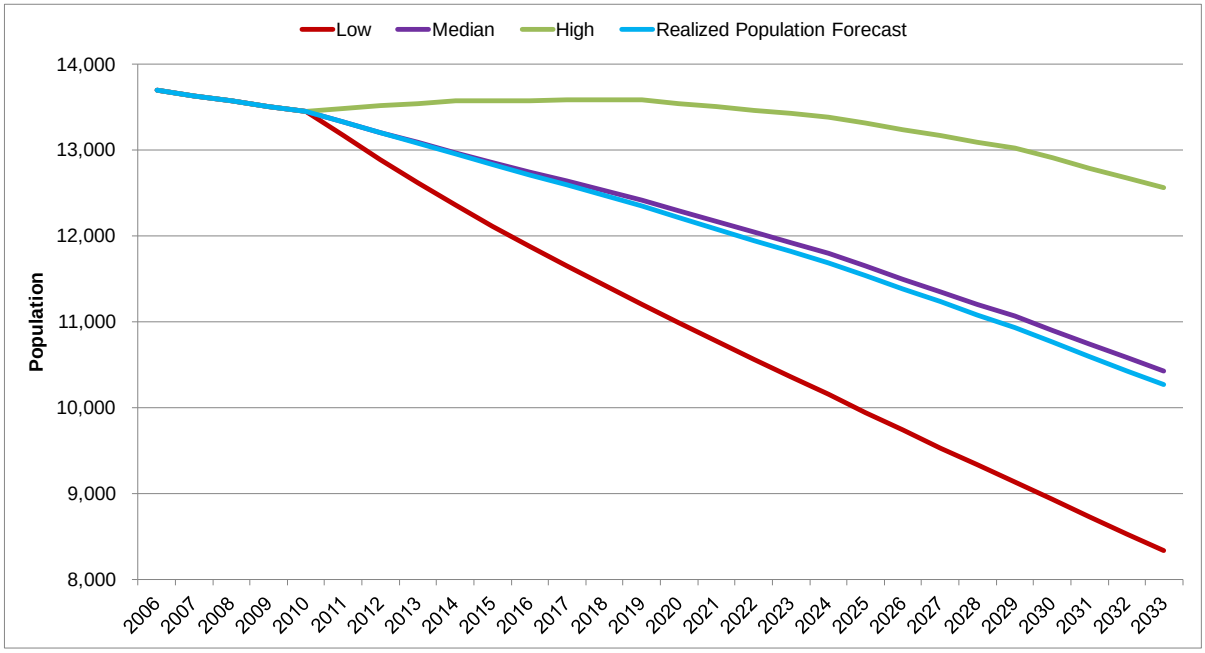

Figure 1. Population Forecast

3.2 Airline Passenger Forecast

The airline passenger forecast was generated using the population projection as a base. First, the historic number of passengers per person living in the Borough was calculated for 2001—2009 using actual reported airline passengers. The number of airline passengers per Borough resident ranged between 13.3 and 16.3 from 2000—2009 with an average value of 15.0. The trend line

showed that this value increased over time. Based on these findings, an overall value of 16.3 airline passengers per Borough resident was used to generate the low, medium, and high airline passenger forecasts from the low, median, and high population forecasts.

Finally, the RAP© process was applied to the low, medium, and high forecasts to develop a realized forecast. The forecasts are illustrated in Figure 2.

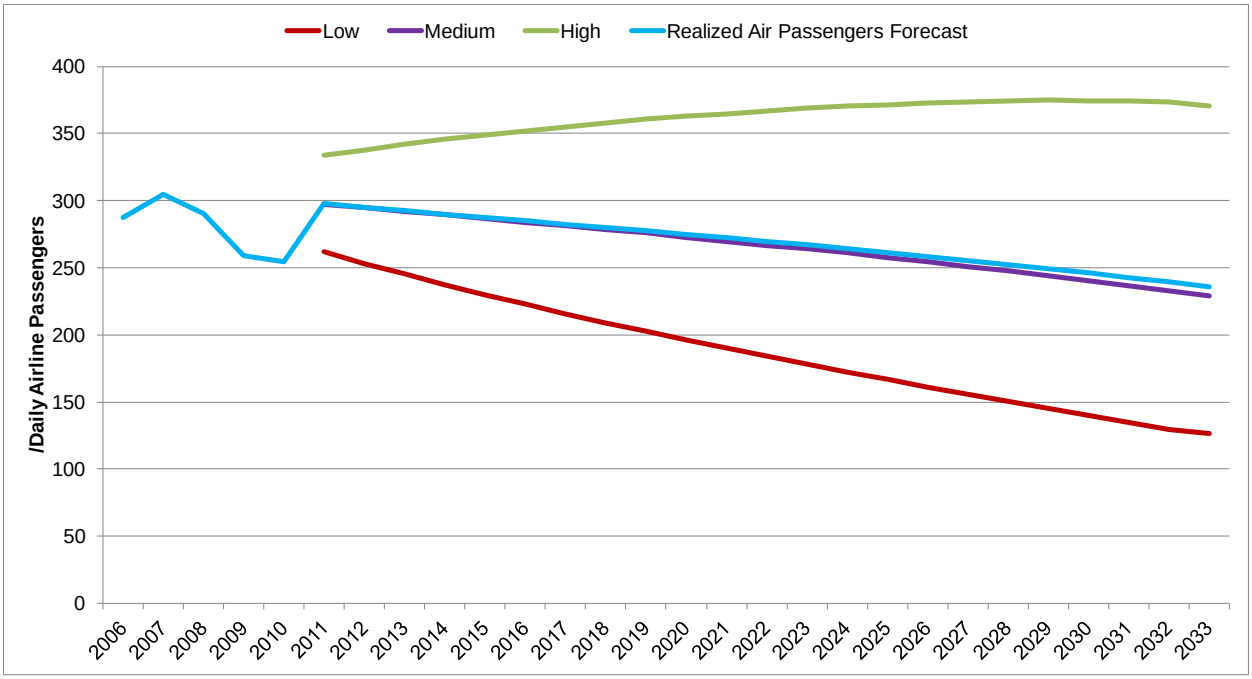

Figure 2. Airline Passenger Forecast

Borough staff stated that an average of 195 employees work at the airport, including all airline, security, and service employees. The number of employees varies seasonally, and 195 is an annual average. The number of employees was assumed to be directly related to the number of airline passengers and changed at the same rate.

3.3 Gravina Island Development Forecast

Expected development on Gravina Island is dependent on the following factors: changes in the population of Ketchikan (as described above), the local economy in Ketchikan, the availability of developable land on Gravina Island, and the type of access. The information and methods used to generate the Gravina Island Development Forecast are presented in this section.

3.3.1 Background Information

Before preparing the forecast for development on Gravina Island, HDR reviewed background reports and information provided by the Borough. Two of these reports are summarized here. The first is *Ketchikan Economic Indicators*, which was prepared for the Ketchikan Economic Borough in 2010. The other is the Ketchikan Gateway Borough Department of Planning and Community Development's *Gravina Island Plan* (2005). The summaries that follow here reflect what is written in these reports. At the time of preparation of this report, the Borough did not have more recent development plans. The trends presented in these sections are those stated in the referenced reports and do not necessarily reflect HDR's observations.

3.3.1.1 The State of Ketchikan Gateway Borough's Economy

The following summary of the Borough's economic is based on *Ketchkian Economic Indicators* (McDowell Group 2010). The Borough's economy has historically relied on fishing, forestry, and mining.[17] In recent years the role of these industries has declined significantly, and in some cases they have been replaced by smaller and more stable industries (e.g. ship / boat building and repair, marine freight, passenger transportation, marine civil construction), giving the Borough a relatively healthy economy. The existing industries are not causing, or expected to bolster, rapid economic growth.

Ketchikan was historically a mining and fishing town with a more recent logging industry. It prospered in the early 1900s with the Klondike gold rush, but as the gold rush ended, the economic focus shifted to fishing and logging. By the early 1950s, the fishing industry had declined, largely due to overfishing, but this was followed by the success of the forestry industry. It too declined, in this case because high regional costs and regulation prevented the harvesting of timber to support other forest product industries. These primary industries are now minor employers in the Borough, and no growth or limited expansion is expected.[18]

As the forestry industry declined in the 1980s, the tourism industry grew. Today, almost one million tourists visit Ketchikan on cruise ships annually. Tourism creates one seventh of the Borough's jobs. The tourism industry had grown rapidly since the 1980s and stabilized recently. There is uncertainty concerning the industry's future growth or decline, but the prevailing view is that, while there will be annual fluctuations, tourism will generally hold steady at today's rate.[19]

The other employers in Ketchikan are a hedge against the uncertainties of tourism. While some industries, such as arts and retail, are reliant on tourism, most other industries are not.[20] Other industries that each make up a small part of Ketchikan's economy include health care, construction, real estate, rental and leasing, finance and insurance, education and workforce training, information technology, seafood, and marine. Most of these are stable employers with some expecting modest growth. Since they are not mutually reliant, there is not large uncertainty in their aggregate growth. These industries are complemented by the largest employers in the Borough: the federal, state, and local governments. They supply more than one quarter of the jobs and more than one third of the wages. They are a stronger moderator on the economy than the multitude of smaller industries because they are even more stable employers.

The *Ketchikan Economic Indicators* (2010) report states that Ketchikan has moved away from its former reliance on an individual primary industry. It now possesses a relatively stable economy with modest prospects for growth. The authors expect that, barring major shifts in government regulatory policy, demand for natural resources, or Ketchikan's popularity as a tourist

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[17] McDowell Group, *Ketchikan Economic Indicators* prepared for Ketchikan Gateway Borough, Economic Development Department (2010).

[18] *Id. Forest Products and Mining Industry Profile*

[19] *Id. Ketchikan Economic Indicators: Tourism/Retail Trade Profile*

[20] *Id. Other Industry Profiles: Health Care, Construction, Real Estate, Rental, and Leasing, Finance and Insurance, Government, Arts, Energy, Education and Workforce Training, Information Technology, Seafood, and Marine.*

destination, this status is expected to continue. The expectation for modest growth is not supported by the Alaska Department of Labor and Workforce Development's population forecasts, which foresee a decrease in population. The population forecasts were used in the 2011 Updated Traffic Model.

3.3.1.2 Borough's Plans for Gravina Island

This section summarizes the Borough's long-term plans for Gravina Island based on the *Gravina Island Plan* (2005).[21] This plan will be updated after completion of the SEIS and selection of a preferred alternative. Table 4 shows the potential number of acres or units available for development by category and location, as listed in the 2005 plan. When numbers are not available, the Borough's plans are described in qualitative terms.

Table 4. Review of Borough's long-term plans for Gravina Island

	Northern Gravina Island	Central Gravina Island	Southern Gravina Island
Industrial	186 acre industrial park with mixed industry split into lots of 5 acres to 20 acres	Timber harvesting on 495 acres, short-term plans to harvest 13 million board feet; Limited fishing; Possible industrial development adjacent to the airport	120-acre fish processing plant
Residential	55 existing residential zoned properties (10 have existing improvements) and additional 287 residential units planned; lot size up to 2 acres	Little near-term residential development; 1,120 acres of future development, a portion of which will be residential.	23 planned lots (20,000 sf) in Clam Cove; Further development of condos on 526 acre at Judy Hill and 138 acres at Gravina Island Point
Commercial and Recreational	Portion of the shoreline identified for commercial purposes. At least 27% (~500 acres) devoted to recreational use.	Most development centered around the airport; Runways, terminals etc; Several recreational sites will be maintained for camping and hiking	Major recreational development at Judy Hill and to a lesser extent Gravina Island point: Golf course, equestrian park, lodges etc. Not-for-profit development (68 acres): Museum, interpretive center, etc. Minor recreational development throughout the rest of the community: Hiking trails, fishing lodge etc.

According to the *Gravina Island Plan*:

- The Borough determined that there is enough available land on Revilla Island to meet projected demand for residential development over the foreseeable future.[22]

[21] Ketchikan Gateway Borough, Department of Planning & Community Development (2005). *Gravina Island Plan: Central Gravina & Airport Reserve Area; North Gravina Area; Clam Cove & Blank Inlet Area*.

[22] The state of available residential land on Revilla Island might have changed since 2005. *Id, North Gravina Area*

- The *Gravina Island Plan* calls for the construction of the North Gravina Island Road connecting the Seley Mill to the airport terminal and ferry.[23] Upgrading this 4-mile road segment would be critical to future development of the North Gravina Island area. While the terrain is relatively unchallenging, the 2005 plan reported a cost estimate of $1.25 million per mile for constructing a road that meets a 35 mph driving standard, with several bridges. [24]
- A considerable amount of land on Gravina Island has limited development potential due to steep slopes, poor drainage, high elevation, salmon spawning stream corridors, and "'prohibitive' wetlands (classified by ADF&G)." These areas may be suitable for recreation, wildlife, flood control, watershed protection and maintaining visual quality. [25,26,27]

As of 2011, the Borough reported that there had been limited activity on Gravina Island since the release of the 2005 plan. The North Gravina Island Road is currently a gravel road providing access to Seley Mill; however, there are plans to upgrade the facility as a logging road to accommodate a second industrial site at near Seley Mill. The Borough will update the *Gravina Island Plan* after completion of the SEIS and selection of an alternative.

In summary, if access is improved between Revilla Island and Gravina Island, Gravina Island can accommodate approximately 20 industrial businesses, a fish processing plant, timber development, more than 1,500 households, and a variety of recreational and commercial businesses. A large portion of Gravina Island is not developable; however, given that the population forecast shows a decrease in population for the Borough, the additional land area on Gravina that is suitable for development is ample to meet community needs, if access is improved sufficiently to make such development attractive.

3.3.2 Gravina Island Development Forecast Method

This section describes how the information presented above, along with the results of the 2002 Traffic Model, input from Borough representatives, and other factors, were used to develop the Gravina Island Development Forecasts. First the 2002 Traffic Model development projections are presented as background information. The variables used to represent development were changed for the 2011 Updated Traffic Model; the differences between the variables in the 2002 Traffic Model and the 2011 Updated Traffic Model are discussed. This is followed by the 2011 Updated Traffic Model's Gravina Island development projections for the ferry and non-toll bridge access scenarios. The final subsection presents the 2011 Updated Traffic Model's Gravina Island development projections for the tolled bridge access scenarios.

3.3.3 2002 Traffic Model Projected Development on Gravina Island

This section summarizes the amount and type of development that was used as input to the 2002 Traffic Model for the Gravina Access Project for the different alternatives under consideration at that time. A full description is included in the 2002 Traffic Memo.

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[23] As of 2011, there was a gravel logging road that provides access to the Seley Mill site; however, the road is in poor condition and can not support heavy use.

[24] *Id, North Gravina Area*

[25] *Id, North Gravina Area*

[26] *Id, Central Gravina & Airport Reserve Area*

[27] *Id, Clam Cove & Blank Inlet Area*

Table 5 provides low-, medium-, and high-development scenarios describing the different amounts and types of development that could occur on Gravina Island. The numbers show how much land was projected to be developed for a given purpose based on the overall demand for that land type in the Borough, economic growth in the area, population growth, and other factors including type and location of access.

The low-growth scenario was used to develop forecasts for the Existing Airport Ferry (no action) and the Improved Ferry alternatives. The 2002 Traffic Model assumed that these options would be accompanied by low economic activity. It describes a scenario where there is low economic growth and minimal population growth. The medium-growth scenario describes the development expected to occur with improved ferry service and medium or high economic activity or with the bridge access scenarios and low or medium economic activity. The high-growth scenario describes the development anticipated to occur with bridge access and high economic activity in the Borough.

Table 5. 2002 Traffic Model Projected development on Gravina Island—Year 2025

	Low Case	Medium Case	High Case
Existing Airport Ferry (no action)			
Residential units	25		
Retail/Comm. Acres	0		
New airport industrial. Acres	0		
Non-airport industrial. Acres	20		
Community acres	0		
Improved Ferry			
Residential units	25	60	
Retail/Comm. Acres	0	2	
New airport industrial. Acres	0	5	
Non-airport industrial. Acres	20	35	
Community acres	0	1	
Airport Bridge			
Residential units		297	610
Retail/Comm. Acres		3	15
New airport industrial. Acres		5	15
Non-airport industrial. Acres		35	65
Community acres		2	4
Pennock Bridge			
Residential units		393	910
Retail/Comm. Acres		4	23
New airport industrial. Acres		5	15
Non-airport industrial. Acres		35	65
Community acres		3	7

3.3.4 Development Types for Trip Generation — 2002 vs. 2011

Because eight years have passed since the previous traffic forecast, the consultant team reviewed many of the previous forecast inputs and assumptions, among them the development estimates for Gravina Island. In this study, development estimates for Gravina Island were created

specifically for traffic forecasting purposes. They are not representative of all potential development on the island—only that which is expected to create trips crossing the Tongass Narrows.

As discussed previously, the following trip sources are driven by development on Gravina Island:

- Residential land
- Retail/commercial land
- Non-airport industrial land

The 2002 Traffic Model included estimated development on Gravina Island for each of these sources. The revision of the model included a review of trip generation rates, which is discussed in the next section. The units used for trip generation were adjusted for some land uses, based on the best available data and most defensible method.

Table 6. Development Units for Trip Generation

2002 Traffic Model User Groups		2011 Updated Traffic Model Trip Sources	
User Group	**Units for Trip Generation**	**User Group**	**Units for Trip Generation**
Residential	Households	Residential	Households
Retail/Commercial	Acres	Retail/Commercial	1,000 SF Gross Floor Area (GFA)
Non-airport Industrial	Acres	Non-airport Industrial	Employees

There was no change to the units for residential development; the number of households is a typical trip generation unit for which reliable data is available.

In the 2002 Traffic Model, retail/commercial and non-airport industrial developments were forecast based on the number of acres. This was then converted to employees by estimating number of employees per acre. The number of employees per acre can vary greatly depending on the type of employment The 2011 Updated Traffic Model uses thousands of square feet (SF) of gross floor area (GFA) as a base unit. The 1,000 SF GFA is a typical unit used to determine trip generation for retail, restaurant, and other commercial developments. It represents the total square feet of built retail area (excluding parking lots, and green space, which may be included in acres of development). The Institute of Transportation Engineers provides reliable trip generation numbers for SF GFA.

3.3.5 Gravina Island Development Projections—Ferry and No Toll Bridge Access Scenarios

Development estimates were completed first for the four non-toll access scenarios. Three estimates—low, medium, and high—were generated for each alternative. The estimates of low, medium, high reflect economic scenarios that might influence development. These can be described as follows:

- Low: Affected by global and local factors, both economic activity and population decline significantly in Ketchikan.
- Medium: As forecast by Alaska Department of Labor and Workforce Development, population declines in Ketchikan.
- High: Population approximately steady in Ketchikan.

Development variables were estimated for each trip source using a variety of information, as follows:

- Residential land: the number of households used in the 2002 model was used as a basis for the medium case. The low and high were adjusted based on population and economic factors.
- Retail/commercial land: the forecast GFA was developed based on HDR's expertise in private development and trip generation. The size of existing local retail developments and known developments in similar-sized communities, as well as the potential customer base were considered. Based on the size of Ketchikan and uncertainty of the type and size of future retail space on Gravina Island, a small shopping center type development is envisioned for Gravina Island in the medium and high bridge access scenarios. This general land use may include any combination of shops and services, including grocery stores, clothing retailers, restaurants, specialty stores, or many other types of business. A 30,000 SF GFA development was assumed for the medium forecast.
- The existing and maximum historic numbers of industrial employees were used to develop low and medium estimates, with population and economic expectations influencing growth. Input from Borough staff was used to develop the high estimate.

Table 7. 2011 Updated Traffic Model Low, Medium, and High Gravina Island Development Estimates for 2033

	Low	Medium	High
Existing Airport Ferry (no action)			
Residential Units (households)	10	20	50
Retail/Commercial (1,000 SF GFA)	0	0	0
Non-airport Industrial (employees)	3	20	60
Improved Ferry			
Residential Units (households)	20	50	80
Retail/Commercial (1,000 SF GFA)	0	0	0
Non-airport Industrial (employees)	3	20	60
Airport Bridge			
Residential Units (households)	100	297	610
Retail/Commercial (1,000 SF GFA)	0	30	60
Non-airport Industrial (employees)	30	100	200
Pennock Bridge			
Residential Units (households)	110	356	732
Retail/Commercial (1,000 SF GFA)	0	30	60
Non-airport Industrial (employees)	30	100	200

Limited services (electricity, water/wastewater) will be a factor in the speed and intensity of development on Gravina Island. It is unlikely that Retail will develop without services in place. The model assumed that water / wastewater infrastructure and electricity will be available in the same year that the bridge opens.

The risk analysis resulted in the realized development estimates listed in Table 8.

Table 8. 2011 Updated Traffic Model Realized Gravina Island Development Assumptions

Development: Realized Cases	2010	2021	2033
Existing Airport Ferry (no action)			
Residential Units (households)	10	13	23
Retail/Commercial (1,000 SF GFA)	0	0	0
Non-airport Industrial (employees)	3	8	24
Improved Ferry			
Residential Units (households)	10	20	50
Retail/Commercial (1,000 SF GFA)	0	0	0
Non-airport industrial (employees)	3	8	24
Airport Bridge			
Residential Units (households)	10	87	316
Retail/Commercial (1,000 SF GFA)	0	30	30
Non-airport Industrial (employees)	3	28	105
Pennock Bridge			
Residential Units (households)	10	102	378
Retail/Commercial (1,000 SF GFA)	0	30	30
Non-airport Industrial (employees)	3	28	105

Residential units and non-airport employees are assumed to increase over time in all cases, as development on Gravina Island progresses. In the case of the Pennock Bridge alternative, development is assumed to spread over both island, with very little additional induced demand for development. It is assumed, however, that as development extends over Pennock Island, existing residents will use the bridge. The Gravina Access Project does not include connecting existing residents of Pennock Island to the bridge; however, it is assumed that these connections will be provided over time by some other means if there is development on Pennock Island.

3.3.6 Development Projection with Tolled Bridge

Each of the two bridge scenarios was also assessed based on the application of three different toll rates. Toll Option 1 represents a high toll that is approximately equivalent to the existing ferry crossing fee of $16 return. Toll Option 2 is a toll of $5 per vehicle, return. Toll Option 3 is a round-trip toll of $2 that provides sufficient revenue in the opening year to fund the annual bridge operations and maintenance costs. All tolls were assumed to be electronic. Electronic tolls do not require drivers to stop to pay; rather vehicle information is collected electronically via a transponder or license plate scan, which is used to bill the driver directly.

With a bridge toll, residential development on Gravina Island would be reduced, compared to a bridge with no toll. If residents were to pay a toll, the cost of living on the island would increase. A prospective buyer would be expected to discount the future costs associated with owning a house on the island into the present price. Since there is a negative relationship between housing pricing and demand,[28] increasing (or decreasing) the toll would decrease (or increase) the

[28] Hanushek, E.A. and Quigley, J.M. (1980). *What is the Price Elasticity of Housing Demand?* The Review of

number of houses bought on the island. The relationship between tolls and the number of households can be quantified using factors called elasticities. Elasticity indicates how sensitive one variable is to changes in another. Table 9 shows the assumed housing consumption elasticity factor; these values are used to estimate the effect of different toll rates on the amount of development on Gravina Island.[29]

Tolls will affect development on Gravina Island in two other ways: general toll road bias and any bias around the selected toll system. Because a toll may be viewed negatively by the local population, the effect of the toll on development can be greater than the actual cost of the toll. Toll road bias has been found to be common in regions that had no prior or minor experience with tolling systems,[30] which is the case in Ketchikan. Tolls may further decrease development if they result in inconvenience. Electronic toll bias is less than manual toll bias because of the increased convenience. Table 9 summarizes all the assumed elasticities for Gravina Island Development due to tolls. The percentage change in the demand for housing is calculated using these values.

Table 9. Gravina Island Development Elasticity Assumptions

Variable	Mean	Source
Housing Consumption Elasticity Factor (Gravina Island)	0.39	Change in housing consumption from a 1% reduction in housing prices as a function of demand and supply price elasticities. Demand elasticity= -0.642, full adjustment supply elasticity= 1 Hanushek and Quigley (1980)
Electronic Toll Bias Adjustment Factor	0.05	HDR assumption in line with industry experts' best estimates.

Retail developments that may depend on Borough-wide customer basis are unlikely to locate on the Gravina Island if a substantial toll were in place. The analysis assumes that a toll of $5 or more round trip is incompatible with any retail development not intended exclusively for local residents. Retail intended only for local residents will not generate trips across the bridge and is not included in the analysis. The lower toll of $2 was assumed to be more palatable to retailers. The elasticity assumptions given in Table 9 were applied to the free bridge retail development assumptions to generate values for Toll Option 3.

The final realized development numbers used in the 2011 Updated Model for Toll Option 1, Toll Option 2, and Toll Option 3 are shown in Table 10 along with the development assumptions for the free bridge access scenarios. As indicated in the table, implementing a toll would reduce the amount of development on Gravina Island compared to a free bridge. The larger the toll, the greater the reduction of development.

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[29] Hanushek et al estimated the elasticity for Pittsburgh and Phoenix households. This type of elasticity is highly dependent on location and economic activity. The consultant team selected Pittsburgh household elasticity to apply to Gravina Island's case due to the lack of more accurate data. By doing so, HDR acknowledges an upward bias in its development estimates.

[30] Vollmer Associates LLP, "183A Project Traffic and Revenue Study—Final Report," Central Texas Regional Mobility Authority, Austin, Dec. 16, 2004.

Table 10. Gravina Island Development Assumptions for 2033—Tolled and Free Bridge Options

Development: Realized Cases	Free Bridge	Toll Option 1	Toll Option 2	Toll Option 3
Airport Bridge				
Residential Units (households)	316	246	284	294
Retail/Commercial (1,000 SF GFA)	30	0	0	28
Non-airport Industrial (Employees)	105	82	94	98
Pennock Bridge				
Residential Units (households)	378	291	339	351
Retail/Commercial (1,000 SF GFA)	30	0	0	28
Non-airport Industrial (Employees)	105	82	94	98

3.3.7 Land Required for New Development

Developable land will be required to build the houses and businesses expected on Gravina Island and Pennock Island. Table 11 shows the land required to accommodate the assumed development.

Table 11. Land Required for New Development (Acres)

Development: Realized Cases	Existing 2010 (Gravina)	Adj (Existing Pennock)	Forecast 2033 Total	NEW (Growth)	Conversion		Acres
Realized Case - Ferry							
Residential units (households)	10		23	13	1	acres per household	13
Retail/Comm (1000 SF GFA)	0		0	0	0.246	acres per 1000 SF GFA	0
New airport industrial				0	0	N/A	0
Non-airport industrial (Employees)	3		24	21	0.154	acres per employee	3
Community acres*			23*	13*	0.007	acres per household	0
TOTAL							**17**
Realized Case - Improved Ferry							
Residential units (households)	10		50	40	1	acres per household	40
Retail/Comm (1000 SF GFA)	0		0	0	0.246	acres per 1000 SF GFA	0
New airport industrial				0	0	N/A	0
Non-airport industrial (Employees)	3		24	21	0.154	acres per employee	3
Community acres*			50*	40*	0.007	acres per household	0
TOTAL							**43**
Realized Case - Airport Bridge (C3-4)							
Residential units (households)	10		316	306	1	acres per household	306
Retail/Comm (1000 SF GFA)	0		30	30	0.246	acres per 1000 SF GFA	7
New airport industrial				0	0	N/A	0
Non-airport industrial (Employees)	3		105	102	0.154	acres per employee	16
Community acres*			316*	2	0.007	acres per household	2
TOTAL							**331**

Table 11: Land Required for New Development (Acres) (cont)

Development: Realized Cases	Existing 2010 (Gravina)	Adj (Existing Pennock)	Forecast 2033 Total	NEW (Growth)	Conversion		Acres
Realized Case - Pennock Bridge							
Residential units (households)	10	50	378	318	1	acres per household	318
Retail/Comm (1000 SF GFA)	0		30	30	0.246	acres per 1000 SF GFA	7
New airport industrial				0	0	N/A	0
Non-airport industrial (Employees)	3		105	102	0.154	acres per employee	16
Community acres*			378*	318*	0.007	acres per household	2
TOTAL							**343**
Realized Case - Airport Bridge (C3-4, Toll 1)							
Residential units (households)	10		246	236	1	acres per household	236
Retail/Comm (1000 SF GFA)	0		0	0	0.246	acres per 1000 SF GFA	0
New airport industrial	0		0	0	0	N/A	0
Non-airport industrial (Employees)	3		82	79	0.154	acres per employee	12
Community acres*			246*	236*	0.007	acres per household	1
TOTAL							**249**
Realized Case - Pennock Bridge (Toll 1)							
Residential units (households)	10	50	291	231	1	acres per household	231
Retail/Comm (1000 SF GFA)	0		0	0	0.246	acres per 1000 SF GFA	0
New airport industrial	0		0	0	0	N/A	0
Non-airport industrial (Employees)	3		82	79	0.154	acres per employee	12
Community acres*			291*	231*	0.007	acres per household	2
TOTAL							**245**
Realized Case - Airport Bridge (C3-4, Toll 2)							
Residential units (households)	10		284	274	1	acres per household	274
Retail/Comm (1000 SF GFA)	0		0	0	0.246	acres per 1000 SF GFA	0
New airport industrial	0		0	0	0	N/A	0
Non-airport industrial (Employees)	3		94	91	0.154	acres per employee	14
Community acres*			284*	274*	0.007	acres per household	1
TOTAL							**289**
Realized Case - Pennock Bridge (Toll 2)							
Residential units (households)	10	50	339	279	1	acres per household	279
Retail/Comm (1000 SF GFA)	0		0	0	0.246	acres per 1000 SF GFA	0
New airport industrial	0		0	0	0	N/A	0
Non-airport industrial (Employees)	3		94	91	0.154	acres per employee	14
Community acres*			339*	279*	0.007	acres per household	2
TOTAL							**295**

Table 11: Land Required for New Development (Acres) (cont)

Development: Realized Cases	Existing 2010 (Gravina)	Adj (Existing Pennock)	Forecast 2033 Total	NEW (Growth)		Conversion	Acres
Realized Case - Airport Bridge (C3-4, Toll 3)							
Residential units (households)	10		294	284	1	acres per household	284
Retail/Comm (1000 SF GFA)	0		28	28	0.246	acres per 1000 SF GFA	7
New airport industrial	0		0	0	0	N/A	0
Non-airport industrial (Employees)	3		98	95	0.154	acres per employee	15
Community acres*			294*	284*	0.007	acres per household	2
TOTAL							**308**
Realized Case - Pennock Bridge (Toll 3)							
Residential units (households)	10	50	351	291	1	acres per household	291
Retail/Comm (1000 SF GFA)	0		28	28	0.246	acres per 1000 SF GFA	7
New airport industrial	0		0	0	0	N/A	0
Non-airport industrial (Employees)	3		98	95	0.154	acres per employee	15
Community acres*			351*	291*	0.007	acres per household	2
TOTAL							**314**

* Community acres not directly forecast in model. Calculated as a function of the number of households.

4 Traffic Forecast Method

4.1 Airline Passenger and Airport Ferry Data

The Borough provided ten years of airport and ferry passenger data for analysis. Using this data, along with information about the number of employees, typical daily deliveries, and construction projects, allowed for the development of airport trip generation rates. This assessment was possible because there are few existing non-airport users of the ferry. The airport data is shown in Table 12 and ferry data in Table 13. The tables include two average columns: a ten year average and a revised average. The revised average excludes 2007 and 2008, years when construction appears to have influenced the number of ferry passengers. Annual ferry passengers, ferry vehicles, and airline passengers over the past ten years are illustrated in Figure 3.

To develop trip generation rates from the airline and ferry passenger data, a few key assumptions were necessary (Table 5). These assumptions are based on the 2002 Traffic Model, discussions with the Borough, and industry standard values where no other information was available.

Table 12. Number of Commercial Airline Passengers

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Average	Refined Average
Inbound Passengers	99,519	95,695	92,659	97,432	101,298	104,906	105,401	111,658	107,069	95,294	101,093	99,026
Outbound Passengers	99,510	94,449	93,424	95,597	101,773	104,966	104,247	110,591	104,878	93,832	100,327	98,475
Total Airline passengers	**199,029**	**190,144**	**186,083**	**193,029**	**203,071**	**209,872**	**209,648**	**222,249**	**211,947**	**189,126**	**201,420**	**197,500**

Table 13. Airport Ferry Passengers

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Average	Refined Average
Walk-on Passengers	198,358	204,181	207,510	210,088	201,798	197,698	191,653	215,938	207,747	193,498	202,847	200,598
Car/Truck Passengers	159,463	152,120	125,991	130,202	126,100	138,092	139,223	185,468	197,937	147,275	150,187	139,808
Bus Passengers	19,033	17,983	15,275	19,260	20,349	20,984	134,28	5,240	13,764	1,915	14,723	16,028
Total Ferry Passengers	**376,854**	**374,284**	**348,776**	**359,550**	**348,247**	**356,774**	**344,304**	**406,646**	**419,448**	**342,688**	**367,757**	**356,435**
Cars/Trucks	85,865	84,091	72,155	74,274	71,253	78,086	80,936	105,751	116,297	88,734	85,744	79,424
Buses	5,398	5,792	5,327	6,308	6,479	6,668	6,181	1,858	4,525	1,075	4,961	5,404
Total Vehicles	**91,263**	**89,883**	**77,482**	**80,582**	**77,732**	**84,754**	**87,117**	**107,609**	**120,822**	**89,809**	**90,705**	**84,828**

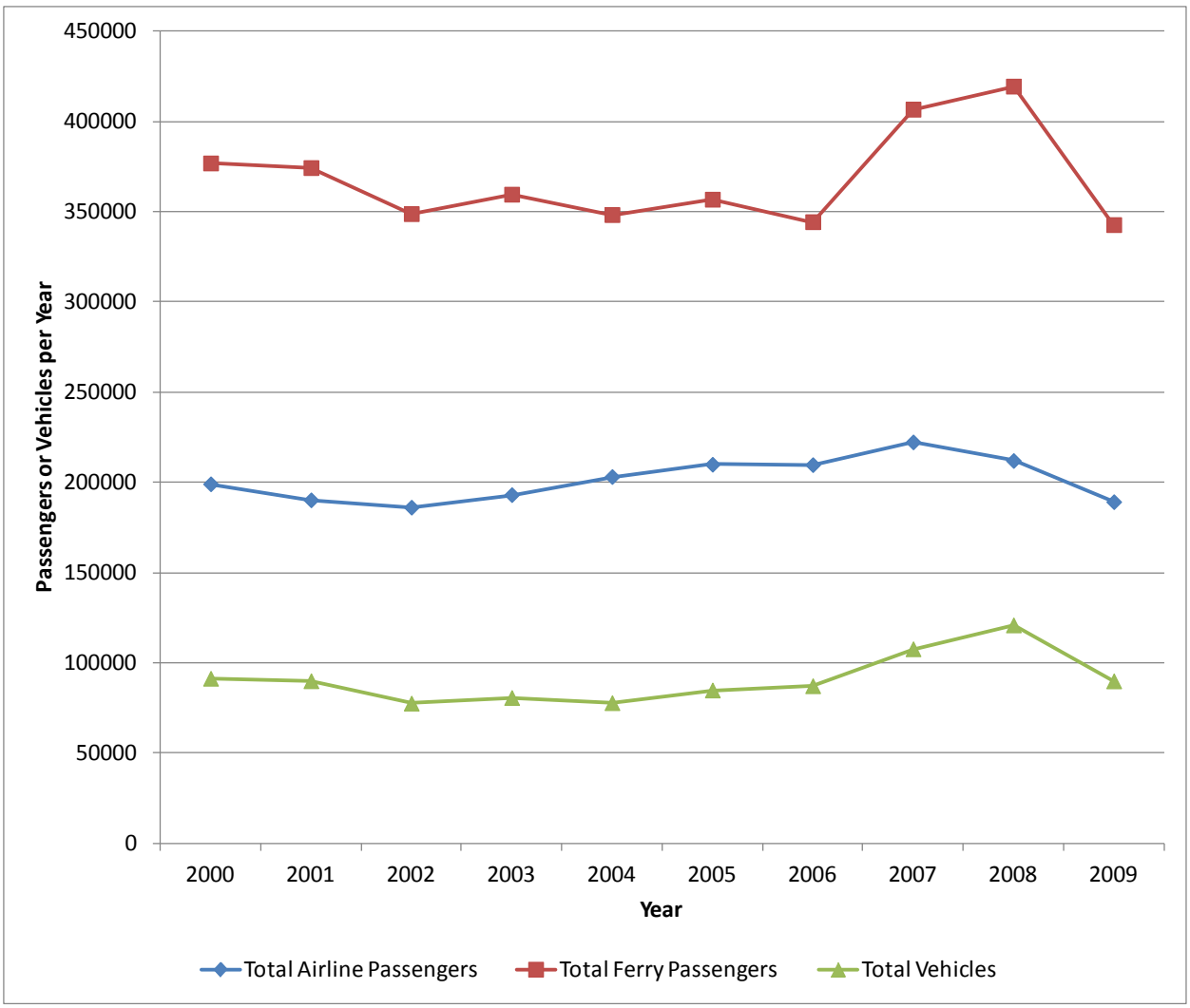

Figure 3. Annual Airline Passengers, Ferry Passengers, and Vehicles

Table 14. Assumptions Concerning Current Travelers to Gravina Island

Assumption	Value	Source
Average number of employees at the airport over the year	195 employees	Airport anecdotal information
Number of working days per employee	240 days	Airport anecdotal information
Average number of vehicle deliveries to or from airport	3 deliveries per day	Airport anecdotal information
Number of non-airport related ferry passengers per day (tourism, recreation, occasional use of ferry by Gravina Island households)	42 passengers	2002 Traffic Model
Vehicle occupancy for non-airport related ferry passenger trips	2.1 people per vehicle	Assumption based on engineering judgement
Accompanying persons per airline passenger	0.65 people per passenger	2002 Traffic Model

4.2 Trip Generation and Occupancy by User Group

Trip generation and occupancy allow traffic forecasting models to estimate the number of person-trips and vehicle-trips generated by a given development. Trip generation rates estimate how many trips start from or end at an area with a given land use based on some variable. Trips generated from residential land, for example, are typically forecast using households as the variable. These can be given as person-trip rates (how many people arrived or left) or vehicle-trip rates (how many vehicles arrived or left). One trip generated is one arrival or one departure. A person who leaves their house in the morning and arrives again in the evening generates two trips per day from their home. Occupancy allows the model to transform person-trips to vehicle trips and vice-versa.

Trip generation rates for the 2011 Updated Traffic Model were developed from the following sources:

- 2002 Traffic Model rates (where no updated information was available)
- Airline passenger and ferry passenger data analysis
- Anecdotal information from Borough personnel
- Trip rates and occupancies from *Institute of Transportation Engineers (ITE), Trip Generation, 8th Edition: An ITE Informational Report (2008)*
- HDR survey of similar northern community

For the 2011 Updated Traffic Model, trip generation rates reflect the average number of trips a day. The trip generation rates used for the 2011 Updated Model are presented in Table 15.

Table 15. Daily Trip Generation Rates

2011 Updated Traffic Model Trip Sources	Person Trip Generation Rate	Source
Airline passengers and accompanying persons	1.65 trips per passenger (on day of arrival / departure)	2002 Traffic Model
Airport employees and deliveries	1.33 trips per employee per day	Airport anecdotal information
Recreation	1.4 return trips between Revilla Island and Gravina Island per Borough household per year.	2002 Traffic Model
Tourism	0.000005 trips per Borough resident per day[31]	2002 Traffic Model
Residential units on Gravina Island	7.7 trips per household per day. Includes all trip purposes both on Gravina Island and Revilla Island.	HDR survey of similar size northern community
Non-airport retail/commercial activity on Gravina Island	57.99 trips per 1,000 SF GFA per day	ITE *Trip Generation* LU 820 [32] (Shopping Center)
Non-airport industrial activity on Gravina Island	2.94 trips per employee per day	ITE *Trip Generation* LU 110 (General Light Industrial)

Person-trip generation rates and vehicle-trip generation rates are related by occupancies when all trips are made by vehicle. When some trips are made by another mode—i.e. by walking, cycling, transit, private marine vehicle, or riding the ferry as a passenger—other adjustments must be made. For the Tongass Narrows crossing, the primary modes are expected to be private automobile, ferry, or private boat. The impacts of the other modes are negligible. [The effects of private boats are addressed through a trip reduction described in the next section.]

[31] Tourism forecasts are not available. Tourism was correlated to population as the best available method.

[32] LU 820 and similar codes in this document indicate the Land Use (LU) code as given in ITE *Trip Generation* (2008).

Occupancy typically refers to the number of passengers per vehicle when all passengers are contained within a vehicle. In the bridge cases, normal vehicle occupancy (passengers per vehicle) was used. For the ferry access scenarios, passengers may either walk on to the ferry, or use a private vehicle. The vehicle occupancies for the ferry case account for the number of passengers per vehicle on the ferry, the analysis considered airline passenger and ferry passenger crossing data. The occupancies are documented in Table 16.

Table 16. Ferry Passenger per Vehicle Occupancies

2011 Updated Traffic Model Trip Sources	Ferry passengers per vehicle	Source
Airport business related	4.2	Derived based on airport data [33]
Non-airport industrial	3.8	Assumption based on airport data and information from ITE *Trip Generation* – Industrial Land Uses
Non-airport retail/commercial	n/a	No retail/commercial assumed in ferry cases
Residential	2.5	Assumption based on airport data and HDR survey of similar size northern community
Recreational	2.0	2002 Traffic Model
Tourism	5.0	2002 Traffic Model

Special factors were applied to the airline passenger and accompanying persons trips to account for the effect of different crossing types. Persons accompanying airline passengers have the following choices available to them:

- Greet or drop-off the passenger at the airport (i.e. cross Tongass Narrows)
  - Walk on to the ferry to cross
  - Drive on to the ferry to cross
- Greet or drop-off the passenger at the ferry terminal on Revilla Island (i.e. do not cross Tongass Narrows)

[33] As presented in Section 4.1

Special factors used for airport trips are provided in Table 17.

Vehicle occupancies for the bridge cases are shown in Table 18.

Table 17. Special Airport Travel Factors

	Factor	Source
Accompanying persons per 100 airline passengers (bridge access scenarios)	65 people/100 passengers	Derived based on airport data[34]
Accompanying persons per 100 airline passengers (ferry access scenarios)	19 people/100 passengers	Derived based on airport data
Vehicles crossing Tongass Narrows per 100 airline passengers* (ferry access scenarios)	28 vehicle crossings/ 100 passengers	Derived based on airport data

*This includes vehicles used by accompanying persons crossing in both directions.

Table 18. Vehicle Occupancies for Bridge Access Scenarios

2011 Updated Traffic Model Trip Sources	Passengers per Vehicle	Source
Airline passengers and accompanying persons	2.1	ITE Commercial Airport LU 021
Airport business related	1.3	ITE Industrial Occupancy
Non-airport industrial	1.3	ITE Industrial Occupancy
Non-airport retail/commercial	1.4	HDR survey of similar size northern community
Residential	1.3	HDR survey of similar size northern community
Recreational	2.0	2002 Traffic Model
Tourism	5.0	2002 Traffic Model

4.3 Trip Reductions and Adjustments

Two types of reductions were included in the model: internal trip reductions and low service/alternative mode reduction. Internal trip reductions account for trips that occur between two land uses on Gravina Island and never use the crossing. Internal trip reduction would include trips between residential and local community facilities, retail, and industrial on Gravina Island. Low service / alternative mode reductions account for trips that are made by private boats or not made at all because of the expense or inconvenience of the crossing. The low service / alternative mode reductions account, in part, for the lack of residential trips on the existing ferry even though there are households on Gravina Island.

Internal reductions cannot be described as stand-alone factors; they are dependent on the relationship with other land uses on the island. A general example can be used to illustrate the concept. Assume a new development has a store and 100 households. The store generates 1,000 trips per hour and 30 percent of them are expected to be local; 300 trips could be from local sources (i.e. 1,000 x 0.3 = 300). Most trips to the store will be from households. The 100 households in the local area would generate around 100 trips per hour. Some of those trips would be to and from work, school, and other activities. Only a portion of those trips would be to the

[34] As presented in Section 4.1

local store. It is not possible for those 100 households to generate 300 trips to the local store; the households are only expected to generate 100 trips in total. It is more likely that those 100 households generate around 10 trips to the local store. The lesser of the two values always governs—i.e. since it is not possible for the internal reduction to be 300 trips (because the households are not generating 300 trips) then the internal reduction must be 10 trips. The model accounts for this by calculating the maximum expected internal trips for each trip type, comparing the internal trips for related land uses, and deducting the smaller value from each trip generation.

Most of the internal trip reductions used relate to residential trips, because most trips on Gravina Island will be to or from households. Some basic assumptions about the composition of total household trips for households on Gravina Island over a day were made based on an HDR survey of a similar-sized northern community. The following distribution was assumed:

- Work—40%
- Community, school, and social[35]—30%
- Shopping and personal business—20%
- Social, recreational, and personal business (on Revilla Island only) [36]—10%

From the first three of these categories, some percentage of trips could be fulfilled 'internally' on Gravina Island. This maximum percentage of each type of trip that could be expected to be fulfilled internally was assumed, for modeling purposes, as follows:

- Work—20%
- Community, school, and social—100%
- Shopping and personal business—40%

Multiplying these factors together resulted in the following maximum internal reduction from residential:

- Work—8%
- Community, school, and social—30%
- Shopping and personal business—16%

Community facilities on Gravina Island, e.g. a small school, are assumed to be constructed when 135 households are built on the island. After this point, community infrastructure was assumed to expand as needed. Based on the timing of the expected bridge openings and need for utilities and other infrastructure, 2020 was taken as the earliest possible opening day for community facilities. Community facilities are expected to serve only the residents on Gravina Island. Any trips

[35] Social and personal business trips are divided into two categories. The first category includes social and personal business trips that can be accommodated on Gravina Island. One example is a trip by a person who lives on Gravina Island to visit the house of another person who lives on Gravina Island. It is understood that residents of Gravina Island will not be able to meet all of their social and personal business needs on Gravina Island. Sometimes, they will need to travel to Revilla Island. Social and personal business trips that can be accommodated on Gravina Island are included in the second and third bullets. The fourth bullet represents the trips that were assumed to be made to Revilla Island.

[36] This category includes social, recreational, and personal business trips that cannot be accommodated on Gravina Island even with the full build-out of the retail development. Some trips are always expected to go to Revilla Island for a wider variety of services.

attracted from Revilla Island are negligible and were not included in the analysis. Community trips were deducted from residential trips that would have otherwise had to leave Gravina Island for these services.

The maximum industrial and retail internal reductions were assumed to be 15 percent and 30 percent respectively. Industrial trips were assumed to interact with residential work trips and retail trips were assumed to interact with residential shopping and personal business trips. This is not a perfect assumption, as some retail trips will actually be residential work trips; however, it is sufficiently accurate for a model with this level of detail.

The actual internal reductions from each trip category would change over time as the mix of residential, industrial, and retail trips changed for each alternative. These relationships are reflected within the model.

There are a number of reasons why initial trip generation should be reduced to account for different behavior by residents. The 2011 Traffic Model considers vehicle and passenger trips that cross over Tongass Narrows by bridge or ferry. This report has already discussed cases where a trip may have both an origin and a destination on Gravina Island and not cross the Tongass Narrows. Alternatively, a different mode of transportation might be used to cross Tongass Narrows. Both anecdotal information and analysis of the ferry data indicate that the existing residents of Gravina Island and some industrial employees on Gravina Island do not use the ferry. The Borough reported the residents of Gravina Island use private boats to reach Revilla Island. Private boats are accounted for in the model using an ‘alternative mode’ factor.

Sometimes a given land use may produce fewer trips than expected because people decide not to make discretionary trips. Discretionary trips are trips that are not necessary. In the example 'typical' household at the beginning of this report, the parents travelling to the restaurant can be considered a discretionary trip. If transportation is inconvenient or expensive, people may decide not to make these discretionary trips. This is accounted for in the model by a 'low service' factor. The reductions are provided in Table 19.

Table 19. Low Service and Marine Mode Reduction Assumptions

Trip source and alternative	Reduction	Source
Non-airport industrial		
Existing airport ferry (no action)	100%	Ketchikan ferry anecdotal information [37]
Improved ferry	50%	Assumption
Bridge alternatives	20%	Assumption
Non-airport retail/commercial		
Existing airport ferry (no action)	n/a	No retail expected in ferry access scenarios
Improved ferry	n/a	No retail expected in ferry access scenarios
Bridge alternatives	10%	Assumption
Residential		
Existing airport ferry (no action)	100%	Ketchikan ferry anecdotal information [38]
Improved ferry	50%	Assumption
Bridge alternatives	20%	Assumption

In all future scenarios, some marine access to Gravina Island is anticipated. A portion of the land designated for rezoning in the *Gravina Island Plan* (2005) is waterfront and the plan calls for small marinas as part of commercial developments, water accessible residential development, and industrial parks with access to waterfront. Residential and industrial land owners and employees of industrial businesses may use boats to make the crossing, even in the bridge alternatives. Some percentage of goods movement can be expected to take place by barge. The low service and marine mode reduction for retail in the bridge alternative was assumed to be lower than that expected for industrial and residential. Residents of Revilla Island crossing the narrows to shop may have the potential to use a boat, but it is assumed that they will be more likely to use the bridge than residents of waterfront Gravina Island properties.

4.4 Effects of Toll on Trip Making

People are more likely to reduce or combine their discretionary trips if the cost of each trip is more. This may also lead to more trips being shifted to private boats. For the 2011 Updated Traffic Model, the trip suppression effect of tolls was represented using a trip elasticity operation.

[37] Representatives from the Ketchikan Borough reported that industries have not historically used the ferry to access the island. Industries based on Gravina Island are expected to have their own private boats and barges in the Existing Airport Ferry (no action) case.

[38] Representatives from the Ketchikan Borough reported that industries have not historically used the ferry to access the island. Industries based on Gravina Island are expected to have their own private boats and barges in the Existing Airport Ferry (no action) case.

A percentage reduction in demand for discretionary trips was developed for each toll option. These reductions were calculated using the average vehicle cost of each crossing, including the toll, and an electronic toll bias of -0.05. The reductions for each toll option were applied to the following trip sources:

- Accompanying persons (of airline passengers)
- Retail / commercial
- Residential
- Recreation
- Tourism

No reduction was applied to airline passenger, airport employee, or non-airport industrial trip sources, because they are not discretionary. Passengers must reach Ketchikan and employees must reach work, therefore they are less sensitive to price.

5 Traffic Forecast Results

The result of the traffic model is a forecast of the average daily number of passengers and vehicles crossing between Gravina Island and Ketchikan. Results are provided for the following ten access scenarios:

Existing Airport Ferry (no action)
1. Improved Ferry
2. Airport Bridge
3. Pennock Bridge
4. Airport Bridge Toll Option 1
5. Pennock Bridge Toll Option 1
6. Airport Bridge Toll Option 2
7. Pennock Bridge Toll Option 2
8. Airport Bridge Toll Option 3
9. Pennock Bridge Toll Option 3

The forecast passenger and vehicle trips, respectively, for the first four access scenarios are shown in Figure 4 and Figure 5. The results of the 2002 Traffic Model are also shown for comparison. The 2011 Updated Model forecasts are lower than 2002 Traffic Model forecasts for a number of reasons: most importantly, the forecast number of residential units is lower in the revised scenario. As expected, the Pennock Bridge results in the most trips, followed by the Airport Bridge and then the ferry options. The tolls result in a significant reduction in trips. Retail development on Gravina Island would have a significant potential impact on trips across Tongass Narrows. The 2011 Updated Traffic Model assumes that a small ‘strip mall’ type development occurs in the non-tolled bridge scenarios. The opening of this type of retail establishment is expected to result in a large increase in trips, as the new retail space would serve as a destination for existing Ketchikan residents. This is considered reasonable based on the limited choice for existing retail in Ketchikan.

All bridge access scenarios are shown together in Figure 6 for passenger crossings and Figure 7 for vehicle crossings.

Table 20 and Table 21 show the distribution of trips by trip source for the each alternative in 2033. Airport trips are a significant portion of crossings for all access scenarios; airline

passengers are captive and most cross Tongass Narrows to reach Ketchikan. Their trips are not discretionary. Airport employees and businesses are similarly unaffected by the crossing type; they must cross the Tongass Narrows to reach work unless they live on Gravina. The number of vehicles, however, is significantly more for the bridge crossings than for the ferry crossings. More employees would choose to bring their vehicles across the narrows when there is a bridge. Similarly, more visitors entering by air can be expected to rent cars if there is a bridge. The fixed link also affects the choices of accompanying persons, who are more likely to cross in the case of a bridge.

Increased development (households, industrial employment, and retail) also generate significantly more trips when there is a bridge. The tables show that when there is a retail establishment on Gravina Island, it generates the second most trips (after the airport). The type and size of retail development has a significant impact on the number of trips. A high level sensitivity was completed examining the impact of developing a big box store on Gravina Island instead of a smaller retail/commercial strip. Big box stores usually have more than 75,000 SF GFA and could generate approximately 2,800 trip ends in a typical weekday – i.e. approximately 1,400 customers, employees, and deliveries could be expected to visit the store each day. However, a big box store was not considered reasonable given the current population projections.

When retail trips and residential trips are both present on Gravina Island, an internal reduction factor is applied. This explains why the total residential trips for Toll Option 3 are less than the total residential trips for Toll Option 2, even though Toll Option 3 has more households. Some trips made by residents in Toll Option 3 are going to local retail and not leaving Gravina Island.

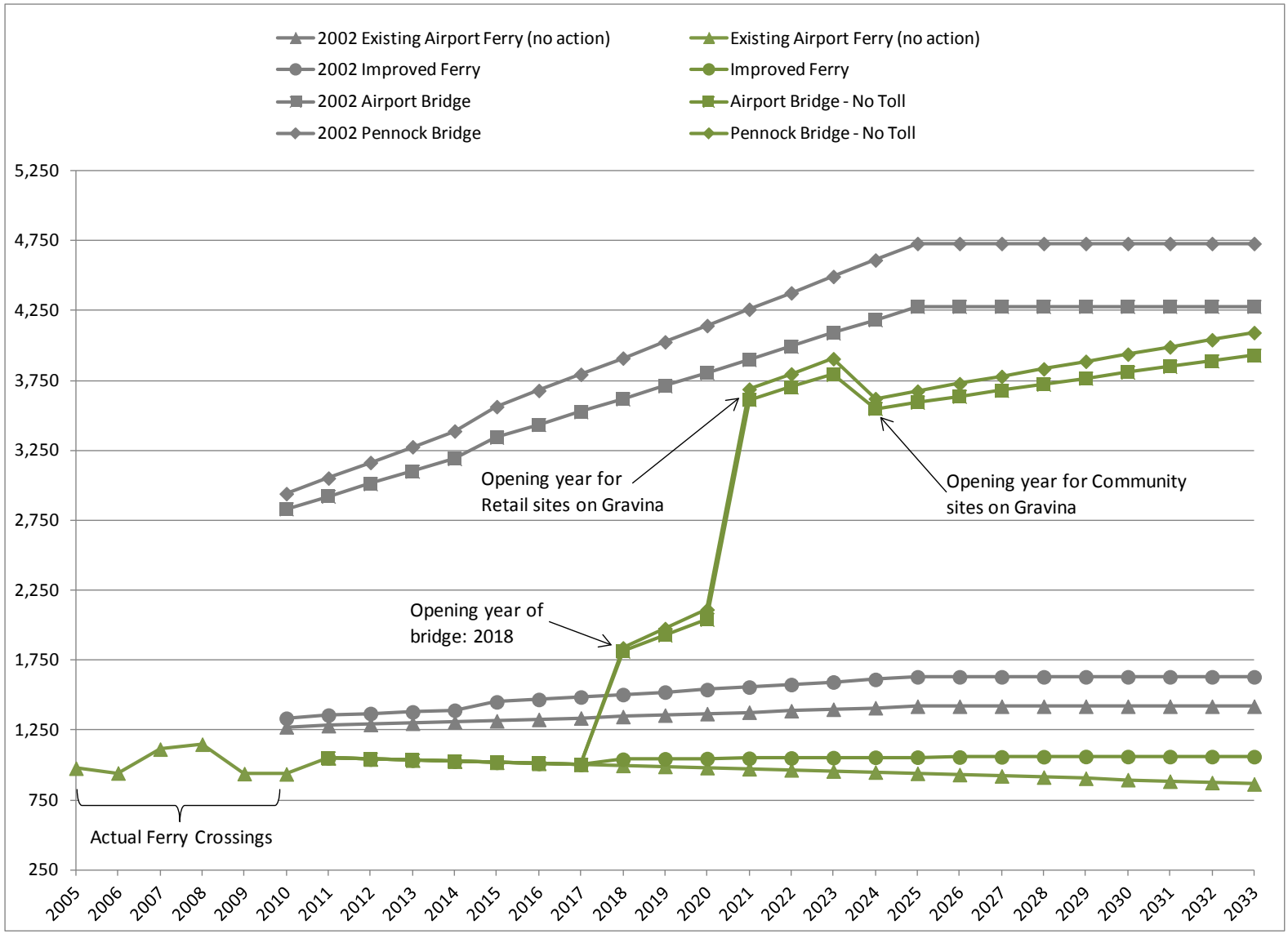

Figure 4. Average Daily Passenger Crossings by Year—Ferry and No-Toll Bridge Access Scenarios

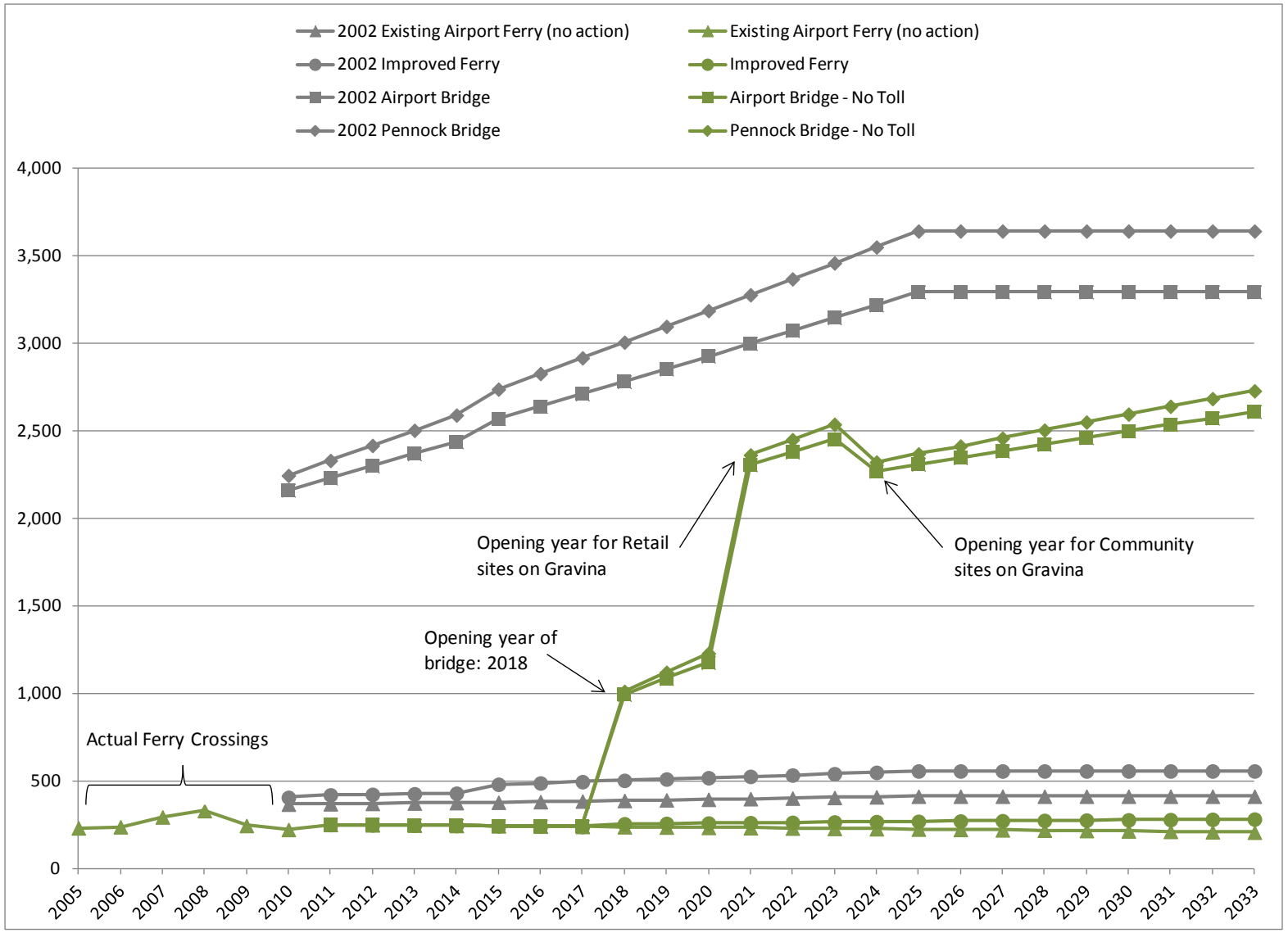

Figure 5. Daily Vehicle Crossings by Year—Ferry and No-Toll Bridge Access Scenarios

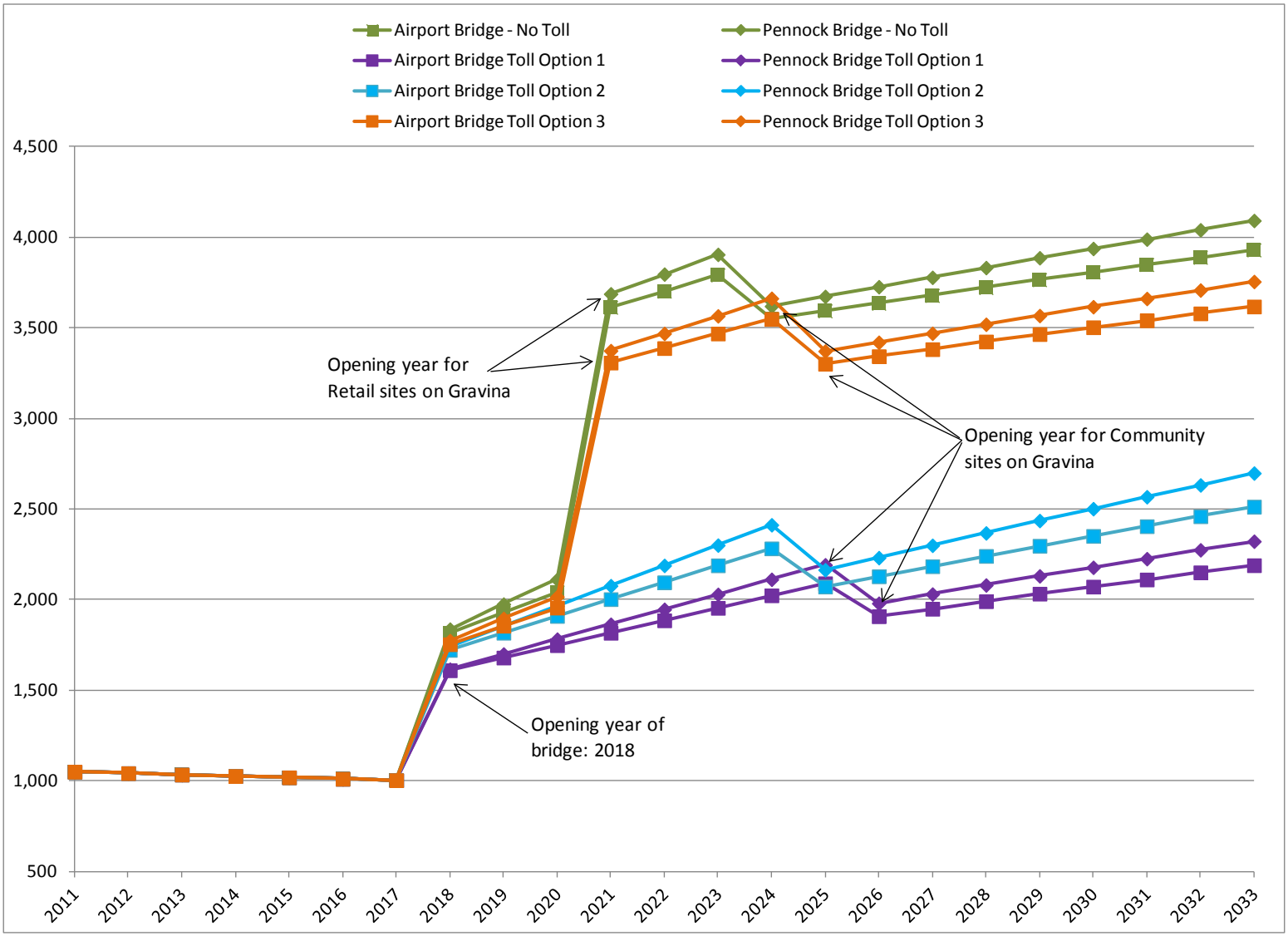

Figure 6. Daily Passenger Crossings by Year - Bridge Access Scenarios

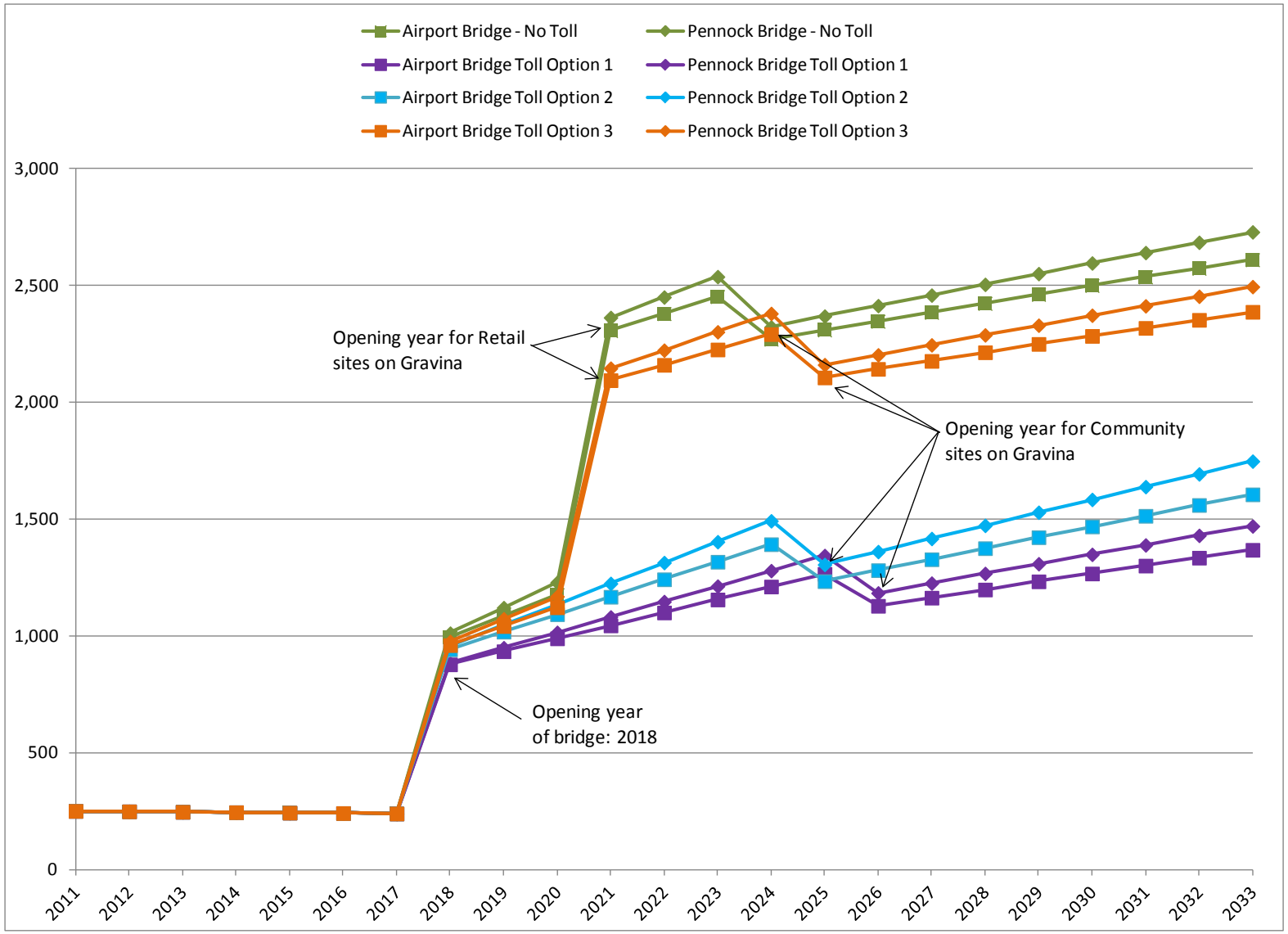

Figure 7. Daily Vehicle Crossings by Year - Bridge Access Scenarios

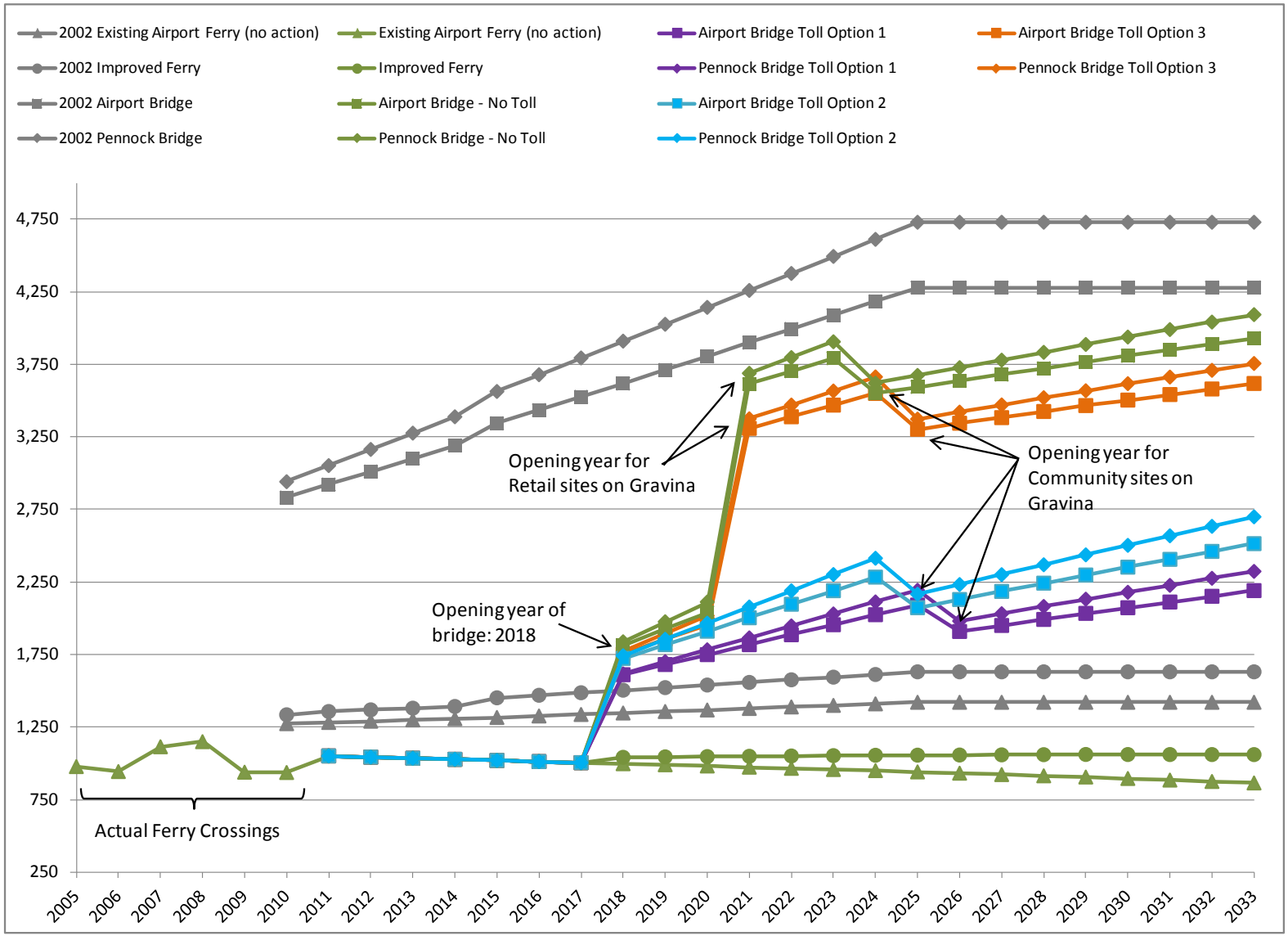

Figure 8. Daily Passenger Crossings by Year - All Access Scenarios

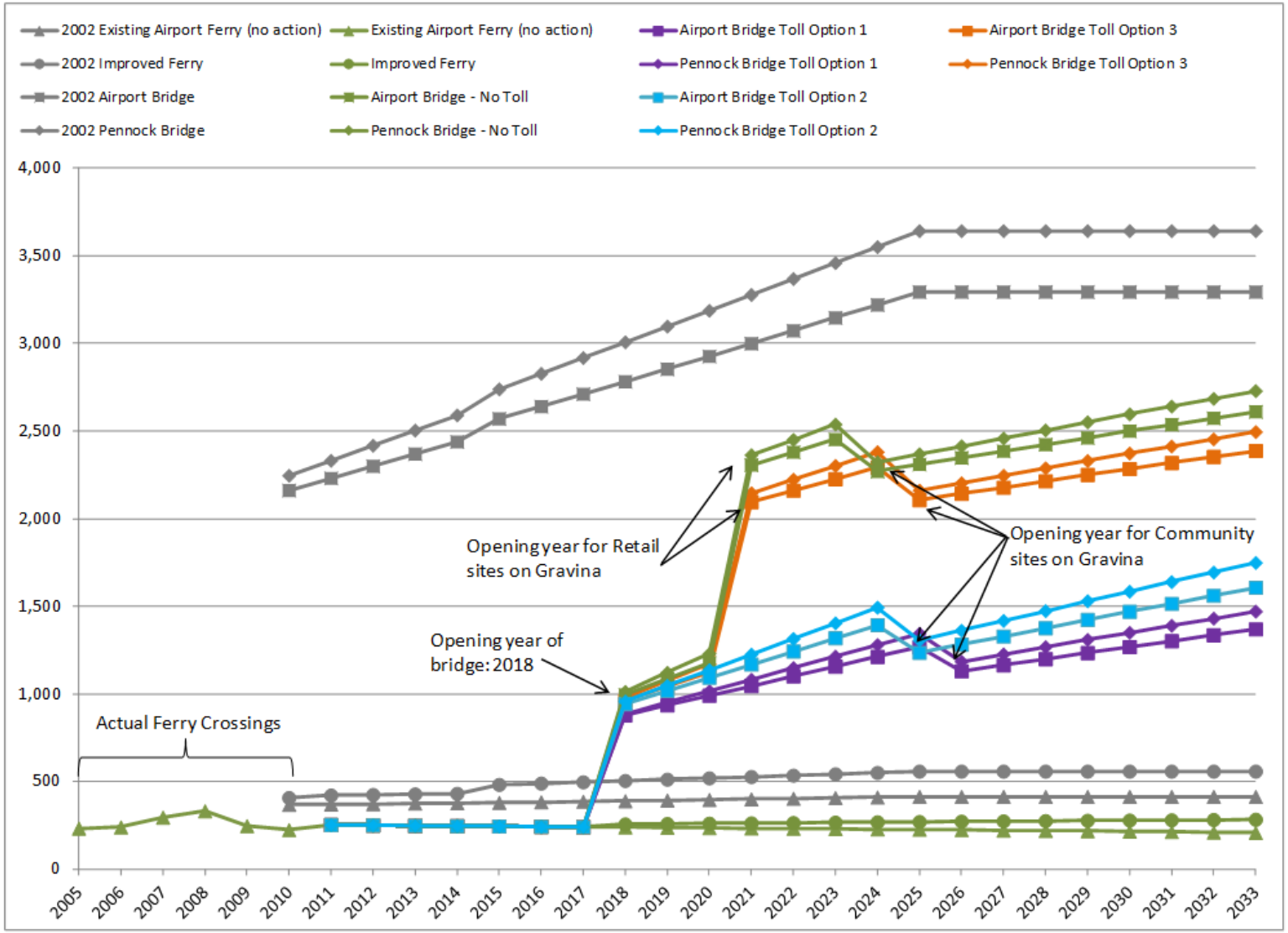

Figure 9. Daily Vehicle Crossings by Year - All Access Scenarios

Table 20. Total Passenger Crossings in 2033 by Trip Source and Alternative

					Toll Option 1		Toll Option 2		Toll Option 3	
	Existing Airport Ferry (no action)	Improved Ferry	Airport Bridge	Pennock Bridge	Airport Bridge	Pennock Bridge	Airport Bridge	Pennock Bridge	Airport Bridge	Pennock Bridge
Air Travel - Passengers	471	471	471	471	471	471	471	471	471	471
Air Travel - Accompanying Persons	116	116	613	613	492	492	558	558	576	576
Airport Business Related	232	232	232	232	232	232	232	232	232	232
Industrial	-	25	201	201	204	204	235	235	244	244
Retail/Commercial	-	-	1,371	1,334	-	-	-	-	1,177	1,144
Residential	11	182	975	1,174	732	864	953	1,138	853	1,023
Recreation	31	31	62	62	54	54	58	58	59	59
Tourism	3	3	6	6	5	5	5	5	5	5
Total	865	1,060	3,930	4,092	2,190	2,323	2,514	2,699	3,618	3,756

Table 21. Total Vehicle Crossings in 2033 by Trip Source and Alternative

					Toll Option 1		Toll Option 2		Toll Option 3	
	Existing Airport Ferry (no action)	Improved Ferry	Airport Bridge	Pennock Bridge	Airport Bridge1	Pennock Bridge	Airport Bridge	Pennock Bridge	Airport Bridge	Pennock Bridge
Air Travel (all)	132	132	515	515	458	458	489	489	498	498
Airport Business Related	55	55	179	179	179	179	179	179	179	179
Industrial	-	6	154	154	157	157	181	181	187	187
Retail/Commercial	-	-	979	953	-	-	-	-	841	817
Residential	4	73	750	895	547	649	726	868	651	782
Recreation	15	15	31	31	27	27	29	29	30	30
Tourism	1	1	3	3	2	2	3	3	3	3
Total	**208**	**282**	**2,611**	**2,730**	**1,369**	**1,471**	**1,606**	**1,749**	**2,388**	**2,495**

6 Summary and Conclusion

6.1 Summary of Changes from 2002 Traffic Model

The 2011 Updated Traffic Model included some major revisions to the 2002 Traffic Model, the most significant of which are:

- Extension of analysis to 2033
- Change in population forecast
- Addition of risk analysis
- Removal of private plane trip generation
- Revision of development numbers
- Update of trip generation assumptions:
  - Airport employees
  - Residential
  - Retail/commercial
  - Industrial
- Update of special airport factors based on Borough airport data
- Introduction of low service and marine mode reductions
- Introduction of internal reductions and interaction calculations
- Relocation of community trips to internal trips
- Addition of three tolled access scenarios

Both the 2011 and 2002 models show the airport as a significant trip generator. The 2002 Traffic Model included an increase in the number of airline passengers along with expected population growth. The 2011 Updated Traffic Model shows a gradual decline in population and therefore a gradual decline in airline passengers.

The 2011 Updated Traffic Model results in a more conservative estimate because of the lower residential development forecast compared with 2002. The economic climate in Ketchikan and globally has significantly changed since the 2002 Traffic Model was completed. There is still some demand for residential land in Ketchikan, but State population forecasts show an overall decline in population. A bridge to Gravina Island would create some demand from existing residents, and the forecasts reflect that.

In access scenarios where retail development is assumed, that becomes the second highest generator of trips, after the airport. Because retail generates trips from employees and customers, even a small retail development can have a significant impact on crossings. If the economy declines further and no retail development takes place, the number of trips would decline significantly from those shown. Alternatively, if a larger retail development—such as a big box store—is built, the number of trips will be significantly more.

6.2 Conclusion

The traffic forecasts show that the Pennock Bridge generates the most passenger and vehicle crossings, followed by the Airport Bridge. Tolling is expected to slow development and suppress traffic. The existing ferry and improved alternatives are expected to result in very little development on Gravina Island and, therefore fewer trips. The total crossings for each alternative in 2033 are summarized in Table 22.

Table 22. Updated 2010 Traffic Model - Total Crossings in 2033 by Alternative

	Passengers	Vehicles
Existing Airport Ferry (no action)	865	208
Improved Ferry	1,060	282
Airport Bridge	3,930	2,611
Pennock Bridge	4,092	2,730
Airport Bridge - Toll Option 1	2,190	1,369
Pennock Bridge - Toll Option 1	2,323	1,471
Airport Bridge - Toll Option 2	2,514	1,606
Pennock Bridge - Toll Option 2	2,699	1,749
Airport Bridge - Toll Option 3	3,618	2,388
Pennock Bridge - Toll Option 3	3,756	2,495

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Appendix A
Optimistic Sensitivity Analysis—
1% Growth

A. Optimistic Sensitivity Analysis—1% Population Growth

A.1 Introduction

In addition to the traffic forecasts developed using the base population forecast that is documented in the main body of the report, HDR also completed an optimistic sensitivity analysis based on 1 percent annual cumulative population growth from 2011 to 2033. This appendix documents that sensitivity analysis.

A.2 Development on Gravina Island

The model required two changes to the base assumptions. First, the population forecast was updated to reflect an annual cumulative population growth of 1 percent. This population forecast is shown in Exhibit A-1.

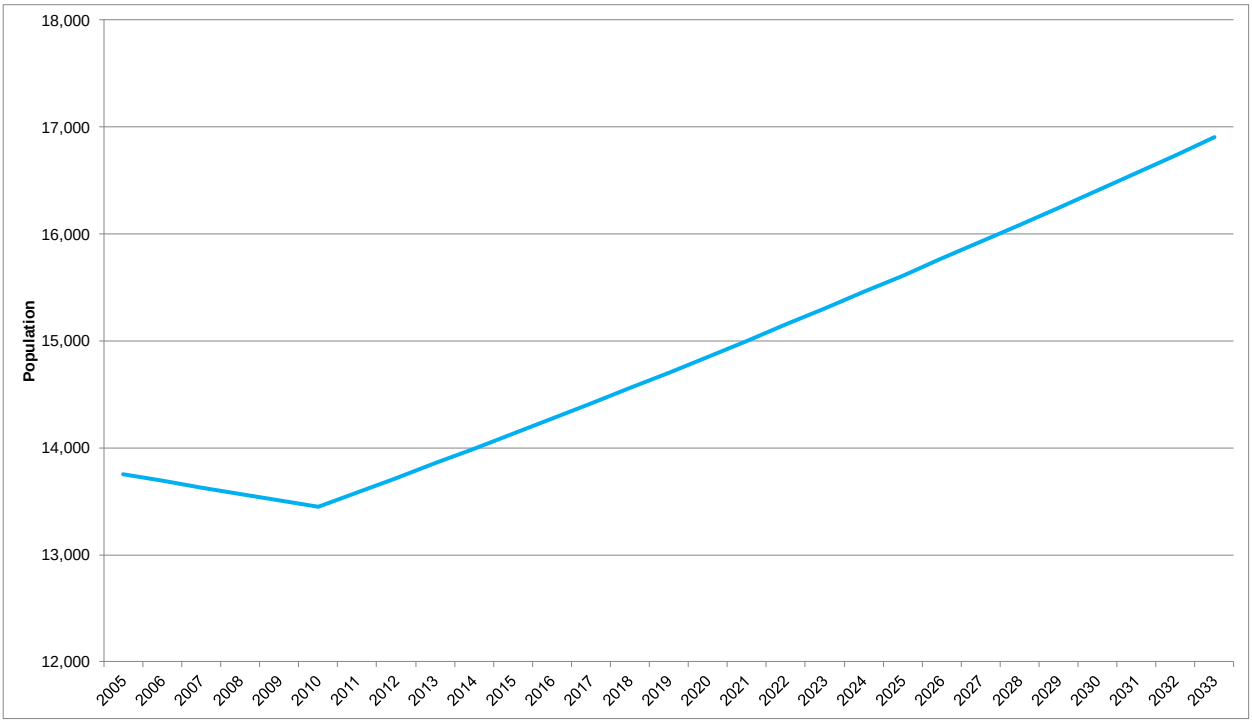

Exhibit 6-1. Optimistic Population Forecast—1% Population Growth

The second change was to the development assumptions for Gravina Island. Given an increase in population, the residential, retail, and industrial land use on Gravina Island would also be expected to change. Because there is more land available on Gravina Island than on Revilla Island, more growth can be expected to occur on Gravina Island. The development assumptions for this scenario are given in Table A-1.

Table A-1. Optimistic Sensitivity Analysis - Gravina Island Development Assumptions

Development: Realized Cases	2010	2021	2033
Existing Airport Ferry (No Action)			
Residential Units (households)	10	44	46
Retail/Commercial (1,000 SF GFA)	0	0	0
Non-airport Industrial (Employees)	3	10	30
Improved Ferry			
Residential Units (households)	10	50	118
Retail/Commercial (1,000 SF GFA)	0	0	0
Non-airport industrial (Employees)	3	10	30
Airport Bridge			
Residential Units (households)	10	340	879
Retail/Commercial (1,000 SF GFA)	0	38	38
Non-airport Industrial (Employees)	3	35	131
Pennock Bridge			
Residential Units (households)	10	355	940
Retail/Commercial (1,000 SF GFA)	0	38	38
Non-airport Industrial (Employees)	3	35	131

The optimistic sensitivity analysis was also applied to the tolled options. The development assumptions for the tolled options are shown in Table A-2.

Table A-2. Gravina Island Development Assumptions for 2033—Free and Tolled Bridge Options

Development: Realized Cases	Free Bridge	Toll Option 1	Toll Option 2	Toll Option 3
Airport Bridge				
Residential Units (households)	879	679	787	816
Retail/Commercial (1,000 SF GFA)	38	0	0	35
Non-airport Industrial (Employees)	131	101	117	121
Pennock Bridge				
Residential Units (households)	940	725	842	873
Retail/Commercial (1,000 SF GFA)	38	0	0	35
Non-airport Industrial (Employees)	131	101	117	121

The result of the model is a forecast of the average daily number of passengers and vehicles crossing between Gravina Island and Revilla Island. Results are shown in Exhibit A-2 and Exhibit A-3 and summarized in Table A-3 and Table A-4.

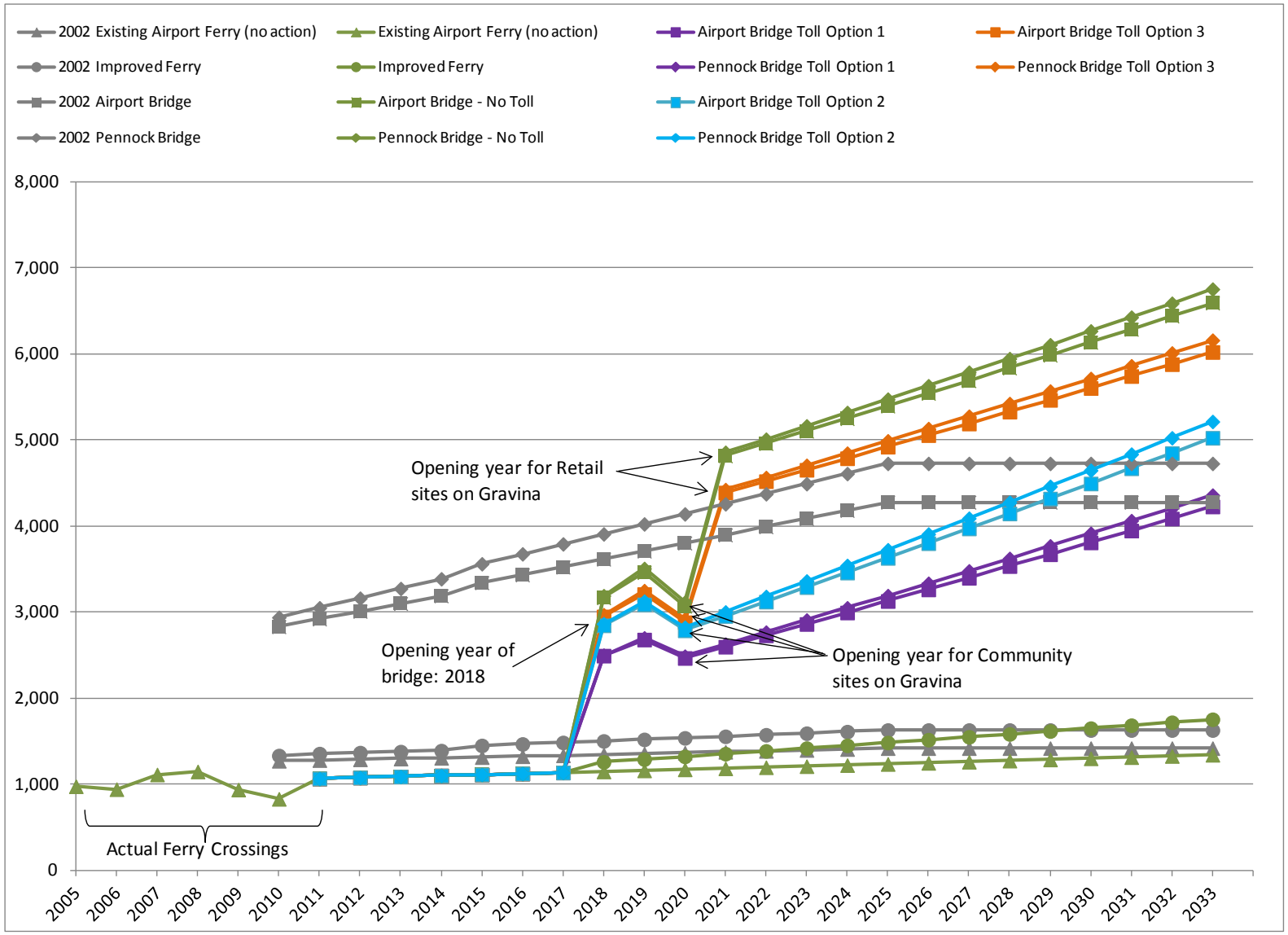

Exhibit A-2. Optimistic Sensitivity Analysis, Daily Passenger Crossings by Year - All Alternatives

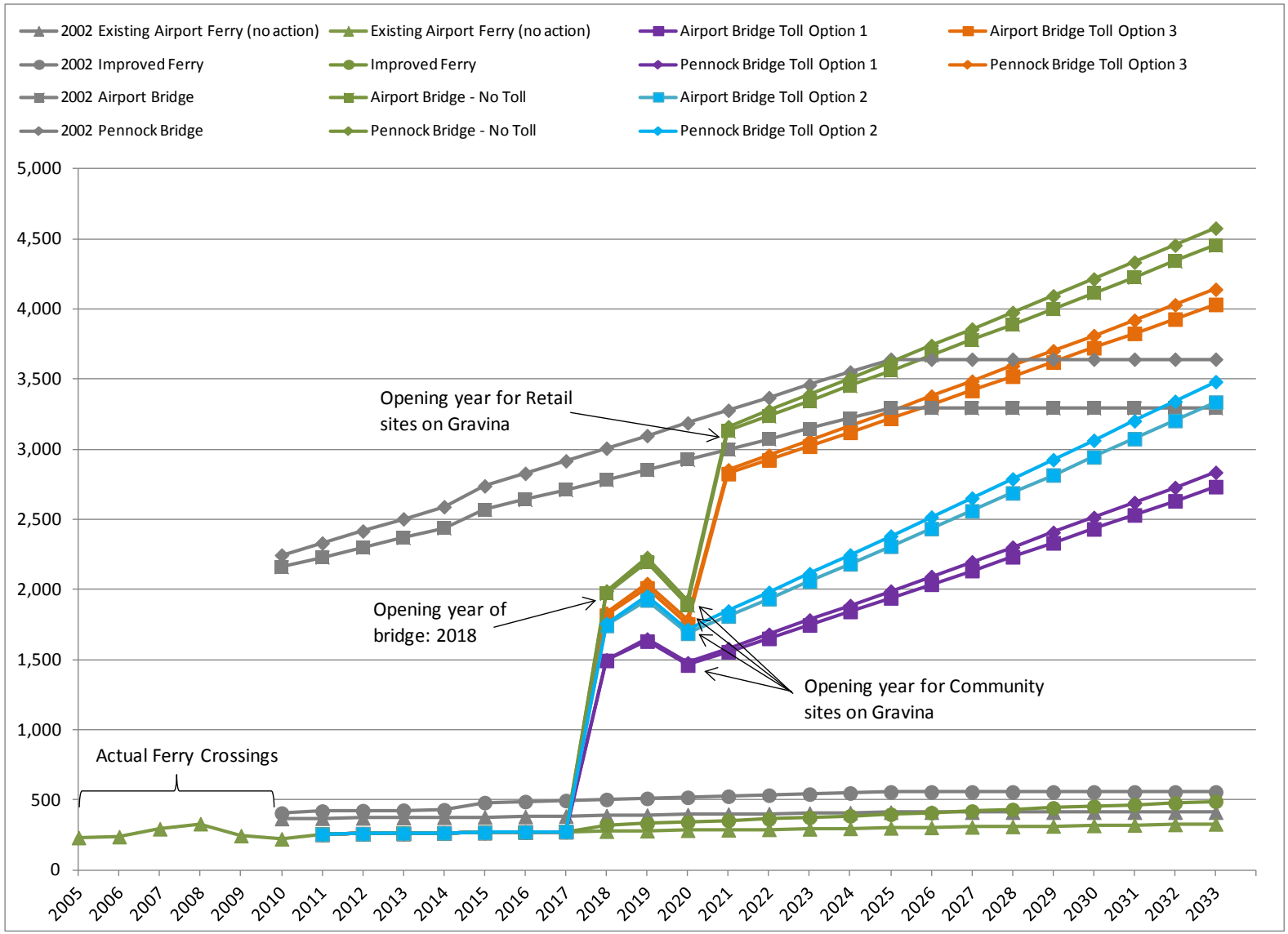

Exhibit A-3. Optimistic Sensitivity Analysis, Daily Vehicle Crossings by Year - All Alternatives

Table A-3. Optimistic Sensitivity Analysis, Total Passenger Crossings in 2033 by Trip Source and Alternative

					Toll Option 1		Toll Option 2		Toll Option 3	
	Existing Airport Ferry (No Action)	Improved Ferry	Airport Bridge	Pennock Bridge	Airport Bridge	Pennock Bridge	Airport Bridge	Pennock Bridge	Airport Bridge	Pennock Bridge
Air Travel - Passengers	755	755	755	755	755	755	755	755	755	755
Air Travel - Accompanying Persons	187	187	982	982	788	788	894	894	923	923
Airport Business Related	291	291	291	291	291	291	291	291	291	291
Industrial	0	31	250	250	253	253	292	292	303	303
Retail/Commercial	0	0	1,427	1,390	0	0	0	0	1,225	1,193
Residential	57	439	2,782	2,980	2,048	2,180	2,694	2,883	2,423	2,594
Recreation	51	51	101	101	89	89	96	96	98	98
Tourism	3	3	6	6	5	5	5	5	5	5
Total	**1,343**	**1,756**	**6,594**	**6,755**	**4,229**	**4,361**	**5,027**	**5,217**	**6,024**	**6,162**

Table A-4. Optimistic Sensitivity Analysis, Total Vehicle Crossings in 2033 by Trip Source and Alternative

					Toll Option 1		Toll Option 2		Toll Option 3	
	Existing Airport Ferry (No Action)	Improved Ferry	Airport Bridge	Pennock Bridge	Airport Bridge1	Pennock Bridge	Airport Bridge	Pennock Bridge	Airport Bridge	Pennock Bridge
Air Travel - Passengers and Accompanying Persons	211	211	825	825	733	733	783	783	797	797
Airport Business Related	69	69	224	224	224	224	224	224	224	224
Industrial	0	8	192	192	195	195	225	225	233	233
Retail/Commercial	0	0	1,020	993	0	0	0	0	875	852
Residential	23	176	2,140	2,289	1,536	1,638	2,054	2,200	1,852	1,983
Recreation	25	25	51	51	44	44	48	48	49	49
Tourism	1	1	3	3	2	2	3	3	3	3
Total	**329**	**490**	**4,454**	**4,577**	**2,734**	**2,836**	**3,337**	**3,482**	**4,033**	**4,141**