Chapter 3 - Facility Requirements

To plan for future infrastructure improvements, an airport must conduct a facility requirements analysis to measure how well existing facilities are able to meet current and projected demand. The objective of this analysis is to determine the long-term flexibility and growth potential of existing infrastructure elements to respond to changing demand scenarios over a 20-year planning period. Those facilities unable to accommodate demand will be the focus of the alternatives analysis which will identify, review, and evaluate infrastructure improvement options to meet the needs of Hector International Airport (Airport) users. This chapter provides a summary of the existing conditions of airside and landside facilities at the Airport and provides recommendations for facility improvements that are anticipated to be needed to meet current and future demand. The recommendations developed in this chapter provide a baseline for not only the development of alternatives, but also future Airport staffing, funding, development, and programming decisions.

The recommendations from the facility requirement analysis are presented in this chapter and organized by the following sections:

3.1 Demand/Capacity Analysis
3.2 Wind Coverage
3.3 Identification of Design Standards
3.4 Runway System
3.5 Taxiway System
3.6 Aprons
3.7 Navigational Aids and Weather Equipment
3.8 Terminal Area
3.9 General Aviation Facilities
3.10 Support Facilities
3.11 Airport Traffic Control Tower
3.12 Summary

3.1 Demand/Capacity Analysis

The purpose of the airfield demand/capacity analysis is to assess the capability of the airfield facilities to accommodate projected levels of aircraft operations. The Federal Aviation Administration (FAA) identifies two definitions of airfield capacity in FAA Advisory Circular (AC) 150/5060-5, Airport Capacity and Delay. The first definition of airfield capacity pertains to the maximum number of aircraft operations that a specific configuration can accommodate during a specified time interval of continuous demand (i.e. an aircraft is always waiting to depart or land). This level of capacity is influenced by weather conditions, number and configuration of exit taxiways, types of aircraft that use a facility, and air traffic control/airspace handling procedures.

The second definition of airfield capacity is the number of aircraft operations that may occur during a specific time that corresponds with a tolerable aircraft delay. An important difference between these two measures of capacity is that one is defined in terms of delay, while the other is not. Among the reasons to determine delay is that each individual airfield has multiple factors that contribute to its ability to accommodate aircraft. Additionally, the relationship between demand and delay is significantly impacted by patterns of peak demand, which is also unique to an airfield.

The following airfield capacity and delay components are used in this evaluation:

Peak hour capacity – The maximum number of aircraft operations that can occur in one hour under specific operating conditions assuming a continuous demand for service. This is also known as an airfield's maximum hourly throughput capacity.

Annual Service Volume (ASV) – Used by the FAA as an indicator of relative operating capacity. ASV is a reasonable estimate of an airport's annual capacity that accounts for differences in runway use, aircraft mix, weather conditions, etc. that would be encountered over a year's time. ASV assumes an acceptable level of aircraft delay as described in FAA AC 150/5060-5, Airport Capacity and Delay.

3.1.1 Factors Affecting Runway Capacity

Many factors can impact airfield capacity and delay, including:

- ✓ Airfield layout and runway configuration
- ✓ Number and location of exit taxiways
- ✓ Runway use restrictions
- ✓ Runway use as dictated by wind conditions
- ✓ The percentage of time the airport experiences poor weather conditions
- ✓ The level of touch-and-go activity
- ✓ Types of aircraft that operate at the airport
- ✓ Surrounding terrain/local geography
- ✓ Changes in air traffic control procedures

3.1.2 Weather Conditions

Weather conditions can impact an airport's capacity by causing conditions that require the facility to close or slow down aircraft operations. There are two categories for weather conditions related to operating aircraft, instrument flight rules (IFR) and visual flight rules (VFR). VFR weather conditions exist when the cloud ceiling is 1,000 feet or greater and visibility is three statute miles or greater. IFR conditions are those below the stated VFR minimums.

It is important to differentiate IFR and VFR conditions because greater separation distances are required under IFR conditions. According to the wind and weather analysis in the following sections, VFR conditions occur approximately 84.7 percent of the time, and IFR conditions occur approximately 15.3 percent of the time.

3.1.3 Touch and Go Operations

Touch and go operations are defined as those conducted by a single aircraft that lands and departs on a runway without taxiing. Such operations are typically associated with training or recurrence exercises. Typically, airfield capacity increases with the ratio of touch and go operations as aircraft are within the local traffic pattern and available for approaches. According to Airport Traffic Control Tower (ATCT) records in 2014, Local Operations totaled 24,620 of the airports 76,209 total operations or 32.3 percent, providing a good approximation of the percentage of touch and go operations, as most local operations are touch and go operations.

3.1.4 Identification of Design Standards

The size and type of aircraft that operate at an airport has a significant impact on airfield capacity. Aircraft are categorized according to size and approach speed (see Table 3.1).

Table 3-1. Aircraft Classifications

Aircraft Classification	Take-off Weight (pounds)	Types of Aircraft	Estimated Approach Speed (knots)
A	12,500 or less	Small single-engine aircraft	70
B	12,500 or less	Small multi-engine aircraft	95
C	12,500 - 300,000	Large aircraft	130
D	300,000 or more	Heavy Aircraft	150

Source: FAA Advisory Circular 150/5060-5, Airport Capacity and Delay

The Mix Index is a mathematical expression utilized in airfield capacity analysis, it is the percent of Class C aircraft plus 3 times the percent of Class D aircraft. Utilizing operational fleet mix projections presented in Chapter 2, Aviation Activity Forecasts, the mix index is estimated to be 27% during VFR conditions and 57% during IFR conditions. Peaking characteristics from Chapter 2 are used to identify design hour demand at the Airport.

3.1.5 Peak Hour Airfield Capacity

Peak airfield capacity is defined as the measure of the maximum number of aircraft operations that can be completed on a runway system in one hour. This calculation incorporates runway use configuration, dimensional criteria and spacing, fleet mix, touch and go activity, and runway exit factor. Utilizing guidelines contained within to FAA AC 150/5060-5, Airport Capacity and Delay, the capacities for the airports primary operating configurations were determined. The two primary configurations available include simultaneous use of two intersecting runways, and use of a single runway. Table 3-2 summarizes the hourly capacities of these two primary configurations for both VFR and IFR weather conditions. Simultaneous use of the intersecting runways is generally not used during IFR conditions at Hector International.

Table 3-2. Peak Hour Airfield Capacity

Airfield Configuration	Description	Weather Conditions	Hourly Capacity
Airfield Configuration 1	Simultaneous Use of Intersecting Runways	VFR	86
		IFR	-
Airfield Configuration 2	Single Runway	VFR	71
		IFR	56

Source: FAA Advisory Circular 150/5060-5, Airport Capacity and Delay, Mead & Hunt

Existing and projected peak hour operational demand was presented in Chapter 2, it ranged from 28 peak hour operations in 2014 to a projected demand for 38 peak hour operations in 2033. Therefore, given the capacities identified above the existing configuration of the airfield is anticipated to satisfy projected peak hour demands through the planning period.

It should be noted however that the hourly capacities of the airfield configurations were reduced slightly due to the limited number of runway exits, particularly on Runway 18/36 within 3,500 to 6,500 feet of the landing threshold. The airfield currently has one exit within this range, while two or three exits within this range would increase hourly capacities 3 to 9 percent depending upon the airfield configuration and weather condition. Therefore, it is recommended that the airport plan on additional exit taxiways from Runway 18/36, to lower runway occupancy times.

3.1.6 Annual Service Volume

Annual Service Volume (ASV) is a reasonable estimate of an airport's annual practical capacity. It accounts for differences in runway use, aircraft mix, weather conditions, pattern of demand (peaking), and other factors that impact capacity at an airport. The formula for calculating ASV contains three variables: Cw (weighted hourly capacity, D (the ratio of annual demand to average daily demand in the peak month), and H (the ratio of average daily demand to average peak hour demand during the peak month). These variables are multiplied to obtain the ASV for the Airport.

$$ASV = Cw * D * H$$

Weighted hourly capacity, Cw, as calculated from the above hourly capacities and in accordance FAA AC 150/5060-5, Airport Capacity and Delay, was found to be 65 operations per hour.

The Daily Demand Ratio (D) is the ratio of annual demand to average daily demand in the peak month. As described in Chapter 2, Aviation Activity Forecasts, the number of Peak Month Average Day (PMAD) operations in 2014 was 231. The ratio of annual demand (76,209 total operations) to the average daily demand (231 operations) results in a D value of 330.

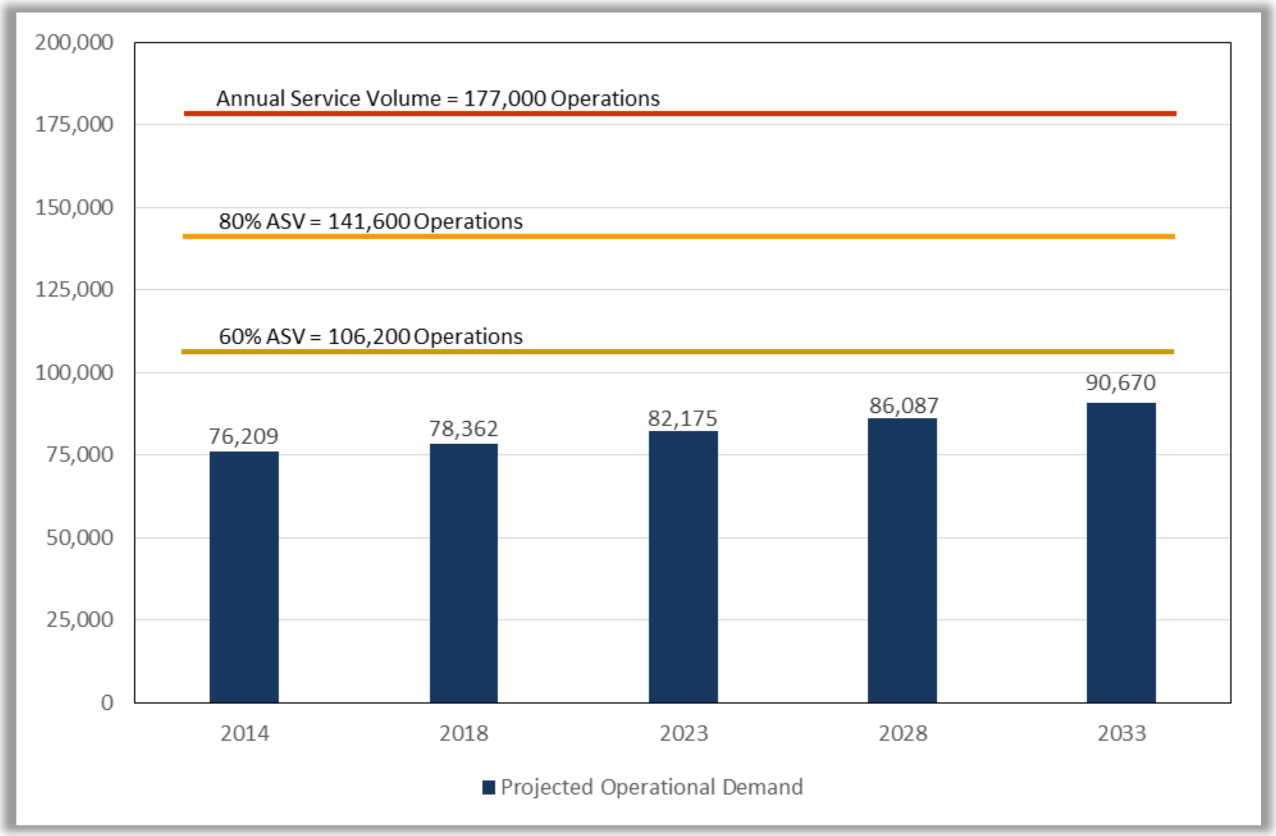
The Hourly Demand Ratio (H) is the ratio of average daily demand to average peak hour demand during the peak month. As was noted in Chapter 2, the number of peak hour operations was estimated at 28. The ratio of average daily demand (231) to peak hour demand (28) results in an H value of 8.25.

ASV for Hector International Airport is defined as follows:

ASV = Cw* D * H
ASV = 65 * 330 * 8.25
ASV = 177,000 operations (rounded)

FAA Order 5090.3C Field Formulation of the National Plan of Integrated Airport Systems (NPIAS) recommends that when an airport's annual operations reach 60 percent of its ASV, additional airfield facilities to increase capacity should be planned. This is based on the need to complete a thorough investigation of alternatives and required environmental evaluations. When annual operations reach 80 percent ASV, new airport facilities should be programmed, or demand management strategies be implemented. This is also meant to provide adequate time for planning and project implementation before demand exceeds capacity. Figure 3-1 presents the projected number of total airport operations and the Annual Service Volume capacity thresholds.

Figure 3-1 Operational Demand and Annual Service Volume



As shown above, operations at the Airport are projected to remain below the 60% capacity planning threshold through the planning period and a capacity increasing runway is not anticipated within the 20-year planning period. However, near the end of the planning period the projected operations are nearing the 60% capacity planning threshold. Additionally, the airport is currently protecting for a future parallel runway for general aviation activity and would like to continue to plan for, and protect space for, this long-term potential need. Therefore, it is recommended that Airport continue to protect for the addition of a parallel runway, either closely spaced or widely spaced, as part of this Master Plan Update. As noted earlier, it is also recommended that the airport plan on one or two additional exit taxiways from Runway 18/36, within 3,500 to 6,500 feet of the landing threshold, to lower runway occupancy times.

3.2 Wind Coverage

Since aircraft typically land and takeoff into the wind, it is important that the orientation of a runway is aligned in the same direction as local prevailing winds. FAA Advisory Circular (AC) 150/5300-13A, Airport Design, recommends that a runway orientation provide least 95 percent wind coverage for aircraft types that use an airport on a regular basis. If sufficient wind coverage cannot be provided by a single runway, then it is recommended that an airport also have a crosswind runway. It is important to note that smaller aircraft are more significantly impacted by crosswinds, or winds that are perpendicular to an aircraft's path of travel.

In evaluating wind coverage at an airport, FAA guidance notes this assessment be computed on a basis that crosswinds not exceed the maximum allowable velocities for the following aircraft categories:

- ✓ 10.5 knots for Airport Reference Code A-I and B-I aircraft
- ✓ 13 knots for Airport Reference Code A-II and B-II aircraft
- ✓ 16 knots for Airport Reference Code A-III, B-III, and C-I through D-III aircraft
- ✓ 20 knots for Airport Reference Code A-IV through D-VI aircraft

Data gathered from the National Climatic Data Center (NCDC) of local wind conditions at the Airport indicates that the orientation of the Airport's main runway, Runway 18/36, provides sufficient wind coverage in a 10.5 knot crosswind 89.51 percent of the time in all weather conditions (**Table 3-2**). It should also be noted as illustrated in the table, that Runway 18/36 provides sufficient wind coverage 89.49 percent of the time in a 10.5 knot crosswind when Instrument Flight Rules (IFR) weather conditions are present. The orientation of Runway 18/36 falls below the 95 percent recommended wind coverage in all weather and Instrument Flight Rules (IFR) conditions.

Table 3-2 FAR Wind Coverage

All Weather Percent Wind Coverage

Crosswind (in knots)	Runway 18	Runway 36	Runway 9	Runway 27	Runway 13	Runway 31
10.5	56.75%	57.14%	51.16%	54.84%	56.34%	58.85%
	89.51%		72.43%		90.44%	
	96.66%					
	99.64%					
13	59.15%	60.20%	57.16%	60.57%	58.28%	62.34%
	94.31%		81.61%		95.38%	
	98.42%					
	99.87%					
16	60.97%	62.72%	63.67%	66.77%	59.66%	64.75%
	97.83%		91.29%		98.58%	
	99.36%					
	99.95%					
20	61.61%	63.97%	67.17%	70.84%	60.06%	65.67%
	99.41%		97.34%		99.74%	
	99.82%					
	99.98%					

Note: Single runway end coverages calculated with a 3-knot tailwind
Source: National Climatic Data Center, FAA AGIS wind analysis tool
Station: Hector International Airport, Fargo, ND
Period of Record: 2005-2015 based on 140,822 observations

VFR Percent Wind Coverage

<table>
<tr><th>Crosswind (in knots)</th><th>Runway 18</th><th>Runway 36</th><th>Runway 9</th><th>Runway 27</th><th>Runway 13</th><th>Runway 31</th></tr>
<tr><td rowspan="4">10.5</td><td>59.69%</td><td>54.87%</td><td>51.40%</td><td>57.03%</td><td>58.18%</td><td>58.13%</td></tr>
<tr><td colspan="2">89.68%</td><td colspan="2">74.33%</td><td colspan="2">91.32%</td></tr>
<tr><td colspan="4">97.06%</td><td colspan="2"></td></tr>
<tr><td colspan="6">99.69%</td></tr>
<tr><td rowspan="4">13</td><td>62.21%</td><td>57.77%</td><td>57.40%</td><td>62.61%</td><td>60.24%</td><td>61.18%</td></tr>
<tr><td colspan="2">94.39%</td><td colspan="2">83.41%</td><td colspan="2">91.32%</td></tr>
<tr><td colspan="4">98.64%</td><td colspan="2"></td></tr>
<tr><td colspan="6">99.88%</td></tr>
<tr><td rowspan="4">16</td><td>64.12%</td><td>60.24%</td><td>63.90%</td><td>68.52%</td><td>60.24%</td><td>61.18%</td></tr>
<tr><td colspan="2">97.92%</td><td colspan="2">92.86%</td><td colspan="2">95.92%</td></tr>
<tr><td colspan="4">99.47%</td><td colspan="2"></td></tr>
<tr><td colspan="6">99.95%</td></tr>
<tr><td rowspan="4">20</td><td>64.81%</td><td>61.43%</td><td>67.26%</td><td>71.91%</td><td>62.09%</td><td>63.95%</td></tr>
<tr><td colspan="2">99.46%</td><td colspan="2">98.24%</td><td colspan="2">99.80%</td></tr>
<tr><td colspan="4">99.87%</td><td colspan="2"></td></tr>
<tr><td colspan="6">99.98%</td></tr>
</table>

Note: Single runway end coverages calculated with a 3-knot tailwind
Source: National Climatic Data Center, FAA AGIS wind analysis tool
Station: Hector International Airport, Fargo, ND
Period of Record: 2005-2015 based on 107,173 observations
VFR = Ceiling greater than or equal to 1,000 feet and visibility greater than or equal to 3 statute miles

IFR Percent Wind Coverage

<table>
<tr><th>Crosswind (in knots)</th><th>Runway 18</th><th>Runway 36</th><th>Runway 9</th><th>Runway 27</th></tr>
<tr><td rowspan="3">10.5</td><td>44.77%</td><td>67.61%</td><td>50.41%</td><td>44.85%</td></tr>
<tr><td colspan="2">89.49%</td><td colspan="2">63.08%</td></tr>
<tr><td colspan="4">94.75%</td></tr>
<tr><td rowspan="3">13</td><td>46.45%</td><td>71.23%</td><td>56.23%</td><td>50.92%</td></tr>
<tr><td colspan="2">94.36%</td><td colspan="2">72.26%</td></tr>
<tr><td colspan="4">97.38%</td></tr>
<tr><td rowspan="3">16</td><td>47.70%</td><td>73.77%</td><td>62.61%</td><td>58.23%</td></tr>
<tr><td colspan="2">97.64%</td><td colspan="2">82.70%</td></tr>
<tr><td colspan="4">98.86%</td></tr>
<tr><td rowspan="3">20</td><td>48.09%</td><td>75.21%</td><td>67.14%</td><td>65.97%</td></tr>
<tr><td colspan="2">99.28%</td><td colspan="2">92.59%</td></tr>
<tr><td colspan="4">99.64%</td></tr>
</table>

Note: Single runway end coverages calculated with a 3-knot tailwind
Source: National Climatic Data Center, FAA AGIS wind analysis tool
Station: Hector International Airport, Fargo, ND
Period of Record: 2005-2015 based on 21,131 observations
IFR = Ceiling less than 1,000 feet but greater than or equal to 200 feet; and/or
Visibility less than 3 statute miles but greater than or equal to 1/2 statute mile

True Bearing Calculation

	Runway 18	Runway 36	Runway 9	Runway 27
Latitude	46-55-58.325 N	46-54-29.489 N	46-55-37.693 N	46-55-37.180 N
Longitude	96-48-57.985 W	96-48-59.052 W	96-49-38.370 W	96-48-07.584 W
True Bearing	180.4716	0.4714	90.4634	270.4818

Calculated using NOAA NGS inverse computation model, NAD83 ellipsoid

Magnetic Declination Calculation

	Runway 18	Runway 36	Runway 9	Runway 27	Runway 13	Runway 31
True Bearing	180.4716	0.4714	90.4634	270.4818	137.3129	317.3204
Declination	3.1167 W	3.1167 W	3.1167 W	3.1167 W	3.1167 W	3.1167 W
Magnetic Bearing	183.5883	3.5881	93.5801	273.5985	140.4296	320.4371
Runway Designation	18	36	9	27	14	32

Note: Magnetic declination calculated for October 15, 2015 using World Magnetic Model (WMM)

As illustrated by the wind analysis, the wind coverage provided by the orientation of Runway 18/36 falls 5.49 percent under the preferred 95 percent in a 10.5 knot crosswind during all-weather conditions. This shortfall justifies the need for the Airport to have a crosswind runway. The Airport currently operates two crosswind runways 9/27 and 13/31. **Table 3-2** shows the wind coverage data for these crosswind runways at Hector Airport, and the coverage of the combined runway system.

This shortfall justifies the need for the Airport to have both crosswind runways. The addition of Runway 9/27 brings the wind coverage above the 95% threshold for all-weather and VFR conditions, but is still slightly under during IFR conditions.

Hector's two existing crosswind runways serve much of the general aviation traffic at the airport, and are invaluable in the efficient and safe use of the airfield for varying types of aircraft. By utilizing all three runways during times of little wind, it is possible for traffic going to all corners of the airport to use the runway that makes sense for the operation being executed. It is the opinion of the Master Plan Advisory Committee (MPAC) that the current runways provide sufficient wind coverage at the Airport, and should all be accounted for throughout the planning period.

3.3 Identification of Design Standards

The design of airport infrastructure such as runways, taxiways, and aprons are based on design standards established by the FAA that promote safety, economy, and efficiency. Design standards that are most appropriate to an airport are based on the operational and physical characteristics of the most demanding type of aircraft that is projected to operate at an airport on a regular basis. FAA AC 150/5300-13A, Airport Design, categorizes design standards that relate to airport infrastructure components based on a variety of factors including the approach speed, wingspan, and undercarriage dimensions of an aircraft. The following describes the two coding systems identified in FAA AC 150/5300-13A, Airport Design, that are used in the design and planning of airfield surfaces.

3.3.1 Runway Design Code

The Runway Design Code (RDC) is a coding system that identifies the design standards of a runway. The first component of the RDC, the Aircraft Approach Category (AAC), is categorized in **Table 3-5**.

Table 3-5: Aircraft Approach Categories

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

Source: FAA Advisory Circular 150/5300-13A, *Airport Design*

The second component of the RDC, the Airplane Design Group (ADG), is illustrated in **Table 3-6**.

Table 3-6: Airplane Design Groups

Group	Tail Height	Wingspan
I	Less than 20 feet	Less than 49 feet
II	From 20 feet to less than 30 feet	From 49 feet to less than 79 feet
III	From 30 feet to less than 45 feet	From 79 feet to less than 118 feet
IV	From 45 feet to less than 60 feet	From 118 feet to less than 171 feet
V	From 60 feet to less than 66 feet	From 171 feet to less than 214 feet
VI	From 66 feet to less than 80 feet	From 214 feet to less than 262 feet

Source: FAA Advisory Circular 150/5300-13A, *Airport Design*

The third and final component of the RDC relates to the visibility minimums of an approach to a runway which is often a factor that helps determine the width of the pavement and the dimensions of protection surfaces. The following categorization of visibility minimum as defined by FAA AC 150/5300-13A, Airport Design, are used in conjunction of the AAC and ADG to determine the dimensions of runway design surfaces:

- ✓ Visual (runways with only visual approaches)
- ✓ Not lower than one mile (runways with instrument approaches)
- ✓ Not lower than ¾ mile (runways with instrument approaches)
- ✓ Lower than ¾ mile (runways with instrument approaches)

The 2002 update of the Airport Layout Plan (ALP) identified that the design standards for the airfield were based upon D-V and TDG-5 aircraft, which were the most demanding type of aircraft operating at the Airport at that time. It should be noted that the RDC determination can be based upon a single aircraft type or a combination of the wingspan and approach speed of two separate aircraft types. Since the Airport receives operations from a variety of commercial jet aircraft, which each have unique physical and operating characteristics, the RDC determination for this iteration was based upon the Boeing 747-400.

Table 3-7: Existing and Future Design Aircraft

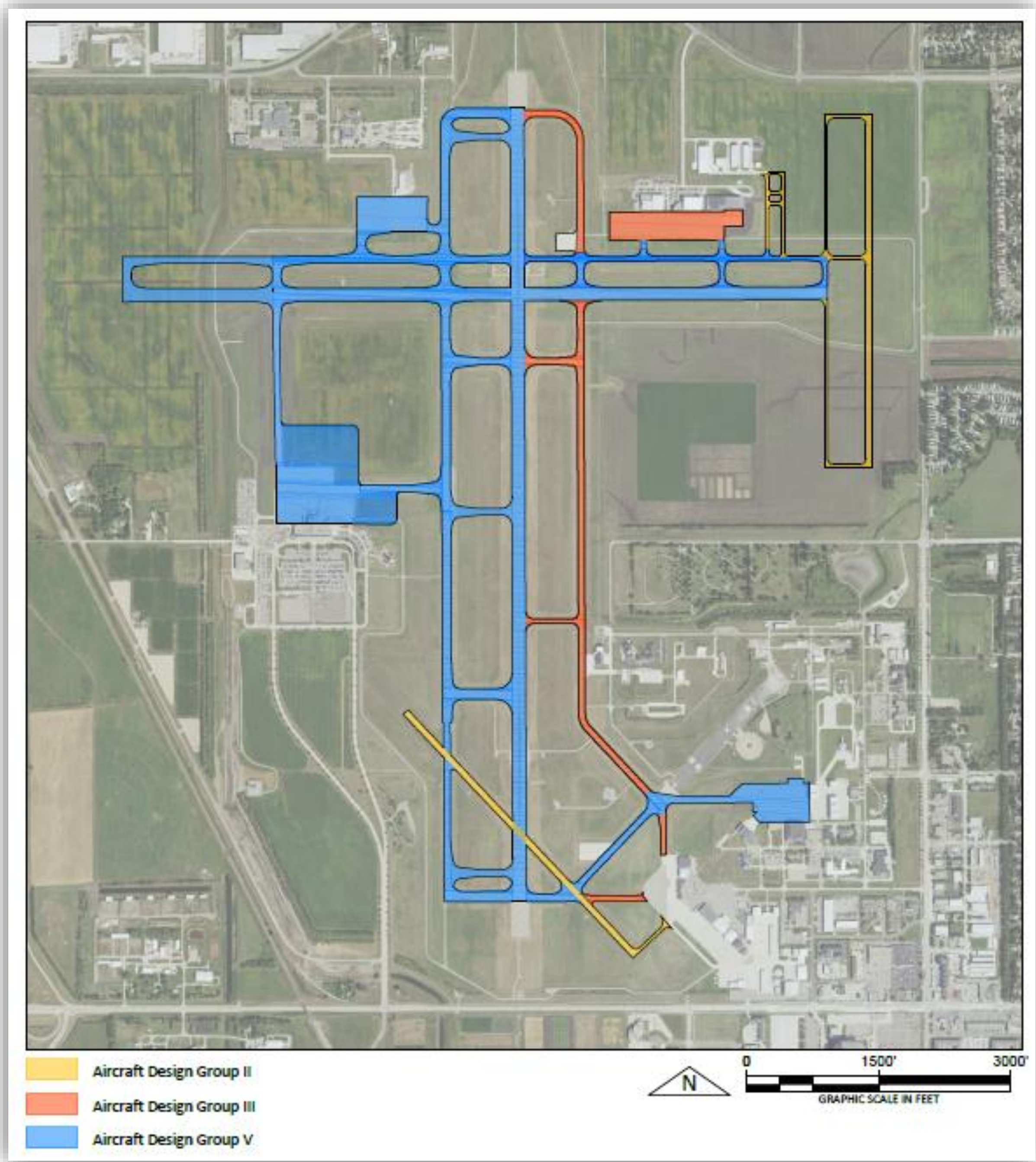
Design Category	Current Design Aircraft	Future Design Aircraft
Runway Design Code (RDC)	D-V	D-V
Aircraft Approach Category (AAC)	D	D
Approach Speed (knots)	141 or greater, but less than 166	141 or greater, but less than 166
Design Aircraft	B-747-400	B-747-400
Airplane Design Group (ADG)	V	V
Wingspan (feet)	171 - <214	171 - <214
Design Aircraft	B-747-400	B-747-400
Taxiway Design Group (TDG)	TDG-5	TDG-5
Design Aircraft	B-747-400	B-747-400

Source: Airport Layout Plan, 2002 Master Plan, Mead & Hunt

While the 500-operation limit is at the D-III/TDG-4 threshold, the Airport also serves an important regional function. With regular visits of large aircraft up to and including the B747-400, a D-V aircraft, it is recommended that Airport continue to serve as the State's only option to facilitate these large aircraft operations. Figure 3-2 shows the Aircraft Design Group map of the airfield and the Airport's current and future plans to ensure these aircraft can continue to operate in a safe and efficient manner, while being cognizant of the financial costs of maintaining these pavements.

During the development of this plan, daily operations of two Airbus A-300 aircraft has commenced. These aircraft are used by Fed Ex to bring regional cargo to their headquarters in Memphis. This aircraft is listed as a C-IV design group aircraft and a TDG 5. Fed Ex is in the process of switching these aircraft out nationally for the Boeing 767-300F. These new aircraft are categorized as C-IV and D-IV, as well as TDG 5. For the duration of the planning period, it is expected that these aircraft alone will more than double the required 500 operations required to establish a combined design aircraft of D-IV.

Figure 3-2: Aircraft Design Group Map of Airfield

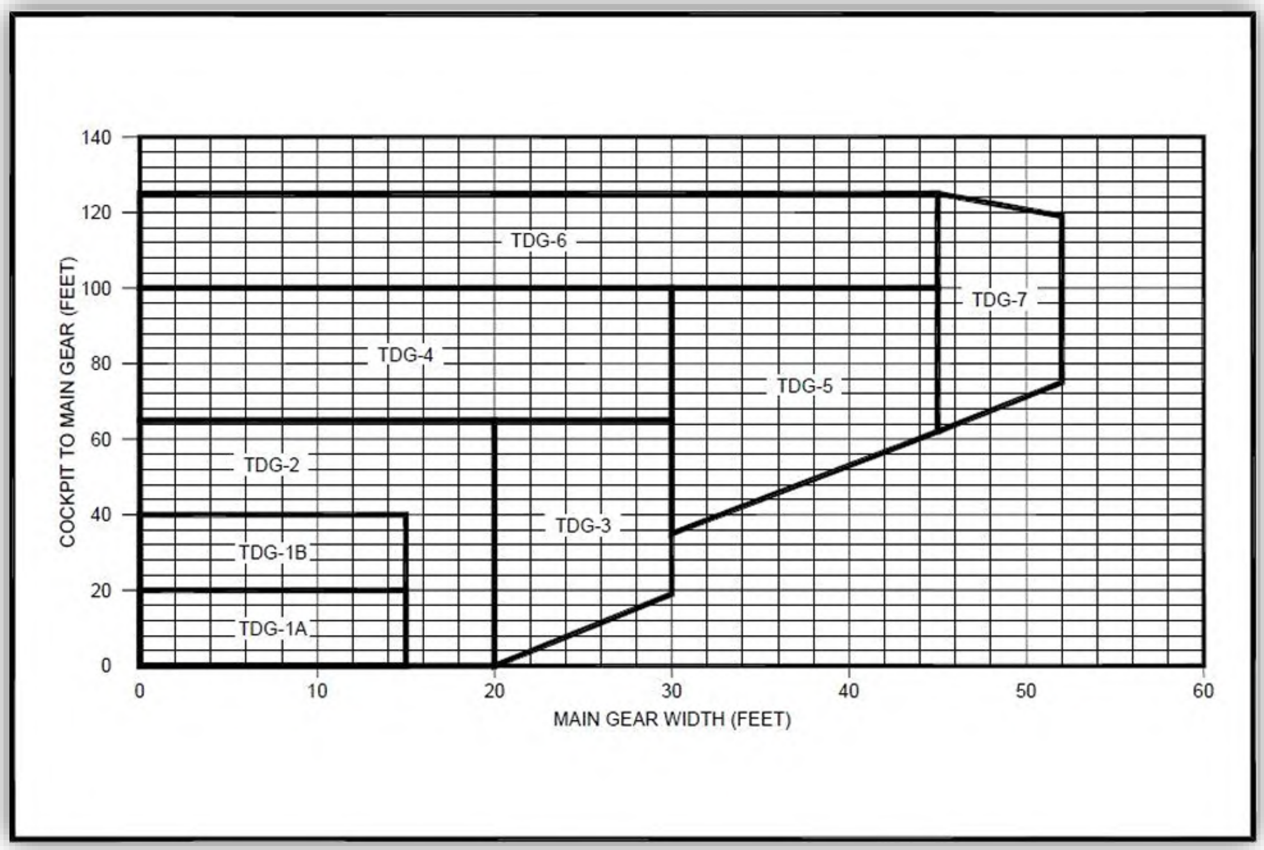


Further analysis of the capability of existing Airport infrastructure to accommodate both the operational needs of RDC category C-III aircraft and larger category D-V aircraft are discussed in the following sections.

3.3.2 Taxiway Design Group

The Taxiway Design Group (TDG) is a classification of aircraft used for taxiway design standards based on the width of an aircraft's main landing gear and the distance between the main landing gear and the cockpit. The width of taxiways and taxilanes, as well as fillet design standards and separation requirements for runways/taxiways and taxiways/taxilanes, are determined by the TDG of the critical design aircraft intended to use the surface. It is important to note that the TDG for a series of taxiways at an airport will often vary by surface based on the purpose of the taxiway. Taxiways parallel to a runway will often be designed to the TDG of the largest type of aircraft anticipated to regularly operate at an airport while taxiways and taxilanes leading to hangar or apron areas will be designed for specific TDG aircraft types using the facilities in that area. Figure 3-1 illustrates how the seven TDG classifications are categorized by FAA AC 150/5300-13A, Airport Design.

Figure 3-3: Taxiway Design Group Classifications



Source: FAA Advisory Circular 150/5300-13A, *Airport Design* (2014)

All the taxiways at the Airport are at least 50 feet in width and are designed to accommodate TDG-4 aircraft. While it is projected that the Airport will continue to receive significant operations by TDG-1, -2, and -3 aircraft throughout the planning period, operations by TDG-4 and TDG-5 aircraft are anticipated to increase as well. Though it is recommended that the Airport continue to maintain its taxiway system to meet TDG-3 and 4 design standards across the entire airfield, TDG-5 should continue to be maintained in areas, to allow parts of the taxiway system to accommodate TDG-5 aircraft to and from Runway 18/36 and the terminal, cargo, and military apron areas as shown on Figure 3-2.

3.4 Runway System

A comprehensive analysis was conducted as a part of this master plan to evaluate how the runways at Hector International can accommodate projected future demand; this review included length, width, grade, and the strength and condition of the pavements. In addition, design surfaces of the runways, such as safety areas, object free areas, and airspace protection surfaces, were also evaluated to determine if improvements may be needed to meet future demand. The following section reviews each component of Runways 18/36, 9/27, and 13/31 that were evaluated as a part of this analysis, and recommends improvements that may be needed for the runways to accommodate future demand.

3.4.1 Runway Length

The length of a runway should be determined by analyzing the landing and takeoff distance requirements of the most demanding types of aircraft (existing or projected) intended to regularly conduct operations on the surface. FAA AC 150/5325-4B, Runway Length Requirements for Airport Design, provides guidelines to determine the recommended length of a runway based on a critical design aircraft that is anticipated to operate on the surface over a period of several years. As such, it is important to first identify the runway length requirements of aircraft that are anticipated to conduct regular operations on the runways during the planning period.

Table 3-8 presents the required runway lengths for commercial jet aircraft types that currently or have the potential to conduct regular commercial airline operations at the Airport during the 20-year planning period. Each runway length presented in the table is based upon the maximum requirements for each aircraft at their MTOW on an 83-degree Fahrenheit day (mean high temperature for July) and adjusted for the elevation of the airfield (901 feet above mean sea level). It should be noted that aircraft manufacturer planning manuals were also referenced, where available, to determine the maximum runway length for each aircraft type.

Table 3-8: Maximum Runway Lengths for Current and Potential Commercial Aircraft

Aircraft	Maximum Takeoff Weight	MTOW Runway Length
Current Scheduled Carrier Equipment Types		
CRJ-200	53,000 pounds	8,300 feet[2]
ERJ-135	44,092 pounds	7,100 feet[2]
ERJ-145	53,131 pounds	7,400 feet[2]
CRJ-900	80,500 pounds	7,700 feet[2]
ERJ-145XR	53,131 pounds	7,500 feet[2]
ERJ-170	79,340 pounds	6,400 feet[1]
A-319	166,499 pounds	7,400 feet[2]
A-320	171,961 pounds	7,500 feet[2]
MD-83	160,000 pounds	7,800 feet[2]
MD-88	160,000 pounds	7,300 feet[2]
Potential Scheduled Carrier Equipment Types		
CRJ-700	72,750 pounds	6,500 feet[2]
ERJ-175	82,673 pounds	6,900 feet[1]
CRJ-1000	90,000 pounds	8,400 feet[1]
ERJ-190	105,359 pounds	6,900 feet[1]
ERJ-195	107,564 pounds	7,500 feet[1]
B-737-800	174,200 pounds	7,800 feet[2]
B-757-200	255,000 pounds	7,500 feet[2]

Notes:

1 – Estimated for 83° Fahrenheit day, field elevation 901 feet mean sea level, maximum takeoff weight

2 – Calculated using manufacturer's hot day chart at field elevation 901 feet mean sea level, maximum takeoff weight

Source: Mead & Hunt, Inc. (2015)

Based on the information presented in the preceding table, it appears the existing 9,001-foot length of Runway 18/36 is adequate for the runway length needs of all existing and anticipated commercial aircraft types operating at MTOW on a hot day. Very few potential commercial aircraft types require more than 9,000 feet of runway to takeoff from the Airport on a hot day at MTOW; as such, it appears that Runway 18/36 provides sufficient runway length for the anticipated scheduled commercial carrier fleet through the planning period.

In addition to evaluating the runway length requirements of commercial service aircraft, a review was also conducted of the adequacy of Runway 9/27 to meet the takeoff distance requirements of general aviation and intermittent commercial aircraft. Based aircraft information obtained from the Airport's Fixed Base Operator, as well as operational counts obtained from the FAA's Traffic Flow Management System Counts (TFMSC) database, were used to determine the types of general aviation aircraft that most frequently conduct operations at the Airport. The based and itinerant general aviation aircraft with the most demanding runway length needs were then identified to evaluate the adequacy of Hector's runways in meeting these needs.

Table 3-12 presents the runway length requirements of based and itinerant general aviation aircraft that most frequently conduct operations at the Airport. It should be noted that airport planning manuals and manufacturer runway length requirement charts were not readily available for these aircraft types to calculate the maximum takeoff distance required for a departure from the Airport on a hot day at MTOW. Instead, sea level takeoff distance requirements for each aircraft at MTOW in International Standard Atmosphere (ISA) conditions were obtained through data sheets provided by each aircraft manufacturer. Using an FAA runway length planning spreadsheet, and entering the temperature and gradient adjustment of the runway, takeoff distance requirements were calculated for each aircraft type operating at MTOW on an 83-degree Fahrenheit day.

Table 3-9: Runway Takeoff Distance Requirements of General Aviation Aircraft

Aircraft Type	MTOW	MTOW Takeoff Distance (Sea Level) [1]	MTOW Takeoff Distance @ FAR elev., 83° F [2]
Based Aircraft			
Hawker 125-700A	25,500 lbs.	5,800 ft.	7,700 ft.
Citation 550	13,300 lbs.	3,450 ft.	4,700 ft.
Citation V	15,900 lbs.	3,200 ft.	4,400 ft.
King Air F90	10,950 lbs.	2,800 ft.	3,800 ft.
King Air 200	12,500 lbs.	2,600 ft.	3,600 ft.
Eclipse 500	5,995 lbs.	2,350 ft.	3,400 ft.
Cessna 208	8,000 lbs.	2,050 ft.	3,000 ft.
Common Itinerant GA Aircraft			
Gulfstream IV	73,200 lbs.	5,300 ft.	7,000 ft.
Citation X	36,100 lbs.	5,150 ft.	6,800 ft.
Embraer 120	24,433 lbs.	5,150 ft.	6,800 ft.
Challenger 300	38,850 lbs.	4,800 ft.	6,400 ft.
Falcon 50	38,800 lbs.	4,700 ft.	6,300 ft.
Dornier 328 Jet	34,524 lbs.	4,500 ft.	6,000 ft.
Learjet 45	20,500 lbs.	4,350 ft.	5,800 ft.
Beechjet 400	15,780 lbs.	3,950 ft.	5,300 ft.
Citation Excel XLS	20,200 lbs.	3,560 ft.	4,900 ft.
Citation CJ1	10,600 lbs.	3,300 ft.	4,500 ft.

Notes:

1 – Sea level MTOW takeoff distances obtained from aircraft manufacture data sheets for ISA temperature conditions

2 – Takeoff distances at Airport elevation (901 feet) on 83° F day estimated from FAA runway calculation planning worksheet

Sources: Aircraft manufacture data sheets, FAA runway length calculation planning spreadsheet

Mead & Hunt, Inc. (2015)

As illustrated in the table, the 6,302-foot length of Runway 9/27 is adequate to meet the runway length needs of most general aviation aircraft types departing from the Airport at MTOW on an 83 degree Fahrenheit day. When conditions require that an aircraft have more runway length than is available on Runway 9/27, aircraft operators have the option of using Runway 18/36, which allows them an extra 2,700 feet. Extending Runway 9/27 up to 8,000 feet as shown on the current ALP would also help support the takeoff distance requirements of itinerant general aviation aircraft that frequently operate at the Airport, such as the Gulfstream V, Citation X, and Global Express, as well as support the commercial airline operations for when Runway 18/36 is closed or crosswind components demand. Excessive crosswind components have been seen occasionally for the A-319 and A-320 aircraft, however, Runway 9/27 is not currently long enough to support most operations from these aircraft.

Runway 13/31 at 3,801 feet in length is adequate to support the light utility aircraft that operate from this runway.

In conclusion, the existing main runway length of 9,001 feet is generally adequate to accommodate current demands. In the future, to meet the runway takeoff distance requirements of both commercial airline and general aviation aircraft, it is anticipated that Runway 18/36 will not need to be extended to accommodate potential aircraft. If future demand justifies it, an extension to Runway 9/27 would allow an increased number of takeoff opportunities during the most demanding conditions of the summer months as well as support commercial airline operations for when Runway 18/36 must be closed or when there are excessive crosswinds on Runway 18/36. It would be prudent for the Airport to continue to protect for this future demand and runway extension of up to 8,000 feet on Runway 9/27, as shown on the current ALP.

3.4.2 Runway Width

The width of a runway is determined based on a combination of the RDC of the critical aircraft intended to operate on the surface and the runway's approach visibility minimums. The required width of a runway for RDC category D-V aircraft, as designated by FAA AC 150/5300-13A, Airport Design, is 150 feet. Since the RDC of Runway 18/36 is D-V, the existing 150 feet width of the runway meets current FAA design standards. Runways 13/31 and 9/27 also meet the criteria of this Advisory Circular with their runway width of 75 and 100 feet respectively. As such, it is not anticipated that improvements will be needed to the width of Runway 18/36, 9/27, or 13/31 throughout the planning period unless an extension to 9/27 was realized.

The Runway Design Code for each of the Airport's runways is as follows:

- ✓ Runway 18/36 D-V
- ✓ Runway 9/27 C-III
- ✓ Runway 13/31 B-II

Runways are often grooved to improve skid-resistance and prevention of hydroplaning during conditions in which the pavement is contaminated with water. Grooves are applied to the entire width of a runway to assist in the drainage of water provided by the transverse slope of the pavement surface. It should be noted that the width of Runway 18/36 is grooved 65 feet either side of the centerline for a total width of 130 feet.

Both crosswind runways, 9/27 and 13/31, are also grooved at full width (stopping 10' from edge) to increase the safety of the pavement.

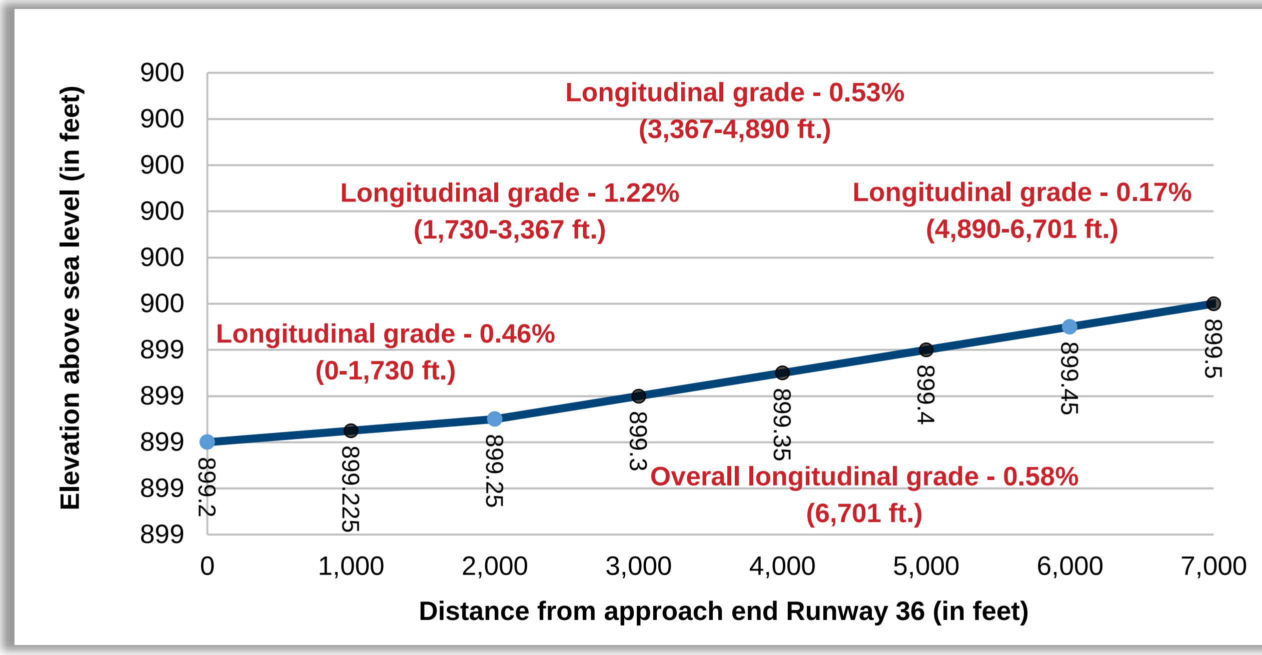
In addition, as a part of evaluating the width of a runway, it is also important to consider the need for paved shoulders, which are beneficial to reduce the potential of foreign object debris (FOD) from jet blast of larger aircraft and help support the passage of maintenance and emergency vehicles. FAA AC 150/5300-13A, Airport Design, states that paved shoulders are required for runways accommodating ADG IV and higher aircraft and are recommended for runways accommodating ADG-III aircraft. Currently, Runways 18/36 and 9/27 do not have paved shoulders. While it is not a requirement for RDC category C-III runways, it is a recommendation; therefore, the inclusion of paved shoulders should be discussed during the next major runway rehabilitation project. Paved shoulders of 20 or 35 feet in width would be necessary to meet design standards identified in FAA AC 150/5300-13A, Airport Design for RDC category C-III and D-V respectively. The Airport currently holds a modification to standard for 15' shoulder widths on Taxiway Alpha.

3.4.3 Runway Grade

Runway gradient design standards are outlined in FAA AC 150/5300-13A, Airport Design, so that pilots and air traffic controllers can view that any one point on a runway is clear of aircraft, vehicles, wildlife, and other objects. Design standards for longitudinal and transverse runway grades are based on the AAC of the critical design aircraft. Gradient standards are the same for AAC category C, D, and E aircraft with the maximum allowable longitudinal grade change between runway ends being ±1.50 percent; it should be noted that the longitudinal grade may not exceed ±0.80 percent in the first and last quarter of a runway.

As illustrated in Figure 3-2, the overall longitudinal grade of Runway 18/36 between runway ends is 0.58 percent and meets current FAA design standards; likewise, the longitudinal grade changes within the first and last quarter of the runway are each less than 0.80 percent and fall within allowable tolerances.

Figure 3-4: Runway 18/36 Longitudinal Grade



Source: Mead & Hunt, Inc. (2015)

The overall longitudinal grade of the runway falls within allowable tolerances. FAA AC 150/5300-13A, Airport Design, states that runways with a full parallel taxiway should be designed so that any point five feet above the runway centerline must be mutually visible with any other point five feet above the runway centerline that is located at a distance that is less than one half the length of the runway. The line-of-sight for Runways 18/36, 9/27, and 13/31 are such that any point above the runway centerline can be viewed from any other point above the runway centerline at a height of five feet. This is consistent with the requirements of the design AC.

3.4.4 Airfield Pavement Strength & Condition

As a part of the North Dakota PCI Study in 2015, an airfield pavement evaluation was conducted by Applied Pavement Technology, Inc. (APTech) to determine the condition of airfield pavement surfaces and develop recommendations for future rehabilitation and repair. To conduct this evaluation, past pavement management records were reviewed from the State of North Dakota airport pavement management system, construction history information, and traffic data. Visual pavement condition inspections to determine the pavement condition index (PCI) were conducted as well as falling weight deflectometer testing to determine the condition of subgrade and pavement layer properties.

The PCI is a rating system that gives a numerical value to the existing condition of pavement based on distresses observed on the surface. The PCI scale ranges from a value of 0 for pavements in a completely failed condition to a value of 100 for pavements with no distress. It is recommended that all pavements be maintained with a PCI value above 70; pavements with PCI values between 70 and 40 or less are more likely to need a major rehabilitation while pavements with PCI values less than 40 need a reconstruction.

The overall PCI value of airfield pavements is 78; this compares to an overall airfield PCI of 76 that was determined in 2008. By type of pavement surfaces, the runways and taxiways are in good condition with PCI values of 90 and 80, respectively. Aprons are in worse condition with a PCI value of 72, which is largely attributed to the unfavorable condition of the South GA apron. Overall, approximately 80 percent of the pavement area has a PCI value between 60 and 70. Less than one percent of the pavement area has a PCI value below 60 while the rest of the pavement have a PCI value above 70. A summary of the PCI values assigned to pavement surface branches as calculated from the evaluation study, as well as a percentage calculation for pavement distress, if any, is presented in Table 3-13.

Table 3-10: Airfield Pavement Surface Pavement Condition Index Values

Pavement Surface Branch	PCI Value	Percent of Distress		
		Climate/ Durability	Load	Other
Runway 18/36	80-83	59%	0%	41%
Runway 9/27	90-99	75%	11%	14%
Runway 13/31	99	100%	0%	0%
Taxiway A	95-99	62%	35%	3%
Taxiway B	86-99	77%	8%	15%
Taxiway C	86-91	84%	0%	16%
Taxiway D	57	36%	8%	56%
Taxiway E	86-92	71%	0%	29%
Taxiway F	100	0%	0%	0%
Taxiway G	98	0%	100%	0%
Taxiway J	100	0%	0%	0%
North Half Airline Terminal Apron	99	100%	0%	0%
South Half Airline Terminal Apron	66-77	42%	8%	50%
North General Aviation Apron	72-80	42%	19%	39%
South General Aviation Apron	43-83	58%	26%	16%
Cargo Apron	83-99	81%	0%	19%

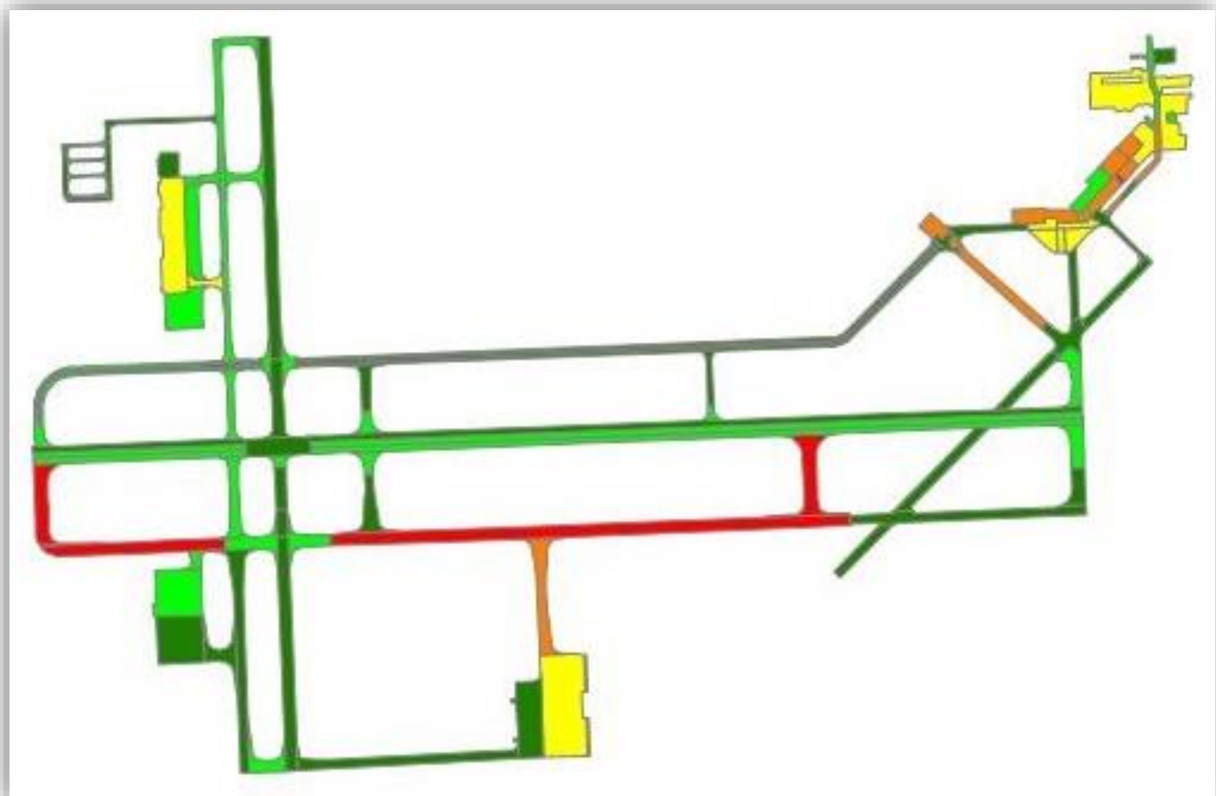
Notes:

1) Distress due to climate or durability includes those distresses attributed to either the aging of the pavement and the effects of the environment or to a materials-related problem.

2) Distress due to load includes those distresses attributed to a structural deficiency in the pavement or mid-panel cracking.

Source: Applied Pavement Technology, Inc. (2015)

Figure 3-5: Hector Airport PCI Map



In summary, Runway 18/36 has an area-weighted PCI of 81 and last was reconstructed in 2004. Typical pavement distresses on runways at Hector include joint seal damage and popouts. The 2017 PCIs of taxiways range from 52 on Taxiway D to 100 on Taxiway A. Durability cracking and joint seal damage are the most predominant distresses on taxiway surfaces. It should be noted that Taxiway C and Taxiway E also have localized spalling and faulting. The North GA and South GA aprons have PCI values of 72 and 43, respectively. The North GA apron has joint seal damage and durability cracking with pumping occurring in many areas. Spalls occurring in many areas have been patched. The South GA apron has widespread weathering with a high degree of joint damage over most areas. There are also significant areas of durability cracking throughout. Finally, the commercial airline terminal apron has PCI values of 99 and 77 for the north and south halves of the surface, respectively. Though the southern surface is in good condition, it does have a notable amount of durability cracking as well as small patches.

A summary of the projected PCI value for each pavement surface branch for the next five years as well as its anticipated functional remaining life is presented in Table 3-14.

Table 3-11: Summary of PCI Projections and Functional Remaining Life

Branch	Projected PCI by Year					Functional Remaining Life
	2015	2016	2017	2018	2019	
Runway 18/36	78	77	76	75	74	8 years
Runway 9/27	94	93	92	93	92	> 10 years
Runway 13/31	100	99	98	97	96	> 10 years
Taxiway A	36	35	100	99	99	0 years
Taxiway B	93	92	91	90	89	> 10 years
Taxiway C	86	85	84	83	82	> 10 years
Taxiway D	54	53	52	51	50	0 years
Taxiway E	90	89	88	87	86	> 10 years
Taxiway F	98	97	96	95	94	> 10 years
Taxiway G	96	95	94	93	92	> 10 years
Taxiway H	82	81	80	79	78	>10 years
Taxiway J	100	100	99	98	97	>10 years
North Half Airline Terminal Apron	100	99	98	97	96	>10 years
South Half Airline Terminal Apron	73	72	70	68	67	7 years
North General Aviation Apron	68	67	65	64	62	0 years
South General Aviation Apron	50	48	46	44	42	0 years
Cargo Apron	79	77	76	75	73	7 years

Key: (green) = PCI value above critical value for section
(yellow) = PCI value below critical value but greater than 40
(red) = PCI value below 40

Source: Applied Pavement Technologies, Inc. (2015)

As indicated in Table 3-14, Runway 18/36 is predicted to have a PCI of 74 by 2019 while taxiways are predicted to have PCI values between 32 and 99 by 2018. Four pavement surfaces are projected to be below the critical PCI value of 70 by 2015 with this increasing to five by 2018. It should be noted that much of Taxiway A has a PCI value of below 40, as is currently in a phased reconstruction plan that will be completed in 2017. Overall, a majority of the pavement surface branches have functional lives greater than 10 years while Runway 18/36, Taxiway D, parts of the Terminal Apron, and the North and South GA have functional remaining lives of less than 10 years.

In addition, a strength analysis was conducted to determine the pavement classification number (PCN) for each runway surface to determine allowable load limits using methodology outlined in FAA AC 150/5335-5B, Standardized Method of Reporting Airport Pavement Strength – PCN). The PCN is a numerical value assigned to a pavement and expresses the relative load-carrying capacity of that pavement in terms of the weight of an equivalent single-wheel load that it can support. PCN is determined based on the frequency and weight of aircraft operations and existing pavement layer properties. Table 3-15 presents the PCN value for each runway surface at the Airport.

Table 3-12: Summary of Runway Surface PCN Values

Surface	PCN Value
Runway 18/36	95
Runway 9/27	25
Runway 13/31	17

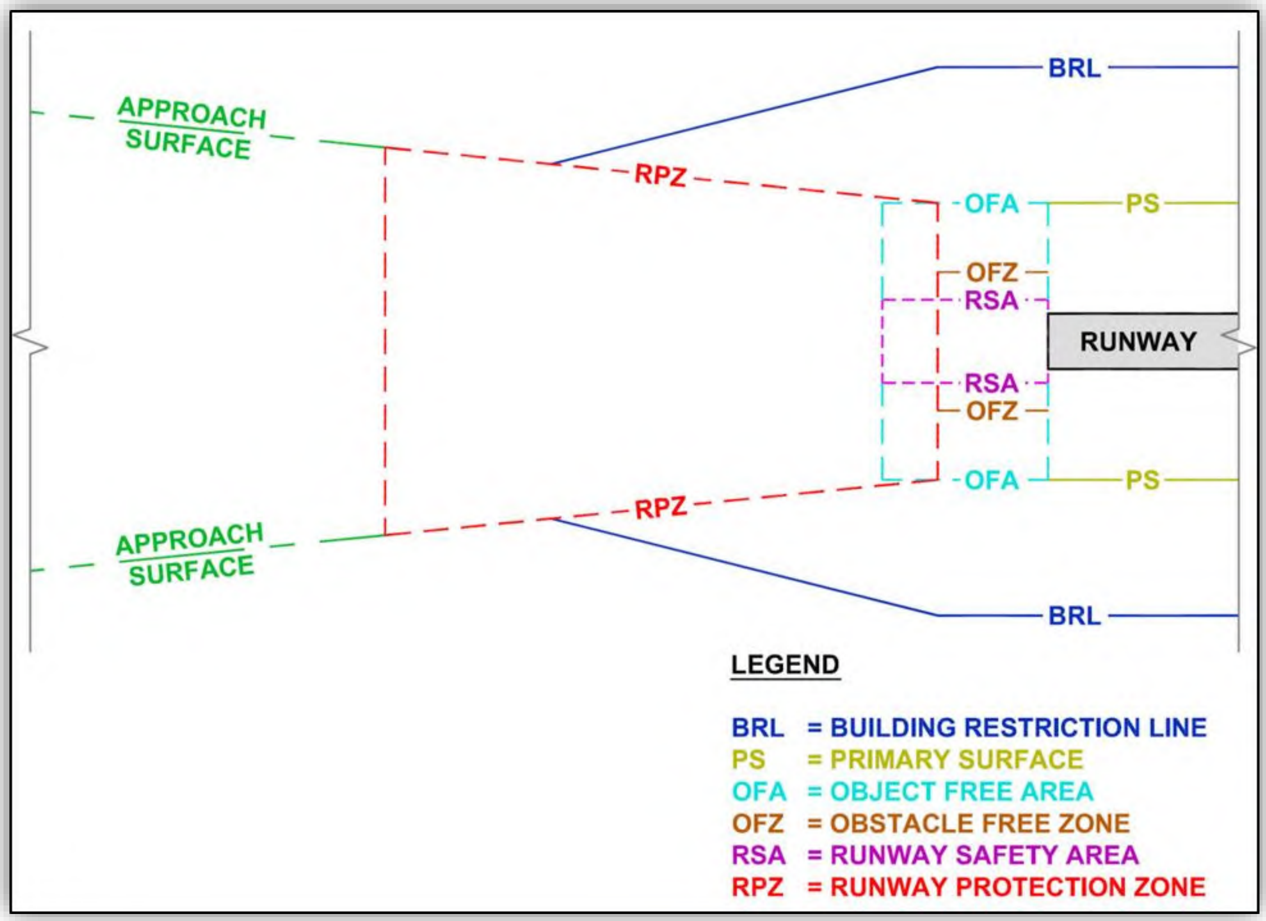
Source: Applied Pavement Technology, Inc. (2015)

In summary, it appears the strength of the pavement surfaces at the Airport is sufficient to meet existing and anticipated operational demands throughout the planning period; however, it is recommended that, in addition to the scheduled reconstruction of Taxiway A, the south general aviation apron and Taxiway D be considered for rehabilitation soon. It is anticipated that the area-weighed PCI of the Airport will decrease from the 2012 value of 78 if no pavement rehabilitation work was completed. Preventative maintenance and rehabilitation of the most critical surfaces as previously noted is anticipated to increase the area-weighted PCI value of the Airport by 2019. A full executive summary from the 2015 PCI Study can be found in Appendix A of this document.

3.4.5 Runway Design Surfaces

In addition to the length, width, and strength of the pavement surface, there are also many other design components associated with runways that protect aircraft from obstructions and provide a margin of safety in the event of an unintentional deviation from the runway. As illustrated in Figure 3-3, these surfaces include safety areas, object free areas, and protection zones. The following section reviews each of these design surfaces as they are associated with Hector International Airport's runways, and evaluates if dimensional changes will be needed to accommodate aircraft that are project to operate there during the planning period.

Figure 3-6: Runway Design Surfaces



Source: Mead & Hunt, Inc. (2015)

Runway Safety Area – The Runway Safety Area (RSA) is a two-dimensional surface at the elevation of the runway that is centered on the extended centerline which provides an area to support an aircraft in the event of an unintended excursion from the runway surface. According to FAA AC 150/5300-13A, Airport Design, runway safety areas must be:

- ✓ Cleared, graded, free of hazardous surface variations, and properly drained.
- ✓ Capable of supporting an aircraft without causing structural damage as well as airfield maintenance and emergency response vehicles.
- ✓ Free of objects except those which are necessary such as navigational signs and lighting upon which must be mounted on low-impact resistant supports.

The RSA for each of the Airport's runways has the following dimensions:

- ✓ Runway 18/36 as a RDC D-V runway has an RSA that is 500 feet in width and extends 1,000 feet beyond each end of the runway.
- ✓ Runway 9/27 as RDC C-III runway also has an RSA that is 500 feet in width and extends 1,000 feet beyond each end of the runway.
- ✓ Runway 13/31 as a RDC B-II runway with visual approach minimums, and an RSA that is 150 feet in width and extends 300 feet beyond each end of the runway.

As noted, the RSA must be kept free of objects except those necessary by function. The Runway 36 RSA extends 1,000 feet beyond the approach end of the runway, and the localizer antenna for Runway 36 is located 1,015 feet from the approach end of the runway, outside of the RSA. It should be noted that the FAA has recently placed an emphasis on maintaining safety areas that meet design standards and are free of all objects, except those necessary by function which must be mounted on low-impact resistant supports. There are no known noncompliant objects within any of the Airport's runway safety areas.

Runway Object Free Area – The Runway Object Free Area (ROFA) is also a two-dimensional ground area at the elevation of the runway and centered on its extended centerline; however, the function of the ROFA varies from the RSA in that it is intended to protect aircraft operating on the runway and within the RSA from colliding with objects. It should be noted that the FAA prohibits aircraft from parking within the OFA, except for ground maneuvering purposes, and all above-ground objects protruding from the edge of the RSA elevation, except those fixed by function for navigational purposes. Dimensions of an ROFA are based on the critical design aircraft intended to use a runway and its approach visibility minimums. The ROFA for Runway 18/36 and Runway 9/27 is 800 feet wide and extends 1,000 feet beyond each runway end meeting design standards for RDC category C-III and D-V aircraft, respectively. The ROFA for Runway 13/31 is 500 feet wide and extends 300 feet beyond the end of the runway, meeting the design standards for RDC B-II aircraft. For all three runways, no known noncompliant objects are within the ROFA and therefore improvements to the ROFA are not anticipated during the planning period.

The glide slope antenna for Runway 36 and the Airport's weather reporting equipment, each used for navigational purposes, are located approximately 400 feet from the centerline of Runway 18/36 outside the boundary of the RSA and the ROFA. While above-ground objects that are fixed by function for navigational purposes are allowed to protrude from the edge of the RSA elevation within the OFA, the FAA recommends that glide slope antennas be located a minimum of 400 feet from the centerline of a runway.

Obstacle Free Zone – The Obstacle Free Zone (OFZ) is a three-dimensional volume of airspace located along the runway and beyond its end. Clearing standards prohibit taxiing aircraft, parked aircraft, vehicles, and other objects, except those fixed by function, from being located within the OFZ when aircraft are departing from or arriving to a runway surface. The OFZ is comprised of three design elements, each of which are described in the following summaries:

- ✓ **Runway Obstacle Free Zone** – The Runway Obstacle Free Zone (ROFZ) extends 200 feet beyond the end of a runway at a width determined by the type of aircraft conducting operations on the runway surface. Since all the runways are designated for use by aircraft over 12,500 pounds, the ROFZ width is 400 feet for all three runways. As there are no known noncompliant objects within the ROFZ's, no improvements are anticipated to be needed to the ROFZs associated with these runways.

- ✓ **Inner-approach OFZ** – The inner-approach OFZ is a volume of airspace centered on the runway centerline and only applies to runways with an approach lighting system (ALS). The inner approach OFZ begins 200 feet beyond the runway threshold and extends 200 feet beyond the last light unit in the ALS. The width is the same as the ROFZ and rises at a slope of 50:1 outward and upward from the beginning of the surface located 200 feet beyond the end of the runway. Since only Runways 18 and 36 are equipped with an ALS, an inner approach OFZ is located 200 feet beyond the end of the runway at a width of 400 feet and extends outward and upward at a slope of 50:1 to a horizontal distance of 2,980 feet on the 18 end and 2,660 feet off the 36 end, which extends 200 feet beyond the last light units of the ALS. The inner-approach OFZ at the approach ends of Runways 18 and 36 meet FAA design standards; as such, improvements are not anticipated during the planning period.

- ✓ **Inner-transitional OFZ** – The inner-transitional OFZ is also a defined volume of airspace located along the sides of the ROFZ and inner-approach OFZ and only applies to runways with lower than ¾ mile approach visibility minimums. Therefore, only Runway 18/36 has an inner-transitional OFZ. The dimensions of the inner-transitional OFZ are based on the type of aircraft intended to us a runway and the category of its instrument approach. For runways with Category I instrument approaches, the inner-transitional OFZ begins at the edges of the ROFZ and inner-approach OFZ and rises vertically to height determined by the following equation:

  $$H_{feet} = 61\text{-}0.094(S_{feet}) – 0.003(E_{feet})$$

  It should be noted that in the equation above, "S_{feet}" is equal to the wingspan of the most demanding RDC to operate on the runway and "E_{feet}" is equal to the runway threshold above sea level. Since the visibility minimums for Runways 18 and 36 are less than ¾ mile, and they are equipped with a Category I instrument approach, an inner-transitional OFZ is found at the approach end of these runways. The height of the inner-transitional surface at the approach end of Runway 18, based upon the wingspan of the B747-400 which is the critical design aircraft, is:

  61-0.094(213 feet) – 0.003(900 feet mean sea level) = 38.28 feet

  At a height of 38.28 feet, the inner-transitional OFZ then extends outward and upward at a slope of 6:1 to a height of 150 feet above the Airport. The height of the inner-transitional surface at the approach end of Runway 36, also based upon the wingspan of the B747-400, is:

61-0.094(213 feet) – 0.003(899 feet mean sea level) = 38.28 feet

At a height of 38.28 feet, the inner-transitional OFZ then extends outward and upward at a slope of 6:1 to a height of 150 feet above the Airport.

- ✓ Precision OFZ – The precision OFZ (POFZ) is defined as a volume of airspace above an area beginning at the threshold at the threshold elevation and centered on the extended runway centerline. The POFZ is 800 feet in width centered on the extended runway centerline and extends 200 feet beyond the runway threshold. The POFZ is in effect at all runway thresholds when all the following operational conditions are met:
  - The approach includes vertical guidance
  - The reported ceiling is below 250 feet, visibility is less than 3/4 statue mile, or the Runway Visual Range (RVR) is below 4,000 feet
  - An aircraft is on final approach within 2 miles of the runway threshold

When the POFZ is in effect, a wing of an aircraft holding on a taxiway waiting to depart may penetrate the POFZ; however, neither the fuselage nor tail may penetrate the POFZ. Vehicles up to 10 feet in height necessary for maintenance are also permitted in the POFZ.

It should be noted that a POFZ is located at the approach end of Runways 18 and 36 and is only in effect when an aircraft is on approach to land when the following conditions are present. While currently no airfield pavement surfaces are located within the POFZ at the approach end of Runway 36, it is important to note this design surface should consideration be given to any future runway, taxiway, or apron improvement projects.

Runway Protection Zone – The Runway Protection Zone (RPZ) is designed to enhance the protection of people and property on the ground. RPZs are to be controlled by an airport and be clear of any incompatible land uses such as occupied buildings, concentrations of people, wildlife attractants, and objects of height. The RPZ is trapezoidal in shape and centered on the extended centerline of the runway located 200 feet beyond the end of a paved runway surface with an inner and outer width that is based on the AAC of the critical design aircraft and type of approach to the runway. Table 3-16 presents the dimensions of the approach RPZ located at either end of each runway.

Table 3-13: Runway Protection Zone Dimensions

Dimensions	Runway 18/36	Runway 9/27	Runway 13/31
Runway Design Code (RDC)	D-V	C-III	B-II
Visibility Minimums	Lower than ¾ mile	Not lower than ¾ mile	Visual
Length	2,500 feet	1,700 feet	1,000 feet
Inner Width	1,000 feet	1,000 feet	500 feet
Outer Width	1,750 feet	1,510 feet	700 feet
Area	78.914 acres	48.978 acres	13.770 acres

Source: FAA Advisory Circular 150/5300-13A, *Airport Design*

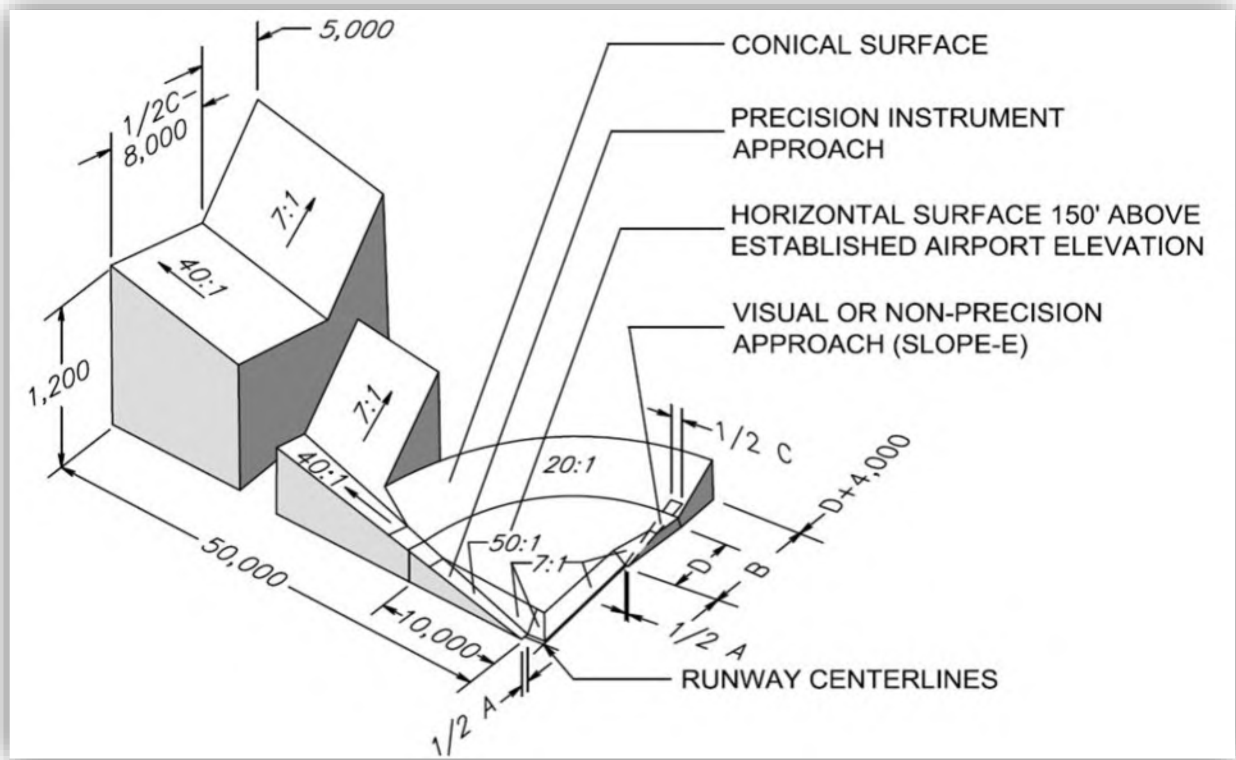
It should be noted that the dimensions of the RPZs found at each end of all runways meet FAA design standards as identified in FAA AC 150/5300-13A, Airport Design, for their respective RDC categories if the approach visibility minimums to either end of the runways remain unchanged. Changes to the dimensions and/or locations to the RPZs are only anticipated if a runway is extended and/or an instrument approach with lower visibility is developed for the runway. This is important to note since the FAA recommends that land within an RPZ be controlled by an airport to prevent and eliminate incompatible objects and activities for the protection of people and property on the ground. Should any runway be extended, or an approach with increased visibility minimums be developed, the acquisition of land or an easement may be needed should any portion of a relocated or increased RPZ fall outside existing Airport property to control incompatible land uses.

There are some public roadways within the RPZs, such as County Road 20 near the approach end of Runway 18, University Drive near the approach end of Runway 27, 19th Avenue near the approach end of Runways 31 and 36, and Dakota Drive near the approach end of Runway 13. These roads are below the approach elevation and do not have an adverse effect on the Airport, nor do the RPZs include any land uses that are residential or places of assembly. Therefore, the RPZs comply with the interim FAA design standards guidance.

3.4.6 Federal Aviation Regulation Part 77 Surfaces

Federal Aviation Regulation (FAR) Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace, was developed to protect airspace surrounding airports to provide safe flight for aircraft from takeoff to landing. In addition to establishing procedures for reporting potential hazards to safe air navigation, FAR Part 77 defines five “imaginary surfaces” that surround each runway at an airport designed to preserve airspace and protect traversing aircraft from obstructions. The dimensions of each of the five imaginary surfaces are based on the category of runway as defined by FAR Part 77 and the most precise approach (existing or planned) for a runway end. A description of the five FAR Part 77 imaginary surfaces and discussion of their dimensions as they are associated with Hector's runways are presented in the following sections while a graphic description is illustrated in Figure 3-4.

Figure 3-7: Federal Aviation Regulation Part 77 Surfaces



Source: Mead & Hunt, Inc. (2015)

Primary Surface – The primary surface is a two-dimensional surface centered longitudinally on a runway and extends 200 feet beyond the end of a prepared hard surface (or at the end of a runway if there is no prepared hard surface). The elevation of the primary surface is the same elevation as the nearest point on the runway centerline and has a width based upon the designation of the runway and type of the approach. Since Runway 18/36 is not considered to be a utility runway and has a precision approach (Runways 18 and 36), the width of its primary surface is 1,000 feet while the length extends 200 feet beyond each end of paved surface of the runway. Runway 9/27 is a non-utility runway with non-precision approaches and visibility minimums as low as ¾ mile so it has a primary surface with a width of 1,000 feet extending 200 feet beyond each end of the pavement. Runway 13/31 is an "other than utility" visual runway, so the primary surface, which extends 200 feet past the end of the pavement, is 500 feet wide.

Approach Surface – The approach surface is centered longitudinally on the extended runway centerline and extends outward and upward from each end of the primary surface. The dimensions of the approach surface at each end of a runway is based upon the type of approach available or planned for that runway end. The inner width of the approach surface is the same width as the primary surface and expands uniformly to a width of:

- ✓ 1,250 feet for utility runways with only visual approaches;
- ✓ 1,500 feet for runways other than utility with only visual approaches;
- ✓ 2,000 feet for utility runways with non-precision instrument approaches;
- ✓ 3,500 feet for non-precision instrument runways other than utility having visibility minimums greater than ¾ statue mile;
- ✓ 4,000 feet for non-precision instrument runways other than utility having a non-precision instrument approach with visibility minimums as low as ¾ statue mile; and
- ✓ 16,000 feet for precision instrument runways.

In addition, the approach surface extends horizontally to a distance of:

- ✓ 5,000 feet at a slope of 20:1 for all utility and visual runways;
- ✓ 10,000 feet at a slope of 34:1 for all non-precision instrument runways other than utility; and
- ✓ 10,000 feet at a slope of 50:1 with an additional 40,000 feet at a slope of 40:1 for all precision instrument runways.

Table 3-17 lists the dimensions of the approach surfaces at either end of Runway 18/36, Runway 9/27, and Runway 13/31.

Table 3-14: Runway Approach Surfaces Dimensions

Dimensions	Runway 18/36	Runway 9/27	Runway 13/31
Inner Width	1,000 feet	1,000 feet	500’
Outer Width	16,000 feet	4,000 feet	1,500’
Horizontal Distance	50,000 feet	10,000 feet	5,000’
Slope	50:1 first 10,000 feet; 40:1 for remaining 40,000 feet	34:1	20:1

Source: FAR Part 77

Transitional Surface – The transitional surface extends outward and upward at right angles to the extended runway centerline at a slope of 7:1 from the sides of the primary and approach surfaces. Those portions of the transitional surface adjacent to precision approach surfaces which project through and beyond the limits of the conical surface extend to a distance of 5,000 feet measured horizontally from the edge of the approach surface and at right angles to the runway centerline.

Horizontal Surface – The horizontal surface is a plane 150 feet above the elevation of an airport whose perimeter is constructed by swinging arcs of specified radii from the center of each end of the primary surface for each runway at an airport and connecting the adjacent arcs by lines of tangent. The radius of each arch is:

- ✓ 5,000 feet for all runways designated as utility or visual;
- ✓ 10,000 feet for all other runways.

Runway 18/36 and Runway 9/27 are not designated as utility or visual; as such, the radii of the arc found at each end of the runways is 10,000 feet. Runway 13/31 is designated as visual, so the radii of the arc found at each is 5,000 feet.

Conical Surface – The conical surface extends outward and upward from the periphery of the horizontal surface at a slope of 20:1 for a horizontal distance of 4,000 feet.

Objects that penetrate the FAR Part 77 surfaces are potential hazards to air navigation unless determined otherwise by an aeronautical study conducted by the FAA. It should be noted that aeronautical studies only determine if an object is a hazard to air navigation and does not give the FAA specific authorization to limit the height of objects that may be identified as hazards to air navigation. As such, it is the responsibility of an airport to work with state or local governmental jurisdictions to control objects that may penetrate FAR Part 77 surfaces. Objects that are identified as hazards to air navigation should be removed (or pruned in the case of vegetation) or illuminated with an obstruction light if the objects cannot be removed or are fixed by function.

3.5 Taxiway System

The design standards of a taxiway are based on the combination of the TDG and ADG classification of the critical design aircraft intended to operate on the surface. The TDG classification of the critical design aircraft determines the width of a taxiway while the ADG classification of the critical design aircraft determines the width of the taxiway safety area and taxiway object free area. Like runways, taxiways are designed with these three components to limit damage to an aircraft in the event of an unintended excursion from the taxiway surface and protect aircraft from obstructions within proximity to the taxiway surface. It should be noted that the design standards of a taxiway system can vary by individual taxiway depending on the purpose of the taxiway and the fleet mix of aircraft intended to operate on the surface.

While many connector taxiways comprise the taxiway system at the Airport, it is most critical that a review is conducted of the design standards associated with Taxiways A, B, and C since they parallel Runway 18/36 and 9/27 and provide access to the runways for all types of aircraft that operate at the Airport. Table 3-18 lists the dimensions of the design surfaces associated with these taxiways. Currently, the width of the taxiways meets design standards for TDG aircraft while the width of the taxiway safety area and taxiway object free area meets ADG design standards, which are classifications of the most demanding type of aircraft anticipated to conduct regular operations at the Airport throughout the planning period.

Table 3-15: Parallel Taxiway Design Surfaces Dimensions

Item	Taxiway A	Taxiway B	Taxiway C
Taxiway Design Group (TDG)	TDG-5	TDG-3	TDG-3
Existing Pavement Width	75 feet	75 feet	50-75 feet
Taxiway Safety Area Width	214 feet	118 feet	118 feet
Taxiway Object Free Area Width	320 feet	186 feet	186 feet

Source: FAA AC 150/5300-13A, *Airport Design*

It is important to note that the increased width of Taxiway A allows the Airport to use the taxiway as a runway in the event of a Runway 18/36 closure. As noted in the projections chapter, operations by TDG-5 and 6/ADG VI and V aircraft such as the Boeing 747 series and Boeing 757 are anticipated to increase throughout the planning period as these types are frequently used by cargo and charter operators amongst others. Hector International Airport is unique in the fact that it currently has the facilities to allow operation of these larger aircraft in this area of the country. Respective of this capability, it is recommended that TDG-5 be maintained for at least parts of the airfield so that these types of aircraft can safely taxi at the airport, as was shown on Figure 3-2.

Improvements to the geometry of the taxiway, taxiway safety area, and taxiway object free area are not needed for Taxiways A, B, and C to meet the design standards for their respective ADG aircraft, however, improvements to the intersection fillets to meet design standards identified in FAA AC 150/5300-13A, Airport Design, will be required as pavements are replaced during the planning period. Connector Taxiways D, E, F, G, H, and J all conform to current FAA design standards and will also require fillet updates as pavement is replaced in the future.

Like runways, taxiways have longitudinal grade requirements based upon the AAC of the critical design aircraft type intended to operate on the surface. According to FAA AC 150/5300-13A, Airport Design, the maximum longitudinal grade is two percent for taxiways designed for Aircraft Approach Category A and B aircraft and 1.5 percent for taxiways designed for Aircraft Approach Categories C, D, and E. Fortunately for the Airport, the terrain makes this a non-issue for pavements at Hector International. All taxiway grades fall well below the percent required by their affiliated approach categories.

FAA AC 150/5300-13A, Airport Design, recommends that connecting taxiways from aprons not have direct access to a runway to reduce the potential for an aircraft to taxi from an apron directly onto a runway to reduce runway incursions. It may be beneficial to relocate the Taxiway C2 connector to the runway so that there is not direct apron access to the runway without a distinctive turn from Taxiway C to the runway. During reconstruction of the South GA Apron, it is recommended that the Airport look at solutions to redesign the “hot spot” intersection of Taxiway D, Taxiway G, and Runway 13/31. This would also satisfy the FAA requirements set forth in this paragraph.

3.6 Aprons

The function of an apron is to accommodate aircraft during the loading and unloading of passengers and/or cargo as well as to support fueling, maintenance, and parking activities. The size and layout of an apron is dependent upon many factors including purpose of the apron, number of aircraft parking positions, size and type of aircraft intended to use the surface, movement patterns of aircraft and ground service vehicles, and locations of support facilities such as hangars and terminal buildings. In addition, aprons should also be designed to accommodate demand during peak periods of operation. Considering these factors, an analysis was conducted to determine the amount of apron space that will be needed to accommodate demand throughout the planning period.

Guidance established in FAA AC 150/5300-13A, Airport Design, was used to evaluate the demand for apron space at the Airport based on the total amount of space that is needed on the busiest day of operation. The total number of itinerant general aviation aircraft operations in 2014 was obtained from the FAA's Air Traffic Activity Data System (ATADS) as well as the projected annual number of itinerant general aviation aircraft operations that can be anticipated at the Airport throughout the planning period. The percent of total operations in the peak month (July - 9.4 percent) was then multiplied by these annual counts to determine the total number of operations in the peak month. This number was then multiplied by 31 to determine the average number of daily operations in the peak month. On peak days, the existing North GA apron is nearly at 100 percent capacity to meet existing demand. An apron demand per aircraft square footage can be calculated to determine the amount of additional apron area that will be needed to meet future demand as presented in Table 3-20.

Table 3-16: Projected Itinerant Aircraft Apron Demand

Criteria	2014	2018	2023	2028	2033
Annual GA itinerant operations	23,356	25,222	27,757	30,480	33,429
Percentage of Total Ops in Peak Month	9.40%	9.40%	9.40%	9.40%	9.40%
Peak Month Operations	2,195	2,371	2,609	2,865	3,142
Peak month average day operations *(peak month operations divided by 31)*	71	76	84	92	101
Existing apron area (sq ft)	409,500	409,500	409,500	409,500	409,500
Itinerant apron demand per aircraft (sq ft)	5,625	5,625	5,625	5,625	5,625
Total itinerant apron demand (sq ft)	398,370	430,198	473,436	519,881	570,180
Apron Surplus (+) / Deficiency (-)	11,130	-20,698	-63,936	-110,381	-160,680

Source: Mead & Hunt, Inc. (2015)

As illustrated in the table, the demand for apron space is anticipated to grow throughout the planning period from an additional 20,698 square feet of apron area needed in 2018 to an additional 160,680 square feet of apron area in 2033. Therefore, it is recommended that apron areas be expanded at the Airport to accommodate the increase in demand that is projected for the planning period.

Like runways and taxiways, aprons have surface gradient design standards as identified in FAA AC 150/5300-13A, Airport Design, to ease aircraft towing and taxiing while promoting positive drainage. Gradient design standards are based upon the Aircraft Approach Category of the most demanding type of aircraft intended to operate on the surface. For Aircraft Approach Categories A and B, the maximum allowable grade in any direction is two percent while the maximum allowable grade for Aircraft Approach Categories C, D, and E is one percent. The general aviation apron is designed for Aircraft Approach Categories A through C and has a maximum grade of 0.5 percent, which is well below the two percent design standard. As such, it is not required that the Airport make any grade changes to the general aviation apron during the design of the pavement surface's next major rehabilitation project.

3.7 Navigational Aids and Weather Equipment

Visual and electronic guidance for pilots on approach to land and during takeoff are provided by Navigational Aids (NAVAIDs) that are located either physically on an airfield, from other nearby ground based electronic equipment, or from orbiting satellites. Several factors such as the type and volume of aviation activity, local meteorological conditions, and established instrument approach procedures dictate the types of NAVAIDs that should be installed at an Airport. Several FAA documents such as AC 150/5300-13A, Airport Design; FAA Order 7031.2C, Airway Planning Standard Number One – Terminal Air Navigation Facilities and Air Traffic Control Services; FAR Part 139, Certification of Airports, and the Aeronautical Information Manual (AIM) offer guidance on the type of visual and electronic NAVAIDs that should be present at an Airport. A review of the visual and electronic NAVAID equipment documented during the inventory effort of the planning process was conducted to determine if any improvements to existing equipment or installation of additional NAVAID equipment will be necessary to meet the projected demand. NAVAIDs are discussed in this section by two categorizations: Visual NAVAIDs and electronic NAVAIDs.

In addition, this section will also review the weather equipment that is installed at the Airport, which also provides important information to pilots that can factor into navigation procedures such as wind direction, wind speed, visibility, cloud ceiling height, and local atmospheric conditions such as rain and snow. This review, which is presented at the end of the section, will focus on whether any upgrades or relocation of the equipment is necessary to improve the accuracy of weather condition reporting at the Airport.

3.7.1 Visual Navigational Aids

Navigational devices that require visual recognition by a pilot are visual NAVAIDs and includes devices such as approach lighting, windsocks, and signage. Visual NAVAIDs are most beneficial in assisting a pilot to visually located a runway and complete the transition from flight to touchdown on a runway. It should be noted that visual NAVAIDs often compliment electronic NAVAIDs and may be required in certain circumstances to fulfill the installment of the electronic NAVAID. The following summarizes the review that was conducted of each visual NAVAID and discusses any improvements that may be necessary for the device to continue to provide accurate navigational information to pilots.

Rotating Beacon – The rotating beacon at the Airport is located on the top of a tower in the southeast corner of the airfield, adjacent to the South GA ramp, and is utilized to identify the location of the Airport to pilots in the air. Illumination of the rotating beacon at night indicates that the Airport is open while illumination during the day indicates the cloud ceiling is below 1,000 feet and/or the visibility is less than three miles. The angle of the light should be positioned as such that on- and off- airport structures and surrounding terrain do not block the light when viewed from the air. Currently, there are no obstructions or surrounding terrain that obstruct viewing of the light beam; however, an improvement to visibility could be achieved by moving the beacon to a darker portion of the airfield, such as the northeast corner.

Wind Indicators – Also known as wind cones, wind indicators are devices that provide surface wind direction and velocity information to pilots. FAR Part 139 directs that a wind indicator be installed at each end of an air carrier runway or at least at a point visible to the pilot on final approach and prior to takeoff. Wind indicators are also required to be illuminated if an airport is open for air carrier operations at night. At the Airport, there are nine wind indicators, one located near each approach end of Runways 18, 9, 27, 13, and 31, all of which are lighted except for the one near the 13 end. Two more windcones are located near the Runway 36 end, a lighted one south of 13/31 and another unlighted one on the north side. The last two windcones are as follows: an unlighted one located near the B-3 Taxiway near the South GA Apron and a lighted one adjacent to the Terminal Taxiway east of the terminal building. No improvements are recommended to the wind indicators other than routine inspections and replacement of worn or faded fabric.

MALSR – The Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR) is a series of light bars located at the threshold of a runway used in assisting pilots confirm the centerline of a runway during landing. At the Airport, a MALSR is located at the approach end of Runways 18 and 36, and meets siting standards set forth by FAA Order JO 6850.2B, Visual Guidance Lighting Systems; as such, improvements to the MALSRs on these ends are not necessary. An approach lighting system such as a MALSR is required for approach visibility minimums below 3/4 mile. As such, it may be beneficial for the Airport to evaluate options for a MALSR or MALSF for the Runway 9 and 27 ends in the future.

Precision Approach Path Indicators – Precision Approach Path Indicators (PAPIs) provide the correct glide slope path for an aircraft on landing to a runway through a series of red and white lights arranged in a single row consisting of either two- or four-light units. A combination of red and white, all red, or all white lights identifies if a pilot is on the glide slope, below the glide slope, or above the glide slope, respectively. A four-light PAPI is located at the approach ends of Runway 18/36 and Runway 9/27, and a two-light PAPI near the ends of Runway 13/31, installed to the siting standards identified in FAA Order JO 6850.2B, Visual Guidance Lighting Systems; as such, improvements to the PAPI units are not necessary.

Runway Edge Lighting – Runway 18/36 is equipped with a high intensity runway lighting (HIRL) system which offers five illumination intensity settings and the ability for pilots to request changes to the intensity of the lights through communications with the air traffic control tower. It should also be noted that HIRL systems are required on runways that have a Category I, Category II, or Category III instrument approach such as the Category I approaches to Runways 18 and 36. The other two runways have MIRL systems which also satisfy design criteria.

Airfield Pavement Markings – Airfield pavement markings applied to runways, taxiways, and apron surfaces provide visual and perceptual navigational cues to pilots and ground vehicle operators when navigating an airfield surface. Examples of pavement markings include those identifying the aiming point, touchdown zone, and designation of a runway, the boundary of a runway and its associated safety area, and the boundary of the movement area where communication with air traffic control is necessary. Runways that support precision instrument approaches are required to include a landing designator marking, centerline, threshold markings, aiming point marking, touchdown zone markings, and side stripes. Runway 18/36 meets these precision marking requirements; only routine maintenance is anticipated throughout the planning period to maintain the reflectivity and visibility standards so that they can be easily identified in reduced visibility and nighttime conditions. Runway 9/27 has non-precision instrument markings, and Runway 13/31 has visual runway markings.

Airfield Signage – Airfield signage complements pavement markings by providing locational and directional information to pilots and ground vehicle operators maneuvering on an airfield. Signage found on an airfield includes runway hold position signs, runway distance remaining signs, taxiway locations, taxiway directional signs, and destination location signs. A review of existing airfield signage found that all airfield signs meet standards set forth in FAA AC 150/5340-18F, Standards for Airport Sign Systems; as such, only routine inspections and maintenance to ensure signs continue meet reflectivity and visibility standards are anticipated throughout the planning period.

Taxiway Edge Lighting – Taxiway edge lighting is an important navigational tool for pilots and ground vehicle operators as it delineates the edge of a taxiway surface when visibility conditions are limited such as during the night and in inclement weather. Airports that support commercial airline service are recommended to have medium intensity taxiway lighting (MITL) systems since three illumination intensities are offered. Since the entire airfield is equipped with a MITL system, no improvements to taxiway edge lighting are anticipated throughout the planning period; it should be noted, however, that the Airport is currently working on upgrading its taxiway lighting to more energy efficient light-emitting diode (LED) fixtures which help reduce energy usage resulting in decreased airfield operating expenses. This is on a project by project basis and is not economical in all situations, but roughly 2/3 of the airfield is now LED.

3.7.2 Electronic Navigational Aids

Electronic NAVAIDs are those navigational devices that transmit a signal to be received by properly equipped aircraft so that a pilot can conduct a landing when visibility is impacted such as during inclement weather, low cloud ceilings, and in nighttime conditions. Electronic NAVAIDs range from signal transmitting devices installed at an Airport to off-airport electronic equipment and orbiting satellites in space. The following section reviews the existing electronic NAVAIDs at the Airport, identifies if they are adequate to meet anticipated demand, and lists actions that should be considered to improve the electronic-based navigational capabilities of the Airport.

Instrument Landing System – An instrument landing system (ILS) is comprised of two components: a localizer and a glide slope antenna. The localizer is an antenna placed at the departure end of a runway that transmits a signal to align aircraft with the centerline of a runway when on approach to land. The glide slope antenna is positioned near the aiming point marking at the approach end of a runway and provides vertical guidance to aircraft to align them with the correct landing decent path. Instrument Landing Systems permit properly equipped aircraft with certified pilots to conduct precision instrument approaches during periods of limited visibility.

The type of precision instrument approach offered by an ILS is categorized based on the minimum cloud ceiling height and visibility requirement that is necessary for a pilot to fly the approach, with Category III approaches offering lower decision heights and visibility requirements than Category I approaches. Currently, the Airport is equipped with a Category I ILS approach to Runways 18 and 36 that offer a minimum cloud ceiling height (also known as decision height) of 200 feet and a minimum visibility requirement of a ½ mile for a pilot to conduct an instrument approach for landing. While other categories of ILS are available that offer lower decision heights and visibility requirements, it appears the Category I approach is adequate to meet existing and projected demand.

It should be noted that Runway 9/27 is not equipped with an ILS or a vertically-guided instrument approach. This is important to consider given that during IFR conditions, Runway 9 provides greater wind coverage at a 10.5 knot crosswind than Runway 18 (50.41 percent to 44.77 percent, respectively). As such, there is some basis for a precision instrument approach to Runway 9. Currently, the FAA is moving away from ground based instrumentation to provide precision instrument approaches in support of satellite based “NextGen” air traffic control and navigation initiatives. Due to this transformation of air traffic control and aircraft navigation, legacy systems such as ILSs are not being installed at airports to provide a precision instrument approach to a runway. However, for an airport to receive satellite-based precision instrument approach minimums, other infrastructure components such as an approach lighting system will still be required. Therefore, it is recommended that the Airport consider installation of an approach lighting system such a MALSR to Runway 9 so that when NextGen initiatives are fully implemented, the runway will be properly equipped to receive approach minimums as low as a Category I ILS. Installation of an approach light system would provide approach minimums below ¾ mile in combination with the current LPV GPS approach, therefore the design surfaces associated with Runway 9 would change to match those of Runway 18/36 as described in the RSA, ROFA, ROFZ, RPZ, and FAR Part 77 sections.

Global Positioning System – Currently, the Airport has four satellite based instrument approach procedures that offer localizer performance with vertical guidance (LPV) to Runways 18, 36, 9, and 27. These approaches each offer properly equipped aircraft and trained pilots the ability to conduct a Global Positioning System (GPS) based approach when the visibility is at its lowest. While the GPS approaches to Runway 18/36 appears adequate to meet the demands of users throughout the planning period, it is recommended an improved GPS based instrument approach offering a visibility minimum of a 1/2 mile and a cloud ceiling minimum of 200 feet be developed for Runway 9 to match the GPS instrument approach capabilities of Runway 18/36; as previously discussed, this would require the installation of an approach lighting system such as a MALSR.

Very High Frequency Omni-Directional Radio Range Antenna – The Very High Frequency Omni-Directional Radio Range antenna, also known as a VOR, is a ground based NAVAID that emits radio signals so that a pilot can determine his or her course and position in relation to the distance from the VOR. While a VOR is not located on Airport property, a VOR is installed approximately 10.1 miles to the southwest of the Airport and is used in navigating a non-precision instrument approach to the Airport. VORs do not offer the accuracy of GPS and the FAA is currently evaluating the necessity, benefits, and costs of these NAVAIDs throughout the National Airspace System (NAS). Many VORs are being decommissioned under an FAA infrastructure reduction. Fargo's system was considered in 2014-2015, but operations and types of users justified keeping it active.

Automated Weather Observation Systems – The Automated Surface Observing System (ASOS) at the Airport is a unit located near the glide slope antenna at the approach end of Runway 36 that measures and transmits local weather conditions at the Airport such as temperature, dew point, altimeter, wind speed, wind direction, visibility, cloud ceiling height, and type of precipitation intensity. It is important that an airport installs weather reporting equipment that is appropriate for the operational needs and atmospheric characteristics of the surrounding environment as well as at a site that accurately reports conditions. The existing ASOS unit installed at the Airport meets the accuracy of weather reporting required for aircraft to conduct Category I precision instrument approaches and does not need to be replaced with a system offering increased weather reporting accuracy to meet the demands of users.

Runway Visual Range (RVR) is an instrumentally derived value reported in feet that represents the horizontal distance a pilot will see down the runway from the approach end. RVR equipment is often most beneficial for runways with a precision instrument approach as it provides more accurate visibility measurements to increase the utilization and throughput capacity of a runway. RVR equipment is also a beneficial safety tool for pilots when deciding to conduct a takeoff of landing in low visibility conditions. Currently, RVR equipment is not installed at the Airport. As such, the installation of this equipment would help to increase the accuracy of visibility measurements during low visibility conditions. Consideration should be given for the installation of an RVR if more accurate visibility reporting is desired at the Airport.

As a part of evaluating the adequacy of the Airport's ASOS unit, it is also important to consider whether the location of the ASOS meets siting criteria identified in FAA Order 6560.20B, Siting Criteria for Automated Weather Observing Systems (AWOS). This FAA order offers guidance on siting weather observing equipment so that sensors and instrumentation are not influenced by artificial conditions such as large structures, cooling towers, and expanses of concrete and tarmac. While each sensor (wind, temperature, cloud ceiling, etc.) has specific siting requirements, all ASOS sensors should be located together and outside of runway and taxiway OFAs. Generally, ASOS units should be placed between 1,000 and 3,000 feet longitudinal distance from the primary runway threshold and between 500 and 1,000 feet from the runway centerline. The ASOS unit at the Airport is located approximately 3,000 feet of longitudinal distance from the threshold of Runway 18 and is located approximately 1,000 feet from the centerline of the runway east of Taxiway B, and as such, complies with FAA Order 6560.20B, Siting Criteria for Automated Weather Observing Systems (AWOS).

The Airport is also home to a supplemental Stand Alone Weather Sensor (SAWS) system that provides wind speed, direction, and gust data, as well as ambient temperature, dew point, and altimeter readings. The SAWS serves as a backup system for the existing ASOS.

3.8 Terminal Area

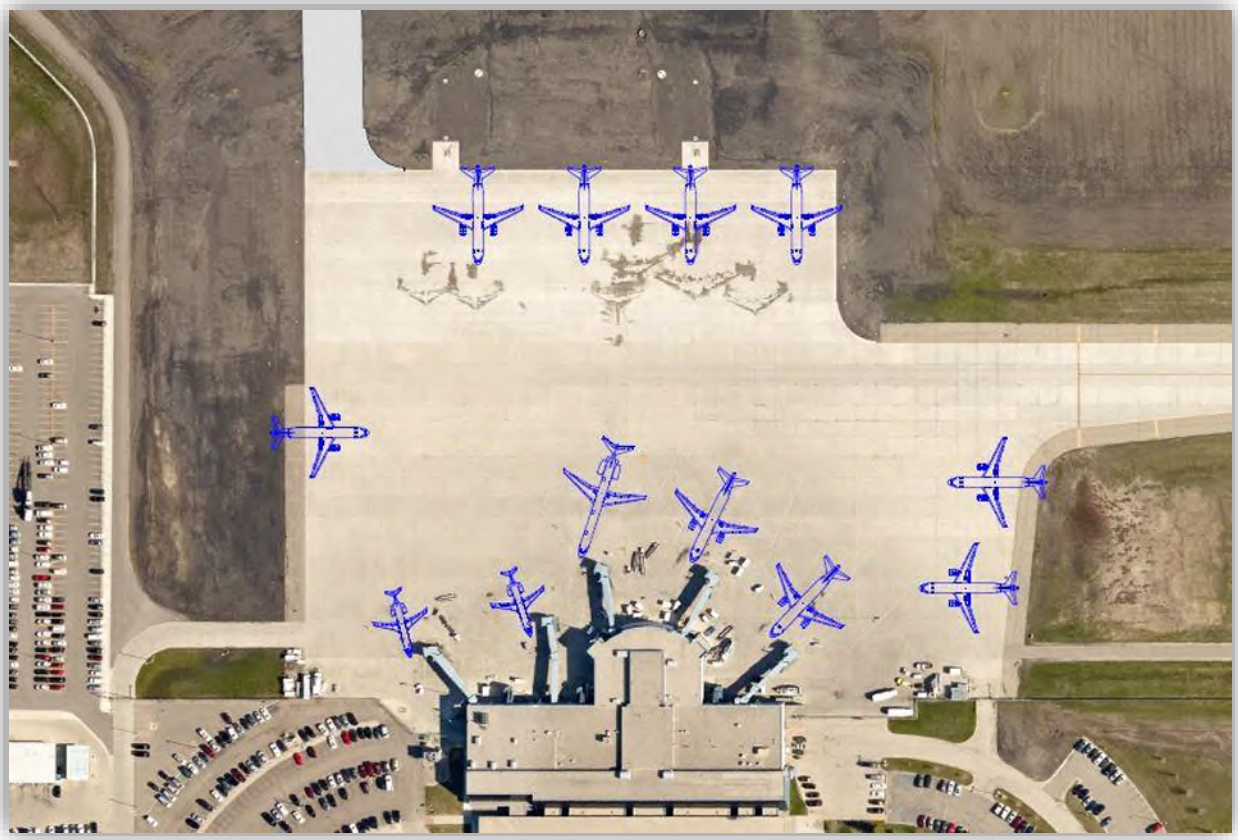
In addition to airside elements, a review of the facility needs in the terminal area was also conducted as a part of this master plan study. Terminal area elements that were assessed include the terminal gates and apron, terminal building, landside vehicular access, and vehicle parking. For the purposes of this master plan, the terminal area review is organized in the following four elements:

3.8.1 Terminal Apron & Gate Requirements
3.8.2 Landside Access
3.8.3 Vehicle Parking Requirements

3.8.1 Terminal Apron & Gate Requirements

The number of gates needed to support forecasted activity is a critical element in determining the overall size and configuration of the terminal complex. A gate is defined as an aircraft parking position near the terminal that is used daily for the loading and unloading of passengers. The Airport currently has five gate positions, each served with a passenger boarding bridge. There are also seven additional aircraft parking positions around the perimeter of the apron, which includes a recent apron expansion area, to accommodate deice operations and parking of aircraft near the terminal building. **Figure 3-5** depicts the passenger terminal building and aircraft parking apron.

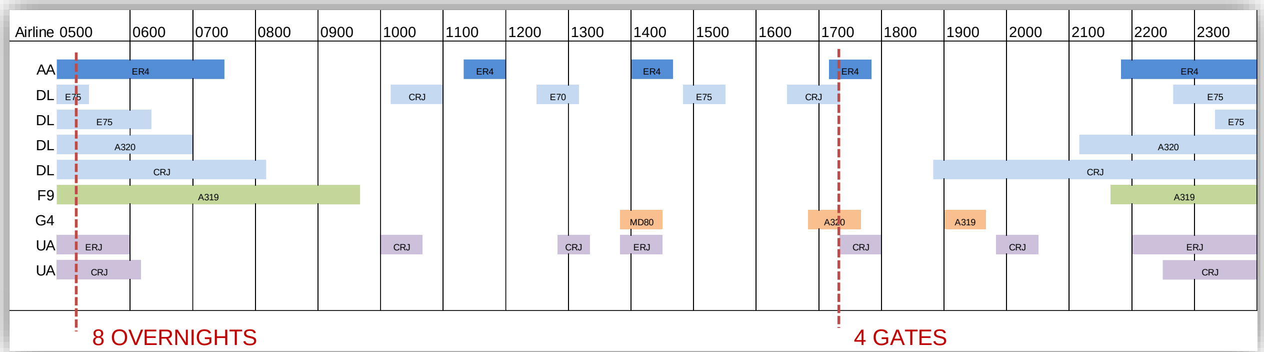
Figure 3-8: Terminal Apron



Source: Mead & Hunt

Terminal Apron - The size of the terminal apron should be able to accommodate the fleet mix of commercial aircraft types present during periods where the demand for space is at its greatest. **Figure 3-6** depicts the airline schedule of the peak month (March 2014) as a ramp chart by carrier. This ramp chart shows a bar for the arrival and departure time of each passenger aircraft at the Airport indicating when a gate or parking position at the terminal is occupied.

Figure 3-9: Air Carrier Ramp Chart



Source: Diio Mi Airlines Schedules

The greatest demand for terminal gate and apron space occurs during the overnight period when aircraft from the final arriving flights of the day are parked and staged for departure the following morning, also known as remain overnight aircraft or RON. RON aircraft parking during the peak month of March are presented in the air carrier ramp chart. As shown, airlines schedules include eight overnight aircraft. It should also be noted that the Airport experiences variations in airline flight schedules which alter the air carrier ramp chart and overnight parking demands. The Airport also experiences occasional RON charter flights that are not included in the ramp chart of scheduled passenger activity.

The forecasted demand for RON aircraft parking on the terminal apron through 2033 is presented in **Table 3-21**. It is assumed that the total number of typical daily departures is directly proportional to the total number of annual scheduled passenger aircraft departures. Using the demand for RON aircraft parking on a typical Wednesday in the peak month of March 2014 as a benchmark, the projected demand for RON aircraft parking by aircraft type was extrapolated from the projected typical daily departures.

Table 3-17: Projected Overnight Aircraft Parking Demand

	Current	Projected			
Year	**2014**	**2018**	**2023**	**2028**	**2033**
Annual Enplanements:	448,848	454,060	505,606	561,097	621,853
Total Annual Scheduled Passenger Aircraft Departures:	7,397	7,299	7,668	8,006	8,592
Peak Month Typical Day (PMTD) Departures:	24	24	25	26	28
Overnight Aircraft Parking Demand:	**8**	**7.9**	**8.3**	**8.7**	**9.3**
Percent of Total Average Daily Depatures:	*33.3%*	*33.3%*	*33.3%*	*33.3%*	*33.3%*

Source: Diio Mi Airline Schedules, Mead & Hunt, Inc. (2014)

As illustrated in the table above, the total number of daily flights is anticipated to increase through the planning period. Likewise, the table also indicates that number of overnight aircraft are also anticipated to increase through the planning period. Therefore, it is anticipated that daily RON aircraft in 2033 will increase to 9.3 or approximately 10 aircraft. Additionally, it is desirable for the terminal apron to be sized to accommodate at least one or two additional aircraft beyond those projected to accommodate late arriving or departing flights, changes in airline flight schedules, charter activity, a new entrant service carrier, or aircraft diversions from other airports due to weather. Therefore, through the planning period the Airport should plan to accommodate at least 11 to 12 aircraft parking positions for RON aircraft.

Terminal Gates – In addition to RON aircraft parking, terminal gate demand during peak activity hours was also evaluated. As noted previously, there are currently five gate positions. As was shown on the airline ramp chart, the peak gate demand outside of RON aircraft parking occurs around 17:20 (5:20 p.m.) when there are four gates used simultaneously. However, it should be noted Delta only has one gate occupied during this period, but during other times of the year they have had two gates occupied simultaneously around this time of the day. Also, unscheduled charter flights, also occasionally occur requiring gate facilities. Therefore, the five gates that the airport has appears about right for current airline and passenger demand.

To determine the required number of peak hour gates, Table 3-22 illustrates the methodologies used to forecast peak hour (PH) gate demands. The first methodology evaluates the percentage of peak month typical day (PMTD) activity occurring in the peak hour. This was found to be 20.8%, maintaining this 20.8% percent indicates that 5.7 (rounded up to 6) gates will be required to accommodate the projected 621,853 enplanements. Methodology 2 examines the number of annual enplanements per gate. In 2014 it is estimated that the airport will accommodate 89,770 enplanements per gate, assuming a similar level of passenger activity per gate in the future, this methodology estimates that 6.9 (rounded up to 7 gates) will be required to accommodate the projected 621,853 enplanements through the planning period.

Table 3-18: Projected Aircraft Gate Demand

	Current	Projected			
Year	**2014**	**2018**	**2023**	**2028**	**2033**
Annual Enplanements:	448,848	454,060	505,606	561,097	621,853
Total Annual Scheduled Passenger Aircraft Departures:	7,542	7,299	7,668	8,006	8,592
Peak Month Typical Day (PMTD) Departures:	24	23	24	25	27
Methodology 1 - Peak Hour Percentage					
Peak Hour Gate Demand:	**5**	**4.8**	**5.1**	**5.3**	**5.7**
Percent of Total Average Daily Departures in PH:	*20.8%*	*20.8%*	*20.8%*	*20.8%*	*20.8%*
Annual Enplanements per Gate:	89,770	93,830	99,455	105,719	109,170
Methodology 2 - Enplanements per Gate					
Peak Hour Gate Demand:	**5**	**5.1**	**5.6**	**6.3**	**6.9**
Percent of Total Average Daily Departures in PH:	*20.8%*	*21.8%*	*23.1%*	*24.5%*	*25.3%*
Annual Enplanements per Gate:	89,770	89,770	89,770	89,770	89,770

Source: Diio Mi Airline Schedules, Mead & Hunt, Inc. (2014)

As illustrated in the table, the peak gate demand is anticipated to increase through the planning period. Since airline schedules are constantly changing, it is recommended that planning be included for at least one or two additional gates beyond the projected demand, to accommodate changes in airline flight schedules, late arriving or departing flights, charter activity, a new entrant service carrier, and aircraft diversions from other airports for weather or other reasons. Also, the passenger enplanement projections had a methodology that projected significantly more passengers than the selected methodology. Having a plan for additional gates and protecting additional space within the terminal area for additional gates is recommended to protect for future growth beyond the planning period or in case passenger enplanements exceed the selected methodology.

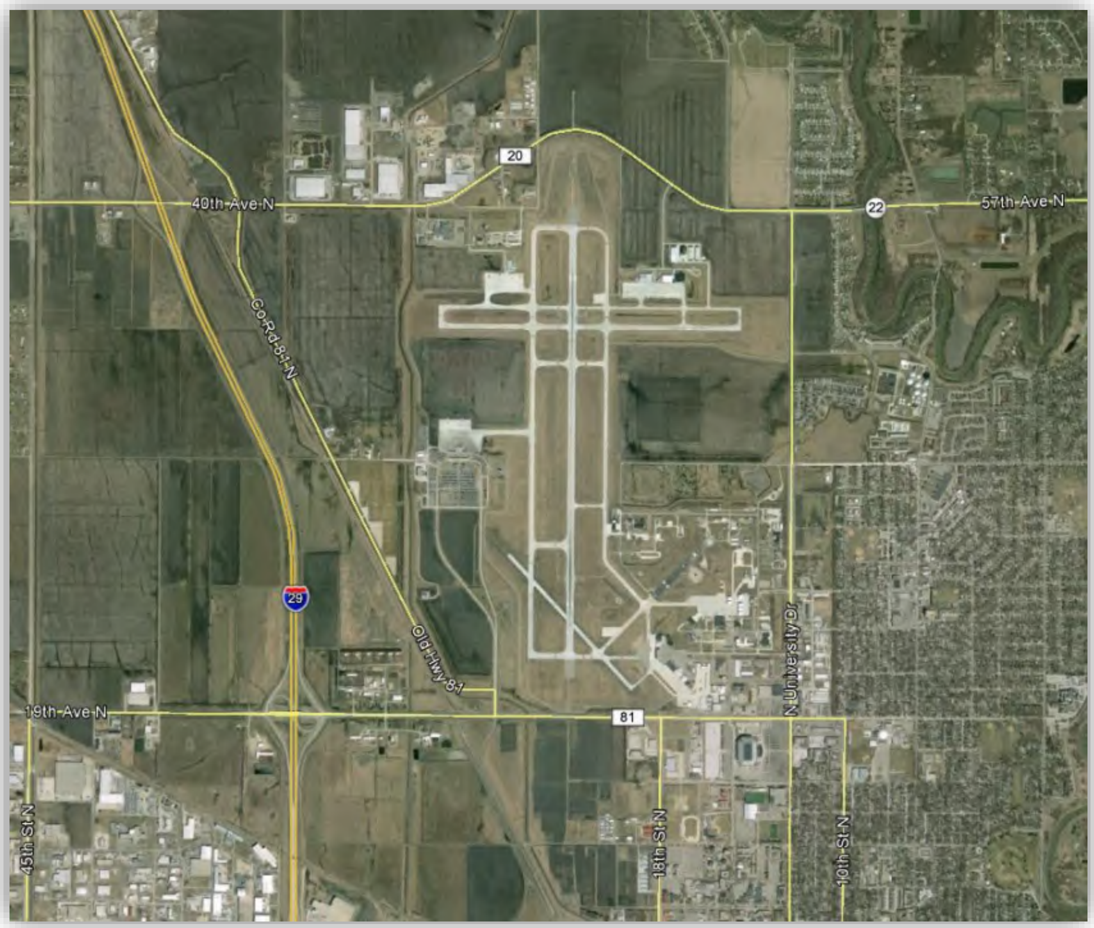
Therefore, for terminal and space planning purposes, it is projected that the airport will have a need for six or seven gates through the planning period, and should protect space for future expansion to eight or nine gates. The existing terminal has five gate parking positions and hold rooms, indicating that planning should occur for at least two additional gates and hold rooms, and space protected for four additional gates.

3.8.2 Landside Access

Landside vehicular access to the Airport was also reviewed as a part of the master planning study. In addition to on-Airport roadways and traffic circulation, access to the Airport from major regional traffic arteries was also evaluated to determine if roadway infrastructure appear adequate.

Off-Airport Access - Overall, the Airport is well situated near Interstate 29 and its interchange with 19th Ave. As illustrated in Figure 3-8, the Airport terminal entrance road, Dakota Drive, is approximately 0.5 miles east this interchange, and 19th Ave serves as the primary arterial access to the commercial terminal area. It appears no highway infrastructure improvements in the region are needed for the community to more efficiently access the Airport.

Figure 3-10: Landside Roadways in Proximity to the Airport



Source: Google Earth (2015)

On-Airport Access - The existing network of on-Airport roadways appears sufficient in providing adequate access to destinations on the airfield. Access to the Airport Terminal is provided from Dakota Drive north from 19th Avenue and from Old Highway 81 via County Road 20. It should be noted that another access road is located on the west side of the Airport via 32nd Avenue North from Old Highway 81. Access to this perimeter road is gated and is not available for public use; instead, it is intended for Airport and emergency vehicles to access locations on the north side of the airfield. Access to the north air cargo facilities is gained via 31st Street North. This road is gated at the ramp, but is accessible by airport operations staff and those with business in that area. The North GA area is accessible by 20th Street North. This gives access to private and public hangar areas, as well as Fargo Jet Center's facility. The ANG Base is accessed from 32nd Avenue North, and is secured to keep out all but ANG staff and approved visitors. The facilities of the South GA and the East Terminal area are accessed via 23rd Avenue. Service roads to the radar, localizer, NAVAIDs and MALSR lighting systems are not available for public use.

3.8.3 Terminal Area Vehicle Parking Requirements

An evaluation of vehicle parking at the Airport to assess the needs for adequate, convenient parking throughout the planning period as enplanements and facilities grow. In addition, an evaluation of employee parking and rental car ready/return parking needs was conducted to determine if future expansion of these lots will be necessary. The basis of these analyses involved benchmarking past and current relationships between parking demand and originating enplanements to project future parking demand based on anticipated levels of enplanements.

Parking Capacity – There are currently 2,024 spaces available for public parking generally south of the commercial airline terminal building and used for daily (1,460 spaces), economy (324 spaces), and hourly (240 spaces) parking. Other parking lots supporting activities of the terminal building include the employee lots (158 spaces) to the east (north and west of the ATCT) and the rental car lots (493 spaces) located on the west side of the terminal building. **Table 3-26** summarizes the current parking capacity at the Airport.

Table 3-19: Terminal Area Parking Supply

Parking Lot	Spaces
Public Parking	
Daily	1,460
Economy	324
Hourly	240
Subtotal Public Parking	2,024
Employee Parking	
East Lot	158
Rental Car Parking	
Ready/Return - West Lot	155
Storage & Staging	338
Subtotal Rental Cars	493
Terminal Area - Airport Total	2,675

Source: Municipal Airport Authority records (2014)

Public Parking Demand – Parking demand at an airport is normally expressed as a ratio of spaces required per 1,000 annual originating enplanements. Like most systems, a parking system runs most efficiently when it is at 85 percent to 95 percent capacity. The allowance of 5 percent to 15 percent of spaces allows for the dynamics of cars moving into and out of spaces, reduces search time for a space, and allows for a temporary loss of spaces due to parking lot maintenance activities, snow cover, or unforeseen circumstances. Ideally, this cushion can also accommodate parking on days which are busier than the average or typical day. On extremely busy days, the capacity of the parking lot should be capable of meeting demand, but the cushion will be limited, and parking space search times could be greater. Therefore, this parking analysis analyzes the peak parking days, so that the system can accommodate the peak parking needs, which then provides an allowance of 5 to 15 percent for average days.

Overnight parking counts are provided to Hector International Airport by their parking operator. This data was reviewed to determine peak occupancy data. December 26th had the peak occupancy in 2014 with 1,411 of the 1,460 Daily Lot spaces occupied and 298 of the 324 Economy Lot spaces occupied. However, the peak parking demand is typically around 9am after passengers have arrived at the airport and parked for the early morning departure flights, before inbound flights have begun arriving.

During late December 2014, the airport indicated that they had approximately 20 overflow cars that could not be accommodated in the public parking lots. Therefore, it appears that the Daily and Economy lots have a deficit of 20 cars and the Hourly lot is operating at capacity on peak days. These occupancy levels have been used to determine a demand ratio that is applied to the forecast enplanements throughout the planning period as shown in **Table 3-27**. This calculation results in a public parking deficit of 20 spaces currently, increasing to nearly 100 spaces in the Hourly parking lot and 715 in the Daily and Economy parking lots by 2033.

Table 3-20: Public Parking Demand Projections

Year	Scheduled Annual Enplanements	Demand Ratio per 1,000 Enplanements	Parking Demand	Parking Capacity	Surplus/ Deficiency
Short-Term / Hourly Parking					
2014	448,848	0.53	240	240	0
Projected:					
2018	454,060	0.53	243	240	(3)
2023	505,606	0.53	270	240	(30)
2028	561,097	0.53	300	240	(60)
2033	621,853	0.53	333	240	(93)
Long-Term / Overnight Parking					
2014	448,848	4.02	1,804	1,784	(20)
Projected:					
2018	454,060	4.02	1,825	1,784	(41)
2023	505,606	4.02	2,032	1,784	(248)
2028	561,097	4.02	2,255	1,784	(471)
2033	621,853	4.02	2,499	1,784	(715)

Note: Long-Term Parking demand & capacity includes Daily (1,460 spaces) & Economy (324 spaces) Lots
Short-Term Parking demand & capacity includes Hourly lot (240 spaces)

Source: Mead & Hunt

It should be noted that the airport and its parking operator have recently evaluated parking rates for the Hourly Lot. The adjustment in the overnight parking rates for this lot has shifted some parkers that are using the Hourly lot for overnight parking to the Daily and Economy Lots. This reevaluation will be completed each time a significant improvement to parking infrastructure is completed.

It should also be noted that the parking demand ratio can be measured with some precision for any year if the proper data is collected. It is not a static number, however, although it has been treated as such in the projections because the nature of airline passengers can change frequently over time due to several factors. For example, if enplanements on low-cost carriers were to comprise a larger portion of the increase in enplanements at the Airport, the parking demand may increase more quickly than enplanements due to the nature of these passengers and longer trip durations. Therefore, it is recommended this calculation be checked each year to track trends and adjusted accordingly to changing patterns.

It should also be noted that the above calculation is quantitative, not qualitative; in other words, there may be enough parking, but it may not provide the level of customer service desired by the Airport. In the future consideration should be given to adjust parking rates, or create VIP parking areas, particularly on the most convenient parking close to the terminal.

Employee Parking Demand – Employees parking at the Airport include those from the Airport staff, TSA, car rental agencies, tenants, and airlines. These employees are generally assigned to the east employee parking lots which have a capacity of 158 spaces. Airport management estimates that on peak days these lots are basically at capacity and are full at times, such as during a shift change. This utilization was used to estimate future employee parking demand, as summarized in **Table 3-28**. A deficit of 61 spaces is anticipated by the year 2033.

Table 3-21: Employee Parking Demand Projections

Year	Scheduled Annual Enplanements	Demand Ratio per 1,000 Enplanements	Projected Parking Demand	Parking Capacity	Surplus/ Deficiency
2014	448,848	0.35	158	158	0
Projected:					
2018	454,060	0.35	160	158	(2)
2023	505,606	0.35	178	158	(20)
2028	561,097	0.35	198	158	(40)
2033	621,853	0.35	219	158	(61)

Source: Airport Management; Mead & Hunt

Rental Car Ready/Return and Storage Spaces – The rental car ready/return lot directly west of the terminal contains 155 spaces. Airport officials and the rental car companies estimate that this lot is undersized by approximately two dozen parking stalls for current operations and activity levels. This correlates to a demand ratio of 0.40 spaces needed per 1,000 annual enplanements. As passenger traffic increases, it is anticipated that rental car transactions will increase at the same rate. The demand ratio is applied to the forecast enplanements throughout the planning period as shown in **Table 3-29**. This calculation results in a deficit of 26 spaces projected for 2018 with the deficit growing to 93 spaces by the year 2033.

Table 3-22: Rental Car Parking Demand Projections

Year	Scheduled Annual Enplanements	Demand Ratio per 1,000 Enplanements	Projected Parking Demand	Parking Capacity	Surplus/ Deficiency
Rental Car Ready/Return Parking Demand Projections					
2014	448,848	0.40	179	155	(24)
Projected:					
2018	454,060	0.40	181	155	(26)
2023	505,606	0.40	202	155	(47)
2028	561,097	0.40	224	155	(69)
2033	621,853	0.40	248	155	(93)
Rental Car Storage Parking Demand Projections					
2014	448,848	0.93	418	338	(80)
Projected:					
2018	454,060	0.93	423	338	(85)
2023	505,606	0.93	471	338	(133)
2028	561,097	0.93	523	338	(185)
2033	621,853	0.93	579	338	(241)

Source: Airport Management; Mead & Hunt

A rental car storage lot with 338 spaces is located just northwest of the ready/return lot, west of the terminal. Occupancy and demand for this lot fluctuates greatly as rental fleets increase and decrease seasonally. Airport officials estimate that during peak months this lot is undersized and the rental car operators are parking cars wherever they can find space. They estimate that each company is short of parking space for 10 to 30 cars, or roughly 80 cars in total on average. This correlates to a demand ratio of 0.93 spaces per 1,000 annual enplanements. As illustrated in the table, the existing lot appears to have a deficit of 241 spaces anticipated by 2033.

Overall, the rental car operation in the commercial airline terminal building needs expansion to provide customers with an acceptable level of rental car service in the future. The actual growth rate of rental car business compared to the passenger growth rate is contingent on the traffic mix (business versus pleasure travel) and future expansion of the Airport service area. Such phenomena could require expansion of the rental car ready/return lot on a schedule different than originally planned. Other unknown factors can greatly influence the accuracy of any current projections such as rental car company mergers and technological or marketing innovations. In any case, it is factual that expansion is needed and that passenger traffic growth projections indicate that an expansion may be needed soon.

Parking Needs Summary – A summary of existing and projected parking capacity and demand throughout the planning period is presented in **Table 3-30**. Review of the table indicates that additional parking deficits will increase through 2018 for public parking, rental car ready/return parking, rental car storage, and employee parking as new air service begins. Through the planning period it is projected that the parking deficits will increase in all areas as enplanements increase. The desired level of customer service should be considered along with the number of spaces provided as plans are developed for future parking facility needs.

Table 3-23: Parking Capacity/Demand Summary

Year	Scheduled Annual Enplanements	Projected Parking Demand	Parking Supply	Parking Surplus / (Deficit)	Projected Parking Demand	Parking Supply	Parking Surplus / (Deficit)
Historical:		Public Parking			Employee Parking		
2014	448,848	2,044	2,024	(20)	158	158	0
Projected:							
2018	454,060	2,068	2,024	(44)	160	158	(2)
2023	505,606	2,302	2,024	(278)	178	158	(20)
2028	561,097	2,555	2,024	(531)	198	158	(40)
2033	621,853	2,832	2,024	(808)	219	158	(61)
Historical:		Rental Car Ready/Return			Rental Car Storage		
2014	448,848	179	155	(24)	418	338	(80)
Projected:							
2018	454,060	181	155	(26)	423	338	(85)
2023	505,606	202	155	(47)	471	338	(133)
2028	561,097	224	155	(69)	523	338	(185)
2033	621,853	248	155	(93)	579	338	(241)
Historical:					Total Parking Demand		
2014	448,848				2,799	2,675	(124)
Projected:							
2018	454,060				2,832	2,675	(157)
2023	505,606				3,153	2,675	(478)
2028	561,097				3,499	2,675	(824)
2033	621,853				3,878	2,675	(1,203)

Source: Airport Management; Mead & Hunt

3.9 General Aviation Facilities

General aviation (GA) operations by local and itinerant aircraft accounted for approximately 63 percent of all aircraft operations in 2014; therefore, it is also important to consider GA facilities at the Airport with reviewing the adequacy of existing infrastructure. Generally, the size and type of facilities needed to support GA activity is directly proportional to the size and type of GA aircraft that operate at an airport. Other factors such as climate, availability of developable land, and anticipated demand also guide facility planning when reviewing the adequacy of GA infrastructure at an airport. The review of GA facilities focused on three components which are presented in this section: the general aviation terminal building, services provided to general aviation users, and hangar space at the Airport.

Though also utilized by commercial airline operators, this review of GA facilities also focused on the adequacy of the fuel farm to meet fuel storage requirements as well as the air cargo facilities at the Airport. Fuel storage capabilities of the fuel farm and its ability to meet the demand for fuel through the planning period will also be discussed in this section as well as the capabilities of existing air cargo facilities to meet the processing requirements of projected air cargo activity.

3.9.1 General Aviation Terminal Building

The Fargo Jet Center general aviation terminal building serves as the focal point for all general aviation activity at the Airport. The terminal serves as the transfer point for pilots and passengers of general aviation flights as well as provide administrative offices for Jet Center staff and provide space for pilots to plan flights and access weather information. The general aviation facilities are also equipped with five conference rooms, a large passenger waiting area, and a reception desk that also serves as the communication center for general aviation line services. Providing approximately 12,000 square feet of area, the general aviation terminal was designed at the time to provide adequate space to meet the long-term demands of public circulation, waiting area space, administrative areas, flight planning/conference room space, and utility/storage areas. It is recommended that future airport planning keep in mind expansion needs of the general aviation terminal building and associated facilities so that these areas continue to meet the demands of the users.

3.9.2 Fixed Base Operator Services

Fixed base operator (FBO) services are those that support general aviation activity, such as fueling, aircraft maintenance and repair, and coordination of ground transportation for itinerant users. FBO services currently being provided at the Airport include 100 low lead (LL) and Jet-A aviation fuels, aircraft maintenance and repair services for single- and multi- engine aircraft, power plant maintenance and repair, and line service personnel available to marshal taxiing aircraft and assist in other ground service aircraft needs. It should be noted that the Airport places an emphasis on providing a high level of customer service when providing FBO services to general aviation users at the Airport; as such, compliments are often received by both based and itinerant users for the friendliness of Airport staff and the efficiency in which FBO requests are handled. While it appears that the world-class FBO services currently being provided at the Airport will meet the needs of based and itinerant users throughout the planning period, it is recommended that the Airport continue to place a focus on efficiency, quality, and courteousness when providing its FBO services to customers. With Fargo Aircraft Maintenance and Jet Center's aircraft maintenance and power plant repair services occurring in nearly 30,000 square feet of hangar, it appears this space will be adequate for existing and projected maintenance operations at the Airport, which is most often work performed on single-engine, twin-engine, and small turbine aircraft.

3.9.3 Hangars

Due to the local weather extremes throughout the year, it is assumed that all based aircraft will desire hangar storage, when evaluating the capacity of existing hangars to meet future demand. Forecasts presented in Chapter 2 project the number based aircraft by fleet mix that can be anticipated at the Airport during the planning period. As summarized in Table 3-33, based aircraft are anticipated to grow from a total of 190 aircraft in 2014 to 272 aircraft by 2033. This equates to 44 additional single-engine aircraft, 21 additional multi-engine aircraft, 14 additional jets, one additional military aircraft, and two additional helicopters.

Table 3-24: Projections of Based Aircraft by Fleet Mix

Year	Single Engine	Multi Engine	Jet Aircraft	Military	Helicopters
2014	119	42	20	4	5
2018	123	47	26	4	5
2023	135	52	28	5	5
2028	149	57	31	5	6
2033	163	63	34	5	7

Source: Mead & Hunt, Inc. (2015)

Given the projected number of based aircraft by fleet mix that can be anticipated throughout the planning period, the demand for box-style and t-style hangars by square feet can be projected. Table 3-34 summarizes the approximate parking area in square feet needed to park each type of aircraft fleet mix classification. It should be noted that the amount of area required to park an aircraft varies based on the size and type of aircraft; as such, planning ratios were used for each fleet mix classification as identified in the table. The size approximations for each aircraft classification included a safety margin for wingtip, nose, and tail clearances.

Table 3-25: Parking Area Sizes for Aircraft Fleet Mix Classifications

Aircraft Type	Examples	Approximate Square Feet
Single Engine	Cessna 172, Cirrus SR-22	1,400 square feet
Multi Engine	Piper Seneca, Beechcraft King Air	2,500 square feet
Small & Mid-Sized Jets	Cessna Citation, Learjet	3,600 square feet
Large Business Jets	Gulfstream G550, Global Express	10,000 square feet
Helicopter	Sikorsky S-76, Bell 206	1,400 square feet

Source: Mead & Hunt, Inc. (2015)

Table 3-25 illustrates the total demand in square feet for hangar space by aircraft fleet mix classification that can be anticipated at the Airport through 2033. As presented in the table, the total demand for hangar space will grow by approximately 46 percent throughout the planning period with single-engine aircraft requiring an additional 61,600 square feet of hangar space followed by multi-engine aircraft (52,500 square feet) and jet aircraft (50,400 square feet). It should be noted that the hangar space demand for single- and multi-engine aircraft should be considered by square feet and the number of T-hangar units needed to house each aircraft.

Table 3-26: Projected Hangar Area Demand by Aircraft Fleet Mix Classification

Aircraft Type	2014	2018	2023	2028	2033
Single Engine					
Projected Based Aircraft	119	123	135	149	163
Approximate Area per Aircraft (sq. ft.)	1,400	1,400	1,400	1,400	1,400
Total Demand (sq. ft.)	166,600	172,200	189,000	208,600	228,200
Multi Engine					
Projected Based Aircraft	42	47	52	57	63
Approximate Area per Aircraft (sq. ft.)	2,500	2,500	2,500	2,500	2,500
Total Demand (sq. ft.)	105,000	117,500	130,000	142,500	157,500
Jet Aircraft					
Projected Based Aircraft	20	26	28	31	34
Approximate Area per Aircraft (sq. ft.)	3,600	3,600	3,600	3,600	3,600
Total Demand (sq. ft.)	72,000	93,600	100,800	111,600	122,400
Military Aircraft					
Projected Based Aircraft	4	4	5	5	5
Approximate Area per Aircraft (sq. ft.)	3,600	3,600	3,600	3,600	3,600
Total Demand (sq. ft.)	14,400	14,400	18,000	18,000	18,000
Helicopters					
Projected Based Aircraft	5	5	5	6	7
Approximate Area per Aircraft (sq. ft.)	1,400	1,400	1,400	1,400	1,400
Total Demand (sq. ft.)	7,000	7,000	7,000	8,400	9,800
Total Demand	365,000	404,700	444,800	489,100	535,900

Source: Mead & Hunt, Inc. (2015)

A summary of the existing hangar capacity at the Airport is presented in Table 3-36. As illustrated in the table, a total of 272,749 square feet of hangar space is available to park based aircraft. This footage is made available by 21 box-style hangars structures with varying numbers of units that offer a total of 201,765 square feet of space and 6 T-style hangar buildings offer 55 T-style hangar units for single- and multi-engine aircraft. The following storage facilities were not included in the calculation of available space for the reasons associated with each item:

- ✓ Air National Guard Base Hangars – MQ-9 Raptor in 2017
- ✓ Army National Guard – future UH-60 Blackhawk mission
- ✓ 22,400 square foot maintenance hangar operated by Jet Center - not intended for permanent parking of aircraft
- ✓ 28,000 square foot transient storage hangar operated by Jet Center – not used for based aircraft
- ✓ 22,500 square foot hangar owned by the Fargo Air Museum – many of the aircraft stored are temporarily on loan and are not based at Hector International Airport

Table 3-27: Existing Hangar Capacity for Based Aircraft

Hangar Style	Number of Structures	Number of Units for Aircraft Parking	Total Approximate Sq. Ft. Available
Box-style	21	64*	201,765
T-style	6	55	70,984
TOTAL	**26**	**119**	**272,749**

Notes:

The number of available aircraft parking positions within each unit varies based on size of aircraft

Source: Mead & Hunt, Inc. (2015)

Table 3-27 illustrates the demand for projected hangar capacity at the Airport for the planning period. As shown in **Table 3-28**, an additional 109,300 square feet of box-style hangar area and 63,000 sq. ft. of additional T-hangar units will be required by 2033. The future demand for box-style hangar space includes what would be needed to house multi-engine, jets, and helicopter aircraft while the demand for T-style hangar space only includes single-engine aircraft. The size and type of projected hangar needs are generalized, and it is recommended that the Airport plan for a variety of sizes and types to accommodate various types of users as demand materializes.

Table 3-28: Projected Hangar Capacity

Hangar Style	2018	2023	2028	2033
BOX-STYLE				
Projected Demand	235,865 sq. ft.	259,165 sq. ft.	283,865 sq. ft.	311,065 sq. ft.
Available Capacity	201,765 sq. ft.	201,765 sq. ft.	201,765 sq. ft.	201,765 sq. ft.
Surplus/Deficit	**- 34,100 sq. ft.**	**- 57,400 sq. ft.**	**- 82,100 sq. ft.**	**- 109,300 sq. ft.**
T-STYLE				
Projected Demand	77,984 sq. ft. (59)	94,784 sq. ft. (67)	114,384 sq. ft. (77)	133,984 sq. ft. (87)
Available Capacity	70,984 sq. ft. (55)	70,984 sq. ft. (55)	70,984 sq. ft. (55)	70,984 sq. ft. (55)
Surplus/Deficit	**- 7,000 sq. ft. (4)**	**- 23,800 sq. ft. (12)**	**- 43,400 sq. ft. (22)**	**- 63,000 sq. ft. (32)**

Projections: Mead & Hunt, Inc. (2015)

It is recommended that construction of any new T-style hangar units should be to a width greater than 41 feet, 6 inches and a height greater than 12 feet. This will allow dedicated parking for larger single-engine and smaller twin-engine aircraft, better utilizing existing and future box-style hangars for larger twin-engine and jet aircraft.

3.9.4 Aircraft Fuel Storage Facilities

There are two main aircraft fuel storage facilities at the Airport, both of which are owned by Fargo Jet Center. The North Fuel Farm, located north of the Jet Center FBO, is comprised of two (2) 15,000 gallon Jet-A fuel tanks, one (1) 22,000 gallon Jet-A fuel tank, one (1) 15,000 gallon 100 low lead (100LL) tank. The other is the West Fuel Farm which consists of two (2) 30,000 gallon Jet-A fuel tanks, one (1) 1,000 gallon 100LL tank, and one (1) 10,000 gallon glycol tank. Combined, these facilities offer the Airport the capability to store 112,000 gallons of Jet-A, 16,000 gallons of 100LL aviation fuel, and 10,000 gallons of glycol.

To evaluate the aircraft fuel storage requirements of the Airport throughout the planning period, it is first important to review the historical sale of fuel to establish a baseline of demand. Table 3-38 illustrates the annual fuel sales at the Airport from 2011 to 2014. As illustrated in the table, an average of 6,866,611 gallons of Jet-A fuel and 116,819 gallons of 100LL fuel have be sold annually between 2011 and 2014.

Table 3-29: Fuel Sales by Year (2011-2014)

Year	Airline Jet-A Sales (in gallons)	General Aviation Jet-A Sales (in gallons)	100LL Sales (in gallons)	TOTAL SALES (in gallons)
2011	5,491,666	1,669,004	121,079	7,281,749
2012	5,262,499	1,303,117	118,182	6,683,798
2013	5,357,722	1,368,437	119,378	6,845,537
2014	5,535,919	1,478,080	108,637	7,122,636
'11-'14 Average	*5,411,951*	*1,454,659*	*116,819*	*6,983,429*

Source: Fargo Jet Center records (2015)

Next, the fuel storage turnover rate, or the rate at which the fuel tanks at the Airport need to be refilled to meet demand, must be calculated. This rate can be calculated by dividing the annual sale of fuel by the number of days in a year to find the average daily fuel sales. The total fuel storage capacity at the Airport is then divided by the average daily fuel sales to determine the average fuel storage turnover rate. **Table 3-29** presents the findings of the historical fuel storage turnover rate for Jet-A fuel while **Table 3-30** presents the historical fuel storage turnover rate for 100LL fuel.

Table 3-30: Historical Jet-A Fuel Storage Turnover Rate

Year	Total Jet-A Sales (in gallons)	Average Daily Fuel Sales (in gallons)	Total Jet-A Fuel Storage Capacity (in gallons)	Average Fuel Storage Turnover Rate
2011	7,160,670	19,618	112,000	5.7 days
2012	6,565,616	17,988	112,000	6.2 days
2013	6,726,159	18,428	112,000	6.0 days
2014	7,013,999	19,216	112,000	5.8 days
'11-'14 Average	*6,866,611*	*18,812*	*112,000*	*5.9 days*

Source: Mead & Hunt, Inc. (2015)

Table 3-31: Historical 100LL Fuel Storage Turnover Rate

Year	Total 100LL Sales (in gallons)	Average Daily Fuel Sales (in gallons)	Total 100LL Fuel Storage Capacity (in gallons)	Average Fuel Storage Turnover Rate
2011	121,079	331.7	16,000	48.2 days
2012	118,182	323.8	16,000	49.4 days
2013	119,378	327.0	16,000	48.9 days
2014	108,637	297.6	16,000	53.7 days
'11-'14 Average	*116,819*	*320.0*	*16,000*	*50.0 days*

Source: Mead & Hunt, Inc. (2015)

As illustrated, the storage capacity of existing fuel tanks at the Airport are capable of storing, on average, a 5-day supply of Jet-A fuel and a 50 day supply of 100LL fuel. It should be noted that an increase in operations of larger, wide-bodied aircraft, such as the Boeing 747, could increase fuel sales since these aircraft types require greater amounts of fuel than existing types operating at the Airport. In addition, fuel sales could also increase if more long range non-stop routes such as those to destinations in the Southeast and Southwest are implemented from the Airport. Increases in operations by larger aircraft and longer range non-stop routes, as projected to occur during the planning period, will increase the fuel storage turnover rate and thus may require an expansion of fuel storage facilities. It is recommended that initial planning be scheduled to prepare for an expansion of fuel storage facilities at the Airport.

3.9.5 Air Cargo

The existing air cargo facility at the Airport is in the northwest quadrant and consists of an apron with two access taxiways. On the north side of the apron, sits a 15,300 square foot privately-owned facility that has been used as a distribution center to sort and load packages for various air cargo operators. Recently, Boeing 747s were used to transfer cattle to Eastern Europe from Hector International Airport. In 2013, a total of 16,284,000 pounds of air cargo was enplaned at the Airport, with much of that amount processed through the airline and GA facilities.

The Forecasts of Aviation Demand previously prepared and presented in Chapter Two projected modest growth in the landed weight of air cargo at the Airport, however, since the preparation of these forecasts FedEx has announced that they will be relocating their regional air cargo distribution center from Grand Forks International Airport to Hector International Airport.

Table 3-32 presents the air cargo landed weights for Hector International (FAR) and Grand Forks International Airport (GFK). It is estimated that FedEx's activity represents approximately 90% of the landed weight at GFK. The Air Cargo table below presents the projected amount of air cargo landed weight for Hector International Airport with the estimated amount of FedEx activity added to the current FAR cargo activity. This projection uses a market share methodology that assumes the air cargo landed weights at FAR increase at the same rate as the FAA's projection for total US domestic revenue ton miles.

Table 3-32: Air Cargo Activity Projection

Year	Total FAR Landed Weight (tons)	Estimated FAR Landed Weight with FedEx tenant: Total GFK Landed Wt (tons)	Estimated FAR Landed Weight with FedEx tenant: FedEx Landed Wt Estimated at 90% of GFK Total (tons)	Estimated FAR Landed Weight with FedEx tenant: Total FAR w/ Est. FedEx Landed Wt (tons)	Total U.S. Air Cargo (mil-rev ton mi)	Historic FAR Market Share	Est. FAR Market Share w/ FedEx
Historical:							
2010	10,726				12,823.07	0.00008%	
2011	11,749				12,046.88	0.00010%	
2012	9,367				12,246.43	0.00008%	
2013	8,142	91,551	82,396	90,538	12,349.67	0.00007%	0.00073%
2014	8,630	96,184	86,566	95,196	12,676.37	0.00007%	0.00075%
2015	6,338	*NA*	*NA*	*NA*	13,088.70	0.00005%	*NA*
Projected:							
2018	6,590			102,195	13,608.36	0.00005%	0.00075%
2023	7,014			108,773	14,484.38	0.00005%	0.00075%
2028	7,415			114,997	15,313.18	0.00005%	0.00075%
2033	7,851			121,754	16,212.92	0.00005%	0.00075%
CAGR (2014-2033)				*1.30%*	*1.30%*		
CAGR (2015-2033)	*1.20%*				*1.20%*		

Sources: FAR Historical Airport Cargo Data - Airport Management Records, GFK Historical Air Cargo Data - FAA Air Carrier Activity Information System (ACAIS)
Total U.S. Air Cargo (Revenue Ton Miles) - FAA Aerospace Forecasts FY2016-2036

The North GA apron that supports air cargo operations is currently being expanded to allow more room for operations, including those for FedEx and small feeder cargo aircraft. Adequate space for air cargo operations, including FedEx, regarding needs for air cargo aircraft parking and maneuvering, ground service equipment storage and maintenance, sortation facilities, and truck and auto parking should be maintained. The airport is currently in lease negotiations and design for accommodation of these facility needs at the North GA/Air Cargo Apron area.

3.10 Support Facilities

Support facilities are those infrastructure elements that are necessary to support the operation and maintenance of the Airport. A review of support facilities including the fire station, snow removal equipment building, and airfield electrical vault and generator was conducted as a part of evaluating the adequacy of existing infrastructure to meet future demand. This section reviews each support facility element and discusses improvements that will be needed, if any, to meet anticipated demand.

3.10.1 Aircraft Rescue and Fire Fighting Facility

As noted in the inventory chapter, the existing 18,750 square feet Aircraft Rescue and Fire Fighting (ARFF) facility is adequate in size to meet the vehicle and firefighting equipment storage needs of the Airport. Built in 2010, the existing facility has all the facilities and storage requirements the Airport is likely to require well into the future. As such, it is anticipated that additional ARFF facilities will be required during the period, unless there is a charge to the ARFF index.

The following elements are based on a review of the existing ARFF facility and its capability to support the firefighting operations at the Airport.

- ✓ ARFF Index – It is anticipated that the ARFF Index capability at the Airport will remain at Class I Index C throughout the planning period based on the fleet mix of commercial aircraft types that are projected to operate at the Airport. An agreement to offer ARFF Index E, upon request, is available by adding NDANG assets. It is recommended that the ARFF facility remain capable of supporting ARFF Index C operational requirements, unless the aircraft operating from the Airport prompt a change earlier.
- ✓ ARFF Vehicles – Hector International Airport has recently taken delivery of two Oshkosh Global Striker vehicles; one is a 6x6 that holds 3,000 gallons of water and 420 gallons of foam, while the second is a 4x4 that holds 1,500 gallons of water and 210 gallons of foam. These vehicles are state-of-the-art and allow the airport to operate smaller crews with no decline in safety. These vehicles, properly maintained, will be fully functional throughout the planning period and offer more than the required functionality required by vehicle criteria.

- ✓ Personnel Areas – Currently, full-time Airport employees perform all functions of the ARFF facility. Most of these dedicated firefighters served at the Airport during prior joint role ARFF/ANG functions when the facility was constructed. Personnel support areas such as a break room, training room, locker area, snow desk/dispatching center, kitchen, and sleeping areas were all included in the design of a new facility. Incorporating these elements allowed the facility to be able to accommodate firefighters for the duration of their shifts which can be multiple days in length.

- ✓ Equipment and Raw Material Storage – In addition to having vehicle bays and personnel areas, adequate storage area for equipment and raw material storage was included in the design of the ARFF facility. As identified in FAA AC 150/5210-15A, Aircraft Rescue and Firefighting Station Building Design, storage areas should be planned to accommodate firefighting turnout gear, first aid medical equipment, rescue tools, and self-contained breathing apparatuses (SCBA). Likewise, it was also important that an area was included in the design of the facility for the storage of raw material firefighting agents such as chemicals and powders. These areas are large enough to store and move several pallets as well as be equipped so that material deliveries can be received in an efficient manner.

3.10.2 Snow Removal Equipment Facility

Like the ARFF facility, the existing Airport snow removal equipment facility currently provides adequate areas for Airport maintenance personnel and storage of equipment. The vehicle bays of the SRE facility are adequately sized to park SRE vehicles which are required to position plow and broom attachments to the side to maneuver into and out of the building. However, since the existing building is essentially at capacity, it is recommended that the Airport plan for an expansion of the SRE building soon, to continue to keep pace with the steady growth of the operations. As additional space is required, expansion to the existing building would be recommended on the current site.

3.10.3 Airfield Electrical Vault and Generator

The airfield electrical vault, includes the generator and components such as transformers, lighting panels, relays, and constant current regulators (CCRs) that are necessary to power lights, NAVAIDs, and other electrical components on the airfield. Since electrical components inside the vault have been upgraded and installed as airfield lights have been upgraded, it is not anticipated that improvements to the vault or generator will be needed to meet the electrical demands of airfield components during the planning period.

It is recommended that any future airfield lighting projects at the Airport consider the components of the vault so major upgrade costs can be avoided if possible.

3.10.4 Collection, Treatment, and Disposal of Deicing Fluids

The application of deicing fluids on aircraft is a necessary and important flight preparation procedure during the winter season to remove and prevent snow, ice, and frost from interfering with the aerodynamic surfaces of an aircraft. However, deicing fluids biodegrade rapidly, which can cause depletion of dissolved oxygen in streams that receive deicing runoff. As a result, measures need to be taken to properly collect and dispose of spent deicing fluids to not adversely impact the water quality of streams, rivers, lakes, and other bodies of water.

Aircraft Deicing Operations

Aircraft are currently deiced at four locations at the airport: Terminal Apron, North GA, South GA, and Cargo Apron. Most deicing is conducted at the Terminal Apron, with limited deicing by Jet Center on the North GA apron. Very infrequent aircraft deicing is conducted at the two other locations.

Seasonal aircraft deicing fluid (ADF) usage in gallons of undiluted product is reported as by the contractors and FBO that conduct deicing. Both Type I and IV propylene glycol based ADF are employed. Average seasonal ADF usage between the 2007-2008 and 2012-2013 deicing seasons was approximately 34,100 gallons of concentrated product prior to dilution, with a trend of increasing usage. Usage at North GA is significantly lower than at the Terminal Apron (e.g., about 2% of all ADF applied in 2012 - 2013 season).

Regulatory Requirements

The Airport is authorized to discharge stormwater impacted by industrial activities, including deicing, under the State of North Dakota's general industrial stormwater permit. Compliance with the permit requires that the Airport prepare and implement a Stormwater Pollution Prevention Plan that ensures that "practices are implemented to minimize the contribution of pollutants", conduct monitoring of deicing season stormwater discharges to assess stormwater quality against benchmark values, and submit an annual report with the results of the monitoring and the amounts of ADF used during the year.

Development at the airport must adhere to the storm water management requirements of both the City of Fargo and the North Dakota Department of Health. Furthermore, FAA Advisory Circular 150/5200-33B "Hazardous Wildlife Attractants on or near Airports" states the maximum time storm water can be detained is 48 hours. To meet these requirements, a comprehensive storm water management analysis will be prepared at for the airport as part of this masterplan. Storm water treatment will be looked be looked at on a regional basis to provide an efficient and cost-effective approach which does not adversely affect development and operation of the airport. A complete storm water management report can be found in Appendix B.

Deicing Runoff Controls

Current controls on runoff from aircraft deicing are focused on passenger aircraft operating from the Terminal Apron where the majority of ADF is applied. All aircraft are deiced off-gate on the north section of the apron where drainage is to two control structures which are vacuumed out when full. Under dry weather conditions, deicing runoff puddles on the ramp surface where it can evaporate in place. When there is enough runoff from deicing operations to begin flowing across the pavement, the airport deploys a vacuum sweeper to intercept and collect the runoff before it reaches the inlets. Collected runoff is discharged directly to the sanitary sewer for treatment at the City of Fargo WWTP. Deicing runoff that reaches the storm sewer inlets flows to underground detention vaults where suspended sediments are removed via settling and filtering through gravel, and is then discharged to the receiving water via Outfall B. Under snowfall conditions, deicing runoff is plowed up with the snow and distributed onto turf areas surrounding the ramp for degradation by natural processes.

North Dakota Department of Health (NDDoH) staff visited the airport in 2014 to discuss compliance with the industrial stormwater permit. They noted periodic and sometimes significant exceedances of the benchmark concentrations for Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), but did not raise any specific concerns regarding potential receiving water impacts. It was suggested that the airport examine alternatives to enhance the effectiveness of the existing deicing runoff collection controls. This visit was prior to the move of all Terminal area aircraft deicing to the new area on the north side of the apron, which is expected to reduce the relative amounts of aircraft deicing runoff that is discharged via Outfall B and improve compliance with the BOD and COD benchmark concentrations. However, the benchmark concentrations are relatively low and observed BOD5 concentrations have been several times higher than the benchmark.

Monitoring data collected during the 2014-2015 deicing season will provide a basis for evaluating the effectiveness of the recent changes in reducing discharge concentrations to levels that are consistently below the benchmarks. If benchmark concentrations are observed to be exceeded, it is recommended that a study be conducted to identify, evaluate, and recommend strategies for improving the existing system's effectiveness in controlling deicing runoff.

3.11 Airport Traffic Control Tower

Fargo's 24-hour Air Traffic Control Tower is operated by the Federal Aviation Administration. It was constructed in 1988, and is maintained jointly by the FAA and the Airport Authority. Due to the age of the control tower, it is technologically and ergonomically insufficient in a few areas. These inefficiencies could be addressed by new construction, which would likely be at a new site on the east side of the Airport, or a major remodel project that could address the issues within the current structure. It would be prudent for the Airport to continue to protect the relocation area, as well as plan for a major remodel during the planning period.

3.12 Summary

Planning and investment made to improve infrastructure facilities at the Airport will allow it to meet the air transportation demands of eastern North Dakota for the next 20 years. This chapter has a review of existing infrastructure at the Airport and its ability to accommodate anticipated demand has identified a few areas that should be the focus of future facility planning and development. The following chapter will evaluate development alternatives for meeting the facility identified in this chapter.