BNA MASTER PLAN
NASHVILLE INTERNATIONAL AIRPORT

Nashville International Airport

Master Plan Update

Chapter 5
Alternatives Evaluation

BNA Nashville International Airport

AECOM

DRAFT

January 2020

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5.1 Introduction

In previous chapters, existing facility and operational conditions at Nashville International Airport (BNA) were documented (Chapter 2); forecasts of future aviation demand were prepared (Chapter 3); and resulting facility requirements were identified (Chapter 4). In this chapter, alternative ways of providing necessary improvements to address expected Airport facility needs are identified, and feasible concepts that meet future needs are developed and refined.

5.1.1 Master Planning and Long-Term Visioning

The Master Plan has projected future activity levels and facility requirements through 2037. While the typical master planning horizon of 20 years provides adequate time for implementation of identified facility and operational needs, the life span of the airport is considerably longer, and master plan "visioning" can provide a benefit by informing short-term facility improvement decisions. It is an important responsibility of master plan visioning to provide insights into long-term alternatives that help the airport make the best near-term use of available land and available funding for future facility improvements, without impeding potential needs beyond the planning period.

At BNA, if actual activity trends continue, additional airfield and terminal capacity will likely be needed within and beyond this master planning period. For the airfield, annual aircraft operations are projected to reach 63% of airfield capacity by 2037, which is above the FAA's suggested trigger for starting planning processes to identify additional airfield capacity. Similarly, the existing terminal building and its roadway and curbside facilities are site constrained. While the BNA Vision program will provide facilities that support the 48-gate terminal and its core passenger processing functions, this master plan has identified the need for core terminal processing facilities that support 61 or more gates within the planning period.

It is likely that, at some point, the ability of the existing terminal building to process the projected passenger growth at an acceptable level of service could become challenged. To be prepared well in advance of facility capacity constraints, BNA should monitor passenger processing trends (passenger arrival, drop-off and pick-up trends, check-in processes, bags per passenger, etc.). Also, BNA should monitor future operational practices and design standards of the FAA, airlines, TSA, and CBP. This will help ensure that terminal core processors have sufficient capacity to process BNA passengers at an acceptable level of service. Based on the rapid growth at the airport, there may come a time in the future when a second terminal may need to be considered.

5.1.2 Alternatives Selection Criteria

The FAA outlines some of the ways that the Alternatives identification and evaluation process can evolve. Of primary importance is that the identification of Alternatives should consider only those alternatives meeting the sponsor's planning need (such as the established facility requirements) and those that the FAA and airport sponsor will be able to implement. The Master Plan should examine each alternative's technical feasibility, economic and fiscal soundness, and aeronautical utility (i.e., built and operated

safely), and consider environmental impact factors in its evaluations. Alternatives not meeting those criteria should be dismissed, while providing reasons for their dismissal. This planning information is important to efficient project development and to streamline the FAA's subsequent Airport Layout Plan (ALP) and environmental approvals, and project permitting processes.

Once alternatives are identified, they are evaluated using criteria appropriate to the potential impacts they may generate, including, but not limited to:

- Meeting FAA design standards,
- Effect on capacity and delay,
- Improvement to passenger processing and travel experience,
- Constructability and construction cost,
- Potential environmental impacts both on-, and off-airport,
- Potential property impacts and land acquisition including residential / business relocation,
- Impacts to roadways and utilities, and
- Opportunity for sustainability enhancement and benefit.

The Alternatives development and evaluation process is intended to result in selection of recommended alternatives and key projects needed for each functional element and providing input into the MNAA decision-making process for overall airport development concepts. The key projects listed and evaluated below are considered paramount to the ability of the airport's airfield, terminal, and landside/support facilities to maintain and improve the community's air service link to the world; to utilize airport property to its fullest capabilities; and to provide aviation and non-aviation development opportunities that maintain the Authority's financial and fiscal soundness in its stewardship of BNA's future.

5.1.3 Summary of Key Projects

An itemized and detailed "Facility Requirements Summary" was presented in Chapter 4 at the end of each major section (Airfield, Terminal, Landside, Cargo, General Aviation, and Airport/Airline Support). While the list of facility requirements through the planning period and beyond for BNA is extensive, the remainder of this Chapter focuses on identifying and evaluating Alternatives for projects that comprise the most near-term and long-term critical components of the airport. *Chapter 6, Implementation Plan*, and the Proposed Airport Layout Plan provide more information on recommended projects that make up the Master Plan.

The key facility improvement concepts evaluated in this Alternatives chapter include:

- Airfield development, including:
    - airfield design standards improvements,
    - additional runway length, and
    - long-term disposition of Runway 2C-20C
- Terminal improvements, including:
    - additional gates,
    - terminal ramp, aircraft deicing, and remain overnight parking facilities, and
    - passenger processing functional area improvements

- Landside facility improvements, including:
    - Terminal approach roadway and curb improvements,
    - Rental car facility expansion
    - Valet parking and remote storage, and
    - Airport People Mover alignment
- Terminal support facility improvements
- General Aviation facility development
- Supplemental aircraft rescue and firefighting (ARFF) facility
- Long-Term visioning - Airfield and Terminal expansion, including:
    - planned 4th parallel Runway 3-21, and
    - long-term terminal capacity improvements

5.2 Airfield Development Alternatives

One of the most important considerations for this Master Plan is determining the portions of the airfield that can be brought up to current FAA Design Group V standards to accommodate the aircraft fleet expected to serve BNA. The following sections provide analyses of the most challenging portions of the airfield related to meeting design standards and evaluation of potential actions needed to improve those areas.

5.2.1 Airfield Standards Improvement Alternatives

The airfield system at BNA currently provides sufficient capacity and minimal delay with its four runways and its system of parallel taxiways and taxilanes serving the runways and access points to and from the passenger terminal gates, general aviation areas, west cargo development area, and the Tennessee National Guard (TNG) complex. Nevertheless, airport design standards have evolved as aircraft have gotten larger, resulting in wider separations between airfield elements such as runways and taxiways, and within the protected areas of the airfield elements themselves, such as taxiway safety and object free areas, shoulders, and blast pads. In addition, FAA guidance for runway protection zones (RPZs) has evolved to enhance the protection of people and property on the ground by maintaining each runway's RPZ clear of incompatible objects and activities.

It is important to the safety of aircraft ground operations and air traffic control that the airfield achieve and maintain compliance with current FAA design standards. Achieving compliance with design standards ensures that pilots can maneuver their aircraft around the airfield with as few operational limitations as possible, which can help lessen workload for air traffic control personnel. Maintaining compliance with FAA design standards is also necessary for eligibility of projects financed through Airport Improvement Program (AIP) and/or Passenger Facility Charge (PFC) funding sources.

BNA's airfield meets many of the criteria required to accommodate Group V operations, with some exceptions described below. The majority of current airfield design standards deficiencies at BNA can be attributed to increased requirements of accommodating larger aircraft than when the airfield was

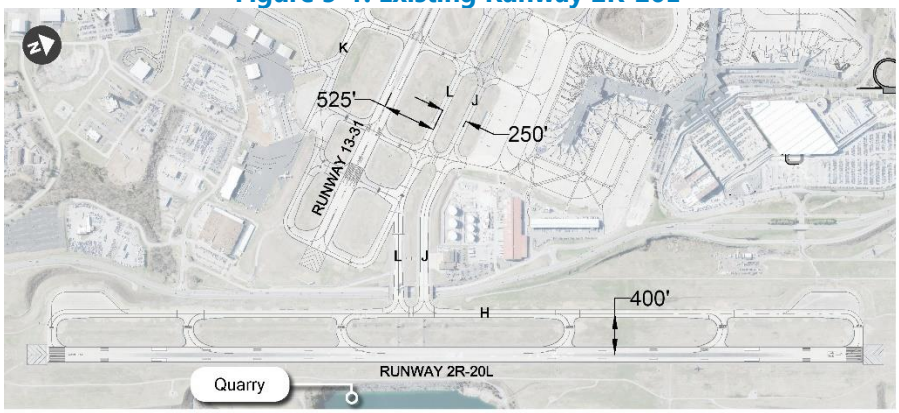
originally designed. Most of the airfield design standards deficiencies can be solved by adding shoulder and blast pad pavement surrounding runways and taxiways/taxilanes and removing or relocating objects from taxiway safety and object free areas, such as windsocks, internal airport service roadways, and fences. For these improvements, it is not necessary to examine alternative ways of achieving the standard; rather, the Airport Layout Plan will identify and include the improvements needed to attain compliance. There are some design standards deficiencies that are more significant in terms of actions that might be needed to ensure that BNA can accommodate Group V aircraft, including the design aircraft (B787-8/9). These deficiencies are discussed below.

5.2.1.1 Runway 2R-20L and Taxiways Hotel, Juliet, and Lima

In October 2018, AECOM prepared a "*Runway 2R/20L Geometry Review*" for MNAA. The report detailed Group IV and Group V design deficiencies and reviewed alternatives for bringing Runway 2R-20L airfield elements into compliance with current FAA design standards. **Figure 5-1** illustrates existing Runway 2R-20L. The major findings of the 2018 Report included:

1. The runway-to-parallel taxiway separation of 400 feet meets separation standards for Group V aircraft, except when conducting operations in less than ½ mile visibility. Runway 2R is one of only two of eight runway ends at BNA equipped with the highest current technology instrument approach capability (Category II/III) (the other runway end is Runway 2L). Since providing all-weather capability is an important factor in maintaining reliable scheduled airline service and airfield capacity, alternatives for achieving the required 500-foot minimum separation between the runway and parallel Taxiway Hotel (H) were evaluated.

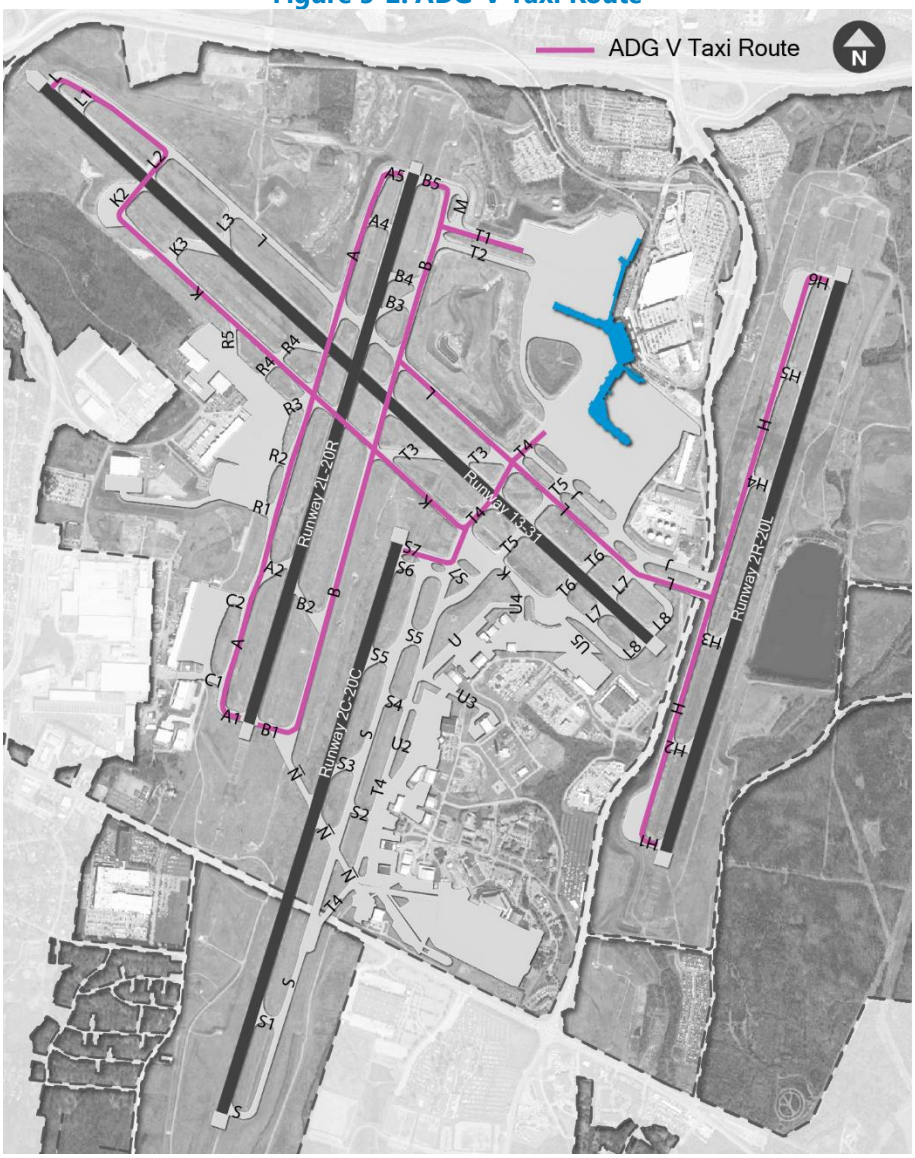
Figure 5-1: Existing Runway 2R-20L



The three alternatives included relocating the runway to achieve the 500-foot separation; relocating Taxiway H to achieve the 500-foot separation; and placing an operational limitation on Group IV and Group V aircraft when visibility conditions were lower than permissible with the 400-foot separation (½ mile). The proximity of a major quarry immediately east and Donelson Pike immediately west of the runway precluded the runway and taxiway relocation options. Thus, the recommended alternative was to place an operational restriction on Group IV and Group V aircraft by requiring those aircraft to hold short of Taxiway H on a segment of Taxiway Lima (L) approaching Taxiway H in visibilities lower than ½ mile.

An additional restriction for Group V aircraft operating on Runway 2R-20L is that Taxiway J is separated from Taxiway L by 250 feet vs. the required 267 feet. This prohibits Group V aircraft from operating without limitation on Taxiway J. To address this deficiency, Group V aircraft operating on Runway 2R-20L use Taxiway L to and from the terminal complex. BNA maintains a Group V Operational Plan that provides pilots and air traffic control personnel with available taxiing routes around the airfield, as excerpted in **Figure 5-2** below.

Figure 5-2: ADG-V Taxi Route



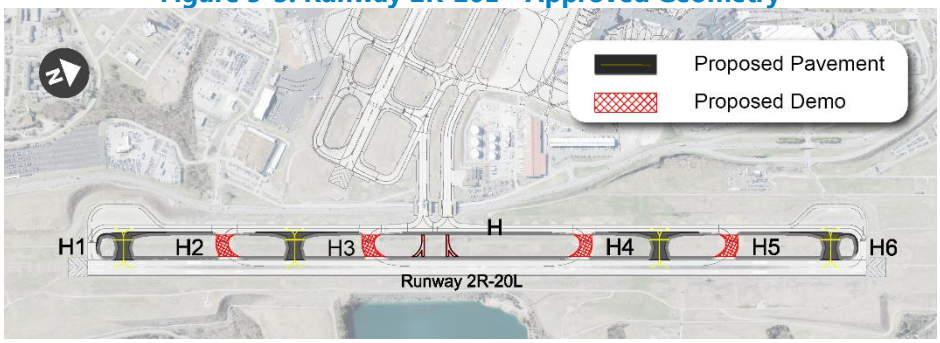
2. The remaining Group V standards deficiencies concerning Runway 2R-20L and Taxiway H relate to:
    a. runway and taxiway shoulder widths, blast pad dimensions, marking, and lighting,
    b. taxiway safety area grading and drainage,
    c. taxiway object free area penetrations,
    d. nonstandard runway connecting taxiway geometry, and

e. nonstandard Taxiway H hold aprons at either runway end.

In December 2018, Atkins/Garver prepared a report entitled, "*Reconstruct Runway 2R-20L, Comparative Analysis Report*" for MNAA (MNAA Project No. 1905). The report utilized the AECOM standards analysis and, as the Runway 2R-20L pavement is planned to be rehabilitated in the near future, the Atkins/Garver analysis reviewed preliminary design/construction-related options to improving Runway 2R-20L and its associated taxiway complex to meet FAA design standards. The evaluation reviewed horizontal and vertical pavement geometry, retaining wall options for taxiway object free area deficiencies along Donelson Pike, airfield lighting requirements, and potential modifications of design standards (MOS). Processing of the request for MOS resulted in FAA requiring that the airport meet design standards for the runway profile and Taxiway H safety area. The approved geometry for Runway 2R-20L and Taxiway H is illustrated below in **Figure 5-3**, and includes:

1. Retaining the 400-foot, Runway 2R-20L to Taxiway H separation, and holding aircraft at least 550-feet from the runway centerline on Taxiways J and L;
2. Relocating taxiway connector locations; and,
3. Retaining runway end hold aprons.

Figure 5-3: Runway 2R-20L – Approved Geometry



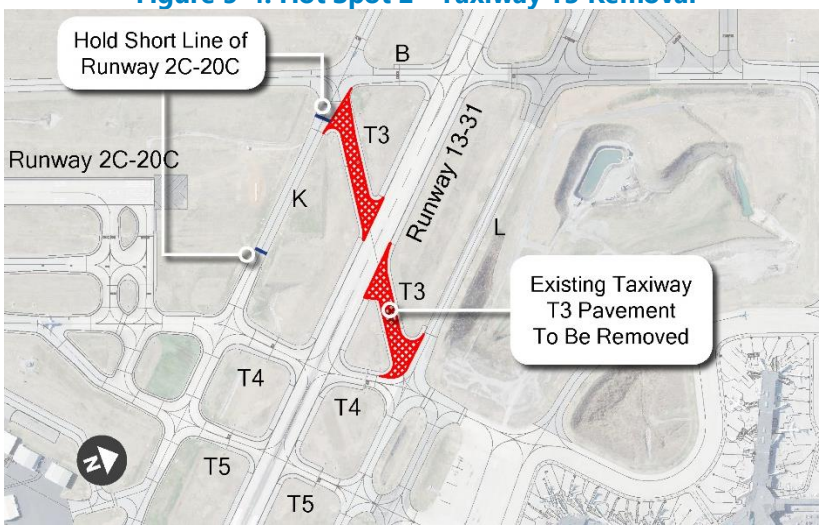
5.2.1.2 Hot Spot #2

At BNA, three taxiway intersection "hot spots" were identified as needing runway incursion mitigation measures designed to improve aircraft ground movement safety. Hot Spots #1 and #3 have been addressed by MNAA in coordination with the FAA's Runway Safety Action Team (RSAT). For Hotspot #1 (intersection of Taxiways A and K), Taxiways R3 and R4 are in the process of being removed (anticipated project completion by June 2020). Hotspot #3 (Taxiways S6 and S7 serving the approach end of Runway 20C) is being resolved by implementing pavement marking and signage improvements and installing runway guard lights in 2020.

The remaining Hot Spot #2 is reviewed in this section to identify ways to bring the taxiway intersection up to current FAA design standards. Hot Spot #2 is located east of Runway 2L-20R at the intersection of Taxiways B, K, and T3, and north of the approach end of Runway 20C. The deficiency associated with Hot Spot #2 is that Taxiway T3 crosses Runway 13-31 and intersects with Taxiway K at an acute angle, reducing pilot and ground vehicle visibility in some movement directions. Also, Taxiway T3 crosses the

approach path of landings to Runway 20C. When Runway 2C-20C is in use, aircraft must hold short of Taxiway T3 on sections of Taxiways K and L until cleared to proceed by air traffic control. Normally, the reconfiguration of angled Taxiway T3 to a standard FAA taxiway design of 90 degrees between Taxiways L and K would be the recommended solution. However, the limitation of Taxiway T3 being located within the approach to Runway 20C indicates that the recommended action to address Hot Spot #2 would be to remove the existing Taxiway T3 and not replace it. Taxiways T4, L, K, and B would remain to provide ground movements to and from Runway 2L-20R and Runway 2C-20C. **Figure 5-4** illustrates the section of Taxiway T3 that would be removed and highlights the "hold short" lines on Taxiway K that protect aircraft penetration of the approach to Runway 20C.

Figure 5-4: Hot Spot 2 - Taxiway T3 Removal



5.2.1.3 Taxiways T1 and T2

Taxiways T1 and T2 connect the terminal apron with Taxiway B near the approach end of Runway 20R. Parallel Taxiways T1 and T2 are separated by a distance of 225 feet, preventing dual simultaneous use by Group V aircraft which requires a 267-foot separation distance. The number of Group V operations at BNA is currently low but is expected to increase during the planning period. As previously shown on the Group V Operational Plan, Taxiway T1 is the designated taxiway for Group V operations rather than Taxiway T2.

Alternatives to providing the required 267-foot separation distance between these parallel taxiways include either relocating Taxiway T1 to the north or relocating Taxiway T2 to the south. **Figure 5-5** illustrates the alternative to shift Taxiway T1 by 42 feet to the south, and **Figure 5-6** illustrates a potential 42-foot shift of Taxiway T2 to the north to provide the required 267-foot separation.

Figure 5-5: Shift of Taxiway T1 to South

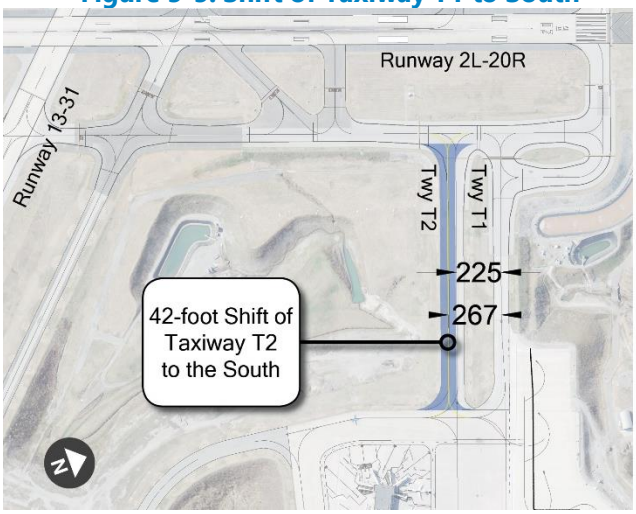
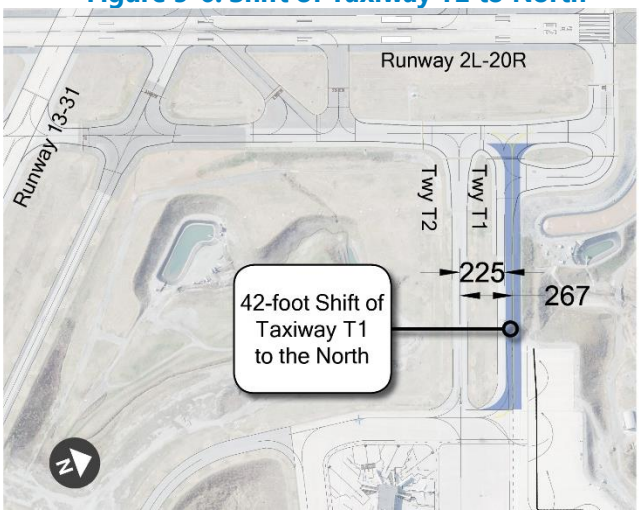


Figure 5-6: Shift of Taxiway T2 to North



For several reasons, a relocation of Taxiway T1 to the north is considered more problematic than a relocation of Taxiway T2 towards the south. Adjacent to the north of Taxiway T1 is a steep embankment approximately 50 feet in height bordering the airport's deicing treatment lagoon and North Pond. Relocating the taxiway closer to the treatment lagoon and North Pond would require fill slopes in excess of the 4:1 slope recommended in FAA's design standards, or alternatively, a lesser fill slope would impact the treatment lagoon and North Pond, requiring modifications or relocations to those facilities. Also, relocating Taxiway T1 to the north would reduce the amount of aircraft queueing for departure on Taxiway B between Taxiway T1 and B5. There is limited land available to relocate the treatment lagoon and/or North Pond facilities, and the potential cost, environmental, and operational impacts of the northward shift of Taxiway T1 could be more significant than the T2 relocation alternative.

Relocating Taxiway T2 to the south would also require moderate fill and potential impact to the Sims Branch watershed, but the terrain drop-off in the vicinity of the taxiway relocation is less severe (between approximately 30 feet adjacent to the terminal apron and 10-15 feet in the vicinity of Taxiway B.

Shifting Taxiway T2 to the south 42 feet is the recommended alternative to meet Design Group V taxiway-taxiway separation standards. The potential environmental and operational impacts of relocating Taxiway T2 towards the south would be less significant than relocating Taxiway T1 towards the north.

5.2.1.4 Runway Protection Zones

Chapter 4, "Facility Requirements" identified incompatible objects and activities within each runway RPZ at BNA. The range of objects and activities in the runway approach RPZs comprise mostly fences, poles, portions of parking lots, above-ground power lines, major public roadways, and a few off-airport property structures. The FAA guidance addressing incompatible objects and activities within RPZs indicates that it is desirable to clear the entire RPZ of all above-ground objects, and further states that where clearing is impractical, airport owners, as a minimum, should maintain the RPZ clear of all facilities

supporting incompatible activities. Land uses that are permissible include airport service roads, underground facilities, and NAVAIDS and their equipment that are fixed-by-function – these objects are not included in this Alternatives analysis.

This Section identifies alternatives for reducing or eliminating incompatible objects and activities within the RPZs. Attention is given to property ownership to help identify objects and activities that are currently within the airport's control to address incompatibilities, and those objects and activities that would require the airport to acquire a property interest to address incompatible conditions.

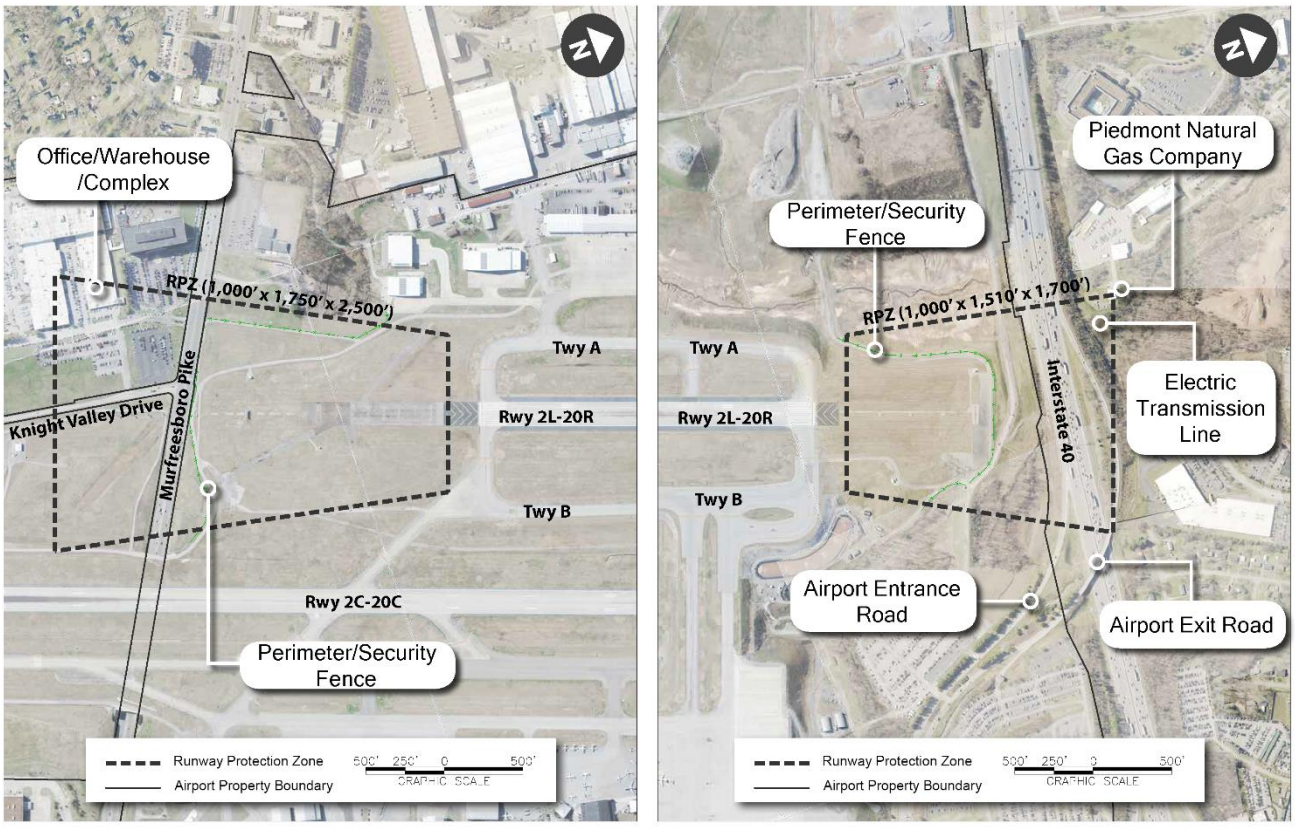
Runway 2L-20R

For the Runway 2L RPZ (**Figure 5-7**), north of Murfreesboro Pike, only the airport's perimeter/security fence would constitute an incompatible object. To the south of the airport security fence, incompatible objects and activities consist of Murfreesboro Pike and Knight Valley Drive, and a portion of the airport-owned Genesco / Metro South office/warehouse complex, including its parking lots with light poles. A recommended extension of Runway 2L would address incompatible objects and activities by tunneling Murfreesboro Pike and removing incompatible portions of the office/warehouse complex and its parking lots/light poles. If the runway is not extended, a mitigation alternative would be to tunnel or relocate Murfreesboro Pike and remove portions of the office/warehouse complex and its associated parking lots and light poles.

For the Runway 20R RPZ, incompatible objects and activities not controlled by the airport include I-40 and its associated airport entrance/exit roadways, and light poles. In addition, north of I-40, there is an overhead electric transmission line traversing the RPZ from east to west, and a small outbuilding supporting the Piedmont Natural Gas Company's facilities located at the outer northwestern edge of the RPZ controlled activity area. On airport property, airport perimeter/security fencing constitutes an object in the 20R RPZ. Alternatives include tunneling or relocating I-40 and its associated airport entrance/exit roadways, relocating the overhead transmission line outside of the RPZ, and working with Piedmont to relocate their structure to another part of their property. On airport property, the perimeter/security fence needs to remain in its current location.

The RPZ incompatibilities on both ends of Runway 2L-20R present challenges in identifying mitigation alternatives. One alternative not explored in detail herein would be to relocate the runway thresholds so that the existing objects/activities would not impede compliance with FAA RPZ compatibility standards. The runway length reduction to avoid the Murfreesboro Pike RPZ penetration would be approximately 1,000 feet for the Runway 2L end but would introduce a new RPZ incompatibility from Monell's restaurant, not located on airport property. To avoid the I-40 RPZ incompatibility, the runway length would need to be reduced by approximately 700 feet for the Runway 20R end. In this alternative, Runway 2L-20R would be reduced from 7,702 feet to approximately 6,000 feet.

Figure 5-7: Runway 2L-20R RPZ

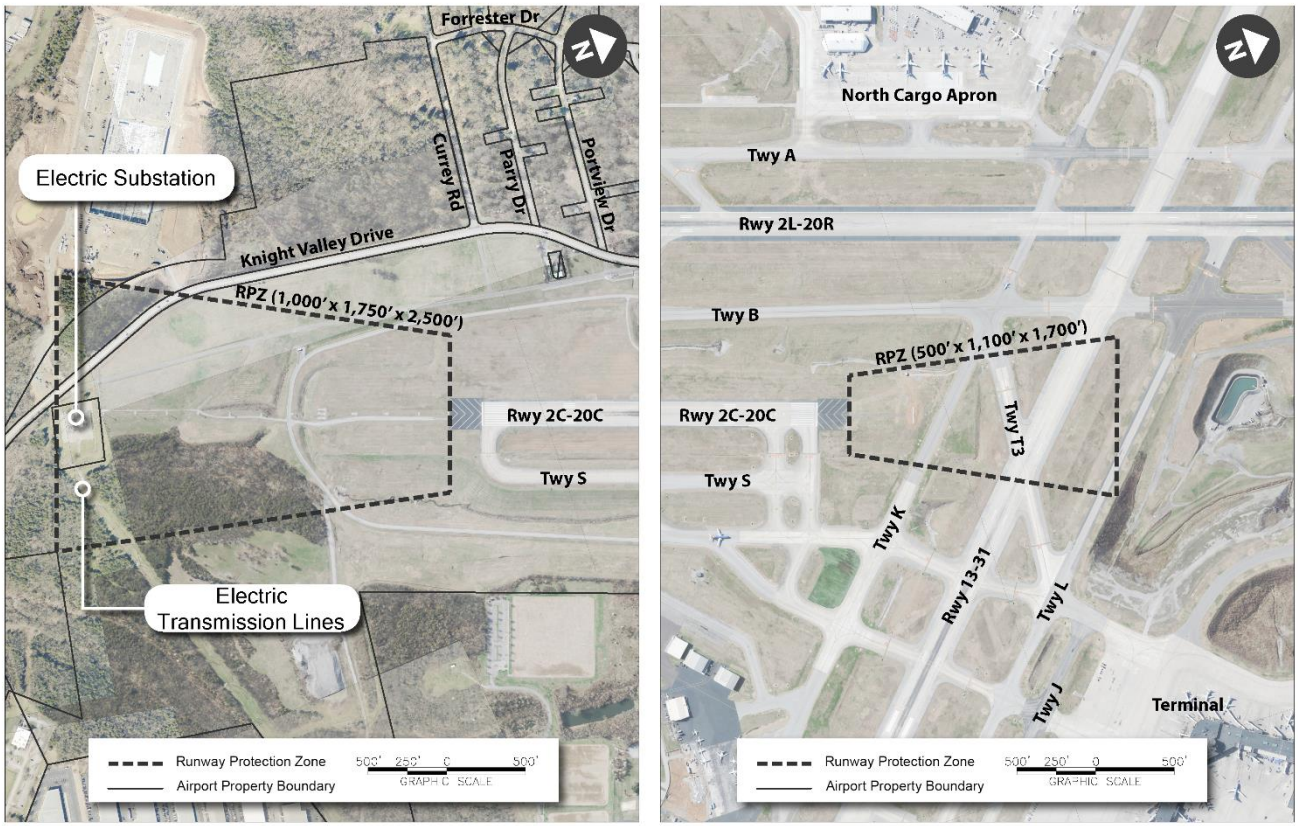


Runway 2C-20C

Objects and activities within the Runway 2C RPZ (**Figure 5-8**) include a portion of Knight Valley Drive, an electric substation, and an overhead power line. These objects are located within both the central and controlled activity portions of the RPZ, towards the outer end of the RPZ. Relocating these objects would comprise one alternative for removing the RPZ incompatibility. On the Runway 20C approach end, RPZ objects consist of Runway 13-31 and portions of the airport's taxiway system. Although not specifically addressed in the FAA's RPZ guidance (AC 150/5300-13A, *Airport Design*), it is assumed that the 24-hour air traffic control provided at the airport maintains positive control of aircraft within the RPZ at all times.

To address the Runway 2C RPZ incompatible objects/activities, one alternative would be to relocate Knight Valley Drive, the substation, and the overhead power line. Another alternative would be to relocate the runway threshold by approximately 1,400 feet, resulting in a reduced runway length from 8,000 feet to 6,600 feet.

Figure 5-8: Runway 2C-20C RPZ

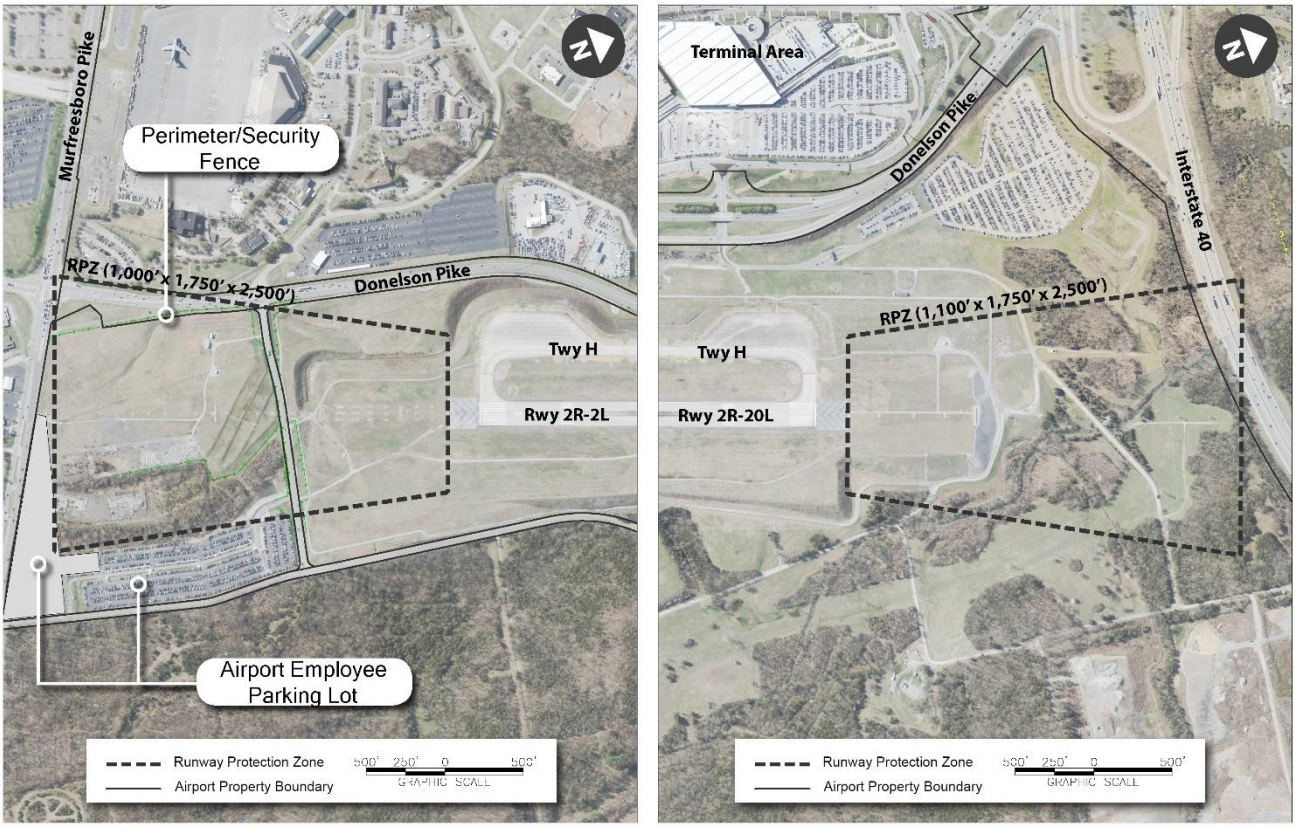


Runway 2R-20L

Incompatible objects in the Runway 2R RPZ (**Figure 5-9**) not controlled by the airport include public roadways (Knapp Boulevard, and a portion of Donelson Pike and its intersection with Murfreesboro Pike). On airport property, a portion of the airport employee parking lot and its light poles, and airport perimeter/security fencing constitute objects and activities within the RPZ. In the Runway 20L RPZ, a small portion of I-40 covers the outer edges of both the central and controlled activity areas.

Alternatives to address RPZ incompatibilities for Runway 2R-20L include relocating major public roadways and relocating a portion of the airport employee lot/light poles. Another alternative would be to relocate both runway end thresholds to avoid the RPZ incompatibilities. A threshold relocation of approximately 1,600 feet would be needed on the Runway 2R end to remove Knapp Boulevard from the RPZ; however, a portion of Donelson Pike would remain with any runway threshold/RPZ relocation, as the roadway geometry curves along the entirety of the runway length. A threshold relocation of approximately 600 feet would be needed on the Runway 20L end to remove the Donelson Pike/I-40 ramp system from the RPZ, although the future relocated Donelson Pike would remain within the RPZ. The result of the potential runway threshold relocations would reduce the length of Runway 2R-20L from 8,000 feet to 5,800 feet.

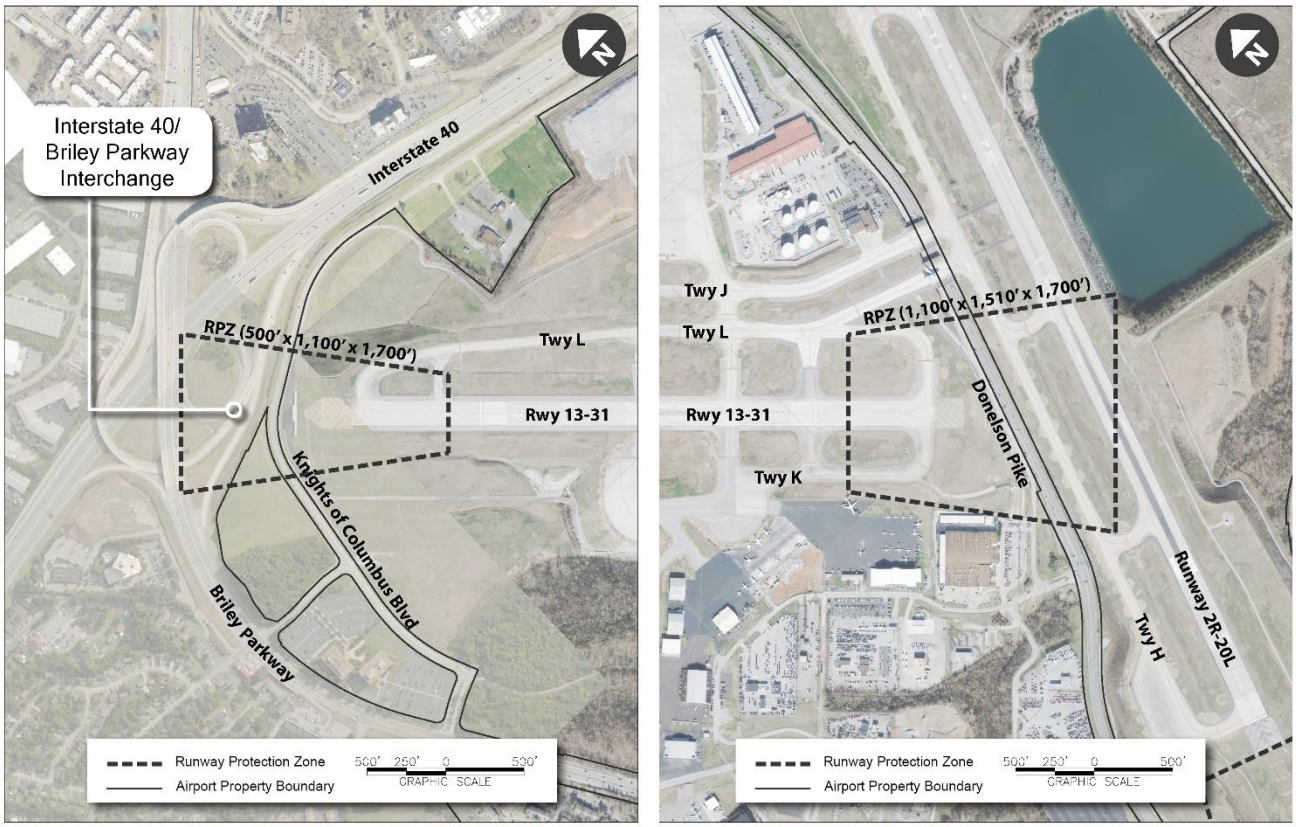
Figure 5-9: Runway 2R-20L RPZ



Runway 13-31

Within the Runway 13 RPZ (**Figure 5-10**), the runway threshold has already been displaced, in part, to reduce the number of incompatible objects. Remaining incompatible objects include Knights of Columbus Boulevard and the I-40/Briley Parkway interchange. For the Runway 31 RPZ, the threshold was also previously displaced, and remaining incompatible objects include Donelson Pike and Runway 2R-20L. Relocating the I-40/Briley Parkway interchange and Donelson Pike appear to be infeasible alternatives. To remove the roadways on both runway ends from being incompatible objects, threshold relocations of approximately 1,600 feet for Runway 13 and 1,850 feet for Runway 31 would result in a reduced length of Runway 13-31 from 11,030 feet to approximately 7,600 feet.

Figure 5-10: Runway 13-31 RPZ



Summary

Most BNA runway approach RPZ object and/or activity incompatibilities would require the relocation of off-airport major public roadways, utility lines, and a private property structure owned by Piedmont Gas Company, or conversely, runway length reductions. Within the airport's property, perimeter/security fences would not be expected to require relocation; however, objects such as the office/warehouse complex, parking lots and light poles are candidate objects and activities that could be evaluated in greater detail, including alternatives presented above. Studying the implications of each of these alternatives is typically the subject of specific detailed evaluation in a targeted effort by a joint, cooperative airport/FAA study. Some airports have engaged in RPZ Risk Assessment and cost-benefit studies, and it is recommended that MNAA and FAA discuss the need for further RPZ evaluation.

5.2.2 Additional Runway Length

Achieving daily scheduled international service to Europe in 2018, BNA is poised to add international service to other destinations. The Facility Requirements chapter evaluated runway lengths needed to serve potential international markets with typical long-haul aircraft. Prior master planning identified the B757 and B747 as the aircraft most likely to be used for international service; however, the airline

industry fleet has evolved to favor long-haul aircraft such as the B777, B787, A330, and A350 which are capable of nonstop Europe and Asia service carrying high payloads in all seasons from Nashville. The recommended runway length to attract and accommodate reliable, long-haul international service that can operate at unrestricted payloads, even in typical hot summer conditions, is 12,000 feet.

BNA's existing Runway 13-31 is 11,030 feet in length, and long-haul international service can continue to operate on 11,030 feet, even if it means providing such service with reduced payload (passengers and cargo) and fuel capabilities. An important consideration in seeking an alternative for BNA to provide 12,000-foot length for its international service, even if it results in BNA having two runways capable of such long-haul service includes:

1. There will be times in the future that Runway 13-31 is not available for periods of time due to required maintenance, such as pavement reconstruction. It is imperative for an airport to provide reliability for airlines to serve their markets once the air service is established;
2. Runway 13-31 is not aligned in the primary north-south traffic flow orientation provided by Runways 2L-20R, 2C-20C, and 2R-20L. Although it is possible to "fit in" current international traffic on the crosswind Runway 13-31 while the airport operates in the north-south flow, projected activity levels could present increasing impacts to airfield and airspace capacity and delay throughout the planning period when fitting in a crosswind operation into the main north-south traffic flow; and
3. The precision instrument approach capabilities of Runway 13-31 are limited in providing all-weather capability and reliability, especially to Runway 13, which only provides a visibility "minimum" of not less than one mile. Full precision instrument approaches provide visibility minimums of ½ mile and lower for Category II/III operations, providing a higher level of operational reliability;
4. There are obstacles within the approach and departure paths of Runway 13-31 that affect long-haul aircraft performance, based on airline one engine inoperative (OEI) takeoff length calculations. Fixed objects such as the Runway 13 and Runway 31 blast fences, Runway 2R-20L, Taxiway H, Donelson Pike, and the I-40/Briley Parkway interchange affect airline OEI calculations of takeoff runway length available, and these objects cannot be relocated.

Runway 13-31 also has some physical limitations that could be a constraint to long-term airfield and land use planning. While there is no current purpose or need to consider decommissioning or shortening Runway 13-31, there could be a time in the future that such an idea is considered, such as beyond the planning period when the number of peak period aircraft operations are projected to require evaluation of additional airfield capacity options.

Prior master planning evaluated (and ultimately recommended) the extension of Runway 2L to the south as the preferred runway to provide runway length needed to serve potential international destinations with B747 and B757 aircraft. The 2013 master plan analysis only evaluated options for extending Runway 2L-20R and 2C-20C. With the continued decrease in airline use of B747 and B757 passenger aircraft for international destinations, the updated analysis within this master plan evaluates each of the four existing runways for their ability to achieve a 12,000-foot length for the modern and projected fleet serving BNA. The analysis below evaluates the feasibility, advantages, and disadvantages of extending each of the four existing BNA runways, and their ability to:

1. Provide 12,000-foot takeoff runway length;

2. Meet FAA design standards for Design Group V aircraft;
3. Maintain or improve airfield and airspace capacity;
4. Support all-weather precision instrument approaches (Cat. II/III);
5. Consider potential environmental impacts associated with the potential runway extension.

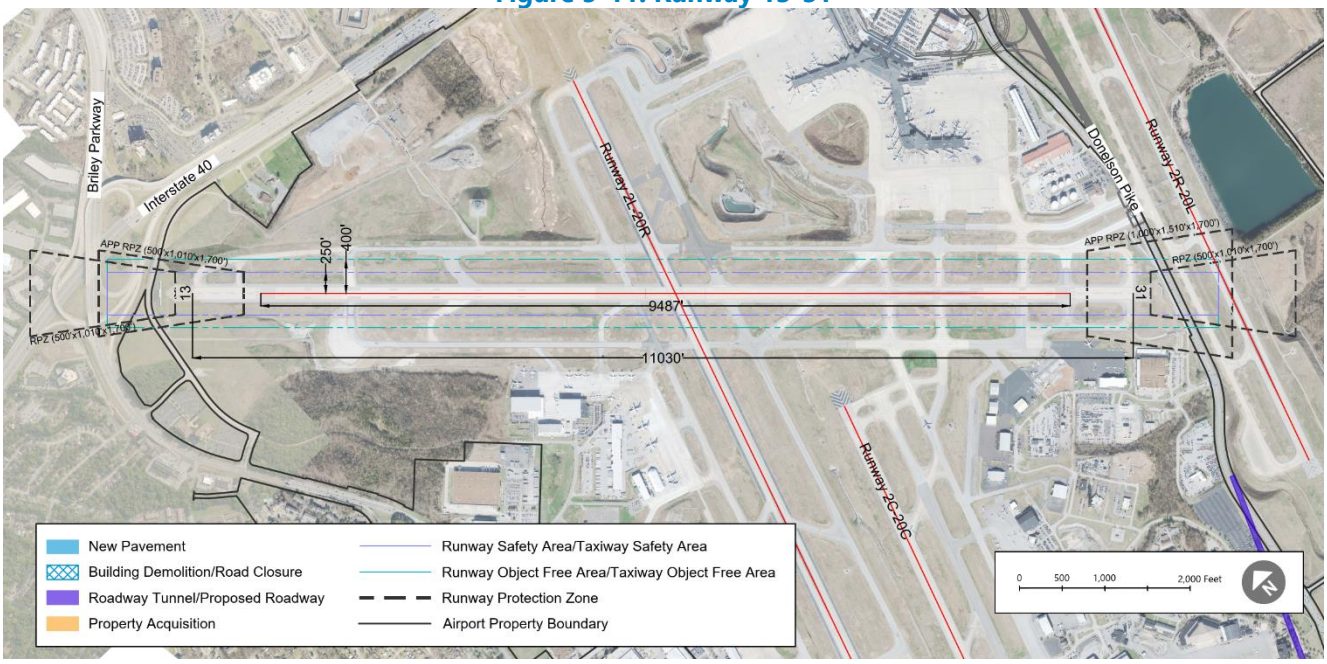
5.2.2.1 Alternative 1 - Extend Runway 13-31

At 11,030 feet in length, existing Runway 13-31 is the longest runway at BNA (**Figure 5-11**). Oriented in a northwest-southeast direction, the runway is not oriented in the main north-south direction of the other three runways (2-20); thus, Runway 13-31 is considered a "crosswind" runway, and is used only when wind, weather, or operating conditions warrant, and when air traffic control can accommodate the operation in the airspace. Importantly, not all of the 11,030-foot length is available for aircraft operations – due to inadequate runway safety areas (RSAs) on both ends, only 10,288-feet has been declared available for takeoff run and accelerate-stop distances in each runway direction. Also, the thresholds to both runway ends are displaced due to obstacles in the approach/departure paths including Runway 2R-20L, Taxiway H, and Donelson Pike (Runway 31 approach), and the Briley Parkway/I-40 interchange (Runway 13 approach), resulting in a shortened landing distance available (LDA) of 9,487 feet. Finally, only Runway 31 is able to maintain a precision instrument approach, whereas the approach to Runway 13 is non-precision with a visibility of greater than one mile due to the inability to construct an approach lighting system within the Briley Parkway and I-40 roadway rights-of-way.

In reviewing the potential extension of Runway 13-31, it is not feasible to provide the 12,000-foot length due to the inability to relocate or tunnel the adjacent major roadways (I-40, Briley Parkway, and Donelson Pike), or relocate Taxiway H and Runway 2R-20L. Also, Runway 13 is not capable of being improved to provide precision instrument approach capability with minimums lower than the existing one-mile visibility. The orientation of Runway 13-31 is not aligned with typical north-south air traffic flow on the existing parallel 2-20 runways, which could lessen airfield and airspace capacity when accommodating Runway 13-31 operations, especially as operations continue to increase during the planning period. Finally, the approach to Runway 31 has some potential limitations and airspace interaction with the Smyrna Airport, located within a few miles to the southwest of BNA.

Based on the evaluation factors, extending Runway 13-31 to 12,000 feet in length is not considered feasible and is removed from further consideration.

Figure 5-11: Runway 13-31



5.2.2.2 Alternative 2 – Extend Runway 2C-20C

Existing Runway 2C-20C is 8,001 feet long and is currently designed to Group IV standards. The Localizer equipment supporting the precision approach to Runway 2C is located within the extended RSA north of the Runway 20C approach end, resulting in the runway having declared distances for accelerate-stop distance available (ASDA) and landing distance available (LDA) of 7,601 feet.

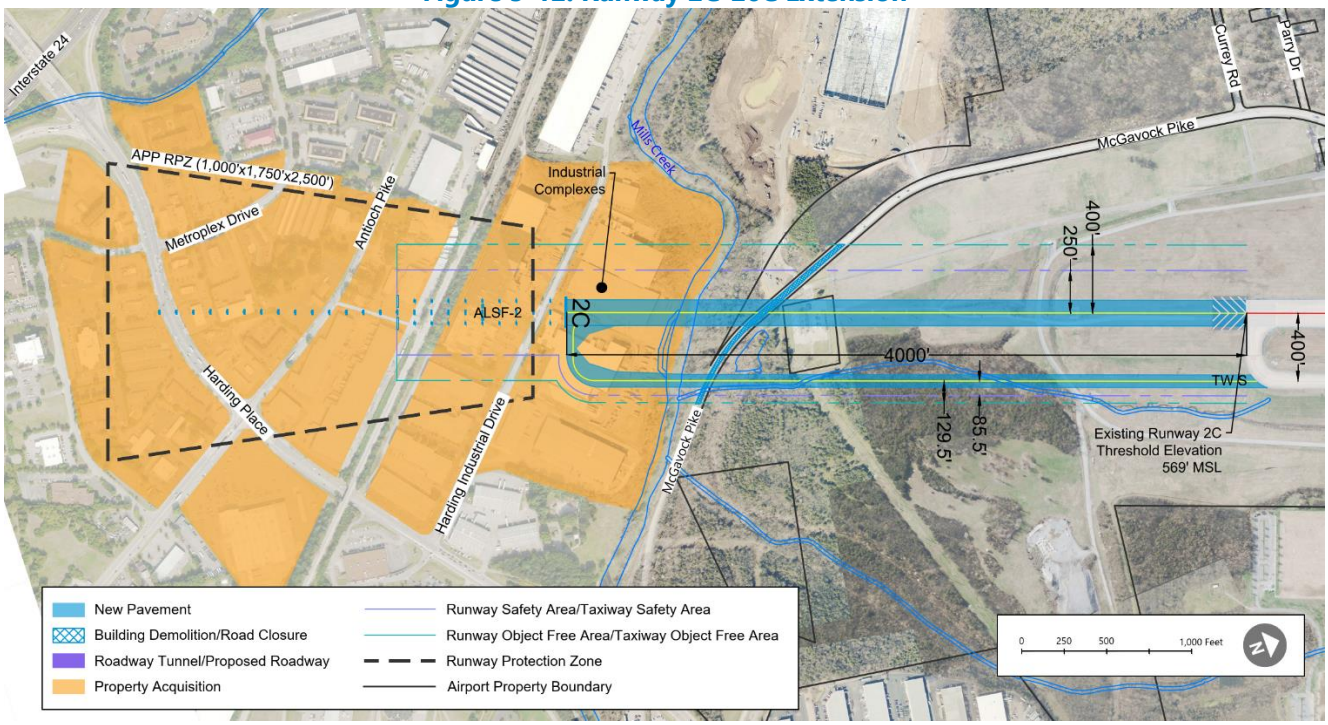
The 2013 Master Plan evaluated the potential for a 2,999-foot extension of Runway 2C-20C to the north towards the terminal apron complex to achieve an 11,000-foot length. The potential extension created new runway/runway and runway/taxiway intersections with Runway 13-31, Taxiway K and Taxiway L, and required aircraft to/from the terminal apron to hold short of Taxiways T1 and T2 to allow Runway 20C approaches and Runway 2C departures. These conditions created an impractical operating condition that reduced airfield capacity considerably. Also, the Runway 20C threshold was displaced, reducing the landing distance available by 642 feet. Finally, stormwater treatment facilities needed to be relocated, and Sims Branch and Snakey Creek stream alterations required Aquatic Resource Alteration Permits. The alternative of extending Runway 2C-20C to the north was dismissed.

In evaluating a potential 12,000-foot length for Runway 2C-20C, the alternative of extending the approach end of Runway 2C to the south by 4,000 feet was explored (**Figure 5-12**). Potential extension of Runway 2C-20C to the south would encounter several issues and constraints. To the south of the existing runway lies large industrial complexes near Harding Place between McGavock Pike and Antioch Pike, requiring displacement of several large businesses, roadways, and a stream (Mill Creek). An approach lighting system providing a Category II/III precision approach (ALSF-2) to an extended Runway 2C would be difficult to install without roadway closures and/or relocations. Finally, the parallel taxiway

system (Taxiway S) serving Runway 2C-20C is separated from the runway at a distance of 400 feet and could not be reconstructed to a Design Group V precision approach standard of 500 feet for visibilities as low as ½ mile (or lower) without severe impacts to facilities and operations at the existing general aviation complex.

Based on the evaluation, extending Runway 2C-20C to 12,000 feet is not considered feasible and is removed from further consideration.

Figure 5-12: Runway 2C-20C Extension



5.2.2.3 Alternative 3 – Extend Runway 2R-20L

Existing Runway 2R-20L is 8,000 feet long and is currently designed to Design Group IV standards. Two alternatives for extending Runway 2R-20L were considered – extending the Runway 2R end by 4,000 feet to the south and extending Runway 2R-20L to both the north and south. The two alternatives are illustrated in **Figure 5-13** and **Figure 5-14**. Both alternatives achieve a 12,000-foot runway length; however, the Runway 2R-20L-to-Taxiway H centerline separation is 400 feet, which does not meet full Design Group V standards for precision approach visibilities of ½ mile or lower.

In the alternative that extends Runway 2R to the south by 4,000 feet, Donelson Pike would need to be relocated to provide the standard Taxiway H Object Free Area (TOFA), and Murfreesboro Pike would need to be tunneled under the extended runway. A significant amount of land acquisition would be required to provide the necessary Runway Protection Zone (RPZ), and local roads (Ezell Pike, Old Ezell Road, Citation Road, and Citation Place) would need to be relocated to make room for the installation of the precision approach lighting system to the extended runway.

In the alternative that extends both runway ends, the actual pavement length of the runway would need to be 13,000 feet with the use of declared distances and displaced thresholds in order to provide the usable length of 12,000 feet for takeoffs and landings. The northerly extension of the Runway 20L end would consist of a 2,350-foot extension, whereas the south extension of Runway 2R would consist of a 2,650-foot extension. The Runway 20L RPZ would lie north of I-40, requiring property acquisition to provide compatible land use. The Runway 2R RPZ would extend slightly over Murfreesboro Pike to avoid tunneling the roadway; however, some land acquisition would still be required to provide land use compatibility.

Figure 5-13: Runway 2R-20L Extension - Extend Runway 2R to the South

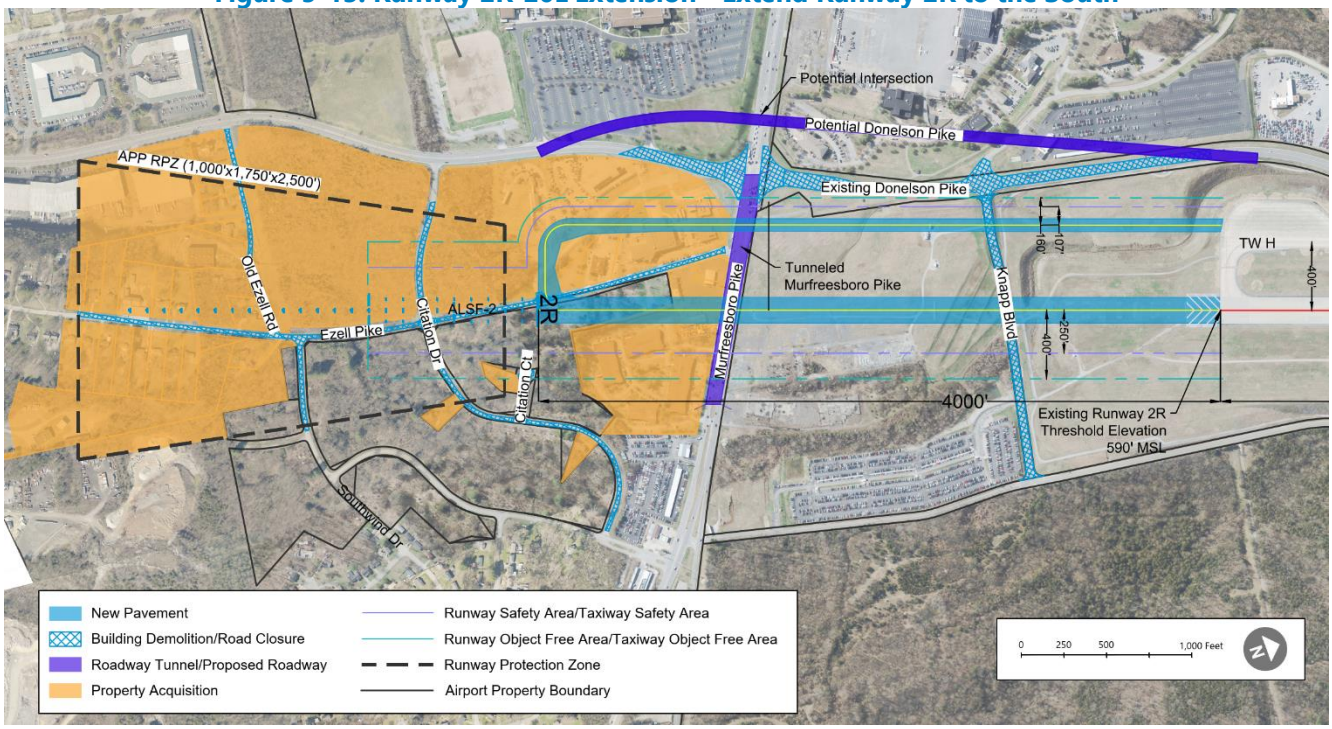
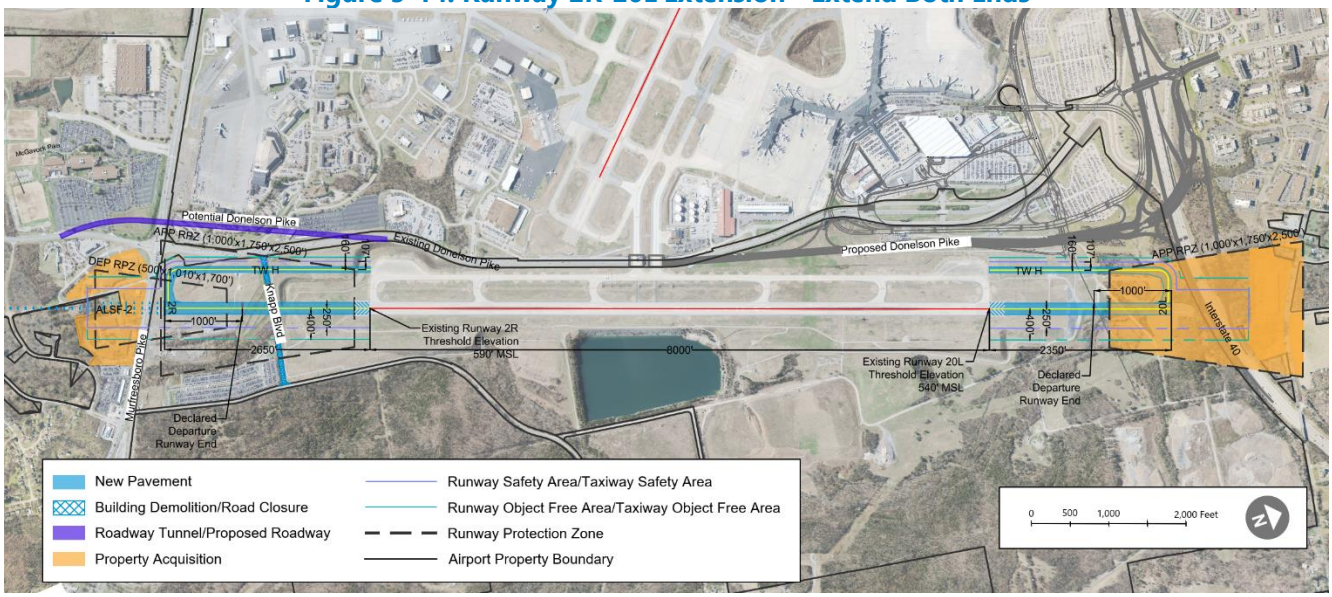


Figure 5-14: Runway 2R-20L Extension - Extend Both Ends



5.2.2.4 Alternative 4 – Extend Runway 02L-20R

Existing Runway 2L-20R is 7,704 feet in length. Parallel Taxiway B is separated from the runway at 525 feet which achieves compliance with Group V design standards for precision approaches with visibilities of ½ mile or lower; however, Taxiway A serving the west cargo and general aviation areas is separated from the runway by 400 feet, which does not meet Group V standards. The existing runway has precision approach capability to each runway end, with Category II/III approach capability to Runway 2L. **Figure 5-15** illustrates the alternative of extending the Runway 2L approach end by 4,296 feet to achieve the 12,000-foot length.

The extension of the Runway 2L approach end was selected in the 2013 Master Plan as the preferred alternative. The MNAA has already accomplished most property acquisition needed for the prior-determined 11,000-foot runway length, primarily in the Airport Estates subdivision. Some properties from that acquisition program remain in progress; however, achieving the 12,000-foot length would require additional property acquisition at the southern end of the subdivision to provide the required RPZ.

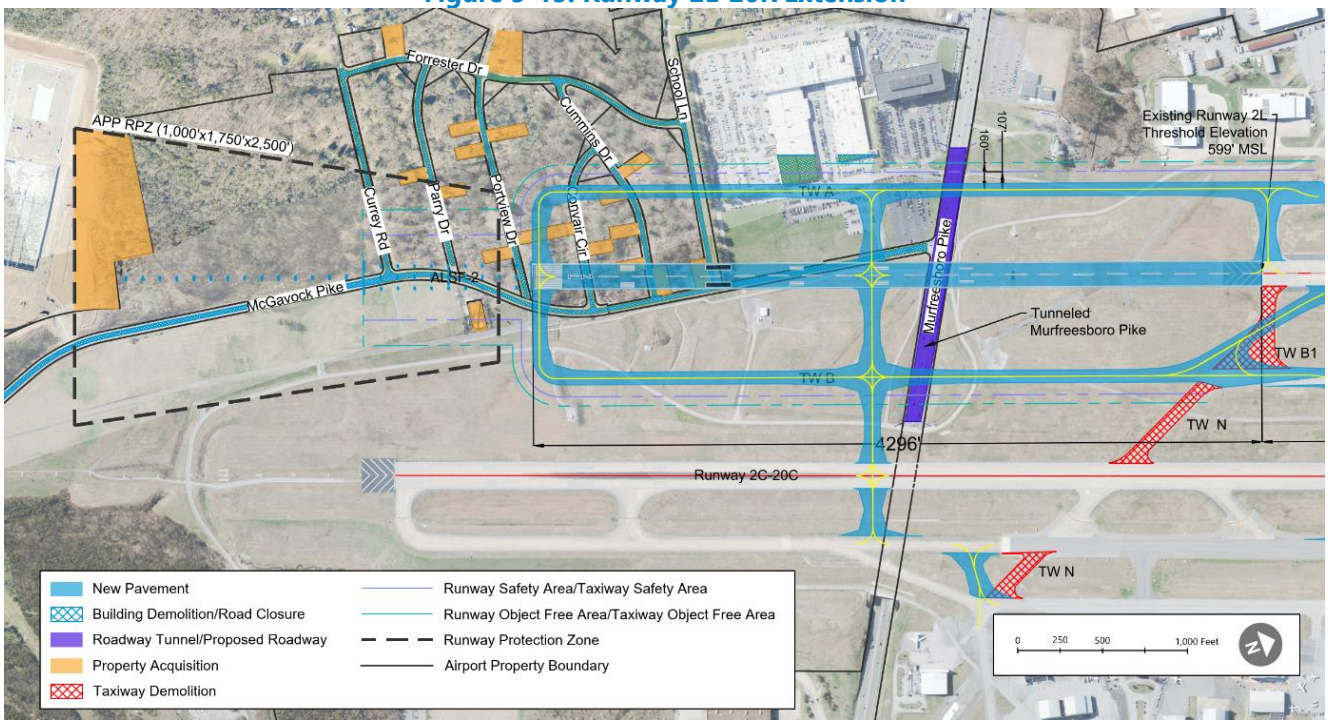
In this alternative, Knight Valley Drive would need to be relocated or replaced and several local roads within the acquired subdivision would also need to be closed. Murfreesboro Pike would be required to be tunneled, since relocation and realignment of Murfreesboro Pike was evaluated and considered infeasible due to its resulting extreme distance from the existing alignment and difficulties in providing a standard roadway geometry and design speed without impacting other major roadways such as Harding Place.

The disadvantage of the 400-foot separation between Runway 2L-20R and Taxiway A would need to be overcome by implementing an operational restriction similar to the existing Runway 2R-20L condition,

where aircraft need to hold beyond 550 feet from the runway centerline in low visibility weather conditions.

Based on the evaluations of each alternative to achieve a 12,000-foot runway length, Alternative 4 (extending Runway 2L-20R) is recommended.

Figure 5-15: Runway 2L-20R Extension



5.2.3 Long-Term Disposition of Runway 2C-20C

Questions have been raised as to the long-term viability of retaining Runway 2C-20C. As indicated in the runway length analysis above, Runway 2C-20C cannot be extended to provide a 12,000-foot takeoff length to accommodate international service, and since the runway is closely spaced with Runway 2L-20R (1,176-foot separation), there is some reduction in airfield and airspace capacity when both runways are used simultaneously for arrivals and departures. Notwithstanding the runway length limitations and impact to airfield capacity due to being closely spaced with Runway 2L-20R, there are some significant benefits of retaining Runway 2C-20C for the foreseeable future:

1. Runway 2C-20C is located adjacent to the General Aviation (GA) complex and provides significant benefit to the airport by reducing some GA use of Runways 2L-20R and 2R-20L, thereby lessening the capacity/delay impact of its separation distance from Runway 2L-20R;
2. Runway 2C-20C serves as a Group V aircraft arrival and departure runway in weather conditions that are not lower than ½ mile visibility;
3. The prior extension of Runway 2C-20C across Murfreesboro Pike represented a significant investment in ensuring 8,000-foot runway length redundancy, supplementing Runways 2L-20R and 2R-20L with similar capability for airport users.

At this time, there is no need to consider decommissioning or reducing runway length for Runway 2C-20C.

5.2.4 Recommended Airfield Alternatives

The evaluations above result in the following recommended alternatives for airfield facility improvements:

1. Improve Runway 2R-20L geometry to meet FAA design standards, as recommended in the AECOM and Atkins/Garver reports, and as modified/approved by the FAA;
2. To address Hot Spot #2 standards deficiencies, remove diagonal Taxiway T3 pavement;
3. Relocate Taxiway T2 to the south by 42 feet to meet Group V taxiway separation standards between T1 and T2 (267 feet);
4. Perform more detailed evaluation of RPZ compliance alternatives, and gain FAA approval;
5. Extend Runway 2L-20R to the south to achieve a 12,000-foot runway length for existing and potential international air service for the modern Group V aircraft fleet; and,
6. Retain Runway 2C-20C.

5.3 Terminal Improvement Alternatives

The existing terminal consists of 43 gates on Concourses A, B, and C. Currently, a six-gate Concourse D is under construction, slated for opening in 2020, resulting in a 49-gate terminal complex. Immediately following Concourse D completion, "Project 3" of the BNA Vision program will commence and will renovate and expand portions of the main terminal. Upon Project 3 completion in 2024, international arrivals only Gate A5 (and its associated interim federal inspection station facility) will be removed, resulting in a post-BNA Vision terminal complex consisting of 48 gates. The Master Plan has projected the need for between 52 - 56 gates by 2022 and 61 or more gates by 2037. With air service increasing more rapidly than forecast, it is likely that additional gates will need to be available by the time BNA Vision Project 3 is completed.

In addition to more gates, the Facility Requirements indicate need within the planning period for additional terminal ramp deicing positions and remain overnight aircraft parking (RON); reconstructing and expanding terminal support facilities (Air Freight/GSE); and improvements to several passenger processing functional areas within the terminal building, including:

- Additional check-in facilities and check-in lobby queue area;
- An additional baggage claim device;
- An additional security screening checkpoint lane;
- Additional baggage screening machines;

- Additional outbound baggage makeup carousel, cart storage area, and circulation; and,
- Additional non-secure side restroom facilities.

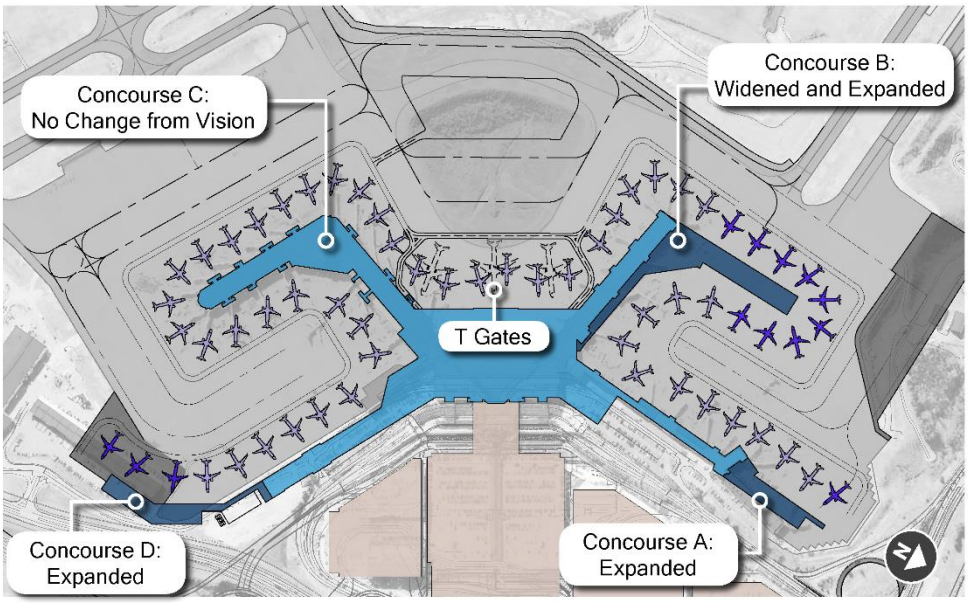
The sections below provide alternatives for improving the terminal gate, deicing/RON, and passenger processing functional area facilities.

5.3.1 Existing Concourses - Potential Gate Expansion

To identify expansion alternatives for the existing concourses after BNA Vision completion, each existing concourse was reviewed. **Figure 5-16** through **Figure 5-20** illustrate alternatives that were explored to achieve a minimum 61-gate terminal complex.

In Alternative 1A (**Figure 5-16**), Concourses A, B, and D are expanded to provide a total of 61 gates. This alternative minimizes the amount of new terminal apron that would be needed to serve expanded Concourse A, although Concourse A would remain a single-sided concourse, potentially reducing opportunities for enhanced concessions and public spaces in the extended concourse. In Alternative 1A, Concourse B is expanded from its post-BNA Vision 11 gates to a 19-gate facility.

Figure 5-16: Terminal Gate Development – Alternative 1A



BNA MPU 2037	Alt 1A
Concourse A	8
Concourse B	19
Concourse C	19
Concourse D	9
T- Gates	6
Total Gates	61

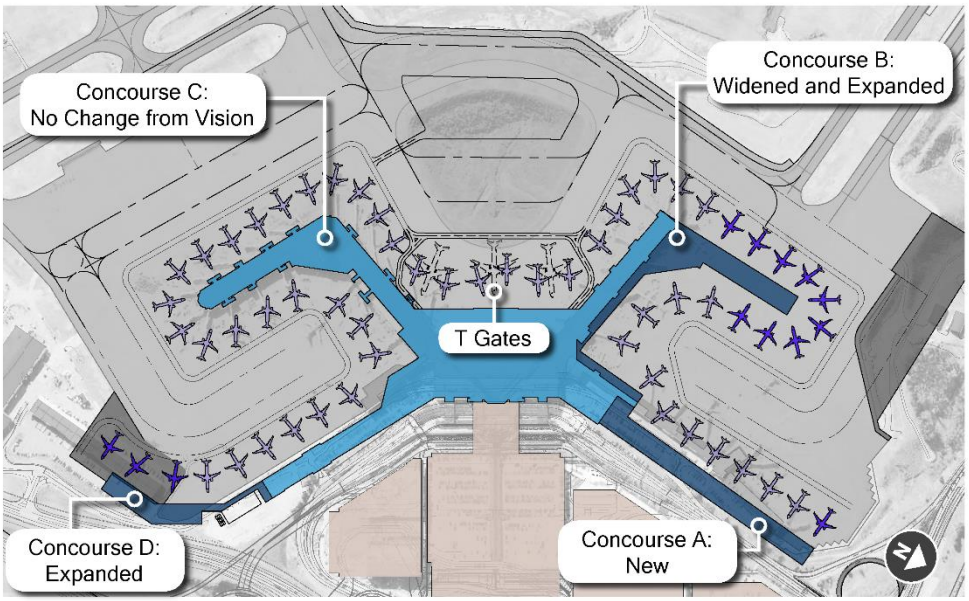
Walking Distance	Alt 1A
Concourse A	1,600 ft
Concourse B	1,625 ft
Concourse C	1,575 ft
Concourse D	2,050 ft
T- Gates	390 ft

Notes:
1. Walking distances rounded to nearest 5 ft
2. Distances measured from center of SSCP exit to furthest gate
3. Distances are approximate and may vary based on final interior configuration

	Existing	Proposed
Apron		
Terminal		
Gate		

Alternative 1B (**Figure 5-17**) addresses the Concourse A width deficiency by redeveloping the concourse into a wider facility to allow for improved concessions and public space, and retains the concept of extending Concourse B by eight gates and adding three gates to Concourse D.

Figure 5-17: Terminal Gate Development – Alternative 1B



BNA MPU 2037	Alt 1B
Concourse A	8
Concourse B	19
Concourse C	19
Concourse D	9
T- Gates	6
Total Gates	61

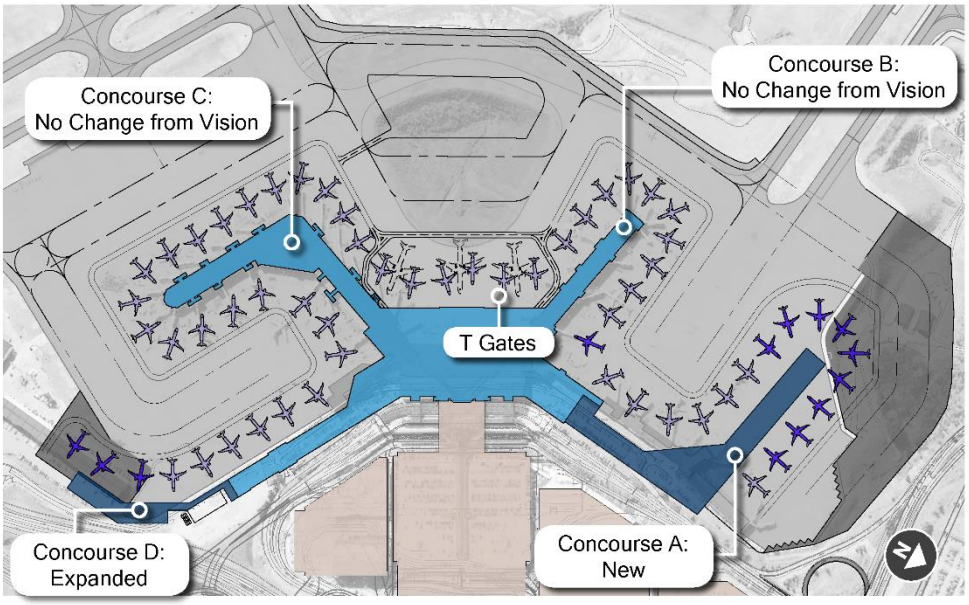
Walking Distance	Alt 1B
Concourse A	1,800 ft
Concourse B	1,625 ft
Concourse C	1,575 ft
Concourse D	2,050 ft
T- Gates	390 ft

Notes:
1. Walking distances rounded to nearest 5 ft
2. Distances measured from center of SSCP exit to furthest gate
3. Distances are approximate and may vary based on final interior configuration

	Existing	Proposed
Apron		
Terminal		
Gate		

Alternative 2 (**Figure 5-18**) creates a redeveloped, double-loaded Concourse A. The amount of terminal apron needed to serve redeveloped Concourse A is greater than Alternatives 1A and 1B, but the redeveloped concourse results in an improved passenger experience, with more typical concessions and public spaces provided. Concourse B remains as a post-BNA Vision 11-gate complex, and Concourse D is extended by three gates in this Alternative.

Figure 5-18: Terminal Gate Development – Alternative 2



BNA MPU 2037	Alt 2
Concourse A	16
Concourse B	11
Concourse C	19
Concourse D	9
T- Gates	6
Total Gates	61

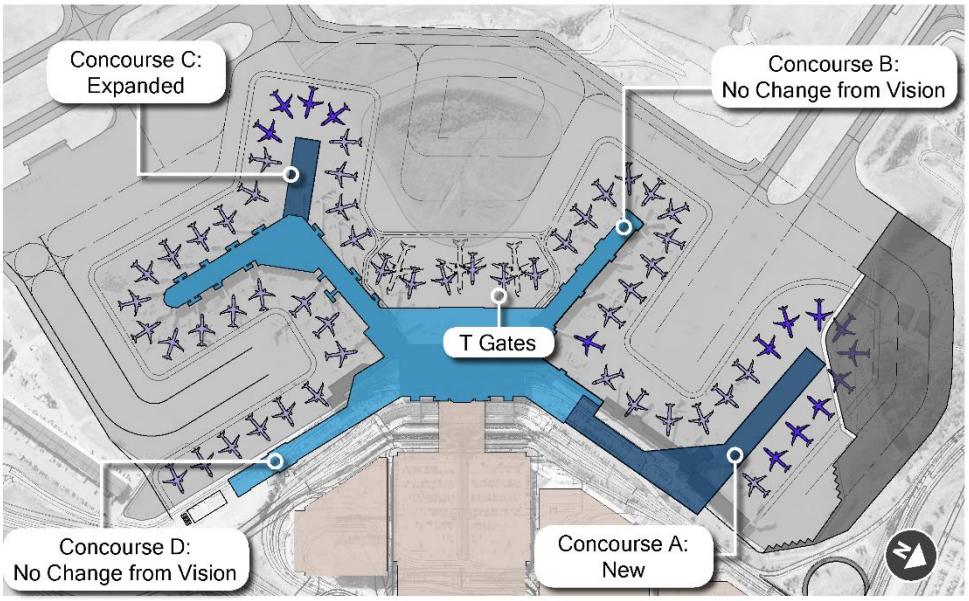
Walking Distance	Alt 2
Concourse A	2,200 ft
Concourse B	1,000 ft
Concourse C	1,575 ft
Concourse D	2,050 ft
T- Gates	390 ft

Notes:
1. Walking distances rounded to nearest 5 ft
2. Distances measured from center of SSCP exit to furthest gate
3. Distances are approximate and may vary based on final interior configuration

	Existing	Proposed
Apron		
Terminal		
Gate		

Alternative 3 (**Figure 5-19**) retains the double-sided, redeveloped Concourse A, and offers a potential expansion of Concourse C by four gates. Although the Concourse C extension provides a lesser walking distance to the outer concourse gates than Concourse A, B, and D alternatives, the extension of Concourse C presents an aircraft circulation issue within the terminal area, making it more circuitous for aircraft to maneuver and creating a point of congestion near the critical junction of Taxiway T4. In reviewing Concourse C expansion alternatives, it was determined that operational impacts to aircraft ground movements to and from the taxiway system and within the limits of the terminal apron would be created. Extending or redeveloping Concourse C to provide additional gates was dismissed from further consideration.

Figure 5-19: Terminal Gate Development – Alternative 3



BNA MPU 2037	Alt 3
Concourse A	16
Concourse B	11
Concourse C	23
Concourse D	6
T- Gates	6
Total Gates	62

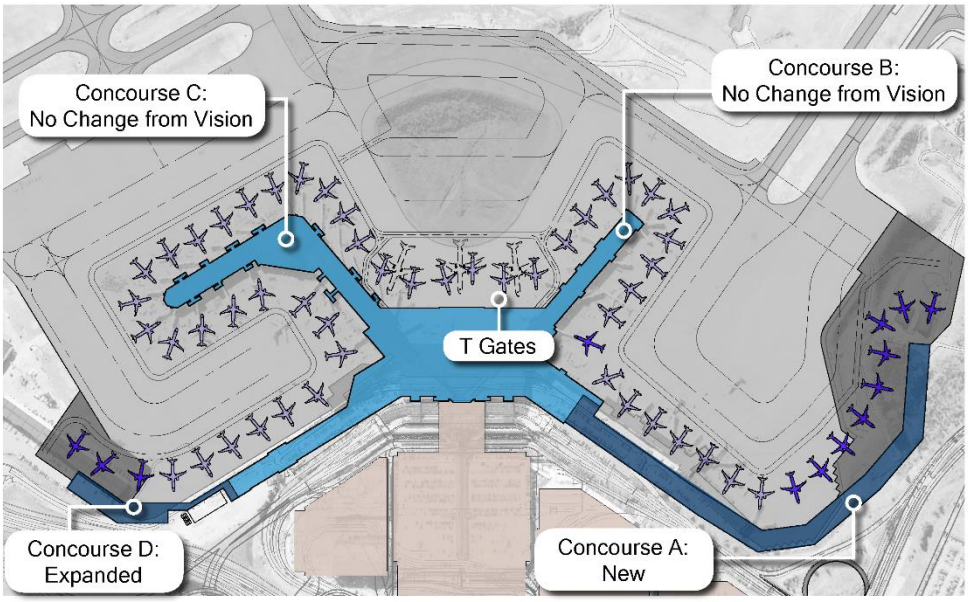
Walking Distance	Alt 3
Concourse A	2,200 ft
Concourse B	1,000 ft
Concourse C	1,575 ft
Concourse D	1,260 ft
T- Gates	390 ft

Notes:
1. Walking distances rounded to nearest 5 ft
2. Distances measured from center of SSCP exit to furthest gate
3. Distances are approximate and may vary based on final interior configuration

	Existing	Proposed
Apron		
Terminal		
Gate		

Alternative 4 (**Figure 5-20**) illustrates an elongated concourse extension alternative for Concourse A, retaining the single-loaded concourse configuration. Walking distance on the extended Concourse A is more than 3,000 feet, creating a distinct disadvantage to the alternative. Conversely, aircraft circulation between Concourses A and B is easier than other alternatives due to the wider pavement expanse and visibility provided.

Figure 5-20: Terminal Gate Development – Alternative 4



BNA MPU 2037	Alt 4
Concourse A	16
Concourse B	11
Concourse C	19
Concourse D	9
T- Gates	6
Total Gates	61

Walking Distance	Alt 4
Concourse A	2,975 ft
Concourse B	1,000 ft
Concourse C	1,575 ft
Concourse D	2,050 ft
T- Gates	390 ft

Notes:
1. Walking distances rounded to nearest 5 ft
2. Distances measured from center of SSCP exit to furthest gate
3. Distances are approximate and may vary based on final interior configuration

	Existing	Proposed
Apron		
Terminal		
Gate		

In reviewing the advantages and disadvantages of Alternatives 1A through Alternative 4, the recommended alternative is Alternative 2, which provides a balance between terminal apron expansion; moderate walking distances to each concourse; and a positive aircraft movement condition with dual apron taxilanes between Concourses A and B and Concourses C and D, important to maintaining terminal area capacity while minimizing aircraft ground movement delays.

The following sections identify and evaluate the refinement of Alternative 2 to redevelop and/or supplement gates on Concourses A, B, and D.

5.3.1.1 Concourse A

Existing Concourse A consists of eight (8) gates arranged in a linear configuration and connected to the main terminal by a circulation corridor along its length. Gate A5 and the interim Federal Inspection Station (FIS) facility is to be demolished once the new FIS is constructed as part of Project 3 of the BNA Vision program, resulting in a 7-gate Concourse A by 2024.

There is sufficient room to redevelop and expand Concourse A by adding apron pavement and adding a double-loaded concourse extension in a configuration that is nearly parallel with Concourse B. The concept would provide for fourteen (14) Group III aircraft gates, and two (2) Group V gates, for a net gain of nine (9) new gates. **Figure 5-21** illustrates the concept to redevelop/expand the existing concourse into a 16-gate concourse. The concept provides for a dual parallel taxilane system to the north of the concourse to facilitate aircraft movements to and from those gates. It is expected that the current deicing system north of existing Concourse A would be affected, requiring relocation or other facility improvements, as discussed in greater detail later in this chapter. **Figure 5-22** illustrates a potential departures level interior layout and space allocation for the redeveloped/expanded concourse,

providing space for holdrooms, improved concessions, circulation corridor, restrooms, and other building functions.

Figure 5-21: Redeveloped/Expanded Concourse A

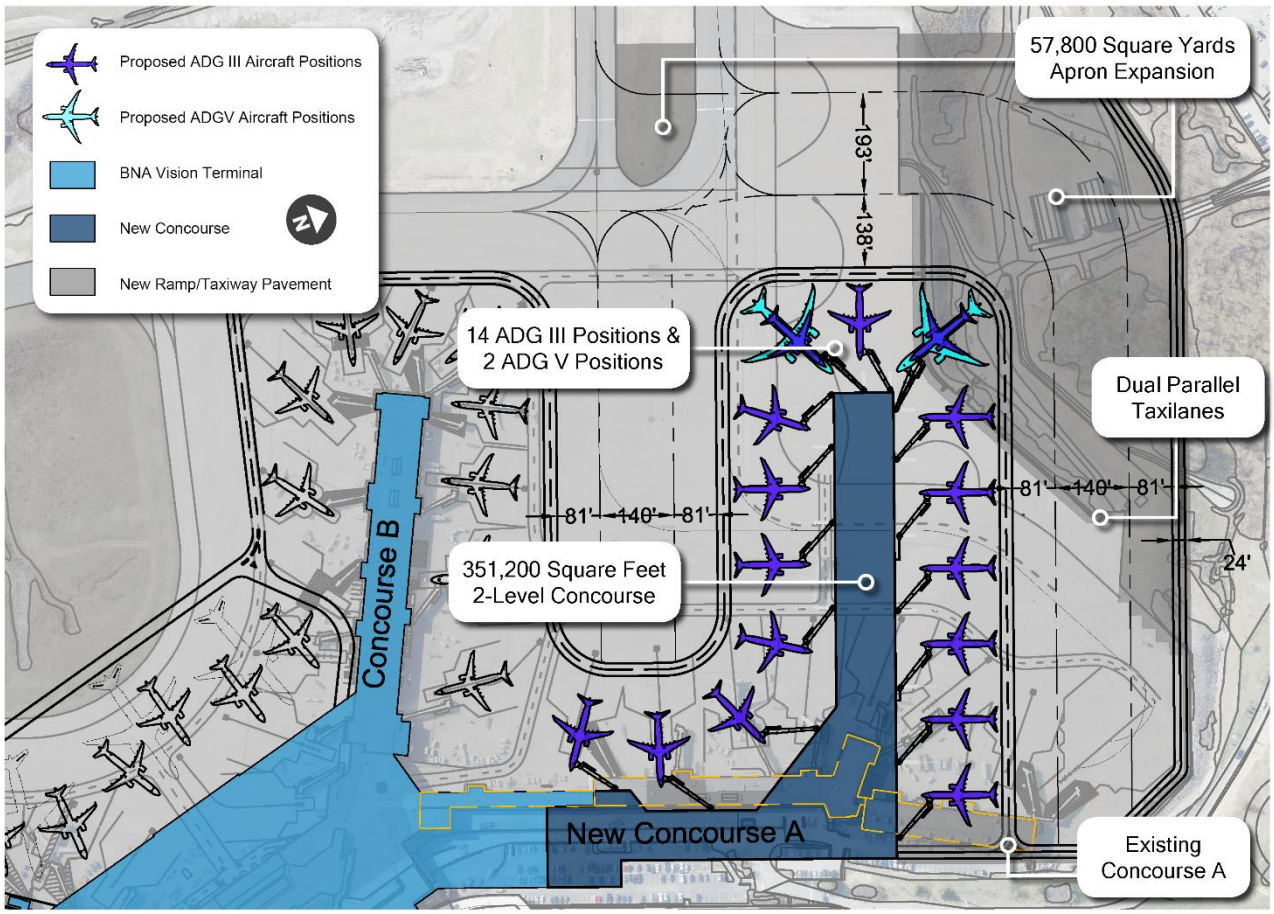
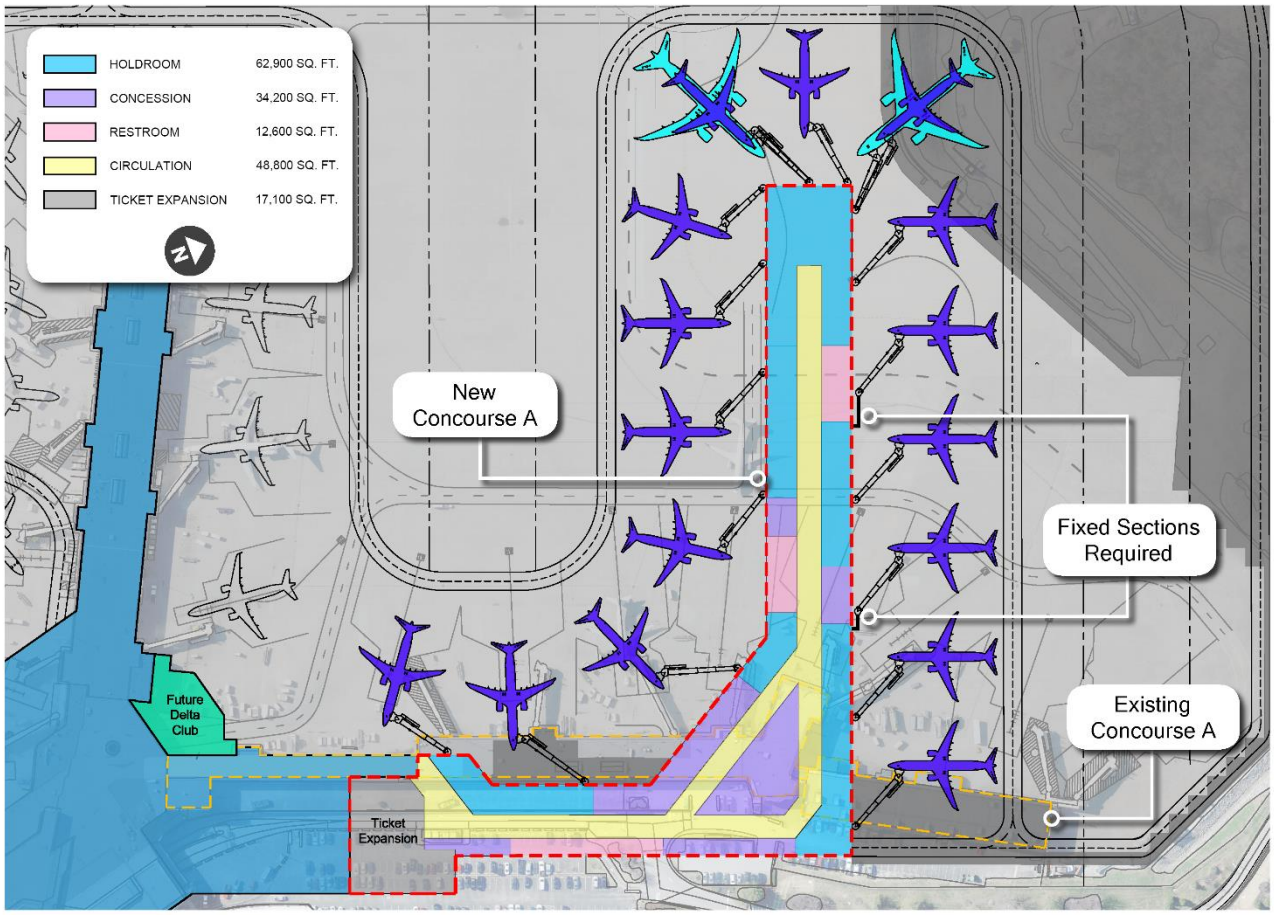


Figure 5-22: Redeveloped/Expanded Concourse A – Departures Level Interior Layout



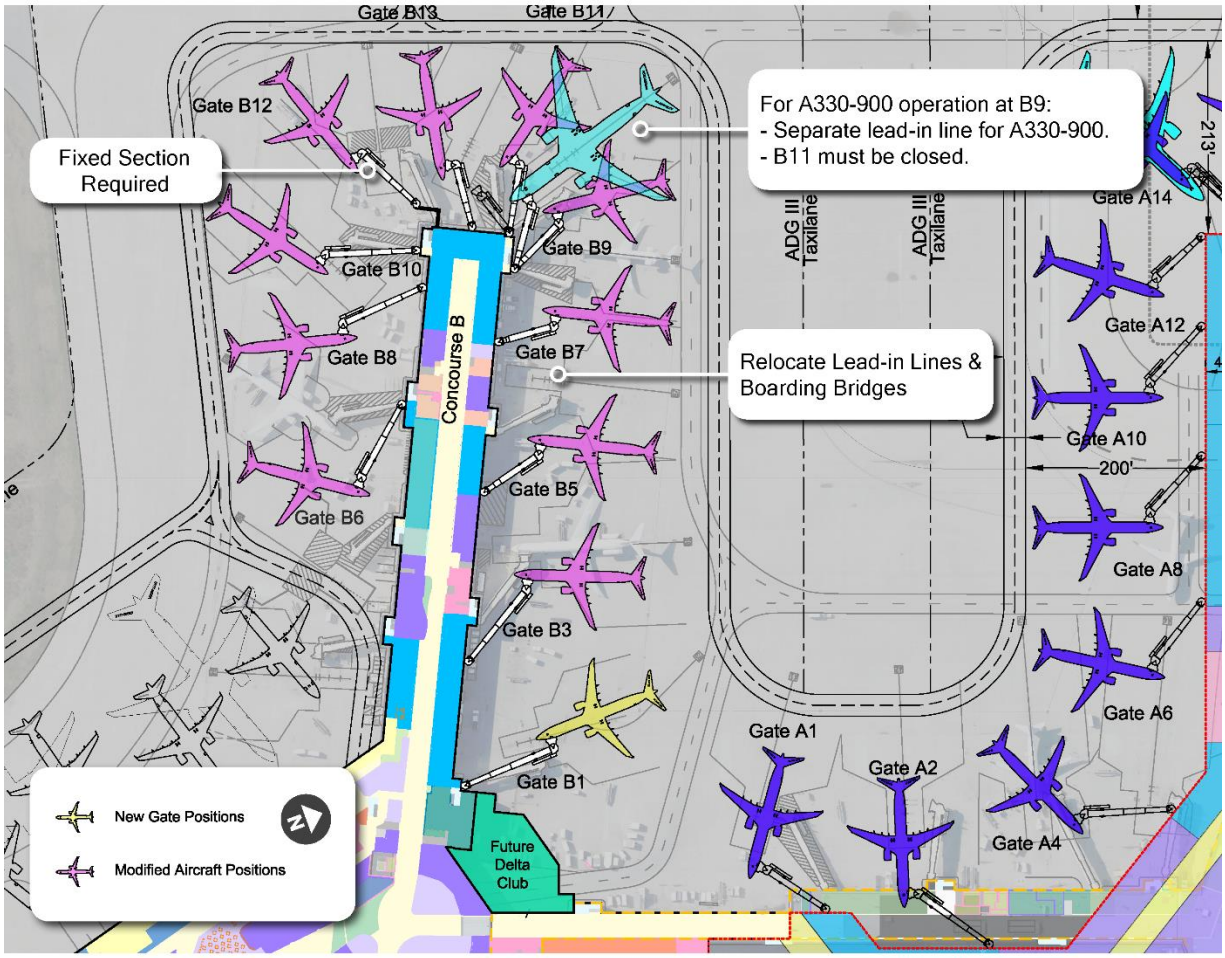
5.3.1.2 Concourse B

Currently, Concourse B consists of 13 gates. Eleven gates are sized for Group III aircraft and two gates are sized for Group V aircraft. Under the BNA Vision program, two gates on Concourse B are to be consolidated into the new T-Gates being developed between Concourses B and C; thus, Concourse B will have 11 gates after BNA Vision's Project 3 is complete in 2024. Gate B11 will be the only Group V capable gate on Concourse B.

Additional expansion or redevelopment of Concourse B beyond the BNA Vision Project 3 concourse adjustments poses several challenges. In general, it would be difficult to add gates to the concourse without significant building expansion due to the current lack of space available for additional holdrooms. Concourse B Expansion Alternative 1 in **Figure 5-23** illustrates a way of adding one gate to Concourse B (new Gate B1). Adding new Gate B1 would require adjusting all other Concourse B gates by relocating aircraft lead-in lines and several passenger boarding bridges. In order to retain Group V gate capability (B11), Gates B9 and B13 would need to be closed when a Group V operation occurs on Gate B11. A significant disadvantage of this alternative is that there would be seven (7) gates that share

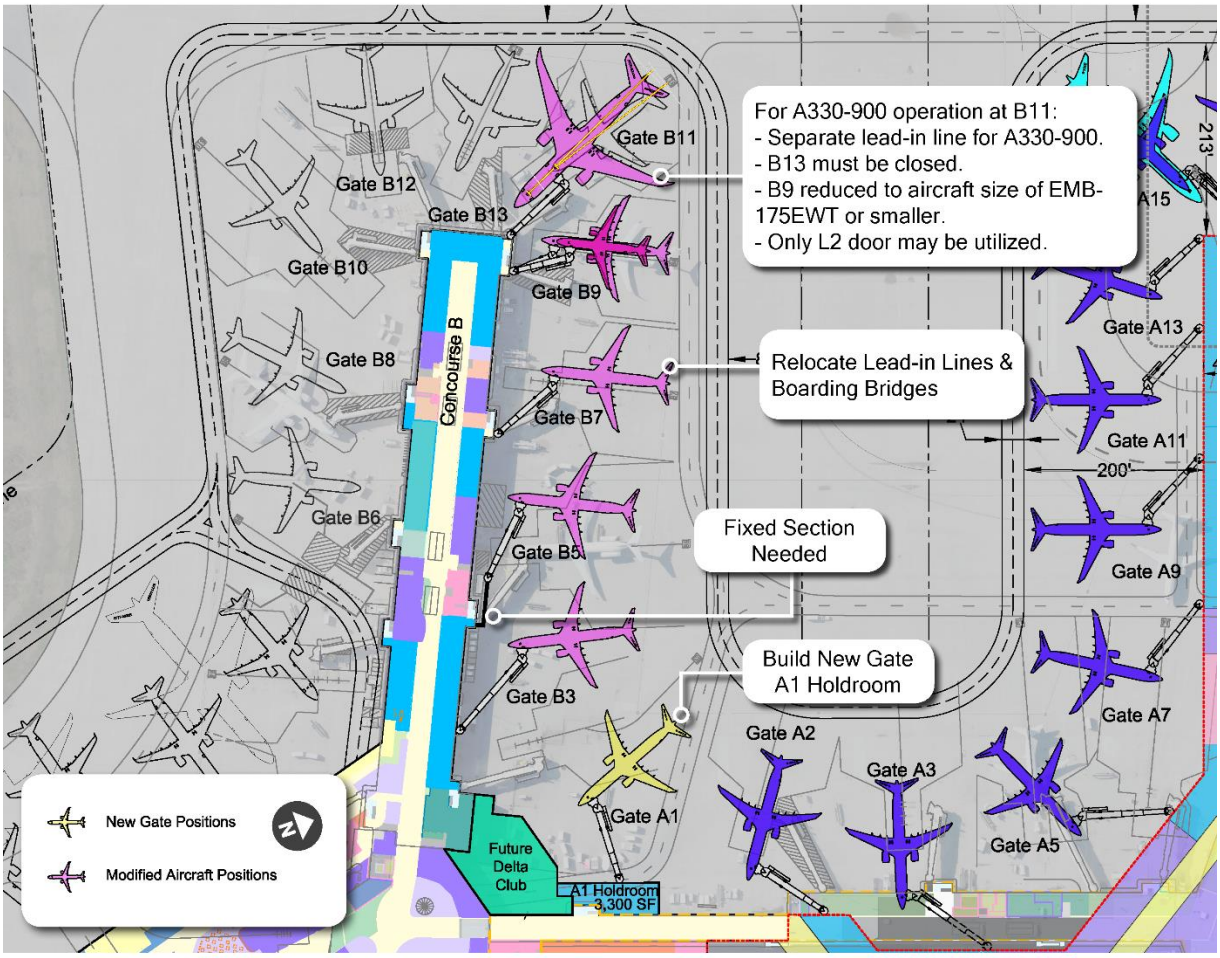
7,120 square feet of holdroom space, whereas the typical holdroom sizing for one Group III aircraft is approximately 3,000 square feet. This is a significant deficiency that renders this alternative infeasible.

Figure 5-23: Concourse B Redevelopment – Alternative 1



Another alternative is to add a gate at the beginning of the redeveloped Concourse A (**Figure 5-24**). While the aircraft would be parked very close to the new Gate B1 alignment in Alternative 1, the gate would be considered Gate A1 and would be accessed from the redeveloped Concourse A. Alternative 2 allows the new gate to be accessed through a new holdroom of appropriate size for Group III aircraft and would be located near the main terminal to be accessible to concessions and restrooms. There are no apparent disadvantages of this alternative, and it is recommended that Alternative 2 be pursued to add new Gate A1 to the terminal inventory when warranted.

Figure 5-24: Concourse B Redevelopment – Alternative 2



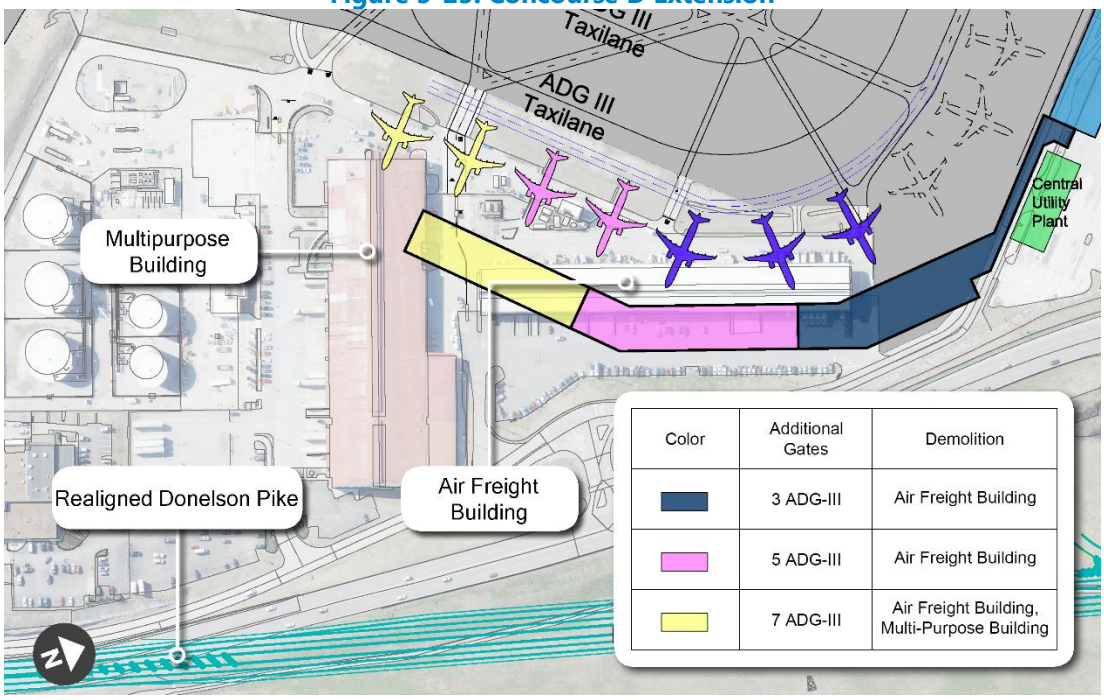
5.3.1.3 Concourse D

A new six-gate Concourse D is under construction as part of the BNA Vision program, which will (when combined with Project 3 of BNA Vision) bring the total number of gates at BNA to 48. To consider additional gates beyond the 10 net new gates on Concourse A (based on Concourse A redevelopment and adding new Gate A1 to the beginning of the redeveloped/expanded concourse), there is an opportunity to consider additional gates on Concourse D.

There is not enough room between Concourse D and Concourse C to develop a perpendicular extension of Concourse D towards Concourse C. Thus, any potential Concourse D extension would need to extend in a linear fashion from the sixth gate at the end of Concourse D and around the Central Utility Plant (CUP). Three alternatives were identified, as illustrated on **Figure 5-25** – a three-gate extension; a five-gate extension; and a seven-gate extension. The seven-gate extension alternative would require the demolition and relocation of the Multipurpose building and would require a walking distance of almost 3,000 feet from the main terminal core; thus, the seven-gate alternative was dismissed from further consideration.

Both of the remaining two alternatives (five-gate extension and three-gate extension) would begin with a corridor around the new Central Utility Plant (CUP), and lead to the additional gates. All existing and potential Concourse D gates would be Group III gates, and there is sufficient space in the three- and five-gate extension area for properly-sized holdrooms, restrooms, and concessions. A disadvantage of both Concourse D extension alternatives is the impact of the extended concourse on the existing Terminal Support (Air Freight/Ground Support Equipment (GSE)) building, which would need to be relocated. The five-gate alternative encroaches on the Air Freight/GSE facility and triturator facility to a greater degree than the three-gate alternative. Concourse D extension impacts to the Air Freight/GSE facilities are discussed below in the section discussing Terminal Support facilities.

Figure 5-25: Concourse D Extension



5.3.1.4 Summary of Existing Concourse Potential Gate Expansion

During this master plan, BNA has continued to experience dramatic annual growth in passengers and airline activity. Existing airline activity has grown, and new entrant airlines have initiated service. During this time, the number of aircraft seats offered has grown significantly, and peak period load factors have also increased, indicative of the extraordinary growth occurring. Airline gate utilization throughout the day is also increasing, resulting in existing and new entrant airlines leasing additional gates.

With only three unleased gates among all 43 gates at the existing terminal, there has been consideration given to the fact that the 48 gates being delivered by the BNA Vision Program by 2024 will likely not be sufficient to accommodate airline/passenger demand – the projected gate demand requirement is 52-56 by 2022, and 61 or more by 2037. Thus, plans are underway to pursue additional gate development, with Concourse A redevelopment/expansion being the preferred first step in providing additional gate

capacity. Concourse A redevelopment/expansion would provide 10 net new gates, bringing the total number of gates to 58.

5.3.2 Additional Gate Expansion Alternatives

With the construction of a redeveloped/expanded Concourse A, a total of 58 gates would be available to meet airline demand. However, within the planning period, it is projected that at least 61 gates are needed, and with the continuation of extraordinary growth of the Nashville area, additional gates could be required. The above analysis of potential expansion of existing concourses revealed that a future expansion of Concourse D (3 gates) would comprise one alternative that would provide a 61-gate terminal complex; however, there are other alternatives to expanding the gate supply within the BNA terminal area that are explored in the following Section to provide additional gate capacity as demand warrants.

5.3.2.1 Satellite Concourse Alternatives

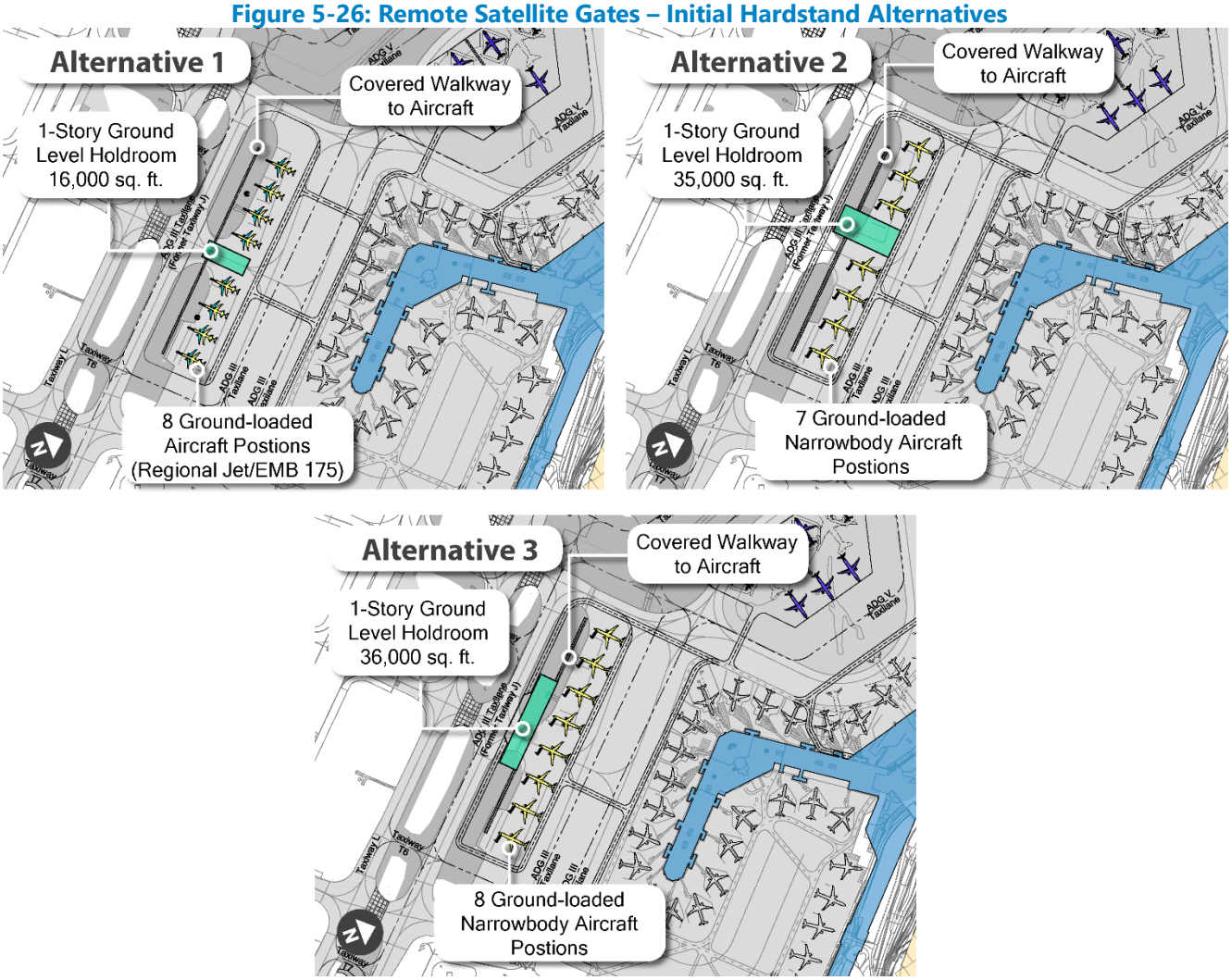
While a Master Plan analysis might not typically delve into construction phasing details of planned terminal improvements, constructing new gates on redeveloped/expanded Concourse A will require temporary airline relocations and there is a shortage of available gates on other concourses to accommodate these temporary airline relocations. It is expected that redeveloping and expanding Concourse A will have construction phasing challenges due to the length of time needed for apron and concourse construction (longer than one or two years). Also, simultaneous peak period gate utilization by most airlines on other concourses will make it difficult to relocate the gate activity of existing Concourse A airlines (currently, United (5 gates), Air Canada (1 gate), and Spirit (1 gate) during Concourse A redevelopment/expansion construction.

Temporary Remote Hardstand Operation

One alternative to addressing gate shortages for airline relocations during concourse construction is to develop gates that are not connected to the main terminal – remote satellite gates. A review of potential locations for remote satellite gates focused on sites that are closest to the existing terminal concourses, and sites that don't require significant advance improvements. One location was considered in the unpaved area of Sims Branch/Snakey Creek but was dismissed due to the length of time required to plan, design, permit, and construct utility, paving, and environmental improvements necessary to mitigate potential impacts. The length of time needed for these required activities would not meet an implementation schedule projected to be required for additional gates (2022-2024).

The most logical site for remote satellite gates is the existing South Apron area bordered by existing Taxiways J, T4 and T6. This site is currently paved and used for aircraft deicing and remain overnight parking (RON) operations. The alternatives considered for remote satellite gates at the South Apron area are discussed below. **Figure 5-26** illustrates three initial "hardstand" alternatives. Hardstand layouts were developed with consideration of aircraft tail height or building height restrictions due to the proximity of the South Apron to Part 77 surfaces associated with Runway 13-31.

Figure 5-26: Remote Satellite Gates – Initial Hardstand Alternatives



Alternative #1 illustrates an aircraft parking area and a single-level, 16,000 square foot holdroom to serve eight Regional Jet/EMB 175 remote hardstand positions. The aircraft would be ground-loaded, meaning that no passenger boarding bridges (PBBs) would be installed at the gates. Considered a short-term alternative to provide gates during construction of redeveloped/expanded Concourse A, access from the main concourses to the remote hardstand positions would be by shuttle bus, and the access between aircraft parking positions would be by covered walkway to minimize exposure to the weather. The value of Alternative #1 is to provide an option for parking and passenger loading of smaller aircraft in the airline fleet at BNA (Regional Jets and EMB 175s). The passenger holdroom would be of minimal size to accommodate passenger waiting and restroom facilities. Proceeding with this alternative would present a disadvantage if BNA's rapid growth exceeds the number of gates delivered by redeveloped/expanded Concourse A. In this situation, the remote hardstand positions of this alternative could need to be redeveloped into a full-service concourse soon after their completion.

Alternative #2 expands the capabilities of the remote hardstand by sizing the facility for Group III narrowbody aircraft. The upsizing of the facility in this alternative would decrease the potential number

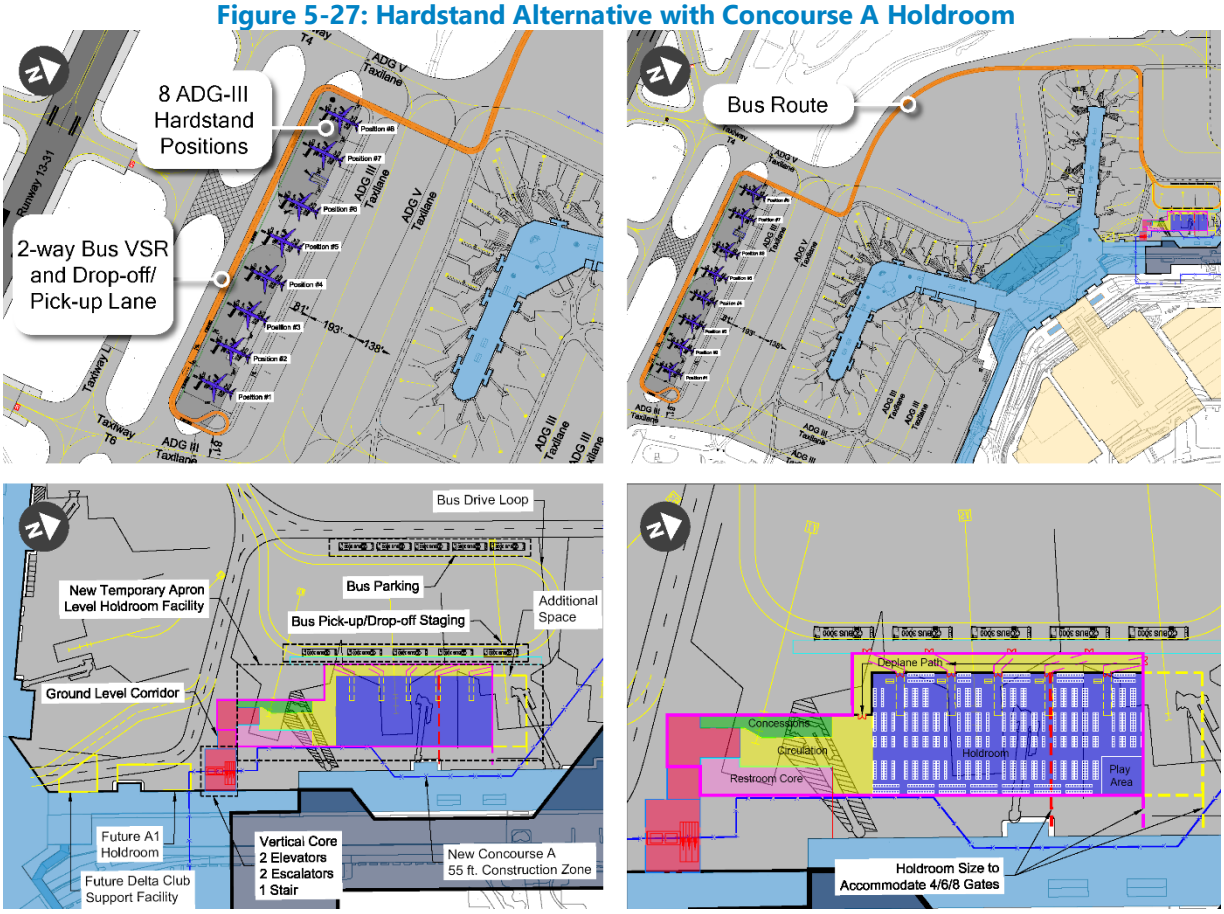
of aircraft parking positions to seven (7) positions. Similar to Alternative #1, the remote hardstand would be considered a shorter-term solution to address gate needs, and access to the remote hardstand gates would be by shuttle bus from the main concourse(s). Access between aircraft parking positions would be by covered walkway. A single-level, 35,000 square-foot holdroom facility would provide seating capacity for passengers waiting for their flight. Similar to advantages and disadvantages associated with Alternative #1, Alternative #2 offers a shorter-term alternative than a full-service concourse but could need upgrade should BNA gate requirements continue to grow at their current pace.

Alternative #3 improves the passenger experience above that of Alternative #2 by providing direct ground-loading access from a single-level, 36,000-square foot holdroom structure to four of the eight aircraft parking positions. Four of the aircraft parking positions would be accessed by a covered walkway. Similar to Alternatives #1 and #2, access to/from the main terminal (s) would be provided by shuttle bus. Alternative #3 also offers a shorter-term, lower cost alternative than a full-service concourse, but could also require upgrade should BNA gate requirements continue to grow at their current pace.

An advantage of the remote hardstand operation is that it would minimize construction zone impacts to current Concourse A airlines during redevelopment/expansion of Concourse A. However, a disadvantage of a remote hardstand operation would be the need to provide a shuttle bus transfer station at the main terminal. Another disadvantage common to the three initial hardstand alternatives is that providing a holdroom facility at the South Apron would introduce an operational element that requires restrooms, concessions deliveries, airline operations areas, trash services, etc. – each of which require additional vehicle movements on the terminal apron. Introducing several vehicle types and vehicle trips to the terminal apron operation could have potential effects on aircraft ground congestion in and around the gate and taxilane areas.

To address disadvantages of Alternatives #1-#3, Alternative #4 was developed. Alternative #4, illustrated in **Figure 5-27**, establishes eight (8) hardstand positions sized for Group III aircraft at the South Ramp location, and establishes a holdroom facility using portions of the existing Concourse A facility for vertical passenger circulation to a new, temporary apron level holdroom. Passengers would proceed from the temporary holdroom facility on shuttle buses to their departure hardstand location. Arriving passengers at the hardstand would use the shuttle bus to access the main terminal for bag claim and airport exit. This alternative would necessitate a construction phasing plan that balances continued Concourse A operations yet allows Concourse A redevelopment/expansion to proceed without significant impact to its construction progression. Alternative #4 would lessen the amount of remote holdroom-related vehicles to the terminal apron and hardstand areas.

Figure 5-27: Hardstand Alternative with Concourse A Holdroom



Permanent, Full-Service Concourse E

In considering the advantages and disadvantages of a temporary remote hardstand operation, the analysis revealed an opportunity to consider another alternative – the potential for a permanent, full-service Concourse E. In light of unabated, high growth and airline gate demand at BNA, Concourse E could provide a similar construction phasing alternative for the Concourse A redevelopment/expansion program to accommodate needed airline relocations during construction, and also avoid the expense of a temporary hardstand operation which would similarly require apron and holdroom development and shuttle bus operations. The result of Concourse E would be permanent gate capacity for the existing terminal complex.

Concourse E could be developed within the same footprint as the temporary remote hardstand operation location (within the area bordered by Taxiways J, T4 and T6), providing up to eight (8), ADG-III sized gates. Assuming the loss of one gate at the existing main terminal for shuttle bus operations, the total number of gates within the entire terminal complex would be 68, assuming all gates associated with BNA Vision (48 gates), Concourse A redevelopment/expansion (net 10 new gates), and a future Concourse D extension (3 gates) are constructed. Having a 68-gate terminal complex would provide terminal capacity for projected master plan demand and provide flexibility for airline gate utilization

and airline relocations during periods of concourse maintenance (i.e. holdroom or passenger boarding bridge modifications) and/or construction.

Figure 5-28 illustrates a potential Concourse E location and generalized layout, and **Figure 5-29** illustrates a potential Concourse E interior layout, which would include holdrooms, concessions, circulation areas, restrooms, and building infrastructure space such as electrical and communication rooms. Concourse E and its associated apron and other infrastructure elements has been estimated to cost $190 million.

Figure 5-28: Concourse E – Location and Generalized Layout

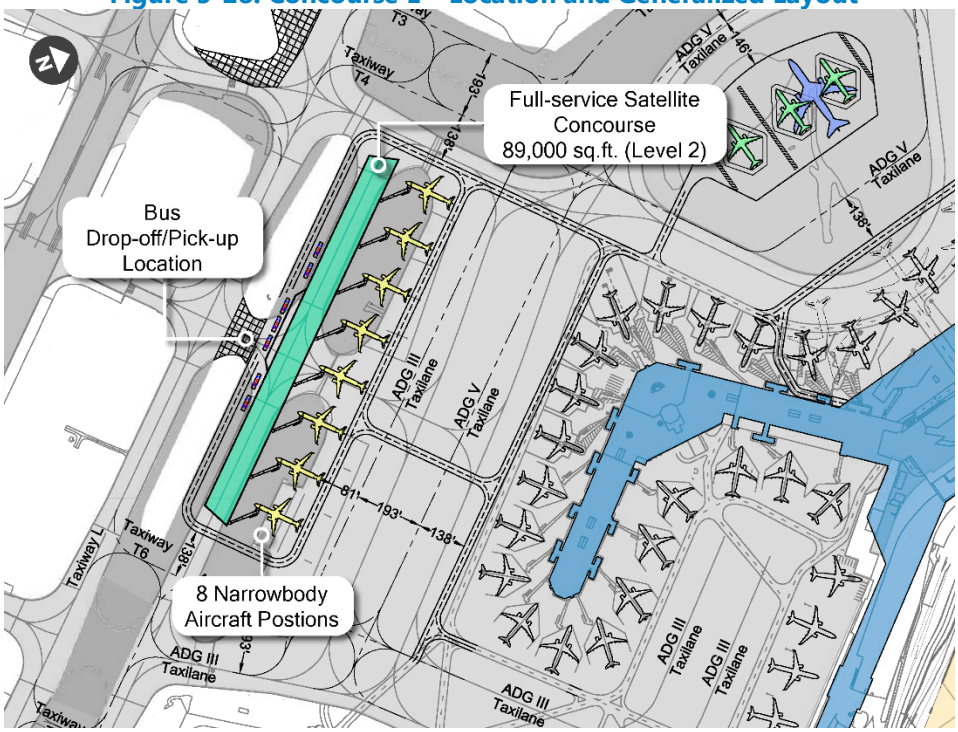
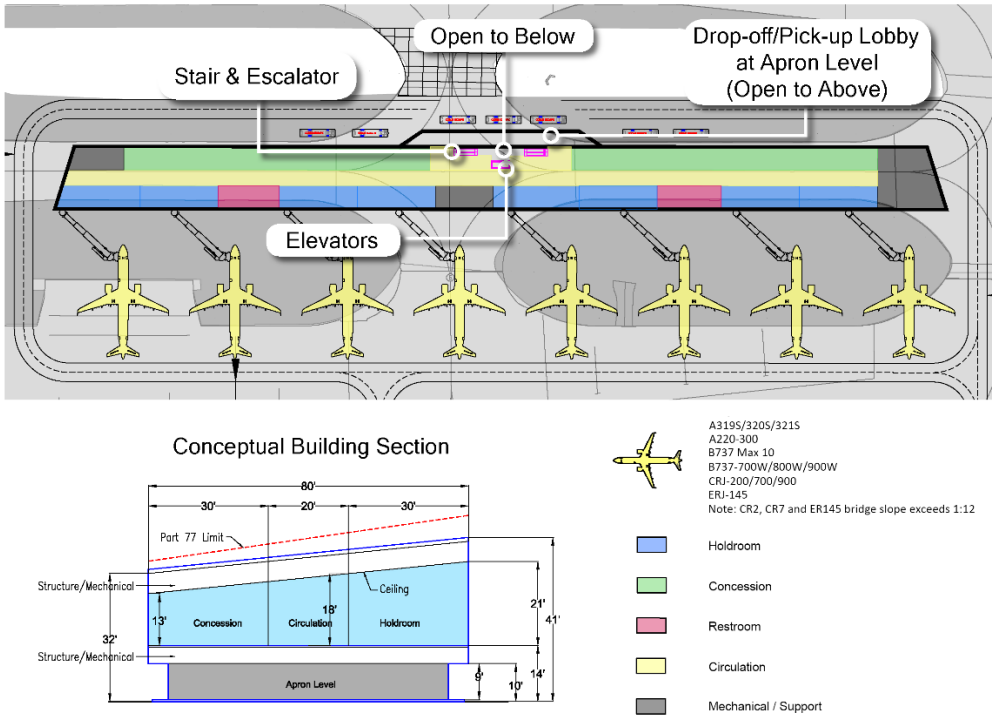


Figure 5-29: Concourse E – Potential Interior Layout



Concourse E - Access Alternatives:

Concourse E operations would require that passengers, airline crews and operations staff, concessions and maintenance/janitorial personnel, etc. have convenient and timely access from the main terminal building. There are generally four access alternatives between the main terminal and Concourse E – pedestrian skybridge, automated people mover (APM), pedestrian tunnel, and shuttle bus.

Pedestrian Skybridge Alternatives

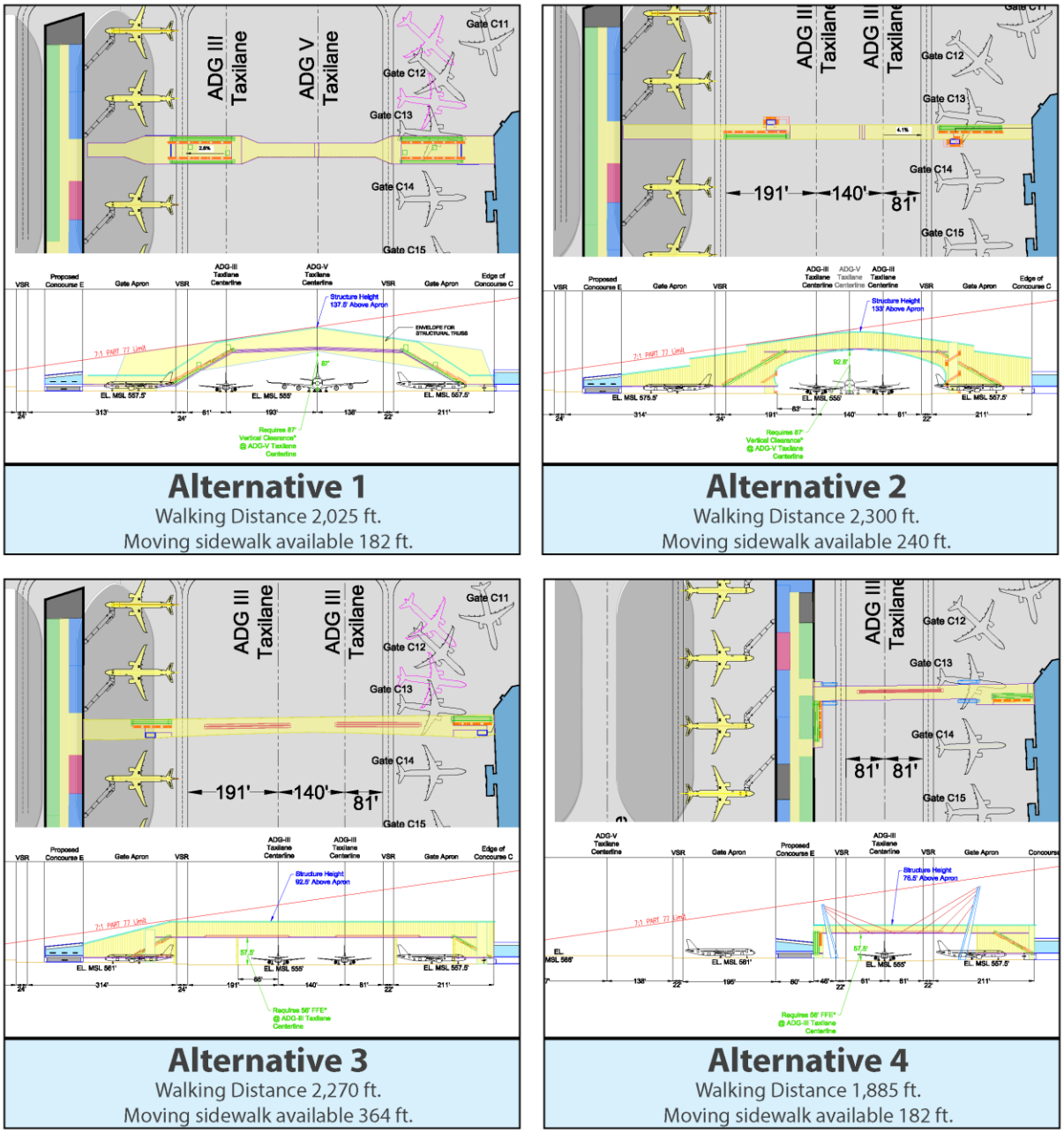
A pedestrian skybridge would be an above-ground passageway (bolstered by a significant structural span support system) connecting Concourses C and E. The skybridge would need to be constructed at a height that would allow aircraft movements along the terminal apron and taxilane system. Four alternatives for the skybridge were identified:

1) skybridge with one ADG-III and one ADG-V taxiway;
2) skybridge with two ADG-III taxiways and an ADG-V taxi ability under the center portion of the skybridge;
3) skybridge with two ADG-III taxiways; and,
4) skybridge with one ADG-III taxiway between Concourse E and Concourse C, and locating Concourse E closer to Concourse C to allow a shorter skybridge and ADG-V Taxilane Juliet on the south side of Concourse E.

For Group III aircraft, the skybridge would need to be 58 feet above the terminal apron/taxilane system, and for Group V aircraft, the skybridge would need to be 87-93 feet above the apron/taxilane system. However, in all alternatives, the skybridge would need to be lower than the Part 77 obstruction clearance surface heights established from the Runway 13-31 centerline. **Figure 5-30** illustrates the skybridge alternatives that could clear Group III and/or Group V aircraft yet remain below the Runway 13-31 Part

77 obstruction clearance surface. Each alternative also lists the walking distance between the main terminal security checkpoint and Concourse E.

Figure 5-30: Concourse E Pedestrian Skybridge Alternatives



An advantage of a pedestrian skybridge would be in providing a direct connection between Concourse C and Concourse E, as well as providing an opportunity for passengers to maintain control of their travel experience without having to wait for another method of transport to/from Concourse E, such as an APM or shuttle bus. A pedestrian skybridge also has an advantage of avoiding environmental effects of shuttle bus or APM alternatives. However, disadvantages of pedestrian skybridge alternatives is that they would require the permanent loss of at least one gate on Concourse C to accommodate the

complex structural elements of the bridge support system. The limitations of the Part 77 surfaces of Runway 13-31 also would create challenges with some alternatives in providing interior vertical circulation to the skybridge in compliance with American Disabilities Act (ADA) criteria. Alternative #4, which would provide a single, ADG-III taxilane between Concourses C and E in favor of bringing Concourse E closer to Concourse C (to reduce the length of the pedestrian skybridge) would require the loss of several Concourse C gates during construction and result in potential congestion for aircraft movements between Concourses C and E once construction was completed.

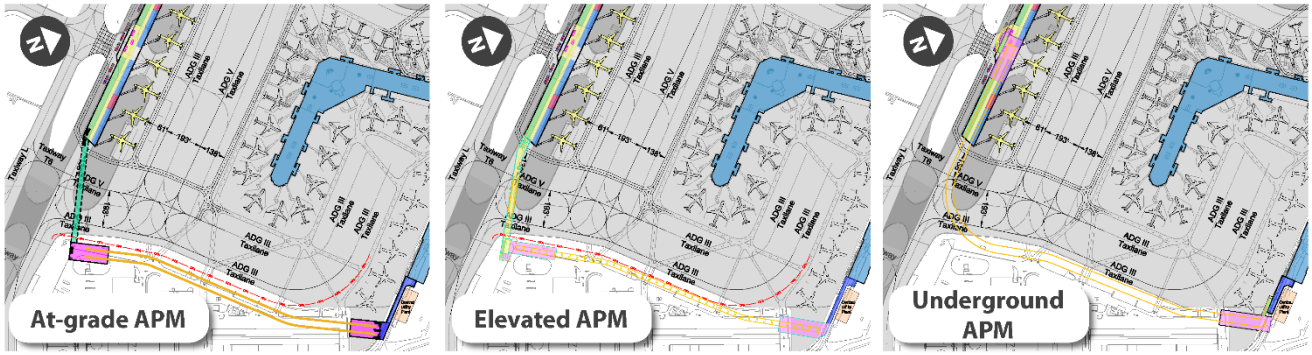
Another disadvantage of the pedestrian skybridge alternatives is the high cost, and complex construction phasing required on the active terminal apron and taxilane system. The construction cost of a pedestrian skybridge has been estimated to range from $71 million to $143 million. Due to physical, operational challenges, as well as total cost, the pedestrian skybridge alternatives are not recommended.

Airport People Mover (APM) Alternatives:

Another alternative is to construct an APM system between Concourses D and E. Illustrated in **Figure 5-31**, the alternatives for an APM system includes an at-grade system, an elevated system, and an underground system. The at-grade APM system concept fails due to cutting off access to the terminal support (air cargo/GSE) facilities. The other two alternatives provide challenges in that they require multiple level changes for passengers, which also adds to the expense of the APM system. In the elevated and underground system alternatives, passengers would proceed from security screening to a vertical circulation node at the end of Concourse D, and then ascend or descend to an APM platform that would bring the passengers to Concourse E. In both alternatives, the Concourse E station would require additional vertical circulation from either the elevated or underground APM system to the concourse level, adding to cost and passenger inconvenience disadvantages.

A disadvantage of the APM system alternatives is that passengers would not control their access to Concourse E, since they would be subject to APM system schedules between concourses. Also, construction impacts of an APM system would curtail use of the active taxilanes at T6 and T7, requiring all aircraft to use Taxilane T4 for terminal and gate access during APM construction. Lastly, the cost of an APM system has been estimated between $234 million and $266 million. Due to passenger convenience challenges, construction phasing challenges, and the overall high cost of an APM system, the APM system alternatives are not recommended.

Figure 5-31: Concourse E APM Alternatives

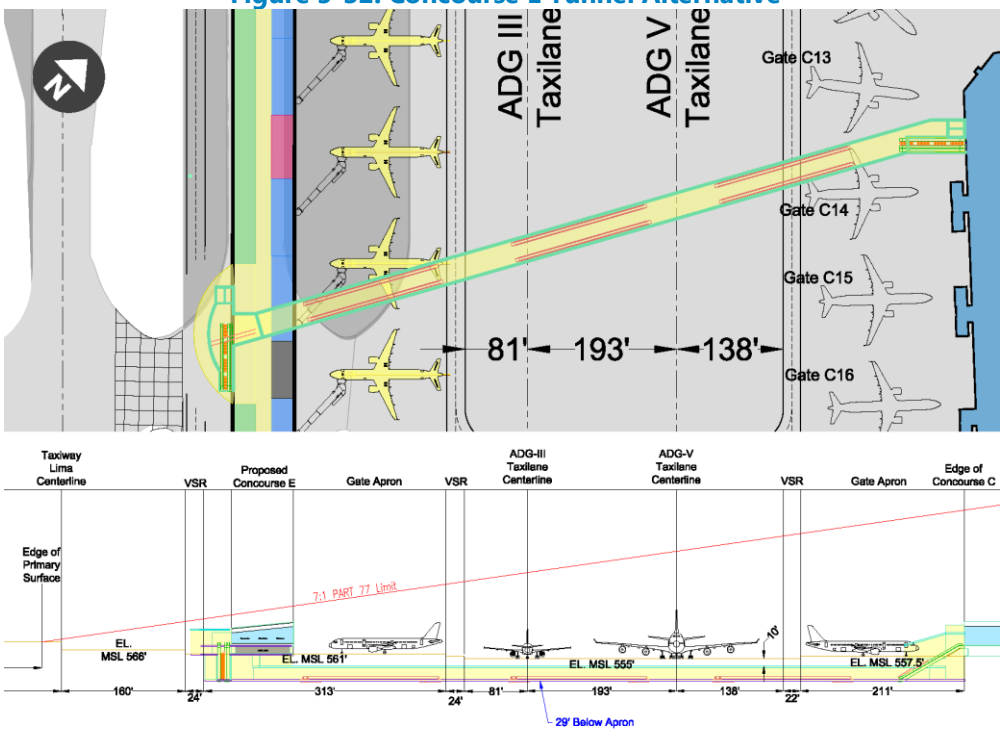


Tunnel Alternatives:

A pedestrian tunnel is another alternative that could connect Concourse C with new Concourse E. The pedestrian tunnel under the terminal apron would provide a direct connection to Concourse E under passenger control. An advantage of the pedestrian tunnel over the skybridge alternatives is that there would be no gate loss after construction. Also, a pedestrian tunnel would offer environmental benefits over APM and shuttle bus options. A disadvantage of a pedestrian tunnel would occur during construction, similar to the skybridge alternatives.

The construction cost of a pedestrian tunnel between Concourses C and E has been estimated at $94 million, which is a disadvantage compared to a shuttle bus alternative, but an advantage over more costly pedestrian skybridge alternatives. **Figure 5-32** illustrates the pedestrian tunnel alternative.

Figure 5-32: Concourse E Tunnel Alternative



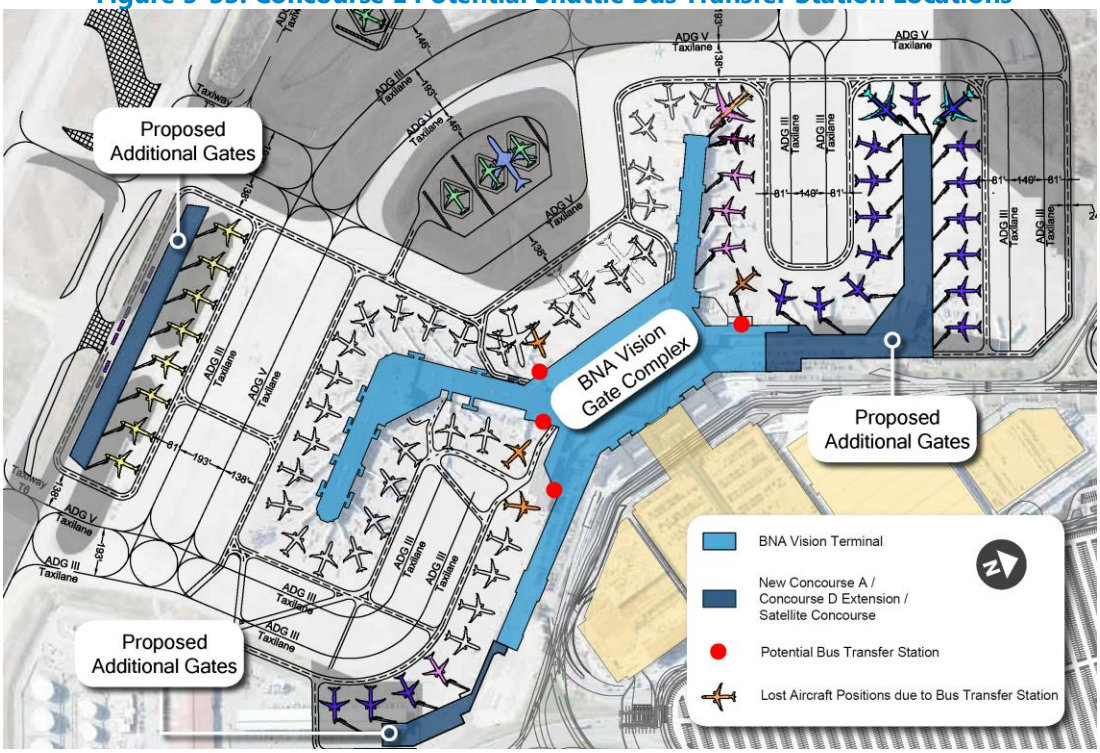
Shuttle Bus Alternatives:

A shuttle bus alternative would be an option that could work for either a temporary remote hardstand operation or permanent Concourse E. In this concept, passengers using Concourse E would be processed in the main terminal building for check-in, security screening, and bag claim functions, but would depart or arrive using Concourse E. Connecting passengers would already be on the secure side of the terminal but would also need to be bused to Concourse E as airline schedules and gate locations warranted.

The size of the aircraft being loaded at the temporary hardstand or Concourse E location would affect the number of shuttle buses that would be needed for each flight, and airline flight schedules would dictate the frequency of shuttle bus traffic between the main terminal and hardstand/Concourse E. A

shuttle bus transfer station at the main terminal would likely result in the loss of at least one gate. Since it is unknown which airline(s) might use the hardstand/Concourse E gate positions, **Figure 5-33** illustrates potential locations for a main terminal shuttle bus transfer station.

Figure 5-33: Concourse E Potential Shuttle Bus Transfer Station Locations



Depending on the airline(s) that use the satellite facility, more than one bus transfer point might be needed, or one centralized location may need to be found regardless of which airline(s) uses the temporary remote hardstand or Concourse E. The shuttle bus transfer station would provide a dedicated point where passengers would descend from the main terminal/concourse and load onto shuttle buses that would take them to the remote hardstand or Concourse E. For most Group III aircraft, more than one bus would be needed to process the number of passengers on each flight. Departing flight "close-out times" (the time needed for passengers to arrive at check-in) would need to be coordinated with affected airlines to ensure that all passengers could be processed and loaded on the bus(es) in time for their connection to the remote hardstand or Concourse E.

One location alternative for a shuttle bus transfer station is at the beginning of Concourse A. This location would be an advantage in the situation where the remote hardstand/Concourse E serves airlines that are currently on Concourse A. A disadvantage of the Concourse A location for a shuttle bus transfer station would be the longer travel distance provided for passengers, crews, concession staff, and other remote hardstand/Concourse E occupants.

Another alternative location for a shuttle bus transfer station location is within Concourse D (currently under construction). In this scenario, remote hardstand/Concourse E occupants (passengers, crews, etc.) would board a shuttle bus that would use the innermost edge of the terminal ramp, and then proceed to the remote hardstand/Concourse E location. A disadvantage of this alternative is the potential for conflicts between shuttle buses and aircraft movements on active airfield segments between the main concourses and the remote hardstand/Concourse E facility.

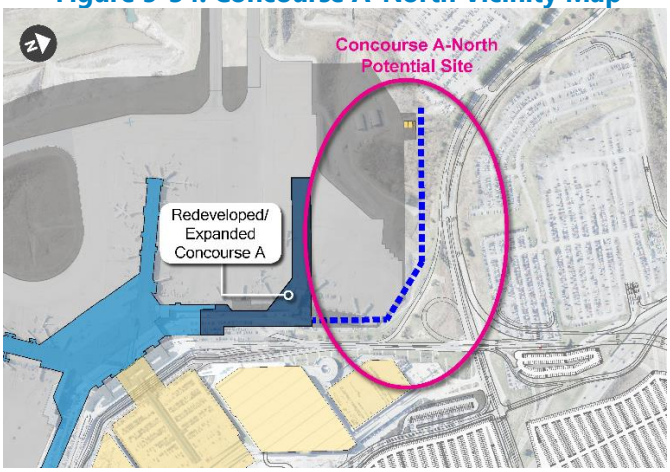
A third alternative is to establish a shuttle bus transfer station near the post-BNA Vision T-gates, providing a central location for any remote hardstand/Concourse E occupant (passengers, crews, etc.). The shuttle bus route to/from the remote hardstand/Concourse E location would be shorter than the Concourse A location and would be well-located for either a short-term or long-term remote hardstand/Concourse E purpose. A disadvantage to this alternative location would be the potential impact to the T-gates, including possible loss of one gate (including Group V capability).

The selected location(s) of a shuttle bus transfer station will depend on the airline(s) that will operate at the remote hardstand/Concourse E location.

5.3.2.2 Concourse A-North

Another alternative that could provide additional long-term gate capacity in the terminal area is to develop another concourse connected to but located north of the planned redeveloped/expanded Concourse A, as generally depicted in **Figure 5-34**. Passengers using Concourse A-North would utilize the existing main terminal for processing (i.e. check-in, security screening, baggage claim, etc.) and would then proceed to the Concourse A-North gates. Due to the walking distance from the main terminal processing area to Concourse A-North gates (approximately 3,000 feet), it is expected that a system of moving sidewalks would be needed. Also, it is possible that further expansion of planned passenger processing functional elements such as curbfront length, check-in facilities, security screening, bag claim, outbound baggage screening and airline baggage makeup, and concourse connector circulation areas could be required to accommodate the additional passenger load of Concourse A-North.

Figure 5-34: Concourse A-North Vicinity Map

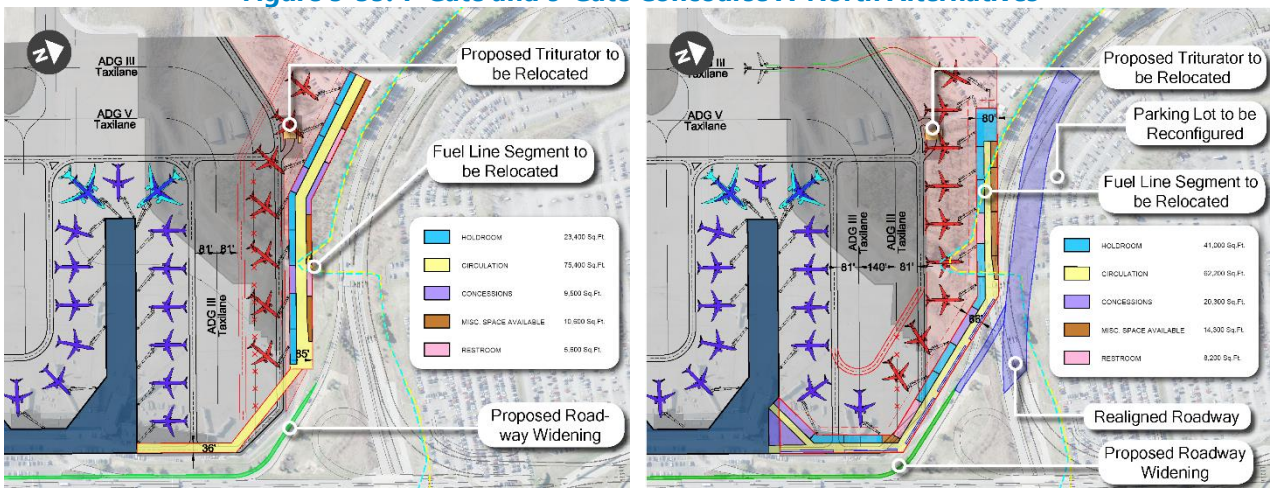


There are a number of site constraints in constructing Concourse A-North such as the existing terminal apron limits; the proximity of the I-40 entrance road and terminal approach roadway; the existing Valet Parking storage lot along the I-40 entrance road; and the Long-Term C public parking lot. The alternatives for Concourse A-North development are further constrained by the bridge structure serving the intersection of the I-40 entrance road, terminal loop roadway system, and terminal roadway access from Donelson Pike.

Figure 5-35 illustrates two alternatives for providing Concourse A-North gates. The first alternative is a seven (7)-gate concourse that connects a public circulation corridor from the north end of redeveloped/expanded Concourse A to the new Concourse A-North gates. This alternative retains the I-40 exit/terminal entrance road in its current alignment, requiring ten (10) gate positions on Concourses A and A-North to share a single Group III taxilane for aircraft movements. The western extent of Concourse A-North would impact a number of spaces in the existing Valet Parking storage lot.

The second alternative provides a nine (9)-gate concourse, also impacting the existing Valet Parking storage lot. The 9-gate Concourse A-North would be accessed from the north end of redeveloped/expanded Concourse A and would provide holdrooms, restrooms, and concessions along the connecting corridor and concourse gate areas. Providing a dual parallel Group III taxilane between concourses would require the realignment of the I-40 terminal entrance road and also impact a portion of the existing Long-Term C public parking lot. A major fuel pipeline serving the airport (Colonial Pipeline) between the Valet Parking storage lot and the intersection with the terminal approach roadway would also be affected by the Concourse A-North construction.

Figure 5-35: 7-Gate and 9-Gate Concourse A-North Alternatives



5.2.1.1 Summary of Additional Gate Expansion Alternatives

This Master Plan has identified and evaluated several feasible alternatives that can provide required terminal capacity well into BNA's future. Subsequent to the completion of BNA Vision's Project 3 that redevelops the existing terminal core facility and adds Concourse D, and subsequent to the redevelopment/expansion of Concourse A, the 61-gate terminal complex should meet airline and passenger needs for the immediately-foreseeable future.

However, with the continued extraordinary growth at BNA, it can be expected that additional terminal gates and related development will be needed within the planning period. With options for further terminal development that include adding either Concourse A-North, Concourse E, or an extended Concourse D, BNA is well-positioned for the planning period to accommodate expected growth.

5.3.3 Terminal Ramp, Aircraft Deicing, and Remain Overnight (RON) Parking Facilities

The area between active concourse gates and the taxiway system comprising the terminal ramp is a very active operating environment. The layout of the terminal ramp facilitates aircraft ground movement into and out of gates as well as aircraft service vehicle and related airline and airport support operations. The terminal ramp area must be sized to support aircraft gate parking; remain overnight aircraft at a gate or off-gate location (RON); aircraft that are queued for gate arrival and departure to the taxiway system; and aircraft deicing areas during winter operations.

To support aircraft deicing and parking requirements for the terminal complex, additional terminal ramp, deicing, and remain overnight aircraft parking (RON) facilities will be needed. With the current rate of airline growth at BNA, and with only three of the 43 existing gates unleased by airlines, it is projected that all existing gates will be occupied for overnight parking in the near future. Even after the projected 2024 delivery of additional gates as part of the BNA Vision program, the 48 gates and available terminal apron and adjacent areas for remain overnight aircraft parking (RON) is expected to be limited in its ability to accommodate increases in terminal ramp, deicing, and RON demand.

The areas between the terminal gates and terminal area taxiway system is optimally situated for off-gate deicing operations and/or RON aircraft parking. At some airports it is necessary to park RON aircraft away from terminal ramp areas due to the lack of available overnight gate space, and this type of operation can cause operational challenges. Aircraft that are being towed between remote RON facilities and the terminal gates can conflict with aircraft that are taxiing under power from the terminal to the runway system, especially during the morning peak period for departures. Avoiding the placement of deicing and RON facilities beyond the terminal ramp and adjacent taxiways that would require runway crossings is an important objective in identifying and evaluating alternatives for locating additional deicing/RON opportunities in the terminal ramp environment.

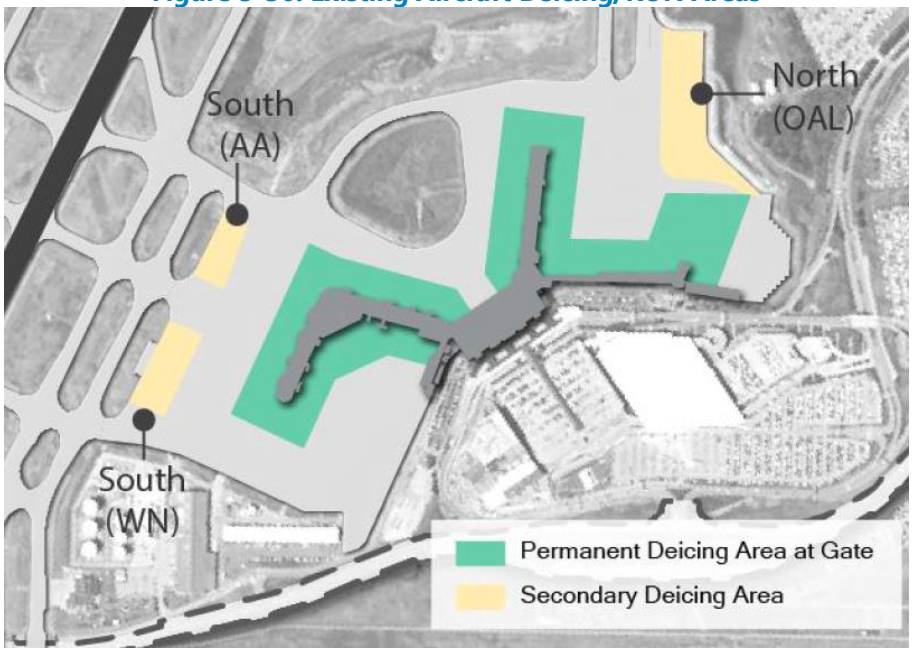
The preferred location for aircraft deicing operations is dependent on factors such as proximity to deicing storage and collection/distribution systems, as well as the length of time it takes a deiced aircraft to taxi to the runway system for departure. **Figure 5-36** illustrates the current deicing locations within the terminal area and indicates that aircraft are deiced either at permanent gate locations or at secondary deicing pad locations adjacent to Taxiway J and at the north end of the existing terminal apron outward from Concourse A, taking advantage of the terminal ramp storm drainage and remote deicing pads' deicing fluid collection and distribution systems.

Proposed use of the South Apron hardstand for additional remote gate development will affect existing deicing positions. Also, the north deicing system outward from Concourse A is expected to be affected by future Concourse A redevelopment/expansion, requiring relocation or other considerations for replacing its deicing pad capacity.

While infrastructure exists for gate deicing, deicing at the gate can cause operational and environmental concerns, and is a factor in leading airports to consider locating deicing pads remote from the gate area. With deicing processes taking 10 – 15 minutes on average, deicing at the gate can also restrict gate availability for arriving flights. Forecasts of peak period arriving and departing flights indicate that BNA's gate areas could become congested if gate deicing remains the primary location for these activities. Terminal ramp congestion can result in delays to departing and arriving aircraft, and lengthy taxiing distances after deicing can lead to departure delays, affecting the timing of the deice operation, especially in peak operating periods. Aircraft are limited to a 20 minute "holdover" time, meaning that a deiced aircraft must depart within 20 minutes after being deiced to maintain the required flight safety in expected in-flight icing conditions. In order to test alternative deicing locations to ensure that the 20-minute holdover time would not be exceeded, a computer simulation model was prepared to evaluate location and deicing efficiency requirements. The results and implications of the simulations are presented in the presentation of the alternatives below.

In addition to commercial air carrier operations, air cargo and GA aircraft also require deicing during peak periods. Currently, both cargo and GA aircraft travel long distances across the airfield to be deiced at the terminal deicing aprons; however, the GA and cargo operators have been requesting to have deicing areas dedicated close to their facilities in the Hangar Lane Area and West Side to improve operational efficiency and lessen potential scheduling conflicts with the airlines.

Figure 5-36: Existing Aircraft Deicing/RON Areas

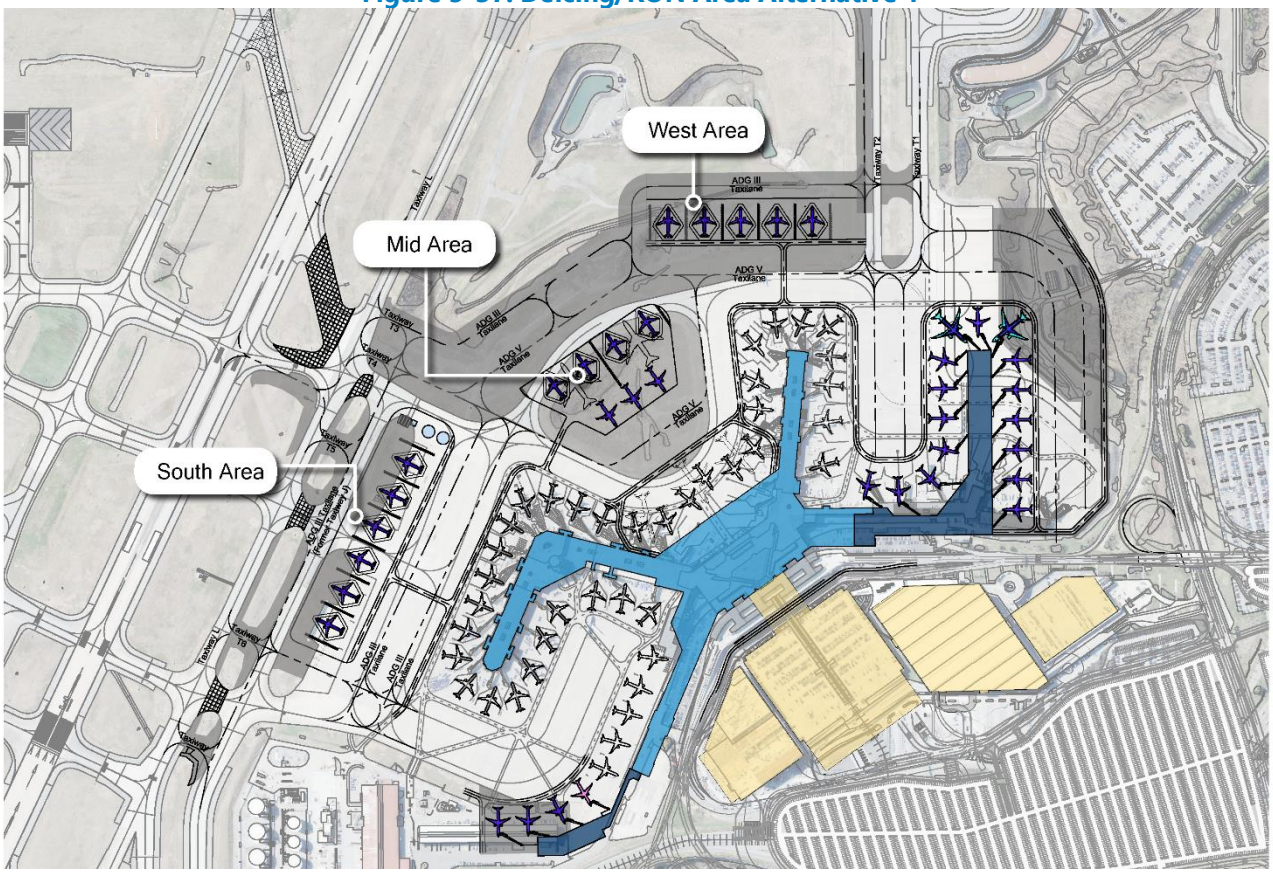


The Facility Requirements evaluation for deicing and RON indicated that a total of 12 deicing positions and 18 RON positions should be planned for 2037 airline activity, which would accommodate the projected 38 peak hour morning departures (7:35 – 8:35am). In identifying alternatives for deicing and RON locations, it is common for airports to plan for use of the same ramp area for both deicing and RON functions, and priority was given to identifying deicing/RON locations between the terminal gates, Taxiways B, L, and J, and Taxiways T1 and T2 on the north. The identified alternatives accommodate long-term airline deicing and RON position needs and assume post-BNA Vision construction conditions. The computer modeling of deicing operations assumed that GA and cargo aircraft would continue to utilize the terminal apron deicing pads.

Alternative 1 is illustrated in **Figure 5-37**. The alternative attempts to minimize the amount of new terminal ramp that would impact the Sims Branch/Snakey Creek area, which are considered constraining physical and environmental factors. Assuming that the South Apron becomes unavailable for deicing/RON due to its potential conversion to remote satellite gates, the resulting configuration would provide a total of 12 RON positions with taxilanes added to maneuver aircraft to/from and around the aircraft positions. While the 12 RON positions do not meet the 2037 projected demand, the alternative does not preclude further deicing/RON development, when demand warrants, beyond the limits of the new pavement shown.

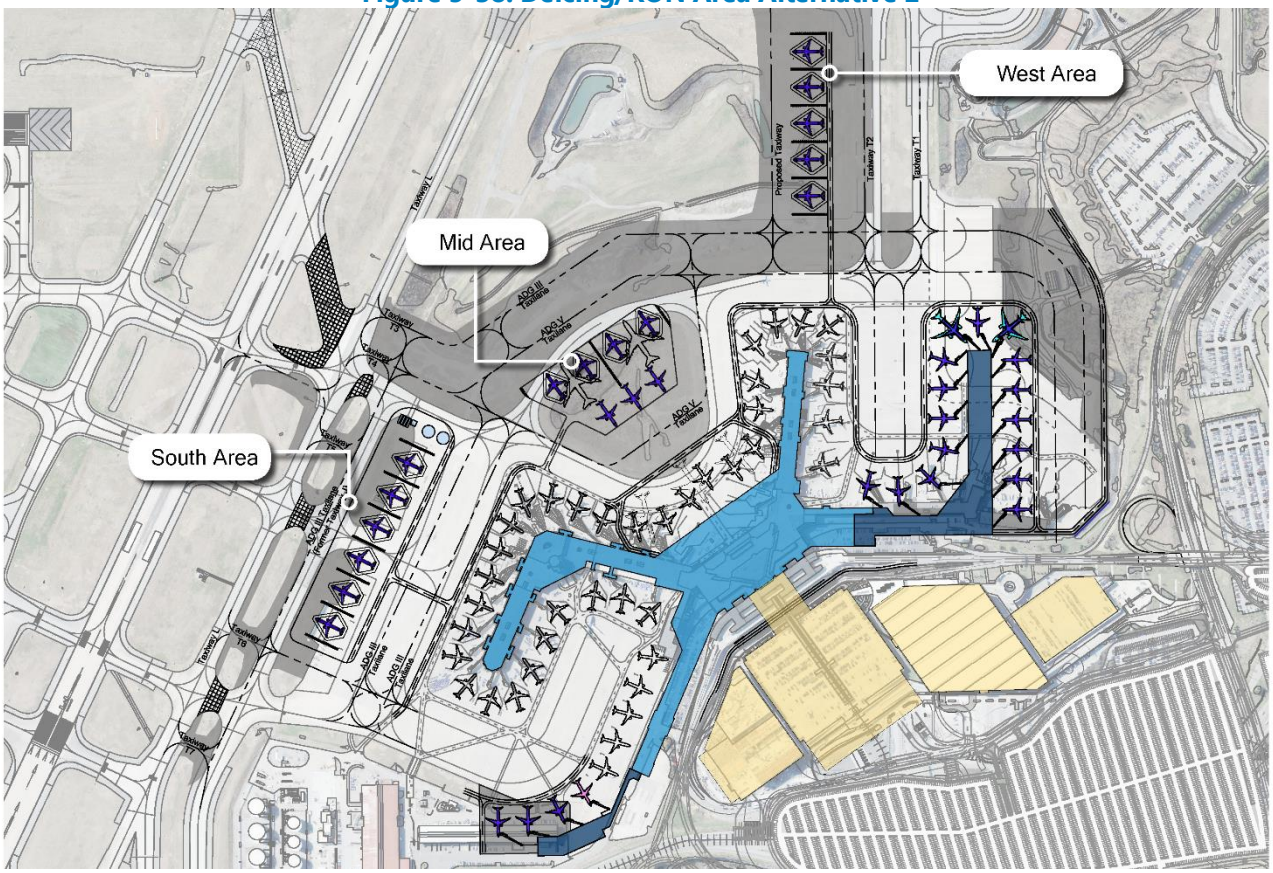
The primary advantage of this alternative is the incremental pavement addition to the existing terminal apron, with the least amount of impact to the Sims Branch/Snakey Creek drainage basin. A disadvantage of Alternative 1 is that during peak deicing operations, the potential for aircraft ground movement congestion around the terminal apron and deicing/RON positions will increase as a byproduct of the time it takes to deice aircraft (10-15 minutes) and the number of aircraft waiting for deicing. The simulation modeling effort indicates that aircraft pushbacks at Concourse B may block traffic going in and out of the West Deicing Area located adjacent to Taxiway T2, and that heavy aircraft traffic is observed at the Mid Deicing Area when the West Deicing Area is not available, resulting in additional ground delay prior to departure.

Figure 5-37: Deicing/RON Area Alternative 1



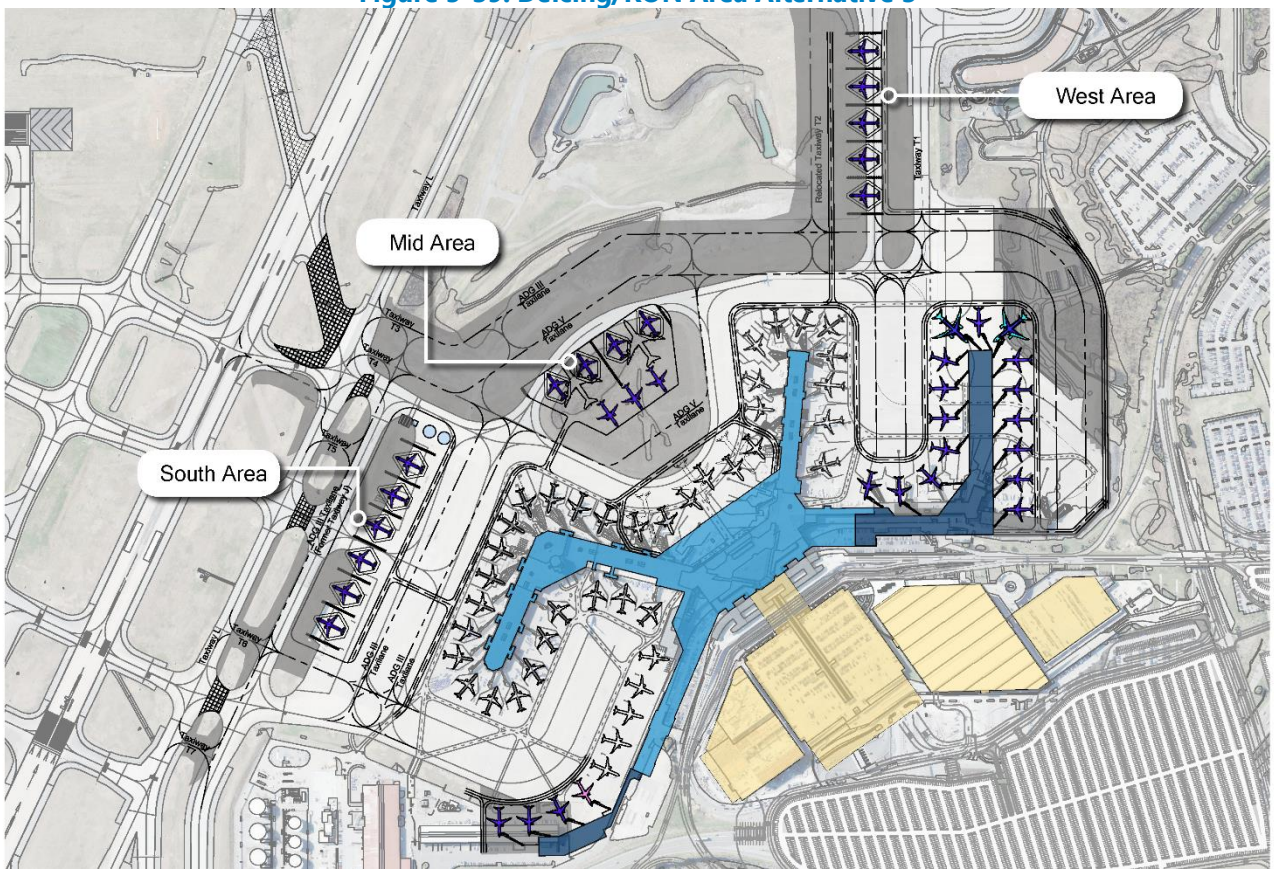
Alternative 2 (**Figure 5-38**) attempts to alleviate some of the potential deicing operation congestion by shifting the deicing/RON positions to just south of Taxiway T2. Assuming that the South Apron becomes unavailable for deicing/RON due to its potential conversion to remote satellite gates, Alternative #2 provides 12 aircraft deicing/RON positions but affects Sims Branch/Snakey Creek to a greater degree than Alternative 1. An additional disadvantage is that aircraft parked at the deicing/RON positions would cast a shadow on Taxiway T1, causing a line-of-sight issue for air traffic controllers in the existing tower. Since this would not be allowed, this alternative could not be implemented until the proposed new air traffic control tower (ATCT) is commissioned. Similar to Alternative 1, there would be an increase in potential ground movement delay at the Mid Deicing Area when the West Deicing Area is unavailable or being used to its own capacity.

Figure 5-38: Deicing/RON Area Alternative 2



Alternative 3 (**Figure 5-39**) also provides 12 deicing/RON positions (assuming the South Apron is converted to remote satellite gates) and attempts to lessen the environmental impact of Alternative 2 by locating the new deicing/RON positions between Taxiways T1 and T2. While the pavement impact is slightly less than Alternative 2, the line-of-sight conflict from the existing ATCT remains, as does the additional capacity and delay constraints to the Mid Deicing Area when the West Deicing Area is unavailable.

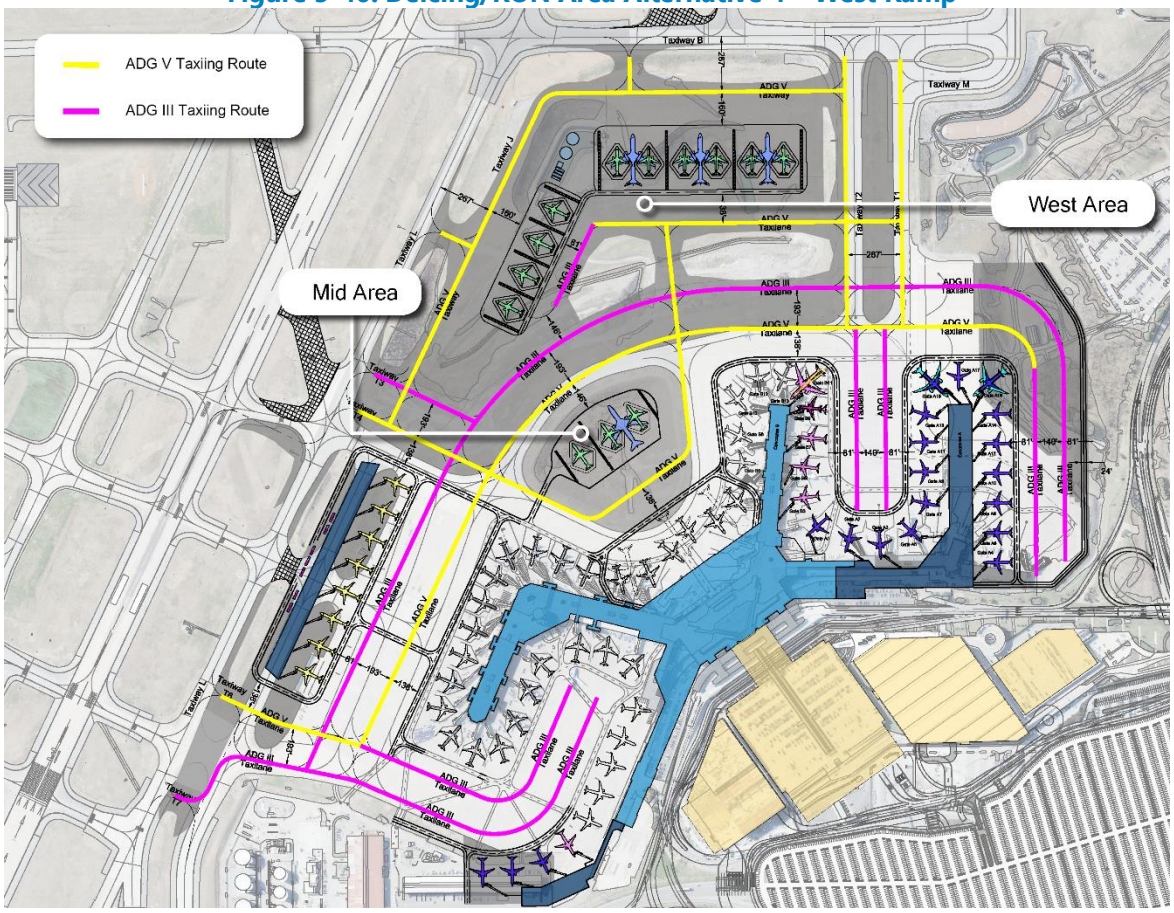
Figure 5-39: Deicing/RON Area Alternative 3



Alternative 4 (**Figure 5-40**) illustrates a new West Ramp alternative that maximizes the use of the area between Taxiways B and L for terminal ramp operations, including deicing and RON. The alternative provides up to ten (13) Group III and Group V aircraft positions for deicing and RON and provides appropriate taxi capabilities within the terminal ramp limits. The alternative also provides dual parallel taxilanes serving the terminal ramp area and designates taxilanes for Group III and Group V aircraft, maximizing the efficiency of aircraft ground movements to and from the terminal concourses to the airfield system.

From an operational perspective, once aircraft are deiced at the new West Ramp location, they are provided the best direct access to the taxiway and runway system, reducing the amount of ground time and reducing the possibility of ground delays due to exceedance of holdover times. Another advantage to Alternative 4 is that it provides better access for General Aviation and Cargo aircraft to deice without entering the terminal ramp area. A disadvantage of this alternative is the potential environmental impacts of filling in the Sims Branch/Snakey Creek watershed, and the resulting stormwater capacity improvements that may be needed to the North Pond area, north of Taxiway T1.

Figure 5-40: Deicing/RON Area Alternative 4 – West Ramp



After reviewing advantages and disadvantages of each of the deicing and RON location alternatives, it is recommended that BNA pursue Alternative 4 (West Ramp). The alternative provides the most advantageous ground movement operation in the terminal area complex, and it is believed that the potential environmental impacts can be mitigated.

5.3.4 Passenger Processing Functional Area Improvement Options

Within the master planning period, it is projected that some passenger processing facilities will need improvement beyond what is being constructed in the BNA Vision program scheduled to be completed in 2024. The facilities needing additional improvement, as identified in the Facility Requirements chapter, include check-in counters, a bag claim device, one security screening checkpoint lane, non-secure side restrooms, baggage screening equipment, and additional airline outbound baggage makeup facilities. The discussion below addresses potential improvements to each of these passenger processing facilities.

5.3.4.1 Additional Check-in, Baggage Claim, and Non-Secure Restroom Facilities

Adding check-in counters and bag claim devices beyond what is being constructed under the BNA Vision program will require that the terminal building core passenger processing area be extended. The alternatives to extend the core of the terminal building include an extension to the north and an extension to the south of the existing building limits. **Figure 5-41** illustrates the areas of the main terminal reserved for check-in and bag claim expansion, **Figure 5-42** illustrates an extension of the terminal building to the north, and **Figure 5-43** shows a southerly extension of the terminal building.

Figure 5-41: North End and South End of the Terminal Building

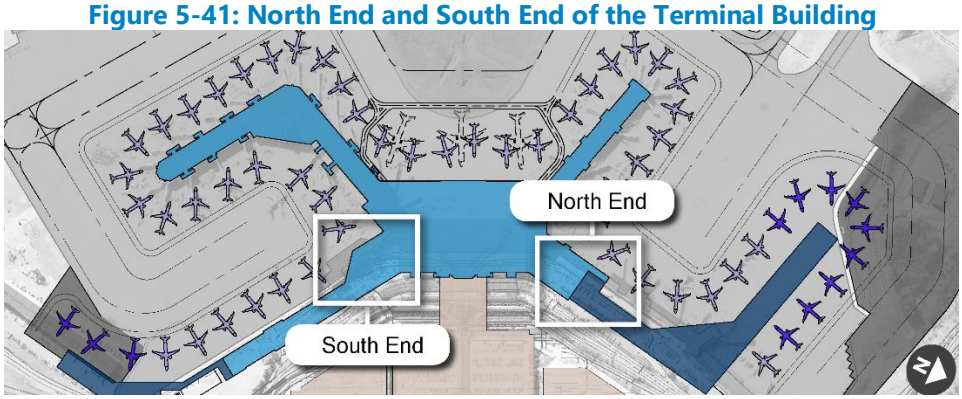


Figure 5-42: Extension of the Terminal Building to the North

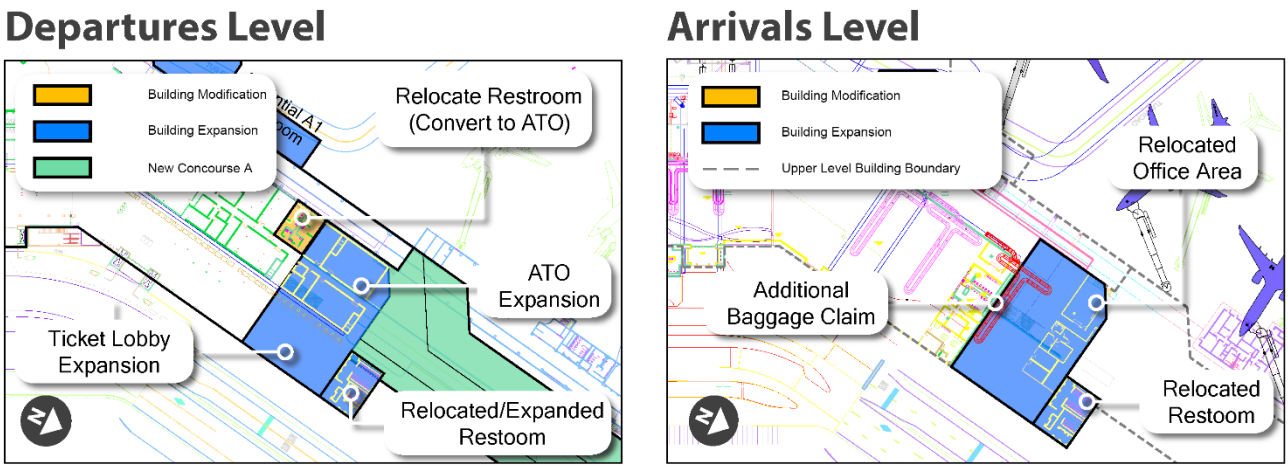
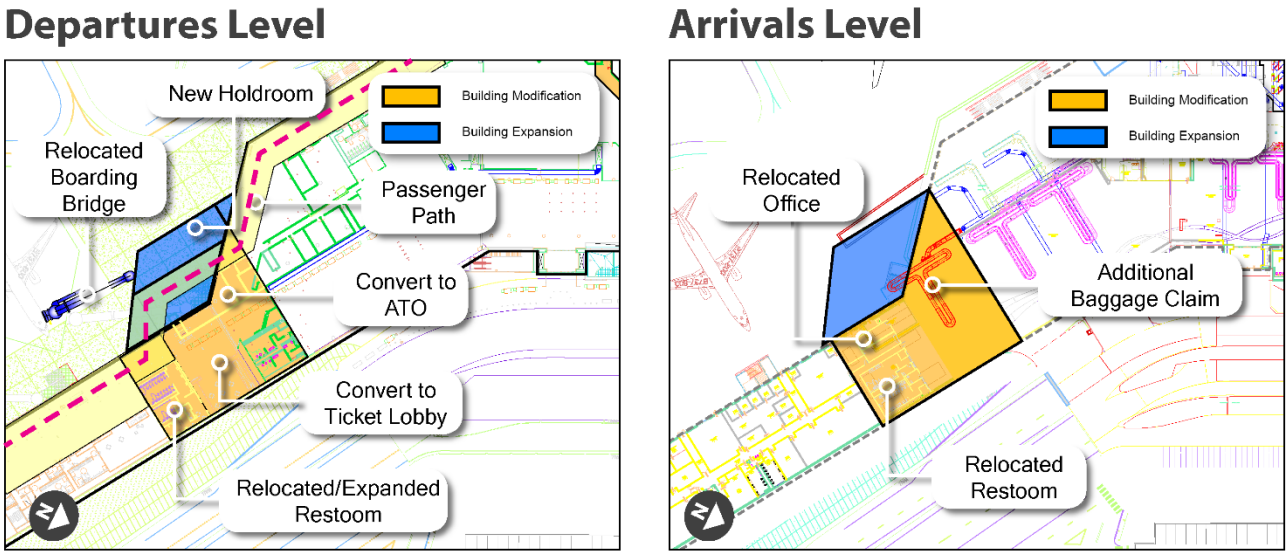


Figure 5-43: Extension of the Terminal Building to the South



Advantages of extending the terminal building to the north include:

1. The extension can be constructed in coordination with the redevelopment of Concourse A, providing necessary space for departure level check-in facilities, potential curbside check-in facilities, and airline ticket offices, as well as lower level bag claim devices and airline baggage service offices;
2. Non-secure restrooms could be added within the building extension area to meet demand.

Potential disadvantages of the northerly building extension include:

1. The building extension would need to be well-coordinated with departures and arrivals level approach roadways and curbside to ensure that building access is appropriately located to accommodate passenger drop-off and pick-up. If the approach roadway and curbside facilities aren't properly located to serve curbside demand near a vestibule, curbside congestion can occur and have unintended adverse effects on passenger flows and curbside capacity.

Advantages of extending the terminal building to the south include:

1. It is plausible to assume that Southwest Airlines may remain as one of the higher growth airlines at BNA. A southerly extension of the terminal building to add core processing check-in, baggage claim, and non-secure side restrooms might be needed to accommodate Southwest's long-term growth.

Potential disadvantages of a southerly building extension include:

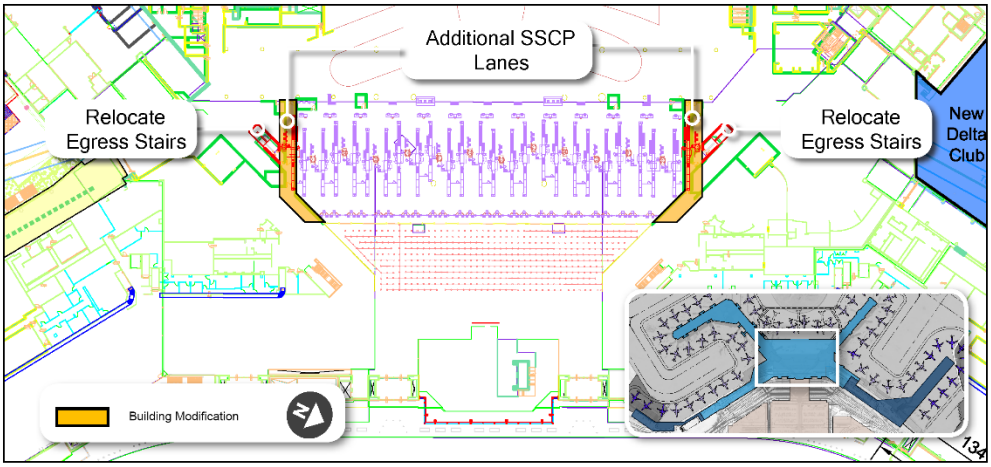
1. Extending the terminal building towards the south will require more complex construction to accommodate the additional check-in, baggage claim, and non-secure side restroom facilities. Immediately behind the current end wall of the south portion of the terminal building is the circulation corridor leading to Concourse D as well as the holdroom for Gate D1. The corridor and gate holdroom would need to be relocated to make space available for the additional terminal building ticketing and baggage claim facilities;

2. Extending the terminal building towards the south also would bring vehicles on both the arrivals and departures levels closer to the very constrained terminal exit roadway system, with added difficulty to taper down the number of travel lanes before merging back into exiting vehicle traffic.

5.3.4.2 Passenger Security Screening Checkpoint Lanes

Long-term projections indicate that an additional passenger security screening checkpoint lane might be needed towards the end of the planning period. Many things could change before the need arises for an additional lane(s), including changes in Transportation Security Administration (TSA) screening protocols, changes in TSA lane design standards, and accelerated or stable passenger growth patterns at BNA. With the BNA Vision program developing 24 total checkpoint lanes by 2024, as illustrated in **Figure 5-44**, the addition of one or two checkpoint lanes would conflict with existing egress stair structures serving the departures and arrivals levels. The stair structure would need to be relocated to provide the space needed for a properly designed checkpoint lane(s).

Figure 5-44: Additional Security Screening Checkpoint Lanes



5.3.4.3 Baggage Makeup and Checked Baggage Inspection Screening Facilities

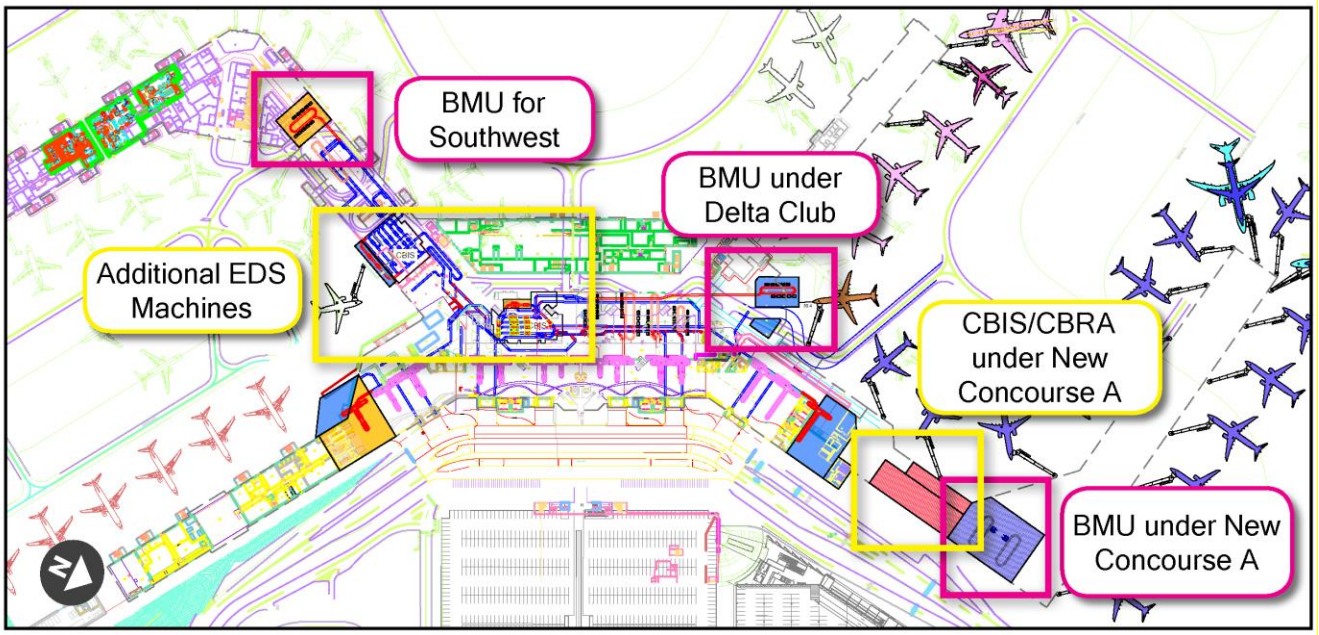
The Facility Requirements chapter identified the need for additional airline outbound bag makeup (BMU) facilities as well as additional checked baggage inspection screening (CBIS) equipment and space. Improvements to these facilities are needed in the near-term future for both the main (north) system and the Concourse C (south) systems. The north BMU and CBIS systems provide capacity for all other airlines except Southwest. The Concourse C BMU and CBIS systems provide capacity for Southwest Airlines, and the existing CBIS system includes a baggage conveyor to the main CBIS system which provides limited overflow capacity.

The north BMU system recently was improved by adding two additional makeup carousels and expanding the space for airline makeup operations. The BMU facilities for American Airlines, Delta Airlines, and United Airlines are used exclusively by those airlines, leaving all other airlines except

Southwest to utilize the 4th carousel and bag makeup room. If airline growth continues unabated at BNA, and new entrant airlines are projected to cause the one dedicated BMU operation for "all other airlines" to become congested during peak periods, this will result in the need for additional north BMU space. For the Concourse C BMU system, increasing peak period service by Southwest Airlines is projected to require additional south side BMU facilities. The north and south CBIS systems are also projected to each require additional equipment and space to meet peak period bag screening demand.

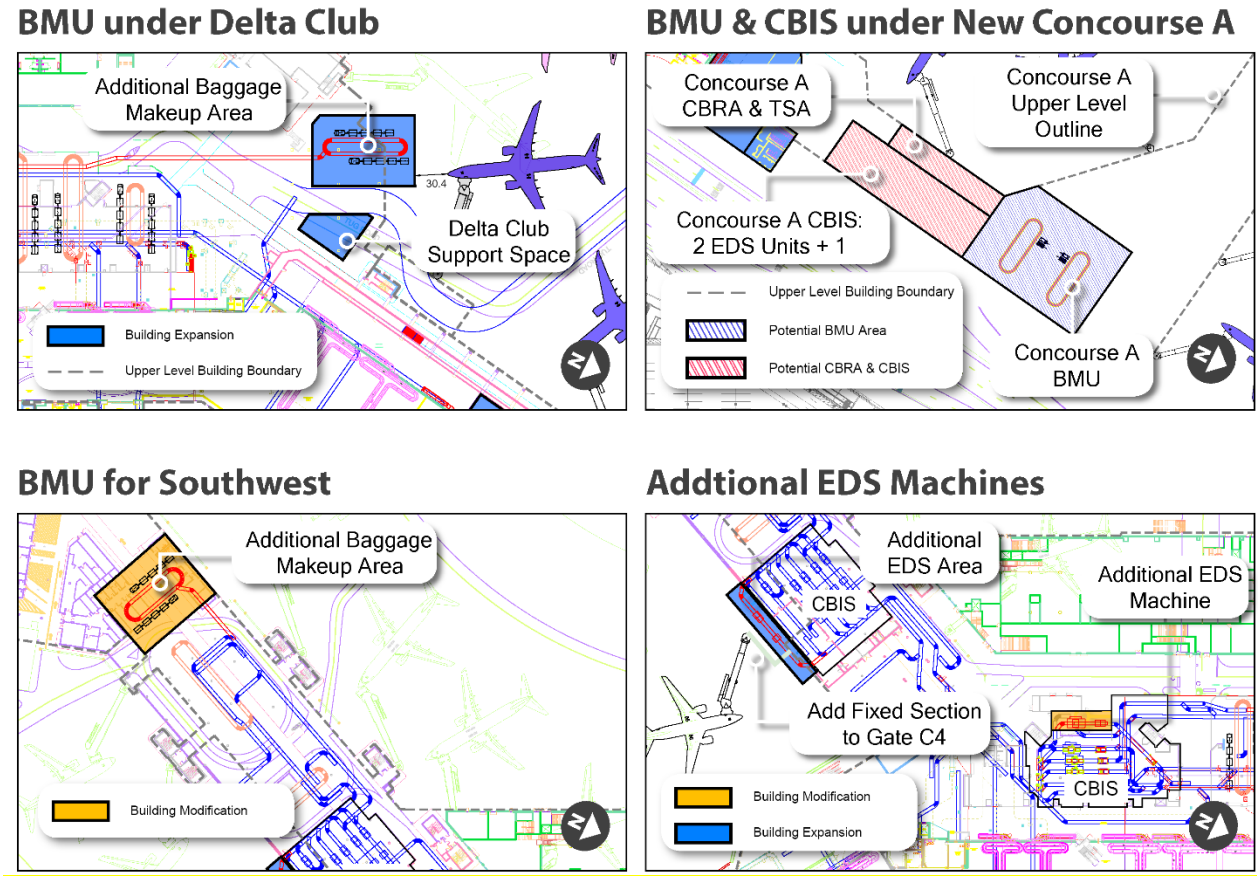
Figure 5-45 illustrates potential expansion locations for the north and south side BMU and CBIS systems, including additional bag makeup carousels and potential expansions of the TSA's EDS machine and screening resolution areas. For the north BMU expansion, **Figure 5-45** also illustrates an alternative for constructing an additional north BMU facility located underneath the proposed Delta Airlines Club on the Concourse B departures level.

Figure 5-45: Baggage Makeup Unit (BMU) and Checked Baggage Inspection Station (CBIS) - Potential Expansion Locations



Depending on the actual timing of need for additional north BMU and CBIS systems improvements, another alternative is to construct supplemental CBIS and BMU systems as part of the planned Concourse A redevelopment/expansion. In this alternative, a portion of the checked baggage coming from the existing or planned expanded north ticketing/check-in takeaway belts would be diverted to new CBIS and outbound baggage makeup systems. This alternative could avoid the need to expand the existing main (north) CBIS system, and could offer additional baggage makeup facilities to accommodate the ultimate 17 gates on the redeveloped/expanded Concourse A. **Figure 5-46** illustrates the potential location of CBIS and BMU systems associated with Concourse A redevelopment/expansion.

Figure 5-46: Potential Baggage Makeup Unit (BMU) and Checked Baggage Inspection Station (CBIS)



For the north CBIS and BMU systems upgrades, the recommended improvements are dependent on the timing of need. If airline peak hour demand exceeds the capacity of the existing systems prior to being able to implement planned Concourse A redevelopment/expansion, then expansion of the main (north) CBIS and BMU systems will be needed. If airline peak hour demand does not exceed existing capacity before the Concourse A redevelopment/expansion is underway, then the Concourse A project can accommodate the required CBIS and BMU systems upgrades.

5.3.5 Terminal Support Facility Alternatives

Adjacent to the southeast of the terminal complex lies terminal support facilities consisting of the Air Freight/Ground Support Equipment (GSE), Multipurpose building, airport fuel farm, and triturator facility. These facilities provide close terminal and concourse proximity for the airlines to interact with their terminal operations. The airport's fuel farm is sufficient to handle demand throughout the planning period, and the Multipurpose building which contains airline related materials and equipment storage is sufficient for future needs. The Air Freight/GSE building is where airlines process "belly cargo" and also provides GSE maintenance operations but is constrained and in need of expansion. Also, additional triturator capacity will be needed and will be developed at the north end of the terminal complex to serve airlines located primarily on Concourses A and B.

In reviewing alternatives for expanding Air Freight/GSE facilities, sites north and south of the terminal complex were considered. Remoteness from the terminal complex; difficulty in accommodating roadway grades between the airfield and terminal support areas; and inaccessibility of north terminal support facilities to required secure side access points were reasons why north side terminal support facilities were dismissed from further consideration. A south side terminal support location was chosen as preferred for evaluation of feasible alternatives.

The desired location for terminal support facility expansion is in, or near, the current location. The Concourse D, 3-gate expansion project would impact the existing Air Freight/GSE facility. Depending on the timing of need for the additional Concourse D gates, there are two alternatives for reconstruction and expansion of the existing Air Freight/Ground Support Equipment (GSE) facilities. One alternative is to wait for the Donelson Pike relocation project to be completed, which would reduce or eliminate any impacts to the current Air Freight/GSE operation, and the other alternative is to develop the Concourse D extension in phases that would affect the Air Freight/GSE facilities and operations. In both Air Freight/GSE facilities redevelopment and expansion alternatives, right-of-way for a future airport people mover system along the realigned Donelson Pike is preserved.

Figure 5-47 illustrates the alternative that would not begin the Concourse D extension project until the Donelson Pike relocation project was completed, avoiding impacts to the existing Air Freight/GSE operation. In this alternative, a new 70,000-square foot Air Freight/GSE facility and operation would first be established prior to demolishing the existing facility, and then Concourse D would be extended. In addition to replacing and expanding the existing Air Freight and GSE maintenance and storage uses, the expanded facility could also include airline catering functions.

If the Concourse D gates are needed prior to the Donelson Pike relocation, **Figure 5-48** illustrates an alternative to redevelop the Air Freight/GSE facilities in phases. Phase 1 would consist of the demolition of the existing Air Freight/GSE building and reconstruction of the air freight portion of the existing building (approximately 45,000 square feet) to reestablish belly cargo functions for the airlines. In this alternative, GSE functions would be affected until they could be reestablished after Donelson Pike relocation is completed. Phase 2 illustrates a GSE/Support building comprising approximately 27,000 square feet.

Figure 5-47: Air Freight/GSE Redevelopment

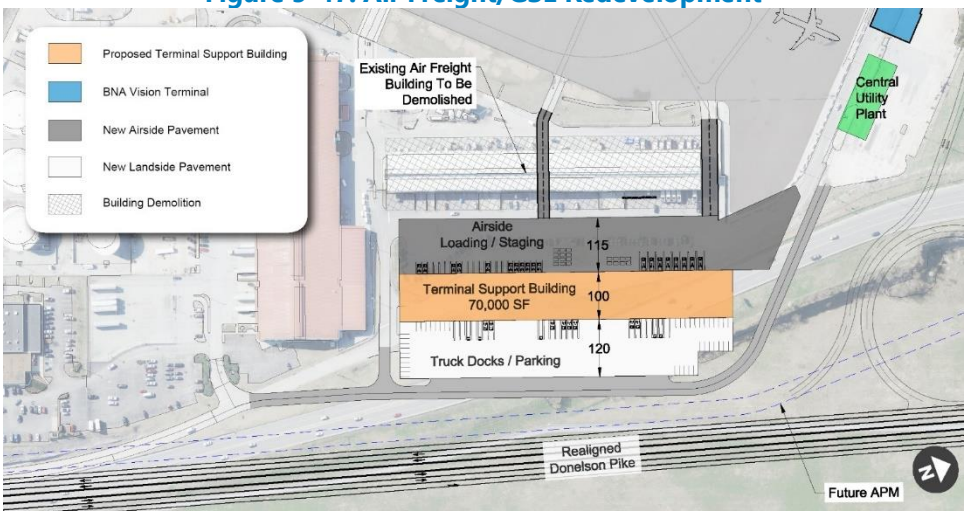
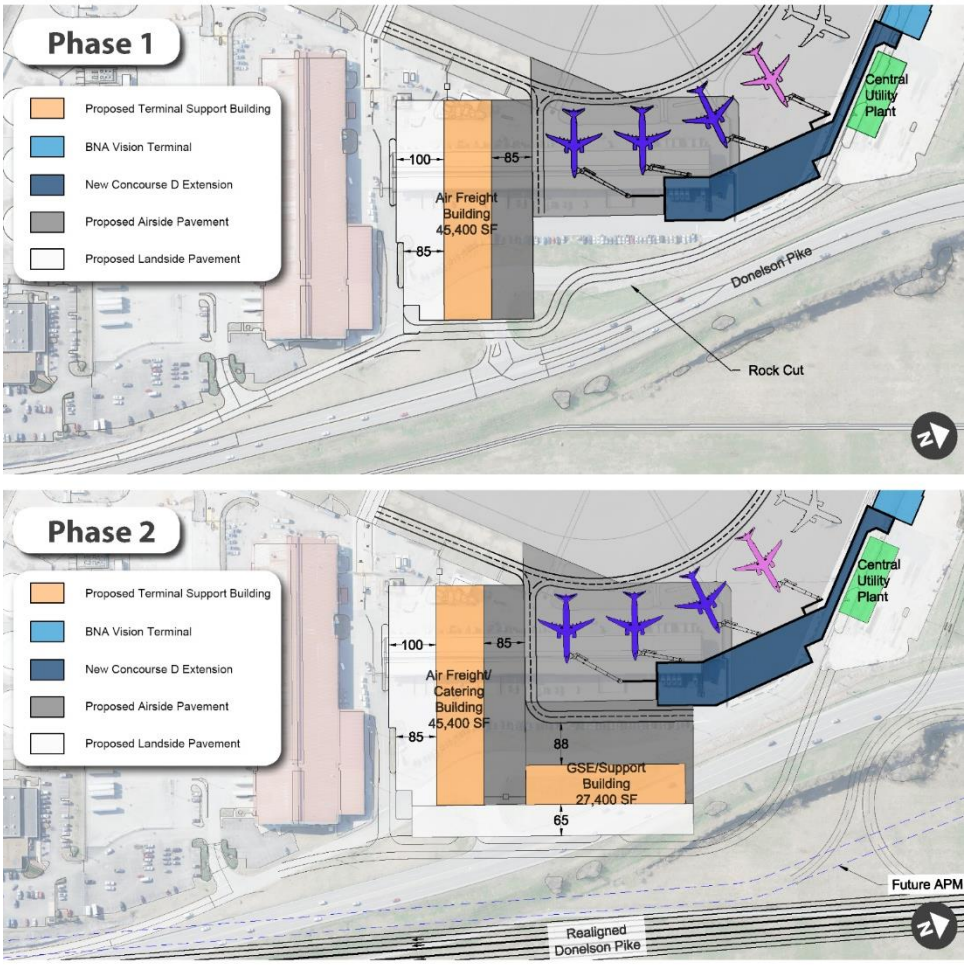


Figure 5-48: Air Freight/GSE Redevelopment - Phasing



Evaluation of the Concourse D expansion alternatives reveals that it would be more advantageous if the Concourse D extension could occur after Donelson Pike is relocated to its final alignment. In this circumstance, construction of the Concourse D extension would have the least impact on air freight and GSE facilities and operations.

5.3.6 Recommended Terminal Improvement Alternatives

The evaluations above result in the following recommended alternatives for terminal facility improvements:

1. Immediate gate demand beyond BNA Vision's 48 gates can be provided by redeveloping and expanding Concourse A to 17 gates (net 10 new gates), bringing the number of near-term available "gates" to 58. Beyond implementation of redeveloped/expanded Concourse A, alternatives exist that could develop either a Concourse A-North, Concourse E, or extended Concourse D (or combination), bringing the total number of terminal complex gates to between 65 and 72;
2. Construction of a new three (3) Group III/ one (1) Group V position "Mid Ramp" and adding a "West Ramp" that provides up to ten (10) Group III/three (3) Group V remain overnight (RON) and deicing positions to replace positions lost at the South Apron (if Concourse E is developed) and north of Concourse A locations;
3. Core terminal passenger processing facilities will need to be expanded to provide long-term capacity improvements to serve the growing passenger demand at BNA. The facilities expected to be needed include additional check-in; two (2) bag claim carousels; non-secure side restrooms; two (2) additional security screening lanes; two (2) additional checked baggage screening machines; and one (1) additional airline baggage makeup facility.
4. Reconstructing and expanding terminal support facilities (Air Freight/GSE) after Donelson Pike is relocated
5. Constructing an additional triturator north of Concourse A to serve Concourse A and B airlines more conveniently.

5.4 Landside Facility Alternatives

Much of the required landside facility improvements identified in Chapter 4 involve the terminal area roadways; the arrivals and departures levels' curb allocations for various mode segments, such as passenger vehicles, transportation network companies (TNCs), and airport public parking and employee parking shuttle buses; and the number of available lanes serving the arrivals and departures levels curbs. Terminal area roadway demand and capacity is also affected by rental car and valet parking facilities and operations. This section identifies and evaluates terminal roadway and curbside lane widening and presents options to further accommodate rental car and valet parking growth.

5.4.1 Arrivals and Departures Levels – Additional Lanes and Curbfront

For the terminal area roadways, BNA is undertaking a Terminal Area Roadway Improvement (TARI) Program which, along with the Tennessee Department of Transportation's (TDOT) Donelson Pike relocation project, will improve terminal approach and exit roadway geometry and capacity. The TARI

and Donelson Pike projects are expected to provide sufficient roadway capacity through the planning period, with the exception of the I-40 inbound approach and outbound exit sections, which are projected to need additional lanes within the next few years. Airport coordination with TDOT is ongoing to assess the timing and extent of I-40 lane improvements.

Regarding the allocation of curb for the various mode groups (private vehicles, shuttle buses, etc.), total curb lengths for the arrivals and departures levels are projected to be sufficient throughout the planning period; however, there has been recent curb congestion observed on both levels. There appears to be several reasons for the curb congestion, including:

- **Terminal area construction** – BNA Vision's landside construction has included redevelopment and new construction of short-term parking garages and has also affected the overall traffic flows on the terminal approach and exit roadways. With only one of three garages complete, Garage A is frequently full. It is possible that the combination of construction activities and lower close-in parking supply have temporarily affected passenger vehicle use behaviors/trends, resulting in a higher curb volume. Once construction is complete, it is likely that curb volume will normalize;
- **Airline growth trends** – Currently, Southwest Airlines comprises approximately 53% of total airline activity, resulting in a higher concentration of vehicle activity in their curbside zone;
- **Enforcement protocols** – The two passenger crosswalks on the arrivals and departures levels can sometimes slow vehicle traffic in the vicinity of the curbs. Also, enforcement of curbside dwell times is often required to keep vehicles moving towards the exit roadways. Curb enforcement is a difficult operational element of curb management that is made more challenging during peak activity periods, which occasionally results in increased curb congestion.

There are operational improvements that can be made to reallocate portions of the curbs to the various mode groups, such as encouraging increased use of the outer curb, relocating some shuttle buses to the ground transportation level, and adding signage to facilitate passenger and vehicle wayfinding. While operational improvements can provide curbside congestion relief, the master plan has also identified the need to add lanes to the arrivals and departures levels. These lane additions will facilitate vehicle movements on the terminal roadway and curbs to add capacity to accommodate future passenger growth.

Evaluations of the terminal approach and exit roadways serving the arrivals and departures levels indicate that congestion is likely to increase through the planning period unless two lanes are added to the outer curb on the arrivals level roadway, and an additional lane is added to the outer curb on the departures level. On the arrivals level, the two outer curb lanes would provide space and capacity for passenger double parking and bypass around parked vehicles. On the departures level, the additional outer curb travel lane would provide additional capacity for the amount of projected vehicle traffic towards the end of the planning period. Adding the lanes as recommended would also help in reducing curb congestion.

When considering widening of the arrivals and departures level approach and exit roadways in front of the terminal, there is an opportunity to also provide a second airport entrance lane from the I-40 exit to the departures level, alleviating the I-40 exit lane deficiency that is projected to occur in the next several years.

5.4.1.1 Arrivals Level

As illustrated in the photo below (**Figure 5-49**), the arrivals level approach roadway geometry to the curbs provides less visibility for drivers needing to decide which lane to access. Use of the outer curb would provide an opportunity to avoid the congestion generated by the majority of passengers being picked up at the middle curb. Unfortunately, the one sign that indicates that the outer curb is available requires a last-second decision due to the roadway geometry and lack of enhanced signage. In response to the existing roadway geometry, many vehicles slow down prior to the decision point, resulting in slow approach speeds, last-second weaving, and under-utilization of the outer curb.

Figure 5-49: Approach to the Arrivals Level Curb

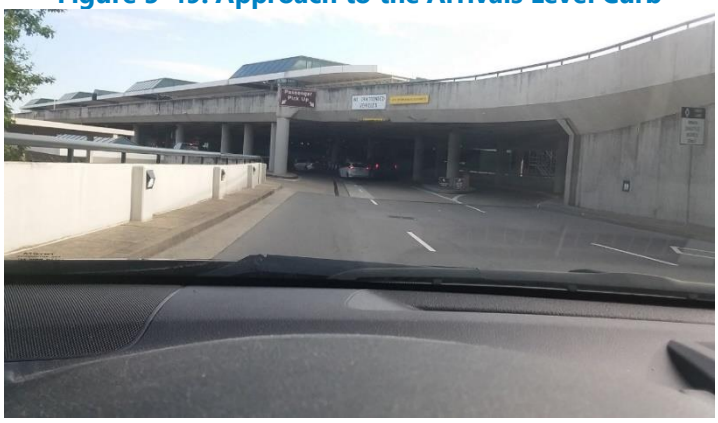
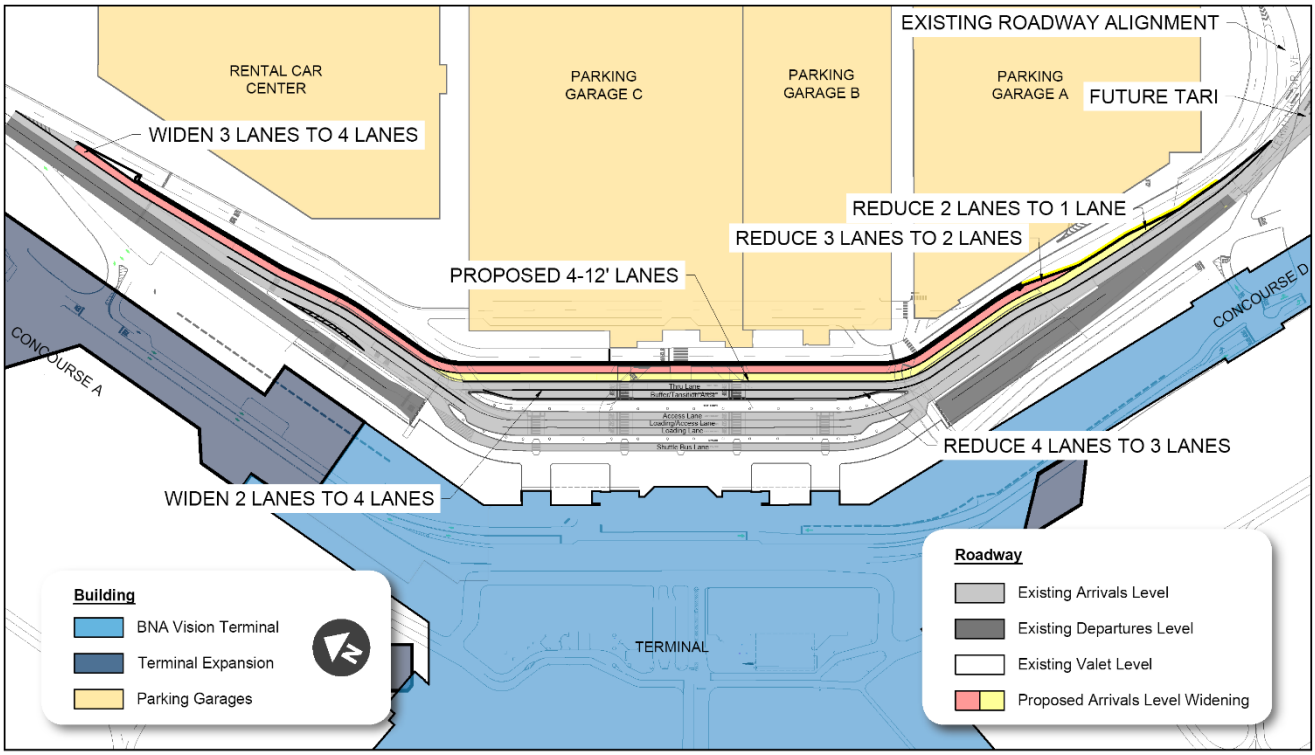


Figure 5-50 illustrates the potential alignment for arrivals level lane widening. The scope of the improvements would include widening the approach roadway starting near the roadway split between the arrivals and departures levels, adding two outer curbfront lanes, and widening the exit roadway. The concept would accommodate double parking use of the outer curb with additional lanes to bypass the curb parking which would improve traffic flow and add the necessary capacity to the roadway.

Figure 5-50: Arrivals Level – Potential Lane Widening

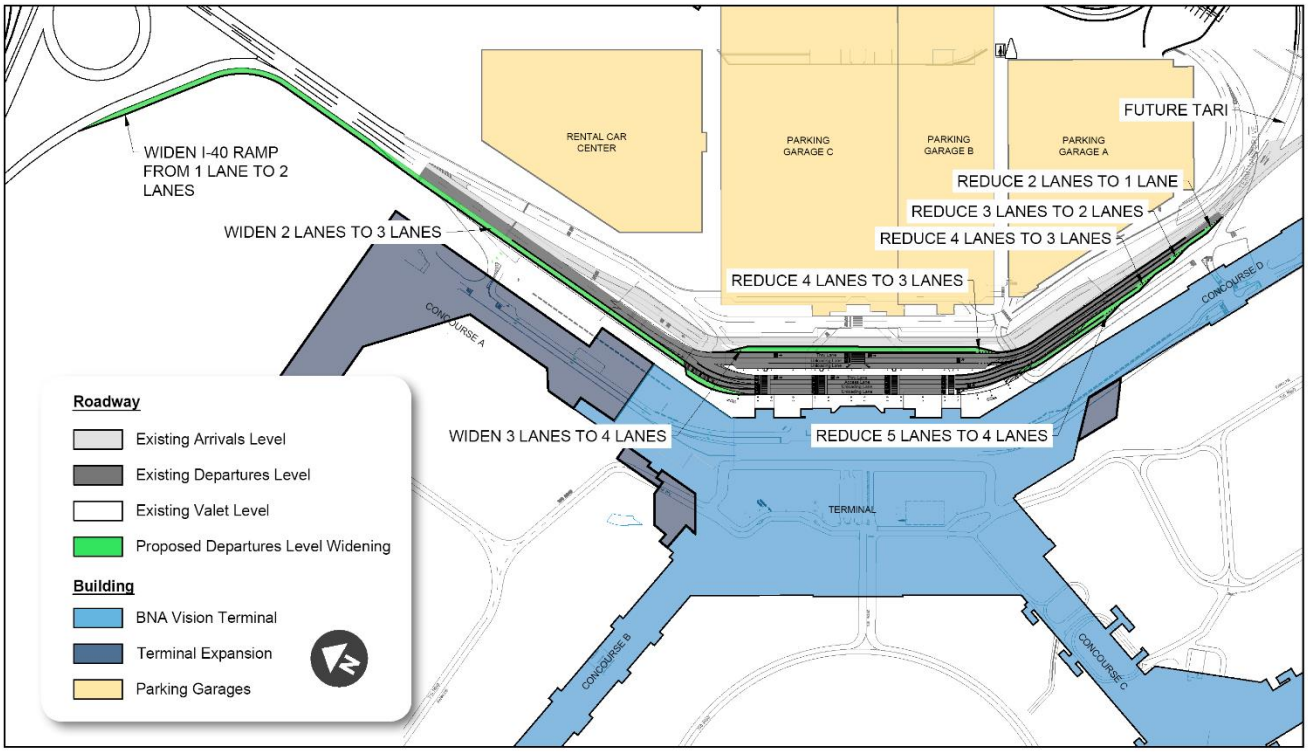


5.4.1.2 Departures Level

For the departures level, the existing outer curb roadway section provides three lanes – one lane for curb loading/unloading, one lane for double parking and/or bypass from the curb, and one additional travel/bypass lane towards the terminal exit roadway. Adding one lane to the existing three-lane outer curb geometry would provide additional roadway capacity in accommodating total vehicle traffic on the terminal roadways and curbs, and operational flexibility to divert traffic from other levels should they become congested during peak periods or pavement maintenance activities.

Figure 5-51 illustrates the potential geometry for widening the departures level roadway and curbfront. The scope of the improvements also includes a second, I-40 exit lane to the departures level at the terminal which would facilitate new curbfront serving the existing and future expanded north ticketing wings. New structural columns would need to avoid travel lanes on the arrivals level below.

Figure 5-51: Departures Level – Potential Roadway and Lane Widening Improvements



5.4.2 Rental Car Facility Improvement Alternatives

Analysis of rental car facility demand and capacity revealed that additional facilities are needed to accommodate growth in the need for rental car ready/return spaces and the quick-turn-around (QTA) functions of the rental car agencies, including an additional four acres of ready/return storage space and up to an additional 10 acres of QTA facilities within the short-term planning period. Beyond the short-term horizon, there is additional rental car facilities that could be needed. The evaluation below discusses both short-term and long-term potential improvements to rental car facilities.

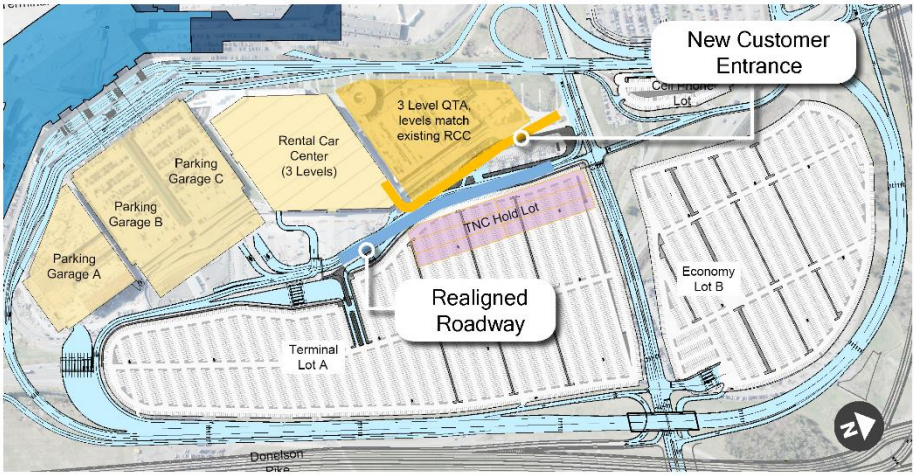
5.4.2.1 Short-Term Rental Car Facility Improvement Alternatives

Four alternatives have been identified adjacent to the existing three-level rental car garage located across from the passenger terminal. The alternatives have varying effects on the existing rental car operation, as well as potential impacts to the TARI roadway geometry, as described below.

Alternative 1 (**Figure 5-52**) illustrates full redevelopment and expansion of the existing rental car facility on its current site, expanding to meet rental car ready/return (storage) and QTA needs. The redeveloped facility would be a 3-level structure to match the existing facility and operation and would provide fueling and wash facilities on each level. In this Alternative, the existing customer entrance would be relocated but the existing garage exit location would remain. The key advantage of this alternative is

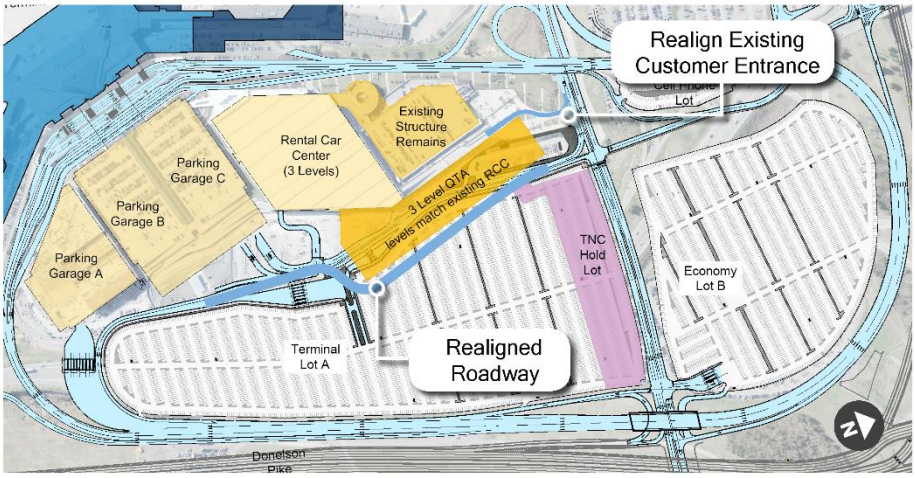
that the rental car facilities would not expand off of the current site, avoiding impact to the capacity of the Long-Term A public parking lot. The primary disadvantage of Alternative 1 is that redevelopment and expansion on the current site would require the existing rental car operation to use existing remote service sites during construction, possibly adversely affecting customer service and rental car operations. Alternative 1 meets the required rental car and public parking facility requirements through 2037.

Figure 5-52: Rental Car Facility Improvements – Alternative 1



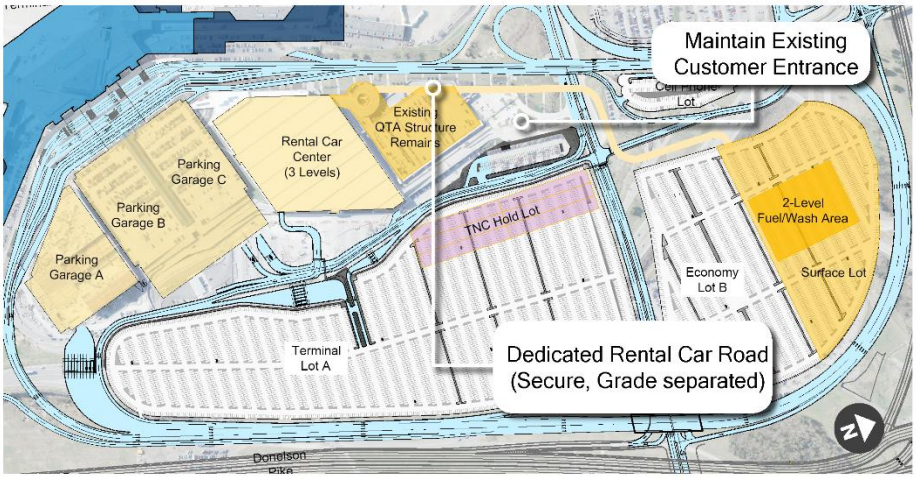
Alternative 2 (**Figure 5-53**) illustrates a three-level garage to be constructed immediately adjacent to the east of the existing facility. In this alternative, the current access to the rental car garage would serve both the existing garage and new facility. The three levels would be constructed to align with the three levels of the existing rental car garage facility and fueling and washing operations would occur on each level. The existing QTA operations in the existing structure would be converted to ready/return spaces and the QTA function would occur within the new structure. Although Alternative 2 meets the required rental car and public parking facility requirements through 2037, the number of Long Term A public parking spaces would be reduced by almost 700 spaces. This alternative requires relocation of the TARI access road to existing Garage A, and a realignment of the adjacent intersection. Advantages of this alternative include constructing additional rental car facilities immediately adjacent to the existing facility and avoiding the challenges of maintaining rental car operations during construction, as presented in Alternative 1.

Figure 5-53: Rental Car Facility Improvements – Alternative 2



Alternative 3 (**Figure 5-54**) proposes a two-level garage adjacent to the existing rental car garage. In this Alternative, the existing QTA building remains, but is converted to ready/return overflow and vehicle staging. A new QTA function is established in Economy Lot B. A new 2-level structure is built immediately east of the existing rental car garage facility, and the surrounding surface lot is used for construction phasing. Alternative 3 maintains the existing customer entrance and exit. Although Alternative 3 meets the required rental car and non-holiday public parking facility requirements through 2037, the number of Long Term A public parking spaces would be reduced by almost 500 spaces, and the number of Economy public parking spaces is reduced by approximately 1,500 spaces. Nearly 1,200 additional public parking spaces would be needed to meet the 2037 public parking demand during peak holiday periods.

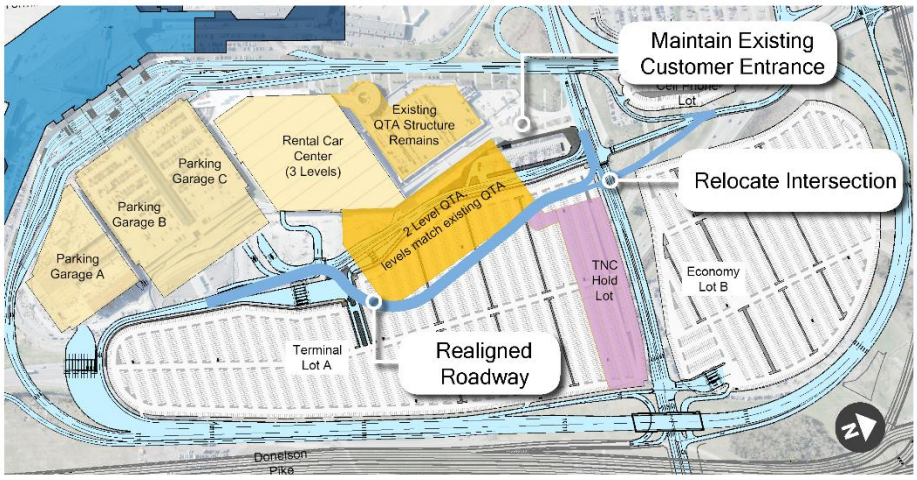
Figure 5-54: Rental Car Facility Improvements – Alternative 3



Alternative 4 (**Figure 5-55**) retains the existing QTA facility and constructs an additional QTA building east of existing QTA. The new two-level structure matches existing QTA levels, with fuel/wash facilities

on the ground level. Alternative 4 maintains the existing customer entrance and exit and requires realignment of the TARI access roadway to Garage A and the adjacent intersection. Alternative 4 reduces Long Term Lot A by approximately 1,200 spaces and meets non-holiday public parking requirements through 2037. However, an additional 350 public parking spaces would be needed to meet the 2037 holiday requirement.

Figure 5-55: Rental Car Facility Improvements – Alternative 4



Alternative 2 is the recommended solution for addressing near-term rental car facility improvement requirements as it offers advantages over the other three alternatives. The proposed three-level garage would be constructed immediately adjacent and east of the existing facility, preserving the current access to serve both the existing garage and new facility. The three levels would align with the three levels of the existing rental car garage facility and fueling/washing operations would occur on each level to support existing rental car company operations. The conversion of QTA to ready/return spaces in the existing structure would facilitate the QTA function being provided within the new structure. Sufficient room is provided for construction phasing without affecting existing rental car operations, avoiding most operational impacts to the existing rental car operation.

5.4.2.2 Long-Term Rental Car Facility Improvement Alternatives

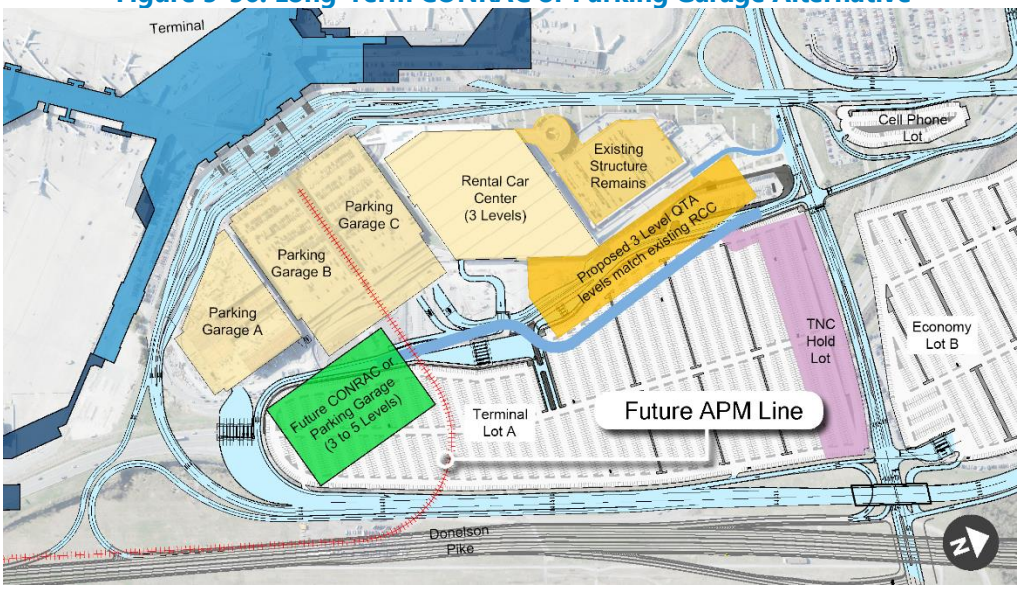
In the long-term, a balance or choice between close-in public parking and close-in rental car facilities may need to be considered. The existing Consolidated Rental Car Facility (CONRAC) was developed on the basis that it could convert to additional public parking capacity in the future if needed. As a result, if additional structured public parking is required, one alternative is to relocate existing and/or expanded CONRAC facilities to a new, close-in garage or extending Garages A, B, and/or C for public parking. However, if terminal area access and roadways become congested to a point where rental car facilities and operations cannot be accommodated without detriment to public vehicle traffic, one alternative is to consider relocating rental car facilities to a remote site. Doing so would free up the existing CONRAC facilities for close-in public garage parking. Should it be desirable to continue to accommodate both CONRAC and public parking with close-in facilities, then consideration can be given to providing

additional garage spaces behind the existing garages, effectively reducing the size of the "Terminal Lot A" public parking lot.

For remote parcel development of CONRAC facilities, there are available parcels within MNAA's ownership that could house remote rental car facilities. The feasibility of remote rental car facility locations will need to consider future airfield, terminal, and landside facility improvements that cannot be evaluated fully at this time. Once future airfield, terminal, and landside facility decisions are made, remote sites for rental car facilities can be evaluated more readily.

Figure 5-56 illustrates the most logical vicinity adjacent to existing rental car and public parking garage facilities for potential CONRAC relocation or additional structured public parking. The site could use existing roadway access to either the existing CONRAC or public parking Garages A, B, and/or C.

Figure 5-56: Long-Term CONRAC or Parking Garage Alternative



There are advantages and disadvantages with adding an additional garage structure behind the existing public parking garages. Advantages of the new garage include providing additional close-in parking which could reduce the need for shuttle busing from remote sites and providing a covered parking experience to keep passengers out of weather.

A disadvantage of the potential new garage location would be that the first level of the new garage would need to be constructed to accommodate moving vehicles destined for the existing garages, lessening the number of new garage parking spaces unless additional garage levels were added. In addition, walking distance from the new garage to the terminal would be long, likely requiring the addition of moving sidewalks or other automated passenger conveyances. Also, having a large volume of passengers walking throughout the garages or being obstructed by moving sidewalk systems throughout could impede vehicle traffic flows, especially during peak travel periods.

If the new garage was dedicated to relocated rental car facilities, a disadvantage would be that rental car customers would need to make their way through the public parking garages, or otherwise be shuttled, to access the relocated CONRAC, reducing the level of service from existing conditions.

5.4.3 Valet Parking and Remote Storage Location Alternatives

The valet parking operation at BNA offers a premium customer service by providing close-in parking operations for the public at higher rates than close-in garage parking. The valet operation at the terminal maintains space for storing customer's cars on the ground level of the terminal roadway system, but additional storage space may be needed through the planning period. A remote valet parking lot located along the I-40 eastbound exit into the airport maintains more than 1,000 spaces, and there are additional spaces for valet parking storage located south of the terminal along Donelson Pike, adjacent to the BNA Express parking facility.

Although there is a possibility that long-term valet parking demand may decrease immediately after construction completion of Garages B and C and redeveloped Long-Term A lot come on line in 2023, the alternatives for additional parking are presented here with the assumption that valet parking demand and storage of vehicles using the valet service will increase throughout the planning period.

The recommended alternative requires the valet operator to reconfigure the valet storage parking lot along the I-40 exit road into the airport to achieve a more compact, high-density storage layout. **Figure 5-57** illustrates the current configuration in the storage lot and provides a way for the valet operator to increase significantly the storage capacity in the existing lot. This alternative would require less investment than other alternatives that would require construction of additional facilities or result in reduced public parking supply. Should the compact storage layout not provide sufficient space for valet parking storage through the planning period, other alternatives could include using a portion of Long-Term A, the R-2 lot, and/or a portion of the parking garage to supplement valet storage parking needs.

Figure 5-57: Valet Parking Remote Storage Parking – Recommended Alternative

Current configuration: 679 spaces

Standard stall layout: 825 spaces

High-density layout: 1,500 spaces

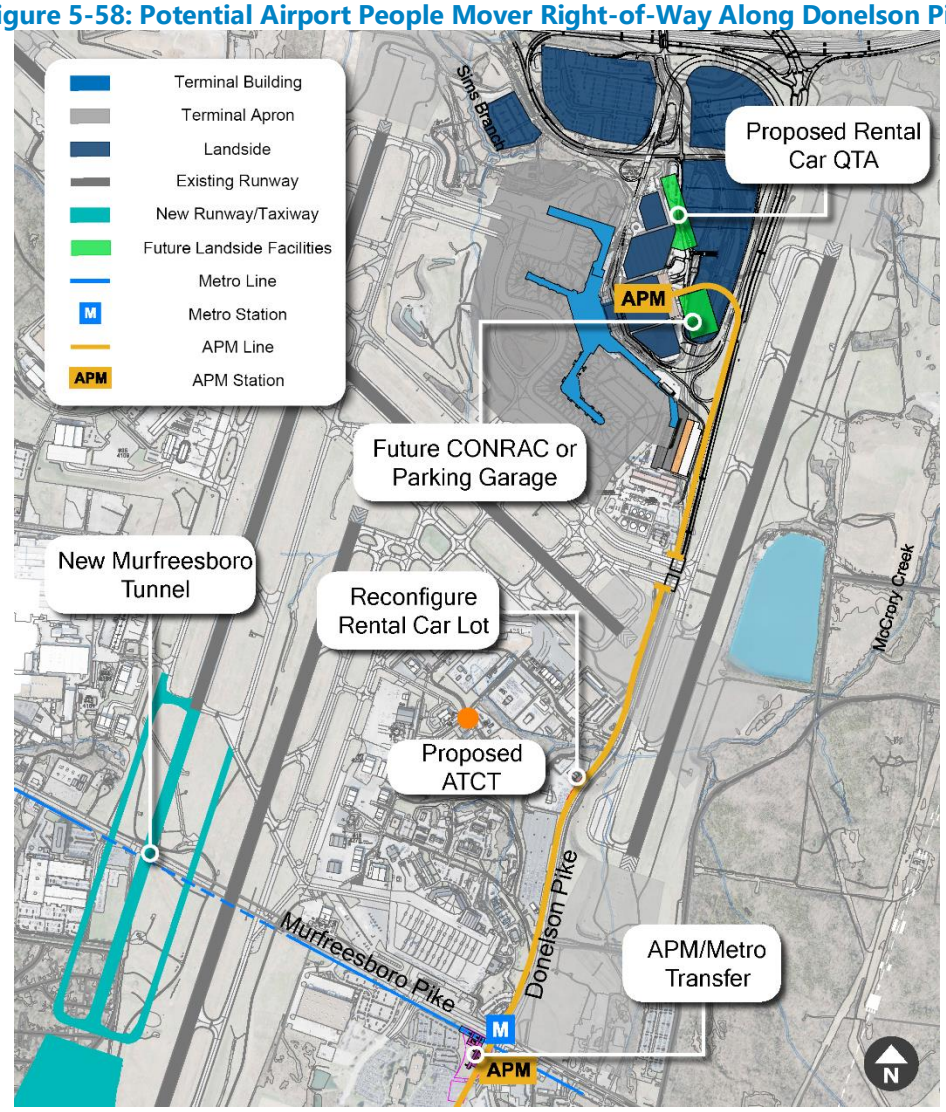
Sources: Satellite images – Google Maps, December 2018
Stall layout – MNAA and InterVISTAS, January 2019

5.4.4 Connectivity Between Potential Metro Light Rail and Airport People Mover (APM) Systems

Prior planning has identified the potential for BNA to be accessible to a future Metro light rail line serving downtown Nashville from various parts of the region in an attempt to address highway congestion. The Metro light rail concept serving the southeast Nashville area is planned to be routed along Murfreesboro Pike. The possibility of connecting the Metro light rail line to the terminal has been previously explored by MNAA, and a right-of-way through the BNA Vision garage development currently under construction was previously identified. For this master plan, the Metro light rail concept has been further explored to coordinate its potential connection with other master plan facility improvements and ensure compatibility between Metro and BNA plans.

Although the planned Metro light rail system has not yet progressed through necessary state approvals, this Master Plan has identified the potential to connect a Murfreesboro Pike Metro line to the passenger terminal via an Airport People Mover (APM) system. The Light Rail/APM transfer station concept could also support an array of airport-related parking, such as long-term public parking and/or employee parking, offering ways to reduce shuttle bus operations and their costs in favor of using the APM connection to the terminal. Depending on property requirements, the transfer station area could also house APM maintenance facilities. **Figure 5-58** illustrates a potential right-of-way along the west side of Donelson Pike that could accommodate the APM. The location of the APM right-of-way would have minimal impacts on BNA planned improvements; however, future analysis would be required to address geometry constraints with the right-of-way passage under the Taxiway J and Taxiway L bridges over Donelson Pike.

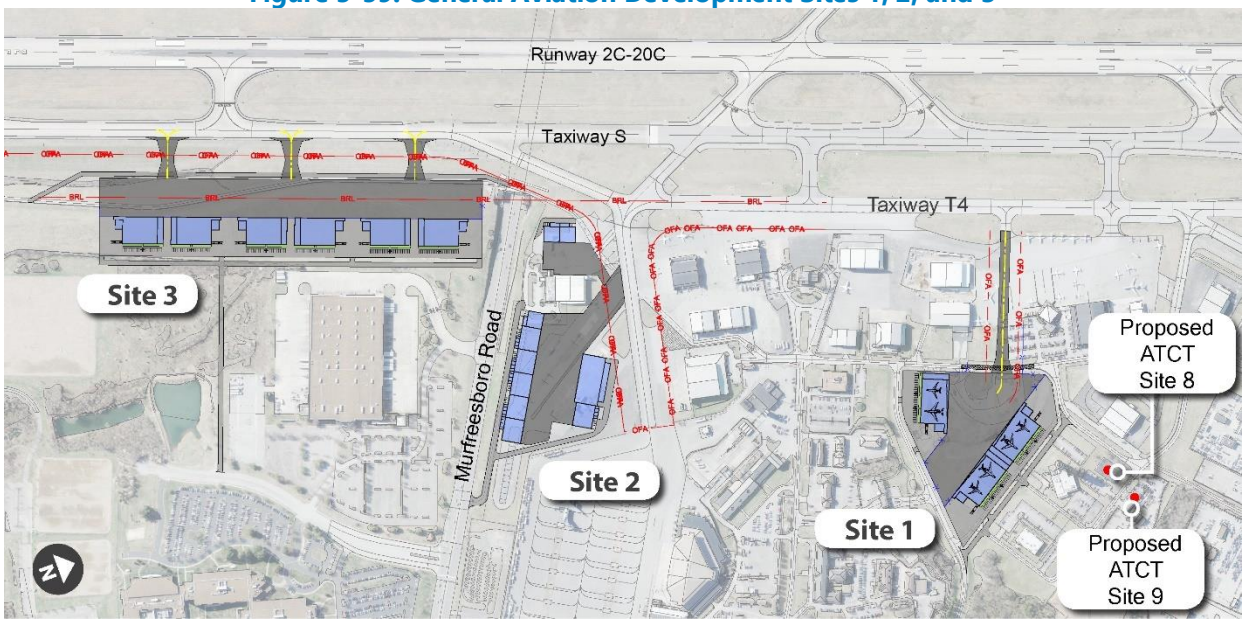
Figure 5-58: Potential Airport People Mover Right-of-Way Along Donelson Pike



5.5 General Aviation Improvement Alternatives

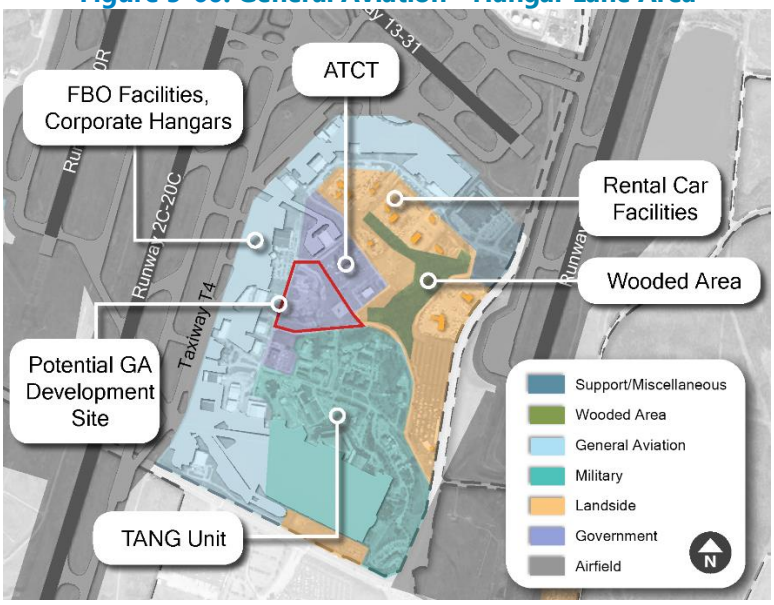
In addition to the focus given to airfield and terminal areas of the airport, there are general aviation (GA) facilities and operations that have important location considerations that need to be explored. The Facility Requirements chapter identified additional general aviation (GA) facility needs through the planning period, especially the need for additional hangar space. Combined, Sites 1, 2, and 3, illustrated on **Figure 5-59**, offer opportunities to meet and exceed projected GA hangar demand through the planning period.

Figure 5-59: General Aviation Development Sites 1, 2, and 3



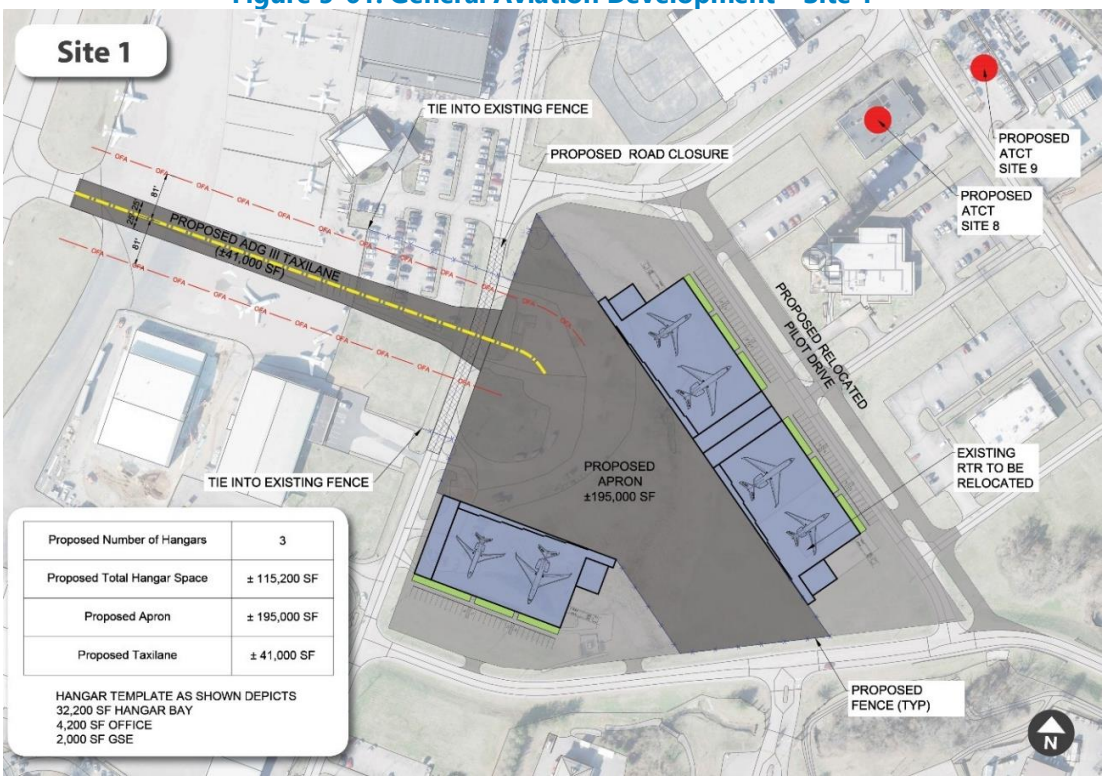
Site 1 is part of the larger Hangar Lane complex serving the main GA operation at BNA. As illustrated in **Figure 5-60**, there is very little remaining undeveloped land in the Hangar Lane area to support additional GA hangar facilities. The Hangar Lane area is nearly fully occupied by Fixed Base Operator (FBO) facilities, corporate hangars that front on the adjacent taxiway system of the airfield, the BNA Airport Traffic Control Tower (ATCT), rental car company remote facilities, a large wooded area with an unnamed tributary, and the Tennessee Air National Guard (TANG) unit on the south portion of the area.

Figure 5-60: General Aviation - Hangar Lane Area



On a portion of the Hangar Lane development area, there is a 10.5 acre parcel (**Figure 5-61**) that could be developed for additional corporate hangar facilities with airfield access provided via a new taxilane that would connect the development area with Taxiway T4. To accommodate the new GA development, a portion of Hangar Lane would need to be closed, and vehicles rerouted to a relocated Pilot Drive. Approximately 115,000 sq. ft. of corporate hangar development could be accommodated

Figure 5-61: General Aviation Development – Site 1



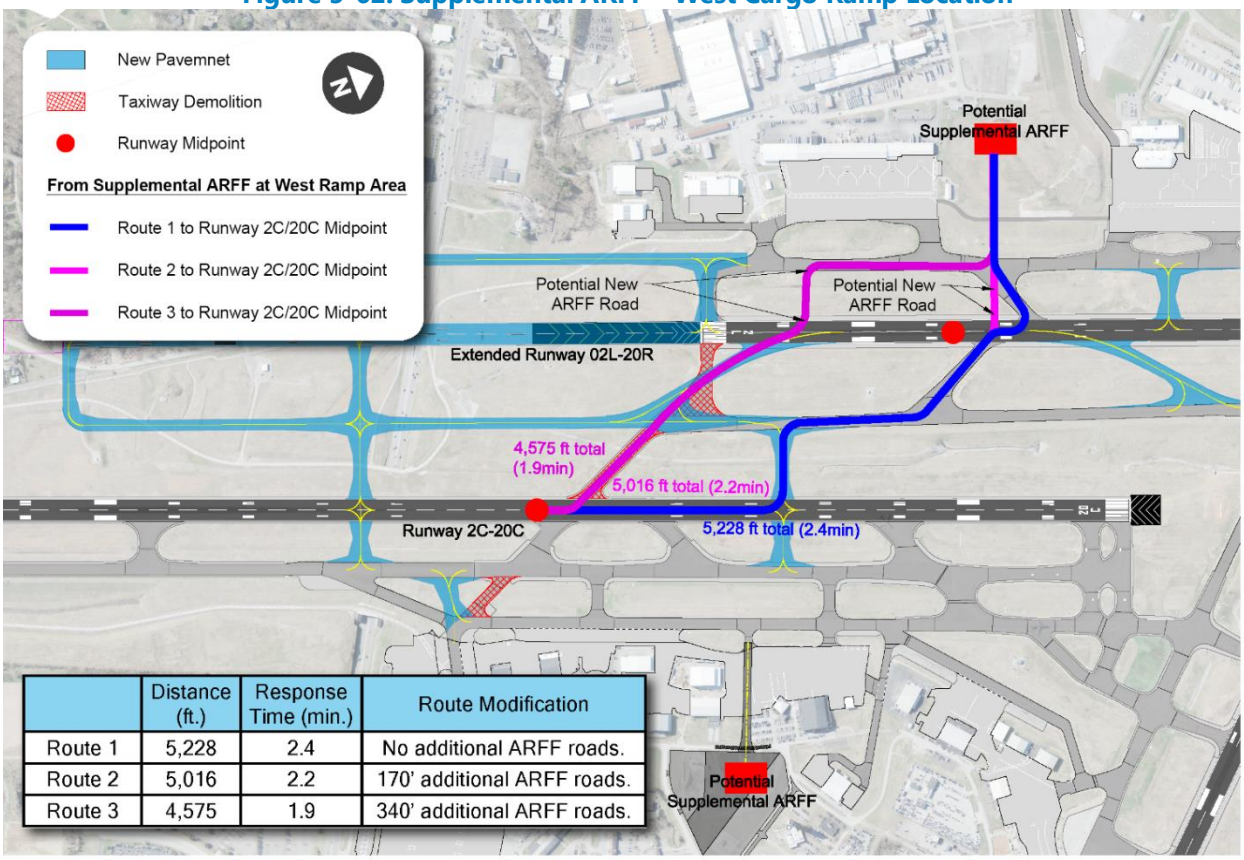
Other MNAA-owned property that could accommodate additional GA hangar development include Sites 2 and 3 (Figure 5-46 above). Site 2 is located adjacent to the south of the existing TANG facilities and comprises approximately nine (9) acres. Approximately 65,000 sq. ft. of new hangar development could be accommodated on the parcel, with access being provided directly from Murfreesboro Pike. Site 3 is an 18.3-acre parcel located south of Murfreesboro Pike and offers direct access to Taxiway S and Runway 2C-20C. Site 3 could accommodate approximately 190,000 sq. ft. of new hangar development.

5.6 Supplemental Aircraft Rescue and Firefighting (ARFF) Facility Alternatives

The existing ARFF facility is located adjacent to the BNA fuel farm west of Donelson Pike and north of the Taxiway J and L bridges across Donelson Pike. The ARFF station response time to an aircraft emergency currently meets the required response times of less than three (3) minutes to the center of each runway. However, the current response time from the exiting ARFF station to the center of Runway 2C-20C is most critical at 2.8 minutes.

There are two options for locating a supplemental ARFF facility. The first option is on a site reserved in the 2013 Master Plan adjacent to the west cargo ramp. Locating a supplemental ARFF at the west cargo ramp adjacent to Taxiway A could reduce ARFF response time to Runway 2C-20C to approximately 1.8 minutes. **Figure 5-62** illustrates the 2013 Master Plan location for a supplemental ARFF facility, and the options for response time routes from the facility to Runway 2C-20C. The response time from the west supplemental ARFF facility to the center of Runway 2C-20C could be reduced to less than two minutes in Option 3. An advantage of the west cargo ramp supplemental facility would be reduced response time to the existing or extended Runway 2L-20R.

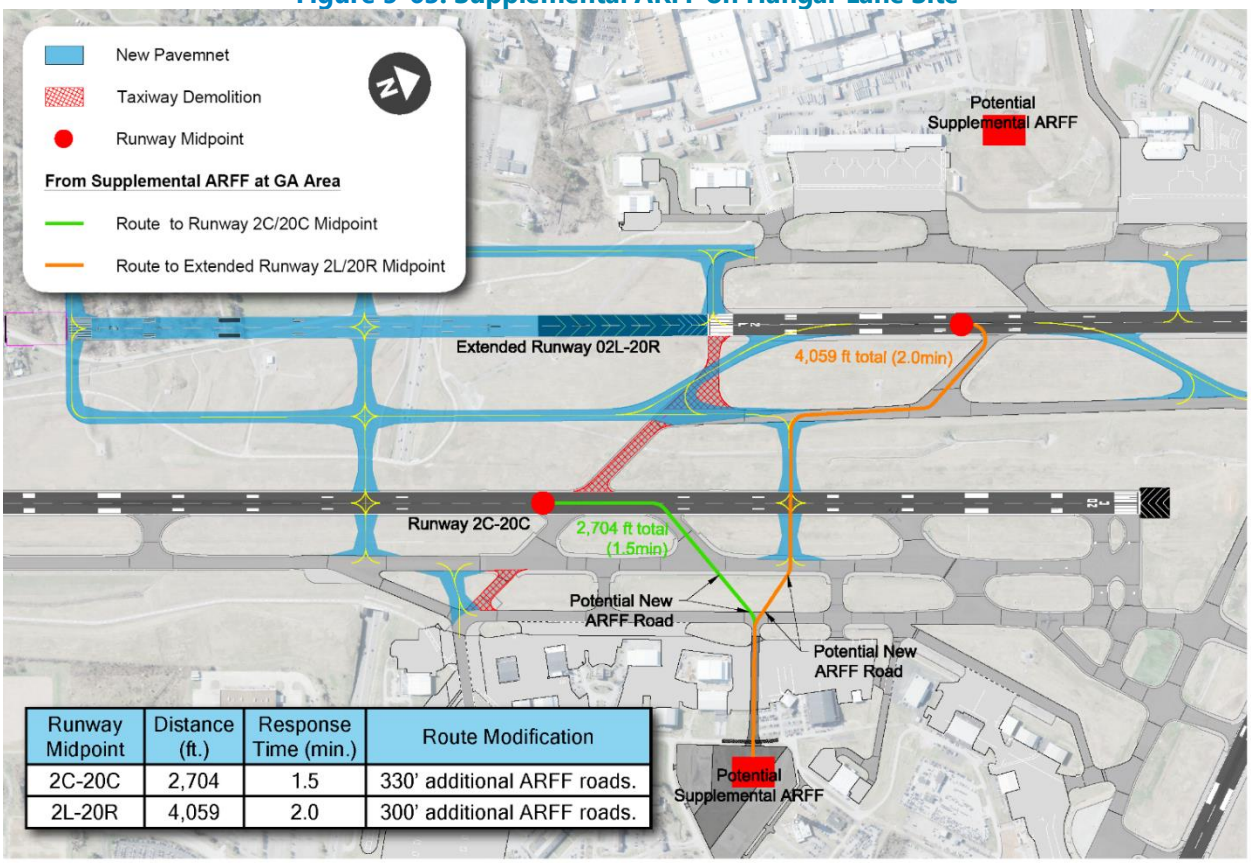
Figure 5-62: Supplemental ARFF – West Cargo Ramp Location



	Distance (ft.)	Response Time (min.)	Route Modification
Route 1	5,228	2.4	No additional ARFF roads.
Route 2	5,016	2.2	170' additional ARFF roads.
Route 3	4,575	1.9	340' additional ARFF roads.

A second option would be to locate the supplemental ARFF facility within the General Aviation Hangar Lane area referred to previously as Site 1 (**Figure 5-63**). The parcel could have access to Taxiway T4 and provide a response time to Runway 2C-20C of approximately 1.5 minutes, and approximately 2.0 minutes to Runway 2L-20R. Although response time from the Hangar Lane site would be less than the site adjacent to the West Cargo apron, the supplemental ARFF would negate the ability to develop additional revenue-producing general aviation facilities. Also, the Hangar Lane site has more terrain variations that would add expense to the ARFF facility improvements than the West Cargo apron site.

Figure 5-63: Supplemental ARFF on Hangar Lane Site



Runway Midpoint	Distance (ft.)	Response Time (min.)	Route Modification
2C-20C	2,704	1.5	330' additional ARFF roads.
2L-20R	4,059	2.0	300' additional ARFF roads.

The recommended location for a supplemental ARFF facility is the site adjacent to the West Cargo apron. At the time of future site design for the West Cargo apron location, ARFF facility siting should provide flexibility for further air cargo development, which might be desirable when demand warrants.

5.7 Long-Term Visioning - Airfield and Terminal Capacity

This master plan has estimated that annual aircraft operations are projected to reach 63% of airfield capacity by 2037, which surpasses the FAA's suggested 60% trigger for starting planning processes to identify additional airfield capacity. Also, the core terminal processing facilities may reach their capacity to accommodate the passenger demands of a BNA terminal complex having 68 gates. At that point, the ability of the existing terminal building to process projected passenger growth at an acceptable level of service could become challenged.

The 2013 ALP was approved with a fourth parallel runway located east of existing Runway 2R-20L; however, additional terminal gates and core processing facilities were not identified. The following sections present airfield and terminal improvements that can provide flexibility for BNA's future long-term planning considerations.

5.7.1 Long-Term Airfield Capacity

The existing and recommended airfield, airspace, and instrument approach facilities should provide capacity to accommodate the projected level of BNA aircraft activity through the planning period. Nevertheless, there may come a time when additional airfield capacity is needed. This could occur in a number of scenarios, such as long-term aircraft fleet change effects on runway occupancy time; the need for taxiway system improvements that further minimize runway occupancy or provide access to new or redeveloped areas of the airport; and adding precision instrument approach infrastructure using future technologies, to name a few. These types of improvements could extend the useful life and capacity of the current airfield infrastructure to accommodate increases in aircraft activity beyond the planning period.

Once incremental airfield capacity improvements can no longer accommodate aircraft movements without unacceptable schedule delay, the most substantial increase in capacity would be realized by adding another runway. The concept of a fourth parallel runway located east of existing Runway 2R-20L was discussed in the 2013 Master Plan and associated Decision Memo #4. That plan reserved airport property and potential airspace for an 8,000' x 150' Runway 3-21, resulting in an airfield capacity estimated at 870,000+ annual aircraft operations - well beyond projected planning period activity levels.

In reviewing the estimated airfield capacity described in the 2013 master plan, it is noted that an assumption was made that the planned 3,500-foot separation distance between existing Runway 2R-20L and the planned 4th parallel runway (Runway 3-21) would allow simultaneous precision instrument approaches, and even triple simultaneous precision instrument approaches (2L-20R, 2R-20L, and 3-21). However, with current technology, a separation distance of 5,000 feet between parallel runways is necessary to provide the airfield facilities and airspace needed by air traffic control (ATC) for simultaneous precision instrument approaches, with some allowances for reduced separation in certain conditions (FAA Advisory Circular 150/5300-13A, *Airport Design*, Paragraph 316). Assuming that current

technologies will not allow triple, simultaneous precision instrument approaches with the planned 3,500-foot separation (i.e. precision instrument approaches occurring simultaneously to Runways 2L-20R, 2R-20L, and 3-21), the annual airfield capacity with the addition of Runway 3-21 is estimated at 665,000 operations instead of the 870,000 previously reported in the 2013 Master Plan. It is always possible that future technologies will allow a reduced runway centerline-to-runway centerline separation.

Figure 5-64 illustrates the 2013 master plan concept for an 8,000-foot long Runway 3-21 and does not include the more recent planning for a potential future Harding Place roadway extension. The 8,000-foot length concept fits in between I-40 and Murfreesboro Pike, including the runway protection zones. The airport's radar facility (Airport Surveillance Radar (ASR-9) is impacted by the planned runway location and would need to be relocated.

Figure 5-64: 2013 ALP Excerpt - Potential Runway 3-21 – 8,000-foot Length

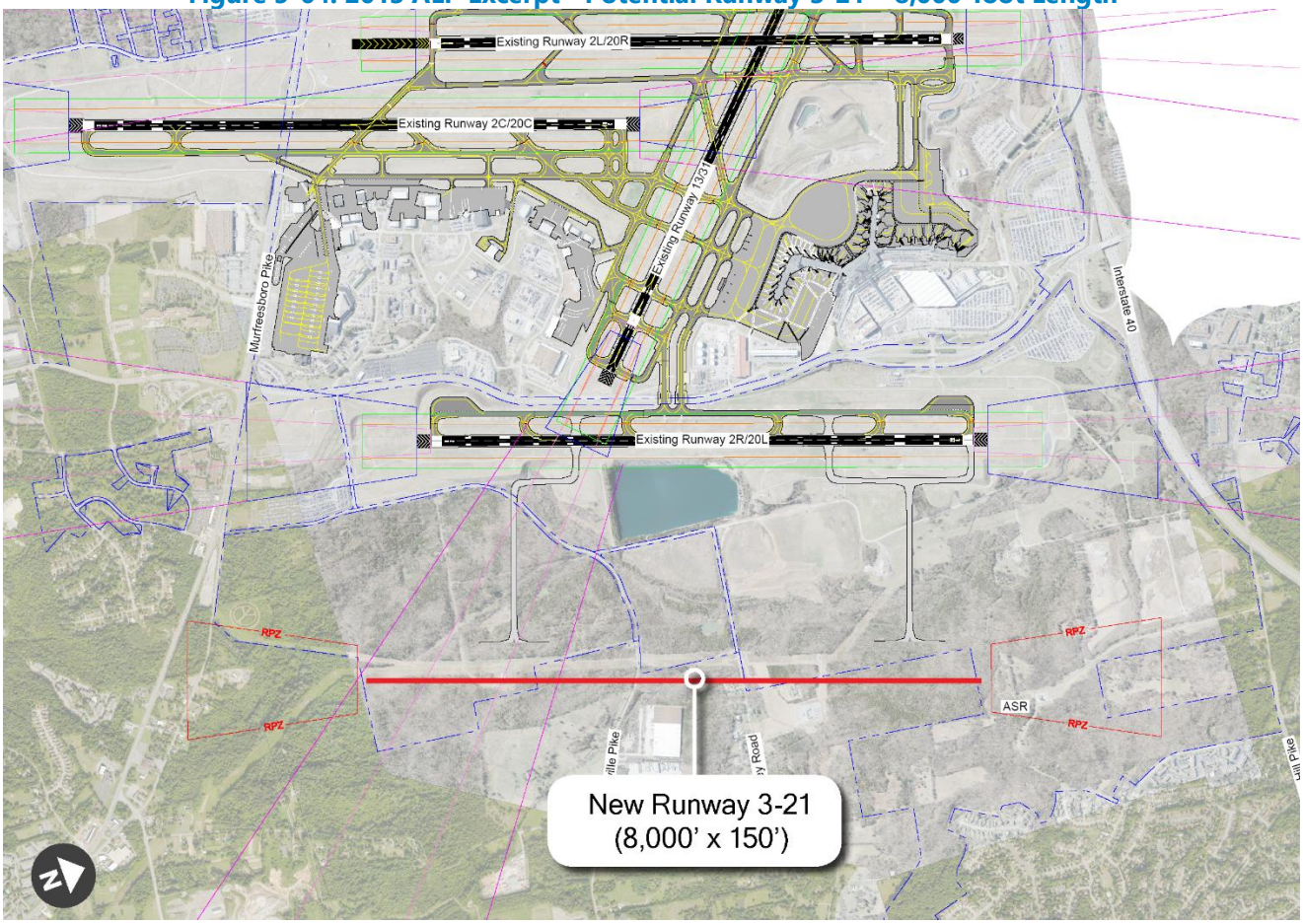
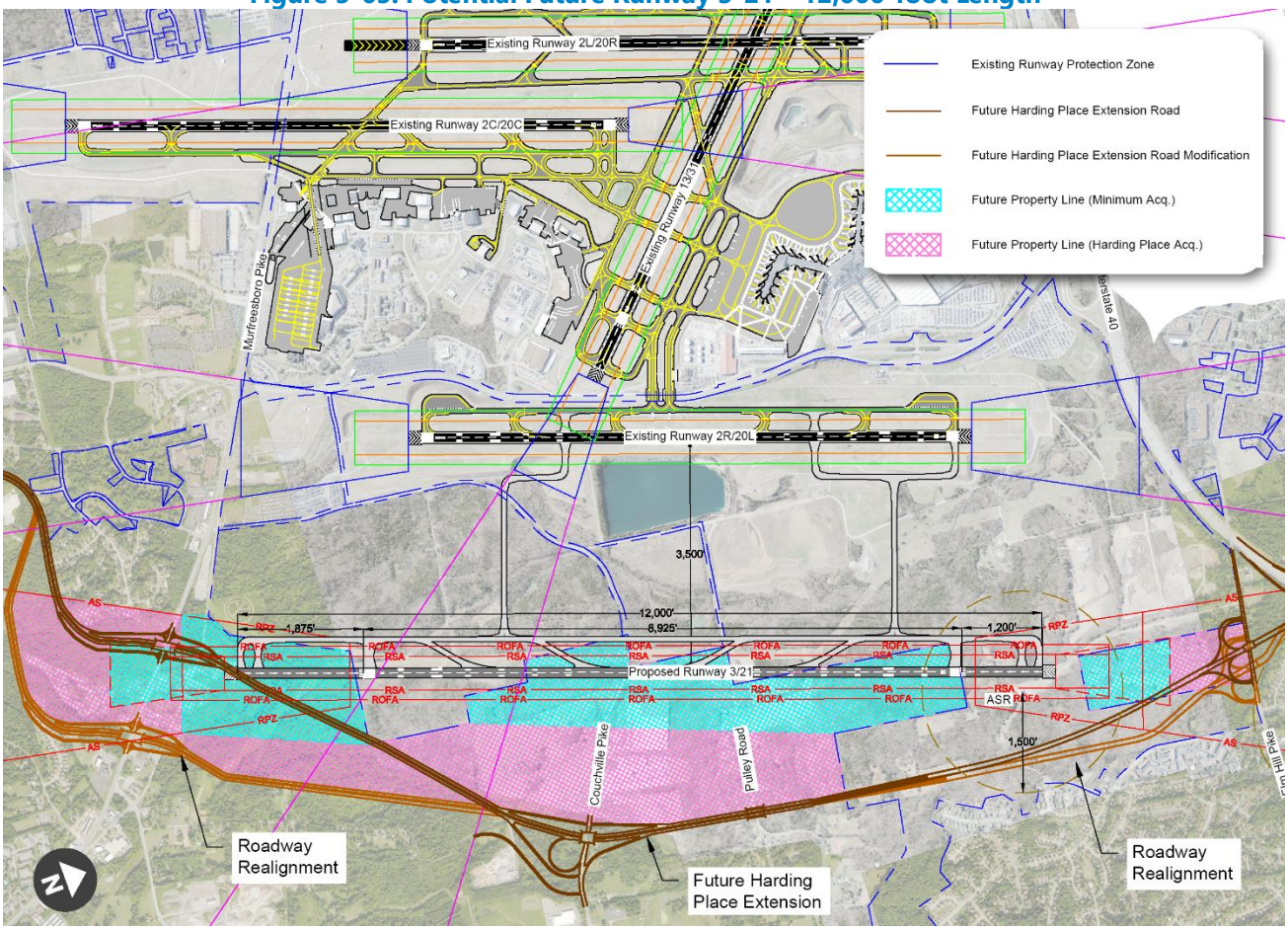


Figure 5-65 illustrates this master plan's concept, maintaining the prior-planned 3,500-foot runway centerline-to-runway centerline separation from existing Runway 2R-20L and protecting for a 12,000-foot long Runway 3-21, including a potential Harding Place extension. Due to the possibility that a future Harding Place alignment could penetrate the runway protection zones (RPZs) for planned Runway

3-21, the runway landing thresholds are shown as displaced to avoid RPZ penetration. While 12,000-foot takeoff length would be provided, landing distance in each direction would be reduced. Similar to the 2013 master plan alternative, the ASR-9 facility would need to be relocated.

Figure 5-65: Potential Future Runway 3-21 – 12,000-foot Length



5.7.2 Long-Term Terminal Capacity

There are several factors that can extend the capacity of the existing terminal, such as changes in passenger processing trends or changes in protocols used by the Transportation Security Administration (TSA) in screening passengers and baggage. There is always a possibility that passenger and TSA processes will evolve to provide quicker processing rates, thereby increasing the number of passengers that can be processed in the peak hours. Also, the capacity of most terminal processors was calculated for originating and destination (O&D) passengers, providing the possibility that some additional capacity exists for connecting flight passengers who do not need to use the core terminal processors, TSA checkpoints, or landside facilities.

However, if BNA continues to grow throughout the Master Plan period, there could come a time when the future built-out terminal complex comprising 68 gates and associated core terminal building

processing facilities is no longer able to process passengers at an acceptable level of service and without significant airline and passenger travel delays. Trying to determine precisely when terminal capacity will be exceeded is not the intent of this Section. Rather, using current understanding of airline flight schedules, increasing aircraft seating capacity, airline gate utilization, and passenger processing protocols, it is possible to estimate the total number of passengers that the 68-gate terminal complex and core terminal building processors can accommodate.

One accepted method of estimating future total passenger demand is to use a "high level" factor of "number of passengers per gate per year". This method simply calculates the current total number of passengers divided by the number of available gates. At BNA, the current estimated (CY2019) total annual passenger demand is 18.5 million passengers being processed on 43 existing gates, equating to approximately 430,000 passengers per gate per year. This number varies greatly among US airports, and can be dependent on airline use agreements, gate utilization, hub airport operations, and/or facility constraints. **Table 5-1** provides a range of passengers per gate per year information for several US airports. BNA has a higher number of passengers per gate per year than many other US airports of similar size, and a lower number of passengers per gate per year than several of the largest airports in the US.

Considering possible future changes in airline gate use agreements, airline flight schedules, and gate utilization, it is reasonable to assume that BNA will increase average airline gate utilization towards a higher number of "passengers per gate per year". Using a planning factor average of 450,000 passengers per gate per year, it is estimated that the future 68-gate terminal complex could provide a total passenger demand of approximately 31 million annual passengers.

Table 5-1: Passengers Per Gate Per Year at Sample US Airports

IATA Code	Major City Served	Gates	Pax per gate per year	Total Pax
ATL	Atlanta	192	559,344	107,394,029
LAX	Los Angeles	132	663,139	87,534,384
ORD	Chicago	191	435,840	83,245,472
DFW	Dallas/Fort Worth	165	418,864	69,112,607
DEN	Denver	139	463,990	64,494,613
JFK	New York	128	481,436	61,623,756
SFO	San Francisco	115	502,077	57,738,840
LAS	Las Vegas	96	519,407	49,863,090
SEA	Seattle/Tacoma	80	623,119	49,849,520
MCO	Orlando	129	369,741	47,696,627
CLT	Charlotte	113	411,041	46,447,638
EWR	New York/Newark	121	378,937	45,851,434
MIA	Miami	131	343,850	45,044,312
IAH	Houston	130	336,981	43,807,539
MSP	Minneapolis/St. Paul	128	297,714	38,107,381
DTW	Detroit	129	273,153	35,236,676
PHL	Philadelphia	112	282,964	31,691,956

LGA	New York	72	417,973	30,094,074
BWI	Baltimore/Washington, D.C.	72	376,815	27,130,655
SLC	Salt Lake City	71	359,919	25,554,244
BNA	Nashville	43	430,000	18,500,000*
AUS	Austin	34	465,292	15,819,912
MSY	New Orleans	42	312,447	13,122,762
SMF	Sacramento	31	388,734	12,050,763
SNA	Santa Ana	20	533,202	10,664,038
SAT	San Antonio	24	418,517	10,044,411
IND	Indianapolis	46	204,651	9,413,962

Source: 2018 ACI-NA Airport Traffic Report

** AECOM BNA estimate for 2019, based on 10 months of actual data, October 2019 MNAA Monthly Reports*

Processing a possible future total of 31 million annual passengers (MAP) on 68 gates would require improvements to passenger processing facilities in the core building and curbside facilities. **Table 5-2** summarizes estimates of peak hour demand generated from 31 MAP, and indicates improvements needed to match the 68-gate capacity for the various passenger processing functions in the terminal core building. **Table 5-2** provides the capacity and improvement requirements for three scenarios – existing (post-BNA Vision) capacity, improvements needed to process master plan projections of 24 MAP (4,100 peak hour enplanements), and improvements needed to provide capacity for a 31 MAP activity level (5,000 peak hour enplanements).

The facility requirements for 31 MAP were calculated based on extrapolations of 24 MAP facility requirements evaluations. It is also important to note that the estimate of processing capacity does not account for the amount of connecting and/or "through" passenger activity – connecting and "through" passengers do not use terminal core or landside facilities, since they typically remain on the concourses. Currently, only Southwest Airlines has any measurable amount of connecting and "through" passenger activity, although it is reasonable to assume that other airlines could have connecting and "through" passenger activity in the future. Higher levels of connecting and "through" passengers in the peak period could result in BNA being able to accommodate a higher level of passengers than 31 MAP.

Table 5-2: Capacity Improvements Required to Accommodate 31 Million Annual Passengers

*Maximum Passenger Capacity at 68 Gates = 31.0 Million Annual Passengers (MAP)**
Corresponding Peak Hour Passenger Demand: 5,000 enplanements / 5,300 deplanements
Corresponding Peak Hour Bag Demand: 3,800 outbound / 3,400 inbound

Terminal Function	Post-BNA Vision Capacity	24 MAP Capacity Requirements	Estimated Improvements Required to Accommodate 31 MAP
Enplaning:			
Departures Level Inner/Outer Curbs	1,300 feet	1,850 feet	2,200 feet
Check-in	48 counters 96 kiosks	62 counters 89 kiosks	76 counters 96 kiosks

	52 bag drop 17 curbside	53 bag drop 17 curbside	65 bag drop 18 curbside
Security Checkpoint	24 lanes 43,000 s.f. (screening area)	25 lanes 38,540 s.f. (screening area)	28 lanes 43,000 s.f. (screening area)
CBIS	6 EDS (500 bph) 8 EDS (360 bph)	7 EDS (500 bph) 10 EDS (360 bph)	8 EDS (500 bph) 11 EDS (360 bph)
BMU	6 bag carousels	8 bag carousels	10 bag carousels
Pre-Security Restroom Stalls (total)	86 stalls	125 stalls	150 stalls
Deplaning:			
Claim Units	24 peak arrivals 12 units	38 peak arrivals 13 units	48 peak arrivals 16 units
Arrivals Level Inner/Outer Curbs	1,050 feet	1,600 feet	2,000 feet

**Based on 450,000 passengers per gate / per year*

As indicated in **Table 5-2** above, portions of the existing terminal core building will need expansion to accommodate a 31 MAP level of activity. The building will need to be expanded to the north and south to provide additional capacity to process passenger check-in, security screening, and non-secure side restrooms on the departures level, and to provide additional baggage claim and non-secure side restroom capacity on the arrivals level. In order to avoid creating vehicle congregation and congestion along the existing departures and arrivals level curbs, the total available curb length will also need to be increased to approximately match the building expansion for check-in, passenger security screening, baggage claim, and non-secure side restrooms. On the secure side of the terminal, additional area for bag screening and airline bag makeup processes will be needed and will require building expansion.

In summary, implementing identified facility improvements should provide sufficient capacity for the existing terminal complex to operate with 68 gates and matching terminal core processing capacity for approximately 31 million annual passengers. There are operational improvements that can also be considered as existing terminal capacity becomes constrained and/or the level of service for the passenger travel experience declines. A sample of operational improvements that may extend the life of the existing terminal complex include using the ground transportation level curb for departing or arriving passenger functions, use of garage space for passengers checking in without baggage, and working with TSA and the airlines to maximize passenger processing throughput during check-in, security screening, bag screening, and baggage claim processes. Operational efficiencies may also be found in airline gate utilization, outbound/inbound baggage processing, and other terminal processing functions.

Prior to the time when the existing, improved terminal complex can no longer provide airline and passenger processing capacity without unacceptable levels of travel delay, the MNAA needs to be prepared to supplement the existing terminal with a second terminal. The planning and implementation

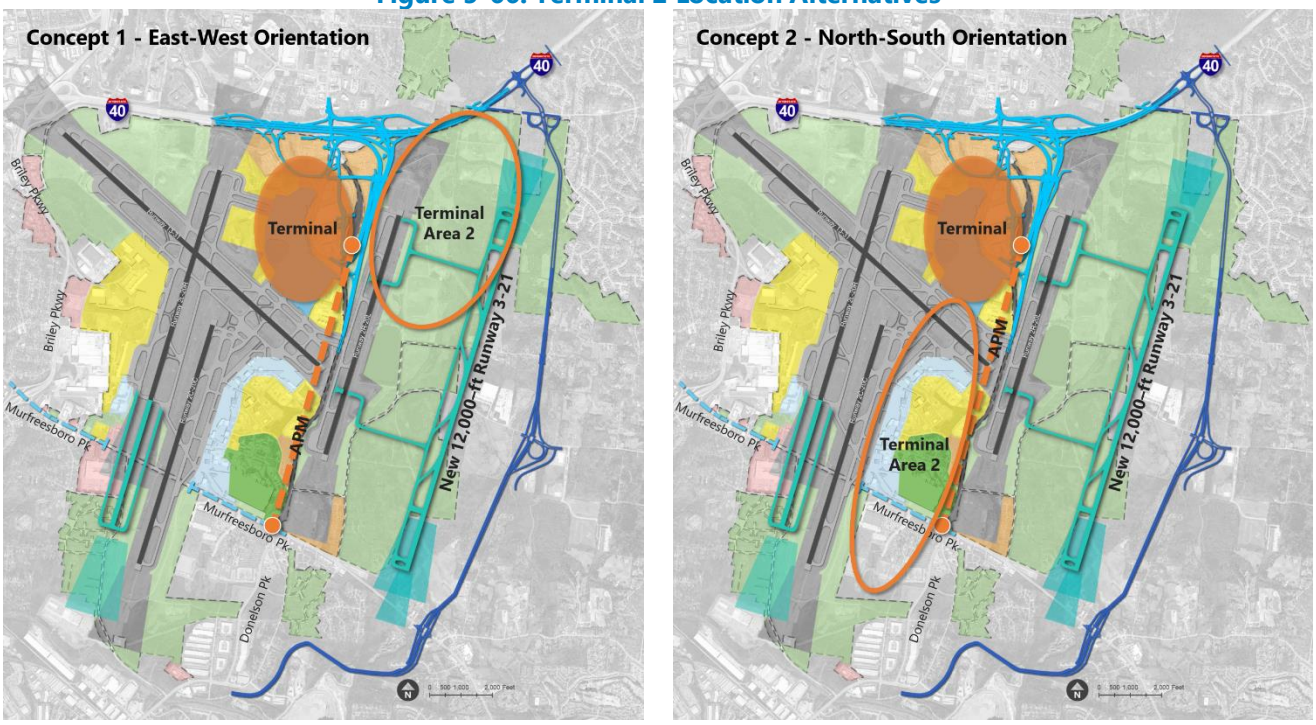
of developing a second terminal complex may take several years to accomplish and may possibly involve either relocating existing airport facilities or developing a "green field" site in currently undeveloped portions of airport property. Regardless of the selected location of a second terminal complex, MNAA should begin steps to plan a second terminal in advance of reaching the 31 MAP activity level, with consideration of the passenger growth rate at the time and the length of time needed to implement the second terminal improvement program.

5.7.3 "Terminal 2" Location Alternatives

A second terminal facility, complete with separate passenger processing facilities from the existing terminal complex (i.e. check-in, security screening, bag makeup and screening, and bag claim) would include terminal and concourse development with gates that are accessible to the airfield, as well as airline support facilities, local and regional ground access, circulation, public parking, and ground transportation facilities.

Two groups of Terminal 2 location alternatives were identified and explored. **Figure 5-66** illustrates an East-West orientation for a new Terminal 2 (Concept 1) and a North-South orientation for a new Terminal 2 (Concept 2).

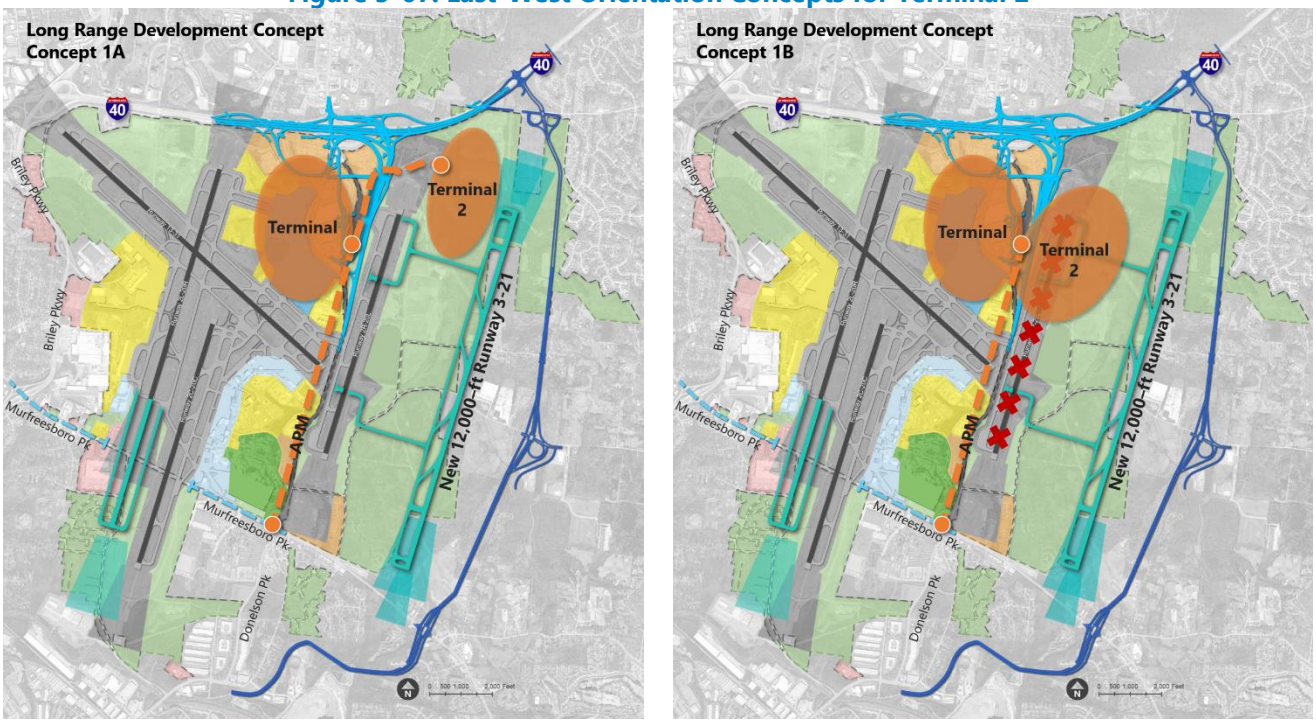
Figure 5-66: Terminal 2 Location Alternatives



In the East-West orientation Concept 1 alternatives, ground vehicle access would continue to be focused on I-40 access, supplemented by public transit/APM coming to the Terminal 1 and Terminal 2 facilities from the south (Murfreesboro Pike corridor). The alternatives for the East-West orientation include one option where Runway 2R-20L is retained resulting in a gap between the existing terminal (Terminal 1)

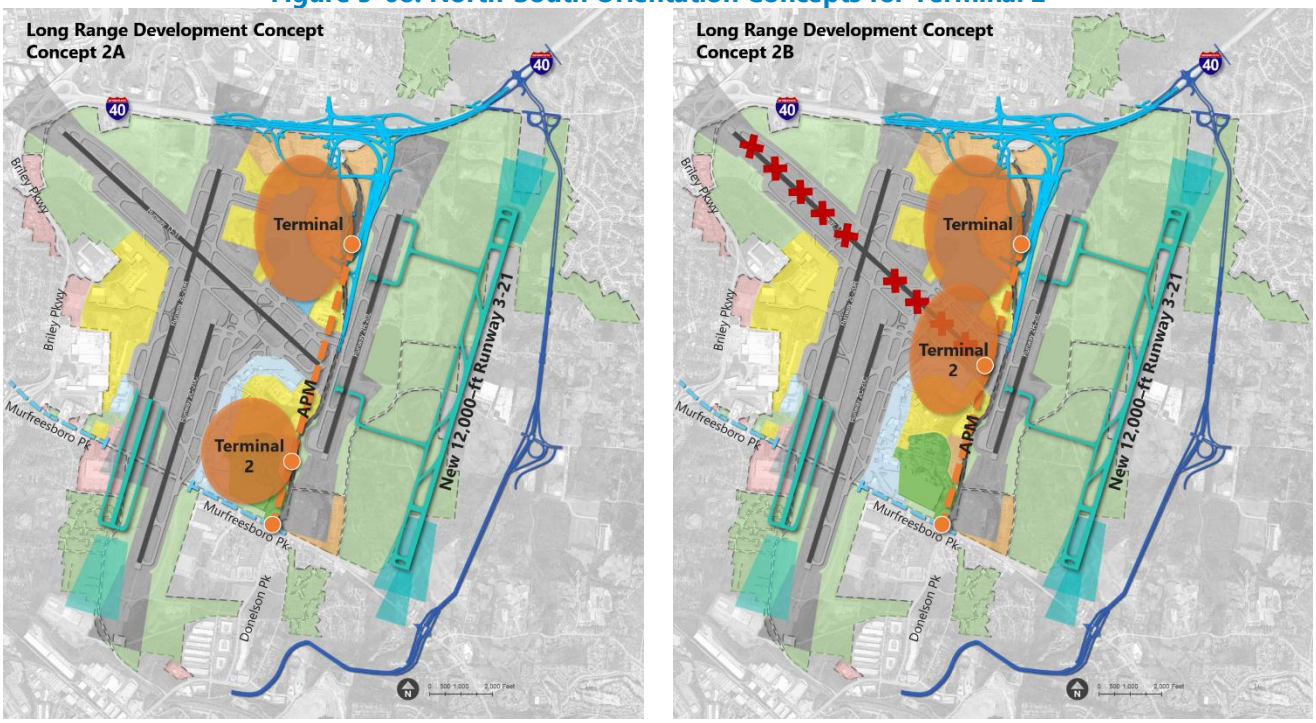
and the new terminal (Terminal 2), and another option where Terminals 1 and 2 share common landside facilities such as public parking and ground transportation. In this scenario, a significant disadvantage is that Runway 2R-20L would need to be removed. **Figure 5-67** illustrates the East-West orientation options for Terminal 2.

Figure 5-67: East-West Orientation Concepts for Terminal 2



In the North-South Concept 2 orientation, two alternatives were identified – one alternative would locate Terminal 2 along Murfreesboro Pike, providing an alternative ground vehicle traffic pattern than I-40, and would be adjacent to a planned future public transit corridor, whereas the other alternative would provide shared airfield between Terminal 1 and Terminal 2, but would require that Runway 13-31 be removed. **Figure 5-68** illustrates the North-South orientation alternatives for Terminal 2.

Figure 5-68: North-South Orientation Concepts for Terminal 2



5.7.3.1 Evaluation of Terminal 2 Concepts

In the east-west orientation, separating Terminal 1 and Terminal 2 as illustrated in Concept 1A (**Figure 5-67**) retains Runway 2R-20L and accommodates the new Terminal 2 infrastructure and support facilities on a mostly vacant portion of airport property. Roadway access would be from I-40 and either the existing Donelson Pike or a potential future interchange with a Harding Place extension, and appropriate wayfinding would be needed to ensure that passengers access their intended Terminal.

Concept 2A (**Figure 5-68**) locates Terminal 2 adjacent to, and north of Murfreesboro Pike. Ground vehicle access and landside facilities such as public parking and ground transportation facilities would likely require property acquisition to provide the land needed to create terminal roadway access and support facility development for Terminal 2. Aircraft access from Terminal 2 to the runway system would require some aircraft to cross Runway 2C-20C to access the Runway 2L-20R system. An advantage of the Concept 2A location is the proximity to the planned future light rail alignment that could serve Nashville along the Murfreesboro Pike transportation corridor. A disadvantage of the Concept 2A site for Terminal 2 is that it would require relocation of Tennessee National Guard and some General Aviation facilities and operations to other airport property.

In both east-west and north-south Concepts 1B and 2B (**Figure 5-67** and **Figure 5-68**), locating Terminal 2 near, or adjacent to Terminal 1 would require closure of a runway – either Runway 2R-20L in the east-west concept or Runway 13-31 in the north-south concept. While having Terminal 2 located in close proximity to Terminal 1 offers advantages in sharing roadway access; sharing core terminal area facilities such as parking and ground transportation services; sharing common access to airfield facilities;

and common passenger wayfinding from adjacent major access points; removing crosswind Runway 13-31 or primary Runway 2R-20L could affect airfield capacity needed to support the future level of aircraft operations. Careful future evaluation should consider the airfield capacity impacts of selecting a final location for Terminal 2.

A factor in selecting a recommended Terminal 2 option will be the cost and phasing of pre-concourse development activities needed to provide the first gate beyond current Terminal 1 capacity. In Concept 1A (**Figure 5-67**), the cost and phasing of pre-concourse development needed is focused on the access, parking, and terminal/airfield infrastructure needed. In Concept 1B (**Figure 5-67**), a replacement runway for closing Runway 2R-20L would be needed before Terminal 2 development could begin. In Concept 2A (**Figure 5-68**), the GA and TANG facilities would need to be replaced before Terminal 2 development could begin, and in Concept 2B (**Figure 5-68**), Runway 13-31 would need to be closed and its pavement removed before Terminal 2 development could begin.

5.8 Sustainability Considerations

5.8.1 Introduction

MNAA's Sustainability Mission Statement is: *To sustain the heartbeat of the Mid - South by cherishing its resources to ensure Music City keeps flying high*. In keeping with MNAA's goals, policies, and initiatives, a multi-tiered sustainability screening analysis was conducted to assess sustainable strategies and opportunities for the priority development projects introduced in this alternatives chapter.

5.8.2 Sustainability Screening

The MNAA Goals and Objectives, as stated in the 2017 Nashville International Airport Sustainability Plan Update, were compared to the goals and objectives of the BNA Master Plan Update. As seen in **Table 5-3,** the Master Plan goals and the MNAA sustainability goals align. Two MNAA sustainability goals *Enhancing the Economic Vitality of BNA* and *Enhancing the Nashville Community* are fully in sync with the goals of the Master Plan.

As presented throughout this chapter, alternatives were developed to meet documented facility requirements by first maximizing existing infrastructure and then by proposing new construction. Where new construction is deemed necessary, sustainability considerations will be factored into the future planning and design in accordance with MNAA's sustainability goals and targets.

Of the two primary functional areas, airfield and terminal, **Table 5-3** reveals that the terminal functional area affords the most opportunity to adhere to MNAA's sustainable strategies, while the airfield affords less opportunity. This is primarily because features like airfield pavement, airfield lighting, marking, signage, and drainage need to comply with current FAA standards to ensure that safe, efficient, and environmentally responsible facilities are developed to meet the needs of the traveling public.

Table 5-3: Comparison of MNAA Sustainability and BNA Master Planning Goals

BNA Master Plan Goals / MNAA Sustainability Goals	Maintain and improve the community's air service link to the world		Provide aviation and non-aviation development opportunities that maintain MNAA's financial and fiscal soundness		Utilize airport property to its fullest capacity
	Airfield functional area	Terminal functional area	Landside functional area	Critical Support Facilities	Land Use
1. Enhance the economic vitality of BNA	■	■	■	■	■
2. Ensure proper investment in the safety, security and development of the people working and using BNA to enhance work/passenger/visitor experience		■	■		
3. Develop and maintain facilities and infrastructure at BNA to support long term efficient flexible growth	■	■			
4. Enhance the Nashville Community	■	■	■	■	■
5. Protect the valuable natural resources in and around BNA					■
6. Minimize use and reliance on traditional energy sources to promote cost savings and environmental stewardship		■			
7. Enhance surface transportation connectivity with the airport service area			■		■

Both the Envision[1] sustainable infrastructure rating criteria and an environmental accounting analysis were utilized in the sustainable screening alternatives analysis.

The subset of Envision criteria included:

Reducing operational and construction waste
Protecting wetlands, surface waters, undeveloped land, and managing stormwater, and
Reducing net embodied carbon, reducing greenhouse gas emissions and reducing air pollutant emissions

Environmental accounting performance indicators included:

- Land use change
- Energy intensity
- Concrete use, and
- Construction and demolition waste

5.8.2.1 Airfield Alternatives

Two types of airfield alternatives were explored: 1) Airfield Standards Improvements and 2) Additional Runway Length options (refer to **Section 5.2.4** for the recommended alternatives). Airfield projects, those located inside of the Air Operations Area (AOA), must adhere to FAA regulations governing their design, construction and operation, and therefore do not offer much opportunity to apply sustainability elements. However, there are a few criteria that are included in the design of recommended airfield alternatives, such as protecting surface waters and undeveloped land and managing stormwater, that meet both FAA design requirements and sustainable practices. During the construction phase, reducing operational and construction waste is an applicable strategy. These criteria would need to be decided and incorporated up front during project scoping.

5.8.2.2 Terminal Alternatives

Three types of terminal improvement alternatives were explored: 1) adding terminal gate capacity 2) adding remain overnight aircraft parking (RON) and deicing positions in the terminal area and 3) enhancing passenger processing functional area facilities (refer to **Section 5.3.4** for the recommended alternatives). The sustainability criteria most applicable to the terminal structure and terminal ramp

[1] The Institute for Sustainable Infrastructure (ISI) created "Envision" to develop and maintain a sustainability rating system for all civil infrastructure. Envision provides a holistic framework for evaluating and rating the environmental and economic benefits of all types and sizes of infrastructure projects using criteria to address a project's impact on its surroundings, technical considerations regarding materials and processes, and other critical choices spanning the project's lifecycle.

alternatives include energy intensity, concrete use, managing stormwater, and reducing operational and construction waste.

The recommended terminal alternatives provide considerable opportunity to utilize sustainable design elements such as materials that use recycled components and are sourced locally. Opportunities to use energy saving HVAC, lighting, plumbing components and window glass treatments are becoming more plentiful and cost-efficient. Using construction materials that reduce heat island effect would also help to meet MNAA sustainability targets.

As with the airfield alternatives, most of these criteria would need to be decided and incorporated up front during project scoping. When the terminal building improvements are complete and operational, energy efficiency could be documented and tracked as a way of ensuring compatibility with MNAA's sustainable targets in the Passenger Terminal Energy Efficiency category.

5.8.2.3 Landside/Support Alternatives

Within the landside functional area, sustainability criteria were applied to the rental car facility improvement alternatives. The most applicable criteria include: reducing operational and construction waste, reducing net embodied carbon, reducing greenhouse gas emissions, and reducing air pollutant emissions. The recommended Rental Car facility expansion alternative, which entails construction of a three-level garage immediately adjacent to the east of the existing facility, will provide improved access and mobility. Sustainability measures will be evident in the operational phase of this project and can be tracked to ensure compatibility with MNAA's sustainability targets.

5.8.3 Screening Results

When the alternatives were compared to each other to assess degrees of sustainability influence, the recommended alternatives, which are planned to meet increasing demands on the BNA facilities, resulted in fewer sustainable opportunities than the alternatives not selected for further study. However, it was demonstrated that sustainable strategies are available for the recommended alternatives at the design, construction, and/or operational phase of each project.

On a broader scale, the following recommendations are provided to further MNAA's sustainable development policies and goals.

5.8.3.1 Pursue a Formal Sustainable Development Policy

Consider enacting an official sustainable development policy that includes specific governance standards, guidance, and development protocols related to the social and environmental impacts of BNA's operations. Sustainability considerations identified as part of the master planning process, and components of BNA's Sustainable Master Plan, may be integrated towards a formal organizational structure that informs the Airport Development Plan and future operations, and focused on Sustainability analysis early in the project scoping and implementation process. In accordance with agreed-upon sustainability standards that benefit MNAA's core planning mission, creating a policy of this nature may consider including sustainability criteria for development efforts, creating an

overarching structure that allows for more informed decisions concerning the relationship of BNA's growth to key sustainability drivers and how future operations may be positively impacted by best practices in sustainable development.

5.8.3.2 Explore Envision or LEED Certification for Components of the Master Plan

Master Plan projects that seek to integrate sustainability features may benefit from incorporating an existing sustainability framework such as Leadership in Energy and Environmental Design (LEED) or Envision. As noted previously, sustainability should be integrated from the planning and design phase and throughout the life cycle of a project, with evaluation and implementation beginning during the design phase - to ensure this is achieved on infrastructure projects such as runway extensions, "Envision" (as referenced in the screening analysis) is the preferred option. LEED serves better for buildings and would be the appropriate choice for the BNA's passenger terminal. Other projects, depending on their characteristics and functions, can be developed relying on more specific frameworks and guidelines such as ParkSmart for parking structures and SITES for landscaping projects.

5.8.3.3 Train MNAA staff in sustainable design and construction

Having staff that are proficient with, and possibly certified, under one or more of the green building and sustainable infrastructure development frameworks is another opportunity to further the successful implementation of sustainable development at BNA. This will allow the Airport to understand project features, define expectations and manage work with third parties most effectively and ensure that all project-related certification requirements are effectively achieved.

5.8.3.4 Land Use

Mostly all of the unregulated, open or unused areas within MNAA's property are slated for future development with little open space available to pursue opportunities for sustainable elements such as reforestation or solar arrays. As Master Plan projects are implemented over the planning period, land use should be re-evaluated to identify where sustainable practices could reduce the environmental impact of the built environment while at the same time creating a financial and/or operational benefit for a project.