Tweed-New Haven Airport: Master Plan Update

An Economic Evaluation-Phase 1

DRAFT

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- EXECUTIVE SUMMARY -

Project Overview

As an integral part of the update of the Master Plan for Tweed-New Haven Airport, the Connecticut Center for Economic Analysis (CCEA) performed an economic impact analysis of the Airport. The analysis considers two scenarios, (a) a *status quo* forecast and (b) a no-constraint forecast. The latter forecast assumes that the Airport will be modernized to accommodate new regional jet service. The no-constraint forecast was further divided into a low-growth alternative and a high-growth alternative for commercial traffic. The analysis shows that the total economic impact of Tweed-New Haven Airport ranges from $63,783,485 for the *status quo* forecast to $327,238,964 for the high-growth alternative by 2019.

CCEA was further charged to study the question of whether the Airport had had an adverse impact on property vales in the neighborhoods surrounding the Airport. The Center studied over 700 residential real estate transactions in the neighborhood surrounding the Airport over the years 1967 to 1999. The analysis found no statistically significant difference in the changes in value of residences within the runway protection zones and those outside of them over the period. The sample was further divided into properties within the 65db noise contour and those outside. Again, no statistically significant differences in price growth between the two groups was uncovered.

Overview of CCEA

The Connecticut Center for Economic Analysis (CCEA) at the University of Connecticut, maintains several regional economic models and through its Forecasting and Analysis Group performs economic impact and policy analysis for a variety of development projects and initiatives throughout Connecticut. For example, CCEA has prepared analyses on the following:

- Groton-New London Submarine Base Closing
- Igor Sikorsky Memorial Airport, Bridgeport
- The Bridgeport Casino proposal
- Connecticut Tourism
- Structured Tax Credits

- Property tax regimes in Naugatuck, Waterbury, and Hartford

Among other projects, CCEA is currently preparing the economic impact analysis of the consequences of rail and highway infrastructure improvements in New Haven, including a new State Street Station, new parking facilities, the Church Street Bridge, and, improved schedules and trains for Metro-North, Shore Line East and Amtrak.

Airport Master Plan Update

The Tweed-New Haven Regional Airport Master Plan Update has three phases:

- Phase 1 - Development of a Scope of Work
- Phase 2 - Inventory, Forecasts, Airport Role, and Initial Screening
- Phase 3 - Alternatives Analysis, Environmental Assessment, Financial Plan, Airport Layout Plans

Phase 1 is now completed; Phase 2 is presently being prepared. There are two elements of the forecasts of aviation demand being developed in Phase 2: scheduled air service market analysis and general aviation activity. Simat, Helliesen & Eichner, Inc. (SH&E) prepared the draft scheduled service market analysis using two scenarios: *base case/status quo*, and *no-constraint*. Within the *no-constraint* scenario, SH&E developed two separate forecasts: a low and high range. These three scheduled service forecasts encompass the reasonable range of potential scheduled passenger activity at Tweed-New Haven Regional Airport between the years 2000-2019.

The two scenarios and the range of forecasts provide the initial basis for developing conceptual facility requirements and alternatives that will be considered in the Airport Master Plan Update. The scheduled service forecast scenarios will be combined with general aviation forecasts (which will be prepared as part of Phase 2) to present a complete picture of potential aviation demand at Tweed-New Haven Regional Airport. CCEA used FAA's current Terminal Area Forecast (TAF) for Tweed-New Haven Airport to identify future general aviation activity (see Appendix 2). The

FAA's TAF will be also be used in development of forecasts for general aviation activity in Phase 2 of the Master Plan Update.

The Market Assessment and Economic Impact Sub-committee met on August 12, 1999, to review the methodology used in preparing the economic impact analysis. The CCEA economic impact analysis serves as one tool for evaluating impacts of the forecast scenarios, particularly in Task 6, Initial Screening.

In the course of the Airport Master Plan Update, CCEA will use two different models to measure potential economic impacts:

- Regional Input-Output Modeling System (RIMS) II
- Regional Economic Models, Inc. (REMI)

CCEA first ran the RIMS model, which is presented here, based on the scenarios presented in the scheduled service market analysis. As noted above, FAA has long used RIMS as their standard airport economic impact model. However, RIMS utilizes a limited number of variables compared to REMI, and has less capacity to assess the impact of various policy decisions, decisions which REMI can evaluate. Moreover, REMI is a dynamic model, which makes it a more sophisticated tool when looking at long-term impacts. As a dynamic economic model, REMI requires more data than is presently available, particularly for development and construction costs of any future airport facilities. As a result, CCEA can only complete a REMI analysis in Phase 3 of the Master Plan Update. CCEA developed a RIMS analysis in this phase of the Master Plan Update because of its comparability with FAA assessments at other airports and to provide an initial measure of the economic impacts of the various forecast ranges. However, this first analysis includes only forecasts for commercial activity; it assumes that there is ***no*** growth in general aviation.

Regional Industrial Multiplier System (RIMS) II

The Bureau of Economic Analysis (BEA) of the U.S. Department of Commerce originally developed the RIMS model in the 1970s. It built RIMS on the basis of the Department of

Commerce input-output (I-O) table of the national economy. It breaks out almost 500 separate U.S. industries, including airports (see Appendix 1 for an overview of the RIMS methodology). As noted above, FAA adopted RIMS as its standard technique for measuring the economic impacts of airports. RIMS measures the economic impact of each industry by accounting for three elements of potential economic impacts:

- **direct**: employment, payroll, revenue generated by services and goods sold on the airport
- **indirect**: what the users and employees of the airport spend off-airport (in the local and regional economy in hotels, restaurants, etc.) as a result of their using or being employed on the airport
- **induced**: the money generated by direct and indirect impacts (described above) is used throughout the regional economy to buy even more goods and services not associated with the airport, which otherwise would not have been available

One of the key elements of the RIMS program is identification of an appropriate multiplier that accounts for induced economic benefits.

Results of RIMS II Analysis

As the following tables reveal, the RIMS analysis shows a positive economic benefit for the region for each of the forecast scenarios. The table presents economic benefits in terms of transportation benefits (based on the cost savings of using Tweed-New Haven Airport versus other airports), as well as direct economic benefits. In addition, the economic impact per capita within New Haven County increases as passenger enplanements increase under the *no-constraint* scenario.

Transportation Benefit of Tweed-New Haven Airport to Tweed-New Haven market area under different scenarios **(1999 dollars)**			
	Base Case	Low No-Constraint	High No-Constraint

1999	$2,637,937	$2,637,937	$2,637,937
2009	$5,209,284	$8,412,880	$19,617,164
2019	$6,467,635	$10,608,664	$25,091,634

Economic Benefit of Tweed-New Haven Airport to Tweed-New Haven market area under different scenarios

(1999 dollars)

Base Case

	Direct Impact	Indirect Impact	Induced Impact	**Economic Benefit**
1999	$4,371,092	$6,722,758	$8,320,387	**$19,414,237**
2009	$9,936,566	$15,419,702	$19,017,201	**$44,373,469**
2019	$12,660,106	$20,091,809	$24,563,936	**$57,315,850**

Low No-Constraint

	Direct Impact	Indirect Impact	Induced Impact	**Economic Benefit**
1999	$4,371,092	$6,722,758	$8,320,387	**$19,414,237**
2009	$16,870,360	$27,564,749	$33,326,331	**$77,761,440**
2019	$21,622,963	$37,149,573	$44,079,402	**$102,851,938**

High No-Constraint

	Direct Impact	Indirect Impact	Induced Impact	**Economic Benefit**
1999	$4,371,092	$6,722,758	$8,320,387	**$19,414,237**
2009	$41,120,954	$84,062,507	$93,887,596	**$219,071,056**
2019	$52,969,958	$119,685,659	$129,491,713	**$302,147,331**

By the year 2019, the analysis projects transportation benefits range from $6,467,635 under the *base case* scenario, to a high of $25,091,634 under the *no-constraint* scenario. Economic benefits

to range from a low of $57,315,850 under the *base case* scenario, to a high of $302,147,331 under the *no-constraint* scenario in the year 2019.

The second part of the current study seeks to assess the impact of the airport on residential real estate values in the adjacent neighborhoods. An analysis of about 700 real estate sales in the target area over the past 32 years (1967-1999) found that there is no statistically significant difference between the price growth of houses in the runway protection zones (RPZs) or within the 65db noise contour, and, the price growth of houses outside the RPZs or outside the 65db noise contour.

Table of Contents

Section 1.1: Economic Analysis

Introduction

The goal of this report is to provide assistance in analyzing the economic benefit of Tweed-New Haven Airport. This analysis provides in turn information that helps frame the discussions of the Technical Advisory Committee about the current and future role of Tweed-New Haven Airport.

This report analyzes the economic impact of two forecast scenarios for Tweed-New Haven Airport that Simat, Helliesen & Eichner, Inc. (SH&E), present in their draft report "Master Plan Update Market Analysis and Forecasts 2000-2019." The no-constraint scenario requires improvements that would permit the Airport to accommodate newer aircraft now being used for regional air travel. These innovations would encourage airlines offering regional travel to increase scheduled flights at Tweed Airport. The modernization would also permit housing of and utilization by more and larger general aviation aircraft. Both the updating itself and the increased air traffic it would encourage will have an economic impact on the Tweed-New Haven market area in particular and the State of Connecticut in general.

To analyze the economic impact of the forecast scenarios, the analysis follows the standard procedures that the Federal Aviation Administration recommends in its economic impact evaluation report[1] and utilizes the SH&E market analysis. That analysis considers two scenarios: a base case scenario that assumes air service patterns will not dramatically change from those seen today; a no-constraint scenario, which includes high and low range forecasts, assumes that Tweed-New Haven Airport will make necessary physical improvements to accommodate increased traffic. It also assumes ***no*** growth in general aviation.

The focus of the first section of this report is to estimate the economic benefits of Tweed-New Haven Airport under each of those three forecast scenarios. Those benefits in each case are the sum of the transportation and economic benefits that are calculated separately.

The transportation benefit is the value of the service that the Airport brings to its surrounding area: time saved and costs avoided by travelers who otherwise would use other airports such as Bradley International, La Guardia, White Plains, and T.F. Green in Providence. This does not include, however, consideration of the

[1] See FAA report "Measuring the regional economic significance of the airports", DOT/FAA/PP/87-1.

degree to which people choose to travel at all or use alternative means of transportation because of such costs. The economic benefit is the regional economic activity, employment, and payroll that can be attributed to the operation of Tweed-New Haven Airport. But, critically, this does not incorporate the economic benefit of outlays for capital improvements, nor ***any*** change in general aviation activity. Thus the analysis calculates these benefits in a highly conservative fashion.

Transportation Benefits

Transportation benefits are the services that a community hopes to get by developing and maintaining the airport. Airports provide a number of public benefits to the surrounding areas. According to the report prepared by the Federal Aviation Administration, the primary benefits of an airport are time saved and cost avoided by travelers who would otherwise use the next best alternative airport. Bradley International Airport, T.F. Green Airport, La Guardia Airport, and the airport in White Plains, N.Y., are the next best alternatives to Tweed-New Haven Airport for the residents of the Tweed-New Haven market area. We express transportation benefits in dollars.

The table below summarizes the estimates of the transportation benefit of Tweed-New Haven Airport to the Tweed-New Haven market area. [2]

Transportation Benefit of Tweed-New Haven Airport to Tweed-New Haven market area under three scenarios
(1999 dollars)

	Base Case	Low No-Constraint	High No-Constraint
1999	$2,637,937	$2,637,937	$2,637,937
2009	$5,209,284	$8,412,880	$19,617,164
2019	$6,467,635	$10,608,664	$25,091,634

[2] To calculate the transportation benefit we used the following formula: Total Annual Transportation Benefit = E(FGN+Y)(b/P-d/P)+(GN+Y)(Qb-Qd). See Appendix 3 for the description of the variables.

The results show a great difference in the transportation benefits of Tweed-New Haven Airport that result from the three forecast scenarios. First, just the existence of the Airport provides 24 minutes of saved time per traveler in the Tweed-New Haven market area. Second, even under the base case scenario, the airport brings $52 of transportation benefit (in 1999 dollars) per person to the market area in 2019. The low no-constraint and high no-constraint scenarios generate much greater the per capita benefits. Under the low no-constraint scenario the per capita transportation benefit equals $86. Under the high no-constraint scenario, the transportation benefit is even higher, at $204 per capita. The estimation of the transportation benefits of increased commercial service at Tweed-New Haven Airport highlight that as the level of service increases, the per capita transportation benefits increase as well.

Economic Benefits

Economic benefits measure the importance of aviation as an industry, in terms of the employment it provides and the goods and services it consumes. While the transportation benefit is typically seen as the primary motive for airport development, economic benefit refers to broad impacts that airports have on regional economies and is critical to appreciating the full value of airport development. Economic benefits fall into three categories: direct, indirect, and induced impacts.

Direct impacts refer to the effects of economic activities of the airport and all airport-related facilities. Some direct impacts (e.g., airport employment) occur on site; others (local production of goods and services for use at the airport) occur off site. The distinguishing feature of a direct impact is that it is an immediate consequence of airport economic activity. Simply put, direct impacts represent economic activities that would not have occurred in the absence of the airport. CCEA captures the direct impact of Tweed-New Haven Airport by estimating the total annual payroll of all businesses that relate to airport operations.

Indirect impacts flow from off-site economic activities, such as services that travel agencies, hotels, restaurants, and retail establishments and that are attributable to the airport. The largest component of indirect impacts is visitor expenditures. Indirect impacts differ from direct impacts in that they originate entirely off site. Even so, indirect impacts are economic activities that would not have occurred in the absence of the Airport. That's why it would be desirable to consider only visitors and not the total annual passengers, as the latter include local residents. However, this data is almost impossible to obtain. That's why the impacts of expenditures of tourists and other visitors using the airport may be overstated, especially for regions that are easily accessible

from other airports or by other means of transportation.[3] However, we attempted to solve this problem by applying appropriate coefficients provided by the FAA to the annual number of arriving passengers and measuring indirect impacts by following FAA-recommended procedure.[4]

Induced impacts are the multiplier effects of the direct and indirect impacts. These refer to the increase in main economic variables that result from successive rounds of spending that direct and indirect impacts generate. For example, most of the income earned by employees of the airport is spent locally. Some of this spending becomes an income to local employees in service areas, and they spend part of their income locally as well. Each successive round of spending creates additional income. We calculate induced impacts of Tweed-New Haven Airport by using FAA-recommended multipliers from the RIMS II model. The multipliers are applied to both direct and indirect impacts of the airport. Finally, the total economic benefit of the airport is simply the sum of the direct, indirect, and induced impacts.

The direct benefits are the sum of compensation benefits and other sources of value-added. The compensation benefit was obtained by multiplying the average airport annual payroll per employee by the estimated number of airport employees. The latter number was derived from two relationships: one between the number of commercial passengers and airport employment, and one between the number of based aircraft and airport employment.[5] Therefore, we considered general aviation and commercial aviation at Tweed-New Haven Airport. Information provided by airport management and confirmed with the figures obtained from the FAA provided the basis for determining average annual payroll expenditure per employee. The other sources of value-added were estimated using figures from the latest version of IMPLAN. For the State of Connecticut, the other sources of value-added in the air transportation industry are 53.8% of compensation benefit.

Indirect impact equals estimated expenditures by visitors. The SH&E forecast provided estimates of the number of arriving passengers. The FAA report provides the numbers for the estimated expenditures per visitor.[6] CCEA adjusted them properly for inflation, size of the airport, and the population of the Tweed-New Haven market area.

[3] See FAA report DOT/FAA/PP/87-1, pp. 16-17.
[4] For details see FAA report DOT/FAA/PP/87-1, pp. 19-22.
[5] Total airport employment = 650.5*passengers (millions) + number of based aircraft / 7.2. This formula was generated based on the information provided by the FAA in its report DOT/FAA/PP/87-1.
[6] See table 3-1, p. 21 in the FAA report DOT/FAA/PP/87-1.

Induced impacts are calculated using a multiplier factor of 0.75, which was taken from the economic impact report prepared by the FAA.[7] The table below summarizes the economic benefits of Tweed-New Haven Airport under different development scenarios.

Economic Benefit of Tweed-New Haven Airport to Tweed-New Haven market area under different scenarios (1999 dollars)				
Base Case				
	Direct Impact	Indirect Impact	Induced Impact	**Economic Benefit**
1999	$4,371,092	$6,722,758	$8,320,387	**$19,414,237**
2009	$9,936,566	$15,419,702	$19,017,201	**$44,373,469**
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Low No-Constraint				
	Direct Impact	Indirect Impact	Induced Impact	**Economic Benefit**
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2019	$21,622,963	$37,149,573	$44,079,402	**$102,851,938**
High No-Constraint				
	Direct Impact	Indirect Impact	Induced Impact	**Economic Benefit**
1999	$4,371,092	$6,722,758	$8,320,387	**$19,414,237**
2009	$41,120,954	$84,062,507	$93,887,596	**$219,071,056**
2019	$52,969,958	$119,685,659	$129,491,713	**$302,147,331**

The results show a significant difference in economic benefits of the Airport under the different scenarios. In 2019 the economic benefit of the airport under the high no-constraint scenario is $353 (1999) dollars per capita for New Haven County. It constitutes more than 1% of the total income of the region, a significant number.

[7] The RIMSII multiplier of 0.75 refers to the population of the New Haven region, which is around 1.5 million.

On the other hand, under the base scenario, the total economic benefit of Tweed-New Haven Airport is $67 per capita for New Haven County, still an impressive number, but obviously smaller than the one that emerges under the no-constraint scenarios.

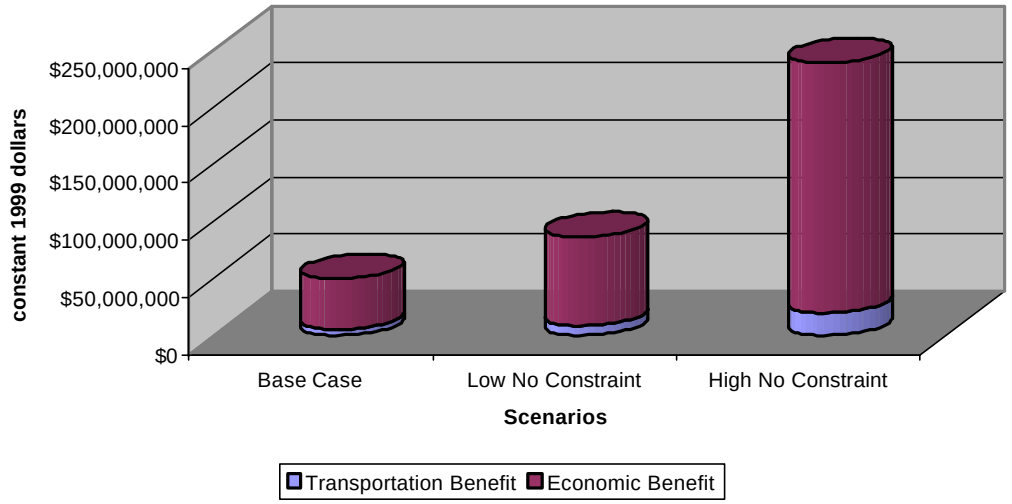
Total Economic Benefit

The results show the benefits of increased service at Tweed-New Haven Airport. Under both forecast no-constraint ranges, the Airport could generate significantly increased income for the region. Increased direct impacts suggested by the results refer to increased airport employment. Increased indirect impacts constitute an increase in employment in businesses related to airport operations. In addition, the increased volume of commercial air traffic would induce a significant amount of income in the region. The charts and the table presented below summarize the total impact (transportation plus economic) of Tweed-New Haven Airport under different forecast scenarios. Development of the high no-constraint scenario compared to the base case scenario would generate an additional $189 million per year for the region in ten years, and an additional $263 million per year by 2019 in 1999 dollars.

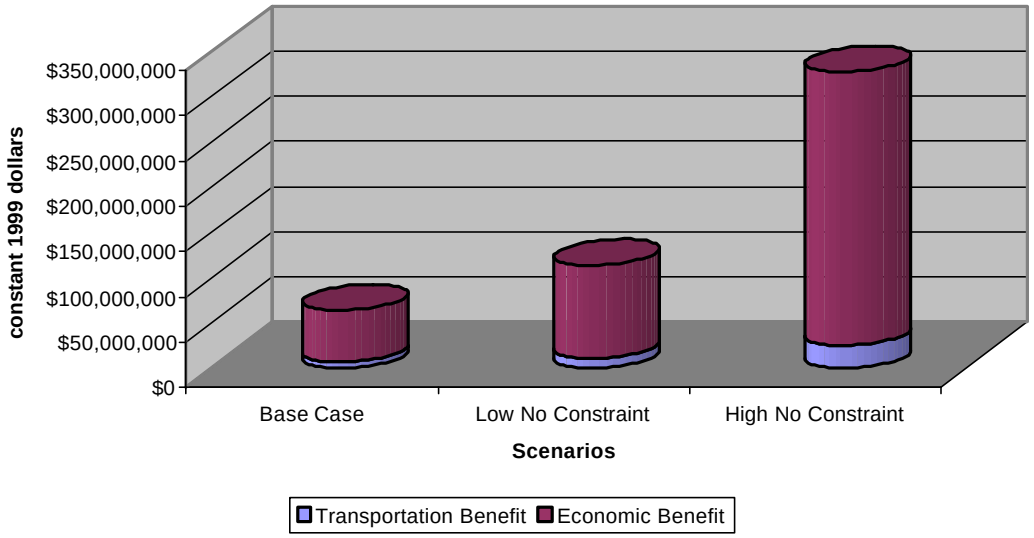
Tweed New Haven Airport Total Economic Impact on Tweed-New Haven market area
(1999 dollars)

	Base Case	Low No-Constraint	High No-Constraint
1999	$22,052,174	$22,052,174	$22,052,174
2009	$49,582,753	$86,174,320	$238,688,220
2019	$63,783,485	$113,460,602	$327,238,964

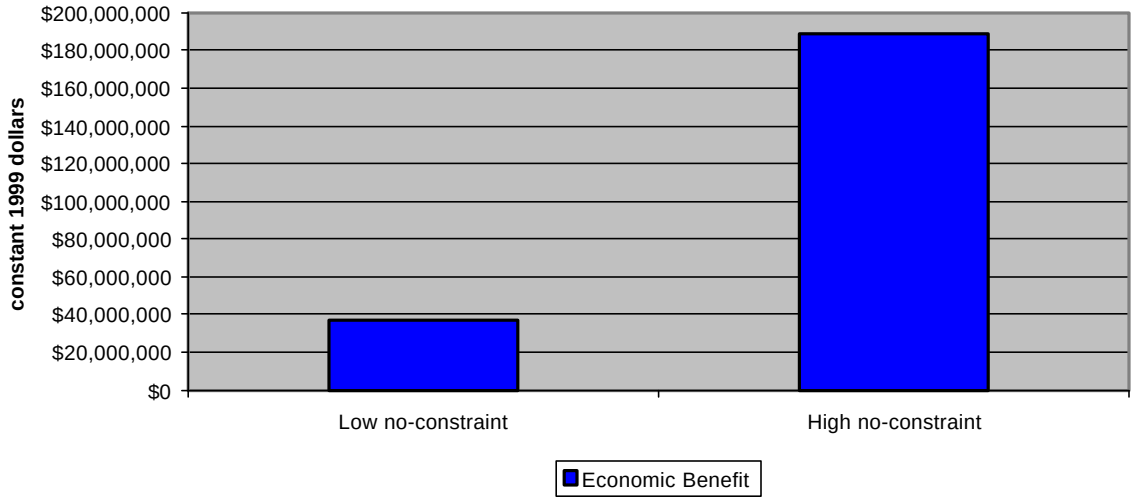
Total Economic Impact of Tweed-New Haven Airport on Tweed-New Haven market area in 2009 under different forecast scenarios



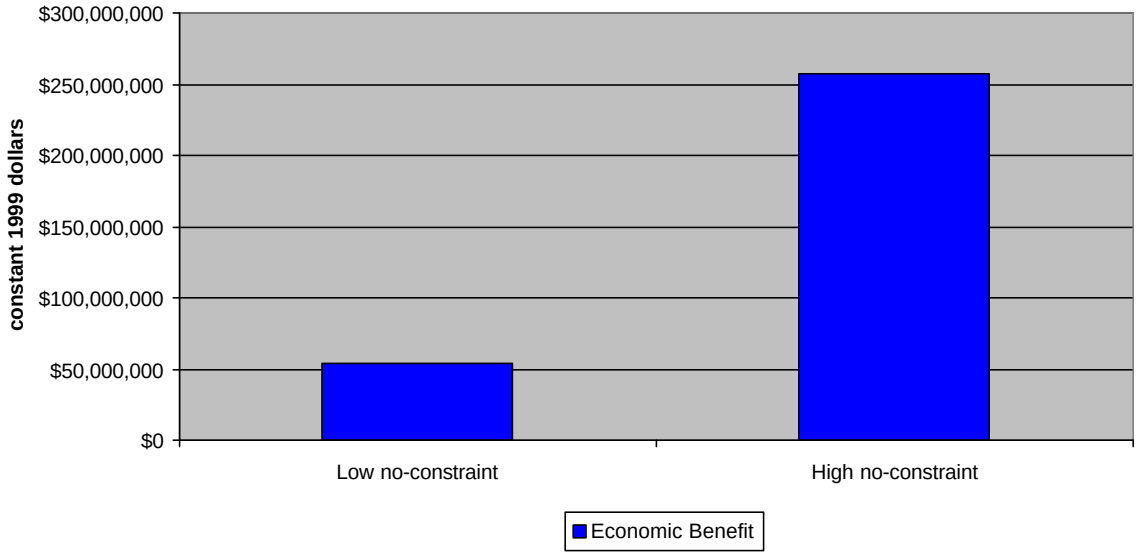
Total Economic Impact of Tweed-New Haven Airport on Tweed-New Haven market area in 2019 under different forecast scenarios



Differences in Economic Benefit between the base case and the low and the high no-constraint cases in 2009



Differences in Economic Benefit between the base case and the low and the high no-constraint cases in 2019



Section 1.2 Airport Operating and Maintenance Costs

While the preceding economic impact analysis identified the benefits generated by the airport, we must recognize that there are costs associated with operating and maintaining the airport, as well as costs for capital improvements. This section presents an overview of those costs, as well as the funding sources that support those expenses.

The City of New Haven owns Tweed-New Haven Regional Airport. The Airport Authority, which operates the Airport, has leased out operation of the Airport to American Port Services (Amport), which is responsible for the day-to-day operation and maintenance of the Airport.

The operating and maintenance (O&M) expenses, for the fiscal year 1999-2000 are $2,149,300, and, are categorized as follows:

Airport Operating and Maintenance Expenses

- Airport Authority Administration
  - Marketing and Air Service Development
  - Depreciation and Reserve
  - Legal and audit
  - Improvements reserve
  - Management
- AMPORT Fees, personnel salaries and benefits
  - Non-Personnel
  - Administration
  - Insurance
  - Maintenance
  - Utilities

Under existing regulations, the Federal Aviation Administration (FAA) does not support airport O&M costs, except for the radio navigation aids such as the on-airport VOR and localizer transmitters, the approach light system, and automated weather observation station.

However, there are a number of revenue sources which offset O&M expenses. Total revenue generated in FY 1999-2000 equals $2,163,590. The single largest source of revenue ($1.2 million) is generated through a subsidy from the City of New Haven and the State of Connecticut, each contributing $600,000. The various sources of revenue are shown below:

Airport Revenues

- Carry-over into FY 99-00
- Subsidy
  - City of New Haven
  - State of Connecticut
- Concessions/Fees
  - Investment interest
  - Fuel flowage fee
  - Land rental
  - Landing/Ramp parking fees
  - Automobile parking revenue
  - Office & counter rental
  - Rental car concessions
  - Telephone concessions
  - Terminal building advertising
  - Vending/coffee machine
  - Miscellaneous commercial revenue

One of the stated goals of the Airport Authority is to increase revenues from other sources to eventually eliminate subsidies from the City and the State. Under the state legislation that was enacted creating the Airport Authority, both the city and state subsidy will be available for only a limited time frame.

Airport Capital Improvement Program (ACIP)

The other expense associated with the Airport is the Airport Capital Improvement Program (ACIP). The ACIP identifies projects to be undertaken at the Airport, the estimated cost for each project, and the potential funding sources for each project. The ACIP is typically prepared for a five-year period, and provides detailed information for each of the five years. In addition to identifying projects that will be undertaken by the airport, the FAA and the Connecticut DOT consider the ACIP when developing their own capital improvement program.

The current ACIP for Tweed-New Haven Airport covers the period between FY 1999-2004, and estimates that total capital improvement costs will equal $18,044,843 over the five-year period. Of that amount, it is projected that the Airport will pay for $1,907,121 (10.6%), $1,241,363 (6.9%) will be paid by ConnDOT, and $14,896,359 (82.5%) will be paid by FAA.

Both ConnDOT and FAA issue grants (not loans) to the Airport for capital improvements. As a result, the money is not paid back to the state or FAA, however, the airport signs grant assurances before accepting the grant. The grant assurance legally encumbers the Airport authority to comply with federal and state regulations, including a commitment to keep the airport open, operating, and available for public use for a period of at least twenty years from the date of accepting the grant.

Section 2: Property Value Analysis

The Tweed-New Haven Airport Authority requested a study of the market value of properties adjacent to Tweed-New Haven Airport. The purpose of the study is to find out whether historically Tweed-New Haven Airport systematically and adversely affected the value of property in the vicinity of the airport.

This study employs a well-established method for estimating the fair market value of properties, namely, the comparable sales approach. The data set includes sales data for approximately 700 single-family houses between 1967 and 1999 (see Appendix 4).[8] The analysis compares sale prices for properties within the runway protection zones (RPZs) to the sale prices of properties outside the RPZs but within the study area (that is, within the target zone, see Appendix 5). The shaded properties in Appendix 4 are the ones within the RPZs. This analysis did not find any systematic differentiation in the market value of properties within the RPZs compared to properties outside the RPZs but within the target zone. Interestingly, properties outside the RPZs did rise in value somewhat faster than those inside between 1967 and 1979, but then rose at a lower rate during the 1980s, when jet service began at Tweed-New Haven. During the 1990s, there was no clear difference in the rate of change in values. Thus, over the entire period, there is no statistically significant difference between the change in property values within the RFZ and those outside of it as determined using a non-parametric Rank Sum test. These three subperiods were selected because they represent distinctly different economic regimes. The first period (1967 to 1979) was one of high and volatile inflation that affected mortgages and interest-sensitive investment. The 1980s saw the return to stable and lower inflation and sustained economic growth, culminating in the highest real estate values in Connecticut history. The third period began as in 1981 and 1982 with a recession, but saw a long and steady recovery and real estate price growth along with historically low inflation and mortgage rates in the mid-1990s.

Tweed-New Haven Airport started operation in 1931. During two periods in 1967 and 1975, commercial jets operated at Tweed-New Haven Airport. Air Wisconsin scheduled jet service into Tweed in 1985. There has long been a question of whether Tweed-New Haven Airport has adversely impacted the market value of residential properties around the airport. While there are numerous studies on property values around airports

(see Appendix 6 for a reference list of these studies[9]), this issue can be understood from a simple economic principle, namely the capitalization of property value in market price.

Suppose the assertion that Tweed-New Haven Airport has caused the adjacent residential properties' values to go down is true. The airport has been in its current location for almost 70 years. Scheduled jet service started as early as 1967, adding to general aviation activity that already existed. We may reasonably assume that anyone purchasing property in the vicinity of the airport after 1967 did so knowing that there was an airport close by, one that accommodated commercial jet service. It is also reasonable to assume that they knew that airport traffic might impact the use and enjoyment of their property, and therefore, they would only be willing to pay a lower price for that property than for similar property located further from the airport. Purchasers thus were implicitly compensated through purchasing the property at a lower price. Almost 70 years after the Airport was built, and more than 30 years after scheduled jet service began at Tweed, the capitalization of residential properties around the airport should have occurred some time ago. This economic logic is consistent with the sales price trend we observe in the historical data: the analysis finds the operations of Tweed-New Haven Airport since 1967 have had no systematic impacts on the values of surrounding residential properties. This conclusion is based on comparing the average sales price growth rates of properties inside and outside the RPZs and within the target area. We looked at three time periods: 1967 to 1979; 1980 to 1989; and, 1990 to the present. There is no statistically significant difference (at the 1% level) between sales price growth rates of properties in either area in any period. In other words, the economic rate of return to investing in property in the RPZs compared to investing in property within the target area but outside the RPZs is essentially the same. Appendix 4 describes the statistical method used to test the significance of the difference of the sales price growth rates, and, contains the summary data used in the calculations.

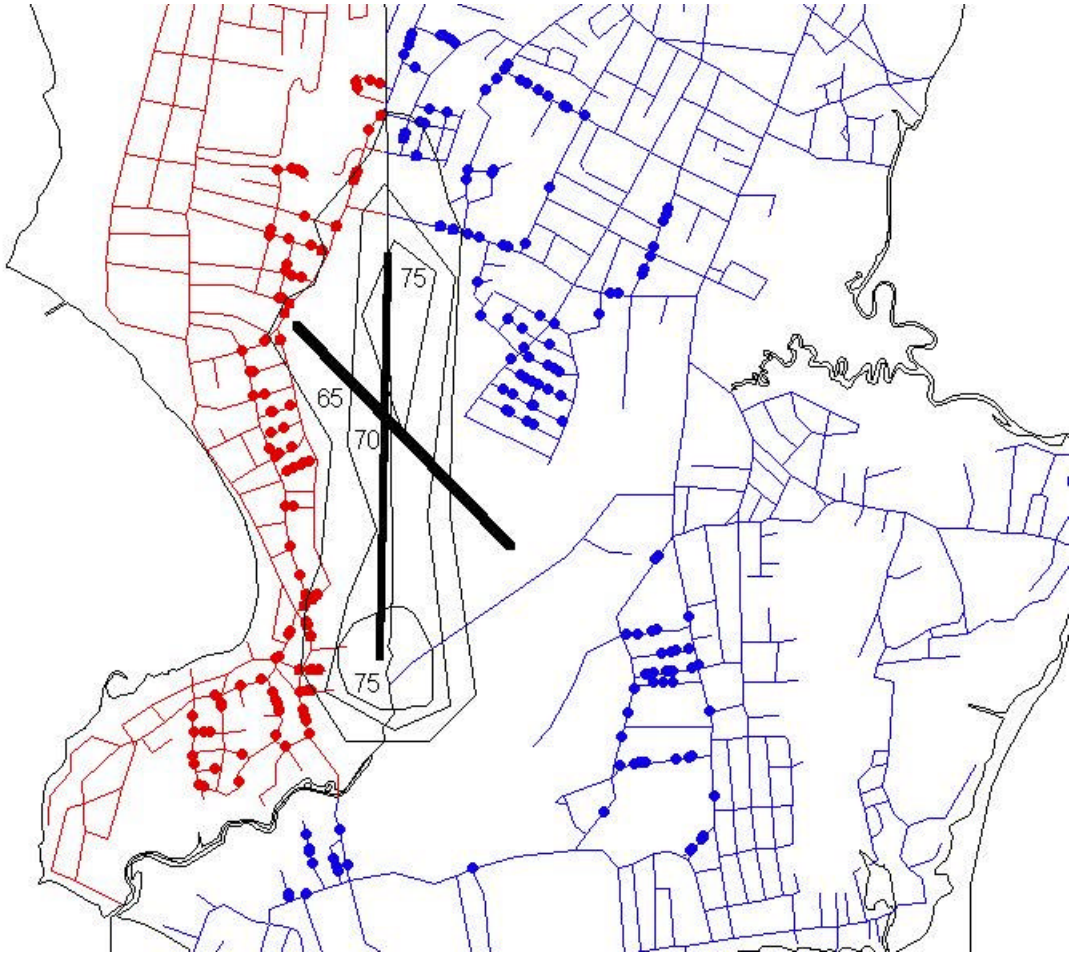
In order to further qualify housing price growth, we identified 25 properties located within the 65db noise contour zone around Tweed-New Haven Airport listed in the following table. All properties used in this portion of the study appear in the map following the table.

[8] We are grateful to Mr. John Leary of Leary Counseling and Valuation, Inc. for providing detailed sales data between the period of 1967-1986 within the study area. His data was used as evidence in 1985 court case of Melillo v. City of New Haven and was approved by the court to be the appropriate evidence (Aircraft Owners and Pilots Association Magazine, October 1999).

[9] We once again would like to express our gratitude to Mr. John Leary for providing part of this list to us.

Address	Town
286 Burr Street	NH
340 Burr Street	NH
348 Burr Street	NH
354 Burr Street	NH
440 Burr Street	NH
9 Concord Street	NH
1840 Dean Street	NH
8 Douglass Avenue	NH
17 Douglass Avenue	NH
24 Douglass Avenue	NH
30 Douglass Avenue	NH
583 Fort Hale Road	NH
19 Morris Causeway	NH
32 Morris Causeway	NH
38 Morris Causeway	NH
15 Townsend Avenue	NH
19 Townsend Avenue	NH
20 Townsend Avenue	NH
24 Uriah Street	NH
32 Uriah Street	NH
18 Bretton Street	EH
21 Bretton Street	EH
273 Dodge Avenue	EH
281 Dodge Avenue	EH
38 Holmes Street	EH

Noise Contour Map With Target Zone Properties



Note: Red dots denote New Haven properties and blue dots indicate East Haven properties; squares are properties within the 65db contour.

Due to the limited number of properties inside the 65db noise contour, a statistical test based on the means of those properties inside and outside the contour as above is not reliable. We use Ordinary Least Squares to estimate the impact of property location, that is inside and outside of the 65db noise contour, on the properties' sales price growth rate. We find no significant impact of housing location on the sales price growth rate. The model is a simple linear regression model written as:

$$P = \beta_0 + \beta_1 zone + \beta_2 67next + \beta_3 67twice + \beta_4 80same + \beta_5 80next + \beta_6 90same + \varepsilon,$$

where P stands for housing price growth rate. The zone variable has value of 1 if the property is inside the 65db contour and 0 otherwise. Each categorical variable controls for the different sales scenarios described in Appendix 7. For example, "67next" has the value of 1 if the property was first sold in the period 1967-1979 and resold again in the period 1980-1989, and 0 otherwise. "67twice" means that the property was first sold in the period 1967-1979 and resold in 1990 or later. "80same" indicates whether the property was first sold and resold

during 1980-1989 (1 if true, 0 otherwise). The other categorical variables have comparable definitions. The categorical variable "67same" is omitted to avoid the statistical problem of multicollinearity.

The data set has 321 properties. Regression results are presented in the following table. The F-statistic for the regression indicates that the model is significant at the customary 5% level. We conclude that the coefficient of the zone categorical variable is not significantly different from zero. In other words, whether the property is located inside or outside of the 65db noise contour makes no significant difference in terms of rate of return to the investment.

Regression Results

ANOVA

	df	*F*	*Significance F*
Regression	6	2.520196932	0.02135217
Residual	315		
Total	321		

	Coefficients	*Standard Error*	*t Statistics*	*P-value*
Intercept	0.080995264	0.009647659	8.395328077	1.599E-15
Zone	-0.002353131	0.017035464	-0.138131297	0.8902249
67next	0.008562362	0.01847391	0.463484019	0.6433375
67twice	-0.028005724	0.023733973	-1.179984665	0.2388967
80same	0.016035501	0.013380018	1.198466338	0.2316364
80next	-0.032039232	0.020651841	-1.551398368	0.1218103
90same	-0.031338473	0.014389094	-2.177932356	0.0301526

Section 3: Conclusions

This Phase 1 economic analysis for the Master Plan update shows how much the New Haven region could benefit from modernization and upgrading of Tweed-New Haven Airport. In aggregate, total economic benefits to the region increase in 2009 by approximately $36.6 million when one compares the low no-constraint scenario with the base case or no change scenario. The magnitude of the gain increases to $189.1 million when the high no-constraint scenario is compared to the base case for 2009. For 2019, the gains are naturally larger. The low no-constraint scenario shows an increase of $49.7 million and the high no-constraint scenario shows an increase of $263.5 million. These figures are conservative estimates of the economic gain for the region that would come from modernizing Tweed-New Haven Airport because they only incorporate the FFA forecast of no increase in general aviation aircraft based at the Airport. When updated estimates of general aviation aircraft based at the Airport consistent with the growth in commercial aviation forecasted under the no-constraint scenario are included in the next phase study, one will observe economic gains from the modernization that are substantially greater than those currently forecast.

The Connecticut Center for Economic Analysis' study of property sales in the area of Tweed-New Haven Airport indicates that there is no statistical difference in the rate of growth of property values when one compares properties located within the Airport's RPZs with those located outside the RPZs. In sum, investments in properties located in the RPZs will bring the purchaser as large a return per year per dollar invested as an investment in other local properties. There is no reason to believe that these results will change if modernization occurs at Tweed-New Haven Airport in the future.

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APPENDIX 1

REGIONAL INDUSTRIAL MULTIPLIER SYSTEM II

This appendix describes the RIMS II multipliers, describes the manner in which they are used, and presents a sample set of calculations for determining regional impacts.[10] RIMS II multipliers are intended to show the total regional effects on industrial output, personal earnings and employment for any county or group of contiguous counties in the United States resulting from any industry activity. Industry descriptions are defined according to the 1977 Bureau of Economic Analysis (BEA) national input-output tables. Induced impacts for any airport-related businesses can be estimated by applying the RIMS II multipliers to activities within the air transportation industrial sector.

RIMS II multipliers are given in three tables: total output multipliers, earnings multipliers, and employment multipliers. In addition, BEA will also provide a household direct coefficient table upon request. The total output multiplier table is used to compute the total impact of a change in demand. These multipliers identify the demands placed on a particular region from the future growth of a business activity. The earnings multipliers measure the impacts on earnings (income) and employment. The employment multipliers are used in calculating the total number of jobs created by final changes in demand. Of the three sets of multipliers, the earnings multipliers are the most suitable for estimating the economic impacts of a particular business activity. The direct coefficient table can be used to determine sales of a particular regional industry when airport expenditures are the only available information.

Each aviation business related to a targeted airport is assigned a Standard Industrial Classification code. The aviation-related business is identified with a corresponding RIMS II code number. Table A-1 presents business activities that are most likely encountered in aviation—related economic studies. These activities can be matched with corresponding RIMS II code numbers. The RIMS II code number will identify the specific multiplier factor to be applied to the affected business.

The RIMS II model uses sales by aviation businesses to estimate the final demand at targeted airports. Business activities are evaluated and defined according to their level of economic consequences to the targeted airport. These activities are grouped into direct and indirect impacts. Business information gathered at each airport includes:

1. magnitude of sales
2. size of purchase
3. identity of purchase
4. number of employees
5. size of payroll

In general, sales should be multiplied by RIMS II multipliers to determine economic impacts. However, if data are lacking for some specific types of business activity, other information, such as expenditures, payroll earnings and number of employees can be used. The following calculations illustrate the RIMS II methods of computing economic impacts from data on airport sales, payroll and employment.

[10] Much of this discussion is drawn from Douglas S. McLeod, Recommended Regional Economic Impact Procedures for Aviation Related Projects, Draft Report for Presentation to the Transportation Research Board Annual Meeting, January, 1987 (15).

Table A-1
AVIATION RIMS II CODE NUMBERS

Business	RIMS II Number
AIRPORT MANAGEMENT	
Administration	650500
Construction	110400
AIRLINES	650500
FIXED-BASED OPERATORS	
Aircraft Servicing	650500
Aircraft Rental	720300
Aerial Spraying	010100
FEDERAL FACILITIES	
Air National Guard	780400
Air Traffic Control	650500
Airport Mail Facilities	650500
Airways Facilities	650500
Armed Forces	780400
Customs Patrol	650500
Forestry Service	040000
Weather Service	730300
ONSITE AVIATION-RELATED	
Advertising	730300
Aircraft Manufacturing	600100
Aircraft Sales (retail)	690200
Airport Parking	750000
Airport Security	650100
Airport Terminal Services	650500
Auto Rental	750001
Auxiliary Aircraft Parts Manufacturing	600400
Aviation School	770402
Avionics Manufacturing	620100
Avionics Repair	730300
Barber Shops	720200
Book Stores	690200
Building Maintenance and Cleaning	730100
Coin-Operated Amusement	760200
Drinking Places	740000
Drug Stores	690200
Engine and Propeller Manufacturing	610700
Fire Departments	790300
Flight Insurance	700500
Flying Clubs	770400

Table A-1 (cont.)

AVIATION RIMS II CODE NUMBERS

Business	RIMS II Number
Flying Instructions	770403
Food Services	690100
Freight Forwarding	650701
Gift Shops	690200
Hotels / Motels	720100
News Dealers	690200
Personnel Supply Services	730100
Police Department	790300
Repair Shops	730300
Restaurants	740000
Taxi Service	650100
Tobacco Shops	650100
Travel Agents	650702

1. Applying the RIMS II Approach to Sales Data

   I. Assumptions
      A. Business — Fixed based operator (from survey)
      B. RIMS II Code Number - 650500 (from A-1)
      C. Sales - $100,000 (from survey)
      D. RIMS II earnings multiplier for code number 650500 - 0.6131 (from RIMS XI tables)

   II. Earnings Impact Calculations
      Sales times earnings multiplier
      $100,00 x 0.6131 = $61,310

2. Applying the RIMS II Approach to Payroll Data

   I. Assumptions
      A. Business - Engine and propeller manufacturer (from survey)
      B. RIMS II Code Number - 610700 (from Table A-1)
      C. Sales - None provided (from survey)
      D. Payroll - $300,000 (from survey)
      E. RIMS II earnings multiplier for code number 610700 - 0.7120 (from RIMS II tables)

   II. Earnings Impact Calculations
      A. Obtain direct coefficient household multiplier for applicable RIMS code number (610700) - 0.3676 (from RIMS II tables).
      B. Calculate economic base multiplier by dividing RIMS IX earnings multiplier (0.7120) by direct coefficient household multiplier (0.3676) = 1.9369.
      C. Determine earnings by multiplying payroll by economic base multiplier. $300,00 x 1.9369 = $581,070

3. Applying the RIMS II Approach to Employment Data

   I. Assumptions
      A. Business - Aerial sprayer (from survey)
      B. RIMS II Code Number - 010100 (from Table A-1)
      C. Sales - None provided (from survey)
      D. Employees - 3 (estimated from airport manager)
      E. RIMS II earnings multiplier for code number 010100 - 0.5662 (from RIMS II tables)

   II. Earnings Impact Calculations

      A. Obtain direct coefficient household multiplier for applicable RIMS code number (010100) — 0.2619 (from RIMS II tables).
      B. Calculate economic base multiplier by dividing RIMS II earnings multiplier (0.5662) by direct coefficient household multiplier (0.2619) = 2.1619.

C. Obtain average earnings per job - $15,000 (from SIC number, RIMS II code number and county).

D. Determine payroll by multiplying the estimated number of employees (3) times the average earnings per job ($15,000) = $45,000.

E. Determine earnings by multiplying payroll by economic base multiplier $45,000 x 2.1619 = $97,286.

APPENDIX 2

FAA TERMINAL AREA FORECAST

REGION STATE: ANE-CT LOCID: HVN
CITY: NEW HAVEN AIRPORT: TWEED-NEW HAVEN

AIRCRAFT OPERATIONS

	Enplanements			Itinerant Operations					Local Operations					
Year	Air Carrier	Air Comm.	Comruuter	Total	Air	AT &	GA	Military	Total OPS	GA	Military	Total	Total	Total Inst.Ops.	Based Aircraft	Carrier
1990	53	43347	43400	4	8491	32812	151	41458	53402	430	53832	95290	13716	84		
1991	33539	54492	88031	1033	9357	32034	148	42572	46685	806	47491	90063	14588	98		
1992	66586	71604	138190	2387	10080	29492	172	42131	33161	997	34158	76289	16876	96		
1993	62827	63196	126023	1943	8947	29482	183	40555	27988	210	28198	68753	15131	96		
1994	58224	72203	130427	1677	9015	27041	192	37925	25374	131	25505	63430	15239	96		
1995	56111	59183	115294	1792	9428	29025	351	40596	21766	108	21874	62470	15826	84		
1996	*22655*	72313	94968	819	11225	28049	392	40485	27025	118	27143	67628	16273	88		
1997	0	70766	70766	0	11181	30523	173	41877	30818	172	30990	72867	15523	70		
*1998	0	73163	73163	0	11559	30886	173	42618	31118	172	31290	73908	15932	70		
*1999	0	75560	75560	0	11702	31245	173	43120	31414	172	31586	74706	16119	70		
*2000	0	77957	77957	0	11835	31659	173	43667	31759	172	31931	75598	16306	70		
*2001	0	80353	80353	0	11960	32079	173	44212	32109	172	32281	76493	16485	70		
*2002	0	82750	82750	0	12077	32506	173	44756	32465	172	32637	77393	16659	70		
*2003	0	85147	85147	0	12186	32826	173	45185	32720	172	32892	78077	16807	70		
*2004	0	87544	87544	0	12288	33177	173	45638	33002	172	33174	78812	16955	70		
*2005	0	89941	89941	0	12382	33531	173	4608633287		172	33459	79545	17094	70		
*2006	0	92338	92338	0	12469	33884	173	46526	33569	172	33741	80267	17228	70		
*2007	0	94734	94734	0	12549	34236	173	46958	33849	172	34021	80979	17354	70		
*2008	0	97131	97131	0	12623	34589	173	47385	34129	172	34301	81686	17475	70		
*2009	0	99528	99528	0	12806	34940	173	47919	34407	172	34579	82498	17698	70		
*2010	0	101925	101925	0	12984	35277	173	48434	34673	172	34845	83279	17914	70		
*2011	0	104322	104322	0	13157	35600	173	48930	34928	172	35100	84030	18124	70		
*2012	0	106719	106719	0	13326	35910	173	49409	35172	172	35344	84753	18327	70		
*2013	0	109116	109116	0	13490	36207	173	49870	35405	172	35577	85447	18524	70		
*2014	0	111512	111512	0	13649	36491	173	50313	35628	172	35800	86113	18714	70		
*2015	0	113909	113909	0	13804	36763	173	50740	35841	172	36013	86753	18899	70		

APPENDIX 3

CALCULATION OF THE TRANSPORTATION BENEFIT

The transportation benefit of Tweed-New Haven Airport is calculated by the following formula:

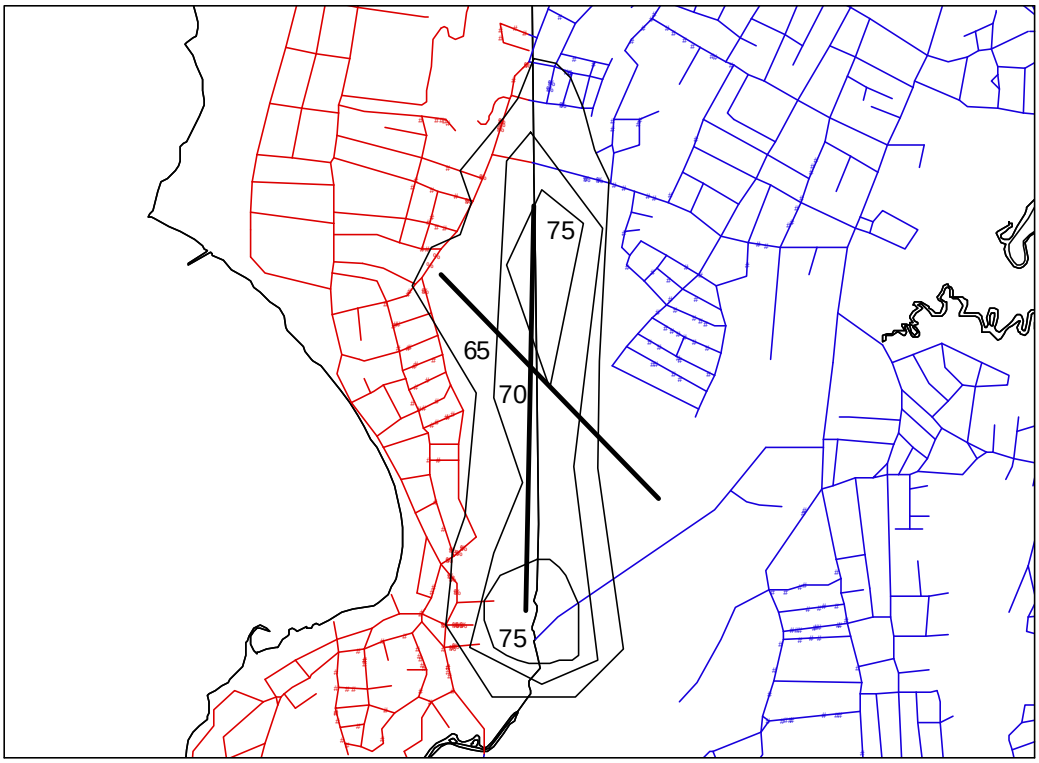
Total Annual Transportation Benefit = E(FGN+Y)(b/P-d/P)+(GN+Y)(Qb-Qd)

where

G	Itinerant operations per based aircraft per year. They are different under different scenarios.
N = 72	Number of based aircraft at Tweed New Haven airport. We obtain this information from the airport's website. The different scenarios assume the same number of based aircraft.
d = 17.7	Ground access distance to Tweed-New Haven airport, in miles. We calculate this number by developing a comprehensive weighted average that considered not only geographical coordinates of the airport's surrounding towns, but also the towns' income and population.
b = 35.6	Ground access distance to the next best alternative airport, in miles. The next best alternative airports are different across the towns depending on their geographical location. We calculate this number by using the weighted average model mentioned above.
E = 30	Passenger time values, in dollars per hour. This number is a typical value suggested by the Advisory Circular.
F = 2.5	Number of passengers per trip per general aviation aircraft. This variable is also a typical variable from the Advisory Circular by FAA.
P = 45	Car speed, in miles per hour. This number is suggested by the Advisory Circular by FAA.
Q = 0.39	Car costs, including amortization, in dollars per mile. This value is also suggested by the Advisory Circular by FAA.
Y	Annual passengers in commercial service. The figures are different for each year under different scenarios. They are obtained from the forecast developed by SH&E.

APPENDIX 4: Historical Sales Data of Residential Properties in the Target Zone

Appendix 5: Target Zone with Runway Protection Zones Map



Scale 1 : 2,000 Feet

Residences (>\= 65 Decibels) - East Haven
Residences (>\= 65 Decibels) - New Haven
Residences - East Haven
Residences - New Haven
Streets - East Haven
Streets - New Haven
Town Boundary - East Haven
Town Boundary - New Haven

Tweed - New Haven Airport

APPENDIX 6

REFERENCES ON PROPERTY VALUES AND AIRPORTS

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APPENDIX 7

MANN-WHITNEY U-TEST RESULT SUMMARY

The Mann-Whitney U-Test (Rank Sum Test) is a useful non-parametric technique to test whether two independent samples have been drawn from the same population.[11] In this study, the two samples are the sales prices of residential properties inside the RPZ and those outside the RPZ.

We divide the study period into three sub-periods, 1967-1979, 1980-1989 and 1990-1999. For the first period 1967-1979, there are three different scenarios. Some properties are first sold within this period and re-sold again within this period. Some properties are first sold in this period but not sold again until the 1980s. The last scenario is the properties first sold between 1967-1979 and not re-sold until the 1990s. We separate these three scenarios in conducting the Rank Sum Test. For the same reason, there are two scenarios within 1980-1989 period and one scenario within 1990-1999 time period. Table 1 summarizes the test statistics (all are significant at the 1% level).

Table 1: Summary of Rank Sum Test Statistics

1967-1979

	U-statistics	μ_U	σ_U	z-score
Scenario 1:	421	434.5	81.18	-0.17
Scenario 2:	91	84	28.98	0.24
Scenario 3:	49	94	28.54	-1.16

1980-1989

	U-statistics	μ_U	σ_U	z-score
Scenario 1:	98	65	18.62	1.77
Scenario 2:	40	54	16.97	-0.82

1990-1999

U-statistics	μ_U	σ_U	z-score
13	7.5	4.61	1.19

[11] See Hamburg, M. (1974), *Basic Statistics: A Modern Approach*, Harcourt Brace Jovanovich, Inc.