Chapter 5
Facility Requirements

5.0 INTRODUCTION

The Facility Requirements chapter of this Sustainable Master Plan Update describes airside and landside facilities, which are needed to accommodate existing and forecast demand at the Buffalo Niagara International Airport (BNIA) in accordance with Federal Aviation Administration (FAA) design criteria and current safety standards. The facility requirements are based upon the FAA approved Aviation Demand Forecasts that were presented in Chapter 3. They have been developed in accordance with the guidelines provided in FAA Advisory Circular (AC) 150/5300-13, *Airport Design*, and 14 Code of Federal Regulations (CFR) Part 77, *Objects Affecting Navigable Airspace*. Development of the facility requirements also considers recommendations of airport management and tenants. The findings of this chapter will serve as the basis for the development of the airside and landside alternatives and development recommendations, which will be presented in subsequent chapters of this report. Major sections of this chapter include:

- Airfield Capacity Analysis
- Airspace Capacity Analysis
- Airfield Facility Requirements
- Terminal Facility Requirements
- Landside Facility Requirements
- Air Cargo Requirements
- General Aviation Requirements
- Support Facility Requirements
- Summary of Facility Requirements

5.1 AIRFIELD CAPACITY ANALYSIS

A demand/capacity analysis for the existing airfield configuration was conducted using the methodology contained in FAA AC 150/5060-5, *Airport Capacity and Delay*, commonly referred to as the FAA's *Handbook Methodology*. This methodology uses a series of tables and equations to calculate an airfield's hourly and annual capacity. The following paragraphs provide a discussion of the handbook methodology and the results derived.

The handbook methodology describes how to measure an airfield's hourly capacity and its annual capacity, which is referred to as annual service volume (ASV). Hourly capacity is defined as the maximum number of aircraft operations that can be accommodated by the airfield system in one hour. It is used to assess the airfield's ability to accommodate peak hour operations.

ASV is defined as a reasonable estimate of an airport's annual capacity. As the number of annual operations increases and approaches the airport's ASV, the average delay incurred by each operation increases. When annual operations are equal to the ASV, average delay per aircraft operation can be up to four minutes depending upon the mix of aircraft using the airport. When the number of annual aircraft operations exceeds the ASV, moderate to severe congestion will occur and the average delay per aircraft operation will increase exponentially.

ASV is used to assess the adequacy of the airfield design, including the number and orientation of runways.

Calculation of an airfield's hourly capacity and ASV depends upon a number of factors including the following items:

- Meteorological Conditions - The percentage of time that visibility or cloud cover is below certain minimums.
- Aircraft Fleet Mix - The percentage of operations conducted by different categories of aircraft.
- Runway Use - The percentage of time each runway is used.
- Percent Touch-and-Go - The percent of touch-and-go operations in relation to total aircraft operations.
- Percent Arrivals - The percent of arrivals in relation to departures during peak hours.
- Exit Taxiway Locations - The number and locations of exit taxiways for landing aircraft.

5.1.1 Meteorological Conditions

Meteorological conditions have a significant effect upon runway use, which, in turn, affects an airfield's capacity. During Visual Meteorological Conditions (VMC), runway use is greatly influenced by the direction of the prevailing winds. During Instrument Meteorological Conditions (IMC), runway use is dictated by a combination of prevailing winds and the type and availability of instrument approach procedures. Operational factors, such as runway length, and noise abatement considerations may also affect runway use. Consequently, airfield capacity is typically higher during periods of VMC than during periods of IMC. Therefore, it is important to properly identify the percent of time that an airfield operates under each condition.

Historical data regarding the percentage of time that VMC versus IMC conditions prevail and the percent of BNIA operations occurring under those conditions were obtained from two sources: meteorological data from the National Climatic Data Center (NCDC) previously presented and operational data obtained from the FAA's Aviation System Performance Metrics (ASPM) web site. Neither of these sources directly indicate the percentage of time that the Airport operates in VMC versus IMC. However, they do provide excellent guidance, from which, an educated estimate can be made.

Meteorological data for BNIA from NCDC indicates that VMC conditions occur approximately 91 percent of the time and IMC the remaining nine percent of the time. Cloud ceilings and horizontal visibility are below Category I approach criteria (i.e., a ceiling height of not less than 200 feet and horizontal visibility of not less than 1/2-mile) approximately 0.7 percent of the time (approximately 61 hours per year).

ASPM data is derived from actual aircraft operational data for 29 major and commuter airlines including cargo carriers such as FedEx and UPS. ASPM data does not include most general aviation and military flights. Consequently, ASPM data does not include approximately 30 percent of the aircraft operations that occurred at BNIA in 2010. Nonetheless, a review of ASPM data from the FAA's web site indicates that aircraft operations during IMC averaged approximately 19 percent of total aircraft operations from 2005 through 2010. An important consideration to note is that aircraft operations may be operated under Instrument Flight Rules (IFRs) even though the actual ceiling and horizontal visibilities meets the FAA definition of VMC. This may occur, for example, when there is a broken ceiling that is at 4,000 feet and horizontal visibility is greater than three miles, but aircraft on approach to Runway 23 at BNIA may still be flying an ILS approach because they cannot see the airport or runway while farther out on the approach. Thus, the flight would be classified in ASPM data as an IMC operation even though the prevailing conditions at the airport would be classified as VFR by the wind data.

ASPM data includes only air carrier and commuter aircraft operations. Therefore, it is logical that ASPM data would indicate a higher percent of operations during IMC than the weather data. Aircraft operations by general aviation (GA) aircraft are more likely to occur during VMC due to the fact that some of the pilots operating these aircraft are not instrument rated or choose not to fly during IMC. Applying the percentages from the meteorological data and the ASPM data by the proportion of aircraft operations they account for results in an estimate of 84 percent of aircraft operations at BNIA occurring during IMC with the remaining 16 percent occurring during VMC. These percentages were used for the airfield capacity analysis.

In addition to determining the percentage of time the airfield operates under VMC and IMC conditions, the NCDC wind data was also used to assess wind direction and velocity. FAA guidelines recommend that an airport's runway system provide wind coverage of 95 percent for all wind directions with appropriate crosswind components based on the aircraft using the runway. If the primary runway's wind coverage is less than 95 percent additional runways are justified. Wind roses and wind persistency graphs for weather condition is provided in **Figures 5-1 through 5-5**.

Table 5-1 presents the wind coverage for Runway 5-23 and Runway 14-32. As the table indicates, Runway 5-23 provides greater than 95 percent wind coverage with all crosswind components higher than 10.5 knots. Runway 14-32 provides greater than 95 percent wind coverage only with a crosswind component of 20 knots. Combined the runway system provides a wind coverage of 98 to 100 percent depended upon the crosswind component. This analysis indicates that the existing runway system exceeds the FAA recommended wind coverage of 95 percent and no additional runways are required from a wind coverage perspective.

Table 5-1 Wind Coverage

		Crosswind Component			
Runway	**Weather**	**10.5 Knots**	**13 Knots**	**16 Knots**	**20 Knots**
Runway 5-23	All-Weather	93.88%	97.03%	99.22%	99.85%
	IFR	93.39%	96.68%	99.07%	99.85%
Runway 14-32	All-Weather	78.06%	86.07%	94.37%	98.22%
	IFR	72.78%	81.81%	91.64%	96.97%
Both Runways	All-Weather	98.37%	99.56%	99.91%	100.0%
	IFR	98.24%	99.53%	99.91%	100.0%

Source: McFarland-Johnson, 2011.

5.1.2 Aircraft Fleet Mix

Variations in aircraft weights and approach speeds affect the required spacing of aircraft on final approach. Greater spacing requirements between aircraft lower the arrival capacity of a runway system. Therefore, if an airport is serving an aircraft fleet mix that has a high percentage of aircraft with greater separation requirements, it will have a lower capacity.

The handbook methodology defines aircraft fleet mix as the percentage of operations conducted by each of the four classes of aircraft. **Table 5-2** summarizes representative types of aircraft found in each classification.

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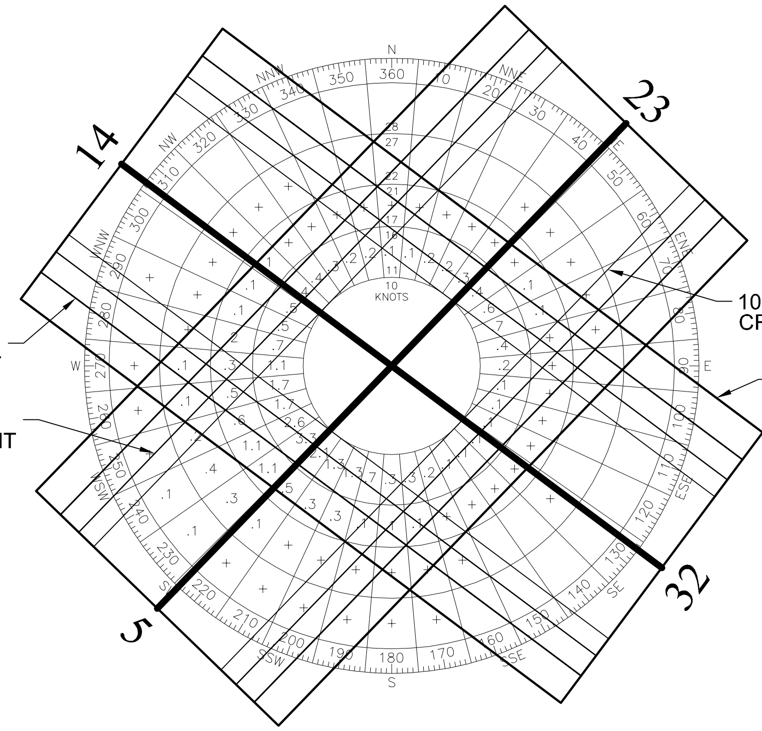
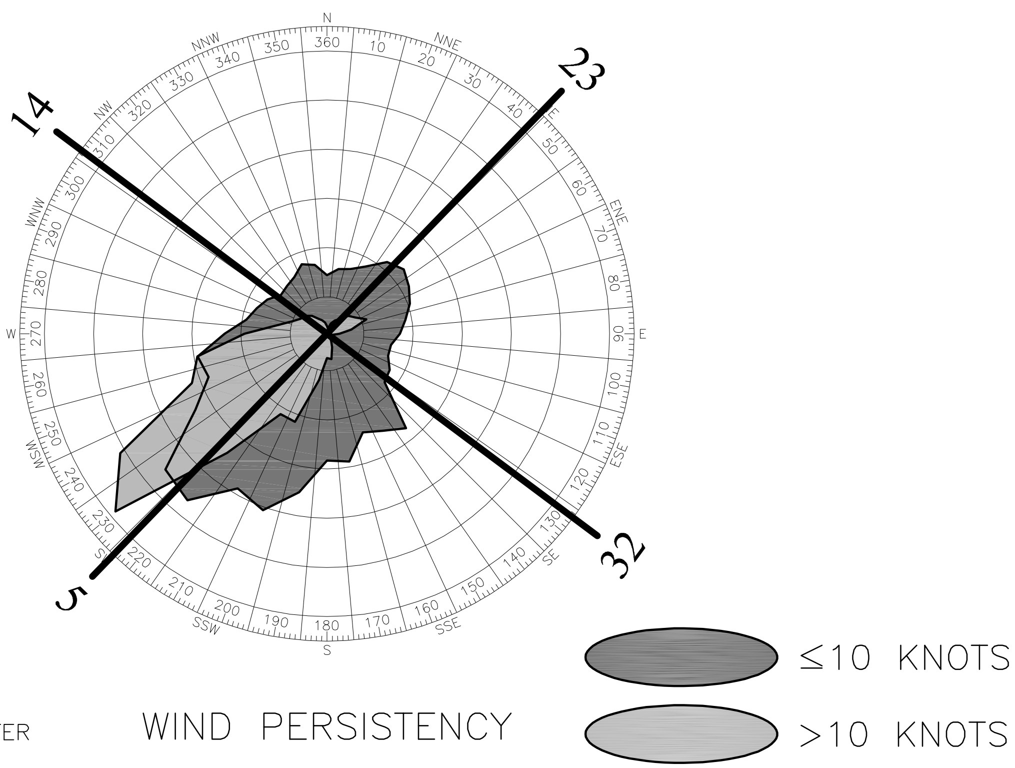
ALL WEATHER WINDROSE AND PERSISTENCY GRAPH

FIGURE 5-1



WINDROSE



SOURCE:
BUFFALO, NEW YORK
NATIONAL CLIMATIC DATA CENTER
2000–2009

WIND PERSISTENCY

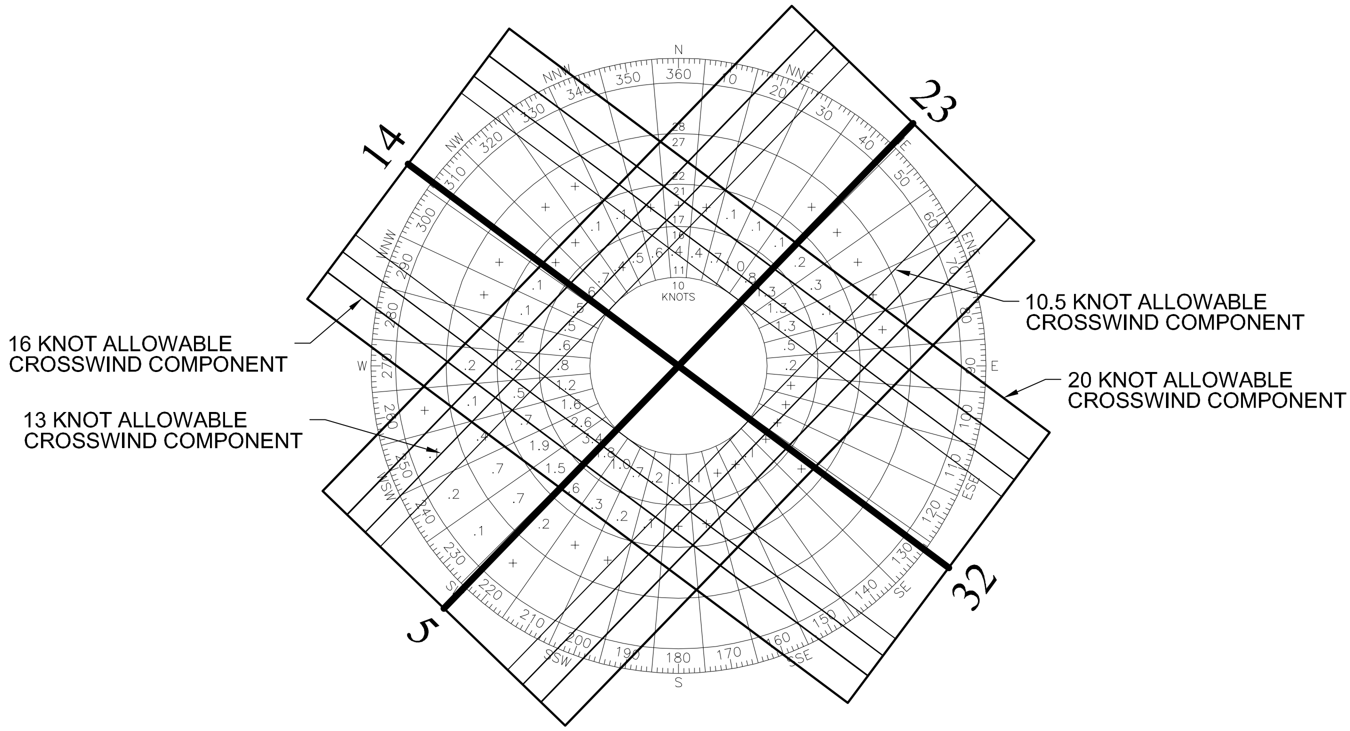
BUFFALO NIAGARA INTERNATIONAL AIRPORT

NFTA Niagara Frontier Transportation Authority *Serving the Niagara Region*

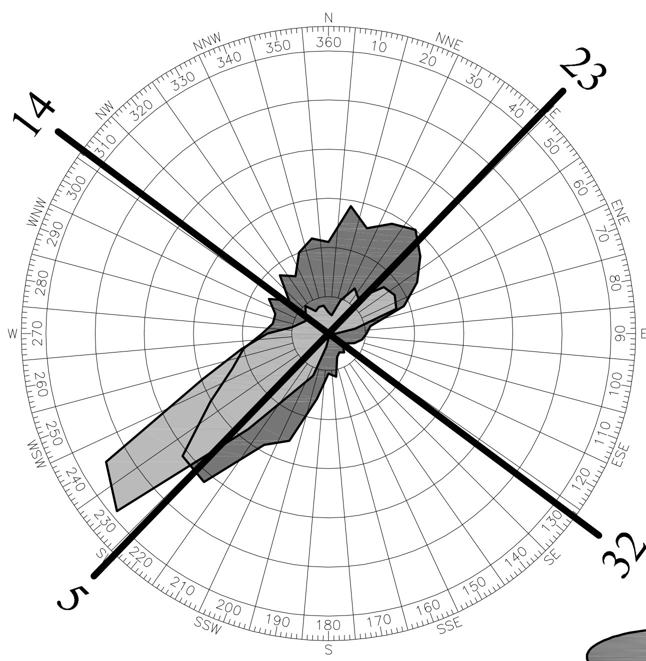
McFarland Johnson

IFR WINDROSE AND PERSISTENCY GRAPH

FIGURE 5-2



WINDROSE
BELOW 1000' CEILING OR 3 MILE VISIBILITY



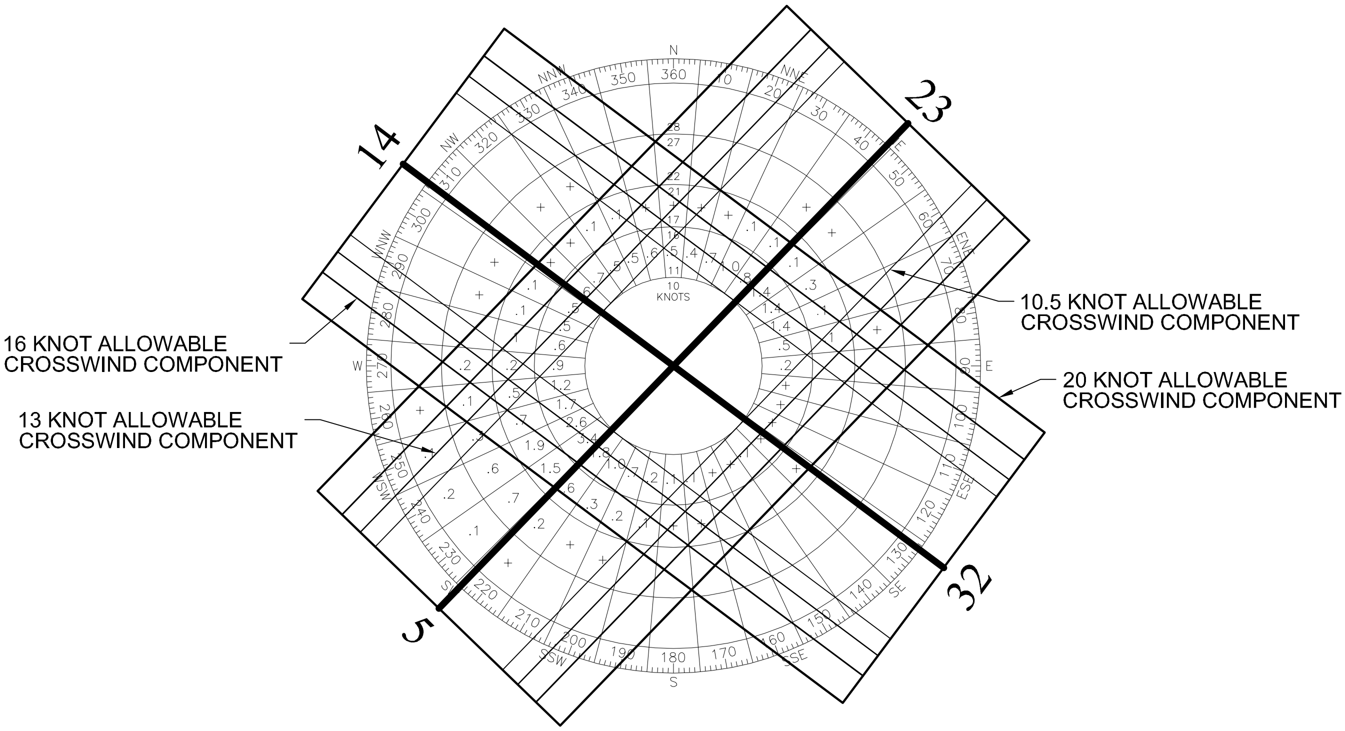
≤10 KNOTS
>10 KNOTS

WIND PERSISTENCY

SOURCE:
BUFFALO, NEW YORK
NATIONAL CLIMATIC DATA CENTER
2000–2009

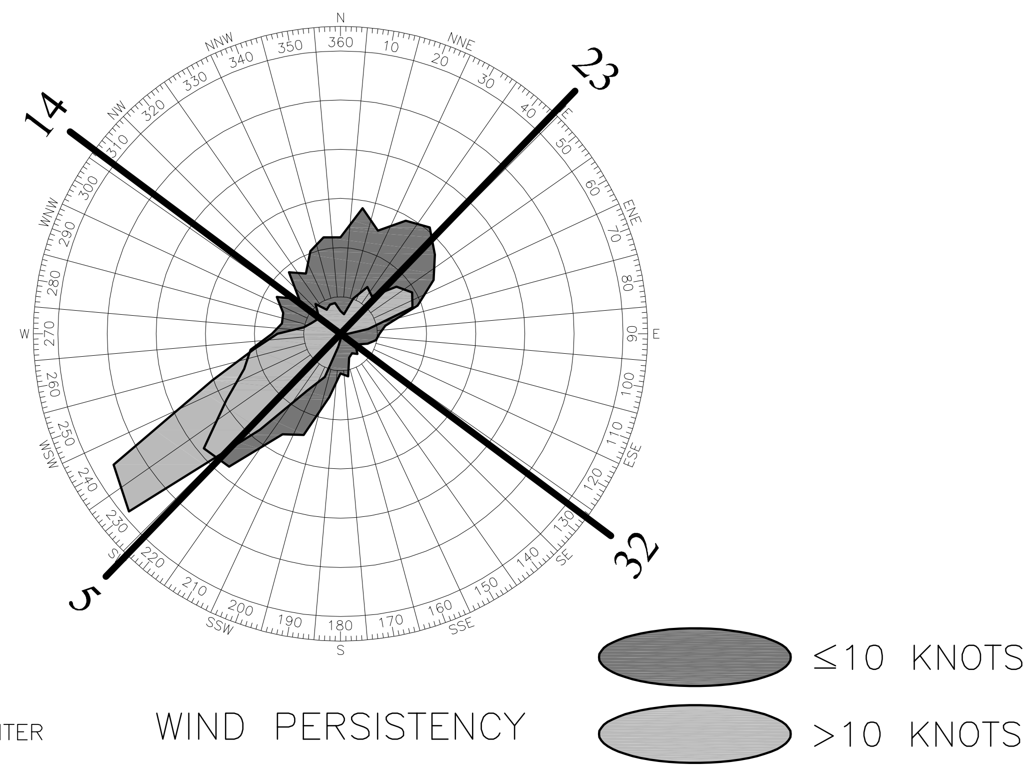
CAT I ILS WINDROSE AND PERSISTENCY GRAPH

FIGURE 5-3



WINDROSE

IFR WITH MINIMUM CEILING OF 200' AND MINIMUM VISIBILITY OF 1/2 MILE

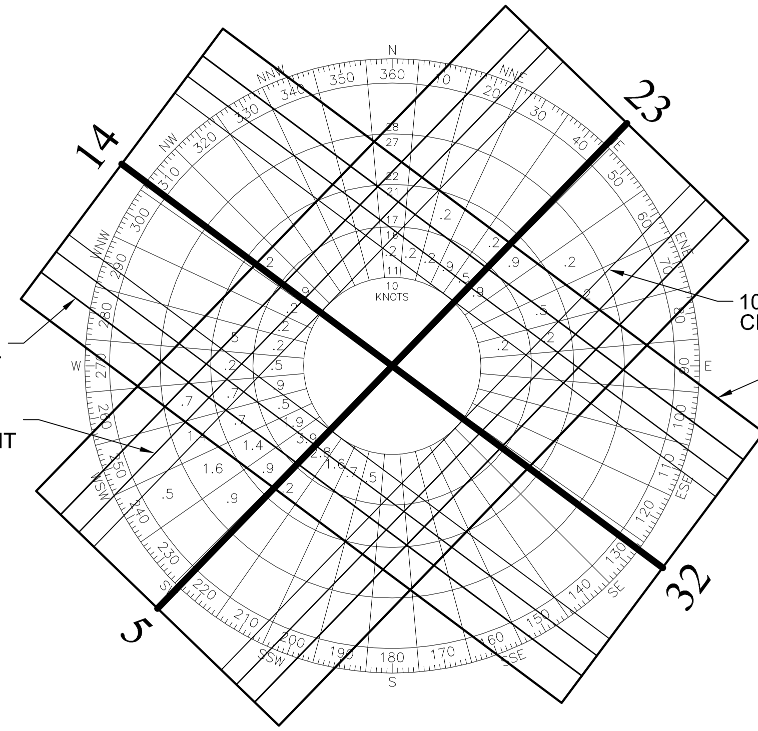


WIND PERSISTENCY

SOURCE:
BUFFALO, NEW YORK
NATIONAL CLIMATIC DATA CENTER
2000–2009

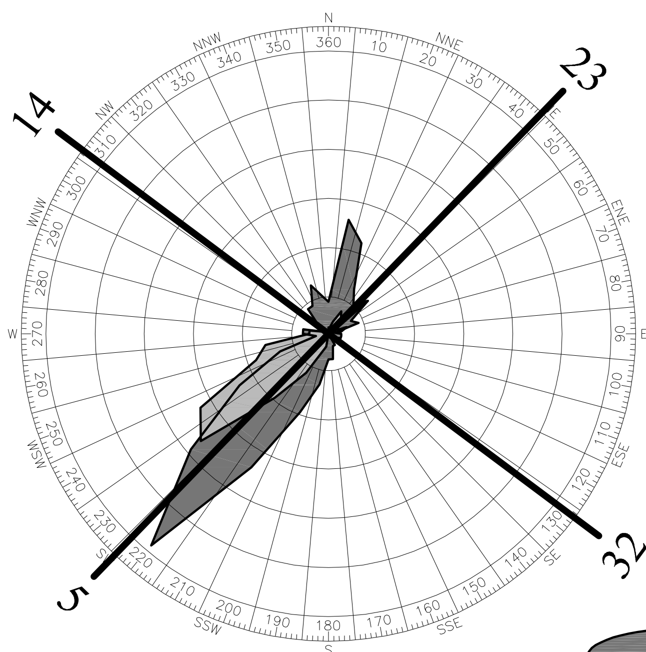
CAT II ILS WINDROSE AND PERSISTENCY GRAPH

FIGURE 5-4



WINDROSE

ABOVE CAT III, CEILING = 100' OR VISIBILITY = 1/4 MILE



SOURCE:
BUFFALO, NEW YORK
NATIONAL CLIMATIC DATA CENTER
2000–2009

WIND PERSISTENCY

BUFFALO NIAGARA INTERNATIONAL AIRPORT

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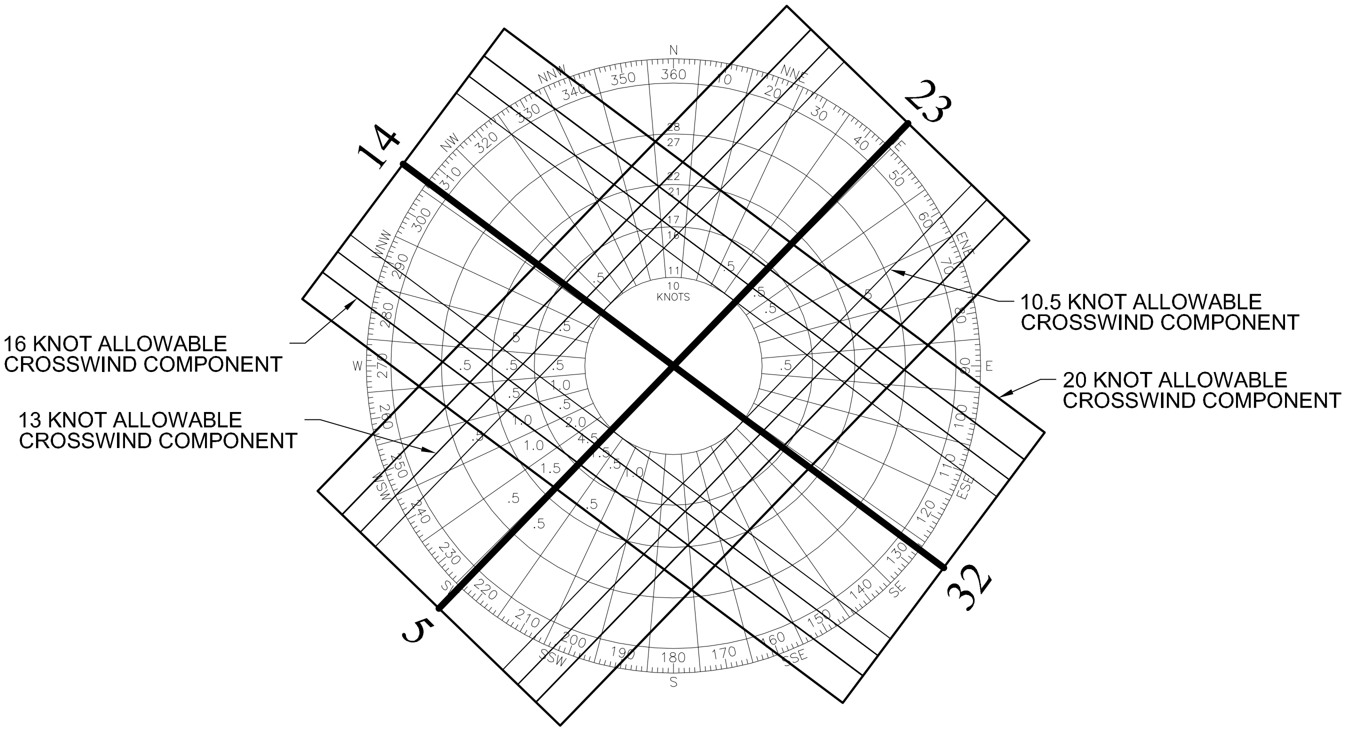
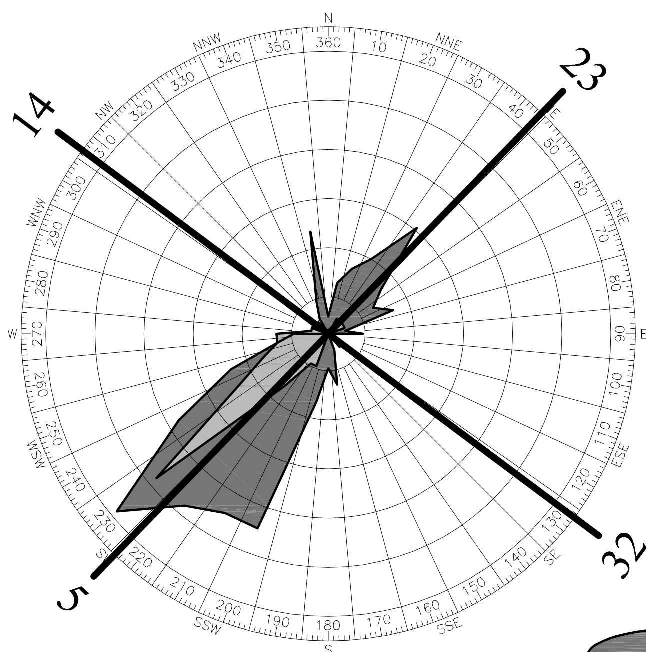
CAT III ILS WINDROSE AND PERSISTENCY GRAPH

FIGURE 5-5



WINDROSE

CEILING BELOW 100' OR VISIBILITY BELOW 1/4 MILE



≤10 KNOTS

>10 KNOTS

WIND PERSISTENCY

SOURCE:
BUFFALO, NEW YORK
NATIONAL CLIMATIC DATA CENTER
2000–2009

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Table 5-2 Aircraft Classifications

Class	Definition	Typical Aircraft Type	
Class A	Small Single-Engine (Gross weight 12,500 pounds or less)	Cessna 172/182 Beech, Bonanza	Mooney 201 Piper Cherokee/Warrior
Class B	Small, Twin-Engine (Gross weight 12,500 pounds or less)	Beech Baron Cessna 402 Beech King Air	Mitsubishi MU-2 Piper Navajo Cessna Citation I
Class C	Large Aircraft (Gross weight 12,500 pounds to 300,000 pounds)	Douglas DC-9 Boeing 737 Airbus A-319 Canadiar CRJ-700 DeHavilland Dash-8 Gulfstream IV	McDonnell Douglas MD-80 Boeing 757 Airbus A-320 Embraer 145 Saab 340 Falcon 900
Class D	Large Aircraft (Gross weight more than 300,000 pounds)	Boeing 767 McDonnell Douglas MD-11	Airbus A-300 Boeing 747

Source: URS, 2011.

Aircraft fleet mix for 2010 at BNIA was taken from the aviation demand forecasts. Based on the forecast fleet mix data, it is estimated that Class A and Class B comprise 34 percent of aircraft operations, Class C aircraft comprise 65.6 percent of aircraft operations, and Class D aircraft comprise 0.4 percent of aircraft operations at BNIA.

The FAA's handbook methodology uses the term "Mix Index" to describe an airport's fleet mix. The FAA defines the Mix Index as the percentage of Class C operations plus three times the percentage of Class D operations. By applying this calculation to the fleet mix percentages for BNIA, a Mix Index of 67 percent is obtained per the following equation:

Class C Operations (65.6) + (3 * Class D Operations (0.4)) = Mix Index (67)

The number of aircraft operations by small GA aircraft that comprise Class A and Class B are significantly lower during instrument conditions. Therefore, it is estimated that the percentage of operations by Class C aircraft increases to 90 percent during instrument conditions from approximately 66 percent during visual conditions. Thus, the Mix Index during IMC would increase to 91.

5.1.3 Runway Use

Runway use data for BNIA was also obtained from the FAA's ASPM web site. The top seven most common runway use configurations and the percent of time each configuration was used are presented in **Table 5-3**. This data is based on ASPM recorded aircraft operations during 2007 which was the only recent year for which a nearly complete data set was available.

Table 5-3 Runway Operational Configurations and Use (Calendar year 2007)

Operational Configuration (Arrivals / Departures)	Number of Aircraft Operations	Percentage of Recorded Aircraft Operations
23 / 23	60,596	72.97%
5 / 5	19,197	23.12%
23, 32 / 23, 32	1,522	1.83%
32 / 32	668	0.8%
Unrecorded	469	0.56%
5, 32 / 5, 32	321	0.39%
14, 23 / 14, 23	230	0.28%
32 / 5, 32	25	0.03%
Unrecorded	18	0.02%
Total	83,046	100.0%

Sources: FAA ASPM web site (http://aspm.faa.gov). 2007 data compiled by URS in 2011.

The data indicates that BNIA operates in a single runway configuration (with both arrivals and departures on Runway 23) approximately 73 percent of the time. This is the most common operational configuration because Runway 23 is aligned with the prevailing winds and it is longer than the crosswind runway. The next most common operational configuration is arrivals and departures on Runway 5. That configuration is used approximately 23 percent of the time. The third most common operational configuration is mixed arrivals and departures on Runway 23 and Runway 32 at nearly two percent of the time. Runway 14 is the least utilized runway and is the only runway without a precision approach or ILS. All other operational configurations are used less than one percent of the time, as indicated in **Table 5-3**.

Runway use has a significant effect on airport capacity, especially at airports where one operational configuration provides greater or less capacity than another. However, in instances where runway operational configurations are similar, it is reasonable to group them together for analytical purposes. The FAA handbook methodology recommends that operational configurations used less than two percent of the time be credited to another runway use configuration. This recommendation was observed for this capacity analysis.

For the purpose of this capacity analysis, two operational configurations were used and assessed. They include a single runway configuration with arrivals and departures on the same runway and a two-runway, crossing configuration with mixed operations (i.e., arrivals and departures) on both runways. These two operational configurations account for the vast majority of aircraft operations that occur at BNIA.

5.1.4 Percent Touch-and-Go Operations

A touch-and-go operation occurs when an aircraft lands and takes-off without making a full stop. These operations are usually conducted by student pilots for the purpose of practicing landings. Touch-and-go operations do not occupy a runway for as much time as a full-stop landing or an aircraft departure. Therefore, airfields handling a high percentage of touch-and-gos can normally accommodate a greater number of aircraft operations within a given period.

Local aircraft operations (which are usually comprised entirely of touch-and-gos) were relatively constant around nine percent of total operations until the early 2000's, at which time they began increasing. This increase was primarily due to helicopter operations by Mercy Flight, which are counted as local operations. However, consultation with air traffic control personnel indicated that touch-and-go operations by fixed-wing aircraft have remained fairly constant in recent years. Therefore, for the purpose of this airfield capacity analysis, a touch-and-go value of nine percent was used. This value is consistent with the value used in the previous master plan and was stable for numerous years before the Mercy Flight operations began.

5.1.5 Percentage Arrivals

The number of arrivals as a percentage of total aircraft operations has an important influence on a runway's hourly capacity. For example, a runway used exclusively for arrivals has a different capacity than a runway used exclusively for departures or a runway used for a mixture of arrivals and departures. In general, the higher the percentage of arrivals, the lower the hourly capacity of a runway. This is because arrivals usually have greater separations between aircraft and longer runway occupancy times than departures.

The FAA’s handbook methodology presents three choices for the percentage of arrivals during the peak hour. The choices are 40, 50, or 60 percent. Before selecting one or more of these percentages, a review of hourly operations at BNIA was conducted. This review consisted of compiling hourly aircraft operational data for the peak month of August. **Figure 5-6** depicts a compilation of the total number of hourly aircraft operations at BNIA during all days in August 2010 as derived from ASPM data. It should be noted that there is some skew of the data since GA and military operations, as well as non-ASPM carrier data are not reflected. Nonetheless, the hourly data reveals that BNIA experiences a large number of airline departures in the early morning between the hours of 6 a.m. to 8 a.m. Aircraft operations during those hours consist of 90 percent or more departures.

Arrivals are slightly more balanced throughout the day, with the highest peaks occurring between 1 p.m. and 2 p.m. and again between 6 p.m. and 7 p.m.; the peak arrivals for the passenger terminal occur between 9:30 p.m. and 11:30 p.m.. The percentage of arrivals during the 6 p.m. to 7 p.m. peak is approximately 62 percent. The percentage of arrivals during the later peak is approximately 60 percent.

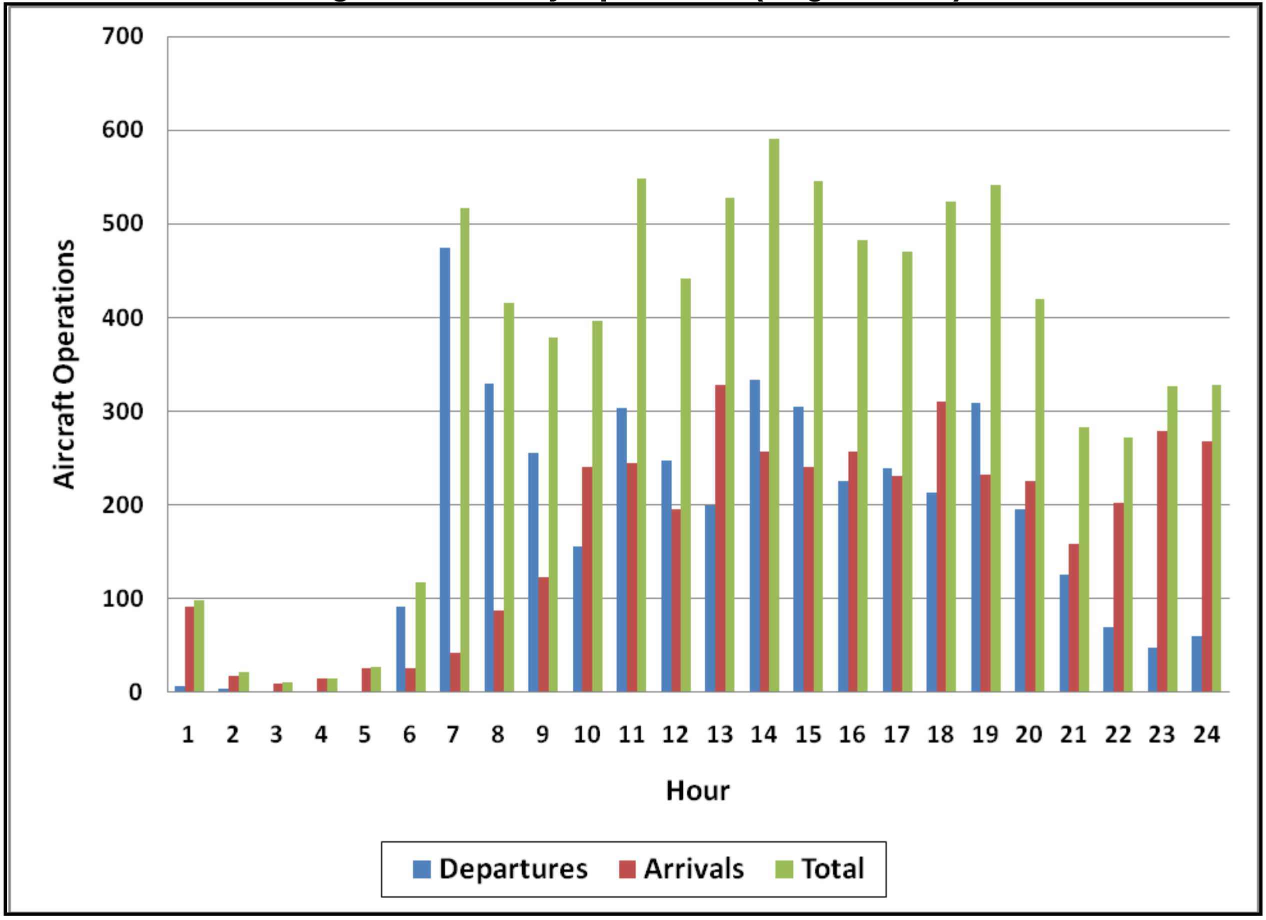
Total aircraft operations peak between 2 p.m. and 3 p.m. The distribution between departures and arrivals during this hour is 56 percent for departures and 44 percent for arrivals. Considering that the ASPM data does not include GA and military operations, which are typically more balanced, a value of 50 percent was used for the airfield capacity analysis.

5.1.6 Exit Taxiway Locations

Exit taxiways affect airfield capacity because their location influences runway occupancy times for aircraft. The longer an aircraft remains on a runway, the lower the runway’s capacity. When exit taxiways are properly located, landing aircraft can quickly exit the runway, thereby lowering occupancy times and increasing the runway’s capacity.

According to FAA criteria, exit taxiways for a runway having a Mix Index of 67 percent (i.e., the Mix Index identified earlier for BNIA during VMC) should be in the range of 3,500 to 6,500 feet from the runway’s threshold for maximum effectiveness at reducing runway occupancy time. Exit taxiways for a runway having a Mix Index of 91 percent (i.e., the mix index identified for BNIA during IMC) should be in the range of 5,000 to 7,000 feet from the runway’s threshold for maximum effectiveness. **Table 5-4** presents information on the number of exit taxiways in optimal locations at BNIA.

Figure 5-6 Hourly Operations (August 2010)



Sources: FAA, ASPM data. Compiled by URS, 2011.

Table 5-4 Number of Exit Taxiways in Optimal Locations

Runway	Number of Exit Taxiways Between 3,500 and 6,500 feet	Number of Exit Taxiways Between 5,000 and 7,000 feet
5	2	2
23	3	1
14	3	2
32	3	2

Source: URS, 2011.

5.1.7 Handbook Methodology Capacities

Hourly Airfield Capacity

The hourly and annual capacities of the BNIA airfield were calculated using the preceding information and the FAA's handbook methodology. Hourly capacity values were determined using the following equation:

Hourly capacity of the runway component = C * T * E

Where: C = Base Capacity
T = Touch-and-Go Factor
E = Exit Factor

The base capacity value (C), the touch-and-go factor (T), and the exit factor (E) are derived from the hourly airfield capacity graphs contained in the handbook methodology. Graphs for the two airfield configurations considered (i.e., single runway and crossing runways with mixed operations) are shown on **Figure 5-7** and **Figure 5-8**.

Using the data presented in the preceding paragraphs and the graphs, it was determined the existing airfield's hourly capacity ranges from 56 to 75 operations during VMC and from 49 to 58 operations during IMC, depending upon the runway configuration being used. The lower value reflects a single runway configuration, while the higher value reflects a crossing runway configuration.

Table 5-5 provides a comparison of these hourly capacities to the projected number of peak hour operations. As the table indicates, forecasted peak hour operations will not exceed the airfield's VMC capacity during the study period. Peak hour operations during IMC will not reach the levels forecasted for VMC conditions, due to reduced general aviation flying in IMC conditions. Thus, it can be concluded that the existing airfield will have sufficient capacity to accommodate average peak hour operations without incurring significant delay.

Table 5-5 Hourly Airfield Capacities

	Hourly Capacity		Estimated Peak Hour Aircraft Operations	
Year	**VMC**	**IMC**	**VMC**	**IMC**
2010	56 to 75	49 to 58	55	40
2015	56 to 75	49 to 58	61	45
2020	56 to 75	49 to 58	64	48
2025	56 to 75	49 to 58	67	50
2030	56 to 75	49 to 58	70	53

Sources: URS, 2011 and FAA AC 150/5060-5, Airport Capacity and Delay.
Note: Estimated peak hour operations were obtained from the Peaking Forecast contained in Chapter 3, Aviation Demand Forecasts.

Annual Airfield Capacity

An airfield's annual capacity, or ASV, is calculated by determining the following three items:

- The airfield's weighted hourly capacity (Cw),
- The daily demand ratio (D), and
- The hourly demand ratio (H).

The airfield's weighted hourly capacity (Cw) is calculated via a formula that considers the hourly capacity values during visual and instrument conditions, as well as the percentage of time that each weather condition occurs. The weighted hourly capacity of BNIA's airfield is calculated to be 55 operations. This capacity is only used for calculating ASV. It does not have any other use and should not be compared to hourly levels of demand.

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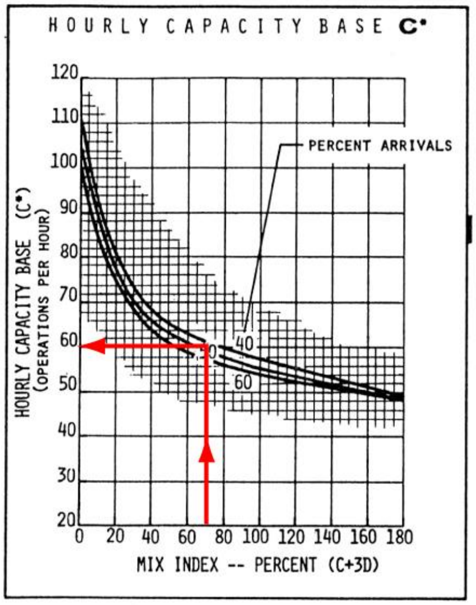
SINGLE RUNWAY CAPACITY GRAPHS

FIGURE 5-7

VFR CONDITIONS



TOUCH & GO FACTOR T

Percent Touch & Go	Mix Index--Percent (C+3D)	TOUCH & GO FACTOR T
0	0 to 180	1.00
1 to 10	0 to 70	1.04
11 to 20	0 to 70	1.10
21 to 30	0 to 40	1.20
31 to 40	0 to 10	1.31
41 to 50	0 to 10	1.40

C* x T x E = Hourly Capacity

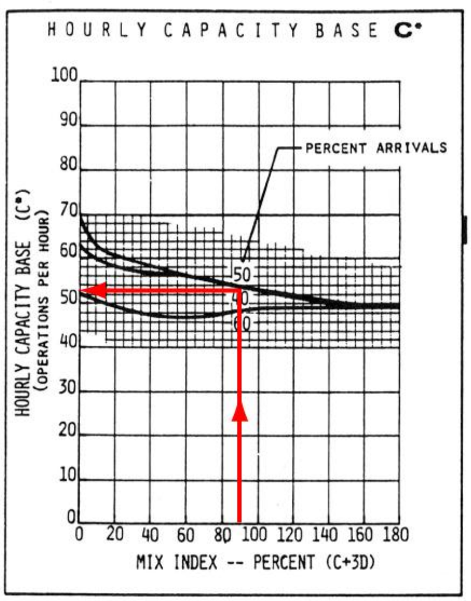
EXIT FACTOR E

To determine Exit Factor E:

1. Determine exit range for appropriate mix index from table below
2. For arrival runways, determine the average number of exits(N) which are: (a) within appropriate exit range, and (b) separated by at least 750 feet
3. If N is 4 or more, Exit Factor = 1.00
4. If N is less than 4, determine Exit Factor from table below for appropriate mix index and percent arrivals

Mix Index--Percent (C+3D)	Exit Range (Feet from threshold)	EXIT FACTOR E								
		40% Arrivals			50% Arrivals			60% Arrivals		
		N=0	N=1	N=2 or 3	N=0	N=1	N=2 or 3	N=0	N=1	N=2 or 3
0 to 20	2000 to 4000	0.72	0.87	0.94	0.70	0.86	0.94	0.67	0.84	0.92
21 to 50	3000 to 5500	0.79	0.86	0.94	0.76	0.84	0.93	0.72	0.81	0.90
51 to 80	3500 to 6500	0.79	0.86	0.92	0.76	0.83	0.91	0.73	0.81	0.90
81 to 120	5000 to 7000	0.82	0.89	0.93	0.80	0.88	0.94	0.77	0.86	0.93
121 to 180	5500 to 7500	0.86	0.94	0.98	0.82	0.91	0.96	0.79	0.91	0.97

IFR CONDITIONS



TOUCH & GO FACTOR T

T = 1.00

C* x T x E = Hourly Capacity

EXIT FACTOR E

To determine Exit Factor E:

1. Determine exit range for appropriate mix index from table below
2. For arrival runways, determine the average number of exits(N) which are: (a) within appropriate exit range, and (b) separated by at least 750 feet
3. If N is 4 or more, Exit Factor = 1.00
4. If N is less than 4, determine Exit Factor from table below for appropriate mix index and percent arrivals

Mix Index--Percent (C+3D) 2-43, 2-50	Exit Range (Feet from threshold)	EXIT FACTOR E								
		40% Arrivals			50% Arrivals			60% Arrivals		
		N=0	N=1	N=2 or 3	N=0	N=1	N=2 or 3	N=0	N=1	N=2 or 3
0 to 20	2000 to 4000	0.81	0.91	0.96	0.83	0.95	0.99	0.92	1.00	1.00
21 to 50	3000 to 5500	0.79	0.86	0.92	0.77	0.85	0.92	0.89	0.98	1.00
51 to 80	3500 to 6500	0.81	0.87	0.93	0.77	0.83	0.91	0.90	0.98	1.00
81 to 120	5000 to 7000	0.83	0.89	0.94	0.80	0.86	0.92	0.83	0.91	0.97
121 to 180	5500 to 7500	0.86	0.94	0.98	0.83	0.91	0.96	0.79	0.89	0.95

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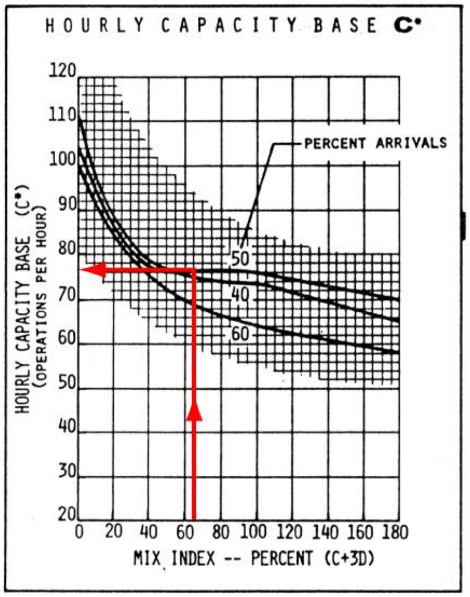
CROSSING RUNWAYS CAPACITY GRAPHS

FIGURE 5-8



TOUCH & GO FACTOR T

Percent Touch & Go	Mix Index--Percent (C+3D)	TOUCH & GO FACTOR T
0	0 to 180	1.00
1 to 10	0 to 70	1.03
11 to 20	0 to 70	1.10
21 to 30	0 to 40	1.17
31 to 40	0 to 10	1.28
41 to 50	0 to 10	1.36

C* x T x E = Hourly Capacity

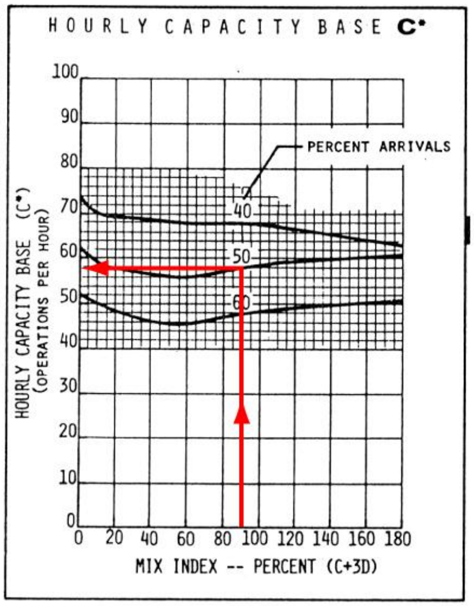
EXIT FACTOR E

To determine Exit Factor E:

1. Determine exit range for appropriate mix index from table below
2. For arrival runways, determine the average number of exits(N) which are: (a) within appropriate exit range, and (b) separated by at least 750 feet
3. If N is 4 or more, Exit Factor = 1.00
4. If N is less than 4, determine Exit Factor from table below for appropriate mix index and percent arrivals

Mix Index--Percent (C+3D)	Exit Range (Feet from threshold)	EXIT FACTOR E								
		40% Arrivals			50% Arrivals			60% Arrivals		
		N=0	N=1	N=2 or 3	N=0	N=1	N=2 or 3	N=0	N=1	N=2 or 3
0 to 20	2000 to 4000	0.81	0.88	0.95	0.78	0.86	0.94	0.74	0.85	0.93
21 to 50	3000 to 5500	0.91	0.92	0.97	0.87	0.92	0.99	0.75	0.87	0.98
51 to 80	3500 to 6500	0.94	0.96	1.00	0.77	0.89	0.97	0.72	0.82	0.91
81 to 120	5000 to 7000	0.96	0.97	1.00	0.81	0.88	0.93	0.80	0.87	0.92
121 to 180	5500 to 7500	0.99	1.00	1.00	0.84	0.94	0.97	0.85	0.94	0.97

VFR CONDITIONS



TOUCH & GO FACTOR T

T = 1.00

C* x T x E = Hourly Capacity

EXIT FACTOR E

To determine Exit Factor E:

1. Determine exit range for appropriate mix index from table below
2. For arrival runways, determine the average number of exits(N) which are: (a) within appropriate exit range, and (b) separated by at least 750 feet
3. If N is 4 or more, Exit Factor = 1.00
4. If N is less than 4, determine Exit Factor from table below for appropriate mix index and percent arrivals

Mix Index--Percent (C+3D)	Exit Range (Feet from threshold)	EXIT FACTOR E								
		40% Arrivals			50% Arrivals			60% Arrivals		
		N=0	N=1	N=2 or 3	N=0	N=1	N=2 or 3	N=0	N=1	N=2 or 3
0 to 20	2000 to 4000	0.98	1.00	1.00	0.99	1.00	1.00	0.98	1.00	1.00
21 to 50	3000 to 5500	0.92	0.99	1.00	0.91	0.99	1.00	0.92	1.00	1.00
51 to 80	3500 to 6500	0.91	0.98	1.00	0.90	0.97	1.00	0.92	0.99	1.00
81 to 120	5000 to 7000	0.94	0.98	1.00	0.91	0.97	1.00	0.91	0.97	1.00
121 to 180	5500 to 7500	0.95	1.00	1.00	0.92	0.99	1.00	0.91	0.99	1.00

IFR CONDITIONS

BUFFALO NIAGARA INTERNATIONAL AIRPORT

NFTA Niagara Frontier Transportation Authority Serving the Niagara Region

McFarland Johnson

The daily demand ratio (D) is calculated by dividing the annual number of aircraft operations by the average daily operations during the peak month. This calculation used data for calendar year 2010 and results in a daily demand factor of 320 (130,843 annual operations/408 average daily demand during the peak month). This value is within the range of demand ratios (i.e., 310 to 350) listed in the FAA's handbook methodology as being typical for an airport with a Mix Index between 51 and 180. As noted previously, the Mix Index for BNIA is estimated to be 67 during VMC and 91 during IMC.

The hourly demand ratio (H) is calculated by dividing the average daily operations during the peak month by the average peak hour operations during the peak month. This calculation was not possible for BNIA because the air traffic control tower does not save historical hourly counts beyond 45 days and August 2010 hourly counts had already been discarded. The FAA handbook methodology indicates that typical hourly demand ratio for an airport with a Mix Index between 51 and 180 is 11 to 15. An hourly demand ratio of 12 was used for the purpose of this analysis. This value is at the low end of the typical 11 to 15 range and should provide a conservative assessment of BNIA's airfield capacity. **Table 5-6** presents the calculated ASV for BNIA.

Table 5-6 Estimated Annual Service Volume

Weighted Hourly Airfield Capacity (Cw)	Daily Demand Ratio (D)	Hourly Demand Ratio (H)	Annual Service Volume
54	320	12	207,000

Sources: URS, 2010 and FAA AC 150/5060-5, Airport Capacity and Delay.
Note: The Cw is a weighted value that considers hourly capacities during VMC and IMC. Therefore, it should not be compared to the hourly capacities presents in the Hourly Airfield Capacities table.

Table 5-7 provides a comparison of the Base Forecast of aircraft operations to the existing airfield's ASV. As the tables indicate, current levels of demand consume approximately two-thirds of available capacity. Projected levels of demand at the end of the study period will consume 81 percent of capacity.

Table 5-7 Comparison of Base Forecast to Annual Service Volume

Year	Forecast of Aircraft Operations	Estimated ASV	Base Forecast as a Percentage of ASV
2010	130,200	207,000	63%
2015	141,900	207,000	69%
2020	150,500	207,000	73%
2025	158,750	207,000	77%
2030	167,000	207,000	81%

Sources: URS, 2010 and FAA AC 150/5060-5, Airport Capacity and Delay.

FAA Order 5090.3C, *Field Formulation of the National Plan of Integrated Airport Systems (NPIAS)*, specifies that airport sponsors should recommend capacity improvements when annual aircraft operations approach 60 to 75 percent of the calculated ASV. The preceding tables indicate that BNIA already exceeds 60 percent of capacity, but is not projected to reach 75 percent of capacity until approximately 2022.

Given that the existing airfield operates with little to no delay, planning for additional capacity would most appropriately focus on operational issues rather than additional infrastructure. Consistent with the 2002 Master Plan, the construction of additional runway's at BNIA is not considered a suitable solution at this point in time due to property and infrastructure constraints. This issue should be revisited at the time of the next Master Plan.

5.2 AIRSPACE CAPACITY ANALYSIS

Airspace in the vicinity of BNIA was described in Section 2.9 of Chapter 2. Airspace constraints in the vicinity of the Airport that may affect capacity include items such as other nearby airfields, physical constraints, such as towers or other tall structures, and regulatory constraints.

5.2.1 Nearby Airfields

Other public use airfields in proximity to BNIA include Buffalo-Lancaster Regional Airport located approximately five miles to the east and Buffalo Airfield located approximately 4.5 miles to the south. While the airspace required for traffic patterns to these airports do overlap, proper separation of air traffic is achieved through the application of vertical and horizontal clearances.

5.2.2 Physical Constraints

A review of the Detroit Aeronautical Sectional chart reveals that there are tall towers in the vicinity of BNIA. However, the majority of these towers are located far enough from the runway ends that they do not have a significant detrimental effect on runway approaches.

Close-in obstructions are located near all runway ends at BNIA and affect the instrument approach minimums that can be achieved especially on the approaches to both ends of Runway 14-32. Obstruction removal in accordance with the standards specified by Federal Aviation Regulations (FAR) Part 77 is needed to ensure that vegetative obstructions do not further degrade existing approach minimums. Obstructions in these approaches are identified in the Airport Layout Plan (ALP) drawing set.

5.2.3 Regulatory Constraints

As described in the Chapter 2, there are a few areas of restricted airspace in the vicinity of BNIA. However, none of these areas are close enough to BNIA to have any impact upon the flow of aircraft operations into and out of the airport. The only Military Operations Area near BNIA is located above Lake Ontario and is also too far to affect operations at BNIA.

In conclusion, there are no airspace constraints in the vicinity of BNIA that have a significant detrimental effect on the capacity of the airspace or the ability of BNIA to accommodate existing and projected levels of aircraft operations.

5.3 AIRFIELD FACILITY REQUIREMENTS

Airfield facility requirements include all the items needed to ensure safe and efficient operation of aircraft at BNIA. This includes runways and taxiways, as well as all the associated geometric clearances from these operational areas. It also includes items such as aircraft parking aprons, navigational aids, etc. The following paragraphs provide a discussion of these items as well as the associated FAA design criteria.

The FAA established airfield design criteria to ensure the safety and efficiency of airfield operations. These design standards specify the dimensional requirements and separation requirements for existing and proposed facilities based upon the types of aircraft expected to operate at the airport.

5.3.1 Critical Design Aircraft

The critical design aircraft is defined by the FAA as the most demanding aircraft (in terms of wingspan length and aircraft approach speed) that presently conducts or is forecasted to conduct 500 annual operations at the airport. Although FAA criteria are established in terms of wingspan/tail height and approach speed, aircraft weight should also be considered when assessing the adequacy of pavement strength.

Review of the Aviation Demand Forecasts presented in Chapter 3 indicate that the most demanding aircraft meeting the operational threshold of 500 annual operations at BNIA during 2010 was the Airbus A-300 which is operated by United Parcel Service (UPS) for cargo operations. This aircraft has a wingspan of 147.1 feet, an approach speed of 132 knots, and a maximum take-off weight of approximately 366,000 pounds.

In terms of passenger airline operations, the most demanding aircraft that regularly used BNIA during 2010 was the Airbus A-320 and the Boeing 737-700. The Airbus A-320 has a wingspan of 111.3 feet, an approach speed of 138 knots, and a maximum take-off weight of approximately 166,000 pounds. The Boeing 737-700 has a wingspan of 112.7 feet, an approach speed of 139 knots, and a maximum take-off weight of approximately 153,000 pounds.

The Aviation Demand Forecasts indicate that the Airbus A-321 and the Boeing 737-800 will become the critical design aircraft for passenger airline operations in the 2015 to 2020 timeframe. The Airbus A-321 has a wingspan of 111.9 feet, an approach speed of in the 130 to 140 knot range and a maximum takeoff weight of 205,030 pounds. The Boeing 737-800 has a wingspan of 117.4 feet (with winglets), an approach speed of 142 knots and a maximum takeoff weight of 174,200 pounds. While larger aircraft, such as the Boeing 757, are occasionally used for passenger airline operations at BNIA, they do not use the airport often enough to qualify as the critical design aircraft now or during future study years.

With regard to aircraft currently in design, but not yet in service, Bombardier is developing the C-series aircraft that will seats passengers in the 100 to 149 passenger range. This aircraft will fit into gates that current accommodate 737-700W aircraft. Boeing is also currently developing an aircraft targeted at the 180-250 seat market. This segment is currently served by the Boeing 757 and Airbus 321, both of which have been, and are projected to be scheduled into BNIA. Design characteristics of aircraft in development should be monitored for any changes to the terminal area that may be required.

5.3.2 Airport Reference Code

The FAA has developed and published minimum standards for the planning and design of airport facilities. These standards are described in FAA AC 150/5300-13, *Airport Design*. This AC provides criteria for grouping of aircraft into Airport Reference Codes (ARC). The ARC is comprised of an Aircraft Approach Category (which is based upon the approach speed of the aircraft) and an Airplane Design Group (which is based upon the aircraft's wingspan or tail height). The ARC for an airport is selected on the basis of the current and future critical aircraft according to the following criteria.

Aircraft Approach Category

The Aircraft Approach Category is based on the landing speed of the aircraft, which is defined as 1.3 times the stall speed of the aircraft as follows:

- Category A - Speed less than 91 knots
- Category B - Speed 91 knots or more, but less than 121 knots
- Category C - Speed 121 knots or more, but less than 141 knots
- Category D - Speed 141 knots or more, but less than 166 knots
- Category E - Speed 166 knots or more

Airplane Design Group

The Airplane Design Group is based on airplane wingspan and/or tail height (whichever is more demanding) as follows:

- Group I – Wingspan up to, 49 ft; or tail height less than 20 ft
- Group II - Wingspan 49 ft up to, 79 ft; or tail height of 20 ft but less than 30 ft
- Group III - Wingspan 79 ft up to, 118 ft; or tail height of 30 ft but less than 45 ft
- Group IV - Wingspan 118 ft up to, 171 ft; or tail height of 45 ft but less than 60 ft
- Group V - Wingspan 171 ft up to, 214 ft; or tail height of 60 ft but less than 66 ft
- Group VI - Wingspan 214 ft up to, 262 ft; or tail height of 66 ft but less than 80 ft

ARC for Buffalo-Niagara International Airport

The current and future ARC for BNIA can be determined on the basis of aircraft fleet mix projections presented in the Aviation Demand Forecasts. As previously noted, the Airbus A-300 was the critical aircraft operating at BNIA during 2010. This aircraft has an ARC of C-IV. According to the forecasts, the Airbus A-300 will continue to be the critical aircraft for cargo operations throughout the planning period. The Boeing 767-300, another popular cargo aircraft and occasional used for sports team charters at BNIA, is also a Group IV and similar in size to the A-300.

For passenger airlines, the Airbus A-321 and the Boeing 737-800 are projected to be the most demanding aircraft throughout the planning period. The A-321 has an ARC of C-III, while the 737-800 has an ARC of D-III. Therefore, it is recommended that an ARC of D-IV be used for planning facilities associated with Runway 5-23 and Runway 14-32.

Not all airport facilities need to be designed to accommodate the most demanding aircraft. Certain airside and landside facilities, such as GA areas or runway/taxiway systems that are not intended to serve large aircraft, may be designed to accommodate less demanding aircraft, where necessary, to ensure cost effective development. Conversely, a new taxiway that is intended to serve large aircraft may require the application of Design Group IV standards. Designation of the appropriate standards to each development area on the airport are shown on the ALP.

5.3.3 Airfield Design Standards

Airfield design standards indicate required runway and taxiway widths, as well as separations between and clearances from these pavements and are based upon ARCs. **Table 5-8** presents a summary of the design standards for a mixture of aircraft that operate at BNIA.

Table 5-8 FAA Design Standards

	Airport Reference Code			
Typical Aircraft Category	B-II GA	B-III Commuter	C-III Air Carrier	D-IV Air Carrier
Aircraft Operational Characteristics:				
Maximum Approach Speed	120 knots	120 knots	140 knots	165 knots
Aircraft Approach Category	B	B	C	D
Maximum Wingspan	78 feet	117 feet	117 feet	170 feet
Airplane Design Group	II	III	III	IV
Airport Reference Code	B-II	B-III	C-III	D-IV
Runway:				
Width	Not Applicable at BNIA	Not Applicable at BNIA	150 feet[1]	150 feet
Shoulder Width			20 feet	25 feet
Safety Area Width			500 feet	500 feet
Safety Area Length Before Threshold			600 feet	600 feet
Safety Area Length Beyond R/W End			1,000 feet	1,000 feet
Object Free Area Width			800 feet	800 feet
Object Free Area Length Beyond R/W			1,000 feet	1,000 feet
Separation from:				
Holdline			257 feet	257 feet
Parallel Taxiway			400 feet	400 feet
Aircraft Parking Area			500 feet	500 feet
Taxiway:				
Width	35 feet	50 feet	50 feet	75 feet
Shoulder Width	10 feet	20 feet	20 feet	25 feet
Safety Area Width	79 feet	118 feet	118 feet	171 feet
Object Free Area Width	131 feet	186 feet	186 feet	259 feet
Separation from:				
Parallel Taxiway/Taxilane	105 feet	152 feet	152 feet	215 feet
Fixed or Movable Object	65.5 feet	93 feet	93 feet	129.5 feet
Taxilane:				
Object Free Area Width	115 feet	162 feet	162 feet	225 feet
Separation from:				
Parallel Taxilane Centerline	97 feet	140 feet	140 feet	198 feet
Fixed or Movable Object	57.5 feet	81 feet	81 feet	112.5 feet

Source: FAA AC, 150/5300-13, Airport Design.
Notes: [1] The standard runway width for Design Group III is 100 feet when serving aircraft with maximum certificated takeoff weights less than 150,000 pounds.

5.3.4 Runway Length

Both runways at BNIA were extended since the last master plan was completed in 2002. Runway 5-23 was extended to a length of 8,828 feet from its previously length of 8,102 feet. Likewise, Runway 14-32 was extended to a length of 7,161 feet from its previous length of 5,382 feet. The extension of both runways were based upon an assessment of runway length requirements specified in the 2002 master plan and were implemented to accommodate existing and future airline operational requirements.

The extension of Runway 14-32 increased the capabilities of that runway from being a limited use GA runway to a runway fully capable of accommodating regional jet and air carrier operations to all existing air carrier destinations. This was made possible by the acquisition and demolition of the former Westinghouse plant (i.e., Buffalo Air Center) which previously limited aircraft operations on Runway 14-32. Furthermore, the installation of an ILS on Runway 32 made this runway capable of accommodating precision instrument approaches.

The extension of Runway 14-32 also enabled Runway 5-23 to be closed for rehabilitation and extended to a length of 8,828 feet as recommended by the previous master plan. This additional length on Runway 5-23 supports air carrier operations to destinations in the western U.S. without payload limitations.

Previous runway length assessments were based on older aircraft then using the airport such as the Boeing 727 and the 737-200. **Table 5-9** presents runway requirements for newer, more efficient aircraft currently using and projected to use the airport in the future, such as the Boeing 737-800 and Airbus A-321.

The runway lengths presented in **Table 5-9** were calculated using the methodology specified in FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*. The AC specifies that runway length analysis for regional jets and airplanes with a Maximum Takeoff Weight (MTOW) of more than 60,000 pounds should be conducted using the airport planning manuals published by the manufacturers of aircraft using the airport on a “substantial use” basis (i.e., 500 annual operations).

This methodology accounts for a wide variety of factors including: airport elevation, runway gradient, aircraft take-off and landing weights, mean maximum daily temperature, runway conditions (wet or dry), length of haul, etc. All of these factors were considered in the development of runway length requirements. However, one exception was made. The AC specifies that runway lengths should be calculated using haul lengths used on a substantial use basis. The AC further states that runway length requirements for long haul routes should be calculated using MTOW, while the requirements for short-haul routes should be calculated using actual operating take-off weights. Since this analysis is interested in the ability of the existing runway system to accommodate aircraft currently using the airport to existing and potential future destinations, the runway length analysis was conducted using MTOW for all aircraft examined.

Table 5-9 Runway Length Requirements

Aircraft	Engine	Runway Length from Manual	Gradient Adjustment[1]	Runway Length Requirement
Passenger Aircraft				
737-700W[2]	CFM56-7B22	7,300	530	7,830
737-800W[2]	CFM56-7B26	8,450	530	8,980
A-320-200	CFM-5B	7,400	530	7,930
A321-200	CFM-56	8,000	530	8,530
EMB-190	GE CF34-10E6	6,890	530	7,420
Cargo Aircraft				
A-300F4-600	GE CF-80C2F	8,300	530	8,830
757-200	RB211-535E4	8,050	530	8,580

Source: Aircraft Manufacturers Airport Compatibility Planning manuals. Data compiled by URS, 2001.
Notes: [1] The gradient adjustment only applies to operations on Runway 5.
[2] The “W” designations after the 737-700 and 737-800 indicates that the winglet model was used.

The aircraft presented in Table 5-9 include the most common aircraft air carrier aircraft used for passenger and cargo service, as well as aircraft that are projected to use the airport in the future such as the Boeing 737-800 and the Airbus A-320. The results of the table indicate that the existing length of 8,828 feet on Runway 5-23 is capable of accommodating essentially all aircraft operations without limitations.

Few, if any, aircraft operations would actually depart BNIA at MTOW. Therefore, although there are distances longer than the length of Runway 5-23 listed in the table, these distances do not have an effect on any existing aircraft operations at BNIA. Furthermore, the longer distances listed for cargo aircraft is not of significance because these aircraft primarily fly to short-haul destinations, such as Louisville and Memphis. Even if these flights occurred to long-haul destinations, Runway 5-23 would be able to support these operations with minimal to no impact on payloads.

With respect to Runway 14-32, this runway serves as a crosswind runway for aircraft that cannot use Runway 5-32 during periods that crosswind components exceed their operational capabilities. The runway also serves aircraft operations when Runway 5-23 is closed for maintenance, snow removal or emergencies. The existing length of Runway 14-32 is adequate to serve aircraft that require its use during periods of high crosswinds. It is also adequate to serve the majority of existing air carrier operations in a secondary role. However, the possibility of increasing associated declared distances on Runway 14-32 to enhance the runway's utility will be explored in Chapter 6.

On the basis of the runway length requirements presented in Table 5-8, no further runway extensions are required. Furthermore, no additional extensions of runway lengths at BNIA are possible without significant property acquisition (including residences and businesses), roadway relocations, and substantial infrastructure improvements. Consequently, no changes to runway lengths at BNIA are recommended at this time.

5.3.5 Runway Width

Both runways at BNIA have a width of 150 feet. This width is consistent with the FAA standard for runways serving aircraft in Design Group IV, as well as that for larger Group V aircraft such as the Boeing 777 and 747. This width is adequate to serve existing and projected aircraft operation through 2030.

5.3.6 Runway Strength

Pavement strength requirements are related to three primary factors: 1) the weight of aircraft anticipated to use the airport, 2) the landing gear type and geometry, and 3) the volume of aircraft operations. According to the Airport's FAA 5010 Form *Airport Master Record*, Runway 5-23 has pavement strengths of 75,000 pounds single-wheel loading, 195,000 pounds dual-wheel loading, and 450,000 pounds dual-tandem-wheel loading. These strengths are sufficient to accommodate all existing and projected aircraft operations on this runway.

Runway 14-32 has pavement strengths of 75,000 pounds single-wheel loading, 195,000 pounds dual-wheel loading, and 240,000 pounds dual-tandem-wheel loading. These strengths are also sufficient to accommodate all existing and future aircraft projected to regularly operate on this runway, such as regional jets and frequently used air carrier aircraft such as the Airbus A-320 and the Boeing 737.

Most operations by air cargo aircraft occur on Runway 5-23 due to its longer length, instrument approach capabilities, alignment with prevailing wind direction, and ease of access to the air cargo apron. Consequently, although the strength of Runway 14-32 is less than the weight of the critical design aircraft (the Airbus A-300), it is not anticipated that significant operations by the Airbus A-300 or Boeing 757 would occur on Runway 14-32.

5.3.7 Runway Safety Areas

Runway safety areas (RSAs) are defined by the FAA as *surfaces surrounding a runway that are prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway*. RSAs consist of a relatively flat graded area free of objects and vegetation that could damage aircraft. According to FAA guidance, the RSA should be capable, under dry conditions, of supporting aircraft rescue and firefighting equipment, and the occasional passage of aircraft without causing structural damage to the aircraft.

The FAA design standard for RSAs surrounding runways serving C-III and D-IV aircraft is a width of 500 feet, a length that extends 600 feet prior to the landing threshold, and a length that extends 1,000 feet beyond the runway end. The RSAs surrounding Runway 5-23 and Runway 14-32 meet this design standard as a result of improvements made in conjunction with the extensions of both runways. These improvements consisted of displacing runway thresholds in conjunction with constructing the runway extensions and implementing declared distances.

5.3.8 Runway Object Free Areas

In addition to the RSA, a runway object free area (ROFA) is also defined around runways in order to enhance the safety of aircraft operations. The FAA defines ROFAs as an area cleared of all objects except those that are related to navigational aids and aircraft ground maneuvering. However, unlike the runway safety area, there is no physical component to the ROFA. Thus, there is no requirement to support an aircraft or emergency response vehicles.

The ROFA dimensions for runways serving C-III and D-IV aircraft is a width of 800 feet and a length that extends 1,000 feet beyond the runway end. The existing ROFA's on Runway 5-23 and Runway 14-32 do not meet FAA design standards due to roadway and fence penetrations. Consequently, the Airport applied for and received Modifications of Standards for these items in three locations: the approach end of Runway 5 and both ends of Runway 14-32. Resolution of items that violate the design standards cannot be achieved without shortening both runways or undertaking cost prohibitive acquisition of adjoining properties, relocation of roads, and infrastructure. Consequently, these Modification of Standards should be maintained in the future.

5.3.9 Declared Distances

Declared distances is a process whereby an airport owner declares only a certain portion of a runway as being available for take-off or landing to meet RSA, ROFA, or runway protection zone (RPZ) requirements in a constrained environment. Consequently, this usually results in a portion of the runway not being used for take-off or landing calculations. Declared distances include the distances the airport owner declares available for an airplane's take-off run (TORA), take-off distance (TODA), accelerate-stop distance (ASDA), and landing distance (LDA) requirements.

In order to provide RSAs that comply with FAA design standards while also maximizing runway lengths, declared distances were implemented at BNIA in conjunction with the aforementioned runway extension and RSA improvements. The declared distances for Runway 5-23 and Runway 14-32 are presented in **Table 5-10**. Opportunities to increase the operational use of these distances to be closer to that of the physical pavement length will be explored in Chapter 6.

Table 5-10 Declared Distances

Runway	TODA	TORA	ASDA	LDA
5	8,828	8,828	8,103	7,568
23	8,828	8,828	8,293	7,568
14	7,161	7,161	6,441	6,121
32	7,161	7,161	6,841	6,121

Source: FAA Form 5010 Airport Master Record, Updated May 2013

5.3.10 Runway Pavement Markings

Both ends of Runway 5-23 and Runway 32 have precision instrument runway markings. Runway 14 has non-precision instrument approach markings. These markings meet FAA design standards and are appropriate for the current and projected future instrument approach capability on each runway.

5.3.11 Taxiways

Taxiways are needed to accommodate the movement of aircraft from parking aprons to the runways and vice versa. In order to provide for the efficient movement of aircraft, it is desirable to have a parallel taxiway and several exit taxiways associated with each runway. The recommended widths for taxiways serving aircraft in Design Groups II, III and IV are 35 feet, 50 feet, and 75 feet, respectively. One exception to these design standards is the width for Design Group III, when the taxiway is intended to serve aircraft having a wheelbase greater than 60 feet. In those cases, the design standard increases to a width of 75 feet.

As noted in Chapter 2, Inventory, the taxiways associated with Runway 5-23 all meet or exceed the required width of 75 feet. Likewise, the taxiways associated with Runway 14-32 also meet or exceed the required width of 75 feet, except for Taxiways Q and P, which have widths of 50 feet. These taxiways primarily serve aircraft using the GA facilities and are adequate to serve aircraft in Design Group III. Improvements to the geometry of these taxiways in front of the GA apron are needed in order to prevent the wheels of larger aircraft from running off the pavement, as this area is used by large business jets and air carrier sized aircraft accommodating sports team charters. Specific improvements are recommended at Taxiway P2 and the intersection of Taxiway Q and Taxiway P.

Other taxiway improvements recommended in the 2002 Master Plan are also recommended in this Sustainable Master Plan. These improvements include a parallel taxiway on the northeast side of Runway 14-32. This improvement would improve the operational efficiency of the airfield by eliminating the need for aircraft taxiing from GA facilities to cross Runway 14-32. Presently, aircraft must taxi from Runway 5-23 to the GA ramp via Taxiway D and must cross Runway 14-32 while in transit to and from the GA apron. Furthermore, GA aircraft departing on Runway 23 must make three runway crossings when taxiing from the GA area to the departure end of Runway 23. This is undesirable from a safety perspective and an air traffic controller workload perspective. Construction of a taxiway on the northeast side of Runway 14-32 would reduce the number of required runway crossings. The construction of the taxiway would also provide direct access from the GA apron to the approach end of Runway 32 and would enable the potential development of property near Mercy Flight for fixed wing aircraft. It is anticipated that this taxiway would be constructed to Group III standards with a width of 50 ft; this would accommodate all general aviation aircraft up to and including the Boeing Business Jet (737).

Another taxiway improvement recommendation is a realignment of Taxiway M, which provides access from Runway 5-23 to the air cargo apron. This taxiway currently has an "S" shaped alignment and is currently the only means of accessing the air cargo apron. A realignment of this taxiway and/or the construction of a new taxiway to Runway 5-23 should be considered in the alternatives analysis. The previous ALP depicted a re-alignment of this taxiway, as well as the construction of a parallel taxiway segment on the northwest side of Runway 5-23. The purpose of that segment would be to provide direct access to the proposed parallel taxiway of the northeast side of Runway 14-32. The need for that taxiway segment will be reexamined in the alternative analysis.

5.3.12 Holding Bays

Holding bays provide space for an aircraft awaiting a departure clearance or conducting an engine run-up to move off the taxiway, thereby clearing the taxiway and providing sufficient space for another aircraft to proceed to the runway for take-off. This reduces delays when an aircraft is conducting engine run-ups or is being held for air traffic control reasons. As noted in Chapter 2, Inventory, there are currently two holding bays at BNIA. These holding bays are located at each end of Runway 5-23 and are sufficient to meet current and future operational needs. No additional holding bays are required.

5.3.13 Airfield Lighting

Approach Lighting

Approach lighting is currently installed on both ends of Runway 5-23. An Approach Lighting System with Sequenced Flashing Lights in an ILS Category (CAT) II Configuration (ALSF-2) is installed on the approach end of Runway 23. This system is required for CAT II/III approaches.

Runway 5 has a Medium Intensity Approach Lighting System with Sequenced Flashing Lights (MALSR). This approach lighting system is the design standard for CAT I approaches and will meet existing and projected needs throughout the planning period. No change to the approach lighting system on Runway 5 is needed.

Runway 32 also has a MALSR that was installed in conjunction with the runway's extension and installation of an ILS. This MALSR supports CAT I approach minimums of 200 feet and 1/2 mile. This approach lighting system meets existing and future needs for Runway 32.

No approach lighting system exists or is required for Runway 14. This runway supports a lateral navigation (LNAV) non-precision approach with visibility minimums 409 feet and one mile. Presently, there is no precision approach to Runway 14, therefore, no need for an approach lighting system. The approach to Runway 14 is supported by Runway End Identifier Lights (REILs) which are sufficient for non-precision approaches.

Runway Lighting

Both Runway 5-23 and Runway 14-32 currently have High Intensity Runway Edge Lights (HIRL). This lighting meets FAA design standards for runways supporting precision instrument approaches and is sufficient to accommodate existing and future aircraft operations.

Runway 5-23 also has centerline lighting and touchdown zone lights. These lighting systems are required to support Runway Visual Range (RVR) minimums less than 2,400 feet and are also required for CAT II/III approaches. Runway 5 and Runway 23 have reduced RVRs of 1,800 feet and Runway 23 is planned to have a CAT II approach in the future. Therefore, the existing centerline and touchdown zone lighting on Runway 5-23 are required to support existing and planned landing minimums.

Taxiway Lighting

All taxiways at BNIA have Medium Intensity Taxiway Lights (MITL) to support nighttime and low-visibility operations. This lighting is sufficient to meet existing and future operational requirements.

Apron Lighting

Apron lighting in the passenger terminal area is provided by high mast lights on top of the passenger terminal. This lighting is sufficient for operations at the passenger terminal.

5.3.14 Navigational and Approach Aids

Runways 5, 23 and 32 have ILS's that provide approach minimums in the general range of 200 feet for decision heights and 1/2 mile for horizontal visibility (i.e., CAT I conditions). The ILS on Runway 5 and 32 are adequate to meet all existing and future needs. The ILS on Runway 23 could be considered for an upgrade to CAT II standards which would reduce approach minimums to a decision height of 100 feet and a runway visual range of 1200 feet. A past review of this issue indicated that substantial additional fill would be required on the north side of the runway in order to provide the required reflective plane to obtain an adequate signal. The Alternatives chapter will explore the feasibility of this action along with any other required facilities to provide CAT II approach capability.

Runway 14 does not have any electronic navigational aids, but currently has a non-precision LNAV approach as described previously. Local wind conditions do not favor the use of Runway 14 for landings during instrument conditions. Therefore, no additional ground based electronic navigational aids are recommended for Runway 14.

With respect to visual approach aids, Runway 5-23 does not have visual approach aids, although it does have approach lighting systems on both ends of the runway (please refer to the Airfield Lighting section for details). The installation of Precision Approach Path Indicators (PAPIs) could be considered on both ends of Runway 5-23. The Alternatives chapter will explore the desirability of this action in consultation with airport management and airport users.

Both ends of Runway 14-32 currently have PAPI's that provide adequate vertical guidance for approaches to that runway.

5.3.15 Summary of Airfield Facility Requirements

Table 5-11 provides a summary of airfield facility requirements.

Table 5-11 Summary of Airfield Facility Requirements

Item	Existing	2015	2020	2025	2030
Runway 5-23					
Length (feet)	8,828	8,828	8,828	8,828	8,828
Width (feet)	150	150	150	150	150
Runway 14-32					
Length (feet)	7,161	7,161	7,161	7,161	7,161
Width (feet)	150	150	150	150	150
Instrument Approaches	Sufficient	Improve Approach Minimums to Runways 23 (CAT II) and 14 (LPV)			
RSAs	Sufficient	No Improvements Required			
ROFAs	MOS'	Maintain Modification of Standards (MOS)			
Taxiways	Insufficient	Improve Taxiway Access for Air Cargo and General Aviation			
Holding Bays	Sufficient	No Improvements Required			
Airfield Lighting	Sufficient	No Improvements Required			

Source: URS Corporation, 2011.

5.4 TERMINAL FACILITY REQUIREMENTS

The 2002 master plan primarily focused on airside facilities and other future needs, because the passenger terminal complex was relatively new at that time and was further expanded to include Gates 15 through 26 at the east end of the terminal. Since that time, landside facilities have experienced growth in a number of key areas. This section examines current and future requirements related to the passenger terminal including assessment of gates and baggage handling requirements.

5.4.1 Basis of Analysis

This section summarizes general planning factors and assumptions used to analyze facility requirements for key functional areas of the passenger terminal. Requirements were analyzed based on a multitude of factors, including Airport staff input, facilities provided at comparable airports, knowledge of industry-wide trends, and guidelines published in the following publications: International Air Transport Association's (IATA's) *Airport Development Reference Manual*, FAA AC 150/5360-13, *Planning and Design Guidelines for Airport Terminal Facilities*, FAA AC 150/5300-13, *Airport Design*, and the Transportation Research Board's Airport Cooperative Research Program, Report 25. Requirements were generated for aircraft gates/parking positions, holdrooms, ticketing and check-in positions, passenger security screening, baggage handling facilities, and Federal Inspection Service (FIS) screening facilities. Additional consideration is given to other terminal requirements including airline operational space, public circulation, both secure and non-secure, concessions, other airport tenants, administration space, and terminal support space including police, custodial, and airport operations.

Methodology

Several space programming techniques were used to determine the future requirements for passenger processing functions of the terminal. These techniques were applied using the standards listed above and are further described in the following text, where appropriate. The specific passenger processing functions examined include the following:

- Airline check-in
- Airline ticket offices
- Passenger and employee screening
- Checked baggage screening system
- Outbound baggage makeup
- Restrooms
- Holdrooms
- Inbound baggage system

The requirements for other non-passenger processing functions are also examined using information gathered from a variety of sources including interviews with Airport staff, airline representatives, and other stakeholders and where applicable, comparison with similar facilities at similar airports, knowledge of industry-wide trends, and industry standards. These functions included the following:

- Other airline space
- Public Space
- Concessions
- Miscellaneous tenant offices
- Airport administrative offices
- Airport operations/storage/custodial
- Mechanical/electrical

The basic approach to the analysis for each function is discussed in the following sections.

Level of Service Standards (LOS)

The International Air Transport Association (IATA) has developed and refined a comprehensive set of standards for planning various passenger processing functions for airport terminal buildings and is typically used as the standard for most terminal space planning issues. These standards are presented in the IATA *Airport Development Reference Manual*, 9th Edition, published in January 2004. These standards primarily apply to calculation of passenger queuing areas and circulation space and are intended to limit passenger densities to enhance individual passenger comfort.

Table 5-12 below provides the IATA Level of Service Area Standards and Definitions for various passenger processing conditions included in this analysis.

- A Excellent level of service. Conditions of free flow, no delays and excellent levels of comfort
- B High level of service. Conditions of stable flow, very few delays and high levels of comfort

- C Good level of service. Conditions of stable flow, acceptable delays and good levels of comfort
- D Adequate level of service. Conditions of unstable flow, acceptable delays for short periods and adequate levels of comfort
- E Inadequate level of service. Conditions of unstable flow, unacceptable delays and inadequate levels of comfort
- F Unacceptable level of service. Conditions of cross-flows, system breakdown and unacceptable delays; unacceptable level of service

Table 5-12 IATA Space Standards with LOS Definitions (in square feet)

Functional Area	A	B	C	D	E	F
Check-in Queuing	19	17	15	13	11	Unserviceable
Wait/Circulate	29	25	20	16	11	Unserviceable
Bag Claim Queuing	22	19	17	15	13	Unserviceable

Source: International Air Transport Association "Airport Development Reference Manual", 2004.

Terminal Area Requirements will be based on maintaining LOS "C" as recommended by IATA because of the stable flow, good levels of comfort and minimal delay, unless otherwise noted.

5.4.2 Assumptions

Percentage of Originating Passengers and Load Factors

For purposes of analyzing passenger terminal space requirements, it is assumed that 100 percent of enplaned passengers are originating. The originating passenger percentage is used to determine the number of passengers who pass through check-in processing and security screening thereby affecting facility capacity requirements.

Load factor

Typically, load factors for the peak month and the average day of the peak month (ADPM) are greater than the annual averages, reflecting increased demand during seasonal peak travel. While data presented in Chapter 3, *Aviation Demand Forecast,* indicates load factors for the mainline fleet from the low 80 percent range in 2010 and increase up to 85 percent by the year 2030; and regional carrier load factors from a 2010 level of 75 to 80 percent by 2030. For purposes of analyzing passenger terminal space requirements (primarily holdroom sizing for seating), a load factor of 85 percent was applied to all calculations.

Passenger Check-in Preferences and Transaction Times

In order to analyze passenger processing requirements for check-in facilities and passenger security screening, it is necessary to determine how this demand will be distributed between these functions. The rate at which these facilities are projected to be used was increased or decreased during the study period to reflect the growth trend of passengers buying tickets in online, printing boarding documents off-site, and traveling with only carry-on baggage as indicated below in **Table 5-13**.

Table 5-13 Airline Check-in Operations

Check-in Type	Percent Originating Pax 2010	Percent Originating Pax 2030	Average Transaction Time (minutes)
Off-Site Check-In With No Bag To Check	**40%**	**50%**	N/A
Terminal Check-in:			
Self-Service Kiosk without Bag To Check[1]	30%	30%	1.5
Staffed Counter Position[2]	25%	15%	2.0
Curbside Check-In	5%	5%	2.0
Terminal Check-in Total	**60%**	**50%**	

Source: URS Corporation, 2011.
Notes: [1] Kiosks dedicated to bag check-in are included in a later analysis.
[2] Agents assist passengers with entire check-in process, whether checking bag or not. First Class check-in is included in a later analysis.

Passenger Security Screening Checkpoints

The following assumptions were utilized to analyze the future demand for security screening of departing passengers. The assumed processing rate for the analysis is 175 persons per lane per hour and is based on information provided by the Transportation Security Administration (TSA) during a data collection interview as noted in Chapter 2. The percentage assumed for employees, etc. is eight percent which was added to the design peak hour passenger screening demand and is based on recent experience at other airports.

Outbound Baggage and Checked Bag Screening Assumptions

The following assumptions in **Table 5-14** were used to analyze future demand for outbound baggage screening and baggage make-up facilities.

Table 5-14 Outbound Baggage and Screening System Assumptions

Item for Analysis	Assumption
Peak Hour Passengers Checking Bags[1]	60%
Checked Bags Per Passenger[2]	1.0
Peak Hour Departure Operations	Per Chapter 3: Aviation Demand Forecast
Bag Size - Standard	95%
Bag Size - Oversized	3%
Bag Size - Out-Of-Gauge	5%

Source: URS Corporation, 2011.
Notes: [1] Number of checked bags remains constant over the study period, should the trend of reduced checked baggage not continue.
[2] It has been identified that certain legacy airlines are currently observing lower 'checked bag per passenger' quantities; For planning purposes, the higher quantity has been used.

Inbound Baggage

The following assumptions in **Table 5-15** were used to analyze the future demand for inbound baggage claim devices and passenger waiting area. A significant number of the passengers flying to and from Buffalo Niagara International Airport are Canadians. In conjunction with this passenger traffic, it is observed that there is a significantly different quantity of 'meeters/greeters' with the Canadian passengers; this issue has been a topic of discussion with the NFTA. While the industry standard for planning is 20% 'meeters/greeters' above the passenger volume, this figure has had to be adjusted for this planning study. The study has reduced the 20% factor by 30% to accommodate this condition.

Table 5-15 Inbound Baggage System

Item for Analysis	Assumption
Bags per passenger[1]	1.0
Meeter/Greeter Ratio	14%

Source: URS Corporation and McFarland Johnson, 2011.
Notes: [1] It has been identified that certain legacy airlines are currently observing lower 'checked bag per passenger' quantities; For planning purposes, the higher quantity has been used.

Holdrooms

Holdroom seating demand was based on assuming an 85 percent load factor for the largest aircraft that can park at each gate. Seating will be provided based on IATA recommended practice for 80 percent of these passengers with additional standing space for 20 percent of passengers. Planning factors of 17 square feet per seated passenger and 12 square feet per standing passenger will be used. An additional square footage allowance was provided for gate check-in podium and boarding queue/gate egress area.

Restrooms

During interviews with staff and based on recent observation, it appears that the existing restrooms provide an acceptable LOS under current levels of passenger demand. An analysis was made of restroom requirements based upon application of International Plumbing Code model guidelines to determine how the existing facilities compare to these criteria. Restroom requirements were estimated separately for:

- Check-in lobby (non-secure side): based on the peak 20-minute originating passengers and well-wishers.
- Arrivals lobby (non-secure side): based on the peak 20-minute terminating passengers and meeter/greeters.
- Boarding area (secure side): based on the peak 20-minute of the total number of passengers (arriving and departing) dwelling in the boarding area.

The industry standard of 0.2 well-wishers per originating passenger and 0.2 meeter/greeters per terminating passenger was assumed, and reduced by 30% to account for Canadian passengers, resulting in a factor of 0.14. The restroom fixtures were then estimated based on one fixture per 10 peak 20-minute passengers, as defined above. An average of 80 square feet per fixture was used to estimate space requirements including circulation. In addition, for every 16 fixtures, 50 square feet of space was allocated for janitor's closets.

5.4.3 Results of Analysis

The facility requirement results are organized by function and area in the tables listed in the following sections. These tables are presented in the following pages:

- Number and Type of Airline Check-in Counters
- Airline Ticket Office Space
- Passenger Security Screening Checkpoint Lane Requirements
- Peak Hour Passenger Volume
- Peak Hour Passenger Volume Surged
- Outbound Baggage Screening Equipment
- Outbound Baggage Make-up Perimeter

- Future Concession Space Requirements
- Public Restroom Area
- Holdroom Space Requirements
- Annual Enplanements per Gate
- Required Gates at 275,000 Annual Enplanements per Gate
- Baggage Claim Population
- Baggage Claim Space

5.4.4 Airline Check-in Counters

Due to the increase in advance ticket purchase and off-site check-in practices, which have taken place in recent years, a general reduction in the number of traditional staffed ticket counters have been observed and the use of kiosk-style check-in units has become more prevalent. For the list of assumptions which have been used for this analysis of Airline Check-in Operations, refer back to Table 5-13.

An evaluation of the requirements for number and type of check-in facilities has been completed and the results are presented in **Table 5-16**. It should be noted that the numbers of units reflected do not necessarily reflect current airline leasehold arrangements at BNIA but instead, reflect the number and type of facilities required to process passenger check-in demand based on observed patterns of current utilization at a minimum LOS C for queuing space during peak periods. It should also be noted that not every airline currently has excessive counter frontage, but reductions should eventually occur for those which do have excess frontage today. In addition, the results of the analysis are based on the effective utilization of each check-in position. Individual airlines may have special requirements requiring additional check-in positions not reflected in the base calculations. Where only one position for Main Agent or Kiosk is required, a second position has been added to insure redundant coverage, should a check-in unit fail.

The analysis reveals that the total existing ticket counter frontage is sufficient to support airline check-in practices throughout the study period. Based on trends observed at other similar airports, airlines will eventually advocate a reduction in traditional ticket counter frontage with an increase in kiosk-style use including units built into the ticket counters, as well as island style units prior to the staffed ticket counters and queuing area.

Therefore, the requirements for the various check-in modes listed below illustrate the following:

- A reduction of staffed ticket counter positions
- An increase in the number of kiosk units
- Curbside check-in facilities remain the same throughout the 20-year planning horizon

As a final item, the reduction in required check-in facilities also reflect an increase in the percentage of passengers arriving at the Airport who have checked-in and printed a boarding pass remotely as indicated previously and who have only carry-on baggage.

Table 5-16 Number and Type of Airline Check-in Counters

Airline	Counter Type	Existing	2015	2020	2025	2030
American	Premium	-	1	1	1	1
	Main Agent	3	1	1	1	1
	Island Style Kiosk	-	-	-	-	-
	Counter Kiosk	2	2	3	3	3
JetBlue	Premium	-	-	-	-	-
	Main Agent	4	2	2	2	2
	Island Style Kiosk	4	4	5	5	5
	Counter Kiosk	-	-	-	-	-
Continental	Premium	-	-	-	-	-
	Main Agent	-	-	-	-	-
	Island Style Kiosk		-	-	-	-
	Counter Kiosk	5	-	-	-	-
Delta	Premium	2	2	2	2	2
	Main Agent	4	2	2	2	2
	Island Style Kiosk	8	8	8	8	8
	Counter Kiosk	-	-	-	-	-
AirTran	Premium	1	-	-	-	-
	Main Agent	1	-	-	-	-
	Island Style Kiosk	4	-	-	-	-
	Counter Kiosk	-	-	-	-	-
United	Premium	-	1	1	1	1
	Main Agent	2	3	3	3	3
	Island Style Kiosk	2	2	4	4	4
	Counter Kiosk	2	4	4	4	4
US Airways	Premium	1	1	1	1	1
	Main Agent	2	2	2	2	2
	Island Style Kiosk	-	-	2	2	2
	Counter Kiosk	8	8	8	8	8
Southwest	Premium	-	-	-	-	-
	Main Agent		1	1	1	1
	Island Style Kiosk		2	2	2	3
	Counter Kiosk	8	8	8	10	10
Prior	Main Agent	2	2	2	2	2
New Airline	Premium	-	-	-	-	-
	Main Agent	-	2	2	2	2
	Island Style Kiosk	-	-	-	-	-
	Counter Kiosk	-	2	2	2	2

Source: *URS Corporation, 2011.*
Notes: *Existing ticket counter allocation based on lease documents and physical observation on site.*
Baggage Drop considered as Main Agent counter
United Future requirements assume consolidated facilities with Continental Airlines.
Two additional airline mergers are in process involving United & Continental and Southwest & AirTran. For purposes of this analysis, these carriers remain separate for existing conditions but are combined for future years.
Southwest indicates they will relocate AirTran to the existing Southwest check-in area with no expansion required.
Available queuing space in the existing ticket lobby appears sufficient to maintain a minimum of LOS C.

5.4.5 *Airline Ticket Office Space*

Current provisions for Airline Ticket Office (ATO) space at BNIA reflect the traditional relationship of ticket counter frontage times 30 feet of depth to determine the amount of ATO space required to support airline's staffing and check-in functions. Recent experiences at similar airports, where leases have been negotiated, indicate a trend of airlines striving to reduce the cost of support space in general and ATO space is no exception. Based on this factor, it is recommended that no further ATO space be considered during the 20-year planning horizon. **Table 5-17** shows the ATO space forecasts.

Table 5-17 Airline Ticket Office (ATO) Space (square feet)

Area	Existing	2015	2020	2025	2030
Check-in Counter Linear Footage	268	178	178	178	183
Airline Ticket Office Space	8,742	5,340	5,340	5,340	5,490

Source: URS Corporation, 2011.
Notes: Assumes future ATO space demand will approximate typical rule-of-thumb of 30 feet of depth times ticket counter frontage. The demand for ATO space may diminish in the future for financial considerations.
ATO space only includes offices located adjacent to the ticketing area. It does not include other support space required by airlines such as gate office, baggage service office, or operations offices.

5.4.6 Passenger Security Screening Checkpoint

The average per lane screening capacity for the current Security Screening Checkpoint (SSCP) at BNIA has been verified as a result of interviews with TSA staff and records of measured average throughput provided by TSA for August, (peak month) 2010. This same data documents the maximum wait time in the queue at 20 minutes. Since the current demand on the SSCP has not reached its calculated capacity, the wait time record indicates that current provisions for queuing may not be sufficient when all 10 lanes are operating at capacity. This will result in the queue filling up and overflowing into the existing ticket lobby area. The minimum recommended queuing area established below should insure that the maximum waiting time in the queue does not exceed the TSA goal of 20 minutes during the peak period.

The functional arrangement of equipment servicing SSCP lanes is laid out in a rectangular format based on TSA recommended minimum lane length and width. The current space used for the SSCP at BNIA has a trapezoidal shape which works efficiently on one side but becomes progressively less efficient over the span of 10 lanes. A simple calculation of average area per lane shows more space required per lane that the minimum standards requires. This result has been factored into the proposed area per lane shown below in **Table 5-18** under the assumption that future lane expansion may have to work with similar geometric constraints.

Table 5-18 Passenger Security Screening Checkpoint (SSCP) Lane Requirements

Security Checkpoint	Existing	2015	2020	2025	2030
Number of Lanes Required[1,2]	10	10	12	13	14
TSA Screening Area[3]	11,860	[5]	13,200	14,300	15,400
Queuing Area[4]	2,960	[5]	4,200	4,550	4,900
Space Required in Square Feet	14,820	[5]	17,400	18,850	20,300

Source: McFarland Johnson, 2010; Compiled by URS, 2011.
Notes:
1 Number of lanes rounded up when less than full lane is required.
2 Assumes no dedicated lane for employee screening.
3 Minimum screening and re-composure area recommended is 1,100 square feet per lane based on the average area per lane occupied for the existing checkpoint layout.
4 Minimum queuing area recommended is 350 square feet per lane.
5 Existing configuration to be retained through 2015.

5.4.7 Outbound Baggage System

Outbound baggage systems are comprised of equipment that support the airlines' departures baggage operations; these include the conveyors that transport baggage from the departures hall to the outbound make-up bag rooms, and the TSA equipment that screens all outbound baggage. To plan for future spatial requirements and for future equipment requirements, baggage demand volumes were first examined. Baggage volumes for existing conditions, as well as future planning milestones were calculated.

Outbound Baggage Demand Volumes

Outbound baggage demand volumes are calculated from passenger enplanements and shown in **Table 5-19**. The planning assumption for "bags per passenger" and "passengers checking bags" are then applied to the enplanement data to determine the demand loads.

Table 5-19 Peak Hour Baggage Volume

Number of EDS Units Required	Existing	2015	2020	2025	2030
Peak Hour Enplanements	1196	1583	1808	2019	2230
Pax checking Bags (60%)	718	950	1085	1211	1338
Baggage Checked (1.0)	718	950	1085	1211	1330

Source: McFarland Johnson, 2011; Compiled by URS, 2011.
Notes: Calculations are based on Table 5-12, Outbound Baggage and Screening System Assumptions.

The baggage handling systems (BHS) and the baggage screening systems work more effectively under a certain threshold (e.g., ~80 percent of capacity). Therefore, the volumes for BHS, as well as the baggage screening volume are examined to accommodate the threshold demand and possible surges above the threshold. The surge factor takes into consideration unforeseen increases in baggage check-in, as in the case of a tour group checking-in. Per TSA's Planning Guidelines and Design Standards (PGDS) for Checked Baggage Inspection Systems (CBIS), a surge factor is applied to the Peak Hour Baggage Volume. The surge factor is applied as a mathematical distribution (Poisson). As the base of the number increases, the surge factor decreases (slightly). The surge factors and resultant baggage demand volumes are listed below in **Table 5-20**.

Table 5-20 Peak Baggage Volume Surged

Factor	Existing	2015	2020	2025	2030
Baggage Checked	718	950	1085	1211	1330
Surge Factor	1.18	1.16	1.15	1.14	1.13
Peak Hour Baggage Volume	847	1102	1248	1381	1512

Source: URS Corporation, 2011.
Notes: Surge Factor calculation from the TSA's PGDS Version 3, Chapter 3.

Baggage Security Screening – Explosives Detection Systems

The TSA baggage screening process is defined as a three stage process. In the first level of screening, bags pass through an Explosives Detection System (EDS). After passing through the machine, a portion of the bags will be cleared and routed to the baggage make-up operations, while the remainder will continue to be transported on conveyors and a second screening operation takes place. The second level of screening is called On-Screen Resolution (OSR) where further examination of baggage images takes place. At the completion of the Level 2 screening, a portion of the bags will be cleared and diverted toward the baggage make-up operation. The remainder of the bags that have not been cleared through the OSR process will be routed into the Checked Baggage Reconciliation Area (CBRA) for Level 3 screening. In CBRA, TSA will utilize Explosives Trace Detection (ETD) to examine bags even further.

The calculation for the required quantity of EDS studies the "demand" imposed by baggage volumes versus the "capacity" of the EDS. The current TSA standard is to provide one additional EDS (N+1) for redundancy. The existing baggage screening system was designed prior to the TSA's PGDS. Consequently, EDS redundancy (N+1) was not considered for the existing system's configuration. However, the EDS with redundancy will be considered for the planning milestones when calculating future requirements.

The existing system throughput was tested and recorded two times by TSA at 1956 and 1865 Bags per Hour (BpH). Since there are six existing EDS, each was considered to be operating at 326 BpH (1956:6) and 311 BpH (1865:6) per EDS, respectively. A value of 311 BpH per EDS will be used as the capacity value in this assessment. Because this assessment is taking into consideration the N+1 redundancy, then only five of the six are primary devices, and the sixth EDS (redundant EDS) is not included in the calculation. This results in the system capacity of 1555 BpH (311 x 5).

As shown in **Table 5-21**, comparing the capacity of the existing system to projected demands, reveals that the existing baggage screening system is able to handle projected demand throughout the study period.

Table 5-21 Outbound Baggage Screening Equipment

Factor	Existing	2015	2020	2025	2030
Baggage Demand	847	1,102	1,241	1,381	1,512
Primary EDS	5	5	5	5	5
EDS Capacity	1,555	1,555	1,555	1,555	1,555

Source: McFarland Johnson, 2011; Compiled by URS, 2011.
Note: Capacity calculation based on TSA data.

The number of OSR stations and ETD inspection table positions were designed and installed in balance with the existing number of EDS; seven OSR stations in the TSA's OSR room and 12 inspection tables in CBRA. The demand load on OSR stations and ETD stations will increase incrementally with the demand on the EDS. Therefore, since the EDS will be able to support projected baggage demands through 2030, the quantities of these stations will support 2030 demand volumes as well.

<u>Baggage Security Screening Spatial Requirements</u>

The baggage security screening spatial requirements are not expected to exceed current space allocations because the existing equipment's capacities meet projected levels of demand through 2030. Current space allocations for the existing system are as follows:

- Level 1 EDS screening operations - 9,500 square feet
- Level 2 OSR operations - 930 square feet
- Level 3 CBRA - 4,900 square feet

<u>Outbound Baggage Make-up</u>

The key component of the outbound baggage system, where growth may be experienced, is the make-up operation, the make-up carousels and the floor space for cart operations. The existing baggage make-up operations occur in the Arrivals level of the terminal, just north of the claim carousel loading area. Cart requirements establish the floor foot-print requirement. Furthermore, there is a corresponding relationship between carts and make-up carousel sizing.

Planning for cart programs reflect the operational need for carts, primarily in the peak outbound condition. Per this program an airline would stage one cart for a peak hour regional jet (gate), in general, and would plan to have one additional cart staged for that gate for a later flight(s). In a similar manner, an airline would stage two carts for a peak hour mainline flight (gate), and would plan to have one additional cart staged for that gate for a later flight(s). Based on this type program, existing conditions require 48 staged cart positions.

With this planning program, it is recognized that only one of three conditions will increase the needed additional cart space and make-up carousel frontage; 1) when the passenger load of regional jet flights grow sufficiently to require the airline to outfit that flight with a mainline narrow-body aircraft, 2) when an airline adds a gate and consequently increases their peak hour make-up operations, or 3) a new entrant airline begins operations.

Table 5-22 compares the existing make-up carousel working frontage to projected needs. Two demand scenarios are included in the table. Both scenarios include growth in the number of seats per the type of aircraft (i.e., regional jet or mainline). The first scenario relates to increase in seats of regional jet flights. The table shows that even though regional jet seats are expected to increase, there is no anticipated bump up to narrow-body aircraft. If there had been an increase that caused a Regional Jet flight to be replaced by a narrow body aircraft, the associated increase in carts needed would have been forecasted, but since there is no increase of this nature, there is no need for additional cart staging in this scenario. The second scenario presents the additional cart requirements that would result from an existing or new air carrier needing an additional gate. In this scenario, a regional jet flight/gate is added prior to 2015 and 2025, and a mainline narrow body flight/gate is added prior to 2020 and 2030.

This report also notes that with an impending merger between Southwest Airlines and AirTran Airways, as well as the merger of Continental and United Airlines, there may be available cart staging at the make-up carousels that are not represented in **Table 5-22**.

Table 5-22 Outbound Baggage Make-up Perimeter (linear feet)

Utilization	Existing	2015	2020	2025	2030
Demand Scenario 1	651 lf	576 lf	576 lf	576 lf	576 lf
Demand Scenario 2	651 lf	600 lf	636 lf	660 lf	697 lf

Source: URS Corporation, 2011.
Notes: The capacity value is based on existing conditions.

5.4.8 Concessions

Existing Concessions Space

A key aspect in the development and operation of an airline terminal building is the commercial concession program which provides an important source of revenue to the airport. BNIA has recently completed a concessions development program and the Team has conducted recent interviews with concession management staff from Delaware North. The information received is summarized below.

The current square footage devoted to food/beverage concessions appears sufficient for the foreseeable future. One potential need identified from observations in the passenger terminal is additional food/beverage prior to security. No concessions currently exist on the first floor of the terminal in the baggage claim area, with only one pre-security food/beverage option located adjacent to the security checkpoint. The market feasibility of a small kiosk-type of concession could be explored in that area. The passenger terminal currently has access to 10 Retail outlets which appear to be well positioned for growth as passenger traffic increases.

Existing Concession Space Deficiencies

The following issues concerning existing concession space deficiencies were identified by Delaware North regarding additional space needs which should be evaluated for near term consideration:

- Storage space for merchandise
- Commissary space
- Office /Employee space

Current planning standards at similar airports allow 15-20 percent of concession area devoted to storage. Storage and support space does not generate revenue like retail space, so it typically has a lower priority for space allocation. The trade-off to balance any loss of revenue for storage space is that access to merchandise to replenish depleted floor displays is readily accessible and restocking the merchandise area as needed will enhance total revenue production. The issue of incorporating secure-side concession storage for merchandise, which has already been cleared by TSA should be evaluated.

With respect to additional office space and locker space, these items are more difficult to justify on the basis of economic trade-off and are more a matter of convenience and employee morale. These would represent reasonable requests for space to be accommodated in the planning and design of an expansion program for additional terminal area. However, in an existing terminal with limited space which creates the need to define highest and best use of available space resources, these items are typically viewed as having insufficient priority or value in the competition for existing space if and when it becomes available.

Future Concessions Space

The following evaluation provides an order of magnitude projection of future concession space in the passenger terminal. In order to accomplish this without a thorough analysis of local market conditions, the application of comparable data recently applied to other concession programs provides the basis of evaluation. **Table 5-23** applies two planning factors which are identified as the high and low-range of square feet of concession space per 1,000 annual enplaned passengers. These factors have recently used for concessions studies at two other airports to project potential future concession space requirements. The average of these two factors has been used to summarize potential future concessions space requirements at BNIA. A split of 60 percent food and beverage to 40 percent Retail and Services is recommended for future concessions development.

Table 5-23 Future Concession Space Requirements (square feet)

Factor Range	Factor[1]	Existing[2]	2015	2020	2025	2030
High	10[3]	32,838	31,309	35,251	39,280	43,310
Low	8[4]	32,838	25,040	28,200	31,424	34,648
Average Area		**32,848**	**28,175**	**31,725**	**35,352**	**38,979**

Source: URS Corporation, 2011.

Notes: [1] *Factor is expressed as square feet per 1,000 annual enplaned passengers.*
[2] *Area is for Level 2 sales area only.*
[3] *The factor of 10 square feet per 1,000 annual enplaned passengers was used for a study conducted for MHT Airport in 2009.*
[4] *The factor of 8 square feet per 1,000 annual enplaned passengers was used at DFW Airport in 2010.*

The analysis suggests that additional concession space may not be required until after 2020. However, the factors used for the analysis do not necessarily reflect current or future trends in the market for additional airport concession space within the current BNIA market area. Concession demand and passenger preferences should be monitored though the planning period for any necessary improvements.

5.4.9 Public Restrooms

For purposes of evaluating future restroom requirements, a factor using the current ratio of plumbing fixtures to the peak 20-minute period of enplaned passengers is utilized as previously outlined above under Section 5.4.2, Assumptions.

As noted in **Table 5-24**, the current restroom area exceeds today's forecast demand. However, based on the impact of forecast growth in peak hour passenger volume, it would appear that future restroom expansion should be evaluated in the 2015 timeframe if growth remains consistent with the current forecast. In addition, a Level 1 restroom expansion should also be considered in conjunction with future baggage claim expansion. Finally, at such time as additional concourse holdrooms are needed, the need for additional restrooms should be evaluated.

A review of the existing plans for the terminal indicates that family restrooms are not currently provided along the concourse with other restroom facilities. It is recommended that two family restroom units of 100 square feet each be included with addition public restroom facilities in 2015.

Table 5-24 Public Restroom Area (square feet)

Location Served	Existing	2015	2020	2025	2030
Non-Secure Level One	1,607	2,128	2,430	2,714	2,997
Non-Secure Level Two	1,607	2,128	2,430	2,714	2,997
Secure Level Two	7,392	9,721	11,046	11,046	11,046

Source: URS Corporation, 2011.

5.4.10 Holdroom Space Requirements

An analysis of holdroom space requirements for BNIA was prepared to examine existing holdroom capacity based on the current and future aircraft fleet mix applying the planning standards for holdroom sizing previously noted and further described below. The analysis calculates the area requirement for each holdroom and compares that to the actual existing holdroom area to highlight areas of deficiency. The analysis then evaluates the long term impact of forecast changes in fleet mix which result in even larger holdroom area deficiencies.

Current and Future Aircraft Fleet

Several sources were used to determine the current range of seating capacity and aircraft types used at each gate including the Official Airline Guide (OAG) Flight Guide and current airline schedules. The largest aircraft using the gate today was adopted as the design aircraft. Its seating capacity was then adjusted to reflect the assumed load factor and this value was used to model seating requirements for existing holdrooms.

For future conditions, the Forecast of Airline Fleet Mix, presented in Table 3-9 of Chapter 3, predicts several trends over the 20-year study period:

- A growth in average load factor over the 20-year planning period
- A modest increase in the level of Regional Carrier to Mainline Carrier activity compared to current activity levels.
- An increase in the average aircraft seating capacity within the Mainline and Regional Carrier categories.

Based on these three factors, assumptions for future aircraft assignments at existing gates previously served by smaller aircraft have been increased to reflect the forecast increase in aircraft seating capacity of the fleet.

Existing Holdroom Size, Capacity and Deficiencies

As previously noted, the evaluation of current holdroom capacity is based on the latest IATA space planning standards utilizing an 80 percent load factor for the assigned 2010 aircraft fleet and then increased to 85 percent for the projected 2030 aircraft fleet. As shown in **Table 5-25**, 10 out of the 24 existing holdrooms today have area deficiencies ranging from 10% to as high as 27% of the IATA standard. When analyzed using the larger aircraft seating capacity and an 85 percent load factor forecast for the 2030 timeframe, 15 out of 24 existing holdrooms have deficiencies ranging from 12 percent to as high as 36 percent.

Resolving Existing Holdroom Deficiencies

To put this issue in perspective, there are three basic options for addressing the conditions associated with holdroom area deficiencies.

- Option 1 - Continue to operate with the existing condition
- Option 2 - Renovate and expand deficient holdrooms
- Option 3 – Concourse expansion

Table 5-25 Holdroom Space Requirements (square feet)

Gate	Occupant	Market Share	Existing Holdroom Area	Assumed 2010 Aircraft Fleet Mix	Aircraft Seats	Required Holdroom Area	Surplus/ Deficient	Assumed 2030 Aircraft Fleet Mix	Aircraft Seats	Required Holdroom Area	Surplus/ Deficient
1	NFTA	-	4,871	767-300	242	3,792	1,079	767-300	242	3,792	1,079
2	US Airways	18%	1,005	ERJ 145	50	1,149	(144)	CR7	65	1,355	(350)
3	US Airways	-	1,736	DH8	37	940	796	E175/E190	86	1,644	92
4	US Airways	-	1,736	CRJ/E175	75	1,432	304	320	150	2,526	(790)
5	US Airways	-	1,892	319	124	2,067	(175)	321	180	2,939	(1,047)
6	US Airways	-	1,892	320	150	2,404	(512)	319	124	2,167	(275)
7	JetBlue	18.5%	1,894	320	150	2,404	(512)	320	150	2,526	(632)
8	JetBlue	-	1,905	E190	100	1,756	149	E190	100	1,756	68
9	Unassigned	-	1,935	733	126	2,093	(158)	320/737	150	2,526	(591)
10	United	9%	1,901	320	138	2,248	(347)	320	138	2,360	(459)
11	American	1.5%	1,855	CR7	65	1,302	533	CR7	70	1,424	431
12	United	-	1,901	CR7	66	1,315	586	319	120	2,112	(211)
14	AirTran	6%	1,613	737	137	2,236	(623)	CR9	86	1,644	(31)
15	Unassigned	-	900	ERJ 145	50	1,108	(208)	ERJ 145	50	1,149	(249)
16	Southwest	26%	2,402	733	137	2,236	166	738	175	2,870	(468)
18	Southwest	-	2,402	73G	137	2,236	166	73G	137	2,346	56
19	Delta	15%	2,270	CR9	76	1,445	825	CR9	76	1,507	763
20	Unassigned	-	1,387	CR7	70	1,367	(16)	CR7	70	1,424	(41)
21	Delta	-	2,270	M80	142	2,300	(30)	738	150	2,526	(256)
22	Unassigned	-	2,018	A319/737	124	2,067	(49)	320/737	150	2,526	(508)
23	Delta	-	2,010	M80	142	2,300	(290)	738	150	2,526	(516)
24	Continental	6%	1,106	Q400	74	1,419	(313)	Q400	74	1,479	(373)
25	Delta	-	2,010	CR9	76	1,445	565	CR9	76	1,507	503
26	Continental	-	1,106	ERJ 145	50	1,108	(2)	Q400	74	1,479	(373)
			46,013			**40,336**	**5,677**			**50,188**	**(4,175)**

Source: Current Lease Documents, Site inspection, current flight schedules and OAG.
Notes: Existing Gate Assignments per terminal plans showing leased hold areas including square footage.
Market Share for each carrier calculated from data collected for the full year of 2009.
Future Gate Assumptions are not necessarily related to current air carrier tenant.
Gate numbers 13 and 17 are not currently used.

The final solution should receive careful evaluation and the issues related to the options are discussed in more detail below.

Option 1 - The primary issue of operating with holdroom area deficiencies is focused on passenger level of service and a number of factors influence the actual results in day-to-day operation. First, the calculated deficiency is based on the assumptions of passenger volume and demand which may not be realized during each peak hour period. In addition, the condition of perceived overcrowding that may result is likely to be localized in holdrooms separated by other uses along the concourse such as restrooms, concessions, etc. A study should be made to determine the degree of impact of each deficient holdroom on adjacent terminal functions. The results may suggest where localized modifications can resolve potential issues of overcrowding or it may be determined that selected holdrooms should be limited to a smaller design aircraft for normal operations which will limit the existing concourses growth potential.

Option 2 – This option expands on the information gathered from Option 1 and would explore the feasibility of expanding the exterior wall line of selected holdrooms to add floor area required to correct localized area deficiencies. This option would require a phased construction approach using currently unassigned holdrooms to maintain each existing air carriers operation while renovation work was accomplished. This is feasible only so long as the existing unassigned holdrooms can function as swing space for the renovation program. As these holdrooms are absorbed in the future, the solution will require the construction of new holdrooms to provide the necessary swing gates for a renovation program to be undertaken.

Option 3 – The final option involves a combination of displacing existing functions between holdrooms to gain area and use of a portion of the currently unassigned holdroom space to replace to those displaced functions in conjunction with holdroom expansion thereby reducing the total number of holdrooms on the concourse. While the ideal solution would not require expansion of the existing concourse footprint, the opportunity to provide addition area on the existing concourse should be evaluated along with where best to add additional gates to the existing concourse since the displaced holdroom will eventually require replacement. The advantage of this approach is that it would evaluate the benefits of adding floor area to the existing concourse to resolve not only current holdroom deficiencies but also provide space for future restroom requirements, future concession and concession support space issues.

5.4.11 Gate Expansion

Problems with potential deficiencies in existing concourse floor area discussed above notwithstanding, it would appear that a total of 24 gates can absorb the forecast growth in peak hour passenger demand based on the following factors:

- Growth in average seats per departure based on increased aircraft gauge forecast between 2010 and 2030.
- Growth in average load factor as forecast between 2010 (80 percent load factor) and 2030 (85 percent load factor).
- Potential growth in gate utilization (average uses per day) of most existing assigned gates coupled with possible cross-utilization of Gate 1 for domestic operations and availability of four currently unassigned gates.

While growth in average seats per departure and increased average load factor have been discussed previously, the issue of improvements in gate utilization should be reviewed in more detail.

One method of evaluating gate capacity is based on Annual Enplanements per gate, which can serve as a factor in calculating gate utilization. **Table 5-26** provides the number of gates and forecast Annual Enplanements per Gate for the existing gates by current air carriers at BNIA based on the 2010 through 2030 forecast. The number of gates currently occupied by existing air carriers was determined from BNIA terminal plans showing various lease areas for the existing terminal. Annual enplanements per gate are calculated based on the current market share of each air carrier applied to the total forecast enplanements for each 5-year increment from 2015 through 2030. Attention is immediately drawn to the growth in level of annual enplanements of existing gates for two existing air carriers, JetBlue and Southwest, particularly if and when, Southwest merges operations with AirTran.

The growth in Annual Enplanements per Gate for JetBlue and Southwest/AirTran is at a level which will require occupancy of additional gates over the 20-year period of this study. The remaining air carriers appear to be able to maintain forecast growth in passenger demand with their currently leased holdrooms.

Table 5-26 Annual Enplanements per Gate [1]

Airline	No. of Gates	Existing	2015	2020	2025	2030
US Airways	5	93,002	112,712	126,832	141,386	155,941
JetBlue	2	238,965	289,608	325,887	363,285	400,682
United	2	116,253	140,891	158,540	176,733	194,927
American	1	38,751	46,964	52,847	58,911	64,976
AirTran	1	155,004	187,154	211,386	235,644	259,902
Southwest	2	335,842	407,017	458,003	510,562	563,121
Delta	4	96,878	117,409	132,116	147,278	162,439
Continental	2	77,502	93,927	105,693	117,822	129,951

Source: McFarland Johnson, 2010; Compiled by URS, 2011
Notes: [1] Based on distribution of current market share without regard for existing mergers of United/Continental and Southwest/AirTran

A common factor used to assess a reasonable number of annual enplanements per gate is the daily rate of gate utilization or Gate Utilization Ratio (GUR), which can be estimated by multiplying the number of departures per day/per gate times the average seats per departure times 365 days to determine a target benchmark for annual enplanements per gate. Most industry sources focus on a range of between 6.5 and 8.5 turns per day as a desirable measure of effective gate utilization. For purposes of this analysis, a rate of 7.5 turns per day was used. The Forecast of Airline Fleet Mix in Chapter 3 projects that the average number of seats per departure will grow from 95 seats per departure in 2015 to 101 seats per departure in 2030. For this analysis, 100 seats per departure were used to calculate annual enplanements per gate. This results in 275,000 annual enplanements per gate at 7.5 departures per day per gate.

Using a ratio of 7.5, **Table 5-27** shows the number of additional gates required by the incumbent air carriers through 2030, which grows from 19 occupied gates today to 23 gates in 2030. For this analysis the selection of a ratio is based on current experience in the industry. It has been assumed that most other airlines have begun to recognize the importance of not only more effective utilization of their aircraft but terminal facilities as well and will eventually improve their respective average gate utilization to enhance their ability to compete. It should be noted that even reducing the Gate Utilization Ratio to 6.5 or 240,000 annual enplanements per gate, the only change in gate requirements is attributed to JetBlue increasing from three to four gates between 2025 and 2030. It should be noted that the gate allocations are based on calculations and not business necessity. Airlines like Southwest and JetBlue place a higher emphasis on a low-cost model and will achieve higher utilization as shown by existing use.

Table 5-27 Required Gates at 275,000 Annual Enplanements per Gate[1]

Airline	Existing	No. of Gates	2015	No. of Gates	2020	No. of Gates	2025	No. of Gates	2030	No. of Gates
US Airways	93,002	5	112,712	5	126,832	5	141,386	5	155,941	5
JetBlue	238,965	2	193,072	3	217,258	3	242,190	3	267,122	3
United	116,253	2	117,408	4	132,116	4	147,277	4	162,438	4
American	38,751	1	46,964	1	52,847	1	58,911	1	64,976	1
AirTran[1]	155,004	1	-	-	-	-	-	-	-	-
Southwest	335,842	2	250,472	4	225,478	5	251,354	5	231,024	6
Delta	96,878	4	117,409	4	132,116	4	147,278	4	162,439	4
Continental[1]	77,502	2	-	-	-	-	-	-	-	-
Total Gates		**19**		**21**		**22**		**22**		**23**

Source: URS Corporation, 2011.
Note: [1] Assumes United/Continental and Southwest/AirTran merge operations in 2012. Forecast passengers and gates currently occupied by each carrier remain the same following operational merger.

Several gates at BNIA handle a significant number of regional carrier operations. These gates would require greater daily utilization to achieve 275,000 annual enplanements per gate due to their lower number of seats per departure. For a gate serving regional carriers, the Forecast of Airline Fleet Mix calculates 65 average seats per departure in 2015 increasing to 70 average seats per departure in 2030. At 275,000 annual enplanements per gate and 70 average seats per departure, a gate serving regional carriers would require a utilization rate of 11 departures per day. However, achieving 11 turns per day is not that difficult when you consider some air carriers providing regional type service may operate two or three regional aircraft through a single gate.

Even with the growth in gate demand over the 20-year study period, the 23 existing domestic gates satisfy the projected long-term demand. In addition, existing Gate 1 currently reserved for FIS use could be cross-utilized for domestic airline activity should yet another gate with holdroom become needed. Therefore, on the basis of this analysis, it would appear that further gate expansion is not required within the 20-year planning horizon. It should be noted that there are several considerations which would change this outcome:

- Issues involving the resolution of the concourse floor area deficiencies discussed previously may in fact lead to the addition of new gates.
- Current legacy air carriers may not make anticipated improvements in daily gate utilization.
- Schedule driven demand for access to gates based on peak hour activity may create future requests for additional gates.
- The airport may experience unforeseen growth in passenger demand.

With the foregoing considerations in mind, further study should be given to the issues of both current and future concourse space requirements to better understand their impact on future concourse level of service and identification of conceptual alternatives for resolution.

5.4.12 Remain Overnight (RON) Parking

Due to the fact that BNIA is a spoke airport, where numerous aircraft are flying into hub airports or focus cities, there are more aircraft departures in the early morning hours than there are gates at the passenger terminal. Therefore, RON parking is required to accommodate these additional aircraft so that they are ready to be tugged to the gate when it is time to begin preparations for their flight.

RON parking is currently provided on the south side of Taxiway K1 and at the far west end of the terminal beyond Gate 1. A formal parking plan has not been established for RON parking although a number of concrete hardstands were constructed at the K1 location to protect flexible pavements from the resulting wheel loads.

A review of aerial photography indicates that up to seven air carrier aircraft could be accommodated in the vicinity of K1 depending upon aircraft size and parking arrangements. Previous aerial photographs reveal that longer aircraft such as MD-80's have been parked at an angle to avoid conflicts with the adjoining taxiway. However, this reduces the number of aircraft that can be parked at this location.

The capacity of the RON parking area at the west end of the terminal is more difficult to determine since it depends heavily on the parking configuration used. However, it appears that several commuter size aircraft can be accommodated in this area. Part 77 height constraints may limit the overall number of aircraft that can be parked in this location.

The demand for RON parking fluctuates with flight schedules throughout the year. A review of the peak month (August) flight schedule for 2010 indicates that RON parking was needed for approximately 31 aircraft. If all 24 gates at the terminal were used for aircraft parking, this would still leave a need for seven parking positions. If the four unassigned gates are not used, the number of required parking positions would increase to 11.

Future demand for RON parking will be determined by future operations, flight schedules and the number of gates. The aviation demand forecasts project that mainline air carrier operations will increase by 50 percent, while regional aircraft operations will increase by 38 percent. However, the number of RON parking positions is not expected to increase proportionately to the increased number of aircraft operations because some spreading of the peak hour typically occurs as the total number of operations increase. This suggests that the peak hour flight schedule will increase by less than these percentages.

With respect to the influence of gates on RON parking requirements, the assessment of gate requirements suggests that future demand can be accommodate with the existing 24 gates at the terminal. Thus, it does not appear that increased number of gates will be a significant driver of RON parking demand, although it is very likely that currently unused gates will be used as demand increases through the study period.

Considering all of these factors, it is possible that RON parking demand could increase by 30 to 40 percent over current levels of demand. This suggests that demand may increase from the current seven to 11 aircraft up to 10 to 16 aircraft parking positions during the study period. Alternatives for accommodating this level of RON parking will be explored in Chapter 6.

5.4.13 Inbound Baggage Systems

Insufficient space for inbound baggage has been noted as a problem to be resolved based on interviews with BNIA staff particularly with respect to the claim hall. The most common method for analyzing claim hall space requirements is based on comparing the amount of available floor area per occupant to adopted level of service standards. While these methods are widely used in the industry, they do not always provide a clear picture of how the final arrangement functions. The reason is that the arrangement of the projected space based on width to depth, its location in the building and other items not included in the calculation such as structural columns, use of smart carts and place of points of access all influence the final function of the area in question. The following section provides a theoretical analysis of the required area for baggage claim without regard to final space layout.

Baggage Claim Space Requirements in Theory

Planning for baggage claim areas and claim carousels is based on two processes: passengers arriving to claim baggage and the bags themselves arriving on the carousel to be claimed. The calculation for baggage claim area space and equipment is complex and requires consideration of the following factors, defining the quantity of passengers and greeters that will need space in and around the claim carousel, the most appropriate frontage of the claim carousel, and the operational spaces in the bagroom to support the off-loading of baggage. It is generally agreed that the passenger/greeter population will be increasing around the claim device for a longer period than the baggage will occupy the device.

The industry standard for domestic claim devices, supporting non-wide-body services, is based on a 20-minute timeframe. To calculate spaces and sizes that will be capable of handling slightly higher than normal operational conditions (allowing for abnormal conditions), the analysis looks to support 50 percent of the arrivals population (claiming bags) in the peak 20 minutes. The claim hall floor space is occupied by claim carousels themselves and the passengers/greeters waiting to claim their baggage. The peak hour passenger arrival volume has been extrapolated from the 2010 Arrival Flight Schedule and other parameters are used to develop the claim hall population information of **Table 5-28**.

Table 5-28 Baggage Claim Population

Claim Unit	Existing	2015	2020	2025	2030
Total Peak Hour Operations	20	25	27	29	31
Peak Hour Arrivals	12	15	16	17	19
Mainline Arriving Flights	8	10	11	12	13
Regional Jet Arriving Flights	4	5	5	5	6
Flights in the Peak 20-min	6	8	8	9	9
Deplaning Pax Claiming Bags	302	388	431	474	538
Deplaning Pax with Mtr/Grtrs	339	436	484	533	605

Source: McFarland Johnson, 2010; Compiled by URS, 2011.

The space in the baggage claim area, as the industry defines it, can be analyzed based on acceptable spatial levels for passengers/greeters. IATA has established LOS standards for baggage claim areas. LOS A is defined as the most generous spatial allowance for passengers/meeter/greeters, while a LOS category of D is considered substandard, and LOS E is considered unacceptably low. LOS B and C are defined as also acceptable for baggage claim areas. The LOS figures, as published by IATA (and converted to English units) are;

A – 28.0 square feet, B – 21.5 square feet, C – 18.3, D – 14.0 square feet, and E – 10.8 square feet. The existing baggage claim space (at the three flat-plate carousels) is 12,760 square feet total. **Table 5-29** calculates the overall required amount of space needed to provide the peak 20-minute population, adequate space based on the LOS standard. Note that LOS – E is not studied, as it is unacceptably low.

From this table it can be seen that the gross floor area of the existing claim hall appears to be sufficient through 2015 if a LOS A is desired, it would be sufficient through 2025 if a LOS B is desired, and would be sufficient through 2030 if LOS C is desired.

Table 5-29 Baggage Claim Space

Claim Unit	Existing	2015	2020	2025	2030
Current Claim Hall square feet	12.760	-	-	-	-
Claim Hall Population	339	436	484	533	605
Claim Hall space LOS – A	9,490	<u>12,200</u>	13,550	14,900	16,940
Claim Hall space LOS – B	7,300	9,370	<u>10,400</u>	<u>11,500</u>	13,000
Claim Hall space LOS – C	6,480	8,250	9,460	10,400	<u>11,420</u>
Claim Hall space LOS – D	4,750	6,100	6,780	7,460	8,470

Source: IATA Standards, 2004; Compiled by URS, 2011.

For the frontage of claim carousel to serve the passengers, two planning practices are applied. The first is based on baggage off-load rate: one cart being unloaded at a time. The cart will have a maximum of 40 bags. The guideline is that the 40 bags should fit within the public space of the carousel. Above this, to provide a convenience factor for the passengers, the carousel holding those bags should only be 80 percent filled. If each bag is given a 3-foot space and the 80 percent factor is applied, the result is that the carousel should provide a minimum of 150 feet of public presentation frontage.

The second planning practice is that two-thirds of the passengers claiming bags should be able to stand at the edge of the claim carousel. For LOS C this equates to two feet per passenger. For a 142-seat narrow body flight, this would equate to approximately 90 feet of frontage. For an 80-seat Regional Jet flight, this would equate to roughly 50 feet of frontage.

Additional consideration is sometimes given for the operational practice of sizing the claim carousel to handle a minimum of two narrow body flights. The added benefit of this practice is that several regional jet flights' bags can be assigned to the carousel, or a combination of one narrow body flight and other Regional Jet flights. In this case, the resultant claim frontage for carousels is in the 180-foot to 200-foot length.

The existing claim carousel frontages (public perimeter) are each in the 170-foot range. The combined result of the latter planning practice in conjunction with the Baggage Claim Space information of Table 5-26, is that it may serve the operations of the terminal well to increase the length of the perimeter of the carousels. If the peninsulas of the claim carousels were increased by 10 feet the overall space at the three devices would be reduced by 330 square feet. The baggage claim space would be 12,430 square feet versus the 12,760 defined in Table 5-26. Referencing the LOS spatial requirements of the table, it can be seen that the LOS A, LOS B, and LOS C spatial needs continue to be met.

While the analysis suggests that the bag handling capacity of the claim belts and floor area of the existing baggage claim hall is sufficient to satisfy current and future demand, observations of actual use of the claim hall indicate that the available claim hall space is, even today, subject to excessive congestion and crowding. This condition is likely due to the arrangement of existing passenger flow patterns related to access and cross-circulation which may be further aggravated by physical obstructions such as columns and other features/facilities. Alternatives for correcting this condition of congestion and crowding along with the other considerations noted below will be evaluated and may include the possible expansion of the baggage claim area beyond the existing terminal footprint.

Other Considerations

One other factor is noted with the baggage claim operations. The airside loading area of the three claim carousels is quite congested at times. The layout of the cart parking area adjacent to the off-loading area, with the adjacent drive aisle, and the adjacent cart staging of the closest make-up carousels is quite tight. The layout does not provide an adequate by-pass lane for tug/carts attempting to get to either of the claim devices further into the bagroom. The existing by-pass lane is only approximately seven feet wide, but should be 10 feet to 12 feet wide. Proper spacing in this airside area should be a minimum of 30 feet from the edge of the claim carousel to the edge of the make-up carousel.

TSA has noted concerns regarding the security of baggage claim operations; specifically the flat-plate carousels, which have two doors leading to the airside, and the carousel passes bags from the public side to the airside at one of those doors. TSA has noted that there are other solutions, such as carousel claim devices, that would provide better security.

It is noted that the airlines will, in many cases, attempt to utilize the claim device adjacent to their Baggage Service office. There have been observations, by airline personnel and airport staff, that this practice causes operational issues, heavy-utilization of the outer carousels, and under-utilization of the center carousel.

Operational, security and functional layout issues within the baggage claim area noted above are studied as part of the development of Chapter 6, Alternatives. This will include planning sketches analyzing points of access, passenger flow patterns, potential claim carousel shapes, other types of carousels and positioning of the off-loading area to determine if feasible solutions can increase the efficiency of the baggage claim area and operations.

5.4.14 Federal Inspection Service Facility

The existing FIS Facility consists of 18,474 square feet on the Level 1 and 6,867 square feet on Level 2 for a total area of 25,341 square feet devoted to FIS use. The current arrival processing capacity of the facility based on current CBP standards is approximately 200 arriving passengers per hour. At this capacity, it can readily process a charter configured for a Boeing 737/A-320 arriving from a warm weather point of origin in one hour or less, assuming the facilities are fully staffed on arrival. Currently there is no international flight activity in the forecast. As suggested previously in Section 5.4.11, Gate Expansion, assuming the demand for international arrival processing takes place at Niagara Falls International Airport for the foreseeable future, the holdroom space and gate with loading bridge serving this facility could be cross-utilized for domestic passenger service, if an additional gate is needed.

5.4.15 Support Functions

Public Space

Public spaces include most of the non-revenue producing areas in the passenger terminal including: queuing areas, seating and waiting areas (exclusive of holdroom seating), and circulation corridors (secure and non-secure). The size and/or area of some of the public space is directly related to requirements imposed by the peak hour volume of passengers handled, such as allowance for common circulation areas in the ticket lobby and baggage claim, while other circulation space is required for access to other facility components. In either case, space must be sufficient to meet applicable life safety codes, avoid pinch points that lead to congestion of passenger flow, and provide the additional space necessary for cross circulation where it can't be avoided.

Public Circulation includes both secure and non-secure areas required to access terminal functions and facilities including terminal entrance/egress vestibules, ticket lobby, baggage claim, all corridors, escalators, open stairs, and ramps. Also included in this category of space are emergency egress stairs.

Miscellaneous Tenant Offices

Police

The terminal space inventory indicates the police currently occupy an office adjacent to the loading dock which provides 177 square feet of space. There have been no requests for additional space located in the terminal by the police at this time.

TSA

TSA currently occupies 9,437 square feet on Level 1 of the terminal and 1.339 square feet on Level 2 for a total of 10,776 square feet. Space on Level 1 is devoted to TSA administration offices and training with space on Level 2 providing additional office space and a break room which can also serve as a duty staff briefing area and conference area. TSA has not expressed a need for additional administrative space at this time, but additional space should be considered at the time it is determined that the existing checkpoint needs additional lanes to meet passenger screening demand.

Mechanical/Electrical

In airport terminal buildings, mechanical and electrical support spaces generally occupy as much as 10 percent of the net floor area of the terminal building. These spaces include rooms housing equipment for heating, cooling, and proper ventilation of the building; all electrical rooms for main and possibly emergency power; local power distribution for lighting and building equipment; special building systems for security; life safety; communications; and other support systems.

A recent survey of existing mechanical space indicates that BNIA currently devotes 5.8 percent of existing terminal square footage to mechanical space. One reason for this low percentage of total building area is that equipment for at least four major air handling systems is located on the

Level 1 roof adjacent to Level 2 space, rather than in a weather protected interior mechanical room.

5.4.16 Airport Administration

Consultations with airport staff indicated that there are three concerns related to existing administrative space. First, the existing space is not contiguous. Some administrative space is on Level 1, while the remainder of the space is on Level 2. Second, all administrative space must be accessed through security. Third, visitors to the airport administrative offices must be escorted and pass through the security checkpoint to attend meetings in the existing airport administrative offices. This process is very inconvenient and time consuming, especially for larger groups of visitors.

With regard to the first two issues, although not configured in an ideal layout, the amount of space allocated to administrative functions appears adequate to meet current needs. Alternatives for non-secure access to the administrative offices can be examined in conjunction with long-range options for future expansion.

With regard to the third issue, an option of providing conference room space on the non-secure side for meetings with visitors can be explored. Such a space could also be used by other civic or community interests and serve as a media briefing room, when such events are necessary. A space able to accommodate up to 20 people seated at moveable tables (serving as a writing surface or for notebook computers) with a podium and wall suitable for projecting video would be ideal. A room of approximately 500 square feet would serve this need.

5.4.17 Rental Car Office Requirements

Rental car operations at BNIA are located both on-airport as well as off-airport. Off-site functions are privately owned by their respective operators and not factored into this analysis. Six rental car companies operate from counter space on the lower level of the Short Term Garage directly across from the passenger terminal. Rental car providers with on-site facilities include Alamo, Avis, Budget, Enterprise, Hertz, and National. Consultations with airport staff and rental car operators have not identified a need for additional service counter or rental car office space by the current on-site rental car companies. However, overcrowding and congestion in the rental counter lobby queuing area has been observed and alternatives to partially or totally eliminate this problem should be evaluated.

5.4.18 Ground Transportation Office Requirements

Combined, there are nearly 100 commercial ground transportation providers serving BNIA. Many services, such as shuttle services and limousines, are on demand service and do not have a schedule for serving the airport. Most hotels in the vicinity of the airport, as well as some hotels in downtown Buffalo, provide shuttle service to/from the airport.

Taxi service is provided by Airport Taxi, which has an exclusive operating agreement for transporting passengers from the airport (other operators may drop off passengers but are not permitted to pick up). The staging area for taxis is located alongside the terminal loop roadway just prior to the terminal; taxis are staged and wait in this area until needed to load passengers from the commercial arrivals curb on the lower level of the passenger terminal, which is supervised by a taxi starter who calls taxis from the staging area to the curb.

5.4.19 Passenger Terminal Facility Requirements Summary

The preceding analysis of passenger terminal space requirements has been applied to provide a summary of future terminal space requirements based on current trends of space utilization and information gathered from discussion with BNIA staff and other airport stakeholders. The summary suggests that, assuming the anticipated reduction in space requirements by the airline industry is implemented at BNIA, that the area gained may be utilized for other purposes where a demonstrated need exists. This potential surplus space combined with current unassigned lease area within the terminal could provide the additional area needed to resolve most additional space requirements anticipated over the 20-year planning horizon of this study.

Several exceptions to this potential outcome are outlined below and include concerns identified during discussion with stakeholders and through the subsequent analysis.

- Resolution of the issues associated with relieving current and future peak hour congestion associated with inbound baggage handling, TSA security concerns, and congestion at the existing loading dock area may best be resolved through expansion of the baggage claim and delivery dock areas.
- It may not be completely feasible to find ways to adjust the way existing and future unassigned areas can be accessed or combined to make effective utilization possible, which may require expansion of the current building foot print to resolve.

Assuming the basic future characteristics of airline operations and passenger processing requirements remain consistent with today's operations, current projections indicate that future terminal expansion to add new gates/holdrooms may not be necessary. However, this is by no means guaranteed. Based on this possibility, some thought should be given to how and where future gates might be located and identify how this might impact future passenger processing requirements.

The existing areas presented below in **Table 5-30** have been compiled from documentation provided by BNIA and include some field verification, where readily accessible. In addition, existing terminal plans were measured to calculate the floor areas to further breakdown the BNIA summary documentation into more discrete functional areas. Occasional small discrepancies were found but the variation is insignificant for purposes of the analysis.

As implied above, the total terminal area in this summary remains the same throughout the 20-year planning period. This is based on the assumption that additional facilities required by the analysis of terminal space requirements included in this document are balanced by use of currently unassigned terminal area and currently leased space which may be forfeited by the airlines over the next few years as they continue to focus on streamlining their operations and as the result of recent airline mergers.

Table 5-30 Summary of Terminal Facility Requirements

Item Description	Existing	2015	2020	2025	2030
Passenger Demand					
Annual Enplaned Passengers	2,583,400	3,130,900	3,523,100	3,927,400	4,331,700
Peak Hour Enplaned Passengers	1,196	1,583	1,808	2,019	2,230
Terminal Space Requirements (square feet)					
Airline Functions					
Ticket Counters[1]	2,814	1,866	1,866	1,866	1,916
Ticket Counter Queuing[2]	4,556	3,022	3,022	3,022	3,101
Airline Ticket Office[3]	8,742	5,340	5,340	5,340	5,490
Outbound Baggage System	41,542	41,542	41,542	41,542	41,542
Holdrooms[4]	34,906	41,642	44,168	44,168	45,317
Inbound Baggage System[5]	27,144	27,144	27,144	27,144	27,144
Airline Operations[6]	29,809	29,802	31,000	31,000	31,500
Airline Clubs	2,891	2,891	2,891	2,891	2,891
Security Screening Checkpoint	14,820	14,820	20,300	20,300	20,300
Concession Space[7]					
Retail/Services	9,626	9,626	9,626	11,515	12,950
Food/Beverage	23,836	23,836	23,836	23,836	23,836
Storage/Office	4,041	6,500	6,500	7,250	7,250
Restrooms					
Non-Secure	3,414	3,414	4,860	4,860	5.994
Secure	7,392	7,392	11,046	11,046	11,046
Public/Miscellaneous Space					
Public Circulation	116,023	116,023	116,023	116,023	116,023
Joint Use Area	14,970	14,970	14,970	14,970	14,970
Common Use/Circulation	22,098	22,098	22,098	22,098	22,098
TSA	10,778	10,778	10,778	10,778	10,778
Airport Administration[8]	6,931	7,500	7,500	7,500	7,500
Federal Inspection Service	25,342	25,342	25,342	25,342	25,342
Mechanical/Electrical	26,442	26,442	26,442	26,442	26,442
Subtotal	**438,117**	**441,997**	**455,103**	**459,767**	**465,378**
Unassigned Area	27,412	23,532	10,426	5,762	142
Total Terminal Area	**465,529**	**465,529**	**465,529**	**465,529**	**465,529**

Source: McFarland Johnson, 2010; Compiled by URS, 2011.

Notes:
1. *Based demand analysis previously in Table 5-16plus 25 percent contingency for special airline requirements.*
2. *Based on area equal to 15 feet deep times ticket counter frontage.*
3. *Based on area equal to 30 feet deep times ticket counter frontage.*
4. *Area based on requirements for current assigned holdrooms with gates added per Table 5-27 Required Gates.*
5. *Area includes common tug circulation for bag delivery plus bag claim area.*
6. *Based on area of existing assigned airline operations area plus use of unassigned operations area for future gate requirements.*
7. *Based on concession analysis in Table 5-23 plus expanded concession storage and office support space.*
8. *Indicates addition of a conference room accessible from the ticket lobby without requiring visitor to pass through checkpoint.*

5.5 LANDSIDE FACILITY REQUIREMENTS

5.5.1 Auto Parking Requirements

Auto parking facilities at an airport are a quintessential component to the overall operation of the airport. All airports strive to provide convenient and economical parking for passengers, but this is especially true for BNIA since Canadian passengers are driving to the airport in part due to the convenience over the much larger and busier Toronto Pearson International Airport. In addition to the passenger convenience, auto parking is also one of the largest revenue sources for the airport. Undersized or inconvenient parking facilities will result in fewer passengers and/or the creation off–airport parking facilities which will reduce revenue for the airport.

This section will discuss the following:

- Existing Parking Areas, Usage and Capacities
- Unique Factors Affecting Parking at Buffalo
- Assessment of Parking Needs
- Recommended Options to Address Needs

<u>**Existing Parking Facilities**</u>

***Short Term Garage* –** The Short Term Garage is a three level parking structure located directly in front of the passenger terminal and provides the only covered parking of any of the lots in the passenger terminal complex. The first level of the garage contains approximately 432 spaces used by the rental car companies and 79 spaces for special NFTA permits. Levels two and three of the parking garage contain approximately 754 short term public parking spaces.

Preferred Long Term – The Preferred Long Term lot is located adjacent to the Short Term Garage and Genesee Street. This lot is the closest surface lot to the passenger terminal and contains 1,439 public spaces. This lot shares a common tollbooth/exit with the Short Term Garage.

Long Term A – The Long Term A lot is located east of the passenger terminal complex. The lot is split into two pieces that are connected by a tunnel underneath the airport entrance road. While it is possible to walk to the terminal from this lot, frequent shuttle service is provided. The Long Term A lot contains a total of 2,693 spaces.

***Long Term B* –** The Long Term B lot is located east of Runway 14-32, unlike the other on-airport parking lots, it is not located adjacent to the passenger terminal and shuttle service is required. This lot contains approximately 1,901 spaces which includes approximately 164 spaces for the nearby Sleep Inn Hotel.

Off-Site Parking – In addition to the lots owned and operated by the NFTA, there are several off-site parking lots available for passenger use. These lots include The Parking Spot (1,100 spaces) and several lots associated with hotels and rental car companies totaling approximately 1,390 spaces.

Both NFTA lots and off-site facilities were included in the analysis of parking demand characteristics and the calculation of the number spaces required.

Peak Season

The combination of a harsh winter climate, appeal to Canadian travelers, and school breaks in the early spring, significantly enhance auto parking demand in the months of February, April, March and occasionally October. **Table 5-31** depicts the average occupancy by lot annually and for the busiest three months of the year; the average occupancy for these months exceeds the annual average by between 10% and 15%. Since annual demand does not accurately depict the parking situation during the busy months of the year, the average of the busiest three months was used to address the proper planning levels for airport parking.

Table 5-31 Parking Lot Occupancy Rates

Annual	Short Term	Preferred Long Term	Long Term A	Long Term B	Avg NFTA
2008	63%	84%	83%	41%	69%
2009	50%	74%	71%	50%	63%
2010	47%	75%	71%	48%	62%
Peak Season	**Short Term**	**Preferred Long Term**	**Long Term A**	**Long Term B**	**Avg NFTA**
2008	73%	93%	94%	51%	76%
2009	56%	86%	82%	60%	74%
2010	53%	86%	82%	63%	74%

Source: McFarland Johnson, Standard Parking, 2011

Maximum Demand

Historical parking records reveal a sharp spike in parking demand during the spring break weeks in March. This period of 1-2 weeks typically experiences an ultimate peak of up to 40% above the average parking demand during the peak season and 7-10% above the overall lot capacity. Because this peak typically accounts for less than 20 days per year the cost to construct and maintain lots to satisfy this demand level would not generate a practical return on investment for the airport. Parking requirements should be based on the peak season, with contingency plans and temporary overflow lots to accommodate the maximum demand scenarios. An additional consideration for overflow parking could be the consideration of a discounted weekly lot with a set weekly-only rate during peak periods to keep some spaces available in the traditional, closer-in long term lots for business travelers.

Planning Thresholds

In addition to using the busiest three months, since parking lot occupancy can be higher on certain days and times within the day, a planning threshold of 80% was applied to the available parking lot capacity. As parking lots approach capacity, it becomes increasingly difficult to find available spaces as well as keep spaces free of snow and ice, which decreases the level of customer service.

Total Spaces Required

The combination of the 80% planning threshold and peak season (busiest three month average) was selected at as the preferred method to determine the required number of vehicle parking spaces for BNIA. As displayed in **Table 5-32**, more vehicle spaces are needed in the short term, with over 3,100 additional spaces required over the next 20 years.

Table 5-32 Vehicle Space Surplus/Shortage

	Short Term	Preferred LT	Long Term A	Long Term B	Off Site	Total
Existing Spaces	754	1,439	2,693	1,901	1,390	8,177
Planning Threshold	603	1,151	2,154	1,521	1,112	6,542
Demand	596	1,431	2,544	1,351	795	6,717
2015 +/-	+7	**-280**	**-390**	+170	+317	**-175**
Demand	679	1,585	2,818	1,497	1,321	7,881
2020 +/-	**-57**	**-434**	**-664**	+24	**-209**	**-1,339**
Demand	811	1,946	3,460	1,838	1,622	9,676
2030 +/-	**-208**	**-795**	**-1,306**	**-317**	**-510**	**-3,134**

Source: McFarland Johnson, 2011

Garage Parking

Within the overall amount of spaces required, the amount of covered/garage parking is an important consideration in the determination of airport parking requirements. Airports of similar and larger size typically construct parking garages when either limited land in available and/or there is demand for premium parking facilities that are covered or in close proximity to the terminal. The current three level garage is used primarily for rental cars (432 spaces) on the first level and short term parking on the second and third level totaling 754 Cars excluding NFTA permit and VIP spaces. It should be noted that the third level is uncovered, meaning only approximately half of the available spaces are actually covered parking**.** Presently, there is no covered parking at the airport marketed towards long term passengers.

Parking data for the airport indicates a strong demand for premium parking at the airport. Observations indicate that the second level (covered) is routinely full, as indicated by garage occupancy being greater than 50%; this indicates that demand for covered parking presently exceeds supply. In addition, premium, close in parking is also in high demand as evidenced by the notably higher occupancy in the Preferred Long Term lot.

Since historical data on covered parking is skewed because of limited covered parking at BNIA, comparable airports were reviewed and benchmarked to assess the amount of covered parking that could be considered for BNIA. **Table 5-33** presents the garage inventory available at similar sized airports in Albany, NY, Hartford, CT, Providence, RI and Rochester, NY. When a comparable level of service is applied to Buffalo, the result suggests that nearly 4,400 spaces of the 9,676 required by 2030 be in the form of garage parking. This number reflects the ratio of covered parking to passenger demand seen at comparably sized airports that could be considered a feasible ratio for BNIA, With limited land available and with the goal to enhance customer service at the airport, it is recommended that covered parking be a key component in future parking expansion.

Table 5-33 Garage Parking Comparison

Airport	Avg Daily Enplanements	Garage Spaces	Ratio
Buffalo - Existing	***7,162***	***754***	***0.11***
Albany	3,569	2,400	0.67
Hartford	7,197	3,500	0.49
Providence	5,899	3,776	0.64
Rochester	3,490	2,430	0.70
Average	5,039	3,027	0.61
Buffalo - Proposed	***7,162***	***4,368***	***0.61***

Source: McFarland Johnson, 2011

In addition to simply planning for demand, operational improvements should be considered when expanding parking facilities to support NFTA;s goal of enhancing customer service and providing a more sustainable operation. Higher lot occupancy makes it increasingly difficult for customers to find available parking spaces. Fewer spaces available results in an increase of vehicle circulation within the lots and also increase shuttle use since available parking spaces may be far between at peak times. Two items to be considered when addressing alternatives include:

Parking Management Enhancements – Quick and efficient parking enhances both the customer service and sustainability of an airport. Electronic or moveable signage that directs vehicles to available spaces with shuttles waiting has the potential to greatly reduce vehicle/shuttle circulation within the parking lots. Directing vehicle towards or away from certain areas can also help to remove snow from lots during the winter months.

Pedestrian Improvements – Several areas both the Preferred Long Term Lot and outer portion of the Long Term A lot are relatively close to the terminal with portions having quicker access on foot than by shuttle. Improvements in sidewalk access and covered walkways can reduce the number of parking lot shuttles required without sacrificing customer convenience.

The alternatives analysis chapter will review the options available for the airport to accommodate the additional 3,200 spaces required by 2030 for passenger vehicles in addition to addressing the need for additional covered/premium parking.

5.5.2 Rental Car Facilities

Rental car facilities are currently split between on-airport and off-airport facilities. Off airport facilities are privately owned and not overseen by the NFTA, these facilities are typically used for vehicle storage, cleaning, and local vehicle rentals. Presently there are six rental car providers at BNIA. Average annual fleet sizes can range between 500 and 1,000 cars, with peak vehicle fleets exceeding 1,300 cars for some of the larger rental car operators. Other peak period rental car activities were reported to include peak daily transactions as high as 700 (350 rentals, 350 drop offs) with as many as 50 pickups in the peak hour for some operators. In the planning for future rental car facilities, one of three potential options exist; each of these options discussed below will be assessed in the Alternatives chapter.

Rental Car Operations Off-Site

Providing all rental car activities off-site would result in each operator to shuttle passengers to their off-site facility. In cases where this occurs, the requirement is to provide dedicated curb frontage to accommodate rental car shuttles. The additional shuttle space would be similar in size to what is currently used by the parking lot shuttles, which consists of 150-200 linear feet. These shuttles would increase traffic on the terminal roadways and exits which may require further modification.

Customer Service On-Site, Support Facilities Off-Site (Existing)

Under the existing rental car operation, rentals and drop-offs are handled on-site in the lower level of the short term garage using the 432 spaces available for rental cars. Peak volumes for rental cars can result in up to 200 pick ups and 200 drop offs. With just over 400 spaces, this requires a constant cleaning and shuttling of cars from the respective off-site facilities (when the adjacent quick turn around cleaning facility is not used). When correlated to projected growth in enplanements, the peak activity is expected to increase to 300 pick ups and drop offs by 2030. In addition to meeting the requirement, for the peak hour alone, a minimum of an additional 30% is recommended to accommodate specialty vehicles such as convertibles or luxury cars with less frequent rentals and to reduce the amount of vehicle shutting required. The resulting requirement is about 800 spaces for rental car operations, nearly double the current level.

In addition to parking spaces, the quick turn around facility which can currently accommodate up to 75 vehicles per hour is undersized for the existing peak demands. A quick turn around facility that can accommodate up to 150 vehicles per hour is recommended if the existing rental car operation method is the preferred set up for future growth.

All Rental Car Operations On-Site

Consolidating all rental car operations into one facility would include the customer operations functions as well as the cleaning and fueling functions. These facilities would need to accommodate that average annual fleet with overflow available for peak periods. Between all six of the rental car operators at the airport, the average fleet size ranges between 500 and 1,000 vehicles; meaning a consolidated facility would require between 4,000 and 5,000 spaces. Given the space requirement, it is anticipated that any consolidated facility would likely be in the form of a garage. Consolidated rental car facilities have become popular for large hub airports, with several small and medium hub airports exploring this option as well. Providing additional uses for the facility such as local and intercity bus or light rail can enhance the benefit to cost ratio of this option. Being a sizeable undertaking, it is anticipated that more detailed needs for rental car operators would be assessed prior to designing a facility of this magnitude.

For peak activity, it was noted that the rental car peak fleet periods typically occur during the summer months, which are not the peak months for passenger vehicle parking which peaks in the spring. Combining these two differing peaks of parking demand could be explored to optimize use of new parking infrastructure.

5.5.3 Terminal Access and Roadway System

Various traffic studies have been completed over the past ten years that addressed traffic congestion along Genesee Street which runs along the south side of the airport. Improvements to Genesee Street were completed in the 2007/2008 timeframe and since that time, there has been significant development along the south side of the road including a number of new hotels, third party airport parking facilities and other businesses.

With this development, future growth along Genesee Street and projected growth for the airport, a traffic analysis was completed to assess current conditions and assessing impacts associated with the forecasted passenger growth at the airport. The analysis completed by MJ evaluated traffic operations within the Study Area, defined for this study as four intersection along Genesee Street, during weekday morning (AM) and afternoon (PM) peak hours for Existing Conditions, 2030 No-Build Conditions (external factors only), and 2030 Build Conditions (using forecasted growth). The Study Area includes the following four intersections:

- Genesee Street at Cayuga Road / Dick Road
- Genesee Street at West BNIA Drive / Route 33
- Genesee Street at East BNIA Drive / Site Driveway
- Genesee Street at Holtz Drive / Sonwil Drive

Descriptions of the existing physical conditions within the Study Area are presented in the following narratives.

<u>Existing Conditions</u>

Evaluation of the existing and future traffic conditions of the Study Area requires an understanding of the existing transportation system. Data such as roadway geometrics and peak hour traffic volumes provide the basis for a thorough understanding of existing conditions and the requisite data necessary to provide projections of future traffic conditions, typically under the Build scenario. The following is a description of key roadways in the vicinity of BNIA.

- Genesee Road is an arterial roadway that includes both four-lane and six-lane segments with a posted speed limit of 40 mph.
- Cayuga Road is a two-lane collector road, located on the west side of the airport with a posted speed limit of 40 mph.
- Holtz Road is a collector road located on the eastside of the airport with a posted speed limit of 35 mph.

<u>Current Traffic Volumes</u>

Manual turning movement counts (TMC) were conducted as part of this study. The TMCs were conducted at the four intersections on March 9, 10, 15 and 16, 2011 during the weekday peak periods from 7:00 to 9:00 AM and from 4:00 to 6:00 PM. The TMC data show that the weekday traffic in the study area peaks between 7:15 and 8:15 AM and between 4:30 and 5:30 PM with the PM peak hour yielding the largest volumes.

To determine if the TMCs required adjustment due to seasonal variation, a seasonal adjustment factor data was obtained from the New York State Department of Transportation – Highway Data Services Bureau (NYSDOT). NYSDOT has developed seasonal adjustment factors based on three land-use classifications, urban, suburban and recreational. The study area for this proposed development is classified as urban and a factor of 0.967 was used to adjust the collected data to represent an average day for both the AM and PM peak hours. The resulting volumes are provided in **Appendix G**. The data was then used to develop a baseline (no-build) and a Build Condition, which adds traffic generated by the projected growth of passengers forecasted for BNIA. Each of these conditions are discussed in more detail in the following sections.

No Build Conditions

The current traffic volumes in the Study Area were projected to the year 2030. Analyzing the 2015 No-Build conditions allows for the impact of the proposed development to be considered apart from the impacts of normal background growth. The 2030 No-Build volumes include existing traffic and new traffic resulting from background growth. To develop the 2030 No-Build volumes, a growth rate was applied to the existing peak hour volumes. A background growth rate of 1.3% per year was used for forecasting purposes. The 2030 No-Build volumes are included in **Appendix G**.

Build Conditions

Trip Generation and Distribution

The projected growth in airport activity, more specifically, passenger enplanements, were used to project traffic volumes over the planning period. As a result of projected growth, the annual passenger enplanements are projected to increase to 4,331,700 in 2030 from 2,665,760 in 2010. Using this increase in annual passenger enplanements, the future trip generation was developed.

For analysis purposes, the future trip generation was calculated using the using the linear regression model developed by Terry A. Ruhl and Boris Trnavskis. This model and methodology was included in the publication “Airport Trip Generation” contained in the Institute of Transportation Engineers Journal, May 1998. The results of the trip generation are shown on **Table 1** and detailed calculations and the publication are included in **Appendix G**.

Table 5-34 Trip Generation

Time Period	Total	Enter	Exit
AM Peak	418	230	188
PM Peak	837	460	377

Source: McFarland Johnson

The projected trips associated with BNIA growth were distributed using the existing traffic patterns. Both the AM and PM trips were distributed using ratios derived from the count data. Next, these trips were combined with the 2030 No-Build volumes to yield the 2030 Build volumes. Detailed calculations and located in **Appendix G**.

Intersection Capacity – Signalized Intersections

Level of service (LOS) is a term used to characterize the operational conditions of a traffic facility at a particular point in time. Numerous factors contribute to a facility’s LOS including travel delay and speed, congestion, driver discomfort, convenience, and safety based on a comparison of the facility’s capacity to the facility’s demand. The alphabetic designations A through F define the six levels of service. LOS A represents very good traffic operating conditions with minimal delays while LOS F depicts poor traffic operating conditions with excessive delays and queues.

Operating levels of service are calculated using the procedures defined in the 2000 Highway Capacity Manual, published by the Transportation Research Board. The operating LOS of a signalized intersection is based on the average control delay per vehicle. The control delay per vehicle is estimated for each lane group, combined for each approach and the intersection as a whole. The criteria, i.e., the delays associated with corresponding levels of service for signalized intersections, as specified by the 2000 Highway Capacity Manual are shown in **Table-35.**

Table 5-35 Signalized Intersection Levels of Service

Level of Service	Controlled Delay (sec/veh) Signalized Intersections
A	≤ 10
B	> 10 and ≤ 20
C	> 20 and ≤ 35
D	> 35 and ≤ 55
E	> 55 and ≤ 80
F	> 80

Source: McFarland Johnson

Presented in **Tables 5-36** through **5-39** are the results of the analysis for the Existing, No-Build, and Build conditions for the intersections located within the study area. The traffic modeling software Synchro, Ver. 7.0 was used for the analysis portion of this Study. The results of the analysis are located in **Appendix G**.

Genesee Street at Cayuga Road / Dick Road

The average control delay and LOS for the intersection of Genesee Street at Cayuga Road / Dick Road for the Existing, No-Build and Build conditions are summarized below in **Table 5-36** An increase in delay is projected mostly due to the background growth, not the traffic produced by project airport growth. Comparing the Existing Conditions to the No-Build and the No-Build to the Build, a 31%, and 8% increase in delay is projected for the AM peak respectively. The PM peak analysis yielded delay increases of 42% and 0.11% comparing the Existing Condition to the No-build and the No-Build to the Build, respectively.

Table 5-36 Capacity Analysis – Genesee Street at Cayuga Road / Dick Road

Intersection Movements	Existing		2030 No Build		2030 Build	
	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
Weekday AM Peak Hour						
Genesee Street EB	49.3	D	77.3	E	82.1	F
Genesee Street WB	27.2	C	49.3	D	52.6	D
Dick Road NB	66.9	E	82.3	F	90.9	F
Cayuga Road SB	38.0	D	43.7	D	44.3	D
Overall Intersection Operation	**54.6**	**D**	**71.3**	**E**	**77.2**	**E**
Weekday PM Peak Hour						
Genesee Street EB	32.9	C	62.4	E	82.1	F
Genesee Street WB	44.5	D	73.8	E	74.3	E
Dick Road NB	70.3	E	89.4	F	102.4	F
Cayuga Road SB	34.2	C	46.2	D	45.7	D
Overall Intersection Operation	**50.5**	**D**	**71.6**	**E**	**79.2**	**E**

Source: McFarland Johnson, 2011

Genesee Street at West BNIA Drive / Route 33

The average control delay and LOS for the intersection of Genesee Street at West BNIA Drive / Route 33 for the Existing, No-Build and Build conditions are summarized below in **Table 5-37.** Significant increases in delay occur as a result of both the background growth and the projected trips. The intersection is also projected to operated at LOS E for the Build AM peak and LOS F for the PM peak during No-Build and Build PM peaks.

Table 5-37 Capacity Analysis – Genesee Street at West BNIA Drive / Route 33

Intersection Movements	Existing		2030 No Build		2030 Build	
	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
Weekday AM Peak Hour						
Genesee Street EB	29.4	C	47.2	D	82.8	F
Genesee Street WB	56.4	E	66.7	E	93.4	F
Route 33 NB	5.4	A	11.3	B	14.6	B
West BNIA Drive SB	40.4	D	71.2	E	91.7	F
Overall Intersection Operation	**30.0**	**C**	**41.6**	**D**	**59.3**	**E**
Weekday PM Peak Hour						
Genesee Street EB	41.6	D	75.1	E	88.3	F
Genesee Street WB	54.9	D	126.3	F	273.6	F
Route 33 NB	15.0	B	43.2	D	43.3	D
West BNIA Drive SB	57.4	E	76.5	E	101.9	F
Overall Intersection Operation	**38.0**	**D**	**81.9**	**F**	**136.8**	**F**

Source: McFarland Johnson, 2011

Genesee Street at East BNIA Drive / Site Driveway

The average control delay and LOS for the intersection of Genesee Street at East BNIA Drive / Site Driveway for the Existing, No-Build and Build conditions are summarized below in **Table 5-38.** As indicated in this table, the intersection will continue to operate at an acceptable level of service for the future conditions during both the AM and PM peaks. The largest delay shown in the table is associated with the movements out of the East BNIA Drive.

Table 5-38 Capacity Analysis – Genesee Street at East BNIA Drive / Site Driveway

Intersection Movements	Existing		2030 No Build		2030 Build	
	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
Weekday AM Peak Hour						
Genesee Street EB	9.5	A	14.0	B	17.0	B
Genesee Street WB	8.8	A	12.6	B	14.2	B
Site Drive NB	15.8	B	17.2	B	16.9	B
East BNIA Drive SB	24.0	C	28.8	C	29.5	C
Overall Intersection Operation	**9.6**	**A**	**13.7**	**B**	**16.1**	**B**
Weekday PM Peak Hour						
Genesee Street EB	13.4	B	17.8	B	20.4	C
Genesee Street WB	13.5	B	19.1	B	23.1	C
Site Drive NB	15.7	B	24.1	C	25.9	C
East BNIA Drive SB	25.6	C	39.6	C	68.9	E
Overall Intersection Operation	**14.1**	**B**	**19.6**	**B**	**24.9**	**C**

Source: McFarland Johnson, 2011

Genesee Street at Holtz Drive/Sonwil Drive

The average control delay and LOS for the intersection of Genesee Street at Holtz Drive / Sonwil Drive for the Existing, No-Build and Build conditions are summarized below in **Table 5-39.** A small increase in delay is projected as a result of background growth and the projected airport growth. Comparing the Existing conditions to the No-Build and the No-Build to the Build, a 31%, and 8% increase in delay is project for the AM peak. The PM peak analysis yielded delay increases of 64% and 5% comparing the Existing Conditions to the No-Build and Build respectively. It was determined that the majority of the delay increase is associated with the background growth rate of 1.3-percent. Also, the intersection will continue to operate at an acceptable LOS under the 2030 Build scenario.

Table 5-39 Capacity Analysis – Genesee Street at Holtz Drive / Sonwil Drive

INTERSECTION MOVEMENT	Existing		2030 No Build		2030 Build	
	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
Weekday AM Peak Hour						
Genesee Street EB	20.0	C	28.4	C	31.5	C
Genesee Street WB	26.0	C	32.3	C	33.8	C
Sonwil Drive NB	36.9	D	16.0	D	46.4	D
Holtz Drive SB	17.2	B	21.2	C	20.9	C
Overall Intersection Operation	**22.6**	**C**	**29.6**	**C**	**31.7**	**C**
Weekday PM Peak Hour						
Genesee Street EB	26.5	C	53.6	D	54.6	D
Genesee Street WB	37.9	D	45.6	D	50.3	D
Site Drive NB	29.1	C	33.8	C	35.4	D
East BNIA Drive SB	22.6	C	37.5	D	39..9	D
Overall Intersection Operation	**28.9**	**C**	**47.6**	**D**	**49.9**	**D**

Source: McFarland Johnson, 2011

Terminal Loop Roadway

With increased vehicle traffic in addition to the capacity constraints at the entrances and exits of the terminal roadway system, the alternatives analysis chapter will explore options to enhance the capacity as well as improve the functionality of the terminal loop roadway system. Key requirements to be addressed in the terminal loop roadway alternatives include:

- Protect or improve customer experience
- Reduce vehicle circulation
- Limit decision points
- Minimize areas of merging/converging traffic

Roadway System Requirements Summary

Results from the Existing, No-Build, and Build conditions showed the majority of the impact to the study area's traffic operations is associated with the background growth of 1.3-percent per year. The intersections including Genesee Street at West BNIA Drive / Route 33 and Genesee Street at Holtz Drive / Sonwil Drive are projected to operate an acceptable LOS for the Existing, No-Build and Build conditions. Intersections including Genesee Street at Cayuga Road / Dick Road and Genesee Street at West BNIA Drive / Route 33 are currently operating at an acceptable level of service, however they are projected to operate at a poor level of service for the No-Build and Build conditions and will continue to deteriorate due to increase in traffic associated with the background growth and the airport expansion. Assessing overall traffic conditions will be evaluated as part of landside development alternatives developed in the next section.

5.6 AIR CARGO REQUIREMENTS

Air cargo facilities at BNIA are described in Chapter 2. They consist of four primary buildings that adjoin the west and south sides of the air cargo apron. **Table 5-40** lists these buildings and their sizes. The Air Cargo Facility building accommodates numerous tenants including UPS, jetBlue, Southwest, Delta, and Continental. The U.S. Postal Service has its own building, as does FedEx. The last building adjoining the air cargo ramp (the Flex Building) is not currently used for processing air cargo, but could be if future tenants have the need to.

Table 5-40 Air Cargo Buildings

Facility	Size (square feet)
Air Cargo Facility (283 Cayuga Road)	90,500
U.S. Postal Service (285 Cayuga Road)	26,000
FedEx (299 Cayuga Road)	75,000
Air Cargo Flex Building (307 Cayuga Road)	27,000
Total	**218,500**
Total Minus Flex Building	**191,500**

Source: McFarland Johnson, 2010.

The amount of cargo building space required depends on the type of cargo operation occurring in the building. The amount of space required for belly-freight and all-cargo operations is typically greater than the amount of space required for cargo integrators, such as FedEx or UPS. This is because cargo terminal space requirements for belly-freight and all-cargo are usually geared toward the storage of cargo, while the building space requirements for integrators is usually geared toward sorting and processing of cargo that quickly leaves the facility.

The forecasts of aviation demand were used to assess the adequacy of existing cargo buildings to accommodate projected level of air cargo. Ratios of 1.0 to 1.5 square feet per annual ton of air cargo are typically applied to determine the amount of space required for belly-freight and all-cargo carriers. A lower ratio of 0.8 is typically applied to determine the space requirement for integrators.

Table 5-41 presents a comparison of forecasted levels of air cargo from Chapter 3, the resulting demand for air cargo building space (using a more conservative factor of 1.5 square feet per ton) and a comparison to the existing amount of air cargo building space actually being used for air cargo.

Table 5-41 Air Cargo Building Space Requirements

Year	Projected Air Cargo (Tons)	Space Ratio	Projected Space Demand (square feet)	Existing Space Available (square feet)	Additional Space Requirement (square feet)
2010	18,708	1.5	28,062	191,500	0
2015	20,655	1.5	30,983	191,500	0
2020	22,805	1.5	34,208	191,500	0
2025	25,302	1.5	37,953	191,500	0
2030	27,799	1.5	41,699	191,500	0

Source: URS Corporation, 2011.

The table indicates that even using a more demanding requirement of 1.5 square feet per ton of air cargo, the existing amount of available space greatly exceeds projected levels of air cargo demand. Therefore, no additional air cargo building space is required through the study period.

With regard to the air cargo aircraft parking apron, the existing apron is approximately 89,000 square yards. This apron accommodates aircraft parking and the storage and movement of numerous pieces of processing equipment including tugs, pallets, cargo loaders, and containers. Previous consultation with air cargo tenants indicates that the average aircraft parking demand consists of up to three air carrier positions for UPS (two Boeing 757 and one Airbus A-300) and two parking positions for FedEx (one Airbus A-310 and one Cessna 208). The existing amount of space on the air cargo ramp far exceeds the amount of space needed to accommodate the parking of these aircraft and provides sufficient space for taxiing and maneuvering.

Since the annual volumes of air cargo projected to occur through the study period are less than historical annual volumes, the demand for cargo aircraft parking spaces is not expected to exceed the capacity of the existing apron. One item that does require further assessment is the taxiway leading to the air cargo apron. This taxiway contains an unusual "S" turn that is undesirable from an operational perspective. The alternatives chapter will present options to improve the taxiway system in this area.

5.7 GENERAL AVIATION REQUIREMENTS

Requirements for GA facilities at BNIA were calculated on the basis of data collected during the inventory, forecasts of aviation demand, consultation with Prior Aviation and BNIA staff, as well as FAA standards. The following facilities were examined:

- Aircraft Hangars
- Aircraft Parking Apron
- GA Terminal
- GA Auto Parking

5.7.1 Aircraft Hangars

As described in Chapter 2, Prior Aviation operates three hangars that serve the needs of GA. These hangars are used for storage of GA aircraft, aircraft maintenance, and the maintenance of ground support equipment. On the basis of information received from Prior Aviation, these three hangars provide 66,600 square feet of space. The storage space quantity is less than the overall size of the hangars due to the fact that some space is consumed by offices/shops and a portion of Hangar 1 is devoted to vehicle and aircraft maintenance.

Hangar requirements are typically calculated using the forecast of based aircraft and an allowance of space per aircraft. **Table 5-42** presents an assessment of projected hangar space requirements on the basis of the forecast of based aircraft previously presented in Chapter 3 and following space factors per type of aircraft.

- 1,200 square feet per single-engine aircraft
- 1,600 square feet per multi-engine aircraft
- 2,500 square feet per jet aircraft

There are significant size variations within each of these aircraft categories that could increase or decrease the amount of space required. In addition, the placement of aircraft inside of open-bay hangars enables aircraft to be placed in a fairly tight configuration that may reduce the amount of space actually required for each aircraft. Nonetheless, the factors can be used to gain an overall understanding as to how the existing amount of hangar space compares to projected level of demand through the study period.

Table 5-42 Hangar Space Requirements

Year	Space for Single-Engine Aircraft	Space for Multi-Engine Aircraft	Space for Jet Aircraft	Space for Rotorcraft	Total Hangar Space Requirement
2015	24,000	18,000	10,800	1,200	54,000
2020	21,600	19,200	12,000	1,200	54,000
2025	21,600	19,200	13,200	1,200	55,200
2030	21,600	19,200	14,400	1,200	56,400

Source: URS Corporation, 2011.

As the table indicates, the total amount of space required ranges from approximately 54,000 square feet to 56,000 square feet versus an existing quantity of approximately 46,600 square feet of space.

Therefore, using space planning factors, the forecast of based aircraft, and an assumption that all based aircraft will desire hangar space; the conclusion is that additional 10 to 20 thousand square feet of hangar space will be required to meet projected demand throughout the study period.

5.7.2 Aircraft Parking Apron

The existing GA apron is approximately 44,750 square yards. It extends from Hangar 1 to Hangar 2 and encompasses the entire area in front of the GA terminal. Reviews of aerial photography reveal that specific areas for tie-downs exist near the GA terminal and in front of Hangar 2. Consultation with Prior Aviation revealed that approximately 12 tie downs are available for based and itinerant aircraft. However, aircraft are also parked on other portions of the apron on an as-needed basis.

Future demand for aircraft parking apron can be estimated on the basis of based aircraft, itinerant operations and space needed for aircraft staging and maneuvering. Currently nearly all aircraft are stored in hangars. Therefore, there is almost no demand for tie-downs of based aircraft. Demand for aircraft parking apron by itinerant GA aircraft operations is estimated based upon an assumption that 50 percent of average day peak month itinerant GA landings may want tie-down space (see **Table 5-43**). A space factor of 600 square yards per aircraft is applied to estimate apron requirements.

Table 5-43 Apron Space Requirements (SY)

Year	Peak Month Itinerant GA Operations	Average Day Peak Month	Landings	Needing Apron	Apron Space Requirement
2010	3,575	115	58	29	17,298
2015	3,707	120	60	30	17,937
2020	3,960	128	64	32	19,161
2025	4,175	135	67	34	20,199
2030	4,389	142	71	35	21,237

Source: URS Corporation, 2011.

Assuming an additional 7,000 to 9,000 square yards for aircraft staging and maneuvering results in an apron requirement of approximately 30,000 square yards in 2030. This is less than the current approximately 44,000 square yards of apron that exists.

Consultation with Prior Aviation revealed that the current demand for tie-down spaces by based aircraft is significantly lower than the existing capacity. Tie-down space for itinerant aircraft is adequate and meets existing and future requirements. With respect to apron for taxiing and maneuvering aircraft to and from tie-downs, hangars, and the GA terminal, there is ample space to accommodate all of these requirements throughout the study period.

5.7.3 General Aviation Terminal

The GA terminal provides space for management offices, pilot lounge areas, rest rooms, food services, flight planning, and other areas for the needs of passengers, pilots, and employees. The GA terminal provides 9,000 square feet of space. Approximately 6,000 square feet of this space is dedicated to terminal purposes. The remaining 3,000 square feet are used for administrative offices.

Consultation with management at Prior Aviation indicates that the existing terminal is adequate to meet existing and future demand. Typical GA operations do not exceed the capacity of the terminal. Only occasional charter operations place a strain on the existing facility. These operations are infrequent and do not justify an expansion of existing facilities.

5.7.4 General Aviation Auto Parking

Automobile parking in the general aviation area consists of spaces at each of the three hangars and at the GA terminal. The number of parking spaces at these facilities is summarized in **Table 5-44**.

Table 5-44 General Aviation Parking Spaces

Facility	Parking Spaces	Disabled Parking Spaces	Total Parking Spaces
Hangar 1	69	1	70
Hangar 2	42	2	44
Hangar 3	60	0	60
GA Terminal	78	2	80
Total	**249**	**5**	**254**

Source: McFarland Johnson, 2010.

Consultation with Prior Aviation revealed that the amount of parking is adequate to meet current and future needs.

5.8 SUPPORT FACILITY REQUIREMENTS

This section addresses the facility requirements associated with facilities that fulfill support functions at the Airport. These support functions include the following:

- Fuel Storage
- Air Traffic Control
- Aircraft Rescue and Fire Fighting (ARFF)
- Airfield Maintenance

5.8.1 Fuel Storage

Fuel storage facilities at BNIA consist of a tank farm on the north side of the airport property and two distribution sites. A remote Jet A fuel dispensing facility is located on the apron northeast of the terminal building and a dispensing facility with all three fuel types (Jet A, Avgas, Mogas) is located adjacent to the fuel farm. Fuel storage consists of three 225,000 gallon Jet A tanks, one 42,000 gallon Avgas tank, and one 20,000 gallon Mogas tank. Fuel is currently delivered to the storage facility by tanker truck, and transferred from the distribution facility to commercial, air cargo, and general aviation users by refueling vehicles. Refueling takes place at all three apron areas: airline, air cargo, and general aviation. The fuel storage and dispensing facilities are owned BNIA. Prior Aviation is responsible for the delivery of fuel to most aircraft.

Jet A Fuel Storage

In order to ensure that the airport has adequate supplies of Jet A fuel to meet future demands, projections of future fuel usage have been made. These projections are based on the number of aircraft operations (Jet A fueled) from 2006 through 2010, and airport fuel records for the same period, in order to obtain a median fuel uplift per departure. For each year projected the uplift per departure is the median of the previous five years. This factor was then applied to the forecasted level of operations to arrive at an estimate of future fuel use for each of the forecast years. Due to the increasing use of Jet A fuel, the airport's present storage capacity of 675,000 gallons is expected to provide a steadily decreasing level of reserve supply. Based on a recommended storage capacity equal to five days usage, current capacity should be adequate through 2030, with the exception of the peak month of August when it dips to 4.7 days. **Table 5-45** shows the number of days supply, at existing capacity, the current facilities will provide during the peak month of August and the average for the balance of the year.

Table 5-45 Jet Fuel Use Projection

Year	Annual Departures	Fuel Uplift Factor (gallons/departure)	Annual Fuel Usage (gallons)	Days Supply at Peak Month	Days Supply Balance of Year (Avg.)
2009	44,948	715	32,135,290	7.0	
2010	44,012	753	33,150,214	6.5	7.6
2015	50,270	727	36,534,138	5.9	6.9
2020	54,922	727	39,914,719	5.4	6.3
2025	58,867	727	42,781,396	5.1	5.9
2030	62,611	727	45,648,073	4.7	5.5

Source: Historical Data - BNIA Fuel Farm Records, Projections - URS Corporation, 2011.

The 2002 master plan used the provision of seven days reserve as a guideline in preparing facility requirements. For the purposes of this analysis, the guideline has been reduced to five days since fuel availability has never been a problem and can be received from more than one source. Another factor, while not taken into account in this analysis, is increased efficiencies such as the replacement of older, less fuel efficient aircraft which would result in an anticipated reduction in the average uplift per departure. A tank rotation analysis confirmed adequate capacity for fuel receipt and recommended settling time without affecting fuel delivery.

Avgas Fuel Storage

The current Avgas storage consists of a single tank having a capacity of 42,000 gallons. BNIA records for 2006 through 2010 show the amount of Avgas dispensed has declined each year from the previous, therefore additional capacity is not required. **Table 5-46** shows Avgas fuel consumption from 2006 through 2010. It is advisable to have a second tank to prevent interruption should the existing tank need to be removed from service for cleaning, inspection, or maintenance. It is also recommended that the system be augmented to add a recirculation system and provide filtration of fuel during receipt.

Table 5-46 Avgas (100LL) Fuel Use

	2006	2007	2008	2009	2010
Gallons	194,094	165,637	128,943	98,155	93,462

Source: Historical Data - BNIA Fuel Farm Records, Projections - URS Corporation, 2011.

5.8.2 Air Traffic Control

The existing air traffic control facilities at BNIA were constructed in 1994. Consequently, these facilities are relatively modern and meet current needs for both an air traffic control tower and a Terminal Radar Approach Control (TRACON) facility. These facilities are capable of meeting projected levels of demand and will meet all needs throughout the planning period.

5.8.3 Aircraft Rescue and Fire Fighting

The existing ARFF station at BNIA was originally constructed in 1970, with five apparatus bays and 8,000 square feet of floor space. The building was expanded in 1984 to approximately 10,400 square feet. The facility is over 40 years old and suffers from a number of deficiencies including a lack of storage space for equipment and materials and the lack of drive-through bays for vehicles. Other noted deficiencies include the following: sleeping quarters directly adjacent to loading air cargo aircraft, undersized workout facilities, lack of dedicated training facilities, and vehicle bays that cannot accommodate newer, larger ARFF equipment.

The FAA has established specific requirements for ARFF equipment. These requirements vary depending upon the frequency and size of aircraft that regularly serve the Airport. **Table 5-47** presents these requirements, which are stated in terms of “Indexes” that begin with Index “A” for airports serving small aircraft and extend to Index “E” for airports serving large aircraft. Each index letter corresponds to aircraft size based on a range of aircraft lengths. Typical aircraft within each range are provided for guidance. Index A is defined as aircraft that have a length of less than 90 feet. The longest index group with an average of five or more daily departures by air carrier aircraft is the index required for the Airport.

As of 2011, aircraft with fuselage lengths in the 126- to 158-foot range (i.e., the Boeing 737 and Airbus A-321) are the largest aircraft that regularly serve (i.e., more than five daily departures) the Airport. Consequently, BNIA currently needs to meet the requirements of the Index C classification. The existing ARFF facility and its equipment currently meet the requirements of Index D.

Table 5-47 Summary of ARFF Equipment Requirements

Airport Index	Length[1] of Aircraft (Representative Aircraft)	Vehicles		Extinguishing Agents	
		Light-Weight	Self-Propelled	Dry Chemicals (Pounds)	Water (Gallon)
A	Less than 90 feet (CRJ-200)	1	0	500 Sodium or 450 Potassium	0 100
B	90 feet to less than 126 feet (CRJ-700)	1	1	500 Sodium or Halon	1,500
C	126 feet to less than 159 feet (B-737/A-321)	1	2	500	3,000
D	159 feet to less than 199 feet (B-767/A-300)	1	2	500	4,000
E	200 feet and greater (B-747)	1	2	500	6,000

Source: FAR, Part 139, Section 139.315.
[1] *Length of largest aircraft providing an average of five scheduled departures per day. If there is less than an average of five daily departures by aircraft in a particular index, then the next lower index applies.*

Projections of future aircraft operations at BNIA indicate that aircraft with lengths in the 159- to 199-foot range (i.e., Index D), such as the Boeing 757 and Airbus A-300, will continue to occur and will primarily be related to air cargo activity. However, an average of five daily departures by these aircraft is not projected during the study period. Consequently, the Airport's ARFF requirements are projected to remain in Index C.

While capital improvements to the existing ARFF station are not required to meet Index requirements, they are needed on the basis of other needs and the age of the structure. The existing building has been built out to accommodate the growth of ARFF needs over the years such as crew quarters for overnight shifts, incorporation of separate male/female sleeping and restroom facilities, and building additions to incorporate new technologies used by ARFF personnel. Essentially, ARFF has outgrown the existing facility with every space utilized for personnel, administrative space and storage, regardless of original use. This has resulted in an inefficient and cramped space that does note meet the needs for ARFF personnel. As such, consideration will be given for the construction and location of a new ARFF station, which is explored in Chapter 6.

5.8.4 Airfield Maintenance

Maintenance of the runways, taxiways, and aprons, particularly during Buffalo's inclement weather, is an important part of airport operations. This and other maintenance needs require a significant amount of specialized equipment that must be cleaned, maintained, and stored. A modern and efficient airport needs sufficient facilities for the storage of equipment and materials, equipment maintenance, and administrative offices. The existing facilities that house airfield maintenance equipment and related uses are scattered among several buildings that are not properly sized nor organized to maximize the efficiency of maintenance operations. They are also outdated.

As described in Chapter 2, airfield maintenance currently occurs in Building 11 (BNIA Fleet Maintenance Building/Airfield Storage) and Building 12 (BNIA Maintenance Garage) as well as

Building 14A&B (Salt Storage Buildings). Building 11 consists of approximately 5,150 square feet, while Building 12 consists of approximately 34,500 square feet.

The maintenance buildings lie within a triangular 6.5-acre area bounded by the Air Cargo facilities to the north, other airport buildings to the west, and the airfield to the southeast. Access to the main terminal is via an airport perimeter road that skirts the southwest end of Runway 5-23, and to the GA terminal via the perimeter road around the northwest end of Runway 14-32. This 6.5-acre site also contains a 9,700-square-foot building leased to Aircraft Service International Group (ASIG), which uses the building and surrounding area for storage and maintenance of its ground support equipment. Several other buildings are also located in this area including Airfield Operations (Building 7) and the Airport Operations Center (Building 6). The perimeter road runs through this area, leaving an estimated five acres for the placement of airfield maintenance facilities.

Inspection of the maintenance building area and interviews with maintenance staff indicate that a number of facility deficiencies exist. Material storage areas are not consolidated. Sand is presently stored in a heated bay of the Maintenance Garage, urea is stored in bags on pallets in a parking bay, and salt is stored in a separate building. The salt storage building was originally designated as a temporary structure due to its location adjacent to a proposed GA parallel runway shown on a previous ALP. This building's location is also undesirable in light of the need to keep salt away from all aircraft operational areas.

Improved facilities are also needed for equipment maintenance. Of the three service bays in the maintenance garage, only two are usually available year round for vehicle maintenance, while the wash bay is used to park the salt truck in winter. Indoor or covered equipment storage space is inadequate for the current and anticipated mix of equipment. Numerous pieces of equipment are stored outside due to lack of covered storage. Finally, maintenance staff indicates that the perimeter road, which provides access to the passenger terminal, becomes congested during the winter months, particularly at the peak of snow removal and de-icing operations.

Additional maintenance facilities are recommended in order to meet both current and anticipated needs. Industry standards call for the identification of discreet use areas for material storage, equipment maintenance, and equipment storage, as well as sufficient outdoor space for circulation, deliveries, employee parking, and expansion.

Based on evaluation of a well-designed maintenance facility at similar airports, a site containing approximately 7 to 10 acres would be sufficient. Based on industry standards, and guidelines contained in AC 150/5220-18A, *Buildings for Storage and Maintenance of Airport Snow and Ice Control Equipment and Materials*, a well-organized facility can be designed containing a total of from 60,000 to 70,000 square feet. The site should be located near the major snow removal areas (i.e., the passenger terminal apron and both runways).