II.3.4 Forecasts of Cargo Volumes

Cargo forecasts were based on an analysis of the belly cargo carrying capacity of scheduled commercial passenger flights and the projected rate of growth of all-cargo carriers serving the airport. A description of the methodology used to project cargo tonnage forecasts is provided in the sections that follow.

Belly Cargo

Most passenger airlines accommodate air freight as a by-product to the primary activity of carrying passengers. It fills belly space that would otherwise be empty. The incremental costs of carrying cargo in a passenger aircraft are negligible, and include only ground handling expenses and a modest increase in fuel consumption.

In the future, it is assumed that carriers will adjust their rates in order to use the given cargo capacity effectively, and that fleet deployment issues will be resolved primarily on the basis of the passenger product. Under these assumptions, the belly cargo traffic at T. F. Green will depend strictly on the availability of capacity.

The forecasts of belly cargo are therefore based on the cargo capacities of aircraft operated by passenger airlines. The effective cargo capacity of a particular flight depends on many variables, including passenger loads, the quantity of checked luggage, density of the cargo, payload restrictions, and other operational factors. Approximate capacities were estimated for each type of aircraft (see **Table II.3-13**). The historical averages were multiplied by the estimated number of annual operations of each aircraft type from the fleet-mix forecasts to produce final belly cargo forecasts.

Table II.3-13
AVERAGE BELLY CARGO LOAD BY AIRCRAFT TYPE
T. F. Green Airport

Aircraft	Average Load (000 pounds)
Fokker 100	54.2
Airbus 319	40.3
Airbus 320	90.1
Boeing 737	58.9
Boeing 737-800	97.6
Boeing 757	108.5
Boeing 767	5,255
McDouglas DC9	52.9
De Havilland Dash-8	0.7
McDouglas MD-88	91.2
Saab SF 340	0.7

Source: USDOT T100 Domestic Segment Database, OAG Max

In future years, as total operations and average aircraft size increase, the amount of belly cargo is expected to increase accordingly. In the Medium and High growth cases, belly cargo capacity will see significant increases beyond 2010 as Boeing 767 or equivalent widebody aircraft are expected to begin operating at the airport. These aircraft will offer palletized capacity, offering substantial tariff and handling economies. They will greatly enhance the quality of Rhode Island's cargo services.

All-Cargo Carriers

Three "integrated" carriers, Airborne Express, Federal Express, and UPS, operate all-cargo flights to T. F. Green. The integrated carriers offer a single, comprehensive, door-to-door cargo product. All shipping functions are performed in-house, including the actual flying of the freight, pickup and delivery, customs clearance, insurance, and sufferance warehousing. They contrast with the air freight services of passenger airlines in which many different firms, including airlines, truckers, forwarders, and customs brokers could participate in a single shipment. The integrated carriers at T. F. Green offer a wide range of time-sensitive and deferred delivery products for all shipment sizes.

Forecasting cargo activity at T. F. Green involves several challenges. Limited information was available on movements of all-cargo carriers. The integrated carriers do not submit statistics to the DOT's Form 41 survey. The OAG did provide information on current all-cargo flight operations at T. F. Green and supplemental trucking services. RIAC furnished information on cargo volumes. Since shippers and consignees are largely indifferent about the airports transited by their shipments, the integrated carriers can change their logistics patterns quickly and simply. An integrated carrier could easily redirect shipments now transiting T. F. Green to other airports. At many airports, individual shippers may control a large portion of the total air freight. Statistical models apply with some validity to passenger service, where many decision-makers are present, but are less adequate in describing individual transactors.

These complications make an econometric model of cargo of only limited value. The forecasts for T. F. Green were therefore derived from the most recent forecasts of air cargo developed by the FAA. The FAA has projected a 4.8 percent annual growth in domestic air freight for the 2000-2012 period.[20] The forecasts are based on the following assumptions:

- No additional integrated carriers will establish service at T. F. Green.
- The airport's current tenants will not alter their methods of serving the region, such as changing the catchment areas of different airports or substituting between road feeder service and cargo aircraft.
- Federal Express will continue to base Cessna Caravan aircraft at T. F. Green to serve Rutland, Nantucket, and Martha's Vineyard.

[20] *FAA Aerospace Forecasts*, Federal Aviation Administration, Washington 2001 Table 1-2.

- There will be no changes to the voluntary curfew.
- Although the integrated carriers may obtain larger facilities, they will do so only to accommodate recent and anticipated market growth. They will not consciously increase cargo volumes at T. F. Green by virtue of having larger facilities.
- There will be no significant migration from Boston to T. F. Green of cargo volumes and aircraft in response to congestion at Boston Logan.
- The airports of Worcester and New Bedford will not emerge as cargo competitors to T. F. Green.
- Except for an orderly and incremental annual growth, there will be no major changes in either inbound or outbound cargo.

Cargo Volume Forecasts

As shown in **Table II.3-14,** total air cargo is expected to increase from 18,562 tons in 2000 to 22,750 tons in 2005 for the Medium case. By 2020, the Medium case projects air cargo volumes will increase to 49,150 tons, an average annual growth rate of 5.3 percent from 2000 to 2020. The High case predicts air cargo volumes will reach 52,550 million tons in 2020 while the Low case projects volumes of 43,300 tons in 2020.

All-cargo aircraft transport the majority of the cargo volumes at the airport. All-cargo volumes are forecast to increase from 16,811 tons in 2000 to 40,380 tons in 2020 for each growth case (Medium, High, and Low). This represents an average growth rate of 4.5 percent annually.

Belly cargo volumes are projected to vary widely over the forecast horizon, depending on the cargo carrying capacity of the passenger aircraft. For example, Boeing 767 aircraft are forecast to be introduced to the passenger fleet in 2010 in the Medium forecast which causes a large increase in belly cargo volumes (over 16 percent annually from 2005 to 2010). B-767 aircraft are not expected to increase significantly from 2010 to 2015; as a result, belly cargo volumes are not forecast to increase significantly over this time period. As more B-767 aircraft are introduced between 2015 and 2020 in the Medium growth case, belly cargo volumes are forecast to increase by over 15 percent annually.

Belly cargo is expected to increase from 9.4 percent of total cargo volumes in 2000 to 15.9 percent in 2020 in the Medium forecast and to 21.3 percent in the High forecast. The Low case, which does not predict as large of an increase in passenger aircraft size, results in 6.5 percent belly cargo in 2020.

II.3.5 Forecasts of Aircraft Operations Demand

This section of the chapter discusses the Existing Role forecasts of aircraft operations. Passenger aircraft operations forecasts are based on the projected passenger volumes and take into account the type and size of aircraft forecast to operate at T. F. Green, the average seat size of those aircraft, and average load factors (percentage of seats that

Table II.3-14
AIR-CARGO VOLUME FORECAST (IN U.S. TONS)
T. F. Green Airport

MEDIUM CASE			
Forecast Year	Belly Capacity	All-Cargo	Total
2000	1,750	16,811	18,562
2005	1,910	20,840	22,750
2010	4,080	26,720	30,800
2015	4,320	33,190	37,510
2020	8,770	40,380	49,150
Average Annual Compound Growth Rate			
2000-2005	1.8%	4.4%	4.2%
2005-2010	16.4%	5.1%	6.2%
2010-2015	1.1%	4.5%	4.0%
2015-2020	15.2%	4.0%	5.6%
2000-2020	8.4%	4.5%	5.0%

HIGH CASE			
Forecast Year	Belly Capacity	All-Cargo	Total
2000	1,750	16,811	18,562
2005	2,080	20,840	22,920
2010	5,350	26,720	32,070
2015	6,670	33,190	39,860
2020	12,170	40,380	52,550
Average Annual Compound Growth Rate			
2000-2005	3.5%	4.4%	4.3%
2005-2010	20.8%	5.1%	6.9%
2010-2015	4.5%	4.4%	4.4%
2015-2020	12.8%	4.0%	5.7%
2000-2020	10.2%	4.5%	5.3%

LOW CASE			
Forecast Year	Belly Capacity	All-Cargo	Total
2000	1,750	16,811	18,562
2005	1,680	20,840	22,520
2010	1,950	26,720	28,670
2015	2,490	33,190	35,680
2020	2,920	40,380	43,300
Average Annual Compound Growth Rate			
2000-2005	-0.8%	4.4%	3.9%
2005-2010	3.0%	5.1%	4.9%
2010-2015	5.0%	4.4%	4.5%
2015-2020	3.2%	4.0%	3.9%
2000-2020	2.6%	4.5%	4.3%

are occupied). Cargo operations forecasts are calculated based on forecast cargo volumes and also take into consideration the size of the aircraft and the amount of cargo carried on each aircraft. The aircraft operations forecasts provide key input for later Master Plan tasks including the evaluation of airside facilities and environmental analysis. This section of the chapter discusses the development of the annual aircraft operations forecast for the following activity categories:

- Passenger Carrier Operations
- Air Cargo Operations
- General Aviation and Military Operations

Passenger carrier operations forecasts were based on an analysis of air carrier networks, historical load factors, and fleet mixes. They were derived directly from the passenger forecasts. The number of commercial operations at an airport depends on three factors: total passengers, average aircraft size, and average load factor. The relationship is shown in the equation below.

$$Operations = \frac{TotalPassengers}{AverageLoadFactor * AverageAircraftSize}$$

This relationship permits literally infinite combinations of load factors, average aircraft size, and operations to accommodate a given number of passengers. A series of "rules of thumb" were derived to meet the specific circumstances of each airline at T. F. Green. These rules were based on current fleet mix, equipment on order, daily and monthly flight frequency, load factor data by airline and aircraft type, flight destination, and the downline operational patterns (particularly the number of flight banks at each hub). The assumptions used to develop forecasts of passenger operations and fleet mix are as follows:

- No new major airlines will enter the market.
- Future load factors for commuter aircraft were assumed to be the larger of 55 percent or current load factors. Some high frequency markets (e.g. New York LaGuardia) use current load factors.
- There will be no major operational changes in the industry, such as widespread gridlock at key hub airports, that would prompt airlines to make fundamental changes in the aircraft they use and how they deploy them.
- All aircraft operating in the future will be derivatives of aircraft presently flying.
- Carriers will make incremental and evolutionary changes, year-by-year, in their fleet mixes at T. F. Green.
- Commuter load factors were based on RIAC passenger data and OAG schedules.

- Future load factors for mainline jet aircraft were assumed to be the larger of 72 percent or current load factors.
- Mainline jet load factors were based on the T-100 domestic segment reports for the year ending December 31, 2000 (see Table B-5, *T. F. Green Load Factor Data – 4th Quarter 2000*, in **Appendix B**, *Forecast Assumptions*) data and RIAC passenger data.

As the load factor thresholds described above were met, it was assumed that airlines would respond in one of two ways. They would either increase average aircraft size or increase frequency, depending on the type of service needed at the origin or destination airport.

Current service at Hartford's Bradley Airport was used to estimate patterns of evolution for the early years of the forecasting period. Bradley has a somewhat more developed selection of hub service than T. F. Green. However, the proximity of the airports means that their service could be roughly similar.

The T. F. Green May 2001 air carrier schedule was used as a guideline to estimate the mix of aircraft used by each carrier to their major destinations. Appendix B, *Forecast Assumptions*, Table B-6, *Assumed Mix of Aircraft*, shows the range of aircraft and seat size used for each airline in the analysis.

Below are the airline-specific assumptions used in this analysis:

- Southwest Airlines' share of traffic will grow progressively from its current 30 percent to 40 percent, 42 percent, and 38 percent for the Medium, High, and Low cases, respectively.
- Future load factors for Southwest will be equal to its current national average of 68 percent. Southwest's load factors at T. F. Green are currently above the national average. As the market matures, it is assumed that load factors will revert back to the national average sometime between 2005 and 2010. Southwest load factors already declined from a high of nearly 75 percent in 1999 to just over 68 percent in 2000.
- All non-Southwest Airlines will keep their current market shares, less any increases in Southwest growth.
- US Airways will consolidate its diverse fleet mix by replacing DC9s, 737s, and MD80s with Airbus 319 and 320 aircraft.
- Regional jet service will increase to Washington Dulles, Cleveland, and Cincinnati, either replacing turboprop operations or augmenting existing large jet service.

The resulting air carrier and commuter operations forecasts for the Medium, Low, and High cases are shown in **Table II.3-15**. The Medium case predicts annual air carrier operations will increase from 49,698 in 2000 to 96,300 in 2020, an average annual growth rate of 3.4 percent. Commuter operations in this case are projected to increase from 47,466 in 2000 to 63,480 in 2020 (1.5 percent average annual growth). Total

Table II.3-15
AIR CARRIER AND COMMUTER AIRCRAFT OPERATIONS FORECASTS
T. F. Green Airport

MEDIUM CASE			
Forecast Year	Air Carrier	Commuter	Total
2000	49,698	47,466	97,164
2005	57,070	50,380	107,450
2010	68,130	55,560	123,690
2015	81,250	57,930	139,180
2020	96,300	63,480	159,780
Average Annual Compound Growth Rate			
2000-2005	2.8%	1.2%	2.0%
2005-2010	3.6%	2.0%	2.9%
2010-2015	3.6%	0.8%	2.4%
2015-2020	3.5%	1.8%	2.8%
2000-2020	3.4%	1.5%	2.5%

HIGH CASE			
Forecast Year	Air Carrier	Commuter	Total
2000	49,698	47,466	97,164
2005	61,660	53,820	115,480
2010	75,850	56,380	132,230
2015	89,830	61,970	151,800
2020	108,980	67,990	176,970
Average Annual Compound Growth Rate			
2000-2005	4.4%	2.5%	3.5%
2005-2010	4.2%	0.9%	2.7%
2010-2015	3.4%	1.9%	2.8%
2015-2020	3.9%	1.9%	3.1%
2000-2020	4.0%	1.8%	3.0%

LOW CASE			
Forecast Year	Air Carrier	Commuter	Total
2000	49,698	47,466	97,164
2005	50,960	48,120	99,080
2010	60,830	52,680	113,510
2015	68,230	55,900	124,130
2020	80,850	60,290	141,140
Average Annual Compound Growth Rate			
2000-2005	0.5%	0.3%	0.4%
2005-2010	3.6%	1.8%	2.8%
2010-2015	2.3%	1.2%	1.8%
2015-2020	3.5%	1.5%	2.6%
2000-2020	2.5%	1.2%	1.9%

passenger operations in the Medium case are forecast to increase from 97,164 in 2000 to 159,780 in 2020, representing 2.5 percent growth annually. In contrast, the High case predicts total passenger operations will reach 176,970 in 2020 while the Low case predicts 144,140 operations in 2020.

Air Cargo Operations Forecast

Cargo operations forecasts were derived directly from the cargo tonnage forecasts and assumptions about the fleet mix of the all-cargo carriers. **Table II.3-16** contains a summary of T. F. Green cargo aircraft, their average loads, and their cargo capacity.

Table II.3-16
AVERAGE CARGO LOADS
T. F. Green Airport

Aircraft	Average Load (pounds)	Capacity (pounds)
Federal Express		
Cessna 208	1,281	3,600
Airbus 310	21,351	60,000
Boeing 727	14,234	40,000
ABX Air Inc.		
McDouglas DC9	12,329	31,800
United Parcel Service		
Boeing 757	19,226	86,800
Boeing 727	9,613	43,400

Source: USDOT T100 Domestic Segment Database, OAG Max, and all-cargo carriers

Similar to the passenger operations methodology the number of all-cargo operations depends on three factors: total annual tonnage, average aircraft capacity, and average load factor. The relationship is shown in the equation below.

$$Operations = \frac{TotalTonnage}{AverageFreightLoadFactor * AverageAircraftCapacity}$$

The following “rules of thumb” about the three factors in the equation used to complete operations forecasts are as follows:

- The market share of T. F. Green’s three all-cargo carriers (Federal Express, UPS, Airborne Express) will remain constant throughout the planning period based on 2000 market shares.
- Cessna Caravan operations by Federal Express will remain constant.

- Federal Express will begin substituting Airbus 310 freighters for Boeing 727 freighters in future years.
- Freight load factors of aircraft will remain constant throughout the planning period. Freight load factor is calculated by dividing annual tonnage carried by total annual capacity.

As shown in **Table II.3-17**, cargo operations are forecast to increase from 3,433 in 2000 to 6,200 in 2020. This represents an average annual growth rate of 3.0 percent.

Table II-3-17
CARGO AIRCRAFT OPERATIONS FORECASTS
T. F. Green Airport

Forecast Year	Air Carrier	Commuter	Total
2000	1,899	1,544	3,433
2005	2,440	1,540	3,980
2010	3,140	1,540	4,680
2015	3,840	1,540	5,380
2020	4,660	1,540	6,200
Average Annual Compound Growth Rate			
2000-2005	5.3%	-0.1%	3.0%
2005-2010	5.2%	0.0%	3.3%
2010-2015	4.1%	0.0%	2.8%
2015-2020	3.9%	0.0%	2.9%
2000-2020	4.6%	0.0%	3.0%

General Aviation and Military Operations Forecast

General aviation activity at T. F. Green declined at an average rate of 5.9 percent annually during the years 1977 through 1994. Activity fell from a total of 196,000 operations in 1977 to 51,700 operations in 1994. However, between the years 1994 and 1998, general aviation activity at T. F. Green increased on an average of 6.7 percent per year, to a total of 66,900 operations. Since 1998, general aviation activity has again declined to about 52,200 annual operations in the year 2000. The North Central Airport serves as a reliever facility for light general aviation activity. As a result, many of the smaller general aviation aircraft previously based at T. F. Green have relocated to North Central Airport.

Annual Operations

The long-term decline of general aviation precludes development of forecasts using traditional techniques such as trend analysis or regression. A model using any common determinant, such as GDP or population, would generate forecasts of a continuing decline. Instead, more qualitative and comparative techniques were used to reflect recent industry changes.

The General Aviation Revitalization Act (GARA) of 1994 addressed many of the issues, such as product liability, that were responsible for the long-term decline of general aviation throughout the United States. Since the GARA, this sector has experienced a steady recovery, with new products, an increase of shipments and billings by over 100 percent, and the creation of more than 25,000 jobs in manufacturing. New Cessna single-engine piston models, introduced in 1997, have proven very successful while Raytheon, Mooney, and Piper also offer several new products. Fractional ownership programs are increasingly popular for corporations, celebrities, and business executives.

The most current national FAA Aviation Forecasts (FY 2001 through 2012) for the U.S. estimate that nationwide general aviation activity will continue to increase in the future. There is general optimism about the future of general aviation because aircraft deliveries continue to increase, the active general aviation fleet is growing, hours flown by general aviation aircraft are on the rise, and the Federal government has initiated several programs geared towards the promotion and increased use of general aviation.

It is generally agreed within the industry that the use of corporate and business aircraft will continue to grow in most metropolitan areas, while the smaller general aviation aircraft (single engine aircraft used for training, sport, and pleasure use) will continue to decline at the busier air carrier airports. This has been the trend at T. F. Green, Boston Logan, Hartford Bradley, and to some extent, at Manchester as well.

The previous master plan prepared for T. F. Green estimated that there would be a slight growth (0.2 percent annually) in general aviation activity at the airport through the year 2015. On the other hand, the FAA TAF for T. F. Green indicates that there will be virtually no growth. The TAF for Boston indicates a 1.0 percent increase in general aviation activity, the TAF for Hartford indicates a 1.6 percent growth, and the TAF for Manchester indicates no growth in general aviation activity.

Based on the above discussion, it was assumed that local general aviation operations at T. F. Green will remain constant throughout the forecasting period. However, it is likely that T. F. Green will experience a continued growth in the use of the airport by itinerant (visiting) corporate and business aircraft. The economy and business climate continues to be favorable in Rhode Island, but it is also likely that the level of local operations will remain constant or decline. Therefore, this forecast of general aviation aircraft operations for T. F. Green assumed a moderate 1.0 percent annual growth in itinerant operations and no growth in local operations – resulting in an overall annual growth rate for general aviation operations of 0.8 percent from 2000 to 2020. The 1.0 percent annual average growth in itinerant operations is consistent with the forecast growth of itinerant general aviation activity at Boston Logan and Bradley airports.

Current military aircraft operations at T. F. Green Airport consist of transient activity for the transport of military personnel, VIPs, and medical airlift flights. Most military aircraft operating in and out of T. F. Green include the military version of the Beech King Air, the DC-9, and an occasional C-131 aircraft. There are currently no military aircraft based at T. F. Green and military aircraft are not permitted to conduct practice approaches or training exercises at the airport.

Military operations are expected to remain relatively unchanged in the future. Since 1995, annual operations have fluctuated from a low of 2,764 in 2000 to a high of 3,518 in 1998. The data shows no general trend as operations vary more or less around 3,000 operations per year. The forecasts assume the average number of operations for the past six years (3,300 operations) will continue through 2020.

Table II.3-18 shows the forecasts of annual general aviation and military operations at T. F. Green Airport. Annual general aviation/military operations are forecast to increase from 54,948 in 2000 to 64,230 in 2020.

Table II.3-18
GENERAL AVIATION AND MILITARY OPERATIONS FORECAST
T. F. Green Airport

Forecast Year	Itinerant General Aviation Ops.	Local General Aviation Ops.	Military Ops.	Total
2000	39,252	12,932	2,764	54,948
2005	41,290	13,000	3,300	57,590
2010	43,390	13,000	3,300	59,690
2015	45,660	13,000	3,300	61,960
2020	47,930	13,000	3,300	64,230
Average Annual Compound Growth Rate				
2000-2005	1.0%	N/A	3.6%	0.9%
2005-2010	1.0%	0.0%	0.0%	0.7%
2010-2015	1.0%	0.0%	0.0%	0.8%
2015-2020	0.9%	0.0%	0.0%	0.7%
2000-2020	1.0%	N/A	0.9%	0.8%

Aircraft Fleet Mix

The general aviation aircraft using the airport vary in size and speed, from small single-engine piston aircraft to large corporate jets. Little historical data is available to estimate a trend over the past decade. The recently completed *Part 150 Study* included an estimate of the average day, peak month operations for general aviation and military aircraft. The estimate used for the *Part 150 Study* is generally consistent with observations made by the airport, Air Traffic Control Tower, and Fixed Base Operators (FBO) personnel. Therefore, the general aviation/military fleet mix used in the *Part 150 Study* (1998 data) was used to project the first 10 years of the forecast period (2000–2010). The forecast fleet mix for the remaining 10 years of the forecast period was based on assumptions of general industry trends and FAA aviation forecasts.

It is generally agreed within the industry that the delivery of new general aviation aircraft will continue to increase during the next 10 years. Orders for corporate jet aircraft have risen steadily over the past few years and should continue to rise. Likewise, the orders for new single-engine piston aircraft have also increased. However, many older piston aircraft will also be retired during this same period as they reach the end of their useful life.

Table II.3-19 shows the forecast general aviation/military fleet mix. It is projected that there will be a slight decline in the number of single-engine piston aircraft using the airport, from 32 percent in 2000 to 30 percent in 2020. It is also projected that the number of large corporate jet aircraft using the airport will increase from 22 percent in 2010 to 25 percent in 2020. The number of multi-engine piston and small corporate jet and turboprop aircraft are expected to remain fairly constant throughout the remainder of the forecast period.

Table II.3-19
GENERAL AVIATION AND MILITARY AIRCRAFT FLEET-MIX FORECAST
T. F. Green Airport

Year	Single-Engine Piston	Multi-Engine Piston	Small Jet/ Turboprops	Large Jet
2000	32%	15%	31%	22%
2005	32%	15%	31%	22%
2010	32%	15%	31%	22%
2020	30%	15%	30%	25%

Summary of Fleet Mix and Aircraft Operations Forecasts

The resulting aircraft fleet mix for air carriers, commuters, cargo operators, and general aviation/military is presented in **Table II.3-20**. **Table II.3-21** presents a summary of the aircraft operations forecasts. Total operations are forecast to increase from approximately 155,545 in 2000 to 230,210 in 2020 with the Medium case, an average annual increase of 2.0 percent. Total annual operations are forecast to reach 247,400 in 2020 under the High case, and 211,570 by 2020 in the Low case. The High case operations are forecast to increase at an average annual rate of 2.3 percent. The Low case predicts a 1.5 percent average annual growth rate.

II.3.6 Forecasts of Peak Period Demand

The traffic demand patterns imposed upon an airport exhibit considerable variations on a monthly, daily, and hourly basis. These variations result in periods, known as peaks, when the greatest constant amount of demand is placed upon facilities required to accommodate passenger and aircraft movement. These peak periods of demand must be considered in the determination of airport facilities so that effective utilization of the facilities can be realized. The objective of developing peak forecasts is to project a design level such that if airport facilities were planned to accommodate that level of demand, the facilities would neither be underutilized nor overcrowded too often.

Table II.3-20
FLEET MIX FORECASTS
T. F. Green Airport

Aircraft	Seat Size	Medium Scenario 2000	Medium 2005	Medium 2010	Medium 2015	Medium 2020	High Scenario 2005	High 2010	High 2015	High 2020	Low Scenario 2005	Low 2010	Low 2015	Low 2020
Passenger Aircraft														
Cessna Light Aircraft	9	10.1%	10.21%	9.9%	9.8%	10.3%	10.8%	10.8%	10.7%	11.2%	10.2%	9.7%	9.6%	9.9%
Beech 19	19	2.8%	3.28%	3.4%	3.7%	4.0%	3.4%	3.7%	4.0%	4.3%	3.3%	3.3%	3.6%	3.8%
Jetstream 41	29	1.6%	0.18%	0.2%	0.1%	0.1%	0.2%	0.2%	0.1%	0.1%	0.2%	0.2%	0.2%	0.1%
Dornier 328	29	0.7%	0.00%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Embraer	30	0.0%	0.00%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Saab 340	34	5.1%	1.81%	1.5%	1.9%	0.9%	1.9%	0.9%	1.1%	0.1%	1.8%	1.8%	1.1%	0.4%
ER3	37	0.0%	2.31%	2.2%	0.9%	0.0%	2.2%	1.4%	0.0%	0.0%	1.5%	1.1%	1.7%	0.5%
Dehavilland Dash 8	37	4.7%	4.48%	3.1%	1.3%	0.9%	3.5%	1.5%	1.3%	0.8%	3.3%	2.1%	1.4%	1.0%
ATR 42	46	1.0%	0.00%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Canadair Regional Jet	50	0.5%	5.83%	6.9%	7.7%	7.4%	6.1%	7.6%	7.0%	6.5%	6.9%	8.1%	8.6%	8.6%
Embraer Regional Jet	50	0.9%	1.72%	2.4%	2.4%	4.0%	2.2%	2.6%	4.0%	4.4%	2.7%	3.2%	2.9%	4.2%
ATR 72	64	0.7%	0.00%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Other Commuter Jets	N/A	2.6%	0.00%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
DC9-10	78	0.0%	0.00%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
F100	97	0.5%	0.00%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
DC9-30	100	1.0%	0.00%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Boeing 737-500	104	0.7%	1.60%	0.4%	0.9%	1.0%	1.0%	1.8%	1.1%	1.5%	1.0%	0.2%	0.6%	0.5%
DC9-40	110	0.4%	1.53%	0.9%	0.0%	0.0%	0.6%	0.0%	0.0%	0.0%	1.8%	1.0%	0.0%	0.0%
Boeing 737-200	118	4.0%	1.02%	1.1%	0.6%	0.0%	1.1%	1.2%	0.6%	0.0%	1.0%	1.1%	0.6%	0.0%
Boeing 737-600	118	0.0%	0.00%	0.0%	0.6%	1.3%	0.0%	0.0%	0.6%	1.4%	0.0%	0.0%	0.6%	1.2%
A319	120	1.5%	4.55%	3.9%	2.9%	0.4%	4.9%	3.6%	0.6%	0.6%	4.9%	6.6%	1.8%	3.0%
DC9-50	125	0.1%	0.00%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Boeing 737-400	126	1.7%	0.00%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MD-88	129	2.2%	1.94%	1.6%	0.0%	0.0%	2.1%	0.2%	0.0%	0.0%	1.9%	2.0%	0.7%	0.9%
Boeing 737-300	137	10.5%	9.45%	11.2%	12.4%	13.4%	9.7%	11.5%	12.6%	13.6%	8.2%	9.4%	10.3%	11.0%
Boeing 737-700	137	3.5%	5.87%	7.8%	8.2%	8.0%	6.5%	7.3%	8.0%	7.9%	5.4%	6.8%	6.9%	7.5%
MD-80	141	0.6%	0.38%	0.4%	0.2%	0.7%	0.4%	0.4%	0.5%	0.0%	0.6%	0.3%	0.8%	0.6%
Boeing 727-200	141	0.7%	0.00%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
A320	142	0.8%	1.96%	3.7%	4.0%	4.7%	4.4%	4.5%	5.0%	4.2%	2.0%	3.5%	5.8%	5.3%
MD-881	142	2.7%	1.46%	0.3%	0.4%	0.7%	0.6%	1.1%	0.5%	0.9%	2.0%	0.8%	1.4%	0.5%
Boeing 737-800	155	0.0%	0.01%	0.4%	2.5%	3.1%	0.0%	1.9%	2.9%	4.3%	0.0%	0.0%	1.2%	1.6%
Boeing 757-200	188	1.3%	3.99%	4.3%	6.5%	7.8%	3.6%	4.5%	7.9%	8.5%	2.8%	2.5%	4.9%	6.2%
Boeing 767-300	218	0.0%	0.00%	0.4%	0.3%	0.9%	0.0%	0.5%	0.6%	1.3%	0.0%	0.0%	0.0%	0.0%
All-Cargo														
727 Freighter	0	0.4%	0.36%	0.4%	0.3%	0.2%	0.3%	0.3%	0.2%	0.2%	0.4%	0.4%	0.3%	0.3%
757 Freighter	0	0.3%	0.31%	0.4%	0.4%	0.4%	0.3%	0.3%	0.4%	0.4%	0.3%	0.4%	0.4%	0.5%
Airbus 300 Freighter	0	0.0%	0.07%	0.1%	0.3%	0.3%	0.1%	0.1%	0.3%	0.3%	0.1%	0.1%	0.3%	0.4%
Cessna-208	0	1.0%	0.91%	0.8%	0.7%	0.7%	0.9%	0.8%	0.7%	0.6%	1.0%	0.9%	0.8%	0.7%
DC9 Freighter	0	0.6%	0.70%	0.8%	0.9%	1.0%	0.7%	0.8%	0.9%	0.9%	0.7%	0.9%	1.0%	1.1%
Gen. Aviation/Mil.														
Single-Engine Piston	N/A	11.3%	10.90%	10.2%	9.3%	8.4%	10.4%	9.7%	8.8%	7.8%	11.5%	10.7%	10.0%	9.1%
Multi-Engine Piston	N/A	5.3%	5.11%	4.8%	4.5%	4.2%	4.9%	4.6%	4.2%	3.9%	5.4%	5.0%	4.9%	4.6%
Small Jet/Turbo	N/A	11.0%	10.56%	9.8%	9.0%	8.4%	10.1%	9.4%	8.5%	7.8%	11.1%	10.4%	9.7%	9.1%
Large Jet	N/A	7.8%	7.50%	7.0%	7.2%	7.0%	7.2%	6.7%	6.8%	6.5%	7.9%	7.4%	7.8%	7.6%
Total		**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table II.3-21
TOTAL AIRCRAFT OPERATIONS FORECAST
T. F. Green Airport

MEDIUM CASE					
Forecast Year	Passenger	Cargo	General Aviation	Military	Total
2000	97,164	3,433	52,184	2,764	155,545
2005	107,450	3,980	54,290	3,300	169,020
2010	123,690	4,680	56,390	3,300	188,060
2015	139,180	5,380	58,660	3,300	206,520
2020	159,780	6,200	60,930	3,300	230,210
Average Annual Compound Growth Rate					
2000-2005	2.0%	3.0%	0.8%	3.6%	1.7%
2005-2010	2.9%	3.3%	0.8%	0.0%	2.2%
2010-2015	2.4%	2.8%	0.8%	0.0%	1.9%
2015-2020	2.8%	2.9%	0.8%	0.0%	2.2%
2000-2020	2.5%	3.0%	0.8%	0.9%	2.0%

HIGH CASE					
Forecast Year	Passenger	Cargo	General Aviation	Military	Total
2000	97,164	3,433	52,184	2,764	155,545
2005	115,480	3,980	54,290	3,300	177,050
2010	132,230	4,680	56,390	3,300	196,600
2015	151,800	5,380	58,660	3,300	219,140
2020	176,970	6,200	60,930	3,300	247,400
Average Annual Compound Growth Rate					
2000-2005	3.5%	3.0%	0.8%	3.6%	2.6%
2005-2010	2.7%	3.3%	0.8%	0.0%	2.1%
2010-2015	2.8%	2.8%	0.8%	0.0%	2.2%
2015-2020	3.1%	2.9%	0.8%	0.0%	2.5%
2000-2020	3.0%	3.0%	0.8%	0.9%	2.3%

LOW CASE					
Forecast Year	Passenger	Cargo	General Aviation	Military	Total
2000	97,164	3,433	52,184	2,764	155,545
2005	99,080	3,980	54,290	3,300	160,650
2010	113,510	4,680	56,390	3,300	177,880
2015	124,130	5,380	58,660	3,300	191,470
2020	141,140	6,200	60,930	3,300	211,570
Average Annual Compound Growth Rate					
2000-2005	0.4%	3.0%	0.8%	3.6%	0.6%
2005-2010	2.8%	3.3%	0.8%	0.0%	2.1%
2010-2015	1.8%	2.8%	0.8%	0.0%	1.5%
2015-2020	2.6%	2.9%	0.8%	0.0%	2.0%
2000-2020	1.9%	3.0%	0.8%	0.9%	1.5%

Two peaking characteristics are analyzed in this section: Peak Month Average Day (PMAD) and the peak hour of the PMAD. These two peaking characteristics are determined for passenger activity and aircraft operations for the planning horizons of 2005, 2010, 2015, and 2020.

Peak Month Average Day Forecasts

PMAD forecasts were derived directly from annual passenger forecasts and historical traffic data. PMAD forecasts were estimated for both passengers and operations. In order to derive PMAD forecasts, the ratio of traffic in the peak month was multiplied by the annual number of estimated passengers or operations and divided by 31, the number of days in the peak month. The peak month ratio is based on the average ratio for the historical years 1995 to 2000. In the case of T. F. Green, August was the peak month in most years.

Table II.3-22 contains a summary of the resulting Medium, High, and Low PMAD forecasts for T. F. Green. PMAD passengers are forecast to increase from approximately 16,800 in 2000 to 33,992 in 2020 in the Medium growth case. PMAD operations in the Medium case show growth from 524 operations in 2000 to 756 in 2020. The High forecast shows PMAD activity increasing to 38,637 passengers and 813 operations in 2020 while the Low case forecasts growth to 28,258 passengers and 695 operations in 2020.

Peak Hour Forecasts

Peak hour forecasts were derived from the PMAD forecasts and an analysis of 2001 August T. F. Green schedules. The passenger peak hour was determined by seat capacity, while the operations peak hour was determined by the total number of scheduled flights. **Table II.3-23** shows peak hour percentages of daily activity for both operations and passenger activity. In order to estimate final peak hour forecasts, these ratios were multiplied by the PMAD forecasts.

Table II.3-23
PEAK HOUR SHARES OF PMAD ACTIVITY
T. F. Green Airport

	Passengers			Operations		
Aircraft Type	**Enplaned**	**Deplaned**	**Total**	**Departure**	**Arrival**	**Total**
Air Carriers	12.8%	11.3%	10.2%	12.8%	11.5%	10.3%
Commuter Carriers	14.9%	14.9%	12.3%	11.8%	11.8%	10.3%
General Aviation/Military	12.6%	11.6%	10.1%	11.0%	11.6%	9.9%
All Aircraft	12.6%	11.6%	10.1%	11.0%	11.6%	9.9%

Table II.3-22
PMAD FORECAST PASSENGERS
T. F. Green Airport

MEDIUM CASE						
	Passengers					
Type	**Direction**	**2000**	**2005**	**2010**	**2015**	**2020**
Air Carriers	Enplaned	7,557	8,466	10,409	12,820	15,609
	Deplaned	7,518	8,466	10,409	12,820	15,609
	Total	**15,075**	**16,932**	**20,818**	**25,640**	**31,218**
Commuter Carriers	Enplaned	871	1,036	1,243	1,284	1,387
	Deplaned	867	1,036	1,243	1,284	1,387
	Total	**1,738**	**2,072**	**2,486**	**2,568**	**2,774**
Total	Enplaned	8,428	9,502	11,652	14,104	16,996
	Deplaned	8,385	9,502	11,652	14,104	16,996
	Total	**16,813**	**19,004**	**23,304**	**28,208**	**33,992**

Aircraft Operations						
Type	**Direction**	**2000**	**2005**	**2010**	**2015**	**2020**
Air Carriers	Departures	77	89	106	127	150
	Arrivals	77	89	106	127	150
	Total	**154**	**178**	**212**	**254**	**300**
Commuter Carriers	Departures	80	85	93	97	106
	Arrivals	80	85	93	97	106
	Total	**160**	**170**	**186**	**194**	**212**
Non-Scheduled	Departures	101	106	110	114	119
	Arrivals	101	106	110	114	119
	Total	**202**	**212**	**220**	**228**	**238**
Total	Departures	255	280	309	338	375
	Arrivals	255	280	309	338	375
	Total	**510**	**560**	**618**	**676**	**750**

Table II.3-22 (Continued)
PMAD FORECAST PASSENGERS
T. F. Green Airport

HIGH CASE						
	Passengers					
Type	Direction	2000	2005	2010	2015	2020
Air Carriers	Enplaned	7,557	9,256	11,730	14,498	17,915
	Deplaned	7,518	9,256	11,730	14,498	17,915
	Total	**15,075**	**18,512**	**23,460**	**28,996**	**35,830**
Commuter Carriers	Enplaned	871	1,116	1,194	1,349	1,403
	Deplaned	867	1,116	1,194	1,349	1,403
	Total	**1,738**	**2,232**	**2,388**	**2,698**	**2,806**
Total	Enplaned	8,428	10,372	12,924	15,847	19,318
	Deplaned	8,385	10,372	12,924	15,847	19,318
	Total	**16,813**	**20,744**	**25,848**	**31,694**	**38,636**

	Aircraft Operations					
Type	Direction	2000	2005	2010	2015	2020
Air Carriers	Departures	77	95	118	139	169
	Arrivals	77	95	118	139	169
	Total	**154**	**190**	**236**	**278**	**338**
Commuter Carriers	Departures	80	90	95	104	114
	Arrivals	80	90	95	104	114
	Total	**160**	**180**	**190**	**208**	**227**
Non-Scheduled	Departures	101	106	110	114	119
	Arrivals	101	106	110	114	119
	Total	**202**	**212**	**220**	**228**	**237**
Total	Departures	255	291	323	357	406
	Arrivals	255	291	323	357	406
	Total	**510**	**582**	**646**	**714**	**813**

Table II.3-22 (Continued)
PMAD FORECAST PASSENGERS
T. F. Green Airport

LOW CASE						
	Passengers					
Type	**Direction**	**2000**	**2005**	**2010**	**2015**	**2020**
Air Carriers	Enplaned	7,557	7,557	8,994	10,722	12,735
	Deplaned	7,518	7,557	8,994	10,722	12,735
	Total	**15,075**	**15,114**	**17,988**	**21,444**	**25,470**
Commuter Carriers	Enplaned	871	1,030	1,207	1,305	1,394
	Deplaned	867	1,030	1,207	1,305	1,394
	Total	**1,738**	**2,060**	**2,414**	**2,610**	**2,788**
Total	Enplaned	8,428	8,587	10,201	12,027	14,129
	Deplaned	8,385	8,587	10,201	12,027	14,129
	Total	**16,813**	**17,174**	**20,402**	**24,054**	**28,258**

	Aircraft Operations					
Type	**Direction**	**2000**	**2005**	**2010**	**2015**	**2020**
Air Carriers	Departures	77	79	95	107	127
	Arrivals	77	79	95	107	127
	Total	**154**	**158**	**190**	**214**	**254**
Commuter Carriers	Departures	80	81	89	94	101
	Arrivals	80	81	89	94	101
	Total	**160**	**162**	**178**	**188**	**202**
Non-Scheduled	Departures	101	106	110	114	119
	Arrivals	101	106	110	114	119
	Total	**202**	**212**	**220**	**228**	**238**
Total	Departures	255	266	292	315	347
	Arrivals	255	266	292	315	347
	Total	**510**	**532**	**588**	**630**	**694**

The resulting peak hour forecasts for passengers and operations for the Medium, High, and Low cases are shown in **Table II.3-24**. Peak hour passengers are forecast to increase from approximately 1,700 in 2000 to 3,417 in 2020 and peak hour operations are forecast to increase from 52 in 2000 to 75 in 2020 in the Medium growth case. The High growth case predicts 2020 peak hour activity will consist of 3,884 passengers and 81 operations. The Low growth case shows 2020 peak hour activity with 2,841 passengers and 69 operations.

II.3.7 Existing Role Master Plan Forecasts and FAA Forecast Comparison

Table II.3-25 shows both the T. F. Green Master Plan Existing Role Medium forecasts and the 2000 FAA TAF for the year 2015, the out-year for the TAF. The T. F. Green Master Plan forecasts are lower than the TAF, but are within the 10 percent threshold that the FAA requires of a Master Plan forecast in order to be accepted by the FAA. The difference in forecasted levels of passenger enplanements and aircraft operations is not unexpected. The Master Plan forecast methodology consists of a "traditional" regression analysis of regional and local economic and aviation variables that are believed to affect traffic at T. F. Green adjusted for several factors. The TAF forecasts consisted of a trend analysis of past T. F. Green traffic within a framework of the national and regional aviation system and are typically less airport specific.

Table II.3-25
COMPARISON OF MEDIUM CASE MASTER PLAN FORECASTS AND FAA TAF FORECASTS
T. F. Green Airport

Forecast	Year	Master Plan	TAF	% Difference
Passenger Enplanements	2015	4,555,400	5,022,329	-9.30%
Commercial Operations	2015	139,180	145,600	6.03%
Total Operations	2015	206,520	207,500	4.79%

Both methods incorporated assumptions about the "extra normal" traffic growth at the airport since 1996 and at what point growth would return to "normal" levels. In discussions with personnel within the forecasting branch of Aviation Policy and Plans at the FAA, it was ascertained that the FAA's most recent published TAF are more aggressive than the Existing Role forecasts in its view of the duration of "extra normal" growth rates. However, it is expected that the annual TAF update to be published early in 2002 will be less aggressive due to reductions in forecasts of national economic growth rates, which would narrow the difference between the two forecasts.

Table II.3-24
PEAK HOUR FORECASTS
T. F. Green Airport

MEDIUM CASE						
	Passengers					
Type	**Direction**	**2000**	**2005**	**2010**	**2015**	**2020**
Air Carriers	Enplaned	967	1,083	1,331	1,640	1,996
	Deplaned	850	957	1,177	1,450	1,765
	Total	1,535	1,724	2,120	2,611	3,179
Commuter Carriers	Enplaned	130	155	186	192	207
	Deplaned	129	155	186	192	207
	Total	214	255	306	316	342
Total	Enplaned	1,081	1,200	1,472	1,782	2,147
	Deplaned	976	1,110	1,361	1,648	1,985
	Total	1,701	1,911	2,343	2,836	3,417

	Aircraft Operations					
Type	**Direction**	**2000**	**2005**	**2010**	**2015**	**2020**
Air Carriers	Departures	10	11	14	16	19
	Arrivals	9	10	12	15	17
	Total	16	18	22	26	31
Commuter Carriers	Departures	9	10	11	11	12
	Arrivals	9	10	11	11	12
	Total	16	17	19	20	22
Non-Scheduled	Departures	11	12	12	13	13
	Arrivals	12	12	13	13	14
	Total	20	21	22	23	24
Total	Departures	28	30	34	37	41
	Arrivals	30	32	36	39	44
	Total	51	55	61	67	75

Note: The enplaned, deplaned, and total peak hours do not necessarily occur in the same hour. The departures, arrivals, and total peak hours do not necessarily occur in the same hour. Air carrier, commuter, and non-scheduled peak hours do not necessarily correspond to the same hour.

Table II.3-24 (Continued)
PEAK HOUR FORECASTS
T. F. Green Airport

HIGH CASE						
	Passengers					
Type	**Direction**	**2000**	**2005**	**2010**	**2015**	**2020**
Air Carriers	Enplaned	967	1,184	1,500	1,854	2,291
	Deplaned	850	1,047	1,326	1,639	2,026
	Total	1,535	1,885	2,389	2,953	3,649
Commuter Carriers	Enplaned	130	167	178	201	210
	Deplaned	129	167	178	201	210
	Total	214	275	294	332	346
Total	Enplaned	1,081	1,310	1,633	2,002	2,441
	Deplaned	976	1,212	1,510	1,851	2,257
	Total	1,701	2,086	2,599	3,186	3,884

	Aircraft Operations					
Type	**Direction**	**2000**	**2005**	**2010**	**2015**	**2020**
Air Carriers	Departures	10	12	15	18	22
	Arrivals	9	11	14	16	20
	Total	16	20	24	29	35
Commuter Carriers	Departures	9	11	11	12	13
	Arrivals	9	11	11	12	13
	Total	16	19	19	21	23
Non-Scheduled	Departures	11	12	12	13	13
	Arrivals	12	12	13	13	14
	Total	20	21	22	23	24
Total	Departures	28	32	35	39	45
	Arrivals	30	34	38	42	47
	Total	51	58	64	71	81

Note: The enplaned, deplaned, and total peak hours do not necessarily occur in the same hour. The departures, arrivals, and total peak hours do not necessarily occur in the same hour. Air carrier, commuter, and non-scheduled peak hours do not necessarily correspond to the same hour.

Table II.3-24 (Continued)
PEAK HOUR FORECASTS
T. F. Green Airport

LOW CASE						
	Passengers					
Type	**Direction**	**2000**	**2005**	**2010**	**2015**	**2020**
Air Carriers	Enplaned	967	967	1,150	1,371	1,629
	Deplaned	850	854	1,017	1,212	1,440
	Total	1,535	1,539	1,832	2,184	2,594
Commuter Carriers	Enplaned	130	154	180	195	208
	Deplaned	129	154	180	195	208
	Total	214	254	297	321	343
Total	Enplaned	1,081	1,085	1,289	1,519	1,785
	Deplaned	976	1,003	1,192	1,405	1,651
	Total	1,701	1,727	2,051	2,418	2,841

	Aircraft Operations					
Type	**Direction**	**2000**	**2005**	**2010**	**2015**	**2020**
Air Carriers	Departures	10	10	12	14	16
	Arrivals	9	9	11	12	15
	Total	16	16	20	22	26
Commuter Carriers	Departures	9	10	10	11	12
	Arrivals	9	10	10	11	12
	Total	16	17	18	19	21
Non-Scheduled	Departures	11	12	12	13	13
	Arrivals	12	12	13	13	14
	Total	20	21	22	23	24
Total	Departures	28	29	32	34	38
	Arrivals	30	31	34	37	40
	Total	51	52	58	62	69

Note: The enplaned, deplaned, and total peak hours do not necessarily occur in the same hour. The departures, arrivals, and total peak hours do not necessarily occur in the same hour. Air carrier, commuter, and non-scheduled peak hours do not necessarily correspond to the same hour.

II.4 Augmented Market Share Scenario

This section discusses potential future activity levels under the "Augmented Market Share" scenario. The Existing Role forecasts call for the evolutionary growth of traffic at the T. F. Green Airport while the airport continues to fulfill its existing role. In contrast, the Augmented Market Share scenario calls for an expanded role for T. F. Green, particularly for residents and visitors of Massachusetts. As with the Existing Role forecasts, this scenario does not consider facility constraints. For purposes of estimating demand for air travel, it assumes facilities (i.e. supply) can be provided to meet demand. Facility constraints are considered in Section II.5 of this chapter, *Capacity Constrained Scenarios*.

The Augmented Market Share scenario was developed in response to input from the SRC. At the July SRC meetings, members identified factors that influence growth. Many of these factors (such as increased marketing, ticket prices at T. F. Green, the future Warwick rail station, congestion at Boston Logan Airport, etc.) were included in this analysis.

In its new role with the Augmented Market Share scenario, T. F. Green would be viewed as a true regional gateway for both traditional and low-fare service. Although it would remain considerably smaller than Boston Logan in virtually all respects, it would be viewed as comparable to Boston Logan. It would serve as the "airport of choice" for the southern New England Region. It would capture a volume of traffic that reflects its "fair share" of the regional total, a level that is commensurate with the population, income, and economic activity of the areas closest to T. F. Green. These Augmented Market Share conditions imply a greater level of passenger and aircraft operations activity at the airport. The assumptions, methodology and results for this scenario are described in the sections that follow.

II.4.1 Socioeconomic Rationale

Under this scenario, it is assumed that the dynamics of airport choice in southern New England would change in favor of greater use of reliever facilities for Boston Logan Airport. The behavior of the region's residents and visitors could change for the following reasons:

- The population growth of Rhode Island and southern Massachusetts is leading to the fusion of the Boston-Providence-Warwick axis into a single, integrated urban community.
- The growth of technology-oriented industries in southern Massachusetts could spread into Rhode Island, significantly boosting the manufacturing base, placing new travel-intensive activity close to T. F. Green, and bringing affluent residents to the region.

- Growing congestion and delays at Boston Logan Airport could encourage many more southern Massachusetts residents to make T. F. Green the airport of choice for both traditional and low-fare service than do so today.
- While the "big dig" construction in Boston is only temporary, surface access to the Boston Logan Airport may remain difficult. The contrast with the faster access to T. F. Green could encourage residents of southern Boston to use other airports.
- Massport could increase its encouragement of the use of reliever airports (including increased advertising and billboards).
- Improved surface transportation, particularly the Warwick railroad station, could stimulate use of T. F. Green. (It should be noted that rail-air connecting activity at other U.S. airports remains modest to date.)

II.4.2 Annual Domestic Traffic Forecasts

The Augmented Market Share scenario domestic traffic forecast was developed according to the following methodology:

- Information was collected on population, income, employment, and economic activity for Rhode Island, and selected counties in Connecticut, Massachusetts and New Hampshire.
- An index of the domestic traffic generation capability for each county was developed. This index is based on population, total household income, non-farm private employment, and retail sales. Each component of the index is scaled to a 0-100 interval to eliminate any distortion resulting from the specific units.
- The index of each county is scaled to reflect the presence of other airports. The coefficients are halved for all counties closer to other airports than T. F. Green.
- The index for the state of Rhode Island is divided by the sum of all indices to determine the total percentage of southern New England traffic T. F. Green "ought" to capture.
- For every destination worldwide, O&D statistics were assembled for the total traffic exchanged with the region. This traffic was disaggregated according to the four regional airports (Boston Logan, T. F. Green, Manchester, and Worcester).
- For each point, the traffic currently served from T. F. Green was compared to the target value. The difference was summed to obtain the total incremental traffic T. F. Green would capture under the Augmented Market Share case.
- In some cases, T. F. Green's current traffic exceeded the target. This excess was subtracted from the incremental component.
- Each destination was considered, along with the possibility that it could become a candidate for nonstop service from T. F. Green.

This methodology required several assumptions on market behavior:

- The analysis excluded the Nantucket, Martha's Vineyard, Provincetown, Portsmouth, and New London airports. Although these airports currently have scheduled flights, the nature of their service does not place them in direct competition with T. F. Green for the region's traffic.
- The Bradley International Airport was not considered a major competitor to T. F. Green in vying for traffic currently using the Boston Logan Airport.
- It is assumed that the region has fully recognized and adjusted to service by Southwest Airlines at T .F. Green and Manchester. There will be no change in customer behavior regarding Southwest, and no further redistribution of traffic from other airlines to Southwest. The redistribution between airports will involve only non-Southwest Airlines traffic. The behavioral changes modeled by the Augmented Market Share scenario thus represent only new attitudes to accessing traditional airlines at different region airports.
- There will be no change in the distribution of traffic among certain destinations from T. F. Green for which Southwest Airlines is especially strong. These include Baltimore, Tampa, Jacksonville, Phoenix, Orlando, Nashville, Kansas City, Houston-Hobby, Chicago Midway, and Islip.
- There will be no change in the distribution of traffic for the Washington National and New York LaGuardia markets, for which Boston Logan has particularly strong service. The Shuttle services are considered to be unique and strictly dependent on the Boston Logan Airport.
- There will be no change in the distribution of traffic for all destinations in Europe, the Middle East, Africa, and the Far East. Passengers will continue to favor Boston Logan overwhelmingly because of its extensive international service. It is assumed that Boston Logan will obtain nonstop service to the Far East during the forecast period. Other regional airports will retain their existing shares of this traffic, but there will be no redistribution.
- Any traffic redistributed to T. F. Green under the Augmented Market Share scenario will grow at the rates forecast by the FAA's TAF.
- Load factors and fleet mix will be similar to those of the Existing Role scenario.

Table II.4-1 shows the components of each county's index that was developed for this analysis. The state of Rhode Island accounts for 18 percent of the total, which represents its appropriate share of the region's air traffic. According to the DOT's traffic statistics, in the year 2000 T. F. Green captured 62.9 percent of the region's Southwest Airlines traffic, but only 13.8 percent of the non-Southwest domestic traffic.[21] The Augmented Market Share scenario calls for increasing T. F. Green's share of the latter to 18 percent. It calls for a similar share of traffic for certain international markets that lack nonstop service from any regional airports.

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[21] United States Department of Transportation Database 1B, Year Ending December 31, 2001

Table II.4-1
DEVELOPMENT OF T. F. GREEN MARKET SHARE TARGET
T. F. Green Airport

State	County	Population	Households	Persons/ Household	Median Household Income	Private Nonfarm Employment	Retail Sales	Weight	Index
Connecticut	New London	259,088	99,835	2.48	44,566	103,413	2,405,028	0.5	31.16
	Windham	109,091	41,142	2.56	41,108	29,391	695,807	0.5	10.82
Massachusetts	Barnstable	222,230	94,822	2.28	40,791	66,257	2,518,765	1.0	53.93
	Bristol	534,678	244,358	2.51	38,866	195,504	5,158,712	1.0	128.74
	Dukes	14,987	6,421	2.30	40,852	4,794	207,564	1.0	3.94
	Essex	723,419	275,419	2.57	44,187	268,252	6,156,185	0.5	83.35
	Middlesex	1,465,396	561,220	2.52	53,268	787,896	14,462,076	0.5	200.00
	Nantucket	9,520	3,699	2.37	48,151	3,905	195,712	1.0	3.09
	Norfolk	650,308	248,827	2.54	54,528	326,590	7,332,919	0.5	90.96
	Plymouth	472,822	168,361	2.74	49,165	142,940	4,895,904	1.0	111.95
	Suffolk	689,807	278,722	2.34	36,260	539,259	4,842,469	0.5	91.40
	Worcester	750,963	283,927	2.56	40,489	287,961	6,231,700	0.5	84.67
New Hampshire	Belknap	56,325	22,459	2.45	38,787	20,889	713,788	0.5	7.17
	Hillsborough	380,841	144,455	2.58	46,650	176,318	4,927,048	0.5	52.49
	Merrimack	136,225	51,843	2.51	43,679	51,764	1,500,710	0.5	16.91
	Rockingham	277,359	104,529	2.63	54,161	114,513	4,218,787	0.5	40.79
	Strafford	112,233	42,581	2.50	39,969	39,309	1,020,041	0.5	12.70
Rhode Island	Rhode Island	1,048,319	408,424	2.47	36,699	402,485	7,505,754	1.0	224.66
Total									1,248.73

Source: U.S. Bureau of the Census

Table II.4-2 shows the resulting forecasts of annual traffic through 2020. The forecasts use the same growth rates as the FAA's TAF for the Boston Logan Airport.[22] Annual domestic operations forecasts were derived from the passenger forecasts and the current T. F. Green fleet mix, excluding Cape Air and Southwest Airlines. This scenario results in 7.1 million annual domestic passengers by 2005, increasing to 12.3 million by 2020. By 2005, this scenario calls for 126,620 annual domestic operations, increasing to 186,310 operations in 2020.

Table II.4-2
ANNUAL DOMESTIC FORECASTS
T. F. Green Airport

Year	Passengers	Operations
2000	5,397,121	95,320
2005	7,143,900	126,620
2010	8,637,400	145,240
2015	10,323,100	163,010
2020	12,297,600	186,310
Average Annual Compound Growth Rate		
2000-2005	5.8%	5.2%
2005-2010	3.9%	0.8%
2010-2015	3.6%	0.7%
2015-2020	3.6%	0.8%
2000-2020	4.2%	1.8%

II.4.3 Annual International Traffic Forecasts

The Existing Role scenario includes a modest level of international charter activity at T. F. Green in the future. It assumes tour wholesalers such as GWV and TNT would establish service to complement their existing offerings at Boston Logan, and serve selected high volume destinations. However, the growing congestion at Boston Logan may require administrative action to shift certain operations to other airports in the region. This section considers the impact of policies that would transfer international charter service from Boston Logan to T. F. Green.

As the integration of the New England economy continues, regional planners are beginning to view the airports in New England as a multi-airport system rather than a set of independent entities. Recently, representatives from the New England states convened the New England Regional Transportation Summit to map a comprehensive strategy for the region. In addition to Boston Logan, the regional airport system is

22 The growth rates are very conservative. The FAA's forecasts already assume spillage of traffic resulting from congestion and delays at Boston Logan.

generally considered to include T. F. Green Airport in Rhode Island, Manchester Airport in New Hampshire, Worcester Airport in central Massachusetts, and Hanscom Field in Bedford, Massachusetts.

An important conclusion of the summit was that the regional airport system could be used to relieve pressure on Boston Logan and to achieve a desired slowdown in overall growth at the airport. Several concepts have been suggested to implement this process. They include a downloading of general aviation operations to Hanscom Field, the use of Worcester Airport as a reliever airport to Boston Logan for scheduled service, and the transfer of charter operations currently at Boston Logan to other airports. T. F. Green Airport may be an excellent candidate to be an international charter reliever for Boston Logan for the following reasons:

- The international charter operations at Boston Logan must use the FIS facilities which are becoming increasingly congested.
- The airport is the only regional airport that has a FIS facility available to accommodate customs and immigration for international flights.
- The airport has convenient and efficient highway access from Boston and is less than an hour away from Boston by car.
- The new Warwick train station will provide even greater access to T. F. Green with direct commuter rail service to Boston.
- T. F. Green is already a potential destination for international charter carriers and is strategically located near many tourist attractions in southeast Massachusetts and southern Rhode Island.

The extent to which any transfer of international charter service would occur from Boston Logan to T. F. Green is difficult to quantify. Important questions that need to be asked include:

- If an actual policy to restrict charter activity is enacted will it consist of an outright ban or use incentives/disincentives to move carriers to other airports?
- What share of the transferred activity will T. F. Green attract versus other regional airports?
- How many of the charter carriers will simply stop serving the region?
- How large will the international charter market to New England be in future years?

Rather than attempt to answer these questions, this analysis predicts the maximum charter activity that could be transferred to T. F. Green in the future. The extent to which T. F. Green would capture this traffic is unknown and this scenario represents the maximum upper limit of international charter activity that could be expected at T. F. Green Airport.

The New England international charter market consists primarily of service to the Caribbean and Mexico to meet the demand of tourists in the winter months. As shown in **Table II.4-3**, Boston Logan processed 561,481 charter passengers to the Azores, the Caribbean, and Mexico in 2000. A further 6,079 passengers traveled to and from several points in Europe. Due to the low volume of trans-Atlantic charter service, it is assumed that this type of service would continue to rely on Boston Logan.

A regression model was developed to project the future growth of international Boston charter traffic to the Caribbean and Mexico that could potentially relocate to T. F. Green. The model used expected growth rates of total U.S. domestic traffic to Mexico/Caribbean to grow the base year (2000) charter traffic at Boston Logan. The model consisted of the following:

- The dependent variable was the total annual passengers from the U.S. to the Caribbean and Mexico. Historical data was obtained from the International Trade Administrations *U.S. International Air Travel Statistic Report* years 1975 to 2000.
- The explanatory variables consisted of U.S. GDP and the average yield of international service to and from the U.S. Historical data was obtained from the FAA and Department of Commerce.
- The model was transformed to a double log specification. This implies a "constant elasticity" relationship in which a percentage change in either GDP or yield leads to a constant percentage change in traffic.

The regression results showed a strong historical relationship, in which economic growth promotes charter traffic but high fares/yields constrain it. In order to forecast future years, forecasts of explanatory variables were superimposed on the model. GDP forecasts were obtained from DRI-WEFA Group, while international yield projections were obtained from the FAA's 2000 Fiscal Year Aerospace Forecasts. Finally, the growth rates of the U.S. to Caribbean/Mexico forecasts were applied to base year international charter traffic at Boston Logan.

Operations forecasts were based on the passenger forecasts and the average load factor of flights in the base year 2000. The load factor was assumed to stay constant throughout the forecast period.

Table II.4-4 provides the resulting international passenger and operations forecasts of Boston Logan charter activity that could relocate to T. F. Green. This analysis predicts 1,326,500 international passengers and 20,180 operations at T. F. Green in 2020. This activity represents the uppermost potential of international charter growth for T. F. Green.

Table II.4-3
ANNUAL INTERNATIONAL CHARTER PASSENGERS AT BOSTON LOGAN INTERNATIONAL AIRPORT
Year Ending December 31, 2000

Destination	Airline	Inbound and Outbound Passengers	
		By Airline	Destination Total
Antigua	Sky Trek Intl	338	
	Allegro	3,903	4,241
Aruba	Sky Trek Intl	173	
	Allegro	29,432	
	Miami Air Intl	93	
	American TransAir	421	
	Omni Air Express	227,389	
	North American	17,505	275,013
Bermuda	Omni Air Express	3,564	3,564
Cancun	Allegro	24,268	
	Miami Air Intl	1,303	
	Sun Country	9,243	
	Omni Air Express	102,900	
	North American	18,842	156,556
Cozumel	Allegro	2,376	2,376
Curacao	Allegro	82	
	Miami Air Intl	152	234
Dublin	Omni Air Express	342	342
Freeport	Allegro	7,774	7,774
International via U.S.	Allegro	8,034	8,034
Keflavik	North American	203	203
Liberia, Costa Rica	Allegro	2,035	
	North American	210	2,245
Manston, UK	World	322	322
Martinique	Allegro	82	82
Montego Bay	Sky Trek Intl	5,097	
	Allegro	468	
	Champion Air	475	
	Miami Air Intl	168	
	Planet Airways	1,154	
	Pan American	4,008	
	Sunworld Intl	2,193	
	Sun Country	9,966	
	Trans Meridian	1,965	
	North American	4,047	
	Pan American	142	
	Other	1,809	31,492

Table II.4-3 (Continued)
INTERNATIONAL CHARTER PASSENGERS AT BOSTON LOGAN INTERNATIONAL AIRPORT
Year Ending December 31, 2000

Destination	Airline	Inbound and Outbound Passengers	
		By Airline	**Destination Total**
Nassau	Sky Trek Intl	2,930	
	Allegro	3,038	
	Other	121	
	Miami Air Intl	1,326	
	Omni Air Express	3,798	11,213
Ponta Delgada	North American	4,367	4,367
Port of Spain	North American	163	163
Providenciales	Allegro	6,080	
	Miami Air Intl	1,416	
	Sun Country	4,605	
	North American	711	12,812
Puerto Plata	Sun Country	6,143	6,143
Punta Cana	Sky Trek Intl	962	
	Allegro	8,177	
	Miami Air Intl	421	
	Planet Airways	77	
	North American	615	
	Other	151	10,403
Rome	American TransAir	358	358
San Jose	North American	608	608
Santa Maria, Azores	North American	1,060	1,060
Santo Domingo	Allegro	4,011	
	Sun Country	503	
	North American	485	4,999
Shannon	American TransAir	4,581	
	Omni Air Express	197	
	North American	76	4,854
St. Kitt's	Allegro	1,069	
	Champion Air	342	
	Pan American	276	1,687
St. Lucia	Sun Country	289	
	North American	7,839	8,128
St. Maarten	Allegro	228	
	Pan American	131	
	Sun Country	604	
	North American	7,324	8,287
Total Azores, South		**561,481**	**561,481**
All Points		**567,560**	**567,560**

Source: United States Department of Transportation Database 28IM, Year Ending December 31, 2000. Note these totals may include certain passengers boarding at other gateways.

Table II.4-4
ANNUAL INTERNATIONAL FORECASTS
T. F. Green Airport

Year	Passengers	Operations
2000	33,817	1,844
2005	755,000	12,010
2010	925,100	14,530
2015	1,109,300	17,150
2020	1,326,500	20,180
Average Annual Compound Growth Rate		
2000-2005	86.1%	45.5%
2005-2010	4.1%	3.9%
2010-2015	3.7%	3.4%
2015-2020	3.6%	3.3%
2000-2020	20.1%	12.7%

II.4.4 Summary of Annual Augmented Market Share Forecasts

As shown in **Table II.4-5**, the Augmented Market Share scenario would result in over 13.6 million annual passengers by 2020. This scenario also results in 206,500 annual operations by 2020.

Table II.4-5
SUMMARY OF ANNUAL FORECASTS
T. F. Green Airport

	Passengers			Operations		
Year	Domestic	International	Total	Domestic	International	Total
2000	5,397,121	33,817	5,430,938	95,320	1,844	97,164
2005	7,143,900	755,000	7,898,900	126,620	12,010	138,630
2010	8,637,400	925,100	9,562,500	145,240	14,530	159,770
2015	10,323,100	1,109,300	11,432,400	163,010	17,150	180,160
2020	12,297,600	1,326,500	13,624,100	186,310	20,180	206,490
Average Annual Compound Growth Rate						
2000-2005	5.8%	86.1%	7.8%	5.8%	45.5%	7.4%
2005-2010	3.9%	4.1%	3.9%	2.8%	3.9%	2.9%
2010-2015	3.6%	3.7%	3.6%	2.3%	3.4%	2.4%
2015-2020	3.6%	3.6%	3.6%	2.7%	3.3%	2.8%
2000-2020	4.2%	20.1%	4.7%	3.4%	12.7%	3.8%

II.4.5 Peak Period Forecasts

The increase in traffic in the Augmented Market Share scenario annual forecasts will increase PMAD and peak hour passenger and operations forecasts. PMAD forecasts were derived directly from the Augmented Market Share scenario annual passenger and operations forecasts. The ratio of traffic in the peak month (August) to annual traffic developed in the Existing Role forecasts was multiplied by the number of estimated annual passengers or operations and divided by 31.

Peak hour forecasts were derived from the PMAD forecasts and an analysis of 2001 August T. F. Green schedules, as in the Existing Role analysis. In this case, the T. F. Green schedule analysis did not include Southwest and Cape Air Operations because the increase in traffic with the Augmented Market Share scenario is based on non-Southwest and non-Cape Air traffic. Thus, the peak hour ratios for passengers and operations differed from the Existing Role peak hour analyses.

Table II.4-6 and **Table II.4-7** show the PMAD and peak hour forecasts for the Augmented Market Share forecasts. This analysis results in 42,181 PMAD passengers and 998 operations by 2020. The Augmented Market Share scenario predicts that 2020 peak hour activity will contain 4,269 passengers and 101 operations.

Table II.4-6
PMAD FORECASTS
T. F. Green Airport

	Passengers				
Direction	**2000**	**2005**	**2010**	**2015**	**2020**
Enplaned	8,428	12,228	14,801	17,698	21,090
Deplaned	8,385	12,228	14,801	17,698	21,090
Total	**16,813**	**24,456**	**29,602**	**35,396**	**42,180**

	Operations				
Direction	**2000**	**2005**	**2010**	**2015**	**2020**
Departures	262	359	403	446	499
Arrivals	262	359	403	446	499
Total	**524**	**718**	**806**	**892**	**998**

Table II.4-7
PEAK HOUR FORECASTS
T. F. Green Airport

	Passengers				
Direction	**2000**	**2005**	**2010**	**2015**	**2020**
Enplaned	1,081	1,632	1,971	2,351	2,796
Deplaned	976	1,461	1,767	2,110	2,512
Total	1,071	2,477	2,998	3,583	4,269

	Operations				
Direction	**2000**	**2005**	**2010**	**2015**	**2020**
Departures	29	41	47	52	57
Arrivals	30	46	52	57	65
Total	52	72	81	90	101

Note: The enplaned, deplaned, and total peak hours do not necessarily occur in the same hour. The departures, arrivals, and total peak hours do not necessarily occur in the same hour.

II.5 Capacity Constrained Scenarios

Earlier sections of this chapter (II.3 and II.4) projected the number of people who would want to travel in the future at T. F. Green; those forecasts considered the market-driven demand for air travel assuming a continuation of the airport's existing role and also with an expanded role. Those forecasts are purely market-driven or "unconstrained" and as such do not take facility constraints or other environmental or community constraints into consideration. They assume that facilities can be provided to meet demand.

This section examines options available to reduce activity or to artificially keep the market-driven demand from materializing at T. F. Green, and then calculates what the resulting air travel demand at T. F. Green would be within the 20-year planning horizon. The capacity constrained scenarios listed below were considered in response to requests by the SRC as discussed in Section II.1, *Introduction,* and depicted on Exhibit II.1-1:

- No New Flights: This analysis considers limiting future activity at T. F. Green Airport to year 2000 levels through government or airport operator restrictions.
- Reduce Facilities: This section considers future activity levels if the current facilities are reduced. Possible options include reducing the length of Runway 16-34 or the closure of Runway 5L-23R.
- No New/Additional Facilities: This section examines future activity levels if the existing airfield, terminal, and landside facilities are not expanded.
- Some Level of Facility Improvement: This analysis considers the impact if some level of facility improvements are implemented.

This analysis contains some discussion of potential impacts and benefits of the scenarios in order to provide context. A detailed evaluation of scenarios will be provided in Chapter IV, *Alternatives*, and in the concurrent Environmental Impact Statement (EIS).

The prediction of air travel demand over a 20-year period is typically based on assumptions about a variety of aviation industry factors, as well as future economic conditions of the air service region. For each of these factors, data is typically available so that changes in factors can be translated into easier adjustments to the predictions. This is an acceptable methodology that is typically used in a master plan forecast. However, forecasts rarely predict actual activity exactly, rather they predict future trends.

Predicting the future reaction of the airlines and the traveling public to facility constraints or "quality of life" factors is more difficult, partially because a lack of measurable data exists on how these factors and constraints could affect decisions to use the airport. People want and need to fly in order to participate in the emerging global economy, and to enjoy quick, affordable access to recreational destinations. The airport is a place that accommodates the demand for air travel – it does not necessarily create the demand. The airlines literally provide the vehicle in which to accomplish the use of air transportation as one mode of travel. They operate in a competitive market place and like most businesses, are largely free to decide how to respond to demand for their services in a given market. Similarly, the traveling public is free to decide how it wishes to go about traveling – by air, ground, or water transportation. Therefore, all discussions of how facilities (or their limitations) might affect air travel demand and actual activity levels, is ultimately speculative. The analysis contained in this section is based on RIAC's consultants' research, industry experience, and professional judgement on what is likely to occur.

Before a discussion of facility constraints and potential limitations to growth can be initiated, it is important to understand the existing utilization of the airport's facilities. As shown in **Table II.5-1**, T. F. Green's airfield is operating at approximately 58 percent of its capacity, the terminal is operating at 81 percent, and the landside at 68 percent.

Table II.5-1
EXISTING FACILITY UTILIZATION
T. F. Green Airport

Airport Element	Current Capacity (Passengers)	Current Demand (Passengers)	Approximate Utilization
Airfield	9,307,900	5,430,900	58%
Terminal	6,701,400	5,430,900	81%
Landside	7,997,600[1]	5,430,900	68%

[1] Based on key airport intersections along Post Road.

Because this analysis looks at the likely effects of constraints to various facilities, the capacity of those facilities needs to be compared to a level of demand. While RIAC has not adopted a forecast on which it will base its planning, the demand forecast that is most likely to occur, the Medium growth case Existing Role forecast, was used for purposes of comparing demand to capacity.

II.5.1 No New Flights

This scenario would limit future activity at T. F. Green Airport to year 2000 levels (approximately 5.4 million passengers and 155,600 aircraft operations annually). This would be achieved by not allowing any additional air service by the passenger and cargo airlines and by freezing activity by the other users of the airport (i.e. zero new activity).

The main issue in this scenario is the method used to stop future growth. The airlines will not voluntarily stop adding service to an airport, so long as it is profitable for them to operate. Airline service, in general, is not based upon the particular needs of any one airport or its host communities, but on the overall airline system. An airline may modify the type of aircraft it uses, time of operation, the number of flights per day, or fares for competitive reasons, cost, profit, or positioning of their aircraft in their network structure. Airlines will strive to provide the service (frequency, times of operation) that their customers (the passengers) want.

T. F. Green has been experiencing strong growth since the introduction of low fare Southwest service in 1996, which stimulated demand. While the rate of growth in air service is anticipated to slow down over the planning horizon, there is still expected to be an increase in the total number of people who will want to travel using T. F. Green (2000 passengers are expected to approximately double over the 20-year planning horizon).

Given that airlines, as businesses, will tend to add service where there is growth in demand, the following sections examine the jurisdiction of government and airport operators in controlling the level of activity at an airport.

Government Limitations on New Flights

Before limits on activity by the government can be considered, government regulation of U.S. airports must be briefly discussed. The Federal government had the jurisdiction to regulate domestic airline fares, routes, and schedules from the 1930s to 1978. The Airline Deregulation Act of 1978 eliminated these regulatory functions domestically in order to promote a competitive market for airline services. This act also specifically precluded other levels of government, including states, from imposing regulations on airlines and service which are considered part of interstate commerce.

Exceptions to deregulation of air service consist of regulations instituted prior to the Deregulation Act in 1978 by the FAA at certain heavily-congested airports in the U.S. The FAA adopted the High Density Rule (or slot rule) at five airports in 1968 that limited the number of operations during peak hours. The slot rule was established to better regulate traffic flows. Contrary to public opinion, the slots were not established as a capacity regulator or for noise abatement. The slot rule was intended to be "temporary" but has lasted over 30 years at Chicago O'Hare, LaGuardia, JFK, and Washington National (the slot rule was suspended at Newark in 1970). These airports are all large hub airports with high delays.

Congress has recently begun to implement elimination of the slot system. The Wendall H. Ford Aviation Investment and Reform Act (AIR-21), which was signed into law April 5, 2000, directed the FAA to eliminate slots at Chicago O'Hare and New York's LaGuardia and JFK Airports in order to increase competition and provide service to underserved markets and cities. At Washington National, additional slot exemptions were to be granted based on this bill. The first airport to ease slot rule restrictions was LaGuardia. The response from the airlines was to add many new flights. Operations increased 29 percent from December 1999 to December 2000, causing airport delays to skyrocket. In response, the FAA in December of 2000 re-established certain temporary slot restrictions (which expire on September 15, 2001) at LaGuardia in order to control delays. Since April of 2000, restrictions at Chicago O'Hare have been lifted for international flights and for service to smaller markets. AIR-21 directed that all slot restrictions be eliminated by July 1, 2002 at O'Hare, and by January 1, 2007 at LaGuardia and JFK airports.

There are other mandatory operating restrictions in place at U.S. airports in addition to the slot rule. LaGuardia and Washington National are subject to the so-called Perimeter Rule which prohibits service to/from cities beyond a certain distance. There are a few other airports in the U.S. that have operating restrictions. These operating restrictions have been implemented in response to unique circumstances at these airports. For example, Congress enacted the Wright Amendment to restrict scheduled passenger aircraft size and markets served from Love Field to ensure the success of the then new Dallas Fort Worth Airport.

In addition, local governments have implemented restrictions at a few other airports in the U.S. One such example is Long Beach, California. Long Beach approved a noise control ordinance in 1981 that capped the number of daily airline departures. However, due to the Code of Federal Regulations, FAR Part 161 (Notice and Approval of Airport Noise and Access Restrictions), which was enacted in 1991, local governments no longer have the power to enact such restrictions without the support of the airport operator and approval from the FAA. The state of Rhode Island operates the T. F. Green Airport and has more power than local governments to control activity at an airport. The Part 161 process and airport operator control of activity will be discussed in the next section, *Airport/Airport Operator Limitations on New Flights*.

There is no precedent for the government to implement restrictions at an airport such as T. F. Green. T. F. Green is not of the size of the larger airports with slot rules, is not a connecting hub, and has infrequent delays compared to the larger hub airports. In light of the current deregulation environment and the desire of Congress to enhance competition and provide service to underserved markets, it is unlikely that the FAA or Congress will implement restrictions on service at T. F. Green. In addition, local governments have no jurisdiction to control the airlines or their air service.

Airport/Airport Operator Limitations on New Flights

There are at least four significant methods available to airport operators for limiting activity at an airport: (1) peak period pricing; (2) the use of other airports; (3) noise restrictions; and (4) limitations on general aviation traffic.

<u>Peak Period Pricing</u>

Although the Deregulation Act and AIR-21 prohibit states and municipalities from enacting laws or rules relating to air carrier prices, routes, or services, DOT and FAA have recently recognized a role for airports in managing congestion and delays. DOT's *Final Rates and Charges Policy*, issued in June 1996, authorizes airports to use a "properly structured peak pricing system that allocates limited resources using price during periods of congestion." However, major airports in the U.S. have thus far not adopted peak period pricing as a tool for managing delay and congestion and limiting operations in peak periods.

The use of peak period pricing would not enable RIAC to prohibit new flights or achieve zero future growth in activity at T. F. Green. This is because peak period pricing is not intended to limit the overall daily activity at an airport, but rather to limit activity during certain hours of the day with high traffic volumes. The purpose of peak hour pricing is to spread activity more evenly throughout the day.

In addition, while the new charges would be passed on to the passengers and higher fares in peak periods could certainly discourage some leisure travelers, business travelers would be less likely to respond to price changes. The timing of travel is often times more important to a business traveler than price. For these reasons, peak period pricing may allow RIAC to encourage the airlines to shift some traffic out of peak periods, but it would not directly limit the number of flights at T. F. Green.

Use of Other Airports

Air travelers in New England have their choice of airports. The largest airport in the region is Boston Logan, which offers extensive long-haul domestic and international service, but is becoming increasingly congested. Other airports in the region include Manchester Airport in New Hampshire, Worcester Airport in central Massachusetts, and Hanscom Field in Bedford, Massachusetts.

There are ongoing regional planning efforts in New England to determine what the optimal roles are for the region's airports. One involved organization is Fly New England, which attempts to market the region's airports as a whole, rather than each independently. Rhode Island is participating in these efforts. In addition, the FAA maintains a Regional Aviation System Plan, which is soon to be updated. The FAA's efforts have been coordinated with each of the six New England states in a cooperative effort to relieve congestion at Boston Logan and to promote air transportation opportunities at each of the region's major airports (i.e. Manchester, Bradley, T. F. Green, Portland). Largely due to the overall air and ground transportation congestion in the Boston area, the FAA and the United States Environmental Protection Agency (USEPA) have supported regionalization efforts.

In addition, the Massachusetts Port Authority (Massport), a public authority which develops, promotes, and manages airports in that state, has developed its own regionalization strategy. This strategy was developed in response to increasing congestion at Boston Logan and it encourages the use of T. F. Green, Manchester, and other New England regional airports instead of Boston Logan. According to Massport's own 1999 passenger survey, "service expansion at other regional airports, particularly the Manchester and T. F. Green/Providence Airports, is diverting passengers from the areas outside of Metropolitan Boston away from Boston Logan Airport." Similar to T. F. Green, Manchester and Bradley airports have experienced recent growth in passenger activity in response to strong economic conditions and favorable airline service. With Massport's new operating agreement at Worcester, a limited amount of further traffic might be channeled to Worcester.

RIAC could enact its own regionalization strategy by encouraging passengers to use Worcester, Hanscom, and Manchester. However, it is unlikely that a significant amount of demand will shift to these airports, given the low-cost air service provided at T. F. Green and the airlines continuing to provide convenient service. Most importantly, passengers generally choose their airport based on proximity to their home or business or based on price. Boston Logan's extreme congestion makes other airports, such as T. F. Green, viable alternatives. Therefore, it is unlikely that significant numbers of T. F. Green passengers would use other airports.

The five other Rhode Island airports, North Central, Quonset, Newport, Westerly, and Block Island, are not capable of providing the necessary facilities to accommodate T. F. Green's current or future demand. None of the airports, with the exception of Quonset, has runways longer than 5,000 feet (considered to be a minimum runway length for even corporate jet aircraft. Passenger and cargo airlines require more than

6,000 feet in order to safely operate to the destinations served at T. F. Green), and none contain enough land to duplicate the facilities, infrastructure, and services currently found at T. F. Green. While Quonset Airport has a 7,500-foot runway, access to the airport currently winds through residential and commercial areas, and could not be developed comparable to the ease of access provided by the I-95 Airport Connector.

Similarly, development of terminal and airfield facilities, as well as utility infrastructure to accommodate current T. F. Green demand for air carrier service at Quonset would require many years of environmental studies and approvals, planning, design and construction, and it is unlikely that the state of Rhode Island nor the airlines and its passengers could afford the cost of dismantling T. F. Green's facilities and reconstructing them at Quonset. In addition, the substantial investments of the state and the airlines into T. F. Green's facilities over time cannot be overlooked. Experience has shown that the airlines would be unlikely to voluntarily move to a new airport which requires substantial infrastructure and facility development.

Noise Restrictions

There are various vehicles to try to minimize noise at an airport that are available to airport operators. Once such vehicle is the Part 150 process. This is a voluntary process that the airport undertakes with the community. The results of these studies provide recommendations on how to minimize noise and incompatible community land uses and to mitigate unavoidable noise impacts. A Part 150 study was completed for T. F. Green in 2000. The study resulted in recommendations to minimize noise impacts. It did not, however, result in restrictions on activity. The recommendations of a Part 150 process may be subject to an environmental review. A Part 150 study does not enable an airport operator to unilaterally restrict or limit activity at an airport. In order to implement such restrictions on activity, an airport operator must follow FAR Part 161. This policy was developed in response to the Airport Noise and Capacity Act of 1990.

When an airport operator is considering any mandatory restriction on access to an airport, Part 161 requires the operator to hold public hearings, gather and maintain documentation related to the restriction, conduct an environmental assessment, and provide public notice of the restrictions. The airport operator must demonstrate that the restriction does not create an undue burden on interstate or foreign commerce, that it maintains safe and efficient use of navigable airspace, and that it does not create an undue burden on the national aviation system. In addition, the airport operator must undertake a rigorous benefit-cost analysis to demonstrate that the benefits (in terms of noise reduction within the 65 DNL[23]) outweigh the costs of the restriction (to the airlines, the airport, and the local community's economy).

In the 11 years since FAR Part 161 has been established, there have been six such studies. San Jose and Flying Cloud Airports started Part 161 studies and consequently

[23] The Day-Night Average Sound Level (DNL) metric is currently the standard noise descriptor specified by the Federal government for transportation noise studies.

terminated them. San Francisco International Airport also started a Part 161 study but suspended the efforts based on an agreement with United Airlines. Three Part 161 studies are currently underway: Pease Air Force Base, Naples, and Burbank. The first two are attempting to impose restrictions only on certain aircraft types. At Burbank, airport officials are attempting to implement a mandatory nighttime curfew on all operations. None of these airports has yet been able to meet the stringent Part 161 criteria. The studies are lengthy due to the level of public involvement required and the level of detail needed for the noise analysis and the benefit-cost analysis.

There is no precedent for imposing a cap on operations at an airport in the U.S. In order to implement such a restriction at T. F. Green, Part 161 regulations would require that the study evaluate where those additional flights would be served. If the demand cannot be served at T. F. Green, it would be served at another airport and a Part 161 study would have to consider the impacts of these flights in a benefit-cost analysis. The benefits to the neighborhoods surrounding T. F. Green would need to be compared to the noise and other impacts at other airports.

An airport operator may be able to develop voluntary agreements with the airlines that restrict operations without going through the Part 161 process. T. F. Green already has a voluntary curfew in effect from midnight to 6:00 a.m. However, the airlines would not be likely to agree to a more stringent cap affecting daytime activity levels.

There are airports whose managers are trying to enforce voluntary noise restrictions without Part 161, however, these actions appear to be illegal and have not been successful. For example, at Westchester County Airport in New York, airport operators started closing the parking garage entrance from 12:30 a.m. to 5:50 a.m. to help enforce a voluntary curfew. They are also imposing excessive nighttime operating fees as part of the renewal of leases. These are an attempt to limit access to the airport without abiding by Part 161 regulations. As a result, FAA determined this was not within the airport's jurisdiction and is threatening to hold up action on the county's request to increase its travel tax from $3 to $4.5 per passenger. The FAA also threatened to withhold other funds unless the airport remains accessible.

General Aviation Activity

Airport operators do not have the legal jurisdiction to exclude general aviation activity at public airports, including air carrier airports. Several courts have determined that such actions are discriminatory and restrictive of interstate commerce. However, certain restrictions on general aviation activity and other types of users have been upheld in the past.[24] For example, an airport operator can charge higher minimum landing fees, or not construct facilities such as T-hangars for general aviation traffic. This may allow RIAC to discourage general aviation activity but would not stop all growth. In addition, a general aviation limit would do nothing to stop growth of the passenger and cargo activity. While some general aviation operations could be displaced, the community/

[24] American Association of Airport Executives Accreditation Module, Airport Capacity and Delay, 1998.

environmental impacts at T. F. Green are mostly associated with passenger and cargo activities. Further, RIAC already has in place a policy that encourages general aviation to use other airports rather than T. F. Green (including Quonset and North Central).

Summary

While it may be possible for RIAC to *restrict* (but not prohibit) flights to some degree, it would be difficult and expensive, and require years of study. If successful, at best, some restrictions could result, but most growth would still occur. One way RIAC could potentially limit future activity would be to not develop the necessary facilities to serve future demand. The sections that follow discuss how reduced or limited facilities can influence future activity levels.

II.5.2 Reduce Facilities

This scenario considers future activity levels if the current facilities were reduced. Possible options include reducing the length of Runway 16-34 or the closure of Runway 5L-23R.

Runway 16-34

Runway 16-34 does not meet current FAA design standards as set forth in Advisory Circular 150/5300-13, *Airport Design*. The FAA requires a cleared and graded runway safety area (RSA) for Runways 16 and 34 that is 1,000 feet beyond the runway ends and 500 feet wide.[25] The existing RSAs for each end of this runway extend slightly more than 200 feet beyond the runway end. Because the runway was constructed prior to the current RSA regulations, it does not have to meet standards until significant improvements[26] are made to the runway.

Only 58 percent of the runways at Part 139[27] airports meet modern RSA design standards.[28] In recent years the FAA has increased its focus on RSAs due to aviation accidents. On October 1, 1999, the DOT issued Order 5200.8, *Runway Safety Area Program*, which requires the FAA to collect and maintain data on the RSA for each runway at airports certificated under FAR Part 139. The purpose of this requirement is to upgrade non-standard RSAs to meet design standards to the extent practicable.

As discussed in Chapter I, Section I.5.1, *Airfield Facilities*, Runway 16-34 was resurfaced with an asphalt concrete overlay in 1978. This overlay is reaching the end of its useful life and the runway surface now has a number of pavement distresses. It is estimated that this runway needs to be resurfaced or repaved within the next three

25 FAA Advisory Circular 150/5300-13 Change 6, page 21-26.
26 FAA defines significant improvements as restoring the 20-year life to pavement.
27 Airports that are served by air carrier aircraft with more than 30 passenger seats are subject to the requirements in Part 139, Certification and Operations: Land Airports Serving Certain Air Carriers of the Federal Aviation Regulations.
28 FAA News Fact Sheet: Airport Safety, January 2000.

years[29] in order to remain in operation. When a runway is repaved, FAA regulations require that a standard RSA be provided, but a resurfacing does not have the same requirements. There are various alternatives for providing an improved RSA for Runway 16-34, including the construction of full-length RSAs at the current runway length, shortening the runway to achieve full RSAs, the use of Engineered Materials Arresting System (EMAS)[30], or the use of declared distances.[31] These alternatives will be studied fully in Chapter IV, *Development Alternatives*. Although there are various alternatives for providing the improved or standard RSA, this analysis examines the potential impact of shortening the runway on future activity at T. F. Green.

If the RSAs are not extended, and no other action is implemented, the length of Runway 16-34 would be reduced to approximately 4,500 feet in order to provide standard RSAs. The passenger and cargo aircraft that operate at T. F. Green cannot regularly use a runway of this length (with the exception of Cape Air and small cargo aircraft); therefore, Runway 16-34 would mostly be usable by general aviation aircraft. The majority of passenger and cargo aircraft would be forced to use Runway 5R-23L as a result.[32]

Closure of Runway 16-34 is also an option to be considered. However, as long as general aviation aircraft can use the runway, RIAC and the FAA would not support closing the runway because of the noise and wind benefits provided by Runway 16-34. Also, whether the runway is closed or shortened, the capacity impact to the passenger and cargo carriers would be virtually the same.

As shown in **Table II.5-2**, the annual capacity of a single runway operation at T. F. Green is only approximately 10,000 annual operations less than the current airfield configuration with the crosswind runway. This is because the crosswind runway is not operated independently of the main runway (5R-23L) due to the intersection of the two runways. Arrivals and departures on Runway 5R-23L must take place in coordination with operations on Runway 16-34. For example, when an aircraft is landing or departing on Runway 5R, arriving or departing aircraft on Runway 16-34 must wait until the Runway 5R aircraft has passed the intersection of the runways. In addition, if a B-757 or larger aircraft is departing on Runway 5R, aircraft waiting to use Runway 16-34 may have to wait even longer to protect against wake turbulence.[33] As a result of this coordination, the capacity of the two runways together is not significantly higher than a single runway.

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29 August 8, 2001, *Pavement Evaluation for Runway 16-34.*

30 Engineered Materials Arresting Systems (EMAS) consists of high energy absorbing materials of selected strength, which will reliably and predictably crush under the weight of an aircraft. EMAS is used to enhance safety at airports where standard length RSAs are not practicable. Source: Advisory Circular 150/5220-22, August 21, 1998.

31 Declared distances treat an airplane's runway performance distances independently. It provides an alternative airport design methodology by declaring distances to satisfy the airplane's takeoff run, takeoff distance, accelerate-stop distance, and landing distance requirements. Declared distances allow for maximum runway length while still providing standard RSAs in the direction they are needed. Source: Advisory Circular 150-5300-13, Appendix 14.

32 These aircraft cannot use Runway 5L-23R because it is used only by small general aviation aircraft, as discussed in Chapter I, Section I.5.1, *Airfield Facilities*.

Table II.5-2
RUNWAY CAPACITY
T. F. Green Airport

	Annual Operations	Average 2020 Delay Per Aircraft (Min.)
Existing Capacity (with Runway 16-34)	221,000	5.7
Single Runway Capacity	211,000	8.1

Source: FAA Airport Capacity Model and FAA Advisory Circular 150/5060-5, Chapter 2.

Under the Medium growth forecast scenario, there could be 230,000 annual operations at T. F. Green in 2020. This activity level exceeds the capacity of the current airfield. Should RIAC decide to plan for accommodating this activity level, a new runway would be needed in the 2010-2015 timeframe, providing annual capacity of approximately 260,000 to 305,000 operations (depending on the location of the runway) with or without Runway 16-34.[34] If this new runway were in place, the available capacity would far exceed demand and shortening Runway 16-34 in this case would not reduce or alter the market-driven forecast demand in 2020. It is therefore assumed, for purposes of this analysis, that an additional runway would not be added.

General Aviation Activity

Without a new parallel runway, and with a shortened Runway 16-34, the 2020 operations demand exceeds the capacity of the airfield. Delays are expected to increase to approximately eight minutes per operation as a result. At airports where passenger airline aircraft line up awaiting their turn to takeoff, general aviation/military activity typically decreases in response to the increasing airfield delay. In 2000, general aviation operations made up over 35 percent of total annual aircraft operations. The majority of this traffic is on multi-engine and corporate jet aircraft. This corporate general aviation aircraft would be more likely to tolerate high delays in order to serve their clients efficiently and be near Boston and other large cities. However, the small single-engine aircraft, particularly non-T. F. Green-based users, may be more likely to use one of the other general aviation facilities in the area. Small-engine aircraft make up 32 percent of the general aviation/military fleet in 2000, decreasing to 30 percent of the 2020 fleet.

Passenger and Cargo Activity

The main benefit of a crosswind runway is not capacity related, but rather to provide wind coverage and a backup runway when Runway 5R-23L is closed for snow removal or maintenance. The FAA recommends that an airport's runway configuration provide coverage during approximately 95 percent of all wind conditions. **Table II-5.3** shows the

33 Phenomena resulting from the passage of an aircraft through the atmosphere.

34 Due to the interactions and coordination required with two parallel runways and an intersecting crosswind runway, the crosswind runway does not provide additional capacity.

percent of time Runway 5R-23L cannot be used due to wind conditions for the different types of aircraft. Runway 5R-23L does not provide the required coverage for all aircraft types and a crosswind runway is needed to satisfy the FAA recommendation.

Table II.5-3
RUNWAY WIND COVERAGE FOR RUNWAY 5R-23L
T. F. Green Airport

No.	Aircraft Class	Crosswind Component (knots)	Percent Rwy 5R-23L Cannot be Used	Percent of 2020 Fleet Mix
1	A-I and B-I	10.5	17.5	13%
2	A-II and B-II	13	6.8	7%
3	A-III, B-III, and C-I through D-III	16	3.6	70%
4	A-IV through D-VI	20	0.5	9%

Notes:
Category A - Speed less than 91 knots
Category B - Speed >=91 knots, < 121 knots
Category C - Speed >= 121 knots, < 141 knots
Category D - Speed >=141 knots, <166 knots
Category E - Speed >=166 knots

Group I - Wingspan < 49 feet
Group II - Wingspan >=49 feet, <79 feet
Group III - Wingspan >=79 feet, <118 feet
Group IV - Wingspan >=118 feet, <171 feet
Group V - Wingspan >=171 feet, <214 feet
Group VI - Wingspan >=214 feet

Source: 1999 T. F. Green Airport Master Plan

The first class consists of general aviation type aircraft such as Cessnas. Class 2 consists of commuter type aircraft such as Saab 340s or Beech 19s. Aircraft such as the Canadair regional jets, Boeing-737s, DC-9s, and MD-80s fall in Class 3. The Boeing-757s or 767s are in Class 4.

Seventy percent of non-general aviation/military operations at T. F. Green fall into the third class in 2020 and can use Runway 5R-23L at least 96 percent of the time. Seven percent are in the second class and would be unable to use Runway 5R-23L 6.8 percent of the time; nine percent are in the fourth class and would not be able to use the main runway 0.5 percent of the time. When these aircraft cannot use Runway 5R-23L they would be unable to operate if Runway 16-34 were shortened to 4,500 feet. Approximately 13 percent of the 2020 fleet falls in the first class; these aircraft, mainly Cape Air Cessna activity, would be capable of using the shortened Runway 16-34 when Runway 5R-23L would be unavailable.

Single runway airports (or airports with short crosswind runways) were researched to determine if air carriers would be willing to continue service at T. F. Green if only one runway were available. There are several airports in the U.S. with passenger levels similar to T. F. Green that have only a single air carrier runway. This confirms that this condition may not be desirable but does not necessarily deter a carrier from serving a profitable market. (However, it is ultimately an airline's business decision whether to serve a market.) One such example is Southwest Florida International Airport, which has a single runway. This airport served 5.2 million passengers in 2000 and has service by major carriers such as Air Canada, Delta, Northwest, United, and US Airways. Other airports with one air carrier runway include Buffalo Niagara International Airport (4.3 million passengers) and Norfolk International Airport (3.0 million passengers).

The passenger and cargo airlines determine their flight schedules based on an airport's normal operating and maximum capacity configuration. Airports typically have periods of time when they are closed, or when the available capacity is less than typical due to winds or weather conditions. The airlines are prepared for this and have contingency plans in place to deal with the lower capacity situations.

Assuming the airlines would continue to serve T. F. Green with a shortened Runway 16-34, they probably would need to cancel more flights than they do today, during bad weather. The estimated annual cancellations are shown in **Table II.5-4**. Approximately, 5,100 passenger and cargo operations (two percent of total operations) would probably be cancelled annually if Runway 16-34 were shortened.

Table II.5-4
ANNUAL CANCELLATIONS WITH SHORTENED RUNWAY 16-34
T. F. Green Airport

No.	Aircraft Class	Percent Rwy 5R-23L Cannot be Used	2020 Annual Cancellations
1	A-I and B-I	17.5	0
2	A-II and B-II	6.8	800
3	A-III, B-III, and C-I through D-III	3.6	4,200
4	A-IV through D-VI	0.5	100
Total			**5,100**

Notes:

Category A - Speed less than 91 knots
Category B - Speed >=91 knots, < 121 knots
Category C - Speed >= 121 knots, < 141 knots
Category D - Speed >=141 knots, <166 knots
Category E - Speed >=166 knots

Group I - Wingspan < 49 feet
Group II - Wingspan >=49 feet, <79 feet
Group III - Wingspan >=79 feet, <118 feet
Group IV - Wingspan >=118 feet, <171 feet
Group V - Wingspan >=171 feet, <214 feet
Group VI - Wingspan >=214 feet

Further, although there are examples of single-runway airports with service by the major air carriers, it is possible that some of the carriers may reduce their overall schedule somewhat. It is estimated that passenger operations could be reduced by five percent due to the shortening of Runway 16-34.

Resulting Activity Levels

Based on the discussion above, constrained forecasts of activity for the Runway 16-34 scenario were developed (see **Table II.5-5**). The market-driven forecasts, developed earlier in this chapter, were reduced as discussed above and by considering forecast load factors and aircraft size for estimating the potential reduction in passengers. In addition, based on the level and type of general aviation activity at T. F. Green, potential reductions in general aviation/military single-engine piston aircraft of 25 and 50 percent from the 2020 forecast levels are projected to result.

Table II.5-5
2020 RUNWAY 16-34 SCENARIO FORECAST ACTIVITY
T. F. Green Airport

	Annual Passengers	Passenger and Cargo Operations	General Aviation/ Military Ops.	Total Operations
Medium Forecast	10,979,200	165,980	64,230	230,210
Reduced Length 16-34				
25% GA Reduction [1]	10,564,000	160,900	56,300	217,200
50% GA Reduction [1]	10,564,000	160,900	51,800	212,700
Reduction in Air Service [2]	10,439,900	158,000	51,800	209,800

[1] Represents a 25 and 50 percent reduction in general aviation/military single-engine piston aircraft activity in addition to the passenger and cargo cancellations.

[2] Represents a 50 percent reduction in general aviation/military single-engine piston aircraft in addition to reductions in commercial service.

Using the Medium growth forecast, it is predicted that 11 million passengers and a total of 230,210 aircraft operations would occur in 2020. Approximately 165,980 passenger and cargo operations and 64,230 general aviation and military operations are forecast for 2020. The reduction in passenger and cargo operations due to cancellations results in a constrained projection of 10.6 million passengers and 160,900 passenger and cargo operations. If a 25 percent decrease in general aviation/military single-engine aircraft would occur, there would be 56,300 annual general aviation operations and 217,200 total operations. A 50 percent reduction in general aviation/military single-engine aircraft would result in 51,800 general aviation/military operations and 212,700 total operations. If some of the air carriers were to reduce service by as much as five percent in addition to a 50 percent reduction in general aviation single-engine activity, 10.4 million passengers and 209,800 operations would result.

The resulting constrained activity levels for 2020 are greater than the projected capacity of a single runway airfield (see Table II.5-2). With a 25 percent reduction in general aviation activity, delays would reach 5.7 minutes per operation and with a 50 percent reduction, delays would be just under five minutes per operation.[35]

As witnessed by the high delays and increasing congestion experienced at airports around the country, airlines will tolerate increasing delays in order to provide service for all passengers who wish to fly. Based on what is occurring at many U.S. airports, it is not realistic to assume that growth will simply stop once a theoretical capacity limit is reached. As a result, capacity determinations are best used for planning purposes, such as identifying when facility improvements are needed, but are less useful in defining limitations on growth. However, there is an upper limit of delays at which point airlines will adjust their service in response to the delays. This upper limit varies by airport. In general, airlines will continue to add service beyond theoretical capacity limits, but as delays continue to increase, the airlines begin to react by altering their flying habits and fleet mix choices.

There is no one, universally applied standard of acceptable delay in the airport industry. Various industry groups have attempted to define this delay threshold. The FAA considers an airport to be congested if the average delay per operation exceeds five minutes.[36] The American Association of Airport Executives (AAAE) states that[37] "…delay increases gradually with rising levels of traffic until the practical capacity of an airport is reached, at which point the average delay per aircraft operation is in the range of four to six minutes. If traffic increases beyond that level, delays increase at an exponential rate." Many airports in the U.S. are currently experiencing delays in excess of these levels. However, based on T. F. Green's role as a spoke airport and its ranking as a medium hub airport, it is assumed that as delays approach the upper limit of the AAAE standard, the air service at T. F. Green will change. Delays are not projected to exceed six minutes per operation with the Runway 16-34 scenarios, so no further reductions to activity would be likely to occur under this scenario.

<u>Summary of Findings</u>

Although the airport could function with a reduced length Runway 16-34, albeit with lower activity levels and higher delays, this runway is important to the overall operation of the airport, and to the role of T. F. Green in providing reliable air transportation to the southern New England region. Also, the *Part 150 Study* for T. F. Green determined that increased usage of Runway 16-34 would have "significant noise benefits." The land use immediately to the northwest of Runway 34 is more compatible than with the parallel 5-23 runways. The *Part 150 Study* evaluated the number of homes in the 65 DNL contour with increased use of Runway 16-34, as compared to the baseline, which assumed that existing use of Runway 16-34 continued. Increased use of Runway 16-34

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35 FAA Airport Capacity Model and FAA Advisory Circular 150/5060-5.
36 1999 Aviation Capacity Enhancement Plan, page 3-5.
37 American Association of Airport Executives Accreditation Module, Airport Capacity and Delay, developed by Stephen M. Quilty, A.A.E., Bowling Green State University, Ohio.

resulted in a reduction of more than 600 to 900 dwelling units in the 65 DNL contour. The elimination of Runway 16-34 for air carrier and commuter aircraft would increase the number of dwelling units in the 65 DNL contour in the areas underneath the Runway 5R-23L departures. In addition, the increases in delays associated with this scenario could result in increased aircraft emissions due to aircraft idling longer on the taxiways while waiting to depart (even though there would be fewer aircraft).

Runway 16-34 also acts as a backup runway for when the main air carrier runway (5R-23L) is closed for maintenance or snow removal. Having a crosswind runway provides flexibility for the air traffic controllers. In addition, ATCT has indicated that shortening Runway 16-34 could increase the risk of runway incursions because more traffic would be operating on the main runway.

In recognition of the importance of this runway to T. F. Green, the FAA and RIAC are exploring temporary improvements that could be made to Runway 16-34 to extend the useful life for several more years prior to being required to upgrade the RSAs. This allows RIAC to study this issue further as the study process continues.

Runway 5L-23R

Another potential reduction in facilities involves Runway 5L-23R. The FAA Runway Incursion Action Team recommends the closure of Runway 5L-23R in order to reduce the potential for runway incursions. This section examines the impact of this potential closure on likely future activity levels. This analysis assumes that Runway 16-34 is available at its current length.

Discussions with Air Traffic Control Tower (ATCT) personnel verified that Runway 5L-23R does not provide significant capacity to the airport. Runway 5L-23R is 4,432 feet long and is used only by small general aviation aircraft in good weather conditions during the daytime. In addition, some aircraft that are landing on Runway 5L-23R line up on approach to Runway 5R-23L and then move over to land on Runway 5L-23R. As a result, this runway only provides an additional two to three operations per hour beyond the capacity of a single runway and only under certain conditions.

Using the Medium forecast demand projections, an additional runway would be needed by 2010-2015, with or without Runway 5L-23R. This timing is based on the fact that the airport would be at 88 to 96 percent of capacity at that time and will be approaching the threshold of acceptable delay. As stated previously, there is nothing to stop the airlines from exceeding the theoretical definition of capacity and operating at a higher level of delay. Without a new runway and without Runway 5L-23R, delays in 2020 are projected to average 5.7 minutes per operation, which is within the range of acceptable delay that was discussed under the Runway 16-34 scenario. Therefore, future air carrier and commuter traffic would not be expected to be constrained.

T. F. Green has relatively limited cargo activity (four flights per day), and does not have a significant impact on the demand/capacity relationship of a runway system. Cargo operations at T. F. Green made up only 2.2 percent of total aircraft operations in 2000. Therefore, cargo operations are assumed to occur as forecast.

General aviation traffic, on the other hand, may be quicker to respond to increasing delays than passenger or cargo activity. As discussed under the reduced-length Runway 16-34 scenario, small single-engine aircraft may be more likely to use one of the other general aviation facilities in the area. Corporate general aviation aircraft would be more likely to tolerate high delays in order to serve their clients efficiently and be near Boston and other large cities. While Runway 5L-23R does not provide significant additional capacity, the general aviation community does value this runway because it allows pilots to separate their aircraft from larger aircraft. It is likely that some percentage of general aviation traffic would choose not to operate at T. F. Green, particularly for training exercises, if Runway 5L-23R were closed. It is therefore likely that small single-engine general aviation traffic would be constrained in 2020 probably on the order of 25 to 50 percent.

As shown in **Table II.5-6**, passenger and cargo traffic is expected to occur without constraint, while general aviation traffic would be constrained if the airfield were not expanded. A 25 percent reduction in general aviation/military single-engine piston activity would result in 222,280 annual operations while a 50 percent reduction would result in 217,780 annual operations.

Table II.5-6
2020 RUNWAY 5L-23R SCENARIO FORECAST ACTIVITY
T. F. Green Airport

	Annual Passengers	Passenger and Cargo Operations	General Aviation/ Military Ops.	Annual Operations
Medium Forecast	10,979,200	165,980	64,230	230,210
No New Airfield Facilities				
25% Reduction [1]	10,979,200	165,980	56,300	222,280
50% Reduction [1]	10,979,200	165,980	51,800	217,780

[1] Based on a 25 and 50 percent reduction in general aviation/military single-engine piston aircraft activity.

II.5.3 No New/Additional Facilities

This section examines the impact on future activity levels if no new facilities are added at T. F. Green Airport. In order to accomplish this, it is necessary to establish and analyze the capacity limitations of the existing facilities. **Exhibit II.5-1** depicts the demand/capacity relationship for the airfield, terminal, and landside system. As discussed previously, the airfield is operating at 58 percent of its passenger capacity, the terminal is at 81 percent, and the landside system is at 68 percent.[38] It is important to note that capacity is not necessarily a static number as depicted on the graph. The airlines, general aviation pilots, and passengers generally react to increasing delays, which can in turn increase or decrease capacity. For example, general aviation activity may decrease in response to high delays. This results in a more homogeneous fleet (similar size aircraft) which increases capacity. For purposes of assessing the impact of RIAC's decisions about facilities, the theoretical capacity limits depicted on the graph are sufficient.

Comparing the Medium scenario forecast demand to the facilities, it becomes clear that the capacity of the terminal and gate facilities will be reached first, in 2005, if the existing facilities are not expanded. The landside system would require improvements in the 2005-2010 timeframe and the airfield in the 2010-2015 timeframe. In addition, the majority of the jet aircraft that are forecast to operate at T. F. Green in the future would incur payload penalties when serving long-haul domestic destinations from the existing facilities.[39]

The capacity of each element of an airport (airfield, terminal, landside) should be in balance. For example, it does not make sense to add a new runway if the terminal or landside system cannot accommodate the same activity levels the airfield could. The demand/capacity analysis shows that the first element of the airport, the terminal and gate facilities, will "fail" by 2005. Theoretically, it might appear that traffic would not grow beyond 2005 even though the airfield and the landside facilities would have excess capacity. However, capacity is also determined based on level of service measures (i.e. passenger or aircraft delay). In other words, capacity is defined as the level of activity at which the airport is operating at an "acceptable" level of delay or level of service. Airports across the country are demonstrating that the definition of acceptable delay is increasing as passengers continually tolerate higher and higher delays in order to use air travel.

Based on what is occurring at many U.S. airports, it is not realistic to assume that growth will simply stop once a theoretical capacity limit is reached. As a result, capacity determinations are best used for planning purposes, such as identifying when facility improvements are needed, but are less useful in defining limitations on growth.

Below is a discussion of each element of T. F. Green and the impact that not expanding the existing facilities would have on future activity. Each element is discussed independently and the resulting activity implications are not cumulative. In each discussion it is assumed that the other elements of the airport are not limiting factors (i.e. if airfield capacity is not added, it is assumed that there is sufficient terminal and

[38] Based on key airport intersections along Post Road.

[39] A payload penalty in this case means that an airline has to reduce the number of passengers or cargo on the aircraft in order to reduce the weight of the aircraft so it can depart on the given runway length. (Heavier aircraft require more runway length for takeoff.)

landside capacity to match the capacity of the airfield). If none of the facilities at the airport were expanded (airfield, terminal, landside), the most limiting factor would dictate future activity.

Airfield

The capacity of the existing airfield facilities is not very different from the Runway 5L-23R scenario discussed in Section II.5.2, *Reduce Facilities*, because Runway 5L-23R does not significantly contribute to the capacity of the airfield. The only difference would be in the level of general aviation traffic, the only users of Runway 5L-23R. It is assumed that general aviation traffic would be reduced 20 to 40 percent from 2020 forecast levels if the airfield is not expanded. This is slightly less than the Runway 5L-23R scenario. As with the Runway 5L-23R scenario, the number of passengers served would be unaffected. As shown in **Table II.5-7**, annual aircraft operations activity would be reduced to 223,180 with a 20 percent reduction in general aviation single-engine traffic, and to 219,580 operations with a 40 percent reduction.

Table II.5-7
2020 NO NEW AIRFIELD FACILITIES SCENARIO FORECAST ACTIVITY
T. F. Green Airport

	Annual Passengers	Passenger and Cargo Operations	General Aviation/ Military Ops.	Annual Operations
Medium Forecast	10,979,200	165,980	64,230	230,210
No New Airfield Facilities				
20% Reduction [1]	10,979,200	165,980	57,200	223,180
40% Reduction [1]	10,979,200	165,980	53,600	219,580

[1] Based on a 20 and 40 percent reduction in general aviation/military single-engine piston aircraft activity.

The increased delays associated with this scenario could result in increased aircraft emissions as aircraft would spend more time on the ground idling while waiting to depart. Delays could push operations later into the evening, creating more noise at a time when more residents are prone to be disturbed by it.

In addition to the need for a new runway, a longer runway will likely be needed in order to accommodate long-haul domestic flights. The existing Runway 5R-23L provides sufficient length to accommodate all arriving aircraft and domestic departures to cities within approximately 800 nautical miles of T. F. Green (the typical longer distance for most of the airport's departures). However, as discussed in Section II.2.2, *Current and Recent T. F. Green Air Service*, there are a number of T. F. Green markets currently without nonstop air service. These cities, many of which are on the west coast, are prime candidates for nonstop service in the future. Without an extended runway, aircraft serving these cities nonstop would have to take payload restrictions or use better performing aircraft such as the Airbus 319, which can serve long-haul markets from the existing Runway 5R-23L. In addition, the airlines could also continue serving these markets with one-stop service instead of nonstop. Some passengers may choose to use nonstop service out of Boston Logan instead of taking the connection out of T. F. Green. However, congestion at Boston Logan currently drives passengers to use T. F. Green and other regional airports (Bradley, Manchester) instead. As a result, the limitation in runway length, while inconvenient, would not be expected to significantly change the market-driven demand for air service from T. F. Green.

Terminal

Both the size of the terminal building and the number of gates will likely need to be expanded by 2005. As discussed previously, passengers will not necessarily stop using T. F. Green simply because additional space or gates are needed.

As shown in **Table II.5-8**, T. F. Green processed 246,900 annual passengers per gate in 2000. Without expansion of the terminal, this ratio would increase to 491,900 in 2020. To put this number in perspective, it was compared to the corresponding ratio for the top 10 airports for which gate information was available (see **Table II.5-9**). This ratio ranges from over 590,000 passengers per gate at Los Angeles International Airport (LAX) to 312,400 at Las Vegas. The average passengers per gate ratio at these airports is 446,100.

Table II.5-8
T. F. GREEN AIRPORT PASSENGERS PER GATE
T. F. Green Airport

Year	Annual Passengers	Number of Gates	Passengers/ Gate
2000	5,430,938	22	246,900
2020	10,822,800	22	491,900

There are ways to minimize delays associated with the terminal and gate facilities. There are peaks and valleys of activity at T. F. Green in any given day. The capacity of the gates and terminal building are based on activity in peak periods. In order to maximize the use of an existing facility, airlines can add flights at off-peak times when the gates and the interior of the terminal building are underutilized. This would allow the existing terminal facilities to reduce delays. However, there are limits to how much traffic can shift to off-peak hours due to passenger preferences for flight times and airline schedules to hub airports.

Table II.5-9
PASSENGERS PER GATE COMPARISON
T. F. Green Airport

Airport	2000 Annual Passengers	Number of Gates [1]	Passengers/ Gate
Los Angeles	66,424,767	112	593,078
Dallas	60,687,122	106	572,520
San Francisco	41,040,995	83	494,470
Houston	35,251,372	74	476,370
Atlanta	80,162,407	175	458,071
Chicago O'Hare	72,144,244	165	437,238
Minneapolis	36,751,632	85	432,372
Phoenix	36,040,469	99	364,045
Detroit	35,535,080	111	320,136
Las Vegas	36,865,866	118	312,423
Average			**446,100**

[1] Based on Official Airline Guide gate descriptions. Represents approximate estimates of gates available. Actual totals may differ slightly.

Source: January 2001 Official Airline Guide terminal diagrams and Airports Council International activity statistics.

Another option is to park aircraft at remote aprons and bus passengers to and from the terminal. There is precedent for doing this, particularly with commuters, at other airports such as LAX and Newark. This would allow the airlines to serve forecast demand without expanding the gate facilities. However, remote aircraft parking does not solve the interior terminal space deficits.

It is very difficult to predict how the airlines and passengers will respond to increasing delays in the terminal. There are many examples across the country of crowded facilities that continue to operate and serve higher and higher levels of activity. An extreme example of a congested facility is the Southwest terminal at LAX. Southwest is processing over 1,600,000 passengers per gate at Terminal 1 at LAX.[40] LAX, particularly the Southwest terminal, is an example of a congested facility that needs expansion. However, even though the theoretical capacity of these facilities has been far exceeded, the airlines continue to serve the demand. This is not how the airlines would choose to operate under optimal conditions, however, they will do so in order to serve the demand for air travel. This example demonstrates that there is a precedent for T. F. Green's largest carrier to operate under congested conditions.

If the terminal is not expanded, it is assumed that traffic at T. F. Green will continue to increase up to the point that the average passengers per gate ratio experienced at the

[40] Los Angeles International Airport Master Plan and Los Angeles World Airports activity statistics.

top 10 airports (446,100 passengers per gate) is reached. This assumes that the airlines respond to the increasing congestion in the terminal and at the gates by moving some of their operations to off-peak hours and using remote parking positions to the extent possible. Other traffic at the airport (cargo, general aviation, and military) would remain unchanged because this traffic does not use the terminal, and therefore is not affected by terminal congestion.

Table II.5-10 shows the resulting constrained 2020 activity. Passengers in 2020 would be reduced to 9.8 million, an 11 percent reduction from the Medium forecast levels. Annual operations would be reduced to 212,150, assuming no change in the 2020 forecast fleet mix. This is a seven percent reduction from the 2020 forecast. As a result of not expanding the existing terminal and gate facilities, these facilities will become increasingly congested and the level of service provided to T. F. Green passengers will decrease.

Table II.5-10
2020 NO NEW TERMINAL FACILITIES SCENARIO FORECAST ACTIVITY
T. F. Green Airport

	Annual Passengers	Passenger Operations	Other Operations.	Total Operations
Medium Forecast	10,979,200	159,780	70,430	230,210
No New Terminal Facilities	9,814,200	142,800	69,350	212,150

Landside

Using the Medium growth case demand, a number of key intersections around the airport would require improvement over the next 20 years due to increasing traffic. As shown in **Table II.5-11**, six levels of service (LOS) are defined for locations with and without traffic signals. Letter designations indicate operating conditions. LOS is a commonly-used qualitative measure describing operational conditions within a flow of traffic and is generally described in terms of speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety. Traffic engineers generally consider LOS D or better as acceptable.

Table II.5-11
INTERSECTION LOS CRITERIA
T. F. Green Airport

Level Of Service	Average Stopped Delay (seconds per vehicle)	
	Signalized Intersection	Unsignalized Intersection
A	≤10	≤10
B	>10 - ≤20	>10 - ≤15
C	>20 - ≤35.0	>15 - ≤25
D	>35 - ≤55.0	>25 - ≤35.0
E	>55 - ≤80	>35 - ≤50.0
F	>80	>50

Source: Highway Capacity Manual 2000

Delays at some intersections are projected to reach LOS E or F by 2020, signaling the need for capacity improvements. **Table II.5-12** shows the projected delays and LOS in 2020 for each intersection in the study area where the LOS is projected to be E or F. Also shown in the table are any proposed improvements. It is important to note that, with a majority of airport-bound traffic using the I-95 Connector, not all of the traffic and delays are the result of airport traffic. Much of the delays can result from commuter-based traffic, particularly in the case of the Airport Road/Commerce Drive intersection. Therefore, this information should be used as a planning tool for Warwick and the Rhode Island Department of Transportation (RIDOT) in considering future improvements to the area's roadway system.

Eight intersections are projected to be at LOS E or F by 2020. As with the airfield and terminal facilities, just because delays are increasing does not mean travelers will simply stop using a certain roadway. Roadways can continue to function at LOS E or F. A prime example of this is at Boston Logan. Other airports such as Atlanta or JFK Airport in New York have roadway systems that are considered "failing" but they continue to operate and passengers continue to travel. However, as volume of traffic at T. F. Green continues to increase and the demand exceeds capacity, the delay per vehicle will continue to rise.

Table II.5-12
2020 ROADWAY INTERSECTION DELAYS WITH GREATER THAN LOS F
T. F. Green Airport

Intersection	2020 Delay (seconds/vehicle) [1]	LOS [1]	Already Planned Improvements
Post Road at Airport Road	82.7	F	Signal coordination along Post Road will decrease delays
Post Road at Coronado Road	106.3	F	Signal coordination along Post Road will decrease delays
Post Road at Off Ramp	86.3	F	Signal coordination along Post Road will decrease delays
Jefferson Blvd at Coronado Rd.	156.7	F	None
Airport Road at Hade Court	69.9	E	None
Airport Road at Commerce Drive	104.9	F	None
Internal Intersection at Short-Term Parking	223.4	F	None
Jefferson Boulevard at Airport Connector Off Ramp Eastbound Left (unsignalized)	329.7	F	Traffic signals planned as part of the Warwick Intermodal Station project would reduce delays to acceptable levels.

Note: All intersections are signalized unless otherwise noted.
[1] Delays were measured for the a.m. and p.m. peak hour. The worst case delay and LOS is depicted.

Roadway systems that are dominated by intersections at LOS F experience long lines, sometimes affecting numerous other roadways throughout the area. LOS F represents a complete stoppage in the flow of traffic for an extended period of time. It occurs either at a point where vehicles arrive at a rate greater than the rate at which they leave the area. Once delay per vehicle begins to exceed 80 seconds (LOS F) on a particular roadway, passengers may begin looking for alternative routes or modes of getting to the airport, alter their times of travel, or use another airport altogether. Therefore, for purposes of this analysis, it is assumed that as the roadways surrounding T. F. Green reach LOS F, the airport will become constrained by its landside facilities and be unable to serve all of the forecast demand.

Table II.5-13 shows the number of intersections that are projected to be at LOS F in the a.m. or p.m. peak hour for the forecast years. Four signalized intersections will be at LOS F by 2015. In addition, the Post Road/Airport Road intersection will be nearing LOS F at this time. Post Road at Airport Road is an important intersection because it affects the entire arterial. The Route 37 Extension project, considered previously in the state’s Transportation Improvement Plan (TIP), should again be evaluated for its potential relief to the roadways in Warwick. Without such improvements, passengers would probably begin to alter their travel habits in response to the increasingly congested roadway system after 2015. Some passengers would come to the airport earlier in order to avoid the traffic congestion and delays at peak hours. Other passengers would seek to use alternative modes of transportation or use other airports. However, the availability of other airports may be limited, particularly considering the traffic congestion problems at Boston Logan.

Table II.5-13
NUMBER OF SIGNALIZED INTERSECTIONS AT LOS F
T. F. Green Airport

Year	Number of Intersections at LOS F	Intersections
2005	1	Jefferson Blvd. at Coronado Road
2010	2	Jefferson Blvd. at Coronado Road, Internal intersection at short-term parking
2015	4	Jefferson Blvd. at Coronado Road, Internal intersection at short-term parking, Post Road at Coronado Road, Airport Road at Commerce Drive
2020	6	Jefferson Blvd. at Coronado Road, Internal intersection at short-term parking, Post Road at Coronado Road, Airport Road at Commerce Drive, Post Road at Airport Road, Post Road at Off Ramp

The deteriorating conditions on the main roadways could have an impact on the surrounding neighborhoods. Some airport passengers, as well as local traffic, would likely seek to find alternative routes through neighborhoods to avoid the main roads. In addition, as congestion increases on the roadway system, cars would spend an increasing amount of time idling. This would lead to increased automobile emissions over current conditions.

In addition to the need for roadway improvements, additional capacity for rental car and public auto parking is needed by 2005. Approximately 2,500 additional rental car and 6,820 long-term parking spaces are needed by 2020. If these facilities are not provided on the airport, independent businesses will likely provide the necessary parking and rental car facilities off airport property, along Airport Road. This would cause inconvenience for passengers because they would be forced to take shuttle buses from the remote lots to the airport, adding to the potential roadway congestion identified above.

A deficiency in rental car and public parking facilities and increasing congestion on the roadways could attract more passengers to use the proposed Warwick rail station to access the airport, but may not have a significant impact on the total air travel demand.

With no facility improvements, T. F. Green could become constrained and unable to serve all of the forecast demand. As discussed previously, beyond 2015 not all activity could be accommodated at T. F. Green. The Medium forecasts project 9.1 million passengers will want to travel at T. F. Green in 2015. It is assumed that some small portion of activity beyond this level would still be served due to passengers traveling at off-peak hours or using alternative routes to the airport. It is also assumed that cargo and general aviation activity would be reduced by 20 percent due to the roadway congestion.

Table II.5-14 depicts the activity levels that would be expected with no additional landside capacity at T. F. Green. Passengers would probably be reduced to 9.5 million in 2020. Annual operations would correspondingly be reduced to 201,400 in 2020.

Table II.5-14
2020 NO NEW LANDSIDE FACILITIES SCENARIO FORECAST ACTIVITY
T. F. Green Airport

	Annual Passengers	Passenger Operations	Other Operations.	Total Operations
Medium Forecast	10,979,200	159,780	70,430	220,210
No New Landside Facilities	9,500,000	145,100	56,300	201,400

The above analysis projects that by 2015 roadway conditions around the airport will deteriorate sufficiently such that they cannot accommodate all of the projected activity for T. F. Green. In addition to the roads near the airport, construction is planned for the Washington Bridge in Providence and I-195. I-195 and the Washington Bridge provide the major means of access to T. F. Green Airport from East Bay communities in Rhode Island and from southeastern Massachusetts and Cape Cod.

While construction is underway there will likely be disruptions in access to T. F. Green, particularly from East Bay communities in Rhode Island and from southeastern Massachusetts and Cape Cod. However, Boston’s roadway system will continue to be congested during this timeframe, limiting the traveling public’s options for alternative airports. It is likely that T. F. Green will still be considered relatively convenient compared to Boston. In addition, the low fares offered at the airport will likely offset the inconveniences that result from the roadway construction. Therefore, while there may be small reductions in traffic levels at T. F. Green while this construction is underway, there is not expected to be any major reduction in demand.

All of the construction will be completed (thereby improving access to T. F. Green) before the capacity of the roads near the airport are projected to limit passenger growth at the airport. Therefore, the long-term 20-year projections identified in this section are not expected to be reduced by this construction.

Entire Airport

As discussed previously, each element of the airport (airfield, terminal, landside) was discussed independently and the resulting activity implications are not cumulative. If none of the facilities at the airport were expanded, the most limiting factor would dictate future activity. If the terminal has more capacity than the roadways and neither the terminal nor the roadways are expanded, then activity would not increase beyond the maximum levels identified for the landside.

Based on the above analysis, the landside (roadways) result in the greatest constraint to growth at T. F. Green. If no improvements are made to the airport, activity would be similar to projections for the no new landside improvements scenario (9.5 million passengers and 201,400 operations).

II.5.4 Some Level of Facility Improvement

The previous section discussed future traffic levels at T. F. Green without improvements to the airfield, terminal, and landside systems. The analysis concluded that there would be slight reductions in the level of activity served if no improvements are made to the airport. Below is a discussion of how a partial level of facility improvements would likely impact future activity levels.

Airfield

An additional parallel runway will likely be needed in the 2010-2015 timeframe. Sections II.5.2 and II.5.3 discussed the impact that no expansion or even reduced facilities would likely have on future activity levels. These analyses concluded that a reduction in capacity would, at most, reduce 2020 activity levels by six to nine percent for operations and five percent for passengers. Not expanding the airfield would result in a three to five percent reduction in operations and no reduction in passengers. Under each of these scenarios, the airfield would be operating above its theoretical capacity limits and delays would be near the upper limit of acceptable delays. Marginal capacity improvements to the airfield, such as taxiway improvements, would allow T. F. Green to accommodate unconstrained demand, but still at high delay levels.

Runway extensions would allow the airlines to provide better service by providing non-stop service to long-haul destinations. Runway extensions would not, however, increase capacity. As stated previously, if the runways are not extended, the airlines will serve long-haul destinations with more efficient aircraft, they will take a payload penalty, or serve the destination with one-stop service.

Providing two parallel runways of the necessary length to serve long-haul destinations would allow T. F. Green to serve forecast demand at reasonable delay levels. This would provide a high level of service for T. F. Green passengers.

Terminal

Section II.5.3, *No New/Additional Facilities*, described the impact of not expanding the terminal facilities. This would result in an 11 percent reduction in passengers served and a seven percent reduction in annual aircraft operations. This reduced level of activity could be served without expanding the terminal facilities but the terminal would become more congested than it is today.

The methodology used in Section II.5.3, *No New/Additional Facilities*, assumed that T. F. Green's passengers per gate ratio would increase up to the average of the top 10 airports in the U.S. Based on 446,100 passengers per gate, the Medium forecast passenger demand could be served if three additional gates (and the corresponding interior space) were provided. The terminal would be congested and passengers would experience high delays, but demand could be served. Any other increases in capacity would improve the passenger's experience and reduce congestion.

Landside

Section II.5.3, *No New/Additional Facilities*, described the impact of not expanding the landside facilities. This would result in a 13 percent reduction in activity. The roadways would be very congested under these circumstances and passengers would be forced to use off-airport remote auto parking and rental car facilities. Improvements to key intersections, such as the Post Road/Airport Road intersection, would allow the Medium forecast demand to be served. Any other increases in capacity would improve the passenger's experience and reduce delay and congestion.

II.5.5 Combined Scenario

Each potential capacity constraining scenario was discussed independently in Sections II.5.1 through II.5.4 to determine its potential effect. There are many combinations of the scenarios that could be pursued to restrict growth. This scenario assumes RIAC pursues several or all of the following: Federal government restrictions, attempts to limit activity through the Part 161 process, initiates a program to encourage the use of other airports, implements peak period pricing, and discourages general aviation activity. It also assumes that RIAC does not implement any facility improvements, closes Runway 5L-23R, and shortens Runway 16-34.

An attempt by an airport to discourage traffic to this extent has never been attempted before and it is therefore difficult to predict the likely impact to traffic. It is not known if it would be legal to restrict traffic to this degree – this would require further study. What is known is that the airport would become increasingly congested and it would be difficult for the airlines to serve the market demand at T. F. Green due to the restrictions. While airlines will accept some level of inconvenience if it is profitable for them to operate in a certain market, it is likely that the aforementioned restrictions would limit future activity growth more so than any of the capacity constraining scenarios could individually. Activity levels could be expected to increase beyond current levels. However, at some point the restrictions would likely force some airlines out of T. F. Green, cause them to reduce service, or change the nature of service they offer (i.e. aircraft type, times of operation). The reaction of the airlines would likely result in future traffic levels that are lower than any one of the other capacity constraining scenarios.

As with the other congested scenarios, increasing delay levels and congestion can actually deteriorate quality of life conditions, even when combined with the reduced growth. The increased delays associated with the combined scenario could result in increased aircraft emissions as aircraft would spend more time on the ground idling while waiting to depart. Delays could push operations later into the evening, creating more noise at a time when more residents are prone to be disturbed by it. It is not known if the reductions in growth levels would compensate for the increased emissions and noise that would result in such a scenario.

II.5.6 Summary of Findings

Table II.5-15 shows a summary of the capacity constrained scenario analysis. The capacity constrained analysis demonstrated that most of the market-driven demand will occur regardless of what decisions RIAC makes about expanding its facilities. If facilities are not improved, delays would increase from current levels, the facilities would become increasingly congested, and the passenger's travel experience would deteriorate. The increases in delay (and resulting costs and impacts) would very likely exceed the noise and air quality benefits that would result from slightly reduced activity levels. In some cases, such as with the shortening of Runway 16-34, noise impacts would be worse than if the length of Runway 16-34 was maintained or extended (according to the *Part 150 Study*). The only way to achieve a significant reduction in activity levels would be for RIAC to pursue all or most of the scenarios that were studied.

II.6 Selected Planning Level

The analysis and forecast scenarios presented in this chapter will be discussed with the SRC. RIAC and the FAA will review all information, and ultimately make a decision about which forecast scenario to adopt for future planning.

Table II.5-15
SUMMARY OF CAPACITY CONSTRAINED SCENARIOS
T. F. Green Airport

Scenario	2020 Million Annual Passengers	Annual Operations	Major Findings
No New Flights	5.4 (Achievability has not been established)	155,600 (Achievability has not been established)	It may be possible to restrict activity to some extent at T. F. Green. The Part 161 process would likely last several years.
Shorten Runway 16-34	10.4-10.6	209,800-217,200	Runway 16-34 offers benefits in terms of noise reduction, wind coverage, controller flexibility, and use as a back-up runway.
Close Runway 5L-23R	11.0	217,780-222,280	The Runway Incursion Action Team recommends the closure of this runway to reduce the potential for runway incursions.
Existing Airfield Facilities	11.0	219,580-223,180	Passengers would experience high delays but most demand could be served
Existing Terminal Facilities	9.8	212,150	Passengers would experience high delays but most demand could be served
Existing Landside Facilities	9.5	201,400	Passengers would experience high delays but most demand could be served
Some Level of Facility Improvement	11.0	230,210	Marginal improvements would allow all demand to be served, but high delays and congestion would result with under-developed facilities.
Combined Scenario	Not Known. Would be less than or equal to 9.5.	Not Known. Would be less than or equal to 201,400.	Such restrictions are unprecedented. Would likely result in greater reduction in activity than the other scenarios.