Gate Requirements

There are various methodologies available to determine future gate requirements. Three of these methods were chosen and applied at T. F. Green in order to create a range of gate requirements:

- Annual Departures per Gate Method
- Annual Enplaned (Departing) Passengers per Gate Method
- Percent Increase in Annual Operations Method

A fourth approach, the peak month average day (PMAD) Departures Per Gate Method, was then used to identify gate requirements by aircraft type for each forecast year. The results from the first three approaches were used to benchmark this methodology.

Table III.2-2
2000 GATE CONFIGURATION AND UTILIZATION
T. F. Green Airport

Aircraft Group	2000 Gates	NBEG Index	NBEG Calculation	Percentage of Total Gates
Cape Air – Cessna	1	0.4	0.4	5%
Turboprop	2	0.4	0.8	9%
Regional Jet	2	0.7	1.4	9%
Narrowbody	11	1.0	11	50%
B-757	6	1.1	6.6	27%
Widebody	0	1.4	0	0%
Jumbo	0	1.8	0	0%
Total Gates	**22**		**20.2**	**100%**

Annual Departures Per Gate Method

Table III.2-3 shows the first method which applies the existing ratio of annual departures per gate to 2020 annual air carrier and commuter departures. The existing ratio is 2,204 annual departures per gate. This approach assumes that the current usage and utilization of the gates will remain constant over the planning period. This method results in a requirement for 37 gates in 2020.

Table III.2-3
ANNUAL DEPARTURES PER GATE METHOD – 2020 GATE REQUIREMENT
T. F. Green Airport

2020 Annual Passenger Departures	Ops./ Gate	Resulting Gate Requirement
79,400	2,204	37

Note: Requirements were calculated based on the draft forecasts and were not updated to reflect the final forecasts.

Annual Enplaned Passengers Per Gate Method

Table III.2-4 shows the second method which takes the existing ratio of annual enplaned passengers per gate of 123,430 and applies it to 2020 forecast annual enplaned passengers. This method assumes that the current usage and utilization of the gates is acceptable and will remain constant over the planning period. This method results in a requirement for 44 gates in 2020.

Table III.2-4
ANNUAL ENPLANED PASSENGERS PER GATE METHOD
T. F. Green Airport

2020 Enplaned Passengers[1]	Enplanements/Gate	Gates[2]
5,411,400	123,430	44

1 Annual passengers divided by two.
2 Requirements were calculated based on the draft forecasts and were not updated to reflect the final forecasts.

Percent Increase in Annual Operations Method

Table III.2-5 depicts the gate requirements associated with the third method. This methodology assumes that the number of gates needed will increase at the same rate as the forecast increase in annual passenger operations through 2020. This method does not take into account changes in fleet mix, which could change gate usage. It assumes that the current usage and utilization of the gates will remain constant over the planning period.

This method determined gate requirements for commuter and air carrier gates separately. Two gates (Gates 8 and 9) are counted as both commuter and air carrier gates based on actual usage. This results in seven commuter gates and 17 air carrier gates in 2000 (for a total of 24 gates). Commuter operations are forecast to increase by 30 percent from 2000 to 2020, which results in a requirement for 10 commuter gates in 2020. Air carrier operations are forecast to increase by 95 percent from 2000 to 2020. This results in a requirement for 34 air carrier gates in 2020. This methodology results in a total requirement for 44 gates by 2020.

Table III.2-5
PERCENT INCREASE IN ANNUAL OPERATIONS METHOD
T. F. Green Airport

	Operations		Gate Requirements		Percent
Gate Type	2000	2020	2000	2020	Increase
Commuters	47,466	61,860	7	10	30%
Air Carrier	49,698	96,840	17	34	95%
Total Gates			**24**	**44**	

Note: Requirements were calculated based on the draft forecasts and were not updated to reflect the final forecasts.

PMAD Departures Per Gate Method

The three previous methodologies resulted in gate requirements ranging from 37 to 44 gates by 2020. These methodologies are based on annual activity levels and as such do not reflect the peaking characteristics that can be observed on a daily basis. In addition, due to the high level of gate sharing by different size aircraft (for example, a gate that can be used by B-757, B-737, and regional jet aircraft), it was difficult to apply these methodologies to determine specific gate requirements by aircraft size. As a result, a fourth approach was used that takes these factors into consideration.

This approach is based on the ratio of scheduled PMAD departures per gate. For the 2000 base case, existing gates were categorized by the maximum allowable aircraft size at each gate. The number of PMAD departures for each aircraft group for existing conditions (year 2000) and the forecast years was derived from the draft forecast fleet mix. The average number of departures accommodated per gate for each aircraft group under existing conditions was then determined. This ratio was adjusted as needed to reflect projected changes in gate usage in the future and then applied to the forecast activity to determine future gate requirements.

Table III.2-6 shows the gate requirements for each aircraft group under this preferred methodology. The departures per gate ratio varies widely by aircraft group due to the way the gates are currently used. First of all, many gates actually accommodate more than one departure at one time. For example, Cape Air uses a single marked gate position but parks multiple aircraft at the gate. Turboprops operate in a similar manner. As a result, these aircraft have high departures per gate ratios.

Secondly, many of the gates at T. F. Green are used by a wide variety of different size aircraft. A B-757 gate may be used by B-757s, narrowbody aircraft such as B-737s, and regional jets. In addition, a gate that is large enough to accommodate a regional

Table III.2-6
T. F. Green Airport
Gate Requirements - Departures Per Gate Approach

2000 REQUIREMENT				
Aircraft Group	**Daily Departures**	**Departures Per Gate**	**Gates Available**	**Percentage of Total Gates**
Cape Air - Cessna	26	26.5	1	5%
Turboprop	41	20.7	2	9%
Regional Jet	12	6.1	2	9%
Narrowbody	78	7.1	11	50%
757	3	0.5	6	27%
Widebody	0	0.0	0	0%
Jumbo	0	0.0	0	0%
Total	**162**		**22**	100%

2005 REQUIREMENT				
Aircraft Group	**Daily Departures**	**Departures Per Gate**	**Gates Required**	**Percentage of Total Gates**
Cape Air - Cessna	28	26.0	1	4%
Turboprop	34	20.6	2	8%
Regional Jet	26	6.0	4	15%
Narrowbody	92	7.1	13	50%
757	8	1.4	6	23%
Widebody	0	0.0	0	0%
Jumbo	0	0.0	0	0%
Total	**188**		**26**	100%

2010 REQUIREMENT				
Aircraft Group	**Daily Departures**	**Departures Per Gate**	**Gates Required**	**Percentage of Total Gates**
Cape Air - Cessna	29	24.0	1	3%
Turboprop	32	18.0	2	6%
Regional Jet	32	6.0	5	16%
Narrowbody	108	7.1	15	48%
757	10	1.4	7	23%
Widebody	1	1.0	1	3%
Jumbo	0	0.0	0	0%
Total	**212**		**31**	100%

2015 REQUIREMENT				
Aircraft Group	**Daily Departures**	**Departures Per Gate**	**Gates Required**	**Percentage of Total Gates**
Cape Air - Cessna	31	20.0	2	6%
Turboprop	31	18.0	2	6%
Regional Jet	36	6.0	6	17%
Narrowbody	122	7.1	17	47%
757	13	1.6	8	22%
Widebody	1	1.0	1	3%
Jumbo	0	0.0	0	0%
Total	**234**		**36**	100%

2020 REQUIREMENT				
Aircraft Group	**Daily Departures**	**Departures Per Gate**	**Gates Required**	**Percentage of Total Gates**
Cape Air - Cessna	34	20.0	2	5%
Turboprop	26	15.0	2	5%
Regional Jet	45	6.0	8	20%
Narrowbody	131	7.1	18	45%
757	19	2.3	8	20%
Widebody	3	3.0	1	3%
Jumbo	0	0.0	1	3%
Total	**258**		**40**	100%

Note: Requirements were calculated based on the draft forecasts and were not updated jet may also be used by turboprop aircraft. The departures per gate ratio reflects the number of departures that fall in each aircraft group, not the number of departures that actually use the gate. This methodology assumes that aircraft from each aircraft group will continue to utilize larger gates throughout the planning period. This is consistent with gate utilization observed at similar sized airports around the country.

In 2000 there were three daily B-757 departures and six B-757 sized gates. This results in a ratio of 0.5 departures per gate. The B-757 gates are actually used more often than this ratio reflects but they are used by smaller aircraft. This ratio is expected to increase in the future as more B-757 departures occur at T. F. Green. Conversely, the departures per gate ratio for narrowbodies is 7.1 which is higher than typical industry standards. The narrowbody gates are actually used less frequently than this because many of the narrowbody aircraft use the B-757 gates.

This analysis showed that the airport is currently "out of gates" (i.e. all gates are leased). **Therefore, additional gates are needed as soon as possible. By 2020, daily departure activity is projected to reach 258 departures per day and a total of 40 gates will be needed.** This is within the range identified by the previous methodologies. RIAC should continue to provide B-757 and B-767 capable gates that will be used primarily by smaller aircraft. This will provide RIAC with maximum flexibility in accommodating aircraft size. In addition, a requirement for one jumbo gate by 2020 was identified. This gate would likely be used by smaller aircraft such as the B-757 and B-767 but would give the airport the capability and flexibility to support larger aircraft such as the B-777.

III.2.2 Passenger Terminal Facilities

A detailed passenger terminal facility requirements program, which estimates the spatial requirements needed to accommodate passenger activity for the planning years, was developed prior to the attacks of September 11, 2001. This space program is contained in Appendix D, *Terminal Space Program*. The terminal space program requirements were organized into six general categories: airline functions; concessions space; Federal Inspection Services (FIS); secure public area; non-secure public area; and non-public area. More detailed requirements were also provided for individual areas within each of these categories. The ensuing changes in security regulations since September 11 have rendered some of the details of this space program obsolete. Security regulations are still evolving and it is not known at this time how much space will be needed for new explosive detection machines, the longer lines at the security checkpoints, or additional space in the holdrooms for passengers who now arrive at the airport much earlier than before September 11.

The terminal space program can be updated at the appropriate time – when more is known about the new security regulations and when it is time to design an expansion to the terminal. For the purposes of this long-term Master Plan, a projection of overall building size is sufficient to plan the future location of any new passenger terminal facilities – a detailed breakout of space is not needed.

One broad-level methodology used to calculate overall terminal building size was based on building area per gate. This methodology estimates future terminal building size based on the number of required gates and an industry standard of interior space per gate, which takes into account all of the functions in a terminal (airline space, security, holdrooms, etc.).

The gate requirements developed in Section III.2.1, *Aircraft Gates*, can be used to estimate future building size based on this methodology. Generally, domestic airport passenger terminals average 20,000 square feet per gate. The 352,400-square foot existing passenger terminal at T. F. Green measures approximately 16,000 square feet per gate. It is likely that T. F. Green's ratio will increase to the industry standard as larger aircraft are used in the future. **Table III.2-7** shows the calculation of total passenger terminal space needed for each planning horizon assuming the 20,000 square feet per gate planning factor.

Table III.2-7
PASSENGER TERMINAL BUILDING REQUIREMENTS
T. F. Green Airport

Number of Gates	Year[1]	Sq. Ft./Gate	Terminal Building Area (square feet)
22	2000 (Existing)	16,000	352,000
26	2005	20,000	520,000
31	2010	20,000	620,000
36	2015	20,000	720,000
40	2020	20,000	800,000

[1] Requirements were calculated based on the draft forecasts and were not updated to reflect the final forecasts.

Based on the building area per gate methodology, approximately 800,000 square feet of terminal space will be needed by 2020. This is similar to the projections of total passenger terminal size in the more detailed space program contained in Appendix D and is sufficient for planning purposes. **Annual activity exceeding six million passengers will trigger the need for initial terminal expansion to approximately 500,000 square feet of building (projected to occur by 2005 based on the final forecasts).** The 2005 requirement of 520,000 square feet will more likely occur two to three years later than indicated in the above table based on the final forecasts. The 2010 projection could shift one to two years and the 2015 requirement will likely occur one year later. The 2020 final forecasts were virtually unchanged from the original projections so the 2020 terminal requirement remains valid.

III.3 Surface Transportation Facilities

This section describes the demand/capacity relationship for the surface transportation facilities at T. F. Green. The purpose of this analysis is to determine the maximum level of activity, as defined by annual or hourly activity, which can be accommodated on the existing surface transportation facilities at a reasonable level of service (LOS). For the purpose of this analysis, the proposed Warwick Train Station is assumed to be in place by mid-2005. The following are the main airport surface transportation facilities analyzed in this section:

- Airport Access Roadways
- Terminal Area Roadways
- Curbfront Facilities
- Public Parking Facilities
- Employee Parking Facilities
- Rental Car Facilities

III.3.1 Roadways

As passenger volumes increase at T. F. Green, airport-related traffic volumes will increase accordingly on area roads, including limited access roads such as the Airport Connector. As indicated in Chapter I, *Inventory*, Section I.5.3, *Landside Facilities*, the Airport Connector provides the primary means of access from I-95 directly to the terminal area roadways. Local roads adjacent to the airport, such as Airport Road to the north, provide access to Governor Francis, Hoxie, Conimicut, and Warwick Neck neighborhoods in eastern Warwick. Access to these neighborhoods is constrained by the shoreline location to the east and south, and by the airport itself. Few alternate routes are available for residents of these eastern neighborhoods to access other parts of Warwick or I-95.

The volume of projected passenger arrivals and departures is important in determining proposed traffic impacts to the airport's key arterial roadways and intersections, which provide direct access to and egress from T. F. Green Airport. These analyses also reflect future passenger enplanement projections, and employee and public parking areas located on the airport property. Also considered in this analysis is the construction and implementation of the proposed Warwick Intermodal Station and its relative impacts to the surrounding roadway infrastructure.

Based on the relationship of the projected enplaning and deplaning passengers to vehicular traffic access and egress, a traffic distribution methodology was developed for the airport roadway system. The primary result of the capacity analysis is the assignment of a LOS rank to traffic facilities under various traffic flow conditions. The concept of LOS is defined as a qualitative measure describing operational conditions within a traffic stream and how motorists perceive the conditions. A LOS definition provides an index for the quality of traffic flow, in terms of such factors as speed, travel time, freedom to maneuver, traffic interruptions, comfort, convenience, and safety.

Six LOS rankings are defined for locations with and without traffic signals. Signalized and unsignalized locations have different thresholds of delay per vehicle based on the methodology outlined in the *Highway Capacity Manual 2000*. Letter designations are assigned to indicate operating conditions, LOS A indicating lower delays and LOS F indicating higher delays. In general, a ranking of LOS D or better is acceptable for an urbanized area. The following are descriptions of delays for LOS A to LOS F:

- LOS A indicates free flow traffic conditions with little or no delay for approaching traffic.
- LOS B indicates relatively low delay, but more vehicles reduce speed than in LOS A.
- LOS C indicates operations with higher delays. The number of vehicles stopping in this grade is significant, but still many cars pass through with no delay.
- LOS D describes operations with delay in the range where the influence of congestion becomes more noticeable. Many vehicles stop and individual cycle failures are noticeable.
- LOS E indicates operations with high delays. Individual cycle failures are a frequent occurrence.
- LOS F describes the worst operating conditions. High delay occurs with over-saturated conditions. Poor progression and long cycle lengths may also be a major contributing cause to such delays.

Table III.3-1 indicates the LOS assignment for each grade, and the delay in seconds for signalized and unsignalized locations.

Table III.3-1
SUMMARY OF INTERSECTION LOS DETERMINATION CRITERIA
T. F. Green Airport

	Average Stopped Delay (seconds per vehicle)	
Level Of Service (LOS)	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

Highway Capacity Analysis (HCS2000) software was used for the intersection capacity analysis. Traffic signal timing plans were collected from the Rhode Island Department of Transportation (RIDOT). These plans are used to time traffic signals in the field and are kept on record with RIDOT. The internal airport intersection at the short-term parking lot was timed in the field to measure signal timing and determine phasing due to the lack of a signal plan.

Methodology

A study area was defined for this analysis and is described in Chapter I, *Inventory*, Section I.5.3, *Landside Facilities*. Vehicle turning movement data and arterial counts for the individual intersections within the study area have been utilized to establish a traffic datum from which to work. This datum was used as a “snapshot” for daily traffic during peak times and is relative to arriving and departing flight information taken for the same time period.

Existing flight schedules were obtained from airline records for flights during the November 2000 study period. The flight schedules were used to obtain data on daily arrivals and departures, aircraft type, and number of total seats on each flight. A 90 percent aircraft occupancy was used to determine the number of passengers per flight.[13] Enplaning and deplaning passengers were then related to vehicles entering the airport arterial system via on-airport roadways and the off-site state highway system. The relationship of passengers to vehicles was determined to be 1.8 average passengers per vehicle (see Table A-9 in Appendix A, *Survey Results*).

The flight schedule was overlaid onto the daily traffic turning movement counts for the arterial roadway system. An additional 30 to 60 minutes was allowed for arriving passengers and departing passengers to reflect the time the passengers would actually be using the roadways. A direct correlation was then made between flights and peak vehicular traffic times. During the p.m. peak period, peak flight times and peak vehicular traffic times occurred virtually at the same time. In the a.m. peak period, the times were slightly offset. The a.m. airport peak begins prior to typical non-airport peak traffic. The airport-generated traffic occurring at these times was then distributed onto the arterial roadway system based on the derived traffic distribution plan.

This distribution was factored against employee traffic, passenger traffic, and taxi traffic based on the percentage breakdown by use. The derived trip generations were subtracted from the total traffic for each movement. An annual growth factor of 1.04 percent, based on RIDOT traffic planning for the city of Warwick, was then applied to the remaining traffic network, factoring out all airport-related traffic. Growth factors for airport traffic were derived based on the projected forecasts for each of the planning years. The two traffic components were then recombined for each of the study years to derive a new traffic count/movement at each of the subject intersections. Exceptions to

[13] This is higher than the load factors used in the forecasting analysis in Chapter II. A 90 percent load factor was used to represent a conservative impact of the airport on local traffic.

this methodology were intersections where all turning movements are 100 percent airport traffic. In this instance peak enplanement times were used for peak vehicular movements and growth was solely enplanement based.

Trip Distribution

Airport traffic was distributed on the arterial road network around the airport based on existing arrival and departure patterns and traffic count data. The overwhelming majority of airport traffic arrives and departs via the Airport Connector. Other local traffic uses Post Road (U.S. Route 1) to reach the minor arterial network, which includes Airport Road, Jefferson Boulevard, and Coronado Road. **Exhibit III-3.1** and **Exhibit III-3.2** indicate arrival and departure travel patterns for the airport.

Airport Access Roadways

Traffic operations for 2005, 2010, 2015, and 2020 indicate a consistent increase in traffic volume due to the projected growth at the airport and regional and local background development growth. This increase in traffic impacts vehicle operations at study area intersections. These operations are impacted during the p.m. peak, which coincides with and overlaps a portion of the peak airport traffic. The a.m. peak hour does not indicate an overlap, so impacts are minimal.

Table III.3-2 presents LOS results for projected analysis years for signalized intersections. **Table III.3-3** presents this information for unsignalized intersections. The LOS roadway analysis in these tables was based on the draft forecasts. The final forecasts project lower passenger volumes from 2005 to 2015 indicating that the need for roadway improvements could possibly be deferred a few years. In addition, there have been changes in the times passengers access the airport due to the increased security requirements since September 11. Passengers must now get to the airport much earlier than before, which can cause changes in the timing and location of roadway congestion. Increases in roadway traffic in the future will trigger the need for roadway improvements and should be monitored closely to determine when roadway improvements will be needed.

Two intersections are currently operating at an unacceptable level of service (Jefferson Boulevard at Coronado Road and Jefferson Boulevard at the Airport Connector Off-Ramp – eastbound left). The second intersection is unsignalized but a signal is planned as part of the Intermodal Station.

As airport activity reaches the range of 6.1 to 6.7 million annual passengers, the Post Road at Coronado Road intersection will need improvements. As airport activity increases to eight million passengers annually, the intersections of Airport Road at Commerce Drive and Post Road at Airport Road will require improvements. Annual passenger levels exceeding nine million will trigger the need for improvements to the intersections of Airport Road at Hade Court and Post Road at the Airport Connector Off-Ramp.

Table III.3-2
EXISTING AND PROJECTED LEVEL OF SERVICE (LOS) – SIGNALIZED INTERSECTIONS, AIRPORT AREA ACCESS ROADS
T. F. Green Airport

	A.M. Peak Hour									
Signalized Intersections	**Existing**		**2005**		**2010**		**2015**		**2020**	
	Delay	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**
Location										
Post Road at Airport Road	30.9	C	35.7	D	42.3	D	51.0	D	60.7	E
Post Road at Coronado Road	17.1	B	18.6	B	20.6	C	24.2	C	41.2	D
Post Road at Off Ramp	14.9	B	15.6	B	16.6	B	17.9	B	20.0	C
Post Road at On Ramp	3.9	A	4.0	A	4.1	A	4.3	A	4.4	A
Post Road at Donald Avenue	13.8	B	14.1	B	14.5	B	15.1	B	15.8	B
Jefferson Blvd at Coronado Rd.	21.6	C	25.3	C	31.2	C	40.9	D	57.8	E
Airport Road at Hade Court	41.4	D	46.9	D	53.8	D	61.8	E	69.9	E
Airport Road at Commerce Drive	38.6	D	52.1	D	67.9	E	85.5	F	104.9	F
	P.M. Peak Hour									
Location										
Post Road at Airport Road	41.1	D	47.9	D	56.9	E	68.4	E	82.7	F
Post Road at Coronado Road	44.2	D	57.3	E	70.6	E	86.7	F	106.3	F
Post Road at Off Ramp	30.9	C	40.0	D	52.6	D	68.1	E	86.3	F
Post Road at On Ramp	4.7	A	4.9	A	5.2	A	5.5	A	5.9	A
Post Road at Donald Avenue	17.3	B	17.9	B	19.3	B	21.7	C	23.0	C
Jefferson Blvd at Coronado Rd.	78.2	E	94.0	F	111.9	F	132.7	F	156.7	F
Airport Road at Hade Court	16.8	B	19.9	B	25.8	C	35.6	D	48.3	D
Airport Road at Commerce Drive	15.6	B	15.3	B	16.3	B	17.6	B	19.5	B

Note: Requirements were calculated based on the draft forecasts and were not updated to reflect the final forecasts.
Note: Delay is expressed in seconds per vehicle.

Table III-3.3
EXISTING AND PROJECTED LEVEL OF SERVICE (LOS) – UNSIGNALIZED INTERSECTIONS, AIRPORT AREA ACCESS ROADS
T. F. Green Airport

	A.M. Peak Hour									
Unsignalized Intersections	**Existing**		**2005**		**2010**		**2015**		**2020**	
	Delay	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**
Location										
Jefferson Boulevard at Airport Connector On Ramp NB Left *	9.3	A	9.6	A	9.8	A	10.2	B	10.7	B
Jefferson Boulevard at Airport Connector Off Ramp EB Left *	81.7	F	121.5	F	175.6	F	242.5	F	329.7	F
Jefferson Boulevard at Airport Connector Off Ramp EB Right *	10.4	B	10.6	B	10.8	B	11.1	B	11.3	B
	P.M. Peak Hour									
Location										
Jefferson Boulevard at Airport Connector On Ramp NB Left *	14.0	B	13.5	B	14.7	B	16.3	C	18.5	C
Jefferson Boulevard at Airport Connector Off Ramp EB Left *	29.3	D	26.2	D	31.5	D	41.2	E	57.7	F
Jefferson Boulevard at Airport Connector Off Ramp EB Right *	14.7	B	14.0	B	14.8	B	15.8	C	17.1	C

* Signals proposed as mitigation for the Warwick Intermodal Station project at the Jefferson Boulevard/Airport Connector ramp intersections will improve the Level of Service (LOS) at these currently unsignalized intersections to the B range in projection years.

Note: Requirements were calculated based on the draft forecasts and were not updated to reflect the final forecasts.

Note: Delay is expressed in seconds per vehicle.

Two intersections along Coronado Road (at Post Road and Jefferson Boulevard) show high delays and LOS F conditions that indicate possible future gridlock conditions by the end of the planning period unless improvements are made. These intersections receive a majority of the traffic growth from the airport. As a result of the increased delay at the intersections, the arterial LOS along Coronado Road will be degraded in the future. This reduction in LOS is primarily caused by increased traffic on the section of Coronado Road that has reduced sight distance and minimum road width on a bridge over the rail line. These conditions will create more congestion on this two-lane roadway compared to existing conditions.

Other locations with high delay and LOS F conditions by the end of the planning period are Post Road at Airport Road and Post Road at Airport Connector in the p.m. peak hour and Airport Road at Commerce Drive in the a.m. peak hour. Traffic along Airport Road is predominantly commuter traffic traveling to and from the eastern portion of Warwick. Very little airport traffic utilizes this road east of the old terminal building.

Traffic on Post Road emanating from the airport egress at Coronado Road is expected to realize a slight elevation in LOS during peak hours due to the relocation of rental car operations to the proposed Warwick Intermodal Station. This relocation will eliminate shuttle bus trips to offsite rental car facilities via Post Road. This slight decrease in volume results in a one to two percent drop in overall Post Road traffic volume during p.m. peak hour arterial traffic.

Terminal Area Roadways

The major terminal area roadway is the terminal loop road that extends from the Airport Connector terminus and encircles short-term parking. This roadway provides direct access to short-term parking and curbside access to the arrival level of the airport terminal. This road continues from the terminal and provides access to and egress from the three parking garages located to the north of the terminal. It then loops around, merging with the departure drop-off ramp and short-term lot egress back to the Airport Connector terminus intersection. The terminal loop road provides direct access onto Post Road at Coronado Road along the northwest corner prior to the ramp/parking merge.

LOS for the airport signalized intersection is presented in **Table III-3.4**. Many of the approach roadways to this intersection have dedicated right, left, or through lanes and limited storage areas, resulting in low LOS in the D to F range as passenger levels approach six million annually. **The airport intersection is barely operating at an acceptable level of service now and will need improvements over the next several years as traffic increases to over six million passengers annually.**

Table III.3-4
EXISTING AND PROJECTED LEVEL OF SERVICE (LOS) – SIGNALIZED INTERSECTION, TERMINAL AREA ROADWAYS (P.M. PEAK HOUR)
T. F. Green Airport

Signalized Intersection	Existing		2005		2010		2015		2020	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Internal Intersection at Short-term Parking	50.5	D	55.7	E	96.3	F	146.7	F	223.4	F

Note: Requirements were calculated based on the draft forecasts and were not updated to reflect the final forecasts.
Note: Delay is expressed in seconds per vehicle.

The airport entrance on Post Road at Donald Avenue provides access to the terminal via the Airport Connector. It links to the upper departure level, the long-term parking surface lot, and connects into the terminal loop road and the Airport Connector terminus. **As indicated in Table III.3-2, Post Road at Donald Avenue will operate at an acceptable LOS through 2020.**

The airport delivery entrance is located at the rear of the RIAC garage, with a signalized intersection on Airport Road. This roadway provides access and egress for fuel deliveries, rental car storage, and maintenance operations north of Airport Road at the Senator Street lot, and to other rental car locations on Post Road. This road is adjacent and parallel to the northwest corner of Runway 16-34. This signal is actuated by traffic exiting Delivery Road and actually functions as a stop sign for right turning traffic**. The current traffic signal requires an upgrade to better handle exiting traffic from Delivery Drive. The loop detection on the Delivery Drive approach is inadequate to cover some right turning traffic.**

III.3.2 Curbfront Facilities

Detailed curbfront requirements were developed prior to the attacks of September 11, 2001 and can be found in Appendix E, *Curbfront Requirements*. This analysis determined that based on operating procedures in place in 2000 and 2001, additional curb capacity would be needed in the 20-year planning horizon. The analysis found that minor changes in the operating procedures of the curbfront would allow it to serve forecast demand.

There have been many changes in the way the curbfront operates since September 11 that have actually improved the capacity of the curbfront. For example, vehicles are no longer permitted to stand at the curb if they are not actively loading or unloading (this is enforced by police officers). In addition, no more than three taxi cabs are permitted to queue at the curb, all others must wait in a holding area. **Provided these procedures remain in place, the curbfront will be sufficient to serve forecast demand through 2020.** However, because security regulations are still evolving, the curbfront capacity should be closely monitored to assess future needs. It is important to note that as the terminal building expands, additional curbfront areas will likely be provided which will improve the level of convenience for passengers.

III.3.3 Public Parking Facilities

There are two types of public parking facilities at T. F. Green: short-term and long-term parking. Short-term parking generally consists of vehicles parking for less than five hours. Long-term parking is for vehicles with day-long, overnight, or longer stays and is generally less expensive than short-term parking.

It is important to note that parking demand is elastic. The demand for a particular lot can change substantially with changes in the price structure. RIAC may be able to manage some future parking capacity deficits by adjusting the price structure of their parking facilities. For purposes of this analysis, the pricing structure is assumed to remain the same as it is today. This does not imply that prices will not change in the future; rather, it assumes the relative cost of one facility to another and to off-airport competitors will remain constant.

Typically in a parking facility requirement analysis the existing demand for parking spaces is obtained from the operators of the parking facilities. Future demand is then projected by increasing the existing demand at the same rate as forecast enplanements. In this case, demand for the existing parking facilities could not be quantified because the parking concession operators at T. F. Green consider that information proprietary. As a result, future demand was estimated based on other methodologies.

Existing Public Parking Facilities

The existing public parking facilities are shown on **Exhibit III.3-3**. Long-term public parking is accommodated along the southern edge of the RIAC property in a 4,700-space vehicle surface lot, the 1,500-space Red Beam Garage, the 1,460-space RIAC garage, and the 750-space valet garage, located immediately west of the terminal building along the terminal loop road.

Short-term hourly parking is located within the 650-space surface lot located in the front of the terminal building within the terminal loop road. Some of the spaces in the short-term lot are no longer available due to security regulations enacted after September 11.[14]

The three largest rental car companies currently use 156 parking spaces in the first level of the RIAC garage for ready/return parking. It is assumed that all rental car functions will be relocated to the proposed Warwick Intermodal Facility by mid-2005, allowing long-term parking to expand into the first level of the garage.

Employees currently use portions of the short- and long-term parking lots. RIAC sources estimate that employee parking occupies approximately 30 percent of the long-term lot (1,410 spaces). Senior airport administration staff currently park in 18 spaces within the RIAC garage.

Considering the other uses in the long-term parking facilities, 6,800[15] of the 8,410 spaces are available for public parking. In summary, there were 650 short-term and 6,800 long-term public parking spaces available on-airport property in 2000.

In addition to the on-airport parking facilities, there are also 3,850 parking spaces in off-airport, privately owned, public parking facilities. This results in 10,650 public parking spaces for use by T. F. Green passengers. RIAC has no control over the privately owned, off-airport facilities so these facilities were not included in this analysis. The exception to this is the Red Beam Garage, which is not owned by RIAC. This garage is immediately adjacent to airport property, functions as an airport garage, and is not likely to be redeveloped for other uses. Therefore, this garage was included in the analysis of public parking facilities.

14 No parking within 300 feet of the terminal building.

15 The 6,800 spaces includes parking by airport administration staff, which represents a small portion of the demand in the garage.

Short-term Parking

The short-term parking demand/capacity relationship and resulting requirements are shown in **Table III.3-5**. Future short-term parking demand was derived by first estimating peak hour parking demand, which is assumed to be 10 percent of PMAD passengers. The peak hour parking demand was then multiplied by the percentage of passengers using personal vehicles (60 percent, as indicated in Table A-8 of Appendix A, *Survey Results*), by the short-term lot usage (27 percent, as indicated in Table A-11, in Appendix A), divided by the average passengers per vehicle (1.8, as indicated in Table A-9 in Appendix A).

Peak hour demand for the short-term parking lot is expected to average less than 50 percent utilization throughout the planning period. **Therefore, the short-term parking lot is sufficient to accommodate forecast demand through 2020.** Even with the loss in spaces due to September 11, this lot would still be sufficient through 2020. RIAC is currently developing restricted egress employee or "trusted agent" parking within the area of the short-term parking lot that falls within 300 feet of the terminal in order to make use of the "lost" spaces.

Table III.3-5
SHORT-TERM PUBLIC PARKING REQUIREMENTS
T. F. Green Airport

					Short-Term Public Parking (spaces)			
PMAD Pass.	Peak Hour Demand[1]	% Personal Cars[2]	Short-term Lot Usage[3]	Pass./ Vehicle[4]	Demand	Capacity	Surplus/ (Deficit)	Year[5]
20,748	2,075	60%	27%	1.8	190	650	460	2005
24,760	2,476	60%	27%	1.8	220	650	430	2010
28,816	2,882	60%	27%	1.8	260	650	390	2015
35,508	3,551	60%	27%	1.8	300	650	350	2020

1 Peak hour parking demand is assumed to be 10 percent of PMAD passengers.
2 Based on survey results – see Appendix A, Table A-8.
3 Based on survey results – see Appendix A, Table A-11.
4 Based on survey results – see Appendix A, Table A-9.
5 Requirements were calculated based on the draft forecasts and were not updated to reflect the final forecasts.

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Long-term Parking

As discussed previously, there are a total of 8,410 parking spaces in the on-airport long-term parking facilities, of which 6,800 are available for long-term parking. Presently, 1,610 spaces in the long-term parking facilities are used for rental car and employee parking.[16] The first priority for RIAC with regard to auto parking is to provide convenient public parking spaces for airline passengers. Public parking is an important revenue source for the airport and the use of these facilities for passengers should be

16 Does not include airport administration parking in the RIAC garage.

maximized. As demand for the long-term parking facilities increases, it will be necessary for RIAC to relocate the rental car and employee parking functions. There are already plans to relocate the rental car functions to the proposed Warwick Intermodal Facility. Employee parking needs will be discussed in Section III.3.4, *Employee Parking Facilities*. For purposes of this analysis, it is assumed that all parking spaces in the long-term parking facilities are available for passenger parking in the future. The exception to this is airport administration staff parking in the RIAC garage. This use is expected to continue in the future and represents a minor portion of the overall parking demand.

Demand for all long-term parking facilities was combined and evaluated in aggregate. Some facilities may have lower or higher utilization rates than others but it was assumed that the use of all long-term parking facilities would be optimized before new lots or garages are constructed. Use of the facilities can be controlled through pricing.

As stated previously, existing parking facility demand was not available. Therefore, for the purposes of establishing future demand levels, a ratio of parking spaces to demand levels was used. Future long-term parking demand was calculated based on a ratio of 2.5 spaces per 1,000 enplanements. At large hub airports, parking studies indicate that a ratio of 2.5 spaces per 1,000 enplanements may be used to approximate total long-term parking needs. At some medium to small hubs, the total long-term parking spaces available tends to be closer to 3.5 spaces per 1,000 enplanements. Parking ratios are typically lower at larger hub airports due to greater utilization of alternative ground transportation modes compared to private cars (including bus, taxi, limousine, and future Amtrak and MBTA service to Providence and Boston).

Often, Rhode Island passengers are dropped off and picked up at the airport by family or friends to avoid paying long-term parking fees, especially for leisure trips. With a small state, in which all areas are within 45 minutes of the airport, this trend is expected to continue. As enplanements grow at T. F. Green in the future, it would be expected that the ratio of total required spaces would decline over the planning period. T. F. Green Airport is a medium-hub airport that is growing into a large-hub airport. Considering recent and projected growth at T. F. Green and the habits of its passengers, a ratio of 2.5 spaces per 1,000 enplanements is appropriate for projecting future long-term parking demand.

Table III.3-6 provides the long-term parking demand/capacity analysis. **By 2005, all of the public parking spaces will be needed for passenger use and employee parking will be displaced from the long-term lot. By 2020, a total of 13,500 parking spaces will be required, resulting in a deficit of 5,090 spaces.** These projections were calculated based on the draft forecasts. Based on the updated final forecasts, the 2005 requirements identified in the table will likely occur two to three years later. The 2010 projections could shift one to two years and the 2015 requirements could shift one year. The 2020 final forecasts were virtually unchanged from the original projections, so the 2020 long-term parking facility requirements are valid. **The first major expansion of the long-term parking facilities will be needed once annual passenger enplanements exceed 3.5 million (projected to occur by 2008-2009 based on the final forecasts).**

Table III.3-6
LONG-TERM PUBLIC PARKING REQUIREMENTS
T. F. Green Airport

	Long-Term Public Parking (spaces)				
Annual Enplanements	Demand[1]	Capacity[2]	Surplus (Deficit)	Utilization	Year[3]
3,350,700	8,400	8,410	10	100%	2005
3,998,800	10,000	8,410	(1,590)	119%	2010
4,653,900	11,600	8,410	(3,190)	138%	2015
5,411,400	13,500	8,410	(5,090)	161%	2020

1 Future long-term parking demand is based on a ratio of 2.5 parking spaces per 1,000 enplanements.
2 Based on 4,700 spaces in the long-term lot, 1,500 spaces in the Red Beam Garage, 1,460 spaces in the RIAC garage, and 750 spaces in the valet garage.
3 Requirements were calculated based on the draft forecasts and were not updated to reflect the final forecasts.

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III.3.4 Employee Parking Facilities

There are currently no designated employee parking lots at T. F. Green Airport. Most employees park within the long-term surface lot (employees use approximately 1,410 parking spaces in this lot). Employees are transported to and from the terminal via airport shuttle busses, which are primarily used to transport passengers.

The analysis presented in Section III.3.3, *Public Parking Facilities*, determined that all of the long-term parking facilities will be needed for passenger use by 2005 and will no longer be able to accommodate employee parking. This will thereby reduce the supply of available employee parking. It is a typical industry standard for employees to park in a dedicated remote lot, rather than in the public parking lots, which provide revenue for the airport.

Based on RIAC data, there are approximately 1,400 employees working in the terminal at T. F. Green, including T. F. Green terminal staff, airline employees, and staff of private concessions and tenants. Not all employees park at the same time due to use of different shifts, vacations, etc. According to RIAC, approximately 75 percent of the employee workforce uses the parking facilities at the same time. This occurs between 7:00 a.m. and 4:00 p.m. on weekdays. In addition, employees from other facilities on the airport (such as the hangars on the Northeast and Northwest Ramps) also park in the long-term lot. RIAC estimates that approximately 1,410 employees park in the long-term lot. Future employee demand levels were determined by applying the growth rate of forecast enplanements to the existing employee parking demand.

The facility requirements for employee parking are shown in **Table III.3-7**. **By 2020, a total of 2,800 employee parking spaces will be needed.** Based on the updated final forecasts, the 2005 requirements will likely occur two to three years later. The 2010 projections could shift one to two years and the 2015 requirements could shift one year. The 2020 final forecasts were virtually unchanged from the original projections, so the 2020 employee parking facility requirements are valid. **Once annual enplanement levels exceed six million (around 2005) employees will no longer be able to park in the long-term lot and a dedicated lot will be required for employee parking.**

Table III.3-7
EMPLOYEE PARKING REQUIREMENTS
T. F. Green Airport

Annual Enplanements	% Increase in Enplanements	Employee Parking (spaces): Demand[1]	Capacity[2]	Surplus/ (Deficit)	Year[3]
2,715,469	N/A	1,410	1,410	0	2000
3,350,700	23.4%	1,750	0	(1,750)	2005
3,998,800	19.3%	2,100	0	(2,100)	2010
4,653,900	16.4%	2,400	0	(2,400)	2015
5,411,400	16.3%	2,800	0	(2,800)	2020

[1] RIAC estimates that 1,410 employees currently park in the long-term lot.
[2] Approximately 30 percent of the long-term lot was available for employee parking in 2000. It is assumed that employees can no longer park in this lot after 2005 as it will be needed to accommodate passenger parking.
[3] Requirements were calculated based on the draft forecasts and were not updated to reflect the final forecasts.

Source: RIAC staff
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III.3.5 Rental Car Facilities

The ease with which rental car customers may rent and return cars is an important factor in the air passenger's satisfaction with T. F. Green Airport. As indicated in Chapter I, *Inventory*, Section I.5.3, *Landside Facilities*, three rental car firms are located in the RIAC garage, adjacent to the terminal, while the remaining six are located off-airport in the vicinity of Post Road and Jefferson Boulevard.

Rental car firms located in the RIAC garage are currently constrained. According to a detailed survey of rental car companies conducted by RIAC in September 2000, only 39 rental car storage spaces are available in the garage (most of the available spaces are used for ready/return). These firms have additional storage capacity off-site, requiring the movement of cars between the garage and the lots north and west of the airport, via Delivery Road and Airport Road.

Table III.3-8 presents existing and future rental car needs as provided by the rental car companies.

RIDOT and RIAC are proceeding with plans to relocate all nine rental car firms to the proposed Warwick Intermodal Station on Jefferson Boulevard. This 4,000-car garage will accommodate ready/return and Quick Turn Around (QTA) facilities for fueling and car washes. The garage is planned to accommodate rental car commuter rail parking.

With connection via a proposed 1,700-foot automated people mover to the airport terminal, the station will function as a new front door to the airport for both rail passengers and rental car customers. The purpose of consolidation of all rental car activities is to provide the following benefits:

- Eliminate the need for shuttle service to off-airport locations
- Free up garage space in the RIAC garage for passenger parking
- Reduce on-airport and Post Road rental car traffic while providing access to the Airport Connector and I-95 via Jefferson Boulevard

The Warwick Intermodal Station garage has not been sized to accommodate all rental car and commuter rail parking needs anticipated in 2020. When the capacity of the garage is reached, vehicle storage for peak season use will require additional sites within the community.

III.4 Air Cargo Facilities

Air cargo encompasses two separate entities at T. F. Green that are defined by their means of transportation: integrated carrier cargo and belly cargo. Integrated cargo carriers provide air transportation as part of a single, seamless, door-to-door product that includes pickup, transportation and delivery, insurance, tracing, customs clearance, and other functions. United Parcel Service (UPS), Federal Express, and Airborne Express are the current integrated cargo carriers at T. F. Green. These carriers operate aircraft that carry only cargo.

Belly cargo is a by-product of the passenger airlines that have room to carry cargo in the under-side baggage compartments of their scheduled flights. This type of cargo is typically handled by the airlines themselves, or by a third-party contractor, who may offer a variety of handling services including delivery. The United States Postal Service (USPS) is a primary user of belly cargo capacity.

Future facility requirements for integrated cargo carriers and belly cargo have been determined for building facilities and landside facilities, as well as for the integrated cargo carriers' airside facilities. These requirements are discussed in the sections that follow.

Table III.3-8
PROJECTED RENTAL CAR REQUIREMENTS
T. F. Green Airport

	2000	2005	2010	2020
Rentals	565,000	671,043	796,988	1,124,231
Average Day	1,548	1,839	2,184	3,080
Maximum Day	2,260	2,684	3,188	4,497
Ready/Return Spaces	610	725	861	1,214
Storage Spaces	904	1,074	1,275	1,799
Total Spaces	1,514	1,798	2,136	3,013
Total Equivalent Spaces*	**1,179**	**1,400**	**1,663**	**2,345**
Nozzles	27	32	38	54
Wash Bays	7	8	10	13
Hertz Ready/Return	160	190	225	318
Hertz Storage	237	281	334	471
Hertz Total Equivalent*	**309**	**366**	**435**	**614**
Avis Ready/Return	128	152	180	254
Avis Storage	189	225	267	377
Avis Total Equivalent*	**247**	**293**	**348**	**491**
Budget Ready/Return	73	87	103	145
Budget Storage	108	128	152	215
Budget Total Equivalent*	**141**	**167**	**198**	**280**
Alamo Ready/Return	70	84	99	140
Alamo Storage	104	124	147	208
Alamo Total Equivalent*	**135**	**162**	**192**	**271**
National Ready/Return	70	83	98	139
National Storage	103	123	146	206
National Total Equivalent*	**135**	**160**	**190**	**268**
Thrifty Ready/Return	31	37	43	61
Thrifty Storage	46	54	64	91
Thrifty Total Equivalent*	**60**	**71**	**84**	**118**
Dollar Ready/Return	27	32	38	53
Dollar Storage	40	47	56	79
Dollar Total Equivalent*	**52**	**61**	**73**	**102**
Enterprise Ready/Return	22	26	31	44
Enterprise Storage	33	39	46	65
Enterprise Total Equivalent*	**52**	**61**	**73**	**102**
Small Company Ready/Return	31	36	43	61
Small Company Storage	45	54	64	90
Small Company Total Equivalent*	**76**	**90**	**107**	**151**

* Ready and Return spaces require approximately 350 square feet per space. Storage spaces require approximately 220 square feet per space. Therefore, one Ready and Return space is equivalent to 1.59 Storage spaces. Total Equivalent spaces are based on the Ready and Return spaces plus 62.86% of the Storage spaces.

Source: RIAC Rental Car Survey, September 2000

III.4.1 Integrated Cargo Carrier Facilities

As shown in **Exhibit III.4-1**, the facilities for the integrated cargo carriers (UPS, Federal Express, and Airborne Express) are located on the Northeast Ramp at T. F. Green and are comprised of one half of Hangar #2, airside apron space, and landside truck/auto parking areas. Several important factors regarding these carriers' operations at T. F. Green include:

- Airborne Express leases its apron space from Northstar Aviation to accommodate a single cargo aircraft (typically a DC-9) as well as its associated Ground Support Equipment (GSE). This aircraft is typically parked on the ramp throughout the daytime. All cargo is off-loaded to trucks from the ramp and sent to nearby sort facilities in both Cranston and Coventry, Rhode Island for processing. This type of operation is typical of Airborne Express at other airports and they have not expressed any interest in establishing a permanent sort facility at T. F. Green. The only facility that Airborne Express currently maintains at T. F. Green is an office located in Hangar #2 for its aircraft maintenance staff.
- Like Airborne Express, UPS also leases its apron space from Northstar Aviation to accommodate a single cargo aircraft (typically a B-757) as well as its associated GSE. Its aircraft is also typically parked on the ramp throughout the daytime. All cargo is off-loaded to trucks from the ramp and sent for processing to a large sort facility that is located within Warwick and very close to T. F. Green. While UPS will establish sort facilities on an airport if there are appropriate economic benefits, it has not expressed any interest in establishing a permanent sort facility at T. F. Green. Similar to Airborne Express, the only facility that UPS currently maintains at the airport is an office located in Hangar #2 for its aircraft maintenance staff.
- Federal Express leases the northern half of Hangar #2 from RIAC as well as apron space from Northstar Aviation. Unlike the other carriers, Federal Express does not have any sort facilities nearby, and therefore must conduct a ramp sort of cargo before loading it on trucks bound for Hartford, Connecticut; Franklin, Massachusetts; Brockton, Massachusetts; and other out-of-state facilities for processing. The area in Hangar #2, leased from RIAC, is used to conduct this limited sorting of cargo, as well as for storage of equipment. Federal Express will establish sort facilities on an airport given appropriate economic benefits. They have expressed a desire to expand their existing limited sort operation to a full sort facility at T. F. Green.
- Federal Express typically utilizes a B-727-200 aircraft at T. F. Green (with an additional B-727-200 during peak demand periods, such as the winter holiday season), as well as three Cessna 208 Caravan "feeder" aircraft. All aircraft are parked on the ramp throughout the daytime. Federal Express has also indicated that they may ultimately replace one of the B-727s with an A300 if the demand warrants it.

In addition to the airport's existing cargo facilities, RIAC is also exploring development opportunities for an airport-owned parcel, known locally as "Aeroland." Located south of Runway 34 and abutting the ATCT, Aeroland is a 15.25-acre site having direct landside access to Industrial Drive, as well as potential airfield access via a new taxiway stub to Taxiway "C." The intent of developing this site is to effectively shift all of the existing integrated cargo carriers from the Northeast Ramp to Aeroland, including accommodating Federal Express' desire to develop a full sort facility at T. F. Green.

A private developer is working with RIAC to actively explore this possibility, however, the process is still in the early stages. Issues relating to wetlands, culverting a stream for the taxiway crossing, and ancillary issues related to abutting industrial development, including the closed Truk-A-Way landfill site, will all need to be addressed to establish the site's ultimate development viability as a cargo facility. The Aeroland development will be considered in Chapter IV, *Alternatives*.

Below is a discussion of the building, airside, and landside facility requirements for the integrated carriers.

Building Facilities

While neither Airborne Express nor UPS is likely to pursue developing a cargo handling or sort operation at T. F. Green because of the close proximity of existing facilities, they will likely continue to maintain limited office space at T. F. Green. As a result, and due to Federal Express' stated interest in establishing a full sort facility at T. F. Green, the development of the building space requirements were based primarily on those of Federal Express.

As such, it has been noted through discussions with Federal Express that a minimum building size for a full sort facility to accommodate cargo loads at T. F. Green for 2000 would be 20,000 square feet, and that this would be sufficient for approximately 10 years, at which time a total of 30,000 square feet would be required.

For purposes of this analysis, this information was used as input for the development of a tonnage per area ratio (TAR) for T. F. Green, defined in units of total annual tons of freight per square foot of cargo floor space. This ratio can then be compared to a derived maximum TAR value, which will typically range from 0.5 tons/square foot to 2.0 tons/square foot, with the latter being representative of a highly efficient automated sort operation. Achieving a higher value of TAR is dependent upon the degree of mechanization, the layout of the building, the type of cargo (international versus domestic; refrigerated, etc.) and on how the cargo is typically packaged for shipping (i.e. pallets, containers, etc.). The determination of a maximum TAR value for the T. F. Green facilities involved a comparison of recommended planning ratios and the existing operational environment, as well as from direct input from Federal Express.

In 2000, the TAR for T. F. Green was 0.87. However, this number reflects existing cargo operations only, and does not consider the spatial requirements for the development of a full sort facility operation. In order to account for this shift in the type of cargo operations being conducted by Federal Express, a maximum TAR value of 0.82 was utilized. This revised value accommodates both the increased spatial requirements of Federal Express, while accounting for the existing level of operations for the remaining two carriers.

The maximum TAR values and the forecast air freight tonnage were used to derive the amount of building area required to accommodate future demand levels. These requirements were then compared to the existing building square footage to determine if a surplus or deficit will be experienced throughout the forecast period.

Table III.4-1 shows that a total of 20,500 square feet of building would be required in 2000 for a sort operation for Federal Express. This results in a deficit of 1,100 feet. When freight volumes reach over 26,000 tons annually, this building size deficit will grow to 13,200 square feet (projected to occur in 2010 based on the final forecasts). **Freight volumes in excess of 40,000 tons will result in a deficit of 29,800 square feet in building area and a total building requirement of 49,200 square feet (projected to occur in 2020 based on the final forecasts).**

It is important to note that the existing building area is comprised of various sections of RIAC's Hangar #2 and is not appropriate for use as a sort facility. The proposed Aeroland development would be able to accommodate all of the projected building facility requirements for the integrated cargo carriers throughout the planning period.

Table III.4-1
INTEGRATED CARGO CARRIER FACILITY REQUIREMENTS
T. F. Green Airport

Tons of Air Freight (U.S. tons)	Existing Facility TAR Value [1]	Maximum TAR Value [2]	Building Area Required with Max TAR Value (square feet)	Surplus/ (Deficit) (square feet)	Year[3]
16,811	0.87	0.82	20,500	(1,100)	2000
20,840	1.07	0.82	25,400	(6,000)	2005
26,720	1.38	0.82	32,600	(13,200)	2010
33,190	1.71	0.82	40,500	(21,100)	2015
40,380	2.08	0.82	49,200	(29,800)	2020
	2000 Building Area Available:		19,400 square feet		

[1] Tons of freight divided by the available building area.
[2] Maximum TAR value based on industry standards and on discussions with integrated cargo carrier personnel.
[3] Requirements were calculated based on the draft forecasts and were not updated to reflect the final forecasts.

Airside Facilities

The aircraft apron areas associated with the integrated cargo carriers were analyzed based on existing and future demand levels to assess the adequacy of the existing facilities to accommodate those demands. The number of PMAD all-cargo aircraft for each forecast year was used to determine the required apron areas. The cargo aircraft were broken down into two categories: air carrier and commuter. The air carrier aircraft category consists of the larger cargo aircraft, including the DC-9, B-727-200, B-757, and A300, while the commuter aircraft category is limited to the smaller, Cessna 208-B Caravan aircraft.

For planning purposes, a total of 6,200 square yards was used as a standard area requirement for each air carrier aircraft, while 1,200 square yards was used for each commuter aircraft. These parking envelopes incorporate standard wingtip clearances and allow room for GSE, as well as room for a taxilane servicing the area.

Table III.4-2 shows that there is cargo apron surplus in 2000 of approximately 6,000 square yards. However, as freight volumes increase to over 20,000 tons annually (projected to occur in 2005), additional apron space will be needed. **By 2020, freight volumes are expected to exceed 40,000 tons annually and an additional 25,000 square yards of apron will be needed, resulting in a total apron area of 53,200 square yards (based on the final forecasts).** The proposed Aeroland development would be able to accommodate this requirement throughout the planning period.

Table III.4-2
INTEGRATED CARGO CARRIER APRON REQUIREMENTS
T. F. Green Airport

Tons of Air Freight (U.S. tons)	PMAD Air Carrier[1] Operations	PMAD Commuter[2] Operations	Apron Area Required[3] (square yards)	Surplus/ (Deficit) (square yards)	Year[4]
16,811	3	3	22,200	6,000	2000
20,840	4	3	28,400	(200)	2005
26,720	5	3	34,600	(6,400)	2010
33,190	6	3	40,800	(12,600)	2015
40,380	8	3	53,200	(25,000)	2020

2000 Apron Area Available: 28,200 square yards

1 Air carrier aircraft include B727-200, B757, DC-9, and A300.
2 Commuter aircraft include the Cessna 208 Caravan.
3 Apron area required assumes 6,200 square yards for air carrier aircraft and 1,200 square yards for commuter aircraft. Square yards per aircraft includes standard wingtip clearances, allows room for GSE, and taxilane clearances.
4 Requirements were calculated based on the draft forecasts and were not updated to reflect the final forecasts.

Landside Facilities

The truck/auto areas associated with the integrated cargo carriers' facilities were analyzed on the basis of a ratio of truck/auto area to building area. Discussions with the personnel from all three carriers indicated that existing accommodations were marginally adequate for their current operations. Most concerns centered on the inefficient layout of the current space available. Layout issues aside, the current ratio of truck/auto area to building area of approximately 1.4 is considered adequate for determining future requirements. This ratio also coincides with the truck/auto requirements stipulated by Federal Express for the establishment of the 20,000-square foot sort facility described earlier.

To determine the future truck/auto requirements, this existing building area to parking area ratio was multiplied by the projected building area requirements shown previously in Table III.4-2. **Table III.4-3** displays the resulting truck/auto area requirements for the current and forecast years. Based on Federal Express' interest in developing a full sort facility at T. F. Green, there is currently a deficit of 1,700 square feet of truck/auto parking area. **By 2020, a total of 68,900 square feet will be needed, 41,900 square feet more than what is currently available.** Based on the final forecasts, the proposed Aeroland development would be able to accommodate this requirement throughout the planning period.

Table III.4-3
INTEGRATED CARGO CARRIER TRUCK/AUTO REQUIREMENTS
T. F. Green Airport

Projected Building Area Requirement (square feet)	Existing Parking Area to Building Area Ratio	Area Required (square feet)	Surplus/ (Deficit) (square feet)	Year[1]
20,500	1.4	28,700	(1,700)	2000
25,400	1.4	35,600	(8,600)	2005
32,600	1.4	45,600	(18,600)	2010
40,500	1.4	56,700	(29,700)	2015
49,200	1.4	68,900	(41,900)	2020
	2000 Area Available:	27,000 square feet		

[1] Requirements were calculated based on the draft forecasts and were not updated to reflect the final forecasts.
Source: RIAC and Federal Express.

III.4.2 Belly Cargo Facilities

As noted in Chapter II, *Forecasts of Aviation Demand*, Section II.3.4, *Forecasts of Cargo Volumes*, most passenger airlines accommodate air freight as a by-product to the primary activity of carrying passengers. This air freight is contained within the available belly space of an aircraft that would otherwise be left empty. The incremental costs of carrying belly cargo in a passenger aircraft are negligible, and include only ground handling expenses and a modest increase in fuel consumption.

The amount of belly cargo at an airport is largely dependent on the available volume and weight "lift" provided by the aircraft that serve the airport. At high passenger load factors there is less "lift" to sell for cargo because the passengers' luggage is occupying space that could be used for cargo. The exception to this is mail, which is often transported under contracts with the airlines, displacing other air cargo in favor of the contract commitment (i.e. mail has priority so it is not supply limited).

As shown in **Exhibit III.4-2**, two facilities at T. F. Green process belly cargo. The first is an 18,000-square foot building located south of the terminal building that is also used for GSE maintenance. Approximately 6,700 square feet of the building and 480 square yards of airside apron is used for processing belly cargo. An additional 5,400 square feet landside is used for shipping/receiving operations. The second facility is the USPS facility, which is located adjacent to the GSE Maintenance/Belly Cargo building. This building is 2,100 square feet and has an 940-square yard apron area used for the storage of mail handling bins and shipping/receiving operations.

Passenger Airlines Requirements

Building requirements for the handling and processing of belly cargo (excluding mail) are based strictly on the forecast availability of belly cargo capacity, as detailed in Table II.3-14. As total operations and average aircraft size increase in future years, the amount of belly cargo is expected to increase accordingly. Through 2010, the average amount of cargo that can be accommodated on the passenger aircraft is expected to increase marginally. Therefore, future belly cargo building requirements are expected to increase at the same rate as the overall growth in the belly cargo capacity through 2010. Belly cargo capacity will see significant increases beyond 2010 as B-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, and creating new demands on future facility requirements. At this point, in order to account for the greater cargo handling capacity, an additional 25 percent annual growth factor was incorporated. Beyond 2010, future requirements are expected to increase at the same rate as the overall growth in departures.

As shown in **Table III.4-4**, the belly cargo facility is currently operating at about 70 percent of capacity. As such, it is projected that a surplus of space will exist until 2010, when the combination of higher annual growth rates in operations and the introduction of widebody aircraft with palletized cargo will start to have a significant impact. When belly capacity reaches over 4,000 tons annually there is projected to be a deficit of 4,500 square feet in belly cargo building space. **As belly cargo capacity increases to 8,000 tons annually in 2020, there will be a requirement for an additional 17,900 square feet of building area.**

Table III.4-4
BELLY CARGO BUILDING REQUIREMENTS
T. F. Green Airport

Belly Capacity (U.S. tons)	Average Annual Compound Growth Rate	Building Requirement[1] (square feet)	Surplus/ (Deficit) (square feet)	Year[2]
1,750	-	4,700	2,000	2000
2,040	3.1%	5,500	1,200	2005
4,030	14.6%	11,200	(4,500)	2010
4,090	0.3%	11,400	(4,700)	2015
7,640	13.3%	24,600	(17,900)	2020

2000 Belly Cargo Area Available: 6,700 square feet)

[1] The belly cargo building requirement is expected to increase at the same rate as belly cargo capacity. Area increased by 25 percent growth factor in 2010 to account for introduction of B-767 aircraft.
[2] Requirements were calculated based on the draft forecasts and were not updated to reflect the final forecasts.
Source: RIAC, Quantum, and Delta Airlines.

The 2000 truck/auto areas associated with the belly cargo facilities were analyzed on a ratio of truck/auto area to building area. Discussions with facility personnel indicated that existing accommodations were adequate for their facility. Therefore, the current ratio of truck/auto area to building area of approximately 1.4 is considered adequate for determining future requirements. However, it is also important to note that facility employees must park in one of T. F. Green's long-term parking lots, and not at the actual facility itself. Therefore employee parking has not been considered in this particular analysis, although it was considered in Section III.3.4, *Employee Parking Facilities*.

Table III.4-5 displays the resulting truck/auto area requirements for the current and forecast years. As shown, there will be a surplus of area until 2010, when there will be a deficit of 6,300 square feet. **This deficit will ultimately increase to 25,100 square feet in 2020 when 34,500 square feet of truck/auto parking area will be required.**

The belly cargo facility requirements were calculated based on the draft forecasts. Based on the final forecasts, the timing of the suggested improvements in this chapter may be off by a few years. Belly cargo is a function of the available volume and weight "lift" provided by the aircraft that serve the airport over the planning period. Belly cargo capacity was adjusted due to the revisions in the passenger forecasts over the planning period. As a result the 2005 requirement for belly capacity will likely occur one year later. The 2010 projections were virtually unchanged from the original projections, so the 2010 belly capacity requirement is valid. The draft forecasts predicted very minimal growth in belly cargo volumes from 2010 to 2015 whereas the final forecasts show more

Table III.4-5
BELLY CARGO TRUCK/AUTO REQUIREMENTS
T. F. Green Airport

Projected Building Area Requirement (square feet)	Existing Parking Area to Building Area Ratio	Area Required[1] (square feet)	Surplus/ (Deficit) (square feet)	Year[2]
4,700	1.4	6,600	2,800	2000
5,500	1,4	7,700	1,700	2005
11,200	1.4	15,000	(6,300)	2010
11,400	1.4	16,000	(6,600)	2015
24,600	1.4	34,500	(25,100)	2020
	2000 Area Available:	9,400 square feet)		

[1] Does not include employee parking which is accommodated in the long-term parking facilities.
[2] Requirements were calculated based on the draft forecasts and were not updated to reflect the final forecasts.
Source: RIAC, Quantum, and Delta Airlines.

of an increase. Therefore, in 2015 there will likely be an increase in the requirement for belly cargo facilities. The 2020 requirements identified in this chapter could occur one year sooner than identified. Belly cargo capacity will trigger the need to expand the belly cargo facilities and should be closely monitored to determine when additional facilities are needed. **Belly cargo volumes in excess of 4,000 tons will trigger the need to expand the belly cargo facility.**

USPS Requirements

Air mail volume is a specific element of belly cargo and is a function of general postal volume trends. Like air cargo, it also depends on the available "lift" capacity on the air carriers' aircraft, only to a lesser degree. Mail is often transported under contracts with the airlines, displacing other air cargo in favor of the contract commitment. It is important to note that the significant upgrade in "lift" capability generated by widebody service will not necessarily have as significant an impact on the air mail facility in that bulk lift capacity has historically only been a consideration at T. F. Green at the specific, limited times of the year of peak mail volumes.

The current air mail facility (2,100 square feet) is currently undersized for sort operations and for the storage of bins. **USPS representatives have indicated to RIAC that they will require a 14,000-square foot building, which will be sufficient throughout the planning period.**

The 2000 truck/auto areas associated with the air mail facility were also analyzed on a ratio of truck/auto area to building area following discussions with USPS personnel. It was determined that the existing parking and apron facilities (totaling 8,500 square feet) were adequate for the sizing of the facility. However, it was also noted that the current