Leigh | Fisher

FINAL TECHNICAL MEMORANDUM NO. 6

ALTERNATIVES DEVELOPMENT AND EVALUATION

Airport Master Plan Update
Detroit Metropolitan Wayne County Airport

Prepared for

Wayne County Airport Authority
Detroit, Michigan

February 2017

DETROIT METRO • WILLOW RUN
WAYNE COUNTY AIRPORT AUTHORITY

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1.0 INTRODUCTION

In accordance with Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5070-6B, Airport Master Plans, the information contained in this Technical Memorandum represents the sixth element of an update to the 2009 Master Plan for Detroit Metropolitan Wayne County Airport (the Airport). The purpose of the Master Plan Update is to provide guidance for the continued improvement of the Airport for the 20 year planning horizon and beyond.

This Technical Memorandum summarizes the approach, development of concept alternatives, identification of evaluation criteria, and selection of preferred alternatives for the Recommended Development Plan (RDP). Concept alternatives were developed for the airfield, passenger terminal complex, ground access and parking, air cargo and aviation support facilities based on assessments of existing capacity and future demand for major aviation-related facilities. This Technical Memorandum is organized as follows:

1.0 – Introduction
2.0 – Airfield Alternatives
3.0 – Ground Transportation and Parking Alternatives
4.0 – Airport Maintenance Complex Alternatives
5.0 – Other Development Alternatives Considered

Master plan project phasing, implementation and financial feasibility analysis will be covered in the Final Master Plan Technical Report.

Concept alternatives were formulated to meet the requirements associated with the forecast aviation demand at the Airport, as documented in Technical Memorandum No. 5 – Facility Requirements. Alternatives for each major component of the Master Plan were developed and refined through a series of interactive workshops, independent work sessions, and stakeholder meetings during which Authority staff and stakeholders collaborated on planning options, challenges, and provided real-time feedback to the Consultant Team (the Team). Some of the major interactive workshops, stakeholder meetings, and work sessions include:

- Collaborative small group work sessions – addressing technical viabilities for rental car sites, parking and ground access options, maintenance facility locations, ramp/snow removal facilities, and security screening were conducted
- Technical subcommittee meetings – over 20 subcommittee meetings were conducted covering specialized subject areas including remote aircraft operations, taxiway/runway safety, discussions with air traffic control tower staff, airport operations, TSA, CBP, airlines and other stakeholder groups
- Technical Advisory Committee (TAC) meetings – three meetings were conducted to obtain feedback and evaluations from a selected list of technical stakeholder groups
- Community Advisory Committee (CAC) meetings – three meetings were conducted to obtain feedback and evaluations from a selected group of community activists
- FAA Airport District Office (ADO) meetings – numerous collaboration meetings were conducted with the local FAA ADO to work out goals, objectives and expectations of the Master Plan Airport Layout Plan set / Exhibit A deliverables for a more streamlined FAA review process

- Public Information Meetings – three meetings were conducted to convey master plan milestones (i.e., project kick-off, alternatives development, and recommended development plan) and obtain feedback from the general public. This serves as a sounding board to drive Project Steering Committee decisions

- Project Steering Committee (PSC) meetings – three meetings were conducted involving senior airport executives as the decision-making body to approve preferred alternatives as recommended by the master planning team

Feedbacks from the above collaborative workshops and meetings were taken into consideration and comments incorporated into the refined concept alternatives, where evaluation criteria were identified for use toward screening down to a preferred alternative.

2.0 AIRFIELD ALTERNATIVES

The Airport has sufficient airfield capacity to accommodate forecast demand throughout the twenty-year planning horizon, as documented in Technical Memorandum No 5. As a result, a key focus of the alternatives analysis was to enhance the safety of the airfield by meeting current FAA design standards and incorporating facility recommendations from the FAA's Runway Incursion Mitigation (RIM) program.

The FAA's Airport and Airspace Delay Simulation Model (SIMMOD)—a fast-time airfield and airspace simulation model—was used to both formulate and evaluate certain airfield alternatives considered in the following sections. Simulation modeling was undertaken in coordination with Authority staff, FAA air traffic organizations (i.e., Detroit ATCT and TRACON) and airport users/tenants. The simulation provides two important benefits: (1) the ability to review animations of the airfield which quickly reveal congestion points in the current condition or in future scenarios, and (2) the ability to review extensive data on travel times and delay for both existing and future conditions. The simulation allowed the consideration of many "what if" scenarios.

Airfield simulations were run for both north flow (landings and take-offs to the north) and south flow. Simulations were also run for the normal operating condition and for the condition when deicing is taking place. More than 20 distinct simulations were run for the airfield alternatives analyses. Since deicing was a major focus of the airfield, the majority of simulations concentrated on deicing, but the normal airfield operating condition was also simulated to test various airfield enhancements.

The following describes some of the manners in which the simulation was used for this analysis:

- Several taxiway extensions were found to provide benefit in reducing travel and delay times, but the benefits were not great enough to justify the capital expenditure at this time, and thus the "improvements" were not included as proposed projects.

- Initial layout of an item such as a modified deicing pad was revealed to have congestions issues under high traffic volumes and the pad layout was thereby modified.

- Airfield facilities, such as a connecting taxiway, that do not meet current design criteria (including RIM) were evaluated to consider how they contribute to airfield efficiency. In some cases, it was found that the facility could be removed in order to meet new standards without impacting capacity. In other cases, the facility was moved in order to meet new standards and also maintain or improve efficiency.

2.1 Runway 3L-21R Reconstruction

Runway 3L-21R, one of the Airport's two primary departure runways, has reached the end of its service life and is in need of near-term reconstruction. The runway is currently 200 feet wide and 8,501 feet long and has design features that do not meet current FAA design standards, such as a lack of paved shoulders and visual screen for aircraft taxiing on Taxiways J and T which cross the extended runway centerline. The runway must meet FAA minimum design standards to meet FAA-eligibility for federal funding for reconstruction. The standard runway width for the future use of Runway 3L-21R is 150 feet, and any runway width greater than the standard is not eligible for FAA funding. Also as documented in Technical Memorandum No 5, the current 8,501-foot runway length is adequate to serve the existing and forecast fleet mix, and therefore, a runway extension is not necessary.

During preliminary consideration of Runway 3L-21R reconstruction options, the following were identified as penetrations to the Runway 21R 40:1 TERPS Instrument Departure Surface (Departure Surface): McNamara Terminal parking structure; Boeing 747-400 and other Group V aircraft tails on Taxiways J and T; and Group III aircraft tails on Taxiway PP. The current definition of the Departure Surface was developed in 2004 and begins at the elevation of the stop end of the runway endpoint and rises at a 40:1 slope. Prior to 2004, the Departure Surface began at 35 feet above the stop end of runway endpoint and continued to rise at a 40:1 slope. The McNamara Terminal Parking Structure opened in 2002, under the guidance of the previous Departure Surface, and is clear of penetrating that Departure Surface. The FAA Office of Airports currently has a Letter of Agreement (LOA) with the Authority to apply "Departure Credits" that enable the Departure Surface to begin 35 feet above the stop end of runway endpoint (per the previous definition) for Runways 3L, 21R, 27R, and 22L. The 35-foot Departure Credit enables each of the aforementioned objects to be clear of the Departure Surface.

Runway 3L-21R is currently a visual runway and the only of the four parallel north-south runways that does not have either precision instrument or non-precision instrument procedures to accommodate arriving aircraft. During snow events where one of the arrival runways is temporarily closed for snow removal, it would be beneficial to have a non-precision instrument procedure for Runway 3L-21R to maintain arrival flow capacity. A non-precision RNAV (GPS) instrument procedure would not require any additional ground-based navigational equipment, and could be achieved by requesting FAA Flight Procedures to develop such a procedure. In order to minimize impacts to RPZs, a non-precision instrument approach would need to be limited to an approach visibility minimum of 1 mile. Any less, which a GPS-procedure is capable of achieving, would increase the size of the RPZ and potentially require other Airport facilities to be relocated. Further, although some older aircraft are not equipped to fly RNAV approaches, virtually all air carrier aircraft will be capable in the near future.

In addition to establishing a non-precision instrument procedure, other recommended facility improvements associated with the runway reconstruction include: extending Taxiway P to allow for enhanced efficiency of aircraft coming out of the Runway 3L deicing pad; maintaining the alignment of parallel Taxiway M; and improving the efficiency of and meeting design standards for deicing pads adjacent to Runway 3L-21 and the 21R deicing pad.

The possibility of relocating Runway 3L-21R to the east in order to protect against the possibility that the existing Departure Credits would be rescinded by FAA were considered in the alternatives analysis. Over 25 variations of potential future runway alignments were considered, with the following two options analyzed in detail:

1. Alternative 1 – Maintain existing Runway 3L-21R centerline and reconstruct the runway at 150 feet wide (see Figure 2-1)

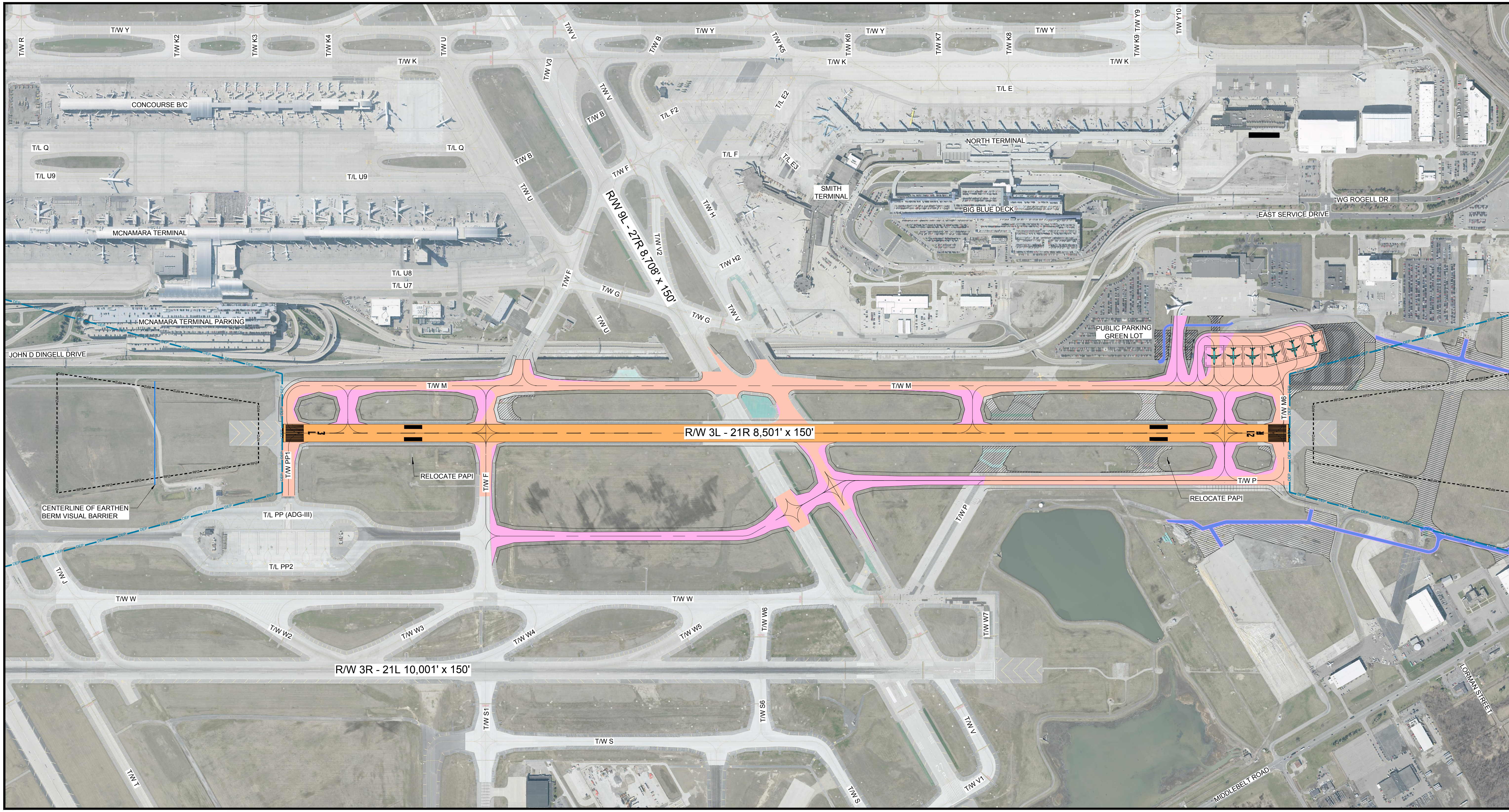
2. Alternative 2 – Shift Runway 3L-21R centerline 110 feet to the east and reconstruct the runway at 150 feet wide (see Figure 2-2)

A summary of Alternatives 1 and 2 is included in Table 2-1, and a detailed description of both alternatives is provided in the following sections.

Table 2-1
RUNWAY 3L-21R RECONSTRUCTION ALTERNATIVE ALIGNMENT SUMMARY
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport

	Existing Conditions	Alternative 1: Maintain Existing Runway C/L	Alternative 2: Shift Runway C/L to the East
Dimensions (W x L)	200’ x 8,501’	150’ x 8,501’	150’ x 8,501’
Shoulder Width	0’	35’	35’
Runways 3L-21R to 3R-21L Separation	2,000’	2,000’	1,890’
Taxiway M to Runway Separation	400’	400’	510’
Taxiway P to Runway Separation	400’	400’	400’
Taxiway PP to Runway Separation	680’	680’	570’
Approach Visibility Minimum	3 miles (Visual)	1 mile (GPS)	1 mile (GPS)
Visual NAVAIDs	HIRL, PAPI	HIRL, PAPI	HIRL, PAPI
Markings	Non-precision	Non-precision	Non-Precision
RPZ Size (w_1 x w_2 x L)	500’ x 1,010’ x 1,700’	500’ x 1,010’ x 1,700’	500’ x 1,010’ x 1,700’

Source: HNTB analysis, August 2016.



LEGEND

Future runway pavement	Building/pavement removal
Future taxiway/apron pavement	Precision approach path indicator (PAPI)
Reconstruct taxiway/apron pavement	Future roadway
Centerline of earthen berm visual barrier	

NORTH

0 400' 800' 1600'

Figure 2-1

RUNWAY 3L-21R EXISTING CENTERLINE ALTERNATIVE

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Detroit Metropolitan Wayne County Airport
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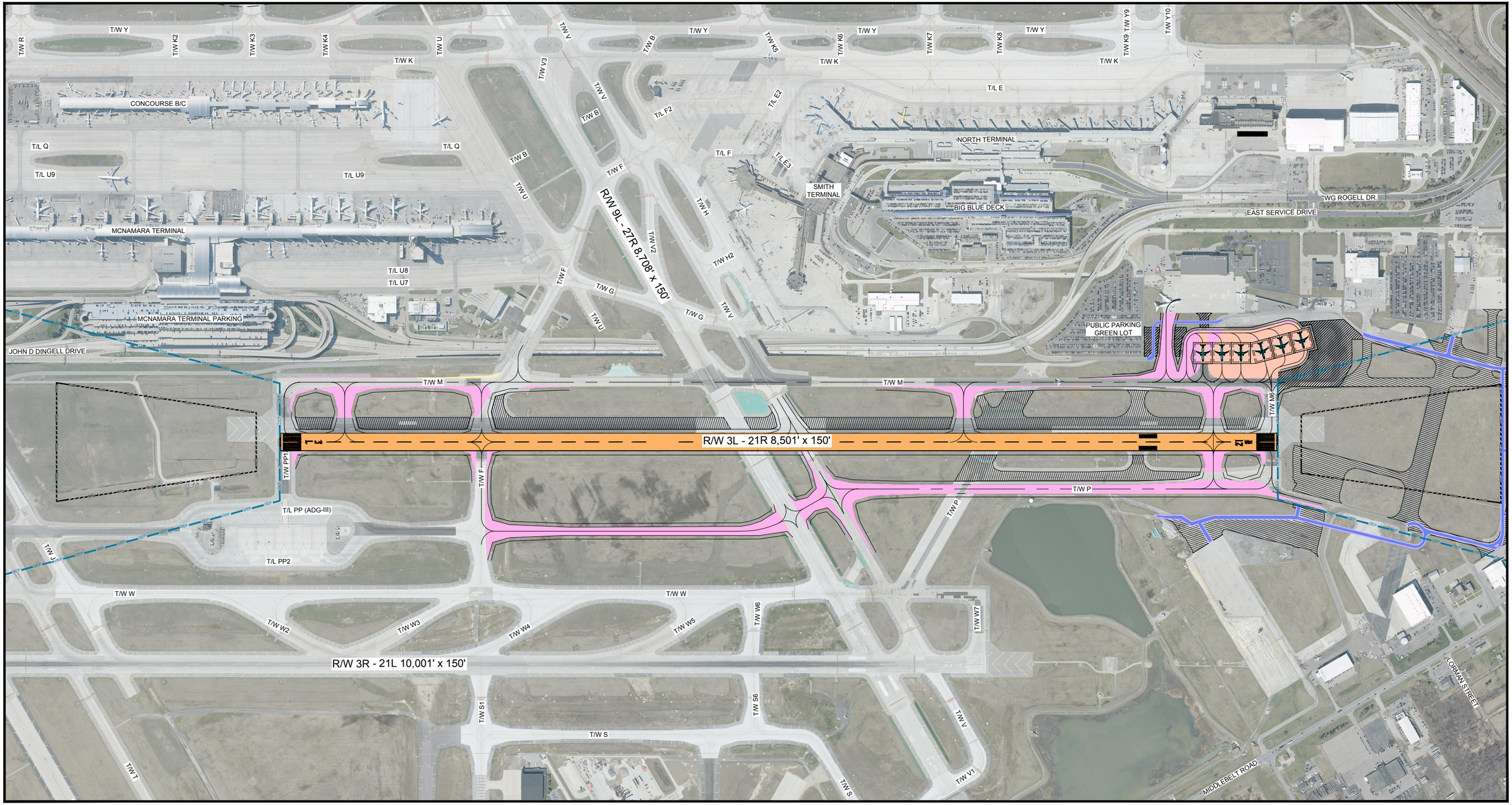

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LEGEND

- Future runway pavement
- Future taxiway/apron pavement
- Reconstruct taxiway/apron pavement
- Centerline of earthen berm visual barrier
- Building/pavement removal
- Precision approach path indicator (PAPI)
- Future roadway

NORTH

0 400' 800' 1600'

Figure 2-2
RUNWAY 3L-21R 110 FOOT OFFSET ALTERNATIVE

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2.1.1 Alternative 1: Maintain Existing Runway Centerline

Alternative 1 maintains the existing centerline of Runway 3L-21R and applies the FAA Departure Credits to ensure aircraft tails are clear of the Departure Surface. It also includes a reconfiguration and reconstruction of the Runway 21R deicing pad to eliminate aircraft tail penetrations to the Runway 3L Departure Surface when aircraft exit the three most northern positions of the pad. Without the reconfiguration, the aircraft using the pad will penetrate the TERPS departure surface even after the application of the Departure Credits. The runway/taxiway connectors would be reconstructed and reconfigured in both options to enable more efficient aircraft movements and enhanced departure sequencing by including a bypass taxiway less than 500 feet from each end of the runway. Alternative 1 also includes an extension of Taxiway P across runway 9L-27R to reduce runway crossings of Runway 3L-21R and taxi distance. A Modification of Airport Design Standards (MOS) would be filed with the FAA Office of Airports to formally adopt the Departure Credits for this runway. This alternative also includes a visual screen needed to meet end-around-taxiway design standards. The estimate rough order of magnitude (ROM) cost for this alternative is $215,000,000.

2.1.2 Alternative 2: Shift Runway Centerline to the East

Alternative 2 shifts the centerline of Runway 3L-21R by 110 feet to the east to remove the McNamara Terminal Parking Structure as a fixed obstruction from the Runway 21R Departure Surface. It also includes a reconfiguration and reconstruction of the Runway 21R deicing pad to eliminate aircraft tail penetrations to the Runway 3L Departure Surface when aircraft exit the three most northern positions of the pad. Without the reconfiguration, the aircraft using the pad will penetrate the TERPS departure surface. The 110-foot shift still allows for simultaneous departures and arrivals on Runways 21L and 21R, respectively (the maximum allowable shift to maintain simultaneous departures and arrivals is 150 feet). This alternative requires the reconstruction and relocation of Taxiway P by 110 feet to the east in order to meet minimum design standards separation. Similar to Alternative 1, it proposes that Taxiway P would be extended across Runway 9L-27R. It does, however, result in Departure Surface penetrations to the tails of taxiing aircraft on Taxiways J, T, and PP. Alternative 2 protects against the possibility of the cancelling of the existing Departure Credits and future McNamara Parking Structure expansion. This alternative also includes a visual screen needed to meet end-around-taxiway design standards. The estimate rough order of magnitude (ROM) cost for this alternative is $265,000,000.

2.1.3 Evaluation of Runway 3L-21R Alternatives

Both alternatives were reviewed extensively by the Authority, TAC stakeholder groups, and the FAA and screened based on a variety of criteria. Table 2-2 compares the two alternatives under six different metrics. Scoring is based on Negative (-), Neutral (0), and Positive (+) for each criterion. The higher the positive score, the greater an alternative performs against the evaluation criteria.

Alternative 1 more closely meets the criteria established by the TAC. The variance in cost and constructability between the two alternatives heavily influences the merits of Alternative 1.

Table 2-2
RUNWAY 3L-21R RECONSTRUCTION EVALUATION MATRIX
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport

Evaluation Criteria	Alternative 1: Maintain Existing Runway C/L	Alternative 2: Shift Runway C/L to the East
Minimizes Cost / Constructible	+	-
Enhances Operational Flexibility / Efficiency	+	+
Preserves / Enhances Capacity	+	+
Compatible with Future Land Uses	+	+
Addresses FAA Design Standards	+	+
Environmental Impact (During Construction)	0	-
Total Score	5	2

Source: HNTB analysis, August 2016.

2.2 Deicing Pads and RON Aircraft Parking Facilities

Other key facilities evaluated for standards compliance, capacity, and efficiency are the deicing pads and RON aircraft parking positions. The existing utilization strategies for deicing at the Airport does not provide for common use deicing. Of the four existing deicing pads, two are dedicated to Delta Airlines (Runway 4R pad and Runway 3L pad), one is dedicated to Delta Connection (Runway 22L pad), and one is dedicated to the airlines operating from the North Terminal (Runway 21R pad). The Facility Requirements evaluated the demand for additional deicing positions and concluded that, while not a hard-fast requirement, the Airport could benefit from two additional widebody aircraft deicing positions (one for Delta Airlines and its alliance partners, and one for North Terminal carriers). Further, the Facility Requirements identified that if the Airport were to meet current design standards for deicing pads, one position would be lost at each deicing pad.

From a pavement perspective, the existing deicing pads are in good condition, with the exception of the Runway 21R pad, which has reached the end of its useful life. FAA design standards are required to be met when pavement reconstruction is needed for taxiways, runways, and aprons.

Prior to the development of potential concepts for deicing pad improvements, the following input was provided by the TAC technical stakeholders groups and FAA regarding future deicing pads:

- Given the constraints on space available for a centralized pad on the airfield and the number of peak aircraft departures, it is not feasible to develop a single deicing pad to serve all aircraft simultaneously while providing the required level of service.
- Any pads undergoing reconstruction, reconfiguration, or greenfield pads must meet current FAA design standards.

- The evaluation should consider whether the existing deicing pads would be more efficiently utilized if common-use strategies were applied.
- Propose a reconfiguration of the 22L pad to meet standards. This pad is currently substandard and could benefit from a reconfiguration to improve neighboring substandard geometry.
- Improve widebody deicing capability for North Terminal carriers and Delta Airlines (and partners).

2.2.1 Runway 22L Deicing Pad

The Runway 22L deicing pad currently accommodates 10 Delta Connection positions that can service up to Embraer 175-sized aircraft. The pad does not have standard vehicle maneuvering areas and vehicle safety zones. The Design Day Flight Schedules (DDFS) associated with the activity forecast show that the physical aircraft size of the Delta Connection fleet is increasing throughout the planning period. With a drawdown of sub-70 seat aircraft, the future Delta Connection fleet will rely on larger aircraft with increasing wingspans and lengths that start to approach those of mainline narrowbody aircraft. In consideration of this, all concepts for the Runway 22L deicing pad will plan for pads designed to large regional jet standards, which is represented by the Embraer 195 aircraft for wingspan and length.

The location of the Runway 22L deicing pad would also require a westward shift in the centerline geometry of Taxiway K in order to maintain TOFA clearance to the deicing pad. As a result, the centerline-to-centerline separation between Taxiways K and Y converges from the standard ADG V separation of 267 feet to 227 feet between Taxiways K6 and Taxiway U. This substandard separation restricts the capability of that section of Taxiways Y and K from being able to accommodate simultaneous ADG V aircraft. Given that Runway 4R-22L is the primary widebody aircraft departure runway, it is important for ATC to have flexibility in taxi routings, and the existing geometry limits flexibility.

The Runway 22L deicing pad is constrained by the now-vacant Smith Terminal, taxiways, and the North Terminal. The Authority has identified near-term plans to demolish the Smith Terminal which will provide additional area to meet current design standards. Given the need for a widebody deicing position for North Terminal carriers, this site also has the potential to accommodate that need as it is close in proximity to the North Terminal. Demolition of the Smith Terminal could also provide additional RON parking positions for the Airport.

A series of preliminary concepts for the Runway 22L deicing pad were developed and reviewed by TAC technical stakeholders groups and FAA. The concepts were intended to show ranges of activity for the 22L pad for both deicing and RON. Key considerations in developing the concepts were to improve access into and out of positions, provide additional aircraft queuing area, and meet new design standards. A sampling of the various concepts considered include:

- Deicing pad with 14 narrowbody positions, 3 widebody positions and five RON positions
- Deicing pad with 10 narrowbody positions, 3 widebody positions, and six RON positions
- Deicing pad with 7 narrowbody positions, 2 widebody positions, and six RON positions
- Deicing pad with 6 large regional jet positions, 3 widebody positions, and four RON positions
- Deicing pad with 10 large regional jet positions, 1 widebody position, and seven RON positions

Several considerations were added to the review of the 22L deicing pad including preserving the ability to extend Taxiway H across John Dingell Drive parallel to Taxiway V, maintaining the existing Rogell Drive roadway alignment, and allowing for the implementation of one additional widebody gate at the North Terminal. Based on stakeholder input and review of the preliminary concepts, it was recommended that the 22L pad be optimized and reconfigured to meet current design standards for either narrowbody or regional jet aircraft while accommodating at least one widebody deicing position for the North Terminal carriers. Two alternatives were carried forward for detailed consideration:

- **Alternative 1** – Alternative 1, presented on Figure 2-3, proposes a site with six narrowbody deicing positions, a single widebody deicing position, and a minimum of nine RON positions. This concept provides for the reconfiguration of Taxiway K in order to meet the ADG V standard for separation between Taxiways K and Y, includes the extension of Taxiway H to the east, and provides for efficient access into and out of the deicing pad. Alternative 1 is predicated on successfully changing the utilization of the deicing pads at DTW so that North Terminal carriers would be able to use the 22L pad and Delta Airlines (and its regional affiliates) would make use of the other deicing pads. The estimate rough order of magnitude (ROM) cost for this alternative is $76,000,000.

- **Alternative 2** – Alternative 2, presented on Figure 2-3, proposes a site with 10 large regional jet deicing positions, one widebody aircraft deicing position and a minimum of seven RON positions. This concept provides for the reconfiguration of Taxiway K in order to meet the ADG V standard for separation between Taxiways K and Y, includes the extension of Taxiway H to the east, and provides for efficient access into and out of the deicing pad. Alternative 2 maintains the existing deicing utilization strategy and does not shift any airlines to use of different pads, with the exception of the widebody deicing position that is available for both North Terminal carriers and for Delta Airlines. The widebody spot, while proximate to the 10 large regional deicing spots, is physically separated from those spots. The intent is to keep the widebody spot close enough to allow deicing crews to quickly service that spot while keeping the spot in a location that allows widebodies to access it without significantly impacting access to the 10 large regional deicing positions. The estimate rough order of magnitude (ROM) cost for this alternative is $76,000,000.

The two alternatives were screened based on a variety of criteria. Table 2-3 compares the two alternatives under seven different metrics. The scoring is based on Negative (-), Neutral (0), and Positive (+) scores for each of the categories. The higher the positive score, the better an alternative performs against the evaluation criteria.

Alternative 2 more closely meets the criteria established by the TAC for evaluating the 22L Deicing Pad options. All of the options require the Smith Terminal to be demolished, which has long been planned, but Alternative 2 maintains the existing utilization strategy for deicing, which was considered a significant benefit by the various stakeholders.

Table 2-3
RUNWAY 22L DEICING PAD AND RON PARKING EVALUATION MATRIX
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport

Evaluation Criteria	Alternative 1: Narrowbody Deicing	Alternative 2: Large Regional Jet Deicing
Minimizes Cost / Constructible	0	0
Maintains Current Utilization Strategy	-	+
Right-sizes Pads for Future Aircraft Fleet Mix	+	+
Provides for an Additional Widebody Position	+	+
Considerate of Proximate Development	+	+
Improves Operational Efficiency	+	+
Addresses Design Standards	+	+
Total Score	4 +	6 +

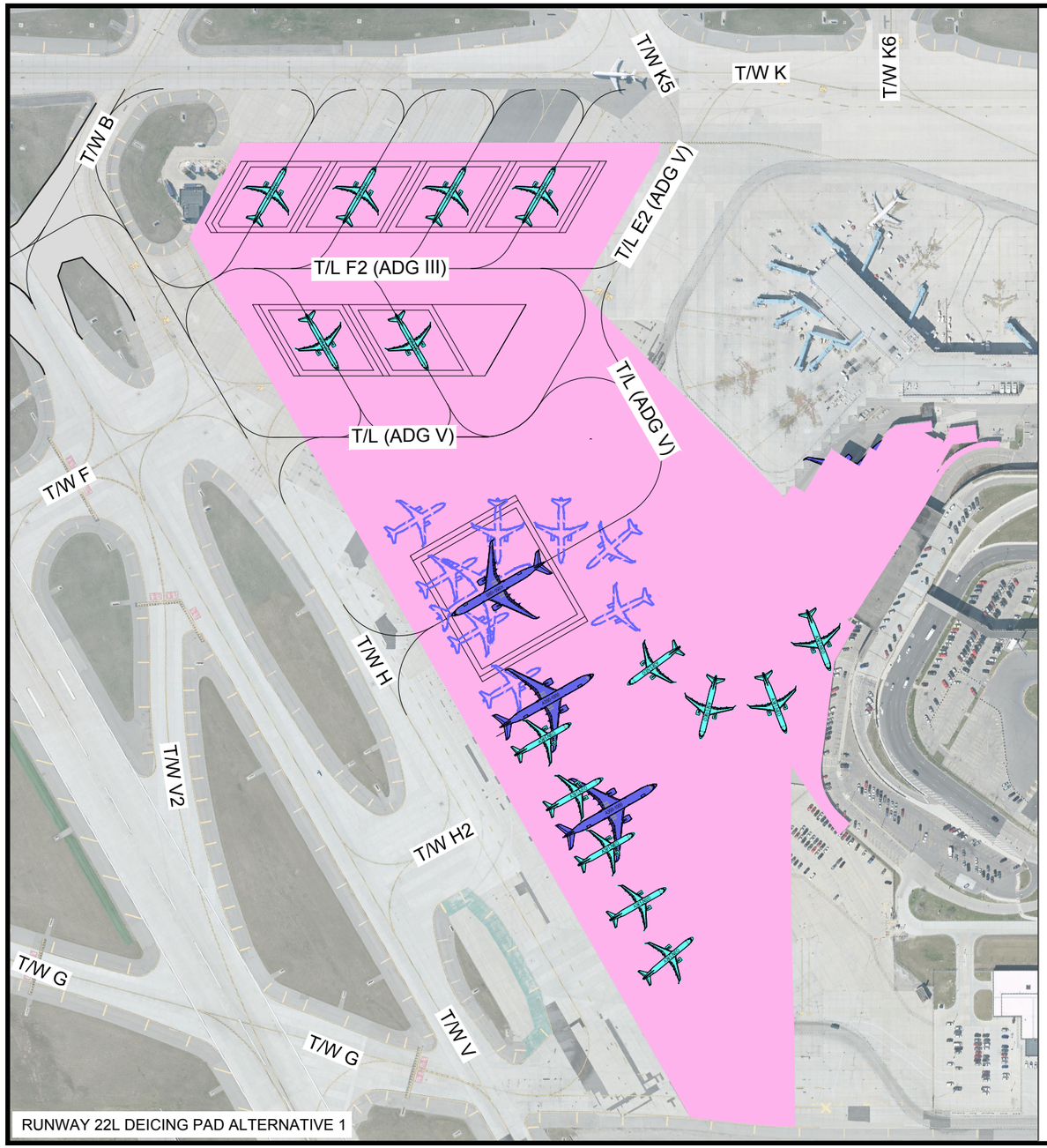
Source: HNTB and LeighFisher analysis, October 2016.

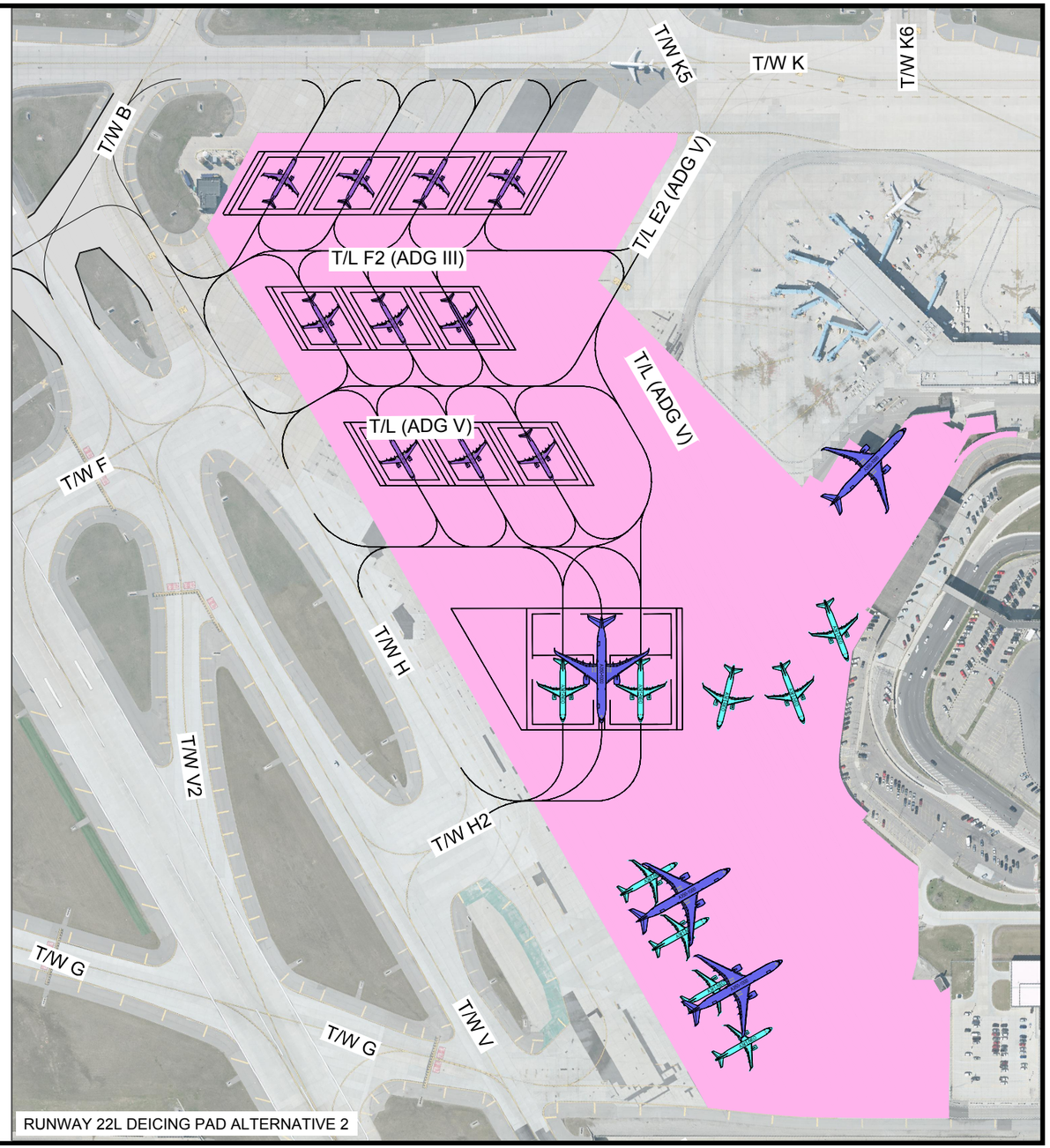
2.2.2 Runway 21R Deicing Pad

As discussed in the description of the Runway 3L-21R reconstruction alternatives, the Runway 21R deicing pad is in need of pavement reconstruction, and aircraft exiting the northernmost three deicing positions onto Taxiway M result in a penetration of the Runway 3L Departure Surface. To remedy the Departure Surface penetrations, the 21R pad can be reconfigured, as depicted on Figure 2-1 and Figure 2-2 to angle away from the departure surface. As aircraft exit the standardized deicing positions, their wings would be physically within the Departure Surface but the fuselage and aircraft tail remain clear. To have an efficient, standards-compliant deicing pad, the existing Signature FBO taxilane connector that traverses through the deicing pad should be relocated to the south to tie into the south end of the Signature apron. This decouples traffic entering into the deicing pad from traffic entering and exiting the Signature FBO ramp. As a consequence of the relocation, approximately 290 vehicle parking spots would be eliminated from the Green Parking Lot to accommodate the taxilane. The 21R pad reconfiguration would continue to accommodate six ADG-III deicing positions for the north terminal carriers.

2.2.3 Runway 4R Deicing Pad

The Runway 4R pad currently services Delta mainline narrowbody and widebody aircraft. The existing pavement location and quantity of positions was determined by Delta to be sufficient throughout the planning period for the existing and forecast fleet mix. It should be noted that new, larger widebody aircraft may result in some temporary operational impacts during deicing due to length limitations of the deicing pad. The Authority does not anticipate the need for pavement reconstruction of the Runway 4R pad within the planning period, and therefore, no changes are proposed for the 4R pad.





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LEGEND

- Future taxiway/apron pavement
- Typical widebody aircraft
- Typical narrowbody aircraft
- Typical regional aircraft
- Alternative RON widebody aircraft
- Alternative RON narrowbody aircraft

NORTH

0 150' 300' 600'

Figure 2-3
RUNWAY 22L DEICING PAD ALTERNATIVES

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2.2.4 Runway 3L Deicing Pad

The Runway 3L pad currently services Delta mainline narrowbody aircraft. The existing pavement location and quantity of positions was determined by Delta to be sufficient throughout the planning period for the existing and forecast fleet mix. With the application of the Departure Credit, aircraft are clear of the Runway 21R Departure Surface at all points of travel. The Authority does not anticipate the need for pavement reconstruction of the Runway 3L pad within the planning period, and therefore, no changes are proposed for the 3L pad.

2.2.5 Runway 4R West Deicing Pad

The existing four pads will adequately serve forecast demand throughout the planning period. The Consultant Team evaluated the potential for expansion beyond the planning period or if demand grows more quickly than forecast, or if widebody aircraft in the current 4R pad that are too long and affect access into that pad become a problem. A supplemental pad west of Runway 4R could provide future deicing capacity for DTW for both narrowbody and widebody aircraft. As shown on Figure 2-4, the Runway 4R West pad could be constructed to flexibly accommodate multiple widebody and narrowbody aircraft, meet current FAA design standards, and provide significant capacity for the deicing operation. To provide maximum flexibility, Taxiway Z would be extended to the south to tie into the new pad to allow for aircraft to taxi to either the north end or south end of Runway 4R-22L. The pad would be configured to allow for aircraft to hold short of the Runway 4R glideslope critical area while keeping clear of the Taxiway Z TOFA to enable free-flowing traffic along Taxiway Z. Optimally, the pad would also connect to Taxiway Q to allow aircraft to use the end-around-taxiway to reach the pad. Other aircraft would cross Runway 4R-22L at Taxiway Y1 and enter the pad. Departing aircraft in north flow would enter Runway 4R at Taxiway Z2. The need for this expansion project should be re-evaluated in the next Master Plan Update. The estimate rough order of magnitude (ROM) cost for this alternative is $60,000,000.

2.2.6 Additional RON Parking Positions

In addition to the RON reconfiguration at the Runway 22L pad, another area of RON expansion is provided by the demolition of Building 715 and addition of aircraft-rated pavement. As illustrated on Figure 2-5, this allows for one additional widebody aircraft parking position or up to two narrowbody aircraft parking positions. The Berry Terminal is also scheduled for near-term removal. The number of RON parking positions adjacent to the Berry Terminal will not be impacted or increased as a result of the removal of the Berry Terminal.

T/W Q

T/W Z

T/W R

GS CRITICAL AREA

R/W 4R - 22L 12,003' x 200'

T/W Y1

T/W Y2

T/W R

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LEGEND

Future taxiway/apron pavement

NORTH

0 150' 300' 600'

Figure 2-4
RUNWAY 4R WEST DEICING PAD & TAXIWAY Z EXTENSION
Alternatives Development and Evaluation
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport
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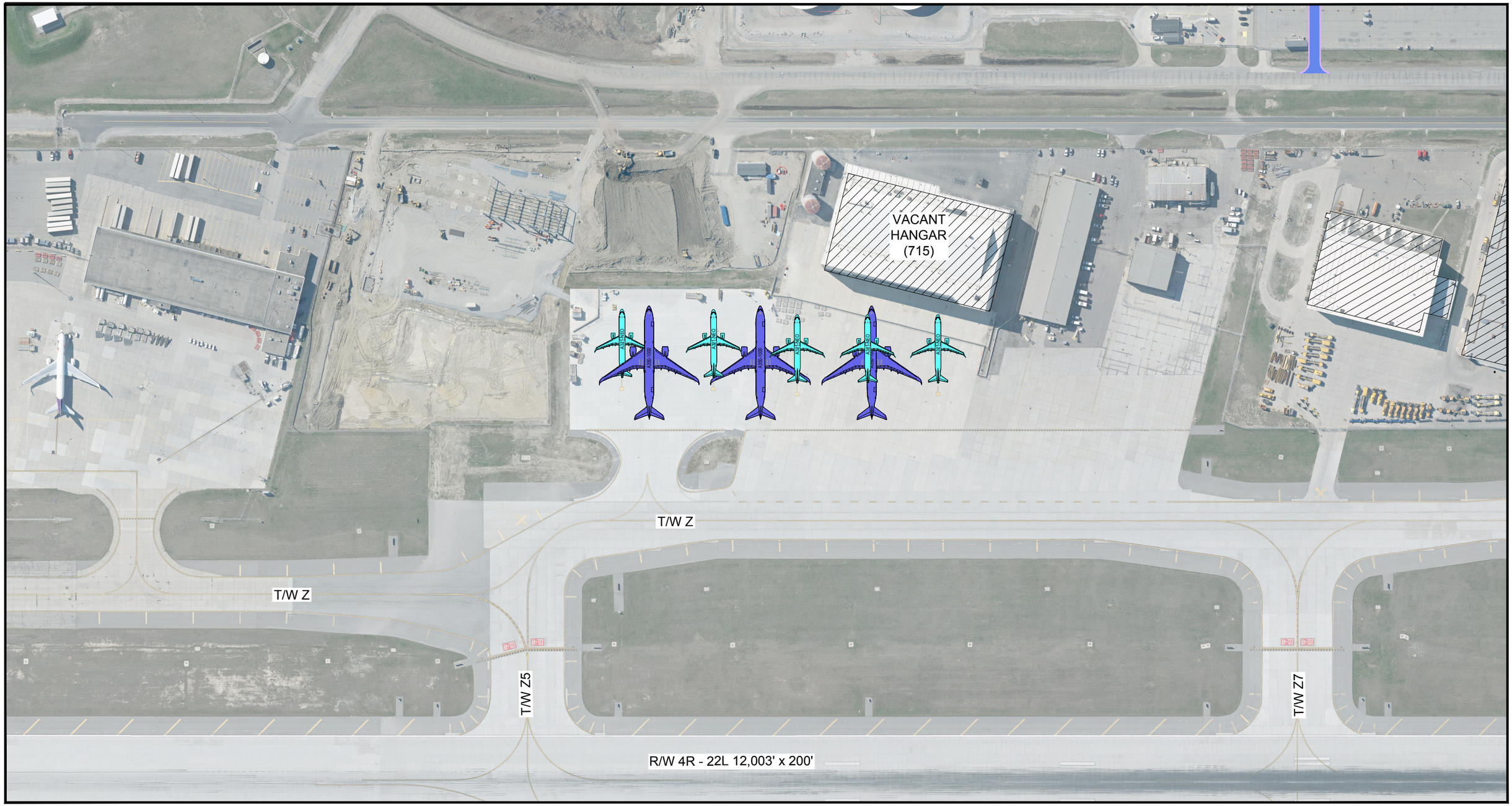

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LEGEND

Future building/pavement removal

NORTH

0 100' 200' 400'

Figure 2-5
RON PARKING POSITIONS

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2.3 Other Airfield Improvements

The following summarized additional airfield improvements that were considered in the Master Plan.

2.3.1 Geometry Standards

A number of single alternatives were proposed to address non-standard geometries identified in the Facility Requirements. These include the following:

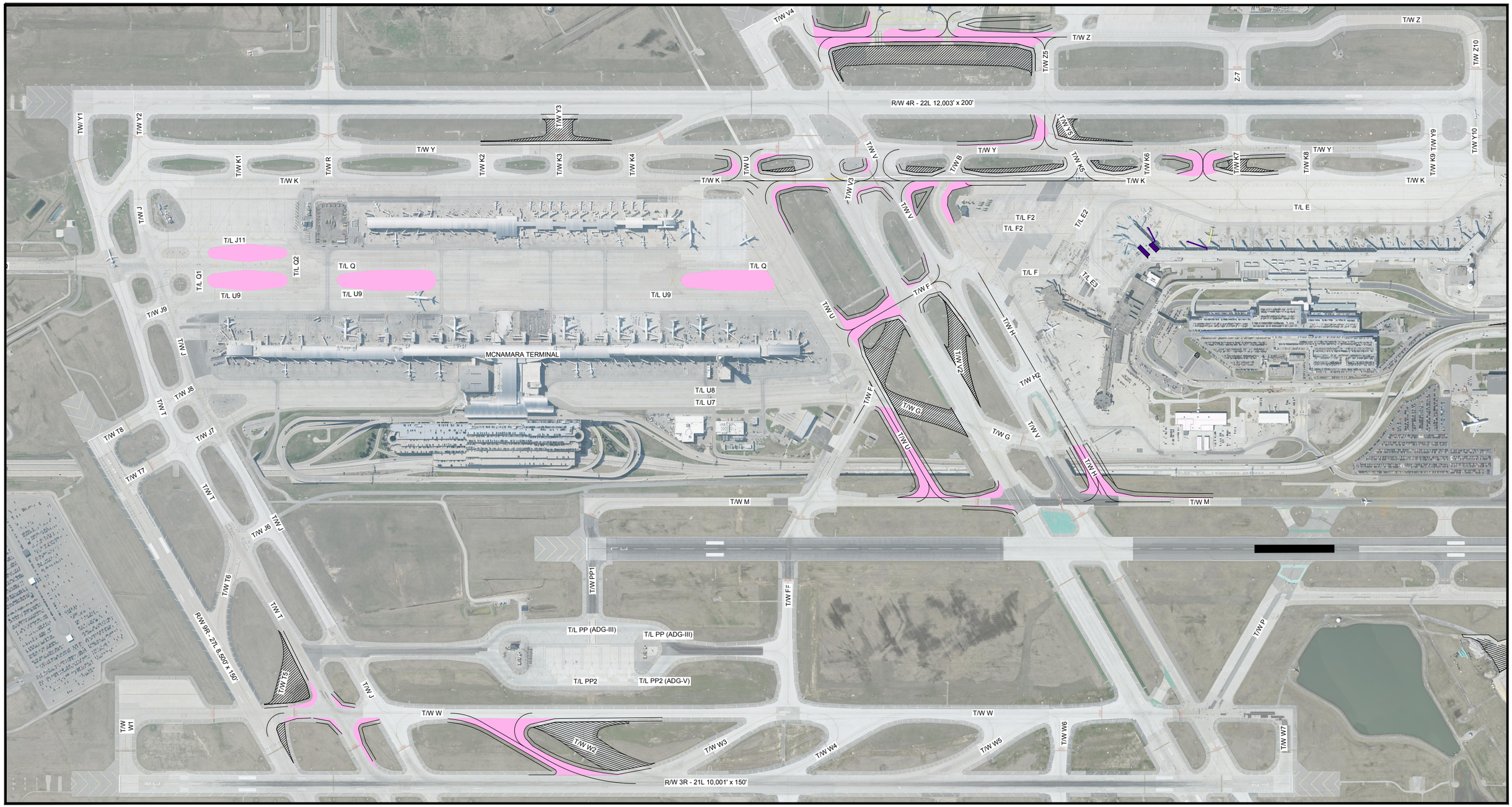
- Taxiway Z Realignment – Taxiway Z between Taxiways Z5 and V is separated from Runway 4R-22L by 400 feet, and north of Taxiway Z5, the separation is 557 feet. For CAT II/III approaches, this separation is required to be a minimum of 500 feet. As depicted on Figure 2-6, the Authority has advanced a design to relocate the sub-standard portion of Taxiway Z to match the alignment of Taxiway Z north of Taxiway Z5. The estimate rough order of magnitude (ROM) cost for this alternative is $14,000,000.

- Runway 27L ROFA Beyond Stop End of Runway – The Runway 27L ROFA beyond the stop end of the runway (Runway 9R end) is penetrated by the vehicle service road and requires a relocation of the roadway to meet design standards as presented on Figure 2-7. The estimate rough order of magnitude (ROM) cost for this alternative is $611,000.

- Runway 9L ROFA Beyond Stop End of Runway – The Runway 9L ROFA beyond the stop end of the runway (Runway 27R end) is penetrated by the vehicle service road and requires a relocation of the roadway to meet design standards as presented on Figure 2-7. The relocation of the roadway requires the infill or bridging of the retention ponds on each side of the roadway. The estimate rough order of magnitude (ROM) cost for this alternative is $400,000.

- Runway 3R ROFA Beyond Stop End of Runway – The Runway 3R ROFA beyond the stop end of the runway (Runway 21L end) is penetrated by the vehicle service road and requires a relocation of the roadway to meet design standards as presented on Figure 2-7. The relocation of the roadway requires the infill or bridging of the retention ponds on each side of the roadway. The estimate rough order of magnitude (ROM) cost for this alternative is $400,000.

- Taxiway K Geometry – As discussed in the Runway 22L Deicing Pad alternatives, the separation between Taxiways K and Y between K6 and U is nonstandard. To remedy this non-standard condition as presented on Figure 2-6, Taxiway K will be realigned to meet standards. This includes the relocation of the centerline and the widening of fillets to meet design standards. The estimate rough order of magnitude (ROM) cost for this alternative is $7,400,000.



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LEGEND

- Future taxiway/apron pavement
- Future building/pavement removal

Figure 2-6
PROPOSED AIRFIELD GEOMETRY MODIFICATIONS

NORTH

0 400' 800' 1600'

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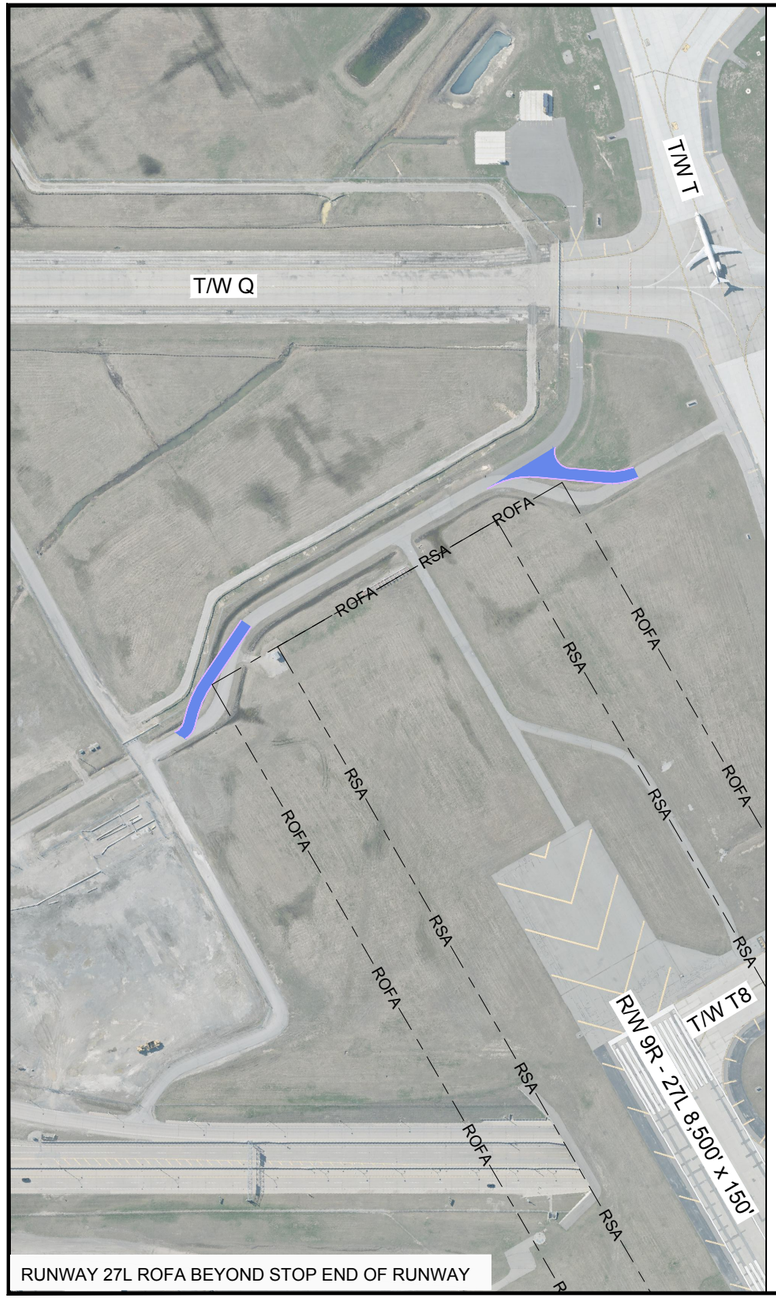
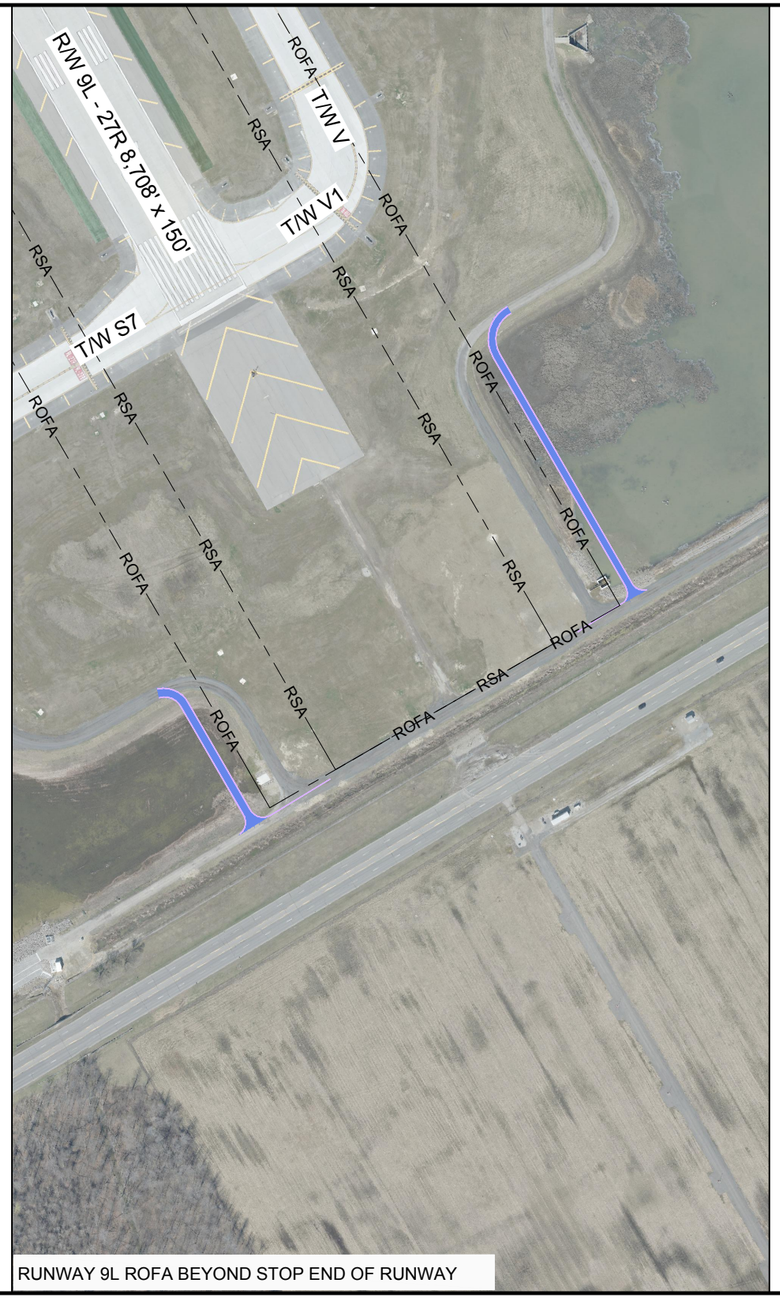
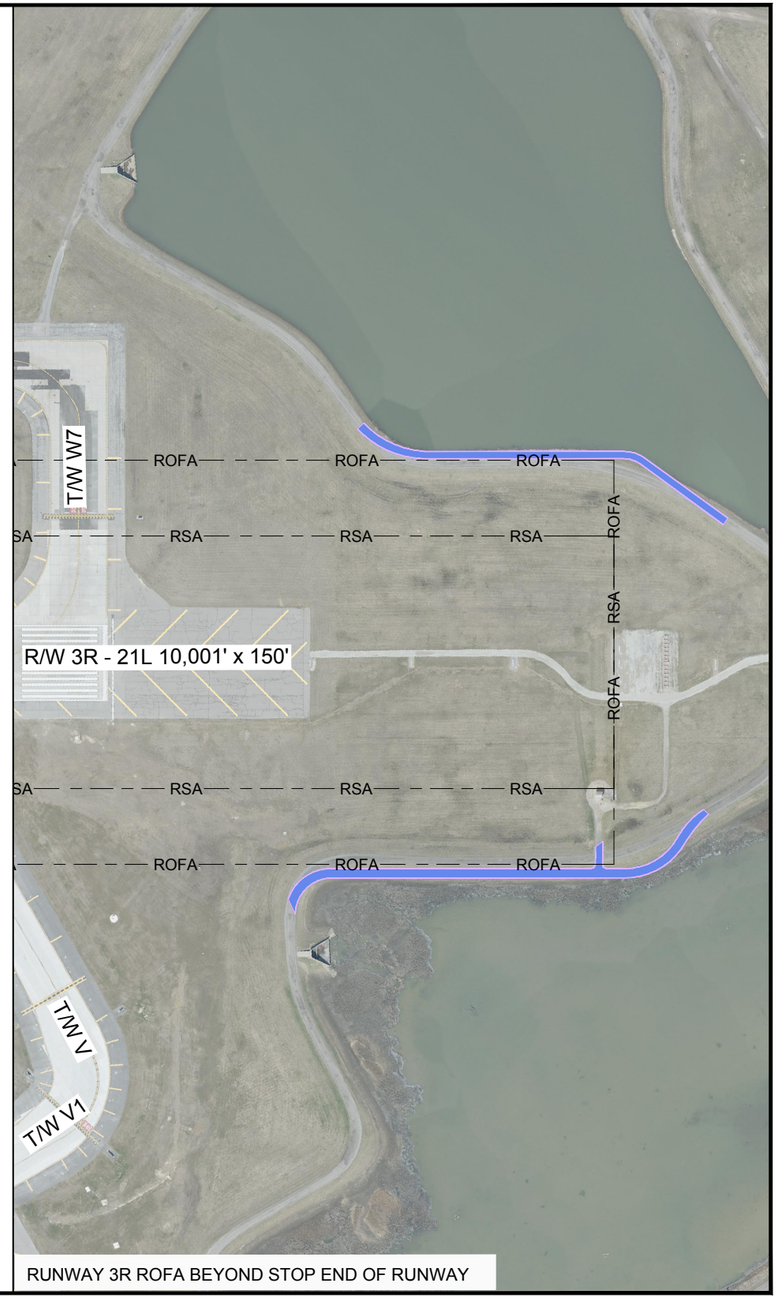


RUNWAY 27L ROFA BEYOND STOP END OF RUNWAY



RUNWAY 9L ROFA BEYOND STOP END OF RUNWAY



RUNWAY 3R ROFA BEYOND STOP END OF RUNWAY

LEGEND

- Future airport service road
- — RSA — Runway safety area
- — ROFA— Runway object free area

NORTH

0 150' 300' 600'

Figure 2-7
RUNWAY ROFA BEYOND STOP END OF RUNWAY

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2.3.2 Runway Incursion Mitigation Improvements

A number of single alternatives were proposed to address RIM geometries. The improvements are intended to reduce the risk of a runway incursion and/or surface incident. The improvements were identified based on an historical analysis of past incursions and incidents at the Airport and prioritize these areas based on the potential severity of an incursion. The following improvements were considered:

- Taxiway F Reconfiguration – As part of the Runway 3L-21R reconstruction project, Taxiway F could be reconfigured to reduce the potential for pilots to lose situational awareness on a long, straight taxi along Taxiway F which intersects and crosses Runway 3L-21R at an angle. By reconfiguring the crossing to a 90-degree intersection with the runway aligned with the portion of Taxiway F east of Runway 3L-21R, aircraft taxiing along Taxiway F will be required to make a situational awareness turn onto Taxiway M prior to crossing Runway 3L-21R. As depicted on Figure 2-6, the 90-degree perpendicular crossing also improves visual acuity of aircraft potentially rolling out on Runway 3L-21R and reduces the crossing distance. The estimate rough order of magnitude (ROM) cost for this alternative is $9,200,000.

- Taxiway W2 Relocation – The de-coupling of Taxiways W2 and W3 by relocating W2 to the south eliminates a wide-expanse of pavement where the two taxiways join. During low visibility and snow-accumulation conditions, it can be challenging to decipher which taxiway to turn onto. A modest relocation of Taxiway W2, as depicted on Figure 2-6 could eliminate the wide expanse of pavement without significantly increasing runway occupancy times on Runway 3R-21L. The estimate rough order of magnitude (ROM) cost for this alternative is $8,800,000.

- Taxiway W Geometry – To eliminate a potentially confusing geometry that results in a wide-expanse of pavement at the intersection of Runway 9R-27L with Taxiways W and T5, it is proposed that Taxiway T5 be demolished. By demolishing Taxiway T5, the number of decision points and directions for pilots exiting or crossing Runway 9R-27L is reduced to improve situational awareness. To meet design standards, the fillets for Taxiway W onto Taxiways J and T would be enhanced to meet FAA design standards. This configuration is illustrated on Figure 2-6. The estimate rough order of magnitude (ROM) cost for this alternative is $3,600,000.

- Taxiways U, G, U2, and V2 Improvements – The intersection of Taxiways U2, V2, G, F, U and Taxilanes U7 and U8 in close proximity to Runway 9L-27R and the McNamara Terminal results in a complex intersection with multiple acute angle runway crossings. As illustrated on Figure 2-6, to simplify geometry, reduce the potential for a runway incursion, and maintain efficiency, a concept was developed to demolish existing Taxiways G and V2 south of Runway 9L-27R, and construct a 90 degree crossing of Runway 9L-27R aligned with Taxiway V2 north of Runway 9L-27R, as well as extend Taxiway U across John Dingell Drive and connecting into Taxiway M. The perpendicular reconstruction of Taxiway V2 will improve the situational awareness of the runway crossing and will reduce the physical length of the crossing. The extension of Taxiway U allows for the southern portion of Taxiway G to be demolished, in effect eliminating a runway crossing in the high-energy portion of the runway. The extension of Taxiway U also provides enhanced access for aircraft coming into or out of the McNamara Terminal to/from Runways 3L-21R and 3R-21L. The extension may also reduce the frequency for which ATC assigns aircraft to taxi along Runway 9L-27R. The estimate rough order of magnitude (ROM) cost for this alternative is $19,700,000.

- Taxiway Y3 Demo – To eliminate the potential of an aircraft errantly entering Runway 4R-22L coming out of the McNamara Terminal, as presented on Figure 2-6, it is proposed that Taxiway Y3 be demolished or closed. A potential relocation of Taxiway Y3 was determined by key airport

stakeholders to be not necessary from a runway occupancy and efficiency standpoint. The estimate rough order of magnitude (ROM) cost for this alternative is $1,000,000.

- Taxiway Y5 Geometry – Taxiway Y5 is currently designated as an ADG VI runway crossing for Runway 4R-22L. The taxiway crosses Runway 4R-22L at an acute angle which ties directly into Taxiway K5 and the North Terminal apron. To enhance situational awareness, reduce the length of the crossing, and continue to meet FAA standards, Taxiway Y5 is proposed to be reconfigured to a 90-degree perpendicular crossing as shown on Figure 2-6. The estimate rough order of magnitude (ROM) cost for this alternative is $2,700,000.

- Taxiway K7 Geometry – Taxiway K7 is proposed to be relocated to eliminate the direct runway entrance and crossing from the North Terminal. As illustrated on Figure 2-6, a modest shift of Taxiway K7 will enhance pilot situational awareness and reduce the possibility of an errant entrance into the protected surfaces of Runway 4R-22L. The estimate rough order of magnitude (ROM) cost for this alternative is $3,800,000.

2.3.3 Efficiency Improvements

In addition to the standards-compliance improvements and RIM geometry improvements, two additional improvements were identified to improve overall airfield efficiency. These include the following:

- McNamara Island Infill – As depicted on Figure 2-6, four islands within the non-movement area between the McNamara Terminal Concourses A and B/C are proposed to be infilled with aircraft-rated pavement in order to enhance the efficiency of aircraft movements. The island infill allows for aircraft to more easily move between Taxilanes Q and U9 and will provide for enhanced ingress into the Runway 4R deicing pad. The estimate rough order of magnitude (ROM) cost for this alternative is $15,300,000.

- Taxiway H Bridge – A potential extension of Taxiway H across John Dingell Drive could enhance the efficiency of aircraft accessing Runway 21R from the North terminal as well as enhance the access into and out of the Runway 22L deicing pad. The extension requires a bridge structure over the roadway, as depicted on Figure 2-6. The extension could also result in fewer ATC assignments of using Runway 9L-27R as a taxiway. The estimate rough order of magnitude (ROM) cost for this alternative is $16,200,000.

3.0 GROUND TRANSPORTATION AND PARKING ALTERNATIVES

The following summarizes alternatives considered to improve airport roadways, curbsides, parking, and rental car facilities at the airport. Alternatives were developed based on the facility requirements discussed in Technical Memorandum No. 5, supplemental data collection, and input from Authority staff and the CAC and TAC stakeholder groups. Alternatives focused on addressing not only deficiencies in requirements but also operational enhancements.

3.1 Airport Roadways

Airport roadways include both the terminal access roadways and non-terminal roadways and intersections that provide access to terminal, parking, rental car and other airport support facilities. Facility requirements determined, with the exception of the intersection of Rogell Drive and Burton Drive, the airport roadways have sufficient capacity to accommodate forecast demand throughout the 20-year planning horizon. As a result, the focus of the roadway alternatives was to improve operations at four key areas:

- Return-to-North Terminal Movement – Currently, vehicles at the North Terminal that need to return to the curbsides or parking along with those accessing the North Terminal from the south must make a U-turn at the intersection of Rogell Drive and Burton Drive. This movement slows down the traffic flow due to the tight turn and flow of on-coming southbound traffic on Rogell Drive. Queues also build along northbound Rogell Drive as vehicles wait to make the turn.
- Intersection of Rogell Drive and Burton Drive – This signal, providing access to the east and west service drives, experiences congestion in the southbound turn lane on Rogell Drive along with the eastbound and westbound movements along Burton Drive. This congestion is projected to increase through the planning horizon.
- North Terminal to McNamara Terminal Connection – Current operations require vehicles exiting the North Terminal heading south to the McNamara Terminal or Eureka Road to exit the North Terminal northbound on Rogell Drive and make a U-Turn at the Burton Drive intersection to head back to the south.
- Big Blue Parking Deck Parking Exit – The existing exit roadway from the Big Blue Parking Deck exit plaza abruptly merges with the outbound North Terminal roadway and provides limited sight distance or space to safely merge with outbound traffic.

3.1.1 Rogell Drive Reconfiguration

Three roadway options were developed to improve the return-to-North Terminal movement and operations at the intersection of Rogell Drive and Burton Drive.

Option 1, shown on Figure 3-1, addresses the return-to-terminal movement for vehicles accessing the North Terminal by providing a dedicated flyover over the intersection of Rogell and Burton drives, connecting the northbound and southbound Rogell Drive movements. The flyover would replace the northbound U-turn movement at the intersection reducing queueing at the intersection in the northbound direction. No other intersection operations are addressed in this option and access to facilities along the east and west service drives remain the same as current conditions. The rough order of magnitude cost to construct this flyover is estimated at $13.4 million.

Figure 3-1
OPTION 1: ROGELL DRIVE FLYOVER
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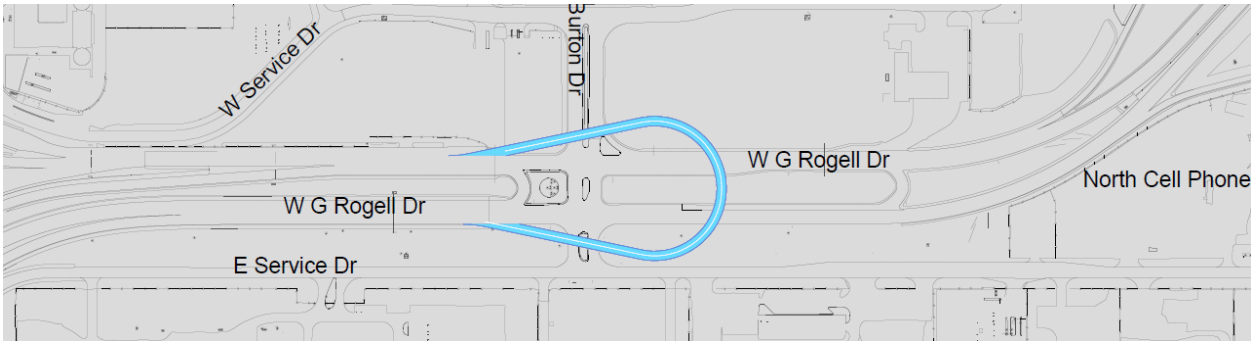
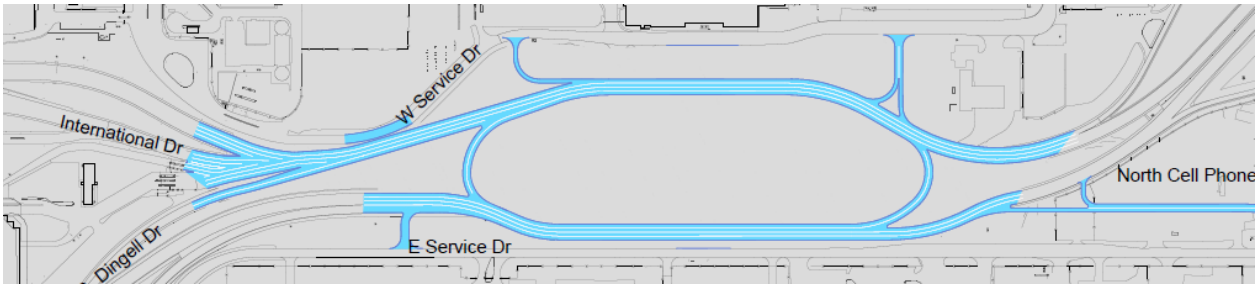


Source: LeighFisher and HNTB, January 2017.

Option 2, shown on Figure 3-2, realigns Rogell to provide a larger median between the northbound and southbound lanes, providing space for a cell phone lot and commercial development. Burton Drive is split with access to the west service road moving north along Rogell Drive and access to the East Service Drive moving south. At-grade, non-signalized movements provide continuous flow merge and diverge movements connecting the northbound and southbound movements on either side of the enlarged median. As shown in Figure 3-2, rental car shuttles could use a dedicated slip-ramp off of northbound Rogell Drive tying into Lucas Drive to access the existing rental car sites from the terminals.

Figure 3-2
OPTION 2: ROGELL-BURTON REALIGNMENT – NON-SIGNALIZED
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport



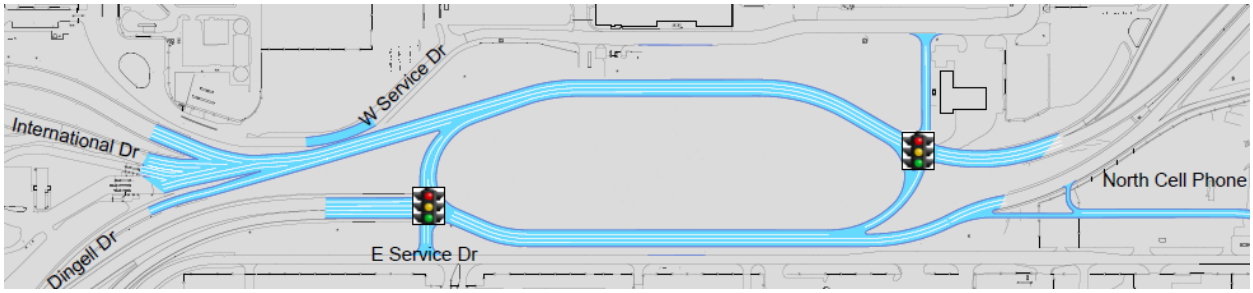
Source: LeighFisher and HNTB, January 2017.

Option 2 allows the free flow of vehicles entering and exiting the airport property, provides a clearly-defined recirculation movement, and includes median space for a cell phone lot and commercial development. The access to the east and west service drives would be off-set allowing distance to weave to the opposite side of Rogell after vehicles make a turn from northbound to southbound or vice versa to exit onto the service roads. Under this option, two new weaving sections would be created: (1) along southbound Rogell Drive

with Return-to-North Terminal traffic crossing traffic entering the Airport, and (2) along northbound Rogell Drive with Return-to-Terminal and traffic bound for the west service road crossing traffic exiting the Airport. Based on preliminary weaving analysis as prescribed in ACRP Report 40, *Airport Curbside and Terminal Area Roadway Operations*, which adapts Highway Capacity Manual criteria for use in slow speed airport conditions, both of these weaving sections are expected to operate with a Level of Service B, which exceeds the minimum requirement of Level of Service D. A rough order of magnitude cost to construct this roadway configuration is estimated at $17.6 million.

The roadway configuration in Option 3, shown on Figure 3-3, is similar to Option 2, but includes signals at the Burton Drive intersections. The return-to-terminal movement could be free-flow with an add lane to reduce the conflict with through traffic along Rogell Drive at the signals. Sufficient queuing capacity must be provided at the intersections. Similar to Option 2, rental car shuttles could use a dedicated slip-ramp off of northbound Rogell Drive tying into Lucas Drive to access the existing rental car sites from the terminals. A rough order of magnitude cost to construct this roadway configuration has been estimated at $17.6 million.

Figure 3-3
OPTION 3: ROGELL-BURTON REALIGNMENT – SIGNALIZED
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport



Source: LeighFisher and HNTB, January 2017

As with Option 2, two new weaving sections would be created: (1) along southbound Rogell Drive with Return-to-North Terminal traffic crossing traffic entering the Airport; and (2) along northbound Rogell Drive with Return-to-Terminal traffic crossing traffic exiting the Airport one in the northbound direction of Rogell Drive. However, the traffic signals significantly reduce the impact of the weave as traffic is metered at the signal allowing space for vehicles to weave across the lanes on Rogell Drive. Based on preliminary weaving analysis as prescribed in ACRP Report 40, *Airport Curbside and Terminal Area Roadway Operations*, which adapts Highway Capacity Manual criteria for use in slow speed airport conditions, both of these weaving sections are expected to operate with a Level of Service B, which exceeds the minimum requirement of Level of Service D.

The three options were screened based on a variety of criteria. Table 3-1 compares the options under six different metrics. The scoring is based on Negative (-), Neutral (0), and Positive (+) scores for each of the categories. The higher the positive score, the greater an alternative performs against the evaluation criteria.

All three options provided the needed Return-to-Terminal movement along Rogell Drive but only Options 2 and 3 improved the Rogell-Burton intersection and materially improved operations along Rogell Drive.

Option 3 has the additional benefit of providing direct access to the service roads through signalization, which effectively eliminated the weaving sections along Rogell Drive further improving traffic flow and access to the East and West Service Drives.

Table 3-1
ROGELL DRIVE RECONFIGURATION EVALUATION MATRIX
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport

	Option 1: Rogell Drive Flyover	Option 2: Rogell-Burton Realignment - Non-Signalized	Option 3: Rogell-Burton Realignment - Signalized
Minimizes Cost / Constructability	+	0	0
Provides Return-to-Terminal Movement	+	+	+
Improves Operations at the Rogell-Burton Intersection	-	+	+
Improves Vehicle Movement Along Rogell Drive	-	0	+
Improves Access to the East and West Service Drives	-	0	+
Provides Opportunity for Commercial Development Accessible by Inbound and Outbound Vehicles	-	+	+
Total Score	2-	3+	5+

Source: HNTB analysis, August 2016.

3.1.2 Rogell-Dingell Drive Connector and Big Blue Parking Deck Exit

Currently, all traffic leaving North Terminal is directed to northbound Rogell Drive. Vehicles traveling south to the McNamara Terminal or Eureka Drive must make a U-turn at the signalized intersection of Rogell Drive at Burton Drive. In addition, the exit lanes from the Big Blue Parking Deck exit plaza abruptly merge with the outbound North Terminal roadway, providing limited sight distance or space to safely enter the North Terminal exit roadway.

Two options were developed to connect Rogell Drive to Dingell Drive in the southbound direction and improve the Big Blue Parking Deck exit.

Option 1, shown on Figure 3-4, constructs a new flyover ramp from Rogell Drive as it exits the North Terminal adjacent to the Big Blue Parking Deck to southbound Dingell Drive. The flyover would diverge from the outer lanes of Rogell Drive, opposite the Big Blue Parking Deck, and cross over the East Service Drive with a bridge structure, connecting to southbound Dingell Drive. In order to achieve sufficient length for the flyover ramp to ascend above the East Service Drive, this alternative requires a northward relocation of the existing East Service Drive access point. In addition to the flyover ramp, this option would reconfigure the Big Blue Parking Deck exit lanes to increase the length of acceleration lane, and provide a shallower merging angle between the parking exit lane and Rogell Drive. The reconfiguration would move the merge point further north along Rogell, so that drivers leaving the Big Blue Parking Deck would be prohibited from weaving to the right across traffic to access the Rogell-Dingell Connector. Drivers exiting the Big Blue Parking Deck and heading south may still be required to exit northbound along Rogell Drive and make a U-turn to

return south, as they do today. Under this option, a two-sided weaving section is created, but the distance between roadways ramps is sufficient to provide a Level of Service A, which exceeds the minimum requirement of Level of Service D. A rough order of magnitude cost to construct this flyover is estimated at $2.0 million.

Figure 3-4
ROGELL-DINGELL CONNECTOR FLYOVER OPTIONS
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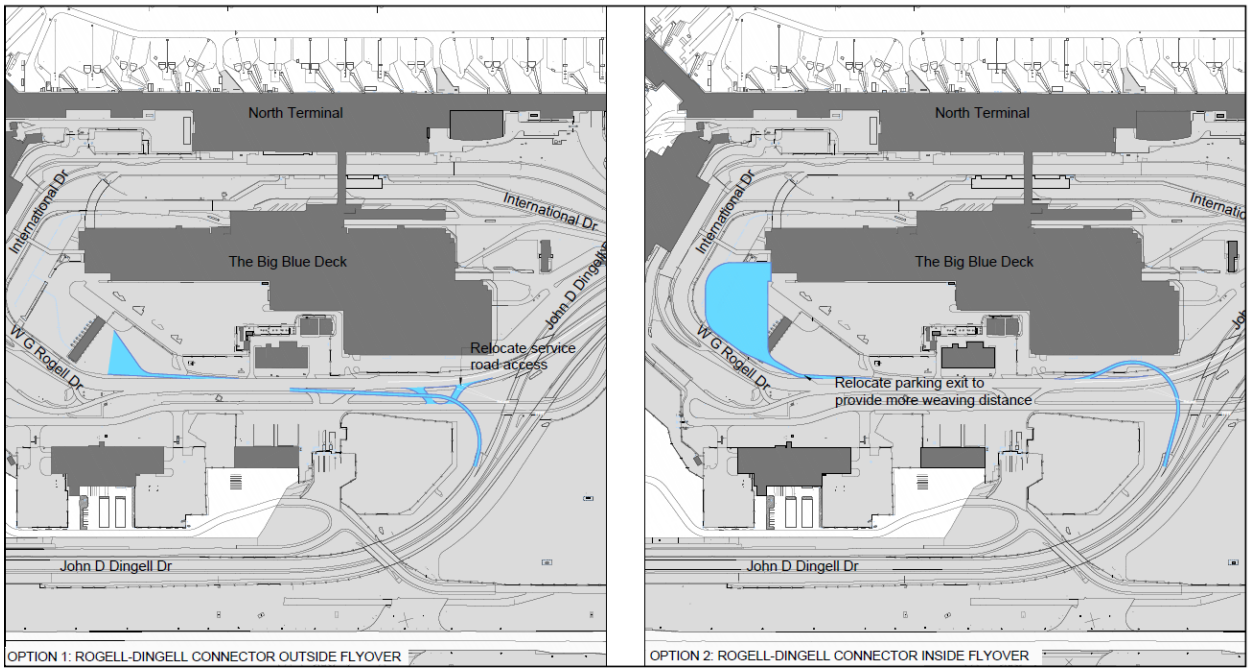
Detroit Metropolitan Wayne County Airport



Source: LeighFisher and HNTB, January 2017.

Option 2 constructs a new flyover ramp from Rogell Drive at the North Terminal Exit to southbound Dingell Drive from the inside Rogell Drive lanes closest to the Big Blue Parking Deck. As shown in Figure 3-4, the flyover ramp would ascend in the space between northbound Rogell Drive and the Big Blue Parking Deck, and cross over both Rogell Drive and the East Service Drive with a bridge structure before merging with the elevated overpass portion of southbound Dingell Drive. This option would allow traffic leaving the Big Blue Parking Deck to use the connector to access southbound Dingell Drive. However, a new weaving movement would be created requiring all traffic leaving the Big Blue Parking Deck and heading north to cross the traffic accessing the connector. In order to provide sufficient weaving distance between existing Big Blue Parking Deck exit and the potential diverge point of the connector the Big Blue Parking Deck exit plaza would require relocation to the south providing additional weaving distance but increasing the cost. A rough order of magnitude cost to construct this flyover is estimated at $2.5 million.

The alternatives were screened based on a variety of criteria as shown in Table 3-2 which compares the options under six different metrics. The scoring is based on Negative (-), Neutral (0), and Positive (+) scores for each of the categories. The higher the positive score, the greater an alternative performs against the evaluation criteria.

Table 3-2
ROGELL-DINGELL CONNECTOR EVALUATION MATRIX
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport

	Option 1: Outside Flyover	Option 2: Inside Flyover
Minimizes Cost / Constructible	+	-
Provides Connection to Southbound Dingell Drive for all Vehicle Movements	0	+
Provides Sufficient Weaving Space	+	0
Improves Parking Exit	+	+
Total Score	**3+**	**1+**

Source: HNTB and LeighFisher analysis, October 2016.

Both options provide a direct connection from Rogell Drive to Dingell Drive, while improving safety and traffic flow from the Big Blue Parking Deck exit plaza. While Option 1 does not provide easy access to the flyover for vehicles exiting the Big Blue Parking Deck, it does provide better weaving conditions for all exiting vehicles as they do not need to cross the vehicles exiting the Big Blue Parking Deck to access the flyover. In addition the estimated construction cost of the outside flyover would be less because it has a shorter elevated section and does not require reconfiguration of the entire parking exit plaza.

3.2 Curbside Facilities

Airport curbside facilities are comprised of separate arrivals and departures curbsides along with ground transportation centers (GTC) at both terminals and the international arrivals curbside at the McNamara Terminal. Facility requirements determined the following deficiencies and future capacity considerations:

- McNamara Terminal Departures Curbside – Currently, the private vehicle drop-off portion of the departures curbside is deficient by 15 feet increasing to 115 feet by PAL 3. Dwell times on this curbside are in the expected range and a reallocation of the hotel valet curb and dedicated inter-terminal shuttle zone to expand the private vehicle drop-off area is recommended to provide sufficient capacity for curbside activity in the future.

- McNamara Terminal Domestic Arrivals Curbside – With observed long vehicle dwell times, this curbside is currently deficient by approximately 625 feet; however, with operations limited to active loading only it is estimated that the arrivals level has sufficient length and number of lanes to meet demand through PAL 3. It is recommended that curbside enforcement is used to limit vehicle dwell times to active loading only during peak periods, eliminating the need for expanded arrivals curbsides.

- McNamara Terminal International Arrivals Curbside – The international curbside is currently deficient by 630 feet increasing to 760 by PAL 3. Dwell times recorded on this curbside are in the expected range reflecting active loading activity only with no extended dwelling of vehicles.

- McNamara Terminal Ground Transportation Center – Currently, the McNamara Terminal GTC has a 240-foot deficit in curbside length with hotel, parking and rental car shuttles requiring additional length. With a reduction of rental car dwell times to reflect active loading and unloading, with no staging of vehicles, this deficit is reduced to 100 feet but increases to 210 feet by PAL 3.

- North Terminal Arrivals Curbside – With observed long vehicle dwell times, this curbside is currently deficient by approximately 600 feet; however, with operations limited to active loading only it is estimated that the arrivals level has sufficient length and number of lanes to meet demand through PAL 1 and will require an additional 100 feet by PAL 3.

- North Terminal Ground Transportation Center – Sufficient space is available to accommodate ground transportation operations through the 20-year planning horizon; however, a reallocation of space among hotel, parking and rental car shuttles may be required to accommodate additional modes such as increased express bus and planned Regional Bus Rapid Transit (BRT) service. Currently, shuttle drivers take their breaks at the North Terminal GTC. The resulting extended dwell times do not currently affect capacity but this will need to be monitored through the planning horizon to limit dwell times as capacity issues arise.

3.2.1 Cell Phone Lot Relocation and Expansion

To address the deficiencies at the McNamara and North Terminal Domestic Arrivals Curbs observed currently and projected through the 20-year planning horizon, increased curbside enforcement is recommended along with a relocation and expansion of the existing cell phone lots to accommodate vehicles moved from the curbside. There are currently two cell phone lots, one north and one south of the terminals. The North Cell Phone Lot is located along the East Service Drive adjacent to the commercial vehicle hold lot. The lot is not visible from the main airport entrance, it is off the main path to the airport, although signs direct drivers to its location, and as a result usage is limited. A temporary cell phone lot is also located off Southbound Rogell Drive north of the North Terminal, however, pavement in the lot is in poor condition and the lot is not consistently utilized. The South Cell Phone Lot is located along Eureka Road between I-275 and Dingell Drive on the primary path to the McNamara Terminal from the freeway. Through discussions with the CAC and TAC stakeholder groups it was determined that the South Cell Phone Lot, which sees a lot of activity, is currently in a convenient location although expansion of the lot should be considered in the future, possibly with development of a South Remote Public Parking Lot. In the same discussions, it was determined that the North Cell Phone Lot should be relocated to provide better visibility and accessibility. It is recommended that the North Cell Phone Lot be relocated along Rogell Drive, north of the southbound lanes prior to the North Terminal. The temporary lot could be upgraded with new pavement and striped off parking spaces until the Rogell Drive Realignment occurs, when the North Cell Phone Lot could be placed in the enlarged median between the southbound and northbound lanes. It is recommended that amenities such as Flight Information Displays (FIDS), restrooms, and concessions vendors be considered. These could be tied to future commercial development in the same area. Not providing a larger, more convenient North Cell Phone Lot while increasing curbside enforcement will result in more recirculating vehicles along the airport roadways and increased congestion. Rough order of magnitude cost estimates for this option vary depending on final location and sizing.

3.2.2 McNamara Terminal International Arrivals Curbside

The McNamara International Arrivals Curbside is located on the bottom of the three terminal levels. The curbside is 420 feet long, however, only 240 feet are dedicated to private vehicle pick-up. The remainder of the curb is dedicated to employee shuttle, TSA and CBP vehicle parking. In addition, a Delta Dash drop-off facility and the primary McNamara Terminal landside loading dock are located on the south end of the curb

further restricting space. During the early morning hours, coinciding with the international arrivals peak hour, trucks backing into loading bays stop curbside traffic while they maneuver into spaces.

Two Options were reviewed to address the deficiencies in the international arrivals curbside.

- Option 1: Combine Domestic and International Arrivals – This option moves private vehicle pick up for international arrivals to the domestic arrivals curbside. The peak periods curbside activity collected in the ground transportation surveys was reviewed to determine if the domestic arrivals curbside could accommodate the increased international arrivals traffic. The international arrivals peak occurs at 6:15 AM while the domestic arrivals peak occurs at 8:45 PM. The resulting overlapping peak would also occur at 6:15 AM. Based on the forecast curbside activity, the domestic arrivals curbside was estimated to have sufficient capacity to accommodate both domestic and international activity through PAL 1. By PAL 3, the resulting deficiency would only be 125 feet, assuming increased enforcement and only active vehicle loading on the curbside. Once private vehicles were moved off the curbside the space could be reconfigured for all or a portion of commercial vehicle use, such as accommodating the planned new express bus and BRT service. The relocation of international arrivals pick-up would require arriving international passengers to circulate up one level to the domestic terminal arrivals once they exit the FIS facility located on the same level as the international arrivals curbside.

- Option 2: Reconfigure International Arrivals Curbside – This option, presented on Figure 3-5, reallocates the international arrivals curbside to provide additional space for private vehicle pick up activity. The north end of the wall around the CBP and Delta Dash Cargo parking area will be relocated to lengthen the curbside. The TSA and CBP parking along the curbside will also be relocated with the employee shuttle pick-up area moved to the northern end of the curbside. This will provide a total of 455 feet for private vehicle pick up with an additional 40 feet for the employee shuttle, resulting in 495 feet of total linear curbside.

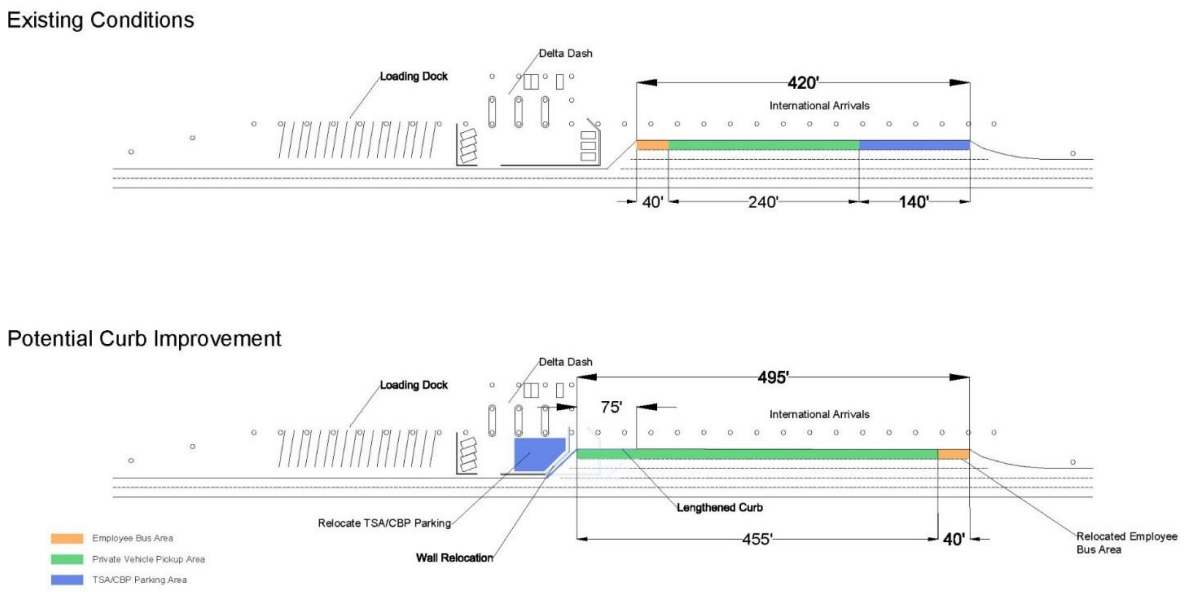
Both alternatives were reviewed by WCAA and the CAC and TAC stakeholder groups and both accommodated international arrivals vehicle activity significantly better than existing operations. However, the inconvenience to arriving international passengers, who tend to travel with more luggage, caused by requiring a level change to access the private vehicle curbside after exiting the FIS facility resulted in the elimination of Option 1.

3.2.3 McNamara Terminal Ground Transportation Center

The existing McNamara Terminal GTC is located within the McNamara Parking structure adjacent to the international arrivals curbside, on the lowest of three curbside roadway levels. The curbside is configured with hotel and parking shuttle zones on the northern section of curb, taxi pick-up adjacent to the GTC building and rental car shuttle zones on the southernmost section of curb. Currently, the GTC has a 240-foot deficit in curbside length and with a reduction of rental car dwell times to reflect active loading and unloading, this deficit is reduced to 100 feet but increases to 210 feet by PAL 3. The location within the parking structure makes it challenging to reconfigure or expand.

Three options were reviewed to increase the capacity for commercial vehicle operations at the McNamara Terminal.

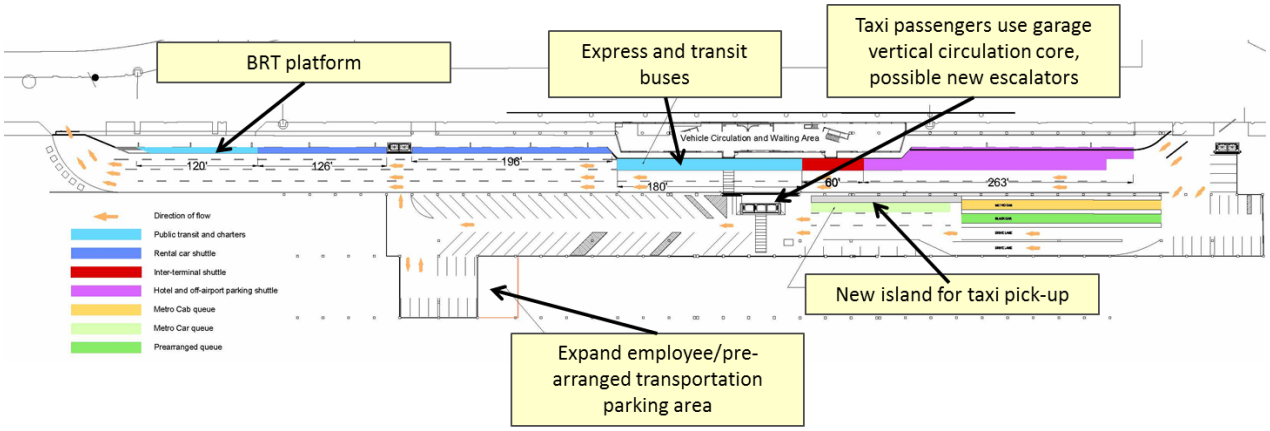
Figure 3-5
RECONFIGURE INTERNATIONAL ARRIVALS CURBSIDE
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport



- Option 1: Relocate GTC to the International Arrivals curbside – If the International Arrivals Curbside were vacated in as described above in the McNamara Terminal International Arrivals Curbside Option 1, all or a portion of commercial vehicle activity could be relocated to the area remaining. In order to accommodate all of the GTC activity the McNamara Terminal landside loading dock would require relocation. However, if commercial vehicle activity were split between the existing GTC and International Arrivals curbside the dock could remain. As McNamara Terminal International Arrivals Curbside Option 1 was eliminated, this concept was not carried forward.

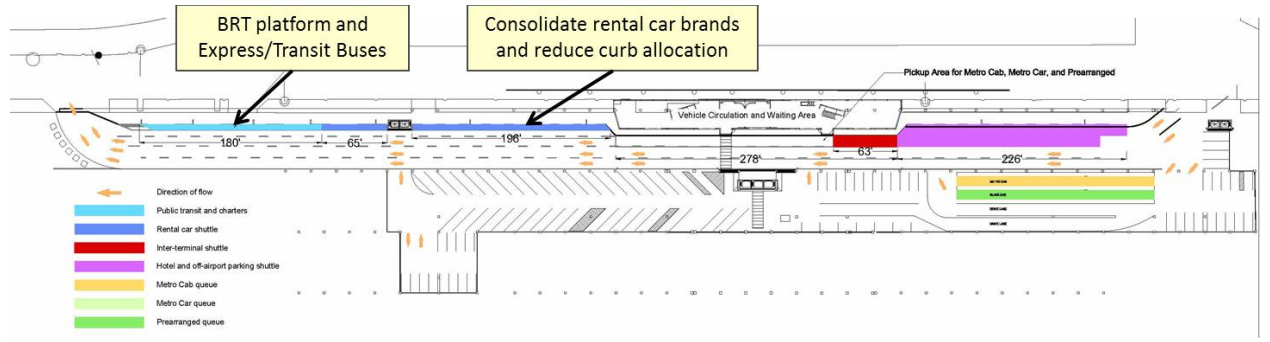
- Option 2: Taxi Pick-up in the Garage – Option 2, shown on Figure 3-6, provides additional curb space by constructing a new median island within the garage for queuing and loading taxi passengers. The new island is located just beyond the taxi queues within the garage and taxi customers directed through the garage to the far side of the commercial curb and then down the existing vertical circulation core in the garage, rather than down into the GTC as they are today. New escalators could be provided to enhance the experience. Pre-arranged transportation parking which occurs in this area would be moved north within the garage to an expanded parking area. This would result in the loss of approximately 26 public parking spaces. The area used today for taxi pick up adjacent to the GTC building will be reconfigured for planned local and express bus service. A dedicated Bus Rapid Transit platform will be provided at the south end of the curb adjacent to the rental car zone. Rough order of magnitude costs for the reconfiguration of the parking area and construction of a taxi island and BRT platform are estimated at approximately $500,000, not including new escalators.

Figure 3-6
MCNAMARA GTC OPTION 2 – TAXI PICKUP IN GARAGE
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport



- Option 3: Reallocate Curbside Pick-up Zones – Option 3, shown on Figure 3-7, focuses on accommodating increased demand through the reallocation of existing curb zones with minimal change to the physical infrastructure. The primary impetus for this option would be a consolidated rental car busing operation, which would reduce the space needed for rental car shuttles activity as the number of vehicles would be reduced. The space made available by the consolidation of rental car shuttles would be reallocated to create space for express and BRT zones, as shown in Figure 3-7. While this provides an increase in capacity during the short term, it does little to accommodate increased long-term capacity for commercial vehicle activity at McNamara Terminal. Rough order of magnitude costs are estimated at approximately $300,000 for the BRT platform.

Figure 3-7
MCNAMARA GTC OPTION 3 – REALLOCATE CURBSIDE PICK-UP ZONES
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport

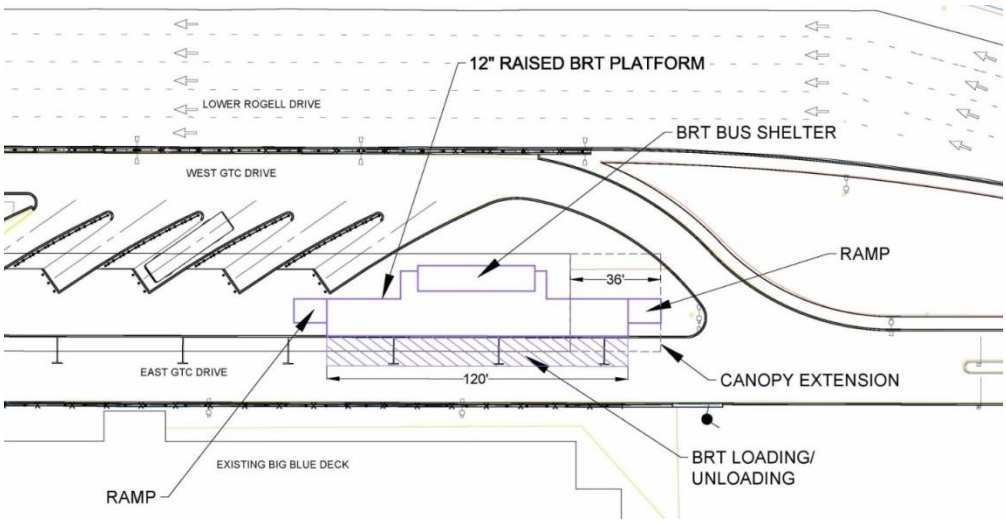


All three options were reviewed by WCAA and the CAC and TAC stakeholder groups and all accommodate future BRT and express bus service. Option 1 was eliminated due to the reduction in passenger convenience and level of service caused by requiring all international arriving passengers to change levels to be picked-up. Of the two remaining Options, Option 2 provides additional physical curbside capacity while Option 3 relies on operational changes in rental car operations to expand capacity on the curbside.

3.2.4 North Terminal Ground Transportation Center

While the GTC at the North Terminal is sufficiently sized to accommodate demand through 20-year planning horizon, new express bus and BRT service is planned and will need to be accommodated. A BRT loading platform is proposed at the north end of the GTC, as shown in Figure 3-8. Rough order of magnitude costs for the BRT platform are estimated at $400,000.

Figure 3-8
NORTH TERMINAL GROUND TRANSPORTATION CENTER
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport



3.3 Public Parking

Public airport parking is accommodated in four primary facilities on the Airport: McNamara Garage, Big Blue Parking Deck and Green Lots 1 and 2 which provide remote surface parking with shuttle service to the terminals. Additional public parking is provided by off-airport private companies. Facility requirements show a current deficit of parking in both the McNamara and Big Blue Parking Deck of 500 and 300 spaces respectively. The Green Lots currently have a surplus of parking. By the end of the planning horizon, an additional 2,500 parking spaces will be required in both the McNamara Garage and Big Blue Parking Deck for a total deficit of 5,000 parking spaces. The Green Lots which are located on the north side of the airport have the closest proximity to the North Terminal and are forecast to have sufficient capacity to accommodate demand through the planning horizon. These estimates are based on the current parking rate structure. Changes to the parking rates can influence demand and the choice of facilities. Changing rates is a form of demand management which can help balance demand among parking facilities and reduce

the need for expensive infrastructure improvements. The alternatives discussed in this section focus on physical improvements to meet forecast demand.

3.3.1 Parking Garage Expansion

Currently, the majority of on-airport parking is provided in the two parking garages with 9,413 spaces in the McNamara Garage and 6,164 spaces in the Big Blue Parking Deck. The Big Blue Parking Deck is located closest to the North Terminal but as it is priced lower than the McNamara Garage some passengers park in this garage and take the inter-terminal shuttle to McNamara.

Three alternatives were reviewed to expand the capacity of structured parking at the Airport.

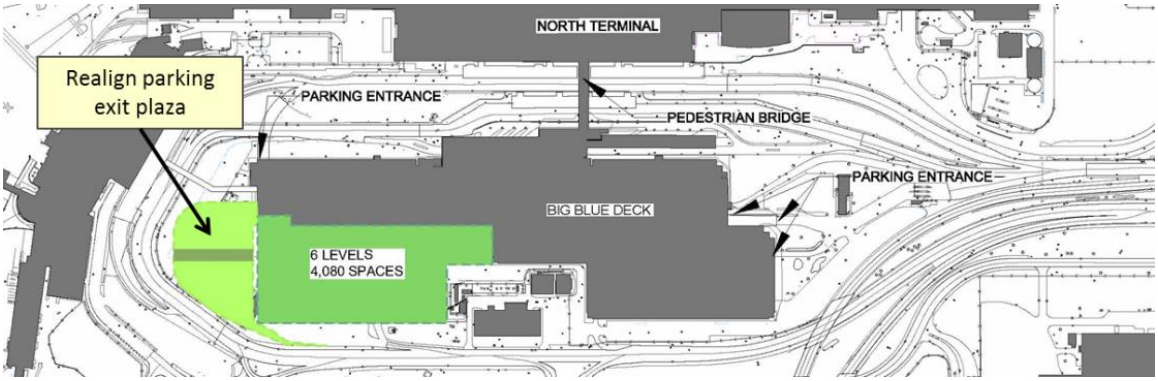
- Alternative 1: McNamara Garage Expansion – This alternative adds 700 spaces at the south end of the garage to address the shortage of parking at the McNamara Terminal which is currently 500 spaces but will grow to 2,500 by PAL 3. Due to development challenges, required relocation of adjacent access roadways and one of the garage helices, and airspace restrictions which limit the height of any expansion, this alternative was eliminated from further consideration. The limited number of parking spaces that could be developed wasn't warranted given the cost development challenges.

- Alternative 2: Big Blue Parking Deck Full Expansion – Alternative 2, shown on Figure 3-9, expands the Big Blue Parking Deck to the south east side of the existing garage. The full expansion provides approximately 4,080 additional parking spaces on four levels, close to the 5,000 total additional parking spaces required in PAL 3. Reconfiguration of the parking exit plaza and relocation of the parking revenue control equipment is required to accommodate the full expansion but the utility plant will remain. Rough order of magnitude costs for the full expansion are estimated at approximately $134 million.

- Alternative 3: Big Blue Parking Deck Partial Expansion – Alternative 3, a partial expansion of Alternative 2 shown on Figure 3-9, expands the Big Blue Parking Deck to the south east side of the existing garage, providing 2,000 additional spaces on four levels, providing most of the additional PAL 3 Big Blue Parking Deck space requirement. The partial expansion would not require reconfiguration of the parking exit plaza. Rough order of magnitude costs for the full expansion are estimated at approximately $67 million.

All alternatives were reviewed by WCAA and the CAC and TAC stakeholder groups. Alternative 1 was eliminated due to the limited expansion opportunity given the development and airspace challenges. Alternative 2 provides more parking than needed in the short- and medium-term but could be a potential longer term option. Alternative 3, the 2,000 space expansion, was recommended to be carried forward as it met the PAL 3 requirement for Big Blue Parking Deck requirements while minimizing impacts to surrounding infrastructure.

Figure 3-9
STRUCTURED PARKING ALTERNATIVES 2 AND 3 – BIG BLUE PARKING DECK EXPANSION
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport



3.3.2 Remote Surface Parking Expansion

While the future parking shortage is expected to be in structured parking, limited opportunities exist to expand the McNamara Garage on the south side of the airport. As a result, opportunities for remote surface parking similar to the Green Lots on the north side were explored. Five potential sites on the south were identified and are shown in Figure 3-10. Each of the remote surface sites is approximately 14.7 acres in size, which would accommodate about 2,000 parking spaces. The sites could all be increased in the future to a range of 16.1 acres to 37.5 acres (2,200 spaces to 5,100 spaces). Sites 1, 2, and 4 provide the most expansion potential, at 4,700, 5,100, and 3,400 spaces respectively. Rough order of magnitude costs for these sites vary based on size and environmental mitigations required, but for the first phase 2,000 space facility are estimated at approximately $13 million.

Opportunity may exist in some portion of the north airfield complex to create additional surface parking beyond the Green Lot and Green Lot 2. However, no significant lands have been identified which are currently vacant. In addition, the Green Lots combined with a Big Blue Parking Deck expansion are projected to meet demand through the planning horizon for the North Terminal. As a result, no new north remote lots were identified to be carried forward.

A summary of each site is included in Table 3-3. Sites 3 and 5 have extensive wetlands throughout the site, complicating development while Site 2 has been identified for other potential development opportunities. Site 1 has no visibility from the airport approach while Site 4 is located east of the airport entrance out of the direct path of most of the passengers as they approach the Airport.

SITE 1

SITE 5

SITE 2

SITE 3

SITE 4

Wayne Road

Vining Road

Runway 4L-22R 10,000' x 150'

Runway 4R-22L 12,003' x 200'

Runway 3L-21R 8,501' x 200'

Runway 3R-21L 10,001' x 150'

Eureka Road

John D Dingell Drive

Goddard Road

I-94

Middle Belt Road

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LEGEND

- Proposed parking site
- Airport property line
- Airport perimeter roadways
- Off-airport property and airfield
- Airport facilities

NORTH

0 800' 1600' 3200'

Figure 3-10
PUBLIC PARKING
SOUTH SIDE SURFACE LOT SITES
Alternatives Development and Evaluation
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport
February 2017

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Table 3-3
REMOTE SURFACE PARKING SUMMARY
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport

	Site 1	Site 2	Site 3	Site 4	Site 5
Initial size shown	14.7 acres 2,000 spaces	14.7 acres 2,000 spaces	14.7 acres 2,000 spaces	14.7 acres 2,000 spaces	14.7 acres 2,000 spaces
Expansion potential	35 acres; 4,700 spaces	37.5 acres; 5,100 spaces	20.3 acres; 2,800 spaces	24.9 acres; 3,400 spaces	16.1 acres 2,200 spaces
Environmental / wetland Issues	No wetlands	Provide buffer to wetlands	Wetlands throughout site	Provide buffer to wetlands	Wetlands throughout site
Alternate development identified	No alternative uses identified	Identified for commercial development	No alternative uses identified	No alternative uses identified	No alternative uses identified
Visibility from Airport approach	No visibility	Good visibility from EB Eureka; known location	Good visibility from EB Eureka	Good visibility from EB Eureka but past airport entrance	Good visibility from EB Eureka
Public accessibility	Longer routing; not direct from Eureka	Similar to cell lot; direct from EB Eureka	Similar to cell lot; direct from EB Eureka	Direct from EB Eureka but past airport entrance	Direct from WB Eureka
Connection to terminals	Longer shuttle route than other options	Direct connection to inbound airport roadway; requires u-turn for access to lot	Direct connection to inbound airport roadway; requires u-turn for access to lot	Direct connection from outbound airport roadway; requires u-turn for airport access	Direct connection from outbound airport roadway; requires u-turn for airport access

Source: HNTB analysis, October 2016.

All sites were reviewed extensively by WCAA and the CAC and TAC stakeholder groups. The screening criteria is depicted on Table 3-4 and based on Negative (-), Neutral (0), and Positive (+) scores for each category. The higher the positive score, the greater the zone performs against the evaluation criteria.

Site 2 most closely meets the criteria for evaluating the remote surface parking sites. Sites 3 and 5 have wetland issues that would require mitigation prior to development. Site 4 is located east of Dingell Drive along Eureka Road providing less visibility to inbound airport traffic. Site 1 is located west of the airfield and has the least visibility and accessibility of all the sites as it is not located along Eureka Road. Sites 2 and 3 score the strongest and have good accessibility but Site 2 can be developed without impacting the wetlands which is a significant benefit.

Table 3-4
REMOTE SURFACE PARKING EVALUATION MATRIX
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport

	Site 1	Site 2	Site 3	Site 4	Site 5
Expansion potential	+	+	0	+	-
Environmental / wetland Issues	+	0	-	0	-
Alternate development identified	+	-	+	+	+
Visibility from Airport approach	-	+	+	-	+
Public accessibility	-	+	+	0	0
Connection to terminals	-	+	+	0	0
Total	0	3+	3+	1+	0

Source: HNTB analysis, October 2016.

3.4 Employee Parking

Employee parking is currently provided in the South Employee Lot, the McNamara Garage for McNamara employees, the Big Blue Parking Deck for North Terminal Employees and the Smith Terminal for employees working at the Smith Building and administrative offices. When the administration building is opened at the North Terminal, parking for employees from the Smith Terminal moving to the new offices will be relocated to the Big Blue Parking Deck closer to the Administration Building. In order to make room for public parking in the Big Blue Parking Deck, a new North Lot is being constructed along Goddard Road west of the maintenance facilities. This lot will be able to accommodate 1,744 spaces which will accommodate all Big Blue Parking Deck, former Smith Terminal and the growth in employee parking through the planning horizon.

3.5 Rental Car Facilities

Individual rental car sites are currently located along Lucas Drive North of the Terminals with primary access provided from Middlebelt Road at Lucas Drive for customers arriving from I-94 east or west of the airport. Secondary access is provided from Rogell Drive at Burton Drive with access to Lucas Drive from the East Service Drive. Shuttles to the terminals are run by individual rental car companies. Considerable consolidation of within the rental car industry has occurred in recent years and while consolidated companies still operated under separate brand names, offering alternative levels of customer product and service, they are owned and operated by four primary companies. The brand families are Enterprise; Hertz, Dollar and Thrifty; Avis, Payless and Budget; and Alamo and National. At DTW, facilities such as Budget/Payless and Avis are located at opposite end of Lucas Drive while Hertz and Dollar/Thrifty are across Lucas Drive from one another. These brands share office space and some vehicle cleaning and maintenance facilities; however, if facilities for brands operated by the same company were located closer together additional economies of scale could be realized with greater sharing of washing, fueling and maintenance facilities. WCAA is conducting a separate study outside of the Master Plan, the Rental Car Facility Improvement Project, to review the potential consolidation and reconfiguration of the existing rental car

sites. This study determined that a consolidated rental car facility would not be warranted in the near- or mid-term and is focusing on the redevelopment of individual facilities.

Analysis in this Master Plan focused on selecting a site for future rental car development and two potential sites identified in a previous planning study conducted by WCAA were provided for evaluation:

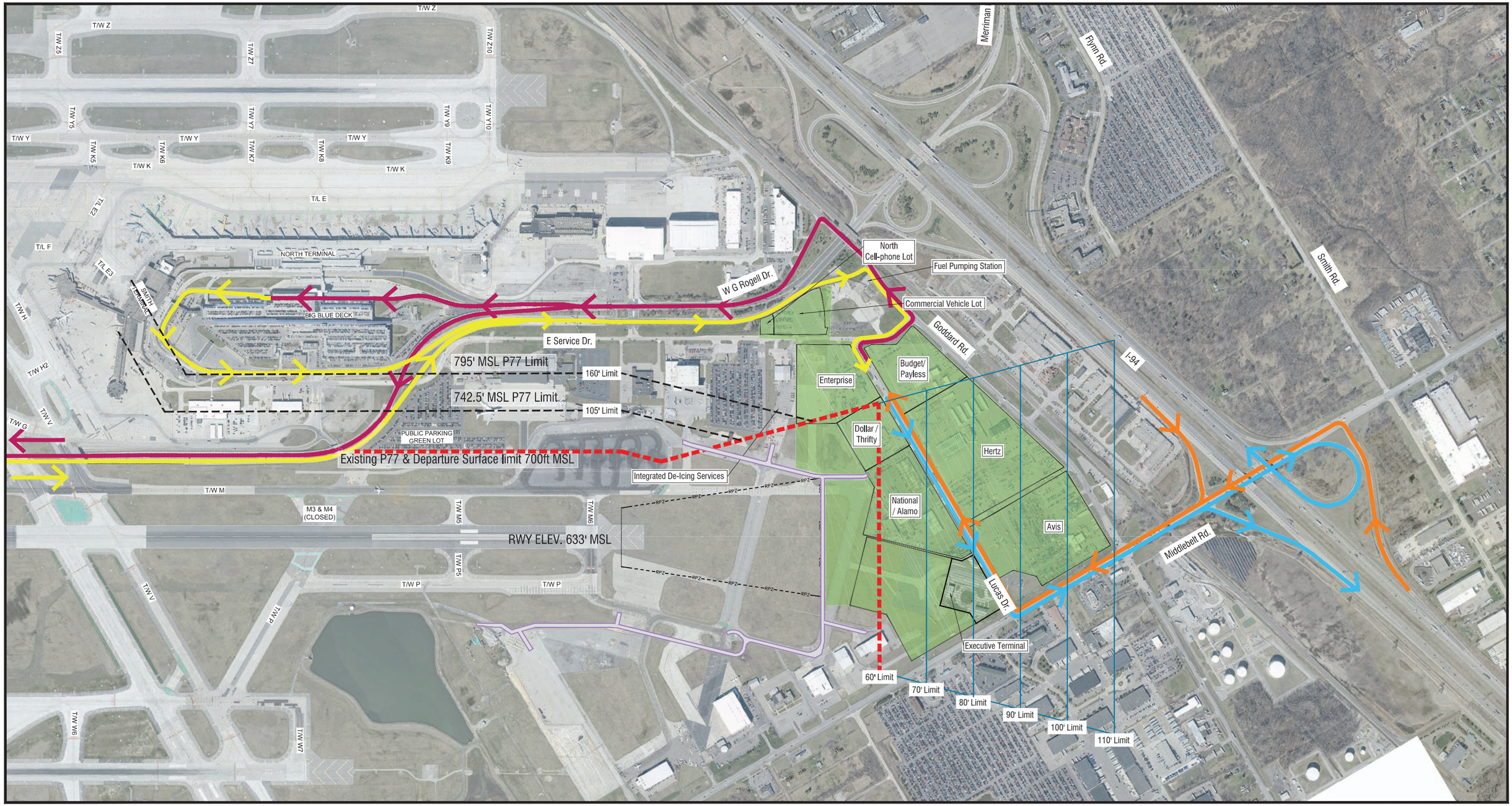
- Zone 1: Rental car facilities remain in their existing location along Lucas Drive with potential reconfiguration (see Figure 3-11)
- Zone 2 – Rental car facilities move across I-94 along Smith Road (see Figure 3-12)

A summary of Zone 1 and 2 is included in Table 3-5.

Table 3-5
FUTURE RENTAL CAR DEVELOPMENT ZONE SUMMARY
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport

	Existing Conditions	Zone 1: Remain in Existing Location	Zone 2: Relocate North of I-94
Size / Requirements	68 acres	81 acres	69 acres
Coordination/Permitting	N.A.	Limited coordination outside WCAA	Coordination with City of Romulus / MDOT
Development Challenges	Constrained sites with old infrastructure	Requires removal / phasing of existing infrastructure	Requires property acquisition, removal of existing infrastructure and new utilities
Accessibility	Primary access from Middlebelt and Lucas Drive	Customer access could be similar to today's operations	Potential for direct access from I-94 and Middlebelt interchange
Terminal Shuttles	3:45 min to North Terminal 7 min to McNamara Terminal	Same or better than today	Worse than today

Source: HNTB analysis, October 2016.



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LEGEND

- Rental car zone 1
- Approx. 60 ft high building limit line
- Part 77 building limit line
- Runway protection zone
- Future airfield service road reconfiguration
- Shuttle access to rental car facility
- Shuttle access to terminals
- Vehicle access to rental car facility
- Vehicle access to terminals

NORTH

0 800' 1600' 3200'

Figure 3-11
RENTAL CAR ZONE 1

Alternatives Development and Evaluation
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport
February 2017

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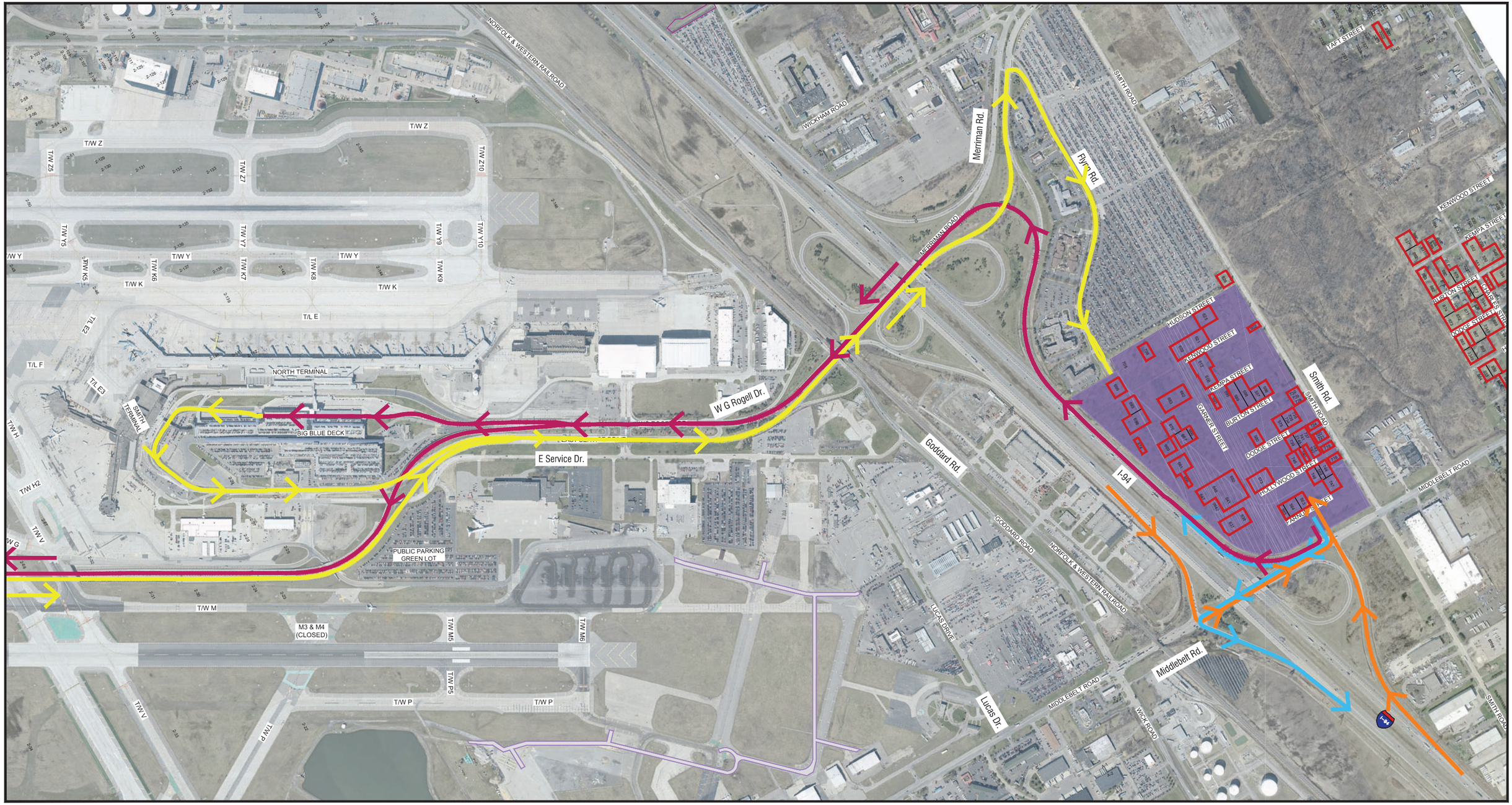

LEGEND

- Rental car zone 2
- Shuttle access to rental car facility
- Shuttle access to terminals
- Vehicle access to rental car facility
- Vehicle access to terminals

NORTH

0 800' 1600' 3200'

Figure 3-12
RENTAL CAR ZONE 2

Alternatives Development and Evaluation
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport
February 2017

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Zone 1 maintains rental car facilities in their current location along Lucas Drive with individual facility configuration determined in the separate Rental Car Facility Improvement Project. Customer access to this location would continue to be provided from Middlebelt Road to Lucas Drive with secondary access from Rogell Drive at Burton Drive with access to Lucas Drive from the East Service Drive, while rental car shuttle service to the terminals would remain the same as today. The height restrictions for development of new facilities are shown on Figure 3-11, with the 60 foot building limit line defined by the existing Part 77 and departure surface. As shown, the majority of the site can accommodate buildings higher than 60 feet. The future planned realignment of the Runway 21L service road around the RPZ allows additional area for expansion south of the Lucas Drive. In addition, the area around the Executive Terminal and the area north of the East Service Drive, once the commercial vehicle hold lot is relocated, could be used in the future for rental car facility expansion providing a total of 81 acres, meeting requirements through PAL 1. Reconfiguration of facilities to better utilize space could also reduce the area required and meet requirements through PAL 2 and beyond.

Zone 2 is located north of I-94 off of Middlebelt Road, between Smith Road and I-94. Primary customer access would be provided from Middlebelt Road, possibly with direct access from the I-94 westbound off-ramp. Rental car shuttles would access the terminal via Flynn Road to Merriman Road which becomes Rogell Drive south of I-94. This site provides 69 acres for development, similar to the existing rental car area; however, a strip of property along the south boundary of the site has been identified for potential future development which could reduce the available area. Although WCAA owns a number of parcels on this site, shown in Figure 3-12, additional property acquisition would be required prior to development. In addition, development of all new rental car facilities and construction of new utilities would be necessary on this greenfield site. Coordination with the City of Romulus and the Michigan Department of Transportation would be required with Smith Road, adjacent to the site, potentially requiring upgrades as the pavement is in poor condition.

Both zones were reviewed extensively by WCAA and the CAC and TAC stakeholder groups. The screening criteria is depicted on Table 3-6 and based on Negative (-), Neutral (0), and Positive (+) scores for each category. The higher the positive score, the greater the zone performs against the evaluation criteria.

Zone 1 more closely meets the criteria for evaluating the potential rental car development areas. Zone 2 requires property acquisition prior to development and requires a complete reconstruction of all rental car facilities to the north side of I-94 which lengthens the shuttle route adding additional time and uncertainty to the operations due to the potential for traffic at the I-94 and Merriman Road interchange to negatively impact traffic. The proximity of Zone 1 to the terminals, existence of existing facilities and infrastructure, limited coordination with agencies outside of WCAA and the potential for additional expansion area were considered significant benefits to Zone 1.

Table 3-6
RENTAL CAR ZONE EVALUATION MATRIX
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport

	Zone 1: Remain in Existing Location	Zone 2: Relocate North of I-94
Size / Requirements	+	0
Coordination/Permitting	+	-
Development Challenges	+	-
Accessibility	0	+
Terminal Shuttles	0	-
Total Score	3+	2-

Source: HNTB analysis, October 2016.

4.0 AIRPORT MAINTENANCE COMPLEX ALTERNATIVES

As documented in Technical Memorandum No. 5, the Airport's existing Maintenance Complex will require future expansion and upgrades to meet future airport maintenance needs. The following conceptual alternatives were identified, considered, and assessed in conjunction with Authority staff and members of the PSC.

- **Building 704/705 Infill** – As shown on Figure 4-1 is a two-story infill solution, which connects the existing fleet services building (704), with storage/service building (705) and maintains quick/easy Airside gate access, close proximity to the new fueling station, and utilizes the existing site infrastructure to serve the new construction. Several building code obstacles that could significantly increase costs as well as a limited footprint to meet the space program were identified.

- **North Parking Lot** – All new construction on an open site (existing parking lot) across West Service Road/Goddard Road. There are potential conflicts with the existing gas line, TERPS, and access to site utilities to feed the new building. The location is considerably further away from the AOA gate for quick airside access and would require additional infrastructure (roadways, utilities) to serve the buildings.

- **Building 703 Infill** – A single story addition/renovation to the Administration/Maintenance building (703) and a new Short/Long Term Vehicle storage building that allows the Fleet Services Maintenance to be physically connected to Inventory Logistics Center. The new Short/Long Term Vehicle storage building is located adjacent to Maintenance/Logistics/Admin Building and maintains the quick and easy airside gate access. Several alternatives of this scheme were studied. Alternatives 3A and 3B are illustrated on Figure 4-2. The refined preferred scheme also allows the North Parking lot area to be fully paved providing 1,700 additional parking spaces, as shown on Figure 4-4.

- **Middlebelt/Northline Road** – All new construction on a greenfield site. The Fleet Service Maintenance and Inventory Logistics Center are grouped together with a separate Short/Long Term Vehicle storage building just adjacent with easy access. However, this site is not adjacent to new fueling facility and would require additional costs to extend utilities to the campus.

- **Wayne Road** – All new construction on a greenfield site. The Fleet Service Maintenance and Inventory Logistics Center are grouped together with a separate Short/Long Term Vehicle storage building just adjacent with easy access. However, this site is not adjacent to new fueling facility and would require additional costs to extend site utilities to the campus. It is also sited in a remote south location, which would require additional time to access taxiways.

- **Middlebelt/Hildebrandt Street** – All new construction on the east side of the airport, which would require demolition of existing hangers and service buildings, as shown on Figure 4-3. The Fleet Service Maintenance and Inventory Logistics Center are grouped together with a separate Short/Long Term Vehicle storage building just adjacent with easy access. However, due to the site restraints, some program adjacencies are not met with the Fleet Service Maintenance layout. This site is also not adjacent to new fueling facility.

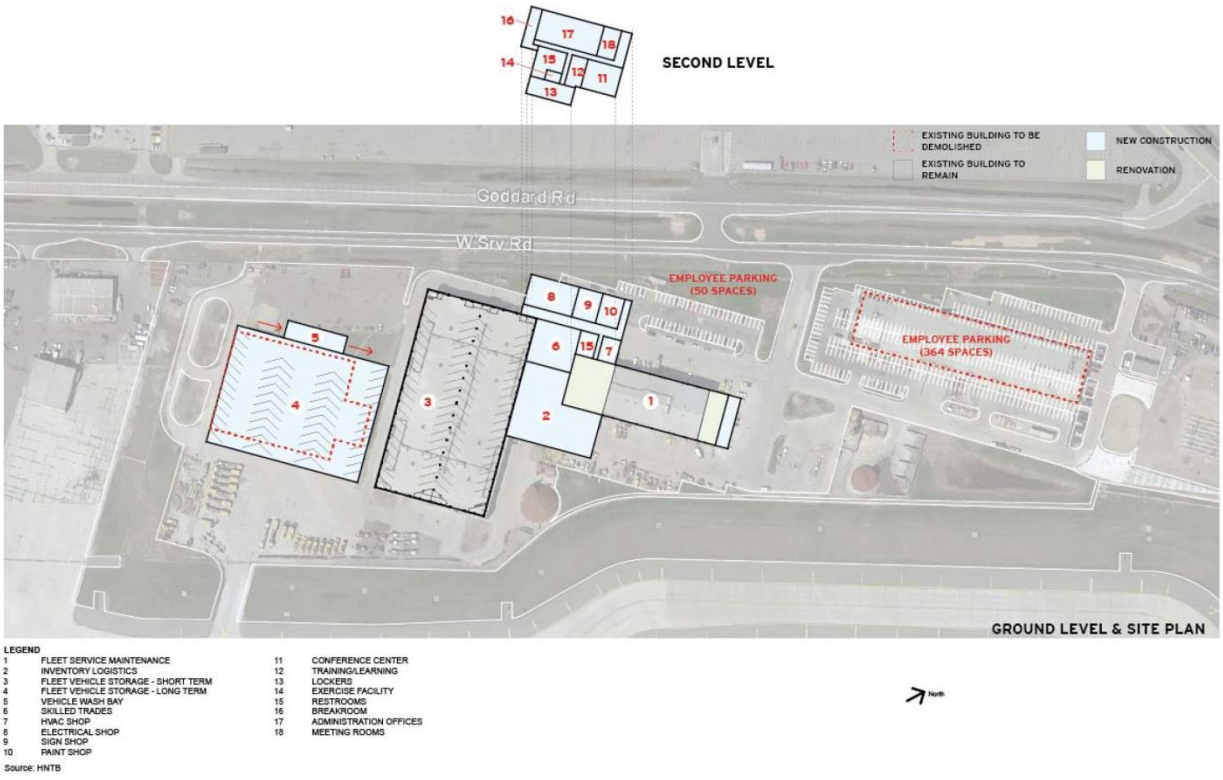
The above airport maintenance facility alternatives were evaluated against the following factors:

- Cost
- Ability to quickly respond to different parts of the airfield during major snow events
- Impact on land that needs to be available in the future with proximity to the airside
- Impact on existing or future needs for landside facilities such as public or employee parking

Based on the evaluation and input provided by PSC staff – the Building 703 Infill scheme was chosen as the preferred alternative, with the refined version depicted on Figure 4-4.

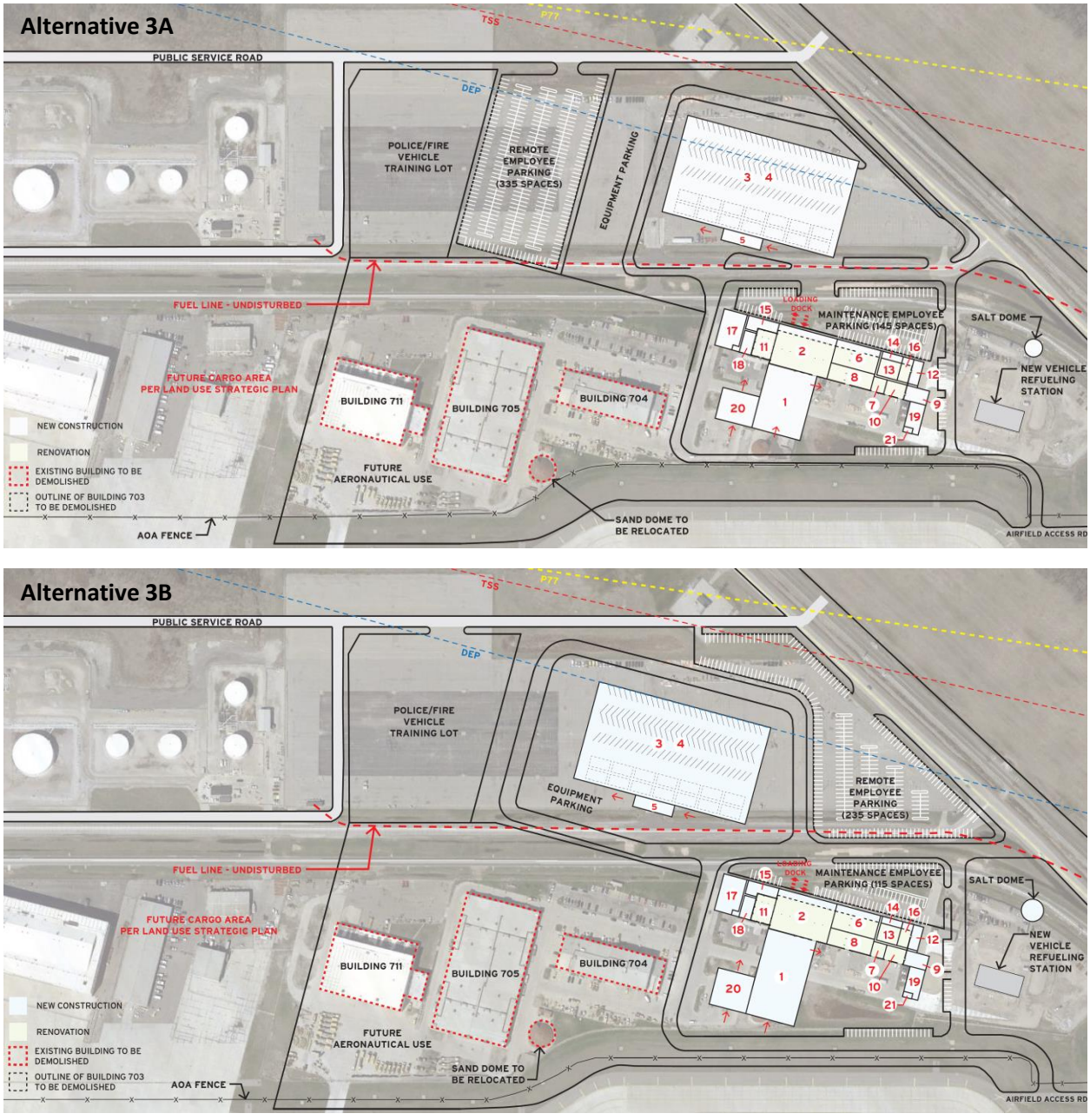
In addition, a new maintenance satellite facility has been proposed on the southeast end of the airport campus for use on a seasonal basis to increase operational efficiencies of field maintenance and airfield operations during snow removal and emergency procedures. This new 2,000 square foot building will be located in the vicinity of Superior and Middlebelt roads and depicted on the Airport's Future ALP, as well as Figure 4-5.

Figure 4-1
BUILDING 704/705 INFILL ALTERNATIVE
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport



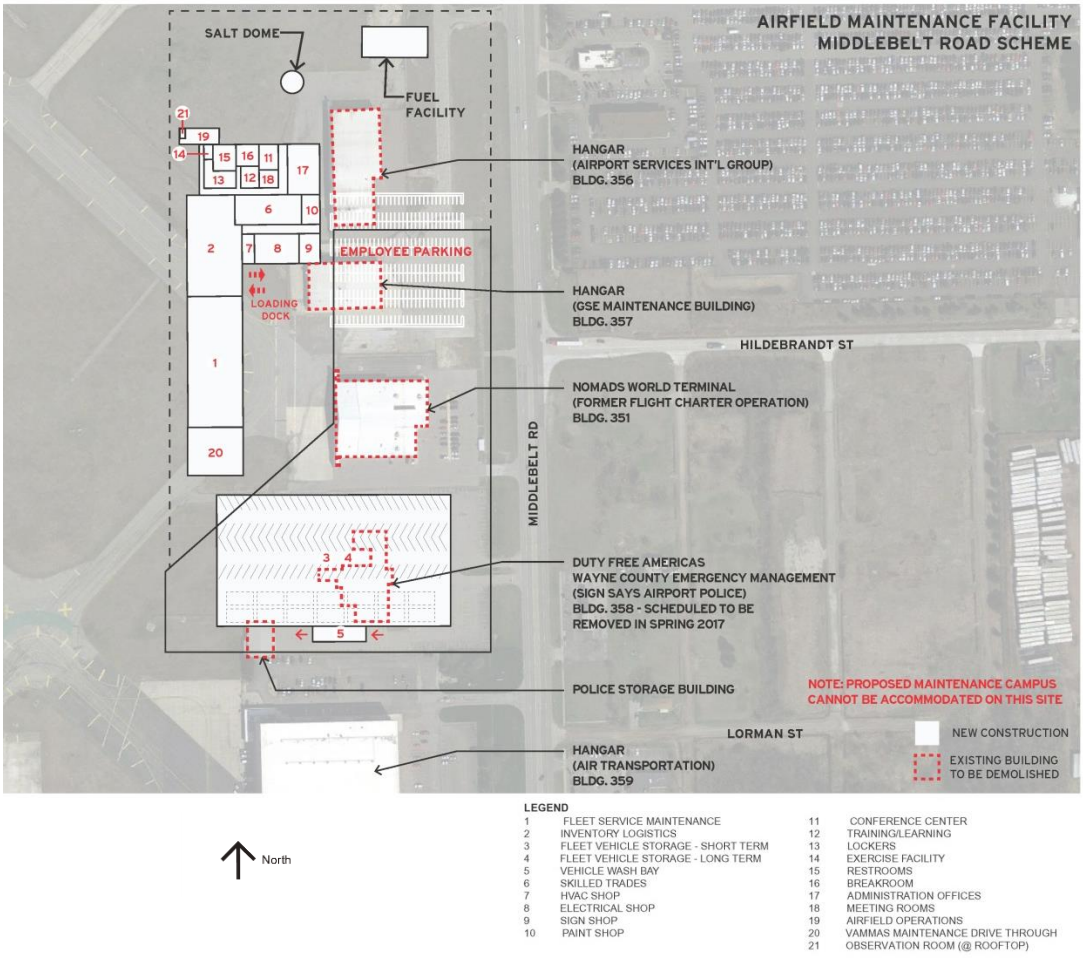
Source: HNTB analysis, October 2016.

Figure 4-2
703 INFILL SCHEME – ALTERNATIVES 3A AND 3B
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport



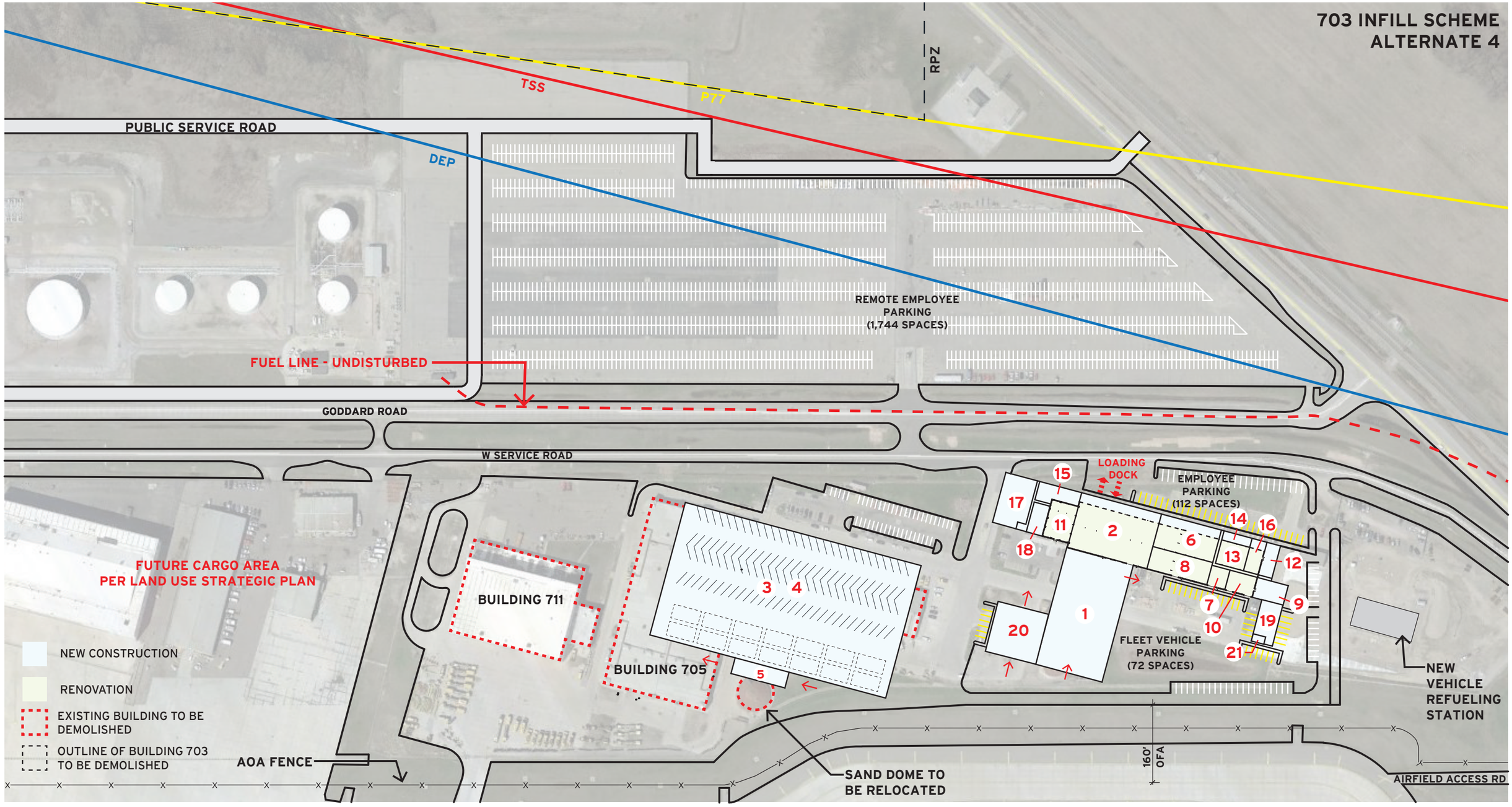
Source: HNTB analysis, October 2016.

Figure 4-3
MIDDLEBELT/HILDEBRANDT STREET ALTERNATIVE
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport



Source: HNTB analysis, October 2016.

703 INFILL SCHEME
ALTERNATE 4



LEGEND

1	FLEET SERVICE MAINTENANCE	11	CONFERENCE CENTER
2	INVENTORY LOGISTICS	12	TRAINING/LEARNING
3	FLEET VEHICLE STORAGE - SHORT TERM	13	LOCKERS
4	FLEET VEHICLE STORAGE - LONG TERM	14	EXERCISE FACILITY
5	VEHICLE WASH BAY	15	RESTROOMS
6	SKILLED TRADES	16	BREAKROOM
7	HVAC SHOP	17	ADMINISTRATION OFFICES
8	ELECTRICAL SHOP	18	MEETING ROOMS
9	SIGN SHOP	19	AIRFIELD OPERATIONS
10	PAINT SHOP	20	VAMMAS MAINTENANCE DRIVE THROUGH
		21	OBSERVATION ROOM (@ ROOFTOP)

North

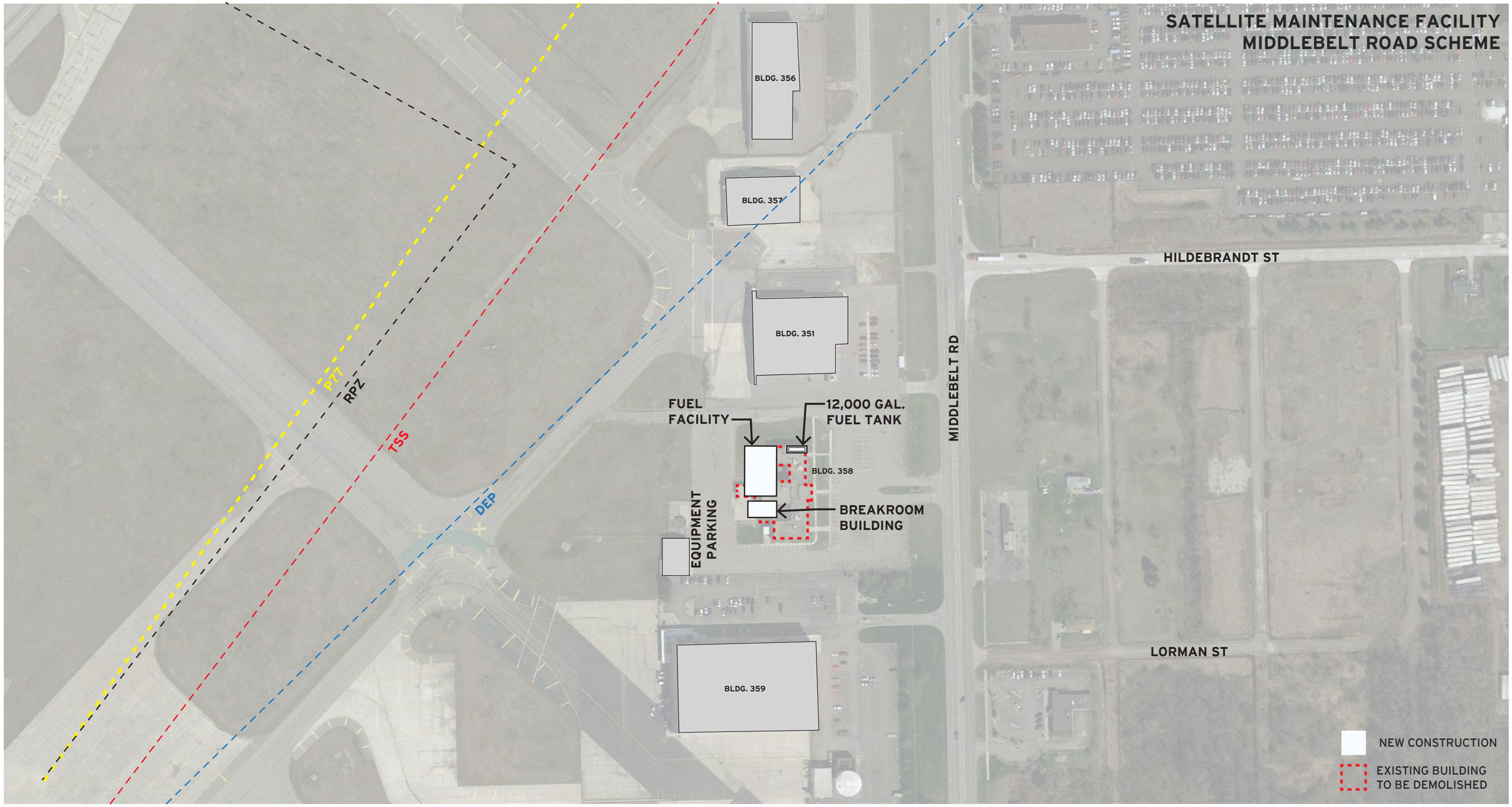
0 25 50 100 200

Figure 4-4

703 BUILDING INFILL
MAINTENANCE FACILITY ALTERNATIVE
Alternatives Development and Evaluation
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport

February 2017

Leigh | Fisher



North

0 50 100 200

Figure 4-5
MAINTENANCE FACILITY SATELLITE LOCATION

Alternatives Development and Evaluation
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport

February 2017

Leigh Fisher

5.0 OTHER DEVELOPMENT ALTERNATIVES CONSIDERED

This section describes the identification and evaluation of additional development alternatives that were considered in the master planning process. Development alternatives considered herein will not be recommended for implementation on the Recommended Development Plan nor depicted on the Future ALP. Rather, the options are being documented for potential reconsideration in future planning endeavors.

5.1 McNamara Terminal

Facility requirements indicated that no additional contact gates are required at the McNamara Terminal throughout the 20-year planning period. However, three additional narrowbody and two additional widebody remote parking positions are required by 2035. Remote parking alternatives are addressed in Section 2.0, Airfield Alternatives. The aircraft gate analysis can be found in Section 3.2 of Technical Memorandum No. 5 – Facility Requirements. Amongst the three key functional elements analyzed in the McNamara Terminal space requirements: check-in, security screening checkpoints, and FIS facilities, only security screening indicated deficiencies in overall space demand by the end of the planning horizon.

5.1.1 Passenger Security Screening Checkpoints

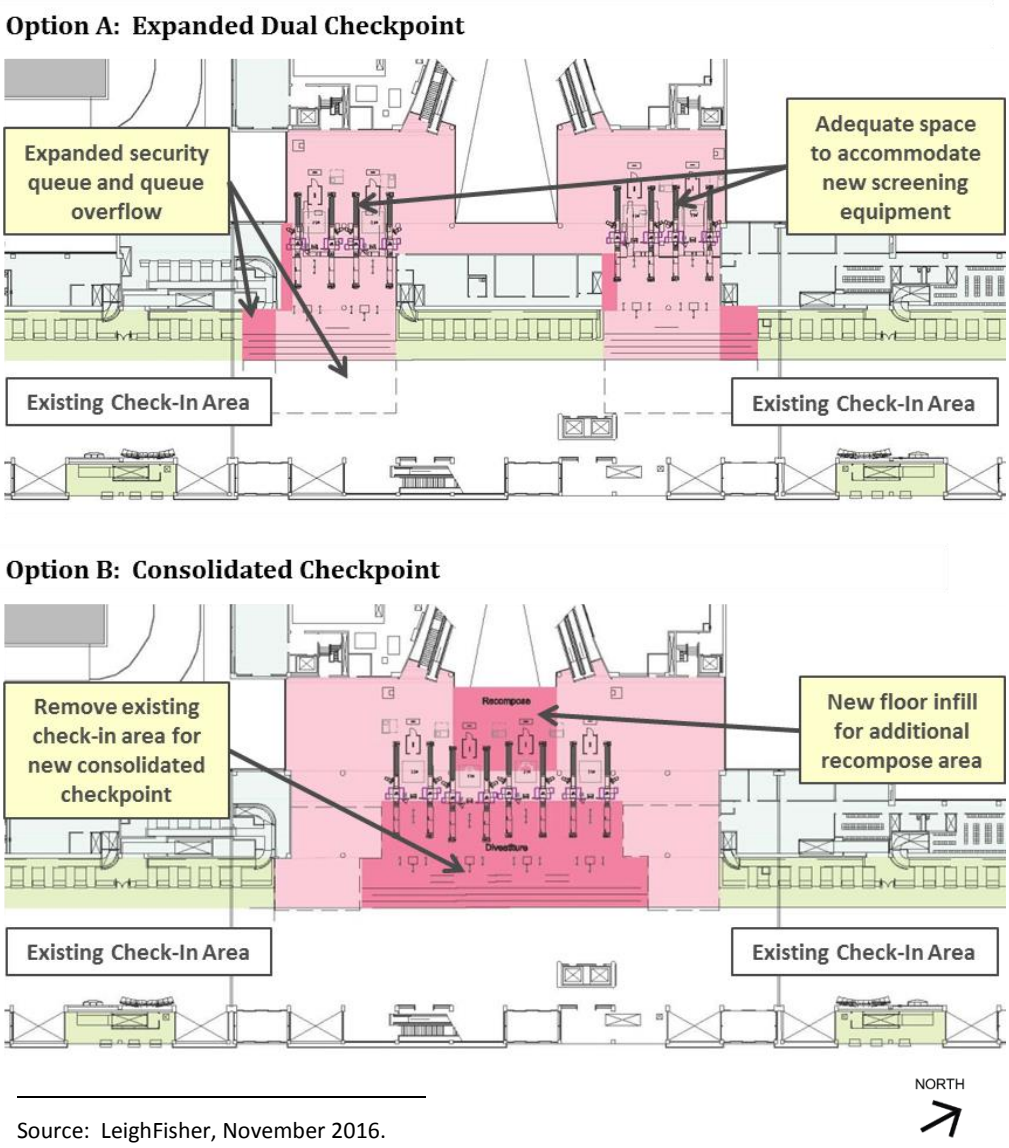
Two primary passenger security screening checkpoints are located adjacent to the Check-in area on Level 3, one to the north and one to the south with five screening lanes each. These two Level 3 checkpoints are sufficient to accommodate 20-year demand. However, future security screening footprints are anticipated to be wider and longer, as illustrated by the latest TSA Automated Screening Lane (ASL) technology, which increases divestiture space requirements by approximately 30%. Development of future checkpoints should accommodate the additional areas needed for screening, queuing, and support functions.

Two checkpoint options were developed to address increased space demands – an expanded dual checkpoint and a consolidated checkpoint, as illustrated on Figure 5-1.

Option A retains independent passenger security screening operations at both the north and south checkpoints on Level 3. Additional space is provided at each end to accommodate the wider and longer security screening equipment, passenger queuing and TSA support space requirements. The rough order of magnitude cost for this alternative is estimated at $2.3 million dollars, including hard and soft costs with a 10% construction contingency.

Option B requires removal and relocation of the central check-in counters currently reserved for premier passengers. In addition, approximately 1,900 square feet of floor area in-fill is needed between the two down escalators from Level 3 security screening to Level 2 concourse to provide for an expanded recompose area downstream of security screening. This allows for the security screening lanes to be consolidated in the center to provide for a more efficient screening operation and available space on both the north and south ends to accommodate future lane expansion. The rough order of magnitude cost for this alternative is estimated at $4.2 million dollars, including hard and soft costs with a 10% construction contingency.

Figure 5-1
MCNAMARA TERMINAL CHECKPOINT OPTIONS
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport

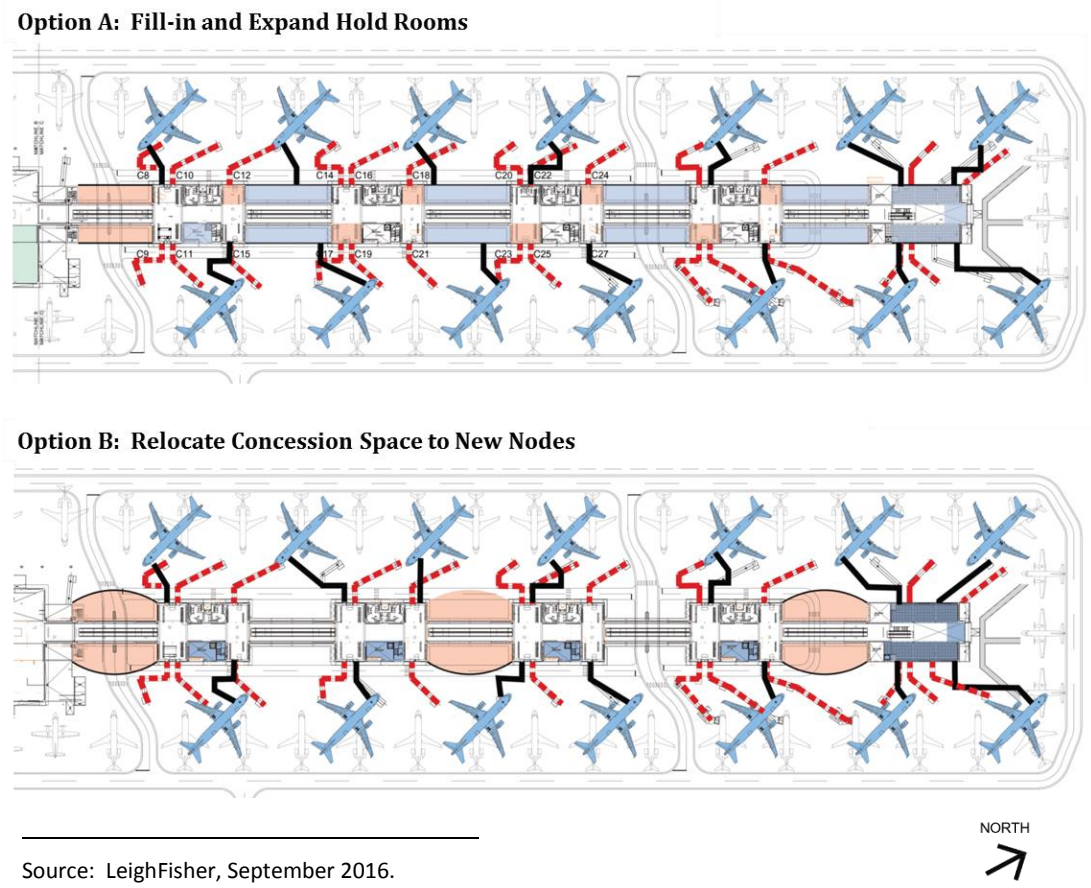


Source: LeighFisher, November 2016.

5.1.2 Long-term Concourse C Expansion Options

At a July 2016 McNamara Terminal Subcommittee meeting, Delta Air Lines suggested potential development options at Concourse C to reactivate approximately 15 underutilized regional jet gates to accommodate future ADG-III aircraft (i.e., RJ900s and B717s). This would require expansion of the holdrooms, passenger boarding bridges, concessions area, and reconfiguration of apron striping. As illustrated on Figure 5-2, two long-term expansion options were developed for Concourse C.

Figure 5-2
MCNAMARA TERMINAL LONG-TERM CONCOURSE C EXPANSION OPTIONS
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport



Source: LeighFisher, September 2016.

Option A adds new holdroom space at four different nodes by expanding building footprint as shown in blue. A total of approximately 43,000 square feet of holdroom area is being provided with this option along with concession areas that are being added near Gates C8 and C9, as shown in orange, and distributed throughout the concourse. This option also requires relocation and reconfiguration of passenger boarding bridges as well as restriping of aircraft lead-in lines to accommodate up to 14 ADG-III aircraft. The rough order of magnitude cost for this alternative is estimated at $118 million dollars, including hard and soft costs with a 10% construction contingency.

Option B increases building footprint at three nodes, as shown in orange, which represents a blend of holdroom/concessions space. A total of approximately 33,400 square feet of holdroom space will be provided with this option, which also requires relocation and reconfiguration of passenger boarding bridges as well as restriping of aircraft lead-in lines to accommodate up to 14 ADG-III aircraft. The rough order of magnitude cost for this alternative is estimated at $94 million dollars, including hard and soft costs with a 10% construction contingency.

Table 5-1 indicates both Options A and B are comparable based on rough order of magnitude costs. According to ACRP Report 25 recommendations, a minimum of 2,560 square feet of holdroom space is required to accommodate each ADG-III gate. With 14 potential ADG-III gates at Concourse C, a total of 35,840 square feet of holdroom space is required. Option A would be more than sufficient to meet the requirement, with a surplus of 7,300 square feet of holdroom space to provide for other amenities and enhance customer experience. Option B, on the other hand, falls short by 2,500 square feet of holdroom space to meet the minimum requirement. If this option is selected for development, it could potentially reduce level of passenger service at the concourse.

Table 5-1
EVALUATION OF LONG-TERM CONCOURSE C EXPANSION OPTIONS
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport

	Option A	Option B
Holdroom area		
Required (sf) *(a)*	35,840	35,840
Provided (sf)	43,110	33,380
Surplus/loss (sf)	*+7,300*	*-2,500*
Estimated ROM cost	$118 M	$94 M

(a) Assumes 2,560 sf of holdroom space is required per ADG-III gate. At 14 ADG-III gates, this calculates to a total of 35,840 sf.

Source: LeighFisher, November 2016.

5.2 North Terminal

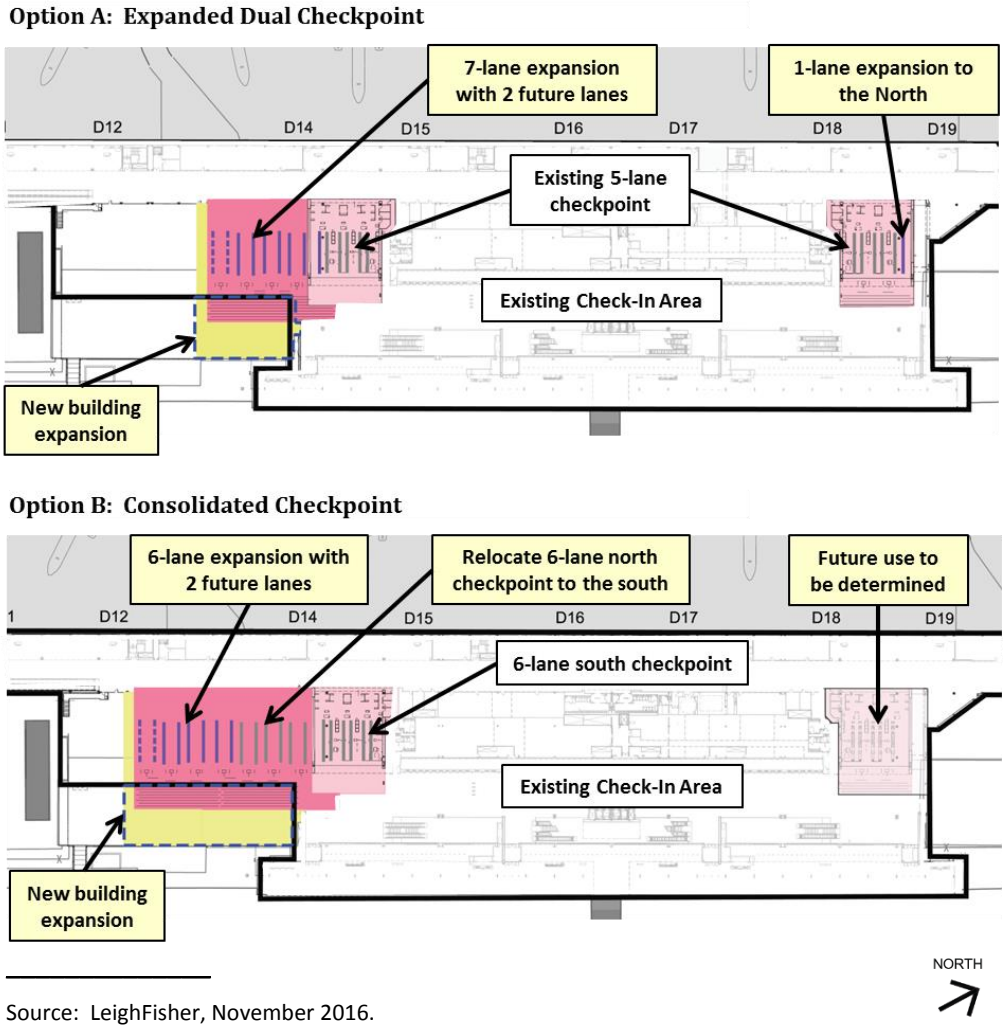
Facility requirements indicated that a total of 29 contact gates will be required by 2035. The three additional ADG-III gates that are currently being planned for at the north end, upon demolition of the Berry Terminal, will be sufficient to handle the 20-year gate demand at the North Terminal. A total of 16 ADG-III remote aircraft parking positions will be required by 2035. Remote parking alternatives are addressed in Section 2.0, Airfield Alternatives. The aircraft gate analysis can be found in Section 3.2 of Technical Memorandum No. 5. Amongst the three key functional elements analyzed in the North Terminal space requirements: check-in, security screening checkpoints, and FIS facilities, only security screening indicated deficiencies in overall space demand by the end of the planning horizon.

5.2.1 Passenger Security Screening Checkpoints

Two primary passenger security screening checkpoints are located in the North Terminal check in lobby, one to the north and one to the south with five screening lanes each. These two checkpoints are insufficient to accommodate 20-year demand. Two additional lanes are already required at both the north and south checkpoints today. By 2035, a total of eight lanes will be required to meet passenger demands.

Two checkpoint options were developed to address increased demand – an expanded dual checkpoint and a consolidated checkpoint, as illustrated on Figure 5-3.

Figure 5-3
NORTH TERMINAL CHECKPOINT OPTIONS
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport



Source: LeighFisher, November 2016.

Option A retains the current dual checkpoint configuration on both the north and south banks. One lane will be expanded on the north for a total of six checkpoint lanes. On the south bank, seven additional lanes will be needed for a total of twelve lanes to accommodate the eighteen lanes that are required to meet 2035 demand. New building expansion will also be needed on the south to handle additional queue areas, public circulations, TSA support areas, and future screening lanes. No changes will be needed at the existing check-in area. This option imposes the least impact on current operations and can be implemented incrementally in the near-term. The rough order of magnitude cost for this alternative is estimated at $15 million dollars, including hard and soft costs with a 10% construction contingency.

Option B proposes a consolidated checkpoint option by moving the six-lane north checkpoint to the south and expanding it to an eighteen lane checkpoint along with the associated building expansion to

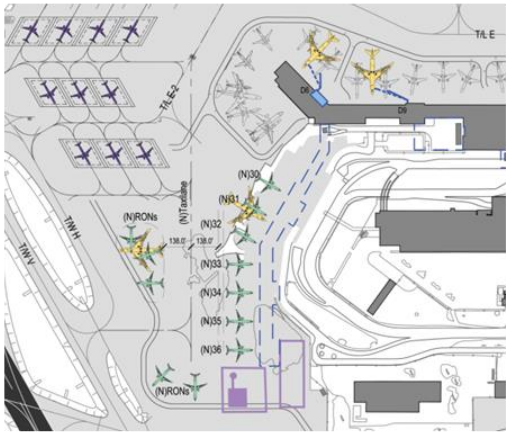
accommodate additional queue, public circulation and future checkpoint lanes. This option allows for more operational flexibility, queue management and could potentially reduce TSA staffing and administrative spaces. One downside is passengers on the north end of the concourse may have longer walking distances depending on where they enter at the terminal. The rough order of magnitude cost for this alternative is estimated at $27 million dollars, including hard and soft costs with a 10% construction contingency.

5.2.2 Long-term Concourse Expansion Options

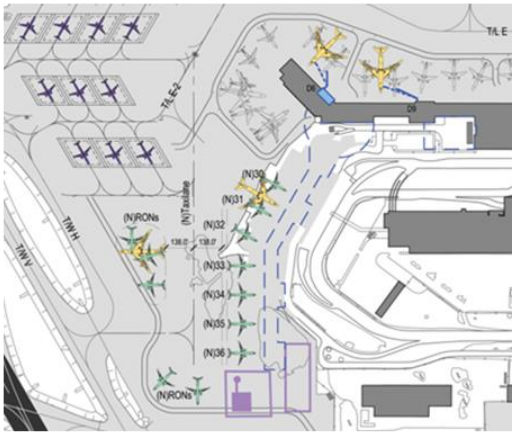
As illustrated on Figure 5-4, three long-term expansion options were identified for the North Terminal in the event actual demand exceeds forecast demand in the 20-year planning horizon.

Figure 5-4
LONG-TERM NORTH TERMINAL CONCOURSE EXPANSION OPTIONS
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport

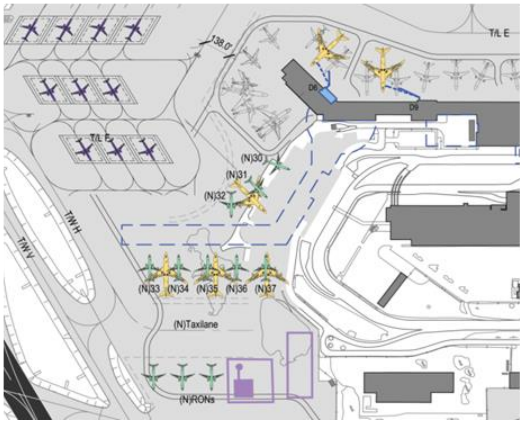
Option A: Single-loaded Concourse with Connector Bridge



Option B: Single-loaded Concourse with Rotunda



Option C: Double-loaded Concourse with Rotunda



Source: LeighFisher, November 2016.

Option A includes the addition of a single-loaded concourse on the south end with a bridge connector to the existing concourse. This provides a net gain of 7 ADG-III gates at the North Terminal with 1 ADG-V compatible position along the new concourse expansion. Assuming the future 22L deicing pad will be in place southwest of the new concourse, the remaining apron will be able to accommodate 5 ADG-III remain overnight (RON) positions (1 ADG-V compatible). The rough order of magnitude cost for this alternative is estimated at $236 million dollars, including hard and soft costs with a 10% construction contingency.

Option B is similar to Option A, but includes a rotunda connector with more spacious circulation around the concourse throat to enhance passenger level of service. Total gate count and RON positions are the same as Option A. The rough order of magnitude cost for this alternative is estimated at $345 million dollars, including hard and soft costs with a 10% construction contingency.

Option C includes a double-loaded concourse with rotunda connector to make more efficient use of concourse facilities. However, the three east deicing positions of the future 22L deicing pad prevented aircraft to park on the west side of the proposed concourse expansion due to required taxilane safety clearance areas. This eliminated a few potential ADG-III positions at the double-loaded concourse, providing for a net gain of just 8 ADG-III gates, 4 of which are ADG-V compatible. A total of 3 ADG-III RON positions can be accommodated south of the proposed airport traffic control tower. The rough order of magnitude cost for this alternative is estimated at $393 million dollars, including hard and soft costs with a 10% construction contingency.

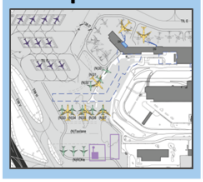
The evaluation matrix for the three North Terminal long-term concourse expansion options is shown on Figure 5-5. Five criteria were assessed including:

- Gates / remain overnight positions
- Rough Order of Magnitude (ROM) cost estimates
- Efficiency use of space (within the proposed concourse)
- Level of service – as defined by the International Air Transport Association
- Concession space

Rough order of magnitude costs were based on 2016 dollars without escalation, and include both hard and soft costs with a 10% construction contingency. Use of space was calculated based on the metric of square feet per gate. The higher the metric, the less efficient the option is in terms of space utilization. Level of Service (LOS) is defined as a measurement of comfort experienced by passengers using the airport terminal facility. The capacity of each element of a terminal facility can vary depending on the level of crowding and/or processing time that is considered acceptable. The terminal should be designed to maintain a minimum LOS, even during the peak periods of the day. LOS “C” corresponds to a situation of overall good levels of service, where flows are stable, delays are acceptable, and a good level of comfort is provided. Therefore, it is the industry accepted level of service standard. Designing to a LOS “A” standard could be overdesigning the facility to meet Thanksgiving Day demands; whereas, LOS “F” is defined as an unacceptable level of comfort.

Concession space is typically evaluated based on square feet per 1,000 enplaned passengers. The North Terminal is configured as a unit terminal which is synonymous to a medium hub operation in terms of annual enplaned passengers that the terminal processes. According to the 2015 Airport Revenue News Fact Book of published concessions data, 12.2 square feet per 1,000 enplaned passengers is the average metric for medium hub airports. If the square feet per passenger metric is too high, concessions may be oversized and individual store yields will be low.

Figure 5-5
EVALUATION OF LONG-TERM CONCOURSE EXPANSION OPTIONS
Airport Master Plan Update
Detroit Metropolitan Wayne County Airport

	Gates/RONs	ROM Cost	Efficiency of Space	Level of Service	Concession Space
Option A 	**+7 ADG-III gates** *(1 ADG-V)* **+5 ADG-III RONs** *(1 ADG-V)*	**$236 M**	90,000 sf / 7 gates **13,000 sf / gate**	12,500 sf bridge/500 pax **25 sf/pax** *(LOS C = 24.7sf)*	**11.9 sf** per 1,000 EPAX in 2035 *(Average medium hub metric = 12.2 sf/1,000 EPAX)*
Option B 	**+7 ADG-III gates** *(1 ADG-V)* **+5 ADG-III RONs** *(1 ADG-V)*	**$345 M**	145,000 sf / 7 gates **20,700 sf / gate**	29,000 sf rotunda/500 pax **58 sf/pax** *(LOS C = 24.7sf)*	**17.7 sf** per 1,000 EPAX in 2035 *(Average medium hub metric = 12.2 sf/1,000 EPAX)*
Option C 	**+8 ADG-III gates** *(4 ADG-V)* **+3 ADG-III RONs** *(0 ADG-V)*	**$393 M**	174,000 sf / 8 gates **21,750 sf / gate**	29,000 sf rotunda/870 pax **33 sf/pax** *(LOS C = 24.7sf)*	**19.0 sf** per 1,000 EPAX in 2035 *(Average medium hub metric = 12.2 sf/1,000 EPAX)*

Source: LeighFisher, November 2016.

5.2.3 Widebody Gates with FIS Access

Currently, four of the North Terminal gates (D3, D5, D9, and D10) are FIS compatible with a sterile corridor connecting the jet bridges to the CBP checkpoint on the lower level of the Terminal. Authority staff indicated that there are already plans to add one ADG-V FIS gate east of D5 (to be called D7) due to increasing international demands. In a number of terminal subcommittee meetings, many discussions relating to how international growth should be handled were also considered. To address these concerns, the potential to add widebody gates with FIS access on the west gates between Gates D4 and D10 were examined.

As indicated on Figure 5-6, two widebody positions at Gates D6 and D9 can be accommodated on the west side with a two-for-one dependency, which means when a widebody aircraft is using the gate, it will eliminate two narrowbody aircraft from accessing the same gate. From an airfield perspective, it was vetted among the North Terminal subcommittee group that the widebody aircraft can maneuver in and out via Taxiway Kilo. From a facility perspective, a new FIS vertical circulation core will be required at Gate D6 that connects to the existing sterile corridor on the lower level of the CBP inspection area. New striping for the widebody position and a new passenger boarding bridge that's long enough to dock to the new widebody position are also required at both Gates D6 and D9. The order of magnitude cost for this alternative is estimated at $11 million dollars, including hard and soft costs with a 10% construction contingency.

Figure 5-6
NORTH TERMINAL FIS GATE EXPANSION OPTION
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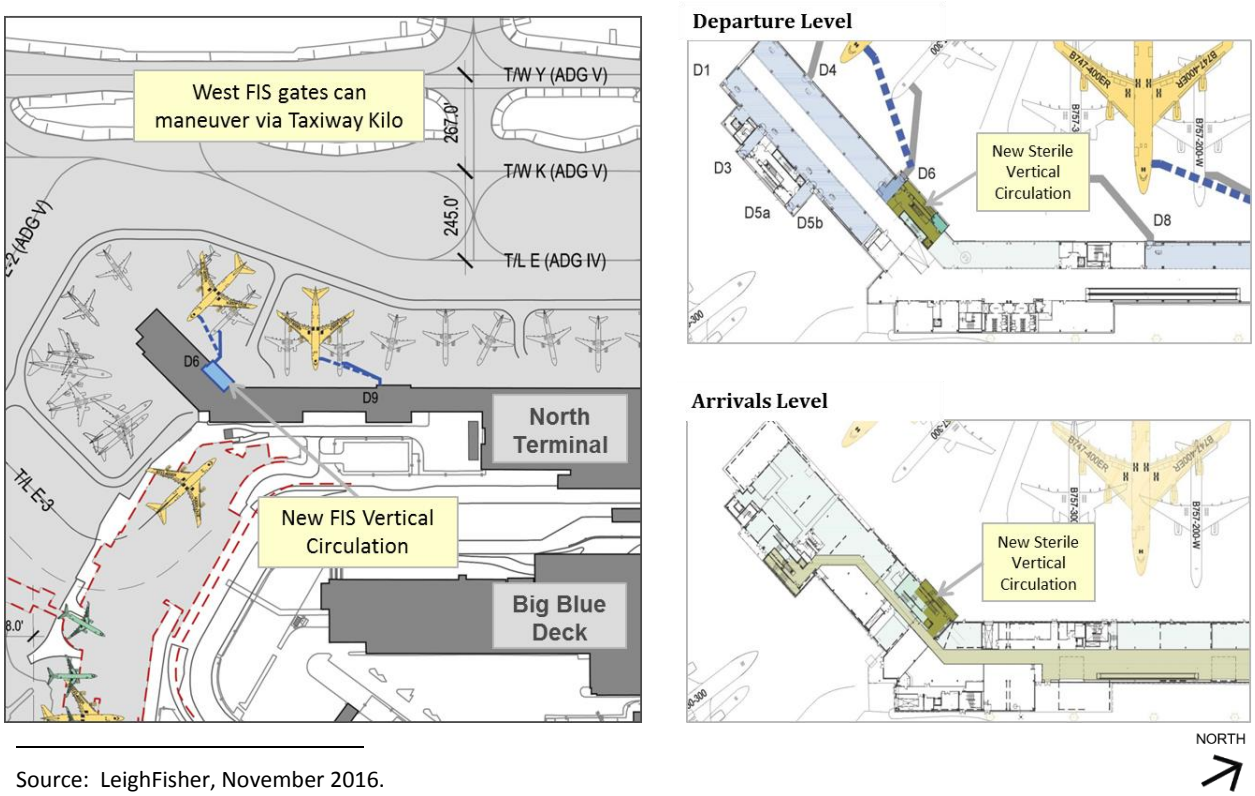

Source: LeighFisher, November 2016.