CHAPTER 5: CONCEPTS AND ALTERNATIVES ANALYSIS

AIRPORT MASTER PLAN UPDATE

PREPARED FOR:

DICKINSON THEODORE ROOSEVELT REGIONAL AIRPORT
DICKINSON, ND

April 2015

Project # 1513301

CONTENTS

Chapter 5 – Concepts & Alternatives Analysis

INTRODUCTION

The Airport Master Planning process follows a logical progression as issues are analyzed, alternatives are developed and a future direction is determined. After existing conditions are inventoried (**Chapter 2**), forecasts for future needs developed (**Chapter 3**), and the requirements necessary to meet those future needs are identified (**Chapter 4**), the next step is to develop and analyze possible alternatives to meet those requirements.

The previous chapter, Requirements, covered all design requirements for the airport. Two design requirements and one existing condition issue are outlined in brief below because of the predominance of these issues in the development of the alternatives being analyzed. These are the Runway Protection Zone, the Runway Safety Area, existing pavement condition of Runway 14-32 and impact of threshold elevation changes.

Runway Protection Zone

The Dickinson Theodore Roosevelt Regional Airport began the master plan update project in 2011 shortly after oil development in western North Dakota began to increase. In 2012 while the master plan process was underway, a significant change in FAA policy took place. The FAA issued an interim land use policy regarding Runway Protection Zones (RPZs) dated September 27, 2012 which stipulated items which were to be excluded from RPZs. If a runway threshold is shifted, relocated or extended, there is a requirement to follow the new FAA guidance. Compliance with this policy change is reflected for alternatives A, B, C, D, F and G.

Runway Safety Area

Also during the master planning process, a change in the application of FAA design standards for the Runway Safety Area (RSA) at Dickinson also occurred. This was mentioned briefly in Chapter 4. The critical aircraft serving Dickinson changed from an ARC of B-II to D-II (CRJ-200). With this change, the correlating RDC for Runway 14/32 changed as well. Specifically, the RSA standard changed from 300 feet wide to 500 feet wide and from 600 feet beyond the runway threshold to 1000 feet beyond the runway threshold. In order to comply with FAA standards, it is important to resolve this matter as soon as possible which requires the following actions:

- Cut and fill RSA in Runway 32 approach area. This grading would not address deficient RSA grading in glide slope critical area for end-fire glide slope antenna – Cost estimates were requested by the FAA specifically for the Runway 32 approach area. The estimate is $4.5 million, with the work done at nighttime between 11:00 pm and 5:00 am
- Replace drainage culverts with drop inlets in approximately 10 locations – No cost estimate
- Grade remainder of RSA to meet FAA standards – No cost estimate
- Terrain grading in the existing glide slope critical area does not meet RSA standards, and control building is located within the D-II RSA. Replacement or relocation of the glide slope antenna array

would likely have to occur, and if a different type of glide slope antenna was installed, significant grading for a new critical area would have to occur – No cost estimate

Existing Runway 14-32 Pavement Section

During the development of this alternative analysis, the requirement length, strength and current condition of Runway 14-32 was taken into consideration. Runway 14-32, currently 6,400 feet x 100 feet and the new runway requirements are 7,700 feet x 150 feet. The current runway was constructed to handle B-II aircraft weighing less than 40,000 lbs.

Also, during the planning process there was question if Runway 14-32 could be improved, widened and extended without substantial reconstruction of the pavement section or if the existing pavement section could have a pavement overlay to provide the strength to support the forecast aircraft. For this reason, there are several appendices included that address the Runway 14-32 existing pavement. These items are as follows and will be referenced in this chapter:

Appendix B – Report of Preliminary Soil Testing (February 27, 2014)
Appendix C – Airport Pavement Structural Evaluation (March 28, 2013)

At the request of the FAA, core samples of the existing runway and surrounding ground were taken in January 2014 in order to determine if an overlay could be added to Runway 14-32 to accommodate the design aircraft. To examine the potential for an overlay, the core samples were completed for three purposes: 1) to determine the thickness and condition of the pavement section and 2) evaluate the California Bearing Ratio (CBR) of the soils. The results were as follows:

1) The core sample findings indicated that the existing Runway 14-32 has an average bituminous pavement thickness of 5 to 6 inches which is consistent with the pavement construction records. Due to the time of year examined, the first 24 inches of the cores were drilled with an auger due to frozen ground. As a result the condition of the pavement base sections and the depth of the base course was inconclusive. However, the findings did not indicate that the pavement was constructed differently than expressed in the pavement construction records.
2) The core sample was able to determine a CBR for the soils in order to recommend a pavement section through the FAARFIELD Pavement Design Program.

Details of these findings can be found in **Appendix B**. In addition, the North Dakota Aeronautics Commission initiated a study of airfield pavements in 2012. These findings were provided for each airport and the report for Dickinson is found in **Appendix C – Airport Pavement Structural Evaluation**.

Based on an examination of the existing pavement construction records and the CBR measurements, multiple pavement sections were developed with the FAARFIELD program to support the variations of forecast aircraft fleet mix. The pavements were designed for two broad groups of aircraft types. One option is titled “Regional Aircraft” and is referring to aircraft less than 100,000 lbs. Maximum Take-off Weight (MTOW) and seating less than 100 passengers. The second option is titled “Narrow Body Aircraft” and is referring to aircraft between 100,000 lbs and 200,000 lbs MTOW with seating between 100 and 200 passengers. The design aircraft for these two pavement section strengths are shown in **Exhibit 1 – Narrow Body and Regional Jet Design Aircraft**. These pavement sections in summary are listed below. Please note,

items 9 and 10 below are the pavement design for the parallel taxiway to be used as a temporary runway. Additional details regarding the pavement designs can be found in **Appendix D – Pavement Design.**

1. New bituminous pavement section for Regional Aircraft
    a. 4 inch bituminous pavement (P-401/403)
    b. 4 inch bituminous base (P401/403)
    c. 12 inch aggregate base (P209)
    d. 16 inch subbase (P154)
2. Bituminous overlay of existing runway pavement section for Regional Aircraft
    a. 11 inch bituminous overlay (P-401/403)
3. New concrete pavement section for Regional Aircraft
    a. 11 inch concrete (PCC Surface)
    b. 8 inch cement treated base (P-304)
    c. 12 inch aggregate base (P209)
4. Concrete overlay of existing runway pavement section for Regional Aircraft
    a. 12 inch concrete overlay (PCC Overlay on Flex)
5. New bituminous pavement section for Narrow Body Aircraft
    a. 9.5 inch bituminous pavement (P-401/403)
    b. 4 inch bituminous base (P-401/403)
    c. 12 inch aggregate base (P-209)
    d. 16 inch subbase (P-154)
6. Bituminous overlay of existing runway pavement section for Narrow Body Aircraft
    a. 16 inch bituminous overlay (P-401/403)
7. New concrete pavement section for Narrow Body Aircraft
    a. 15 inch concrete (PCC Surface)
    b. 8 inch cement treated base (P-304)
    c. 12 inch aggregate base (P-209)
8. Concrete overlay of existing runway pavement section for Narrow Body Aircraft
    a. 15 inch concrete overlay (PCC Surface)
9. New Bituminous ”Super” Taxiway Pavement – Outer edge design – for Regional Aircraft
    a. 4 inch bituminous pavement (P-401/403)
    b. 4 inch bituminous base (P-401/403)
    c. 12 inch aggregate base (P-209)
    d. 12 inch subbase (P-154)
10. New Concrete ”Super” Taxiway Pavement – Outer edge design – for Regional Aircraft
    a. 10 inch concrete (PCC Surface)
    b. 8 inch cement treated base (P-304)
    c. 12 inch aggregate base (P-209)

EXHIBIT 1 – NARROW BODY AND REGIONAL JET DESIGN AIRCRAFT

NARROW BODY DESIGN AIRCRAFT

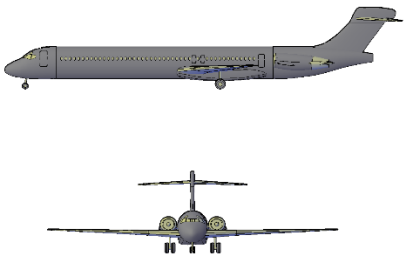
AIRBUS A320-200

LENGTH: 123.26 FT
WINGSPAN:117.5 FT
RUNWAY DESIGN CODE: C-III
TAXIWAY DESIGN GROUP: 3
MAX TAKE-OFF WEIGHT: 172,000 LB

AIRBUS A319

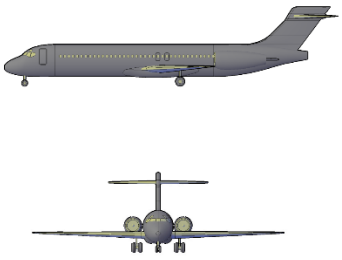
LENGTH: 111.02 FT
WINGSPAN: 111.88 FT
RUNWAY DESIGN CODE: C-III
TAXIWAY DESIGN GROUP: 3
MAX TAKE-OFF WEIGHT: 166,400 LB

McDONNELL DOUGLAS MD-83



LENGTH: 147.83 FT
WINGSPAN: 107.78 FT
RUNWAY DESIGN CODE: D-III
TAXIWAY DESIGN GROUP: 4
MAX TAKE-OFF WEIGHT: 160,000 LB

BOEING B717-200



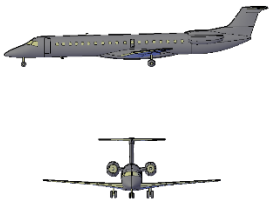
LENGTH: 124 FT
WINGSPAN: 93.25 FT
RUNWAY DESIGN CODE: C-III
TAXIWAY DESIGN GROUP: 2
MAX TAKE-OFF WEIGHT: 121,000 LB

REGIONAL JET DESIGN AIRCRAFT

EMBRAER E175 LR

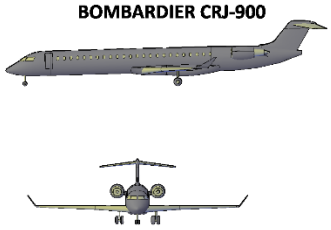
LENGTH: 103.94 FT
WINGSPAN: 85.3 FT
RUNWAY DESIGN CODE: C-III
TAXIWAY DESIGN GROUP: 3
MAX TAKE-OFF WEIGHT: 85,500 LB

EMBRAER E145 EP/ER/EU



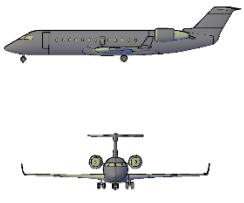
LENGTH: 98.00 FT
WINGSPAN: 65.75 FT
RUNWAY DESIGN CODE: C-II
TAXIWAY DESIGN GROUP: 2
MAX TAKE-OFF WEIGHT: 53,100 LB

BOMBARDIER CRJ-900



LENGTH: 119.32 FT
WINGSPAN: 81.53 FT
RUNWAY DESIGN CODE: D-II
TAXIWAY DESIGN GROUP: 2
MAX TAKE-OFF WEIGHT: 80,500 LB

BOMBARDIER CRJ-200



LENGTH: 87.82 FT
WINGSPAN: 69.65 FT
RUNWAY DESIGN CODE: D-II
TAXIWAY DESIGN GROUP: 1B
MAX TAKE-OFF WEIGHT: 53,000 LB

ALTERNATIVES CONSIDERED BUT DISCARDED

Three particular alternatives were reviewed and discarded as follows:

- Airport Relocation
- Relocation of Highway 22 to Acquire Runway Protection Zone
- Overlay Runway and Maintain Threshold Elevation

Airport Relocation

In **Chapter 4 – Airport Requirements**, it was determined that a significant portion of the existing airport would need to be improved, including:

- Extending and strengthening the primary runway
- Constructing new taxiways for the primary runway
- Providing expanded commercial service terminal, parking and apron space
- Expansion of general aviation facilities

Relocation of the airport was briefly examined; however, it was determined that all of the required improvements could occur on the existing airport property without significant land acquisition. Also, it was anticipated that the cost of relocating the entire airport would be significantly more and would be found to be an unnecessary action, and therefore this option was discarded from further consideration.

Relocation of Highway 22 to Acquire Runway Protection Zone

The Runway Protection Zone (RPZ) for Runway 32 extends beyond airport property and across North Dakota Highway 22 along the east side of the airport. FAA guidance on RPZs that was issued during Phase I of this Master Plan only permits certain use of the land; a highway is not a permitted use of land. Therefore, all of the alternatives examined in Phase I shifted or relocated the primary runway to comply with the revised land use guidance for RPZs.

In Phase II of the Master Plan, Alternative H was introduced which kept the Runway 32 threshold and the RPZ in its current position. Clarification from the FAA was provided that if the threshold was not moved, there would be no requirement to change the land use within the RPZ, and Highway 22 could remain in place.

Regardless of this direction, the FAA also requested that analysis of relocating Highway 22 be performed to determine the feasibility of this action in comparison to other Alternatives under consideration.

North Dakota Highway 22 is a trunk highway, owned and maintained by the NDDOT. This highway is currently a two-lane highway. NDDOT has been examining use and expansion of this highway in the past year and is contemplating the expansion of this highway from two to four lanes from the city of Dickinson out to the airport to help accommodate the increased traffic on this highway. They are also examining extending this four-lane section further south of the airport.

Brief analysis of rerouting the highway was completed. A diagram of this potential alignment is a depicted in **Figure 1**. This analysis included a rerouting to accommodate existing speed limits on the highway, and

keep the resultant right-of-way outside the RPZ. It was found that to complete this action, the following would need to occur:

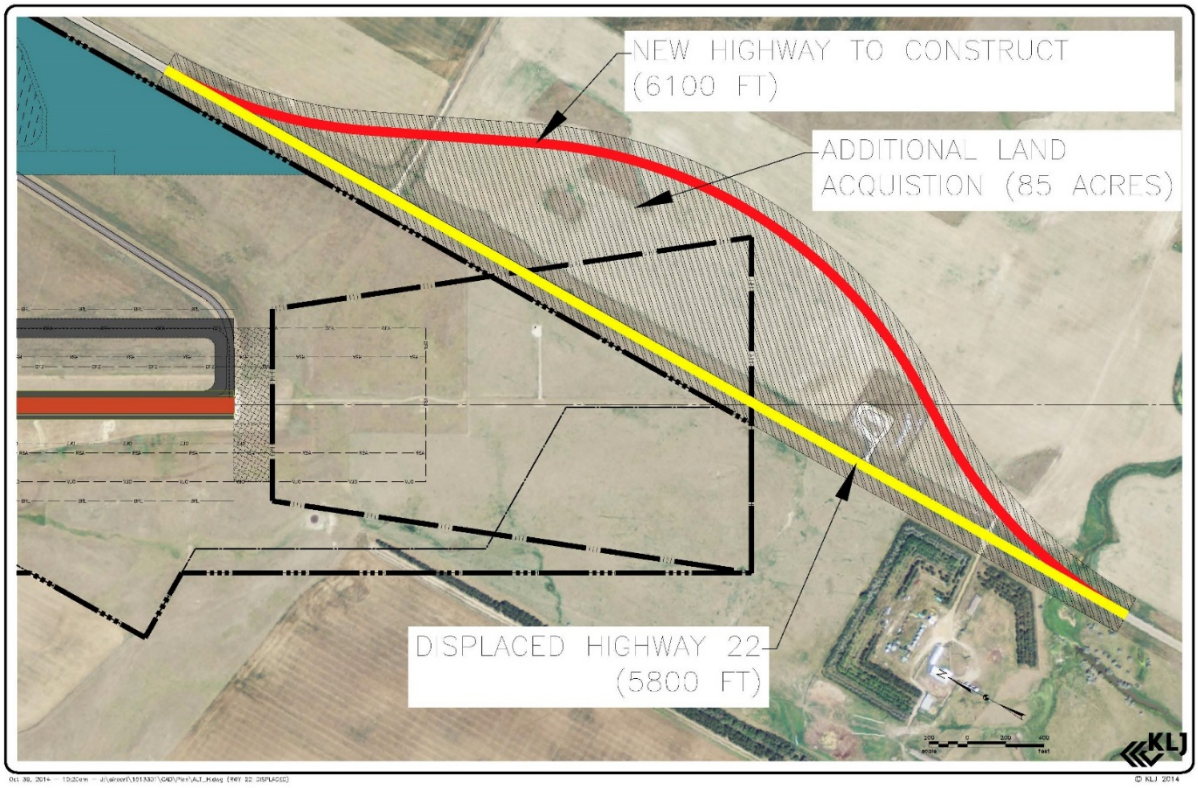
- Abandoning of approximately 5,800’ of roadway
- Construction of approximately 6,100’ of new roadway
- Acquisition of approximately 85 acres of additional land for the RPZ and relocated road

Relocation of this highway would only be applicable to Alternative H. The alternative to relocating this section of highway was to shift the runway to the north, as reflected in Alternatives F and G. Both alternatives F and G would require additional land acquisition to the north and west of the existing property to accommodate the shifted and extended runway options. The greatest difference in land to be acquired between these options to the north and west would be between Alternative F and H which, coincidently, is approximately 85 acres.

If the RPZ was required by the FAA to be cleared of incompatible uses at some time in the future (which is currently not required), it would require comparable additional land acquisition as the other alternatives under analysis, plus the cost of constructing a 2 or 4-lane highway.

Given that clearance of the RPZ is not required at this time, and other alternatives under consideration would require the clearance of the RPZ of incompatible uses, additional analysis of this option is not required.

FIGURE 1 – HIGHWAY 22 RELOCATION



Overlay Runway and Maintain Threshold Elevation

The FAA BIS ADO asked about the possibility of reconstructing only the end of the runway to allow keeping the elevation change of the Runway 32 threshold to less than 6 inches to avoid the requirement of completing an aeronautical survey, and subsequent modifications to current instrument approach procedures. Avoiding this change would expedite the completion of the project as the FAA Instrument Flight Procedure development group is taking upwards of 2 years to revise and or develop a new instrument approaches.

Per FAA AC 150/5300-18, and the AGIS Transition Policy for Non-Safety Critical Projects, dated August 23, 2012, an aeronautical survey would be required if the runway end is moved more than 1 foot longitudinally, 1 foot transverse or 6 inches vertical from its existing position as this would be considered a safety critical project. This change in elevation would trigger the revision to instrument approaches mentioned above.

Based upon the FAA pavement design standards, an overlay would raise the runway threshold a minimum of 11 inches if the existing runway base was not reconstructed. Therefore, if an overlay of the existing runway end were to be pursued, with the existing base, an aeronautical survey based upon the new runway end elevation and the development of revised standard instrument approach procedures to that runway end would need to occur.

Analysis of maintaining the existing Runway 32 threshold by excavating the existing base was also examined. It was determined that while this could be accomplished, it would result in the total full depth reconstruction of approximately 3,000 feet of Runway 32 in order to accommodate FAA runway design parameters, such as no grade changes (vertical curves) in the runway profile in the first and last quarter of the runway length for AAC C, D or E runways (AC 150/5300-13A – Chapter 3 – Section 313.b.2) as well as maintaining a 5 foot tall line of sight (AC 150/5300-13A – Chapter 3 – Section 305.b.2). In addition, the portion of the runway that could be overlaid would need to be widened to 150’ with new construction, and the north end of the runway would need to be extended.

While this option would be technically possible, the complexity of construction and questionable long-term performance of this resultant “island” of overlaid runway in the middle of the runway would not outweigh the potential cost and time savings of this option in comparison to the other alternatives under consideration. Therefore, this construction option is considered analyzed but discarded from further evaluation.

CONCEPTS AND ALTERNATIVES:

Given the previously discussed design standard requirements and space requirements for airport facilities, alternative layouts of the various facilities must be developed.

Seven alternative layouts for the airport were developed that show different facility configurations. These alternatives have been labeled A, B, C, D, F, G and H. Alternatives A, B, C, D and F were examined in 2012 with Phase I of this Airport Master Plan effort. There was an Alternative E created which was very similar to Alternative D but was never developed into a formal concept for further consideration.

All seven alternatives will be explained in this chapter with exhibits and detailed analysis, and comparison will focus only on alternatives F, G and H.

Assumptions for Alternatives A, B, C and D

Alternatives A, B, C and D, examined in 2012 (Phase I), were based on a number of assumptions. These assumptions were updated for alternatives F, G and H and are detailed later in the chapter. The assumptions for alternatives A, B, C and D are as follows:

- Airport Reference Code: C-II design standards
- Ultimate Primary Runway dimensions: 9,000’ x 150’
- Primary runway shifted 400’ to the west and utilizing existing runway as a parallel taxiway
- Both the Primary and Crosswind Runways will have traditional parallel taxiway alignments
- Primary runway will have precision approaches to both ends, and runway protection zones designed to meet those standards
- AWOS relocated to the west side of the primary runway

ALTERNATIVE A

This alternative, shown in **Exhibit 2**, was developed to show expansion of the existing commercial service terminal at its current location. The general aviation apron would be expanded on either side of the general aviation hangar complex. The general aviation apron would be expanded to both the east and west, with ultimate development extending toward the commercial service terminal. Corporate hangar locations will be to the west of the current FBO, and FBO facilities would be expanded to the east. The industrial park that has been preliminarily platted by Stark Development Corp is shown along ND Highway 22. A variety of hangar development lots have been developed along the east side of the primary runway.

Advantages:

- Significant amount of space can be devoted to private and corporate hangar development.
- Apron expansion is centered around existing FBO operations.
- Forecast demands for the terminal during this planning period can be accommodated within the proposed location.

Disadvantages:

- Hangar development to the north within 400 feet of the parallel taxiway would preclude the ability to utilize that taxiway as an alternative landing surface in the future.
- Apron expansion in the near term will not accommodate FBO hangar development.
- Terminal area expansion will be limited by the crosswind runway and FBO development.
- Expansion of the terminal while maintaining airline operations will be challenging.
- Industrial park development, as laid out, may impede upon the ability to expand within the infield.

In summary, Alternative A makes little change in the location of the airline terminal or general aviation facilities, thus allowing expansion to occur while building on existing facilities. For general aviation, expanding adjacent to the existing area will provide enough space to meet demand. The arrangement for small hangars in Alternative A, with a long row of hangars and taxilane (Items 6, 7, and 8 on **Exhibit 2**) can create access problems to hangars as a single aircraft could block access for 30+ planes to enter or exit their hangars. This alternative includes a much larger amount of small hangars than would foreseeably be needed in the planning period.

For the terminal area, the majority of the facilities have already expanded beyond their ability to function properly and new facilities are needed to meet existing and future demand. Alternative A does not allow a 'greenfield' development for the terminal area and thus limits the ability to develop a more functional layout that meets demand. The terminal will also remain far removed from the primary runway which will continue to require longer than necessary taxi times for airlines. In addition, the industrial park area would occupy a portion of the airport that is prime for aeronautical development such as airline or general aviation use. This location of an industrial park could impede development of the airport in the future.

Alternative A is identical with Alternatives B, C and D in constructing a new primary runway west of the existing primary runway and converting the runway into a parallel taxiway. The runway threshold is moved north only a few hundred feet and therefore the RPZ for Runway 32 extends over North Dakota Highway 22 which would not meet new FAA guidance for compatible uses in the RPZ.

EXHIBIT 2 – ALTERNATIVE A

1. 9000' x 150' GROUP III PRECISION RUNWAY CAPABLE OF SUPPORTING 150K# AIRCRAFT.
2. 50' WIDE GROUP III PARALLEL TAXIWAY WITH 25' SHOULDERS AND MITL.
3. 4700' x 75' GROUP II NONPRECISION RUNWAY.
4. 35' WIDE GROUP II PARALLEL TAXIWAY AND MITL.
5. RELOCATED AWOS AND WIND SENSOR LOCATION WITH 500' AND 1000' BRL CLEARANCES.
6. 50' DEEP HANGAR LOTS WITH AUTO PARKING AND GROUP I ACCESSIBILITY.
7. 60' DEEP HANGAR LOTS WITH AUTO PARKING AND GROUP I ACCESSIBILITY.
8. 80' DEEP HANGAR LOTS WITH AUTO PARKING AND GROUP II ACCESSIBILITY.
9. 120' DEEP HANGAR LOTS WITH AUTO PARKING AND GROUP II ACCESSIBILITY.
10. 25' WIDE TAXILANE WITH 80' TOFA
11. 35' WIDE TAXILANE WITH 115' TOFA AND SETBACK TO ACCOMODATE A 60' DEEP APRON.
12. 120' DEEP CORPORATE LOTS WITH AUTO PARKING AND GROUP II ACCESSIBILITY.
13. LARGE AND SMALL AIRCRAFT PARKING WITH TIEDOWNS.
14. 200' DEEP FBO LOTS WITH AUTO PARKING AND GROUP II ACCESSIBILITY.
15. AREA ALLOTTED FOR TERMINAL EXPANSION NEEDS
16. PREVIOUSLY PLATTED INDUSTRIAL LOTS BY STARK DEVELOPMENT CORP.

N

600 0 600 1200
scale feet

PRELIMINARY

FOR PLANNING PURPOSES ONLY

Rev'd.

DICKINSON-THEODORE ROOSEVELT REGIONAL AIRPORT
DICKINSON MUNICIPAL AIRPORT AUTHORITY (OWNER)
DICKINSON, NORTH DAKOTA

SHEET NO. A

Kadrmas Lee & Jackson
Engineers Surveyors Planners

ULTIMATE AIRPORT LAYOUT ALTERNATIVE A

DRWN. BY	CHK'D BY	COMPUTER NO.	LAST REVISED
MTK		1511304	07/13/2012

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Plotted-5/22/2015-9:41am © Kadrmas, Lee & Jackson 2012

ALTERNATIVE B

This alternative, shown in **Exhibit 3**, has the terminal area developed to the south of the crosswind runway, and the existing terminal area being converted to other uses. The general aviation apron is expanded to the west, and then to the north to parallel the primary runway. Space for FBO expansion would be to the north end of the apron. Corporate and T-hangar development would surround the existing FBO apron.

Advantages:

- General aviation expansion to the west would reduce taxi time for aircraft and improve access for the aircraft.
- Relocation of the terminal would provide for sufficient expansion opportunities beyond the planning period.
- Redevelopment of the existing terminal area for other purposes would provide economic benefits for the airport and a prime location for non-aeronautical development on the airport.
- Corporate hangar development would be close to the airport entrance, yet separate from the FBO apron.
- T-hangar development can easily be accommodated.

Disadvantages:

- The utilization of the existing terminal for non-aeronautical purposes would require FAA approval.
- Relocation of the terminal would require extension of utilities and construction of an access road from the existing FBO to the commercial apron.
- Significant apron expansion would need to occur to facilitate FBO expansion.
- Airport maintenance and SRE storage would occupy apron frontage.
- Hangar development to the north and terminal apron to the south within 400 feet of the parallel taxiway would preclude the ability to utilize that taxiway as an alternative landing surface in the future.

In general, Alternative B makes use of the airport land east of the primary runway and south of the crosswind runway for terminal development. This 'greenfield' approach will allow the optimal layout and facilities to be created without being impeded with existing structures. The terminal would also be close to the primary runway which creates minimal taxi times for airlines. The terminal apron is constructed adjacent to the primary taxiway but because of the setback necessary for aircraft on the taxiway, a portion of this apron would not be usable for parking aircraft or vehicles. Also, having a long stretch of apron connected to a taxiway can create problems with vehicles inadvertently going onto taxiways without being in radio communication with aircraft on the airfield.

The Alternative B general aviation area expands adjacent to the existing facilities which allows sufficient room for development. The small hangars (Items 6 and 11 on **Exhibit 3**) are situated in short sections to create few conflicts for aircraft entering or exiting hangars. This alternative includes a much larger amount of small hangars than would foreseeably be needed in the planning period. There is no area identified for industrial development but the existing terminal area could be reused for this purpose if demand dictates.

Alternative B is identical with Alternatives A, C and D in constructing a new primary runway west of the existing primary runway and converting the runway into a parallel taxiway. The runway threshold is moved

north only a few hundred feet and therefore the RPZ for Runway 32 extends over North Dakota Highway 22, which would not meet new FAA guidance for compatible uses in the RPZ.

EXHIBIT 3 – ALTERNATIVE B

1. 9000' x 150' GROUP III PRECISION RUNWAY CAPABLE OF SUPPORTING 150K# AIRCRAFT.
2. 50' WIDE GROUP III PARALLEL TAXIWAY WITH 25' SHOULDERS AND MITL.
3. 4700' x 75' GROUP II NONPRECISION RUNWAY.
4. 35' WIDE GROUP II PARALLEL TAXIWAY AND MITL.
5. RELOCATED AWOS AND WIND SENSOR LOCATION WITH 500' AND 1000' BRL CLEARANCES.
6. 60' DEEP HANGAR LOTS WITH AUTO PARKING AND GROUP II ACCESSIBILITY.
7. 35' WIDE TAXILANE WITH 115' TOFA AND SETBACK TO ACCOMMODATE A 60' DEEP APRON.
8. 120' DEEP HANGAR LOTS WITH AUTO PARKING AND GROUP II ACCESSIBILITY.
9. LARGE AND SMALL AIRCRAFT PARKING WITH TIEDOWNS
10. 120' DEEP FBO LOTS WITH APRON FRONTAGE
11. 60' DEEP T-HANGAR LOTS WITH AUTO PARKING AND GROUP I ACCESSIBILITY.
12. AIRPORT MAINTENANCE/SRE FACILITY
13. 120' DEEP CORPORATE LOTS WITH AUTO PARKING AND GROUP II ACCESSIBILITY.
14. EXISTING TERMINAL AREA CONVERTED TO AERONAUTICAL AND NONAERONAUTICAL LEASABLE PROPERTY.
15. TERMINAL LOCATION AND PARKING AREA.
16. 425' DEEP TERMINAL AREA FOR TERMINAL BUILDING, EXPANSION OF TERMINAL BUILDING,ARFF, RENTAL VEHICLE FACILITY ETC.
17. ACCESS ROAD

N

600 0 600 1200
scale feet

PRELIMINARY

FOR PLANNING PURPOSES ONLY

Rev'd.

DICKINSON-THEODORE ROOSEVELT REGIONAL AIRPORT
DICKINSON MUNICIPAL AIRPORT AUTHORITY (OWNER)
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SHEET NO. B

Kadrmas Lee & Jackson
Engineers Surveyors Planners

ULTIMATE AIRPORT LAYOUT ALTERNATIVE B

DRWN. BY MTK | CHK'D BY | COMPUTER NO. 1511304 | LAST REVISED 09/10/12

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Plotted-5/22/2015-9:48am © Kadrmas, Lee & Jackson 2012

ALTERNATIVE C

This alternative, shown in **Exhibit 4**, converts the existing commercial service terminal into FBO expansion or other aeronautical use and links to the existing general aviation apron. Expansion of the general aviation apron is limited with expansion to the south and west, with existing terminal apron being utilized for a portion of the required transient parking. A new terminal is located to the south of the crosswind runway along ND Highway 22. The acreage identified by Stark Development Corporation is located to the east of the proposed terminal location.

Advantages:

- Reuse of commercial terminal for a general aviation terminal would address current FBO space constraints.
- Significant opportunity for a mix of hangar development area is shown to the north of the airport.
- Adequate space for expansion of apron east and west of existing general aviation apron is available.

Disadvantages:

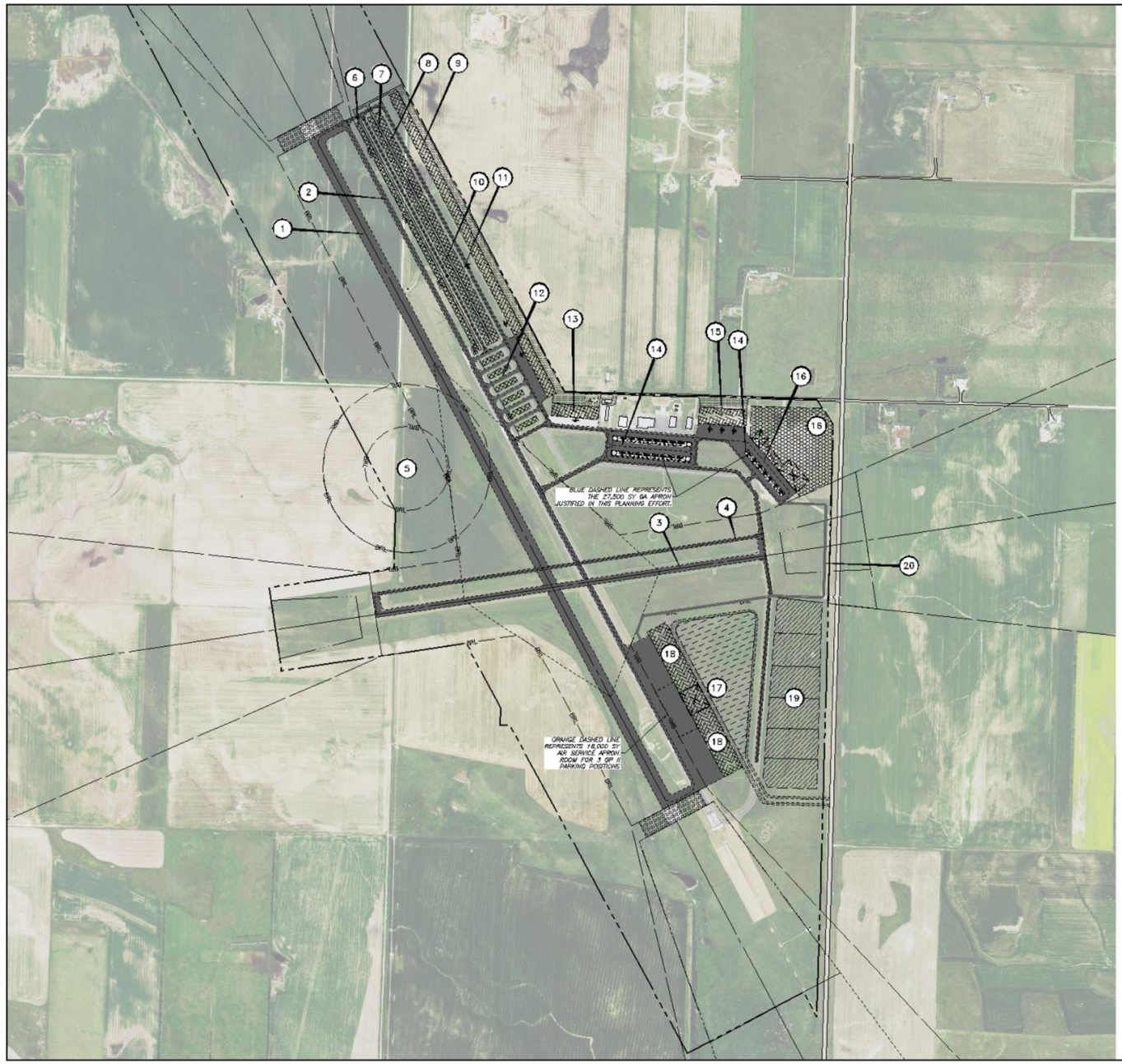
- Relocation of the terminal would require extension of utilities and construction of an access road from the existing FBO to the commercial apron.
- Hangar development to the north and terminal apron to the south within 400 feet of the parallel taxiway would preclude the ability to utilize that taxiway as an alternative landing surface in the future.
- Maintaining industrial park to the south may not impact needs for demands for the terminal expansion space through the planning period, but could impact ability to expand in the future.

In general, Alternative C includes the terminal east of the primary runway and south of the crosswind runway for a 'greenfield' terminal area development. Also in this area is an industrial park which, as configured, removes much of the property depth that could otherwise be used for the terminal area. The terminal apron is configured adjacent to the primary taxiway which prohibits some of the apron from being used for parking and creates the opportunity for vehicles to inadvertently go onto the taxiway without being in communication with aircraft on the airfield.

The Alternative C general aviation area expands adjacent to the existing facilities. It includes a variety of hangar types. The T-hangars (Item 12 on **Exhibit 4**) allow easy entry and exit with little conflict from other aircraft. The small hangars (Items 6, 7 and 8 on **Exhibit 4**) could readily be blocked by a single aircraft resulting in 20+ aircraft unable to enter or exit their hangars. This alternative includes a much larger amount of small hangars than would foreseeably be needed in the planning period.

Alternative C is identical with Alternatives A, B and D in constructing a new primary runway west of the existing primary runway and converting the runway into a parallel taxiway. The runway threshold is moved north only a few hundred feet and therefore the RPZ for Runway 32 extends over North Dakota Highway 22 which would not meet new FAA guidance for compatible uses in the RPZ.

EXHIBIT 4 – ALTERNATIVE C



1. 9000' x 150' GROUP III PRECISION RUNWAY CAPABLE OF SUPPORTING 150K# AIRCRAFT.
2. 50' WIDE GROUP III PARALLEL TAXIWAY WITH 25' SHOULDERS AND MITL.
3. 4700' x 75' GROUP II NONPRECISION RUNWAY.
4. 35' WIDE GROUP II PARALLEL TAXIWAY AND MITL.
5. RELOCATED AWOS AND WIND SENSOR LOCATION WITH 500' AND 1000' BRL CLEARANCES.
6. 50' DEEP HANGAR LOTS WITH AUTO PARKING AND GROUP I ACCESSIBILITY.
7. 60' DEEP HANGAR LOTS WITH AUTO PARKING AND GROUP I ACCESSIBILITY.
8. 80' DEEP HANGAR LOTS WITH AUTO PARKING AND GROUP II ACCESSIBILITY.
9. 120' DEEP HANGAR LOTS WITH AUTO PARKING AND GROUP II ACCESSIBILITY.
10. 25' WIDE TAXILANE WITH 80' TOFA
11. 35' WIDE TAXILANE WITH 115' TOFA AND SETBACK TO ACCOMMODATE A 60' DEEP APRONS.
12. 60' DEEP T-HANGAR LOTS WITH AUTO PARKING AND GROUP II ACCESSIBILITY.
13. 150' DEEP CORPORATE LOTS WITH AUTO PARKING AND GROUP II ACCESSIBILITY.
14. LARGE AND SMALL AIRCRAFT PARKING WITH TIEDOWNS.
15. 200' DEEP FBO LOTS WITH AUTO PARKING AND GROUP II ACCESSIBILITY.
16. EXISTING TERMINAL AREA CONVERTED TO GA TERMINAL/SRE STORGE/ARFF EXPANSION ETC.
17. TERMINAL LOCATION AND PARKING.
18. 250' DEEP TERMINAL EXPANSION AREA – RENTAL CAR/EMPLOYEE PARKING.
19. PREVIOUSLY PLATTED INDUSTRIAL LOTS BY STARK DEVELOPMENT CORP.
20. ACCESS ROAD

N

600 0 600 1200
scale feet

PRELIMINARY

FOR PLANNING PURPOSES ONLY

Rev'd.

DICKINSON-THEODORE ROOSEVELT REGIONAL AIRPORT
DICKINSON MUNICIPAL AIRPORT AUTHORITY (OWNER)
DICKINSON, NORTH DAKOTA

SHEET NO. C

Kadrmas Lee & Jackson
Engineers Surveyors Planners

ULTIMATE AIRPORT LAYOUT ALTERNATIVE C

DRWN. BY	CH'D BY	DWGFILE NO.	LAST REVISED
MTK		1511204	09/10/12

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Plotted-5/22/2015-9:55am © Kadrmas, Lee & Jackson 2012

ALTERNATIVE D

This alternative, shown in **Exhibit 5**, is a composite of Alternatives A, B and C. It scales back "ultimate" development to a modest layout that will meet the forecast demands during the planning period while still providing for continuity of development in the future.

This alternative moves the commercial service terminal area south of the crosswind runway, and reflects the apron and parking requirements for the terminal identified in the forecast. This relocation would impact the ability of Stark Development to construct the industrial park as previously platted, but some space would remain to construct a portion of this industrial park. The existing terminal would be reutilized for either aeronautical or non-aeronautical purposes by the airport. Industrial type development could potentially occur in this area.

The general aviation apron would be expanded directly to the west, and an FBO expansion area would be made available on the west side of the existing T-hangars. Corporate hangar development areas would be constructed between the existing general aviation apron and current terminal location. T-hangar units would be developed along the existing parallel taxiway.

Advantages:

- This alternative has shifted all development to the east to clear the Object Free Area that would exist around the parallel taxiway (existing runway) should this pavement be used as an alternative landing surface in the future.
- Expanding the general aviation apron to the west would expedite efficient movement of aircraft on the airport and limit taxi time. This apron expansion has been identified as one of the most critical airfield needs.
- T-hangar development along the existing parallel taxiway could also accommodate current demands for hangar space. Vehicle access to these would need to be constructed as well.
- The corporate hangar development area would allow for hangars up 100 feet deep and still provide space for these corporate hangars to be constructed on apron frontage and not impact the taxilane.
- The terminal relocation is recommended due to the cost of constructing and phasing an expansion of the existing terminal while still conducting operations from it. Additionally, this relocation would provide for sufficient space to expand should demand increase significantly over forecasted levels of traffic.

Disadvantages:

- The utilization of the existing terminal for non-aeronautical purposes would require FAA approval.
- Relocation of the terminal would require extension of utilities and construction of an access road from the existing FBO to the commercial apron.
- Alignment of T-Hangars perpendicular to prevailing winds could increase snow accumulation between the hangars.

In general, Alternative D includes the terminal area east of the primary runway and south of the crosswind runway. This provides a 'greenfield' with sufficient room for optimal layout and facility development. The terminal location will require the least amount of taxi time for airlines. The terminal apron is separated from the primary taxiway by connectors which allows maximum use of the terminal apron for parking. This also improves safety since a vehicle would need to travel down a connector taxiway to enter the taxiway system. The building locations are sufficiently separated from the primary taxiway to allow its use as an alternate runway if the primary runway is in need of major maintenance.

The general aviation area for Alternative D includes sufficient number and variety of hangars to meet demand through the planning period. There is no industrial park included with this alternative but the existing terminal area could be used for such purposes if it is needed.

Alternative D is identical to Alternatives A, B, and C, regarding the airfield, by constructing a new primary runway west of the existing primary runway and converting the runway into a parallel taxiway. The runway threshold is moved north only a few hundred feet and therefore the RPZ for Runway 32 extends over North Dakota Highway 22, which would not meet new FAA guidance for compatible uses in the RPZ.

EXHIBIT 5 – ALTERNATIVE D

1. 9000' x 150' GROUP III PRECISION RUNWAY CAPABLE OF SUPPORTING 150K# AIRCRAFT.
2. 50' WIDE GROUP III PARALLEL TAXIWAY WITH 25' SHOULDERS AND MITL.
3. 4700' x 75' GROUP II NONPRECISION RUNWAY.
4. 35' WIDE GROUP II PARALLEL TAXIWAY AND MITL.
5. RELOCATED AWOS AND WIND SENSOR LOCATION WITH 500' AND 1000' BRL CLEARANCES.
6. 60' DEEP T-HANGAR LOTS WITH AUTO PARKING AND GROUP II ACCESSIBILITY.
7. 120' DEEP FBO LOTS WITH APRON FRONTAGE
8. LARGE AND SMALL AIRCRAFT PARKING WITH TIEDOWNS
9. 150' DEEP CORPORATE LOTS WITH AUTO PARKING AND GROUP II ACCESSIBILITY.
10. EXISTING TERMINAL AREA CONVERTED TO AERONAUTICAL OR NONAERONAUTICAL LEASABLE PROPERTY OR AIRPORT SUPPORT FACILITIES (ARFF/SRE ETC) .
11. COMMERCIAL APRON GSE ACCESS ROAD
12. TERMINAL AREA RESERVED FOR FUTURE EXPANSION, ARFF, EMPLOYEE PARKING, RENTAL CAR FACILITY ETC.
13. TERMINAL LOCATION AND PARKING AREA.

N

500 0 500 1200
scale feet

PRELIMINARY

FOR PLANNING PURPOSES ONLY

Rev'd.

DICKINSON-THEODORE ROOSEVELT REGIONAL AIRPORT
DICKINSON MUNICIPAL AIRPORT AUTHORITY (OWNER)
DICKINSON, NORTH DAKOTA

SHEET NO. D

Kadrmas Lee & Jackson
Engineers Surveyors Planners

ULTIMATE AIRPORT LAYOUT ALTERNATIVE D

DRWN. BY	CHK'D BY	COMPUTER NO.	LAST REVISED
MTK		1511304	09/10/12

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Plotted-5/22/2015-10:08am © Kadrmas, Lee & Jackson 2012

CONCLUSION OF ALTERNATIVES A, B, C AND D

Alternatives A, B, C and D were completed based on a smaller design aircraft and without considering new FAA guidance regarding compatible uses within Runway Protection Zones. As a result of these two significant changes, it has been determined that **none of these four alternatives will provide Dickinson with the airside facilities that will be necessary to meet the future needs in a manner sufficient to meet FAA design guidelines**.

The landside development concept developed in Alternative D was incorporated into Alternatives F, G and H and therefore this component of Alternative D remains a part of the further reviewed alternatives.

As noted before, an Alternative E was drafted initially, but it was determined to not include in this document since it did not vary significantly from Alternative D.

ALTERNATIVES F, G AND H

Alternatives F, G and H were developed in great detail after the initial Airport Master Plan effort and therefore the assumptions for these alternatives vary somewhat from the assumptions for alternatives A, B, C and D. These are the assumptions for alternatives F, G and H.

- Airport Reference Code: D-III design standards
- Future Primary Runway dimensions: 7,700' x 150' with 162,000 pound dual wheel (for Narrow Body pavement design) gross landing weight capacity
- 4,700 feet x 75 feet crosswind runway, with full parallel taxiway and one mile visibility minimums
- Both runways will have traditional parallel taxiway alignments with TDG 4 (50 feet wide, 20 foot shoulders) for Runway 14-32 and TDG 2 (35 feet wide) for Runway 7-25
- Primary runway will have precision approaches[1] to both ends
- AWOS relocated to the west side of the primary runway
- Conventional and FBO hangar lot areas will be developed west and east of the existing hangar area
- Airline Terminal will be relocated south of Runway 7-25 with a 16,600 sy apron and vehicle access directly from State Highway 22
- Existing Terminal area would be converted to either aeronautical, non-aeronautical use or airport support facilities
- New Snow Removal Equipment Building and addition to Aircraft Rescue and Firefighting building

Overview of Alternatives

F. *Shift the Primary Runway* – Constructing a new 7,700 foot long Primary Runway 400' west of existing runway and convert existing Runway to a Parallel Taxiway (**Exhibit 6 – Alternative F**)
G. *Relocate the Threshold and Extend the Existing Primary Runway* – Relocate the Runway 32 Threshold 1,712 to the northwest, Reconstruct 4,688 feet of the Existing Runway and Extend the Runway 3,012 feet northwest (**Exhibit 7 – Alternative G**)
H. *Extend the Existing Primary Runway* – Reconstruct 6,400 feet of the Existing Runway at Current Runway 32 Threshold and Extend the Runway 1,300 feet northwest (**Exhibit 11 – Alternative H**)

[1] The FAA is instituting new approaches such as the LPV (Localizer Performance with Vertical Guidance) Approach which will provide similar approach capabilities to the traditional ILS (Instrument Landing System) Approach without the need for ground based electronic aids such as Localizers and Glide Slopes. The LPV Approach may be a viable option for each end of the primary runway which will cost less than a traditional ILS. To achieve similar visibility and ceiling minimums, the same runway design standards and approach lighting for ILS approaches would be needed for LPV approaches.

Construction Options

Each of the three evaluated alternatives, F, G and H, create essentially the same facility with varying amounts of landside space available for development, which will be addressed later. In reviewing these three alternatives, there are five different construction options which will be considered. These are as follows, including the applicable alternatives (in parenthesis):

1. Construct New Primary Runway Option (Alt F)
2. Construct Parallel Taxiway as Temporary Runway Option (Alt G & H)
3. Shift, Extend and Widen Crosswind Runway for Temporary Runway Option (Alt G & H)
4. Relocated Primary Runway Threshold Option (Alt G & H)
5. Closure of Primary Runway Option (Alt G & H)

Instrument Weather Conditions During Temporary Runway Use Period

An item of information that will impact the airport during the temporary runway use for Alternatives G and H, and possibly F, is the typical instrument weather conditions during construction. This information is not a consideration in recommending any of the three alternatives but will be helpful in the design phase of this project. The construction period is considered from May 1 to October 20 and the IFR conditions reported include IFR, IFR for Circling Minimums and IFR below Cat I Minimums. For the time when the temporary runway is in use, unless a new temporary procedure is developed, the Circling Minimums will be the best available approach for the temporary runway.

Table 1 – IFR Conditions at Dickinson

Minimums	Ceiling (Feet)	Visibility (Miles)	Observations Below Stated Minimums		Estimated % of Flights cancelled due to availability of only Temporary Runway
			% of Conditions Annually	% during Construction (May 1 to Oct 20)	
IFR	1000	3	26.3	15.9	5.9
Circling	500	1	12.0	7.8	
Cat I	200	½	3.4	1.9	

ALTERNATIVE F

This alternative, found in **Exhibit 6**, has the following features:

Runway 14-32	Construct new runway 400 feet southwest and 1,009 feet northwest from the current threshold so that the runway protection zone is completely on airport property
Runway 7-25	Maintain as existing
GA Apron	Expand to the west and south [add 34,000 sy (21,600 sy additional space for parking and apron taxilanes)]
Hangars	T-Hangars perpendicular to Runway 14-32 and north of existing hangar area and 60 foot deep hangar lots also perpendicular to Runway 14-32
Property	Acquire an additional 297 acres

Advantages:

- All required development identified in this plan can be accommodated in this layout.
- The construction of the primary runway will have minimal impact on current airport operations since the runway is constructed west of the current runway.
- The runway protection zones for the primary runway will be all on airport property.
- This alternative provides the largest amount of area for general aviation development.
- The amount of land available for the landside terminal area (76.7 acres) is much greater than the current landside terminal area (17.6 acres) and would be enough to handle forecast activity during the planning period.

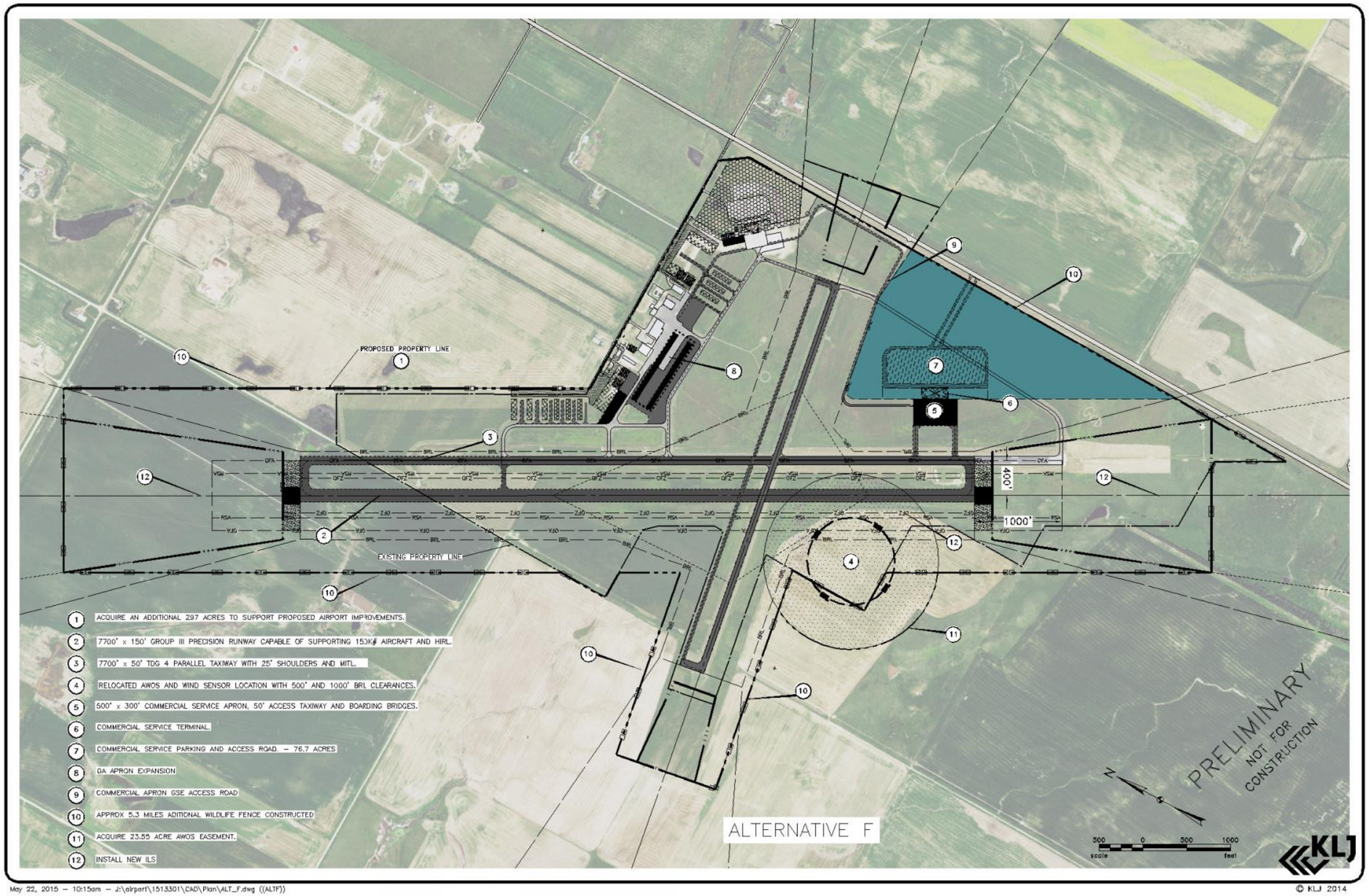
Disadvantages:

- This alternative requires the greatest amount of land acquisition.
- It will be necessary to fill a ravine area for the runway safety area for Runway 32. However, this work will be able to be completed with minimal impact on airport operations.

Operational Performance

Alternative F involves the new runway shifting 400 feet to the west and parallel to the current location of Runway 14-32. This alternative provides for using the existing runway as a parallel taxiway until its reconstruction would be completed. This alternative results in there being no incompatible land uses inside of the Runway Protection Zone for Runway 32. The terminal area for Alternative F would have 76.7 acres available for development. All other features of this alternative are identical to Alternatives G and H.

EXHIBIT 6 – ALTERNATIVE F



Alternative F: Construction Option 1 – Construct New Runway

Project Description

This construction option would have the new runway built with minimal impact on the current airport operations. A majority of the earthwork, aggregate base, pavement, lighting, and NAVAIDs can all be constructed without closing the airport to aircraft operations. Once the new runway has been constructed, aircraft operations could be switched to that runway while the current runway is extended and reconfigured to serve as a parallel taxiway.

There is a portion of the new runway work that will occur in the existing approach and departure surfaces. In order to limit airspace obstructions during construction, this 600 foot portion of the runway can be constructed at nighttime with the airport closed or with the Runway 14 threshold displaced. Either of these options can be done at the same time as the runway construction with minimal impact on airport operations.

Project Costs

The construction cost estimate for this option ranges from $39,566,000 to $62,889,000. This cost estimate is for the completed primary runway and full parallel taxiway only. **Table 2** contains the various cost estimates for the new runway based upon type of paving and fleet mix utilized for designing Alternative F. Complete cost estimates are included in **Appendix H**.

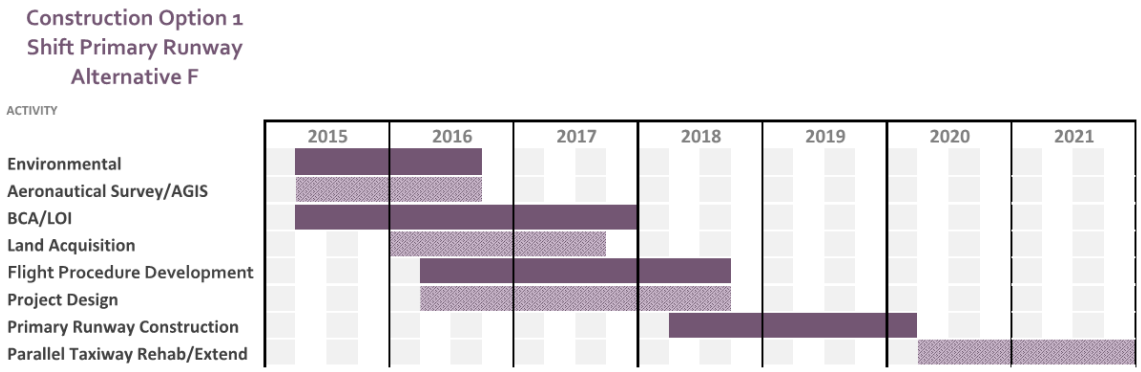
Table 2 – Alternative F – Project Costs

Item	Costs for Regional Aircraft		Costs for Narrow Body	
	Asphalt	Concrete	Asphalt	Concrete
Primary Runway				
Land Acquisition	$602,000	$602,000	$602,000	$602,000
Airport Wildlife Fence	$550,000	$550,000	$550,000	$550,000
Construct 7700' x 150' Runway Pavement	$24,164,000	$36,319,000	$29,262,000	$42,597,000
High Intensity Runway Lighting and PAPIs	$939,000	$939,000	$939,000	$939,000
Total Primary Runway =	$26,255,000	$38,410,000	$31,353,000	$44,688,000
Convert Existing Runway into Taxiway & Extend =	$13,311,000	$14,633,000	$16,742,000	$18,201,000
Total Project =	$39,566,000	$53,043,000	$48,095,000	$62,889,000

Project Phasing

The timeline for this option can be broken into multiple construction projects that can be completed in different years. The most likely breakdown is detailed in **Figure 1**. The primary runway would be available for use within five years, and taxiway rehabilitation and extension could be completed over a two-year period once the runway is operational.

FIGURE 1 – ALTERNATIVE F – PROJECT TIMELINE



After the runway construction is completed, a parallel taxiway can be completed by constructing 2,300 feet of new taxiway and remarking and lighting 5,400 feet of the existing runway as a parallel taxiway. Overlay of the existing runway (converted to a taxiway) is included as well to handle the forecast aircraft loads. This will be phased after completion of the primary runway over two years, and thereby reduce initial construction costs.

Alternative F – Summary Analysis

Outlined below is a summary of the evaluation factors that have been described previously for Alternative F. This section will indicate factors which make this alternative either more or less preferable. **Table 16** provides a summary of this information for all three alternatives F, G and H.

Evaluation factors that make the Alternative F more preferable:

- Allows for largest acreage for terminal area development, 76.7 acres, which will allow development beyond the current planning period (recommended area for terminal area development during the planning period is 24.2 acres).
- Existing Primary Runway remains operational for the majority of the project with minimal impact on aircraft operations.
- No additional cost to construct a temporary runway is required to complete this alternative.
- Runway Protection Zone for Runway 32 will be completely clear of incompatible land uses and in compliance with FAA RPZ policy guidance.
- This alternative has the lowest price range of any of the alternatives at $39,566,000 to $62,889,000.

Evaluation factors that make Alternative F less preferable:

- Requires the greatest amount of land acquisition with 297 acres.

ALTERNATIVE G

This alternative, found in **Exhibit 7**, has the following features:

Runway 14-32	Relocate threshold 1,712 feet northwest from the current location and widen and extend runway to 7,700 x 150 feet so that runway protection zone is completely on airport property
Runway 7-25	Maintain as existing
GA Apron	Expand to the west, south and east [add 29,000 sy (18,200 sy additional space for parking and apron taxilanes)]
Hangars	T-Hangars east of expanded apron
Property	Acquire an additional 232 acres

Advantages:

- All required development identified in this plan can be accommodated in this layout.
- The amount of additional land to be acquired would be less in comparison to Alternative F.
- Room for expansion of the general aviation area to the south of the existing area could accommodate additional growth beyond this planning period.
- Since the threshold is shifted there would be no longer be a need to fill the existing runway safety area for Runway 32.
- The amount of land available for landside terminal area development (38.8 acres) is sufficient to handle forecast activity during the planning period.

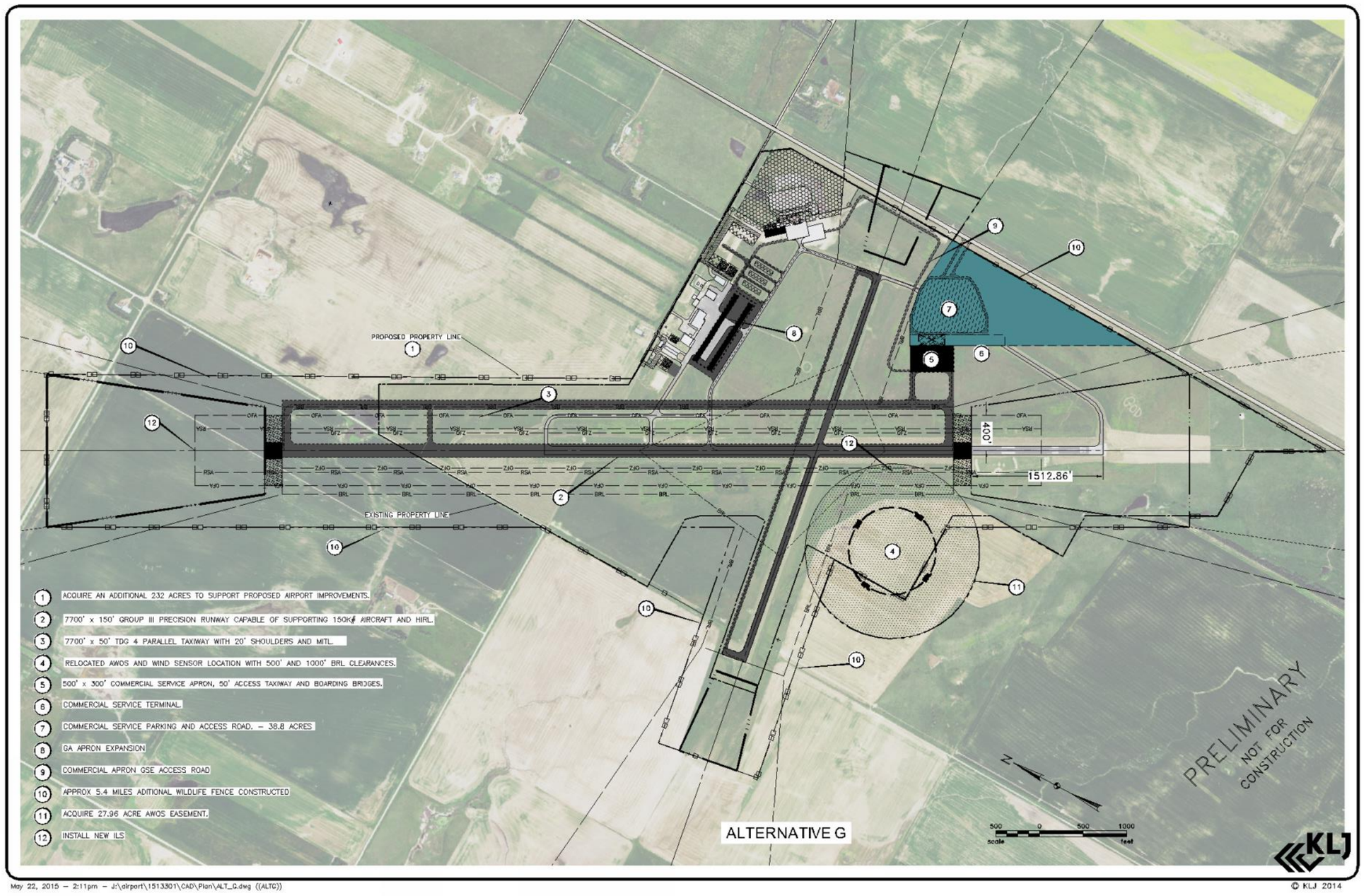
Disadvantages:

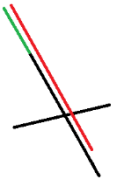
- Area to develop additional general aviation facilities would be confined, and may limit ultimate development of the airport.
- This configuration would likely require complete reconstruction of the runway and construction of a parallel taxiway. This will have a significant impact on airport operations during construction. The impact on airport operations will be addressed as construction phasing is considered.

Operational Performance

Alternative G involves relocating the threshold of Runway 32 by 1,712 feet north-northwest then extending the runway 3,012 feet. This relocated threshold allows the Runway 32 RPZ to be outside of North Dakota Highway 22, and therefore in compliance with current FAA RPZ use policy. The terminal area for Alternative G would make 38.8 acres available for development. All other features of this alternative are identical to Alternatives F and H.

Exhibit 7 – Alternative G





Alternative G: Construction Option 2 – Construct Parallel Taxiway as a Temporary Runway

Description of Project

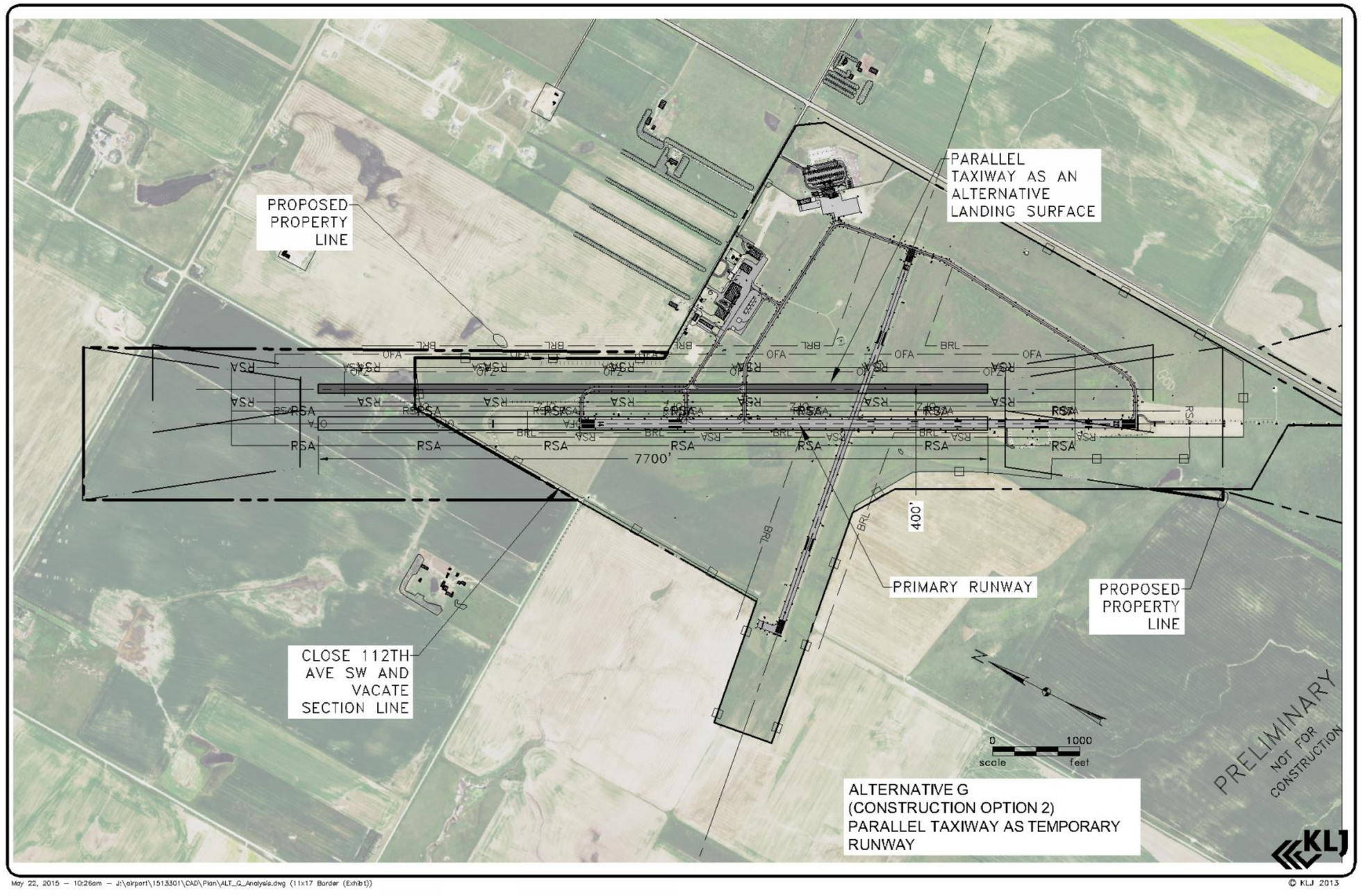
An option to maintain service to current aircraft serving Dickinson during runway construction is to construct a full length parallel taxiway to Runway 14-32 which is capable of operating as a runway. This "super" taxiway could be constructed as a 7,700 foot long by 100 foot wide runway and used as a landing surface while the primary runway is being reconstructed. The design requirements for the parallel taxiway call for Taxiway Design Group 4 which is a 50 foot taxiway with 20 foot shoulders on each side. This results in 90 feet of pavement required for the new parallel taxiway, only 10 feet short of the 100 feet required for it to serve as a temporary runway.

The taxiway pavement could be constructed as a 50 foot taxiway with 25 foot shoulders on each side and thus have marking and lighting reconfigured to serve as the full parallel taxiway after its use as a temporary runway. For cost analysis purposes, the 25 foot shoulders have been designed to last a minimum of 5 years, and therefore have a slightly thinner pavement section, and thereby a reduced cost.

When the taxiway is initially constructed, both runway and taxiway light cans would be installed. The runway light positions would be used while it is in use as a runway; following that period, taxiway fixtures could be installed at the 50 foot taxiway width.

Exhibit 8 shows the layout for the extended and reconstructed parallel taxiway for Alternative G.

Exhibit 8 – Alternative G – Parallel Taxiway for Temporary Runway



Project Costs

The construction cost estimate for this option ranges from $47,189,000 to $76,696,000. This cost estimate is for the completed primary runway and full parallel taxiway being utilized as a temporary runway only. It is anticipated that the temporary runway would have approach visibility minimums of not lower than 1 mile. **Table 3** contains a cost estimate for the parallel taxiway as temporary runway for Alternative G. Complete cost estimates are included in **Appendix H**.

Table 3 – Alternative G – Option 2: Parallel Taxiway Project Costs				
Item	Costs for Regional Aircraft		Costs for Narrow Body	
	Asphalt	Concrete	Asphalt	Concrete
Temporary Runway/Parallel Taxiway				
Construct 7700' x 100' Runway Pavement	$17,203,000	$25,631,000	$20,646,000	$27,762,000
Medium Intensity Runway Lighting and PAPIs	$890,000	$890,000	$890,000	$890,000
Convert Temporary Runway back to Taxiway	$1,095,000	$1,095,000	$1,095,000	$1,095,000
Total Temporary Runway/Parallel Taxiway =	*$19,188,000*	*$27,616,000*	*$22,631,000*	*$29,747,000*
Primary Runway				
Land Acquisition	$531,000	$531,000	$531,000	$531,000
Airport Wildlife Fence	$556,000	$556,000	$556,000	$556,000
High Intensity Runway Lighting and PAPIs	$976,000	$976,000	$976,000	$976,000
Construct 7700’ x 150’ Primary Runway	$45,902,000	$38,488,000	$31,132,000	$44,949,000
Total Primary Runway =	*$28,001,000*	*$40,551,000*	*$33,195,000*	*$46,949,000*
Total Project =	**$47,189,000**	**$68,167,000**	**$55,826,000**	**$76,696,000**

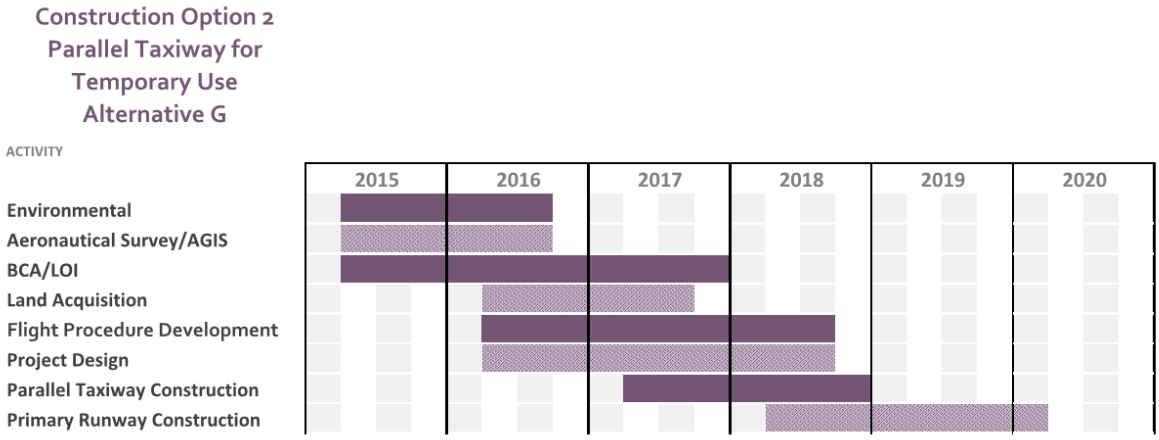
Project Phasing

Because of the airport configuration and the need to keep the airport open to the traveling public, it will be necessary to complete the construction of the temporary runway/parallel taxiway in multiple segments. The segmenting of the work will enable access to the active primary runway by at least one taxiway.

There is a portion of the parallel taxiway construction that will occur in the existing approach and departure surfaces. In order to limit airspace obstructions during construction, this 600 foot portion of the runway can be completed at nighttime with the airport closed or the Runway 14 threshold displaced. This requirement will also hold true for the New Runway option as well since it has the same separation distance from the existing primary runway. The construction of this 600 foot portion of temporary runway/parallel taxiway could be completed at nighttime with the airport closed or the Runway 14 threshold displaced.

The estimated timeline for this construction option is detailed in **Figure 2**. Because the parallel taxiway will need to be completed prior to proceeding with the primary runway phase, it is estimated that the runway would be operational within five years.

FIGURE 2 – ALTERNATIVE G – PARALLEL TAXIWAY PROJECT TIMELINE



A drawback of this option is that when aircraft are using the temporary runway as a landing surface there will only be GPS and VOR circling approaches to the runway, and no precision instrument landing system (ILS). Additionally, the lack of a parallel taxiway will require aircraft to back taxi more than 3,000 feet for this construction option.

Viability of Parallel Taxiway as a Temporary Runway Option for Dickinson

This construction option is potentially viable but requires an increased level of safety and phasing coordination during construction periods. This option requires a greater expense upfront because of the requirement to construct the taxiway prior to the primary runway.

Alternative G: Construction Option 3 – Shift, Extend and Widen Crosswind Runway for Temporary Runway

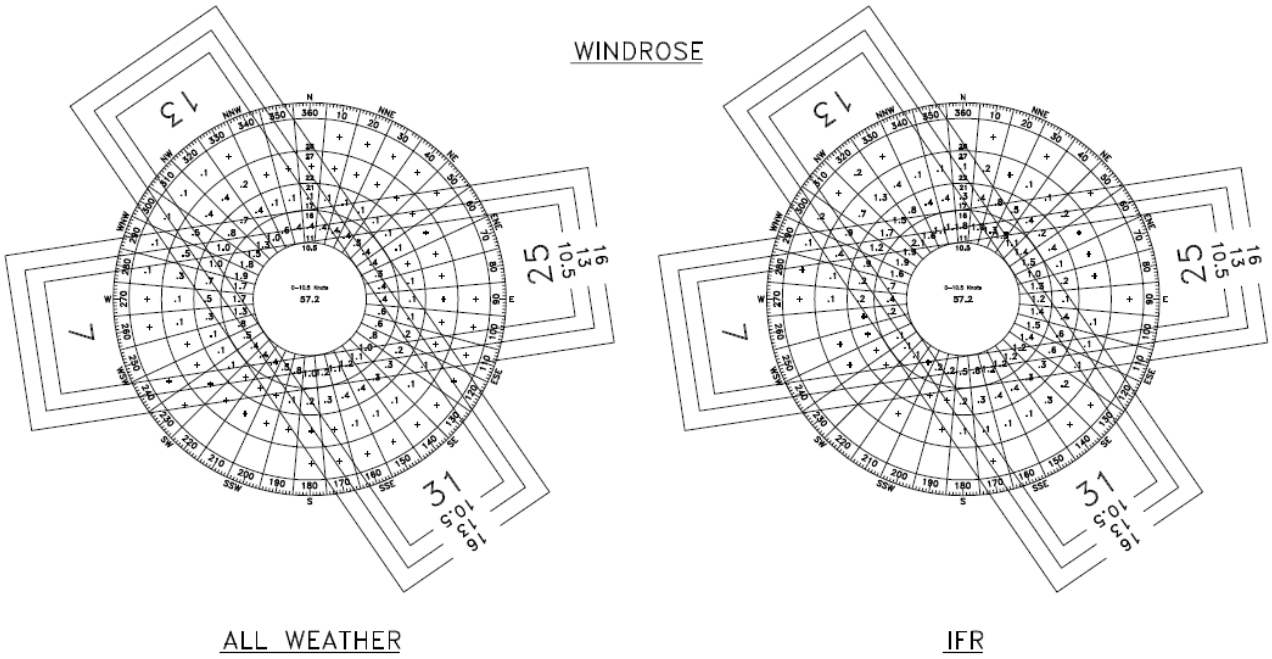
Description of Project

When a commercial service airport closes one runway to allow for major pavement rehabilitation they often transfer aircraft operations to a secondary runway, which is typically a parallel or crosswind runway. Dickinson Theodore Roosevelt Regional Airport does not have a parallel runway, so the option of expanding the crosswind runway to handle commercial operations was analyzed. The crosswind runway (Runway 7-25) in Dickinson is currently 4,700 feet long and 75 feet wide. This runway is rated at a pavement strength of 16,000 pounds single wheel load/20,000 pound dual wheel load and meets the FAA design standards for Runway Design Category B-II. The length and pavement strength limitations make this runway unusable to both commercial airlines as it is currently configured. The runway protection zones are also currently sized at 500 feet wide at the inner end by 700 feet wide at the outer end and 1000 feet long.

If Runway 7-25 were modified to handle the current commercial service aircraft, it would need to be upgraded to meet the needs of the current critical aircraft, the CRJ200, a D-II design aircraft with a 53,000 pound dual wheel load. To accommodate this critical aircraft, the runway would need to be 7,200 feet long and 100 feet wide based on current stage length flights for this aircraft. The runway protection zones would also be sized at 500 feet wide at the inner end by 1,010 feet wide at the outer end and 1,700 feet long. Since this is an increase in RPZ size, the threshold must be displaced 1,190 feet to the west to comply with the FAA Interim Guidance on land use within RVZ.

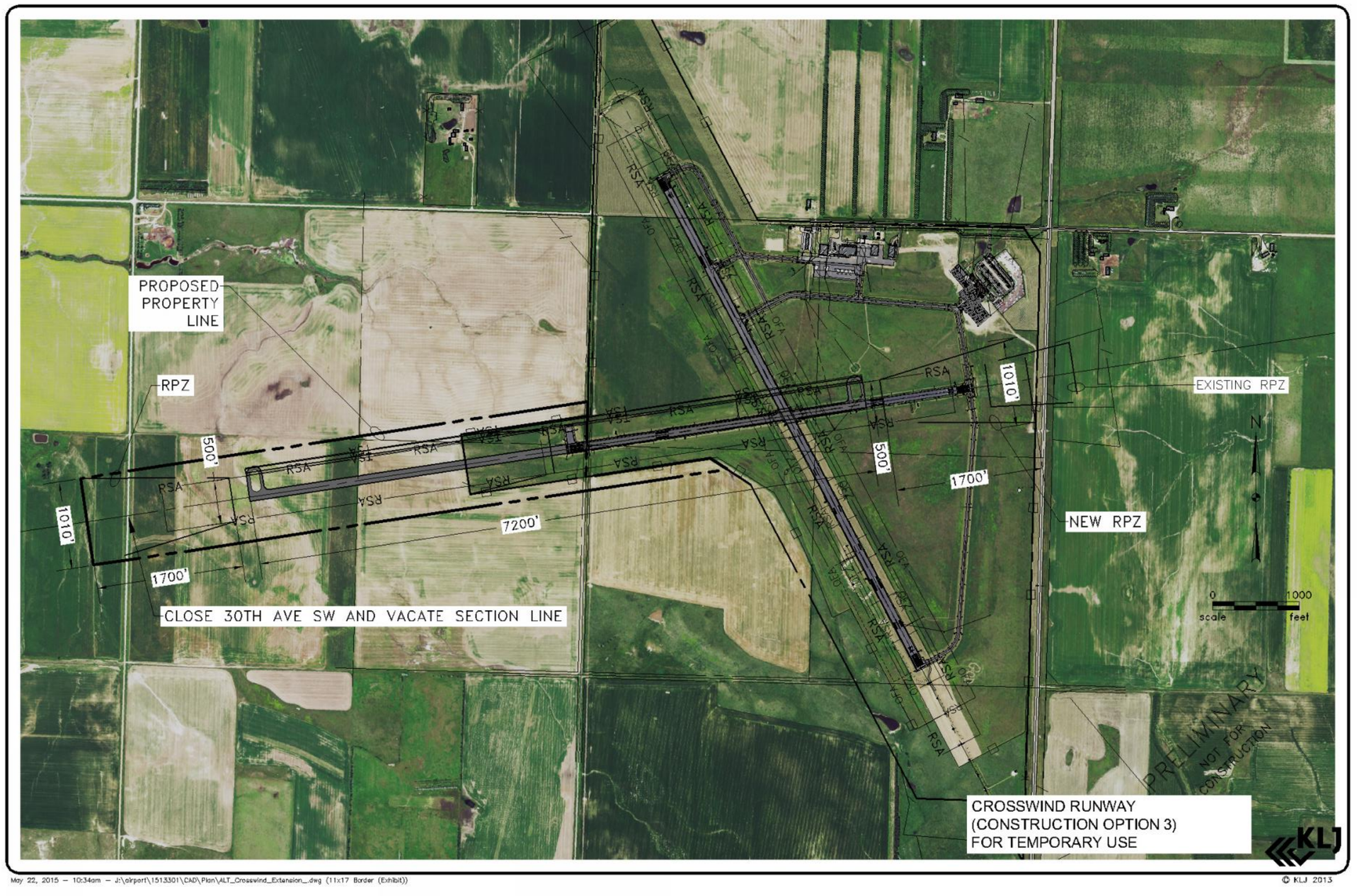
One aspect of using Runway 7-25 as the primary runway during reconstruction of Runway 14-32 is that the wind coverage, particularly in IFR conditions is below the 95% coverage for 16 knots, (see **Figure 3**) which is used to determine functionality for D-II aircraft as seen in Figure 3. **Exhibit 9** shows the layout of the airport with the extended crosswind runway.

FIGURE 3 – CURRENT WIND DATA – DICKINSON



	All Weather Windrose Data			IFR Weather Windrose Data		
Runway	**10.5 Knots**	**13.0 Knots**	**16.0 Knots**	**10.5 Knots**	**13.0 Knots**	**16.0 Knots**
Runway 14 - 32	84.27%	91.43%	97.10%	79.52%	88.70%	96.15%
Runway 7 - 25	78.21%	86.59%	94.27%	66.56%	77.85%	88.88%
Combined	96.19%	98.86%	99.76%	92.58%	97.14%	99.34%
Source: National Climatic Data Center						
All Weather - 83,919 Observations IFR – 6,257 Observations						
Dickinson Theodore Roosevelt Regional Airport - Station Number 72764						
2000 To 2009						
+ = Less than 0.05%						

EXHIBIT 9 – CROSSWIND RUNWAY FOR TEMPORARY USE



Project Costs

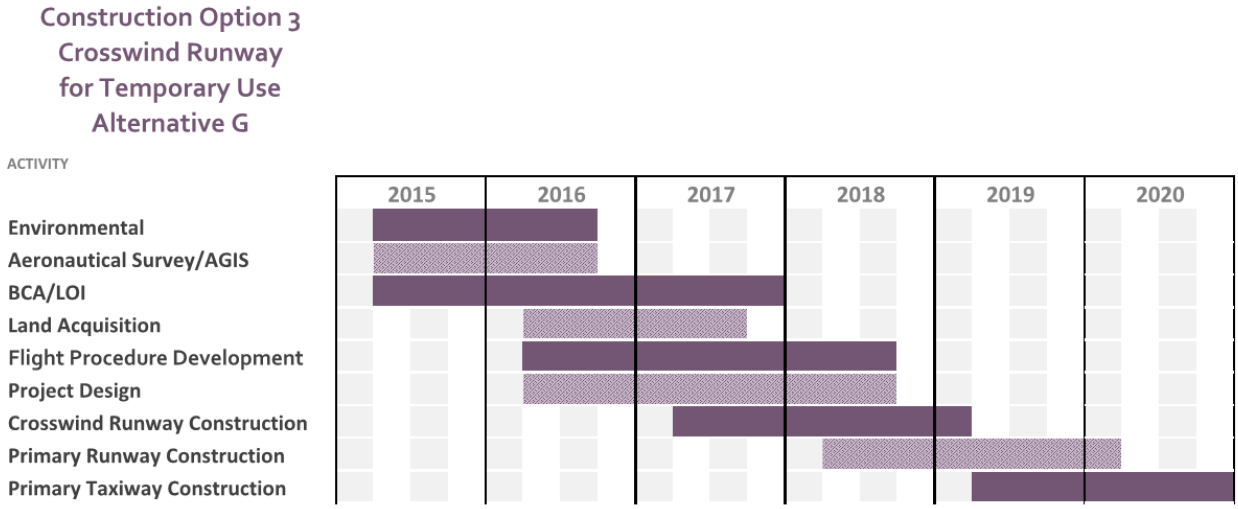
The construction cost estimate for the upgrades to Runway 7-25 to meet D-II standards would be $19,475,000. This option still requires construction of the primary runway and taxiway and would range from $39,459,000 to $64,748,000 for Alternative G – Option 3. **Table 4** contains a cost estimate for the crosswind runway expansion analysis. A detailed cost estimate is included in **Appendix H**.

Table 4 – Alternative G – Option 3: Crosswind Runway Project Costs				
Item	Costs for Regional Aircraft		Costs for Narrow Body	
	Asphalt	Concrete	Asphalt	Concrete
Temporary Runway				
Land Acquisition	$440,000	$440,000	$440,000	$440,000
Airport Wildlife Fence	$293,000	$293,000	$293,000	$293,000
Construct 7200' x 100' Runway Pavement with Turnouts on Runway Ends	$17,821,000	$17,821,000	$17,821,000	$17,821,000
Medium Intensity Runway Lighting and PAPIs	$921,000	$921,000	$921,000	$921,000
Total Temporary Runway =	$19,475,000	$19,475,000	$19,475,000	$19,475,000
Primary Runway				
Land Acquisition	$531,000	$531,000	$531,000	$531,000
Airport Wildlife Fence	$556,000	$556,000	$556,000	$556,000
Construct 7700’ x 150’ Primary Runway	$25,938,000	$38,488,000	$31,132,000	$44,886,000
Construct High Intensity Runway Lights with PAPIs	$976,000	$976,000	$976,000	$976,000
Total Primary Runway =	$28,001,000	$40,551,000	$33,195,000	$46,949,000
Primary Parallel Taxiway Phase =	$11,458,000	$15,667,000	$13,189,000	$17,799,000
Total Project =	$58,934,000	$75,693,000	$65,859,000	$84,223,000

Project Phasing

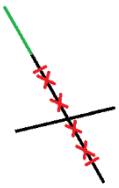
The estimated timeline for this construction option is detailed in **Figure 4**. Because the crosswind runway construction would need to be completed prior to proceeding with the primary runway phase, it is estimated that the primary runway would be operational within six years. Added to that timeline is the parallel taxiway, which means that the primary runway with full parallel taxiway would be operational within six years.

FIGURE 4 – CROSSWIND RUNWAY OPTION PROJECT TIMELINE



Viability of Extending Crosswind Runway Option

There are significant drawbacks to this option. First, the runway would need to be displaced by 1,190 feet to accommodate the D-II aircraft which means an additional 1,190 feet of new runway would need to be constructed on the other end. Second, the runway would need to be 7,200 feet long to accommodate the existing airline traffic, which is far beyond the justifiable length of 4,700 feet for the crosswind runway at Dickinson Theodore Roosevelt Regional Airport. Lastly, to fully complete the project, the primary parallel taxiway must still be completed which will take additional money and time in comparison to the other options.



Alternative G: Construction Option 4 – Displaced Primary Runway Threshold

Description of Project

It has been determined that aircraft used by the airlines at Dickinson Theodore Roosevelt Regional Airport currently require a runway length of 7,200 feet for existing destinations. Additional calculations were made to determine if a shorter portion of the current 6,400 foot runway could be used temporarily and therefore allow the remainder to be reconstructed. In the calculations it was found that the most critical aircraft is the CRJ200 used daily by Delta to Minneapolis. United uses the Embraer 135 and 145 aircraft between Dickinson and Denver. See **Table 5** for a summary and **Appendix F** for details of the calculations.

Even though the crosswind runway is weight rated at 20,000 pounds (dual wheel) and is only 75 feet wide, the runway length of 4,700 feet was examined to determine if airlines could reduce the passenger load sufficiently to operate from a runway this short. The results of the analysis are summarized in **Table 5**. The load factors resulting from using a 4,700 foot runway would be 54% for a CRJ200, 70% for an Embraer 135 and 58% for an Embraer 145. This load factor is below the 80% 'break even' load factor and therefore a 4,700 foot runway would be too short to meet the airline's needs as a temporary runway during construction. Eighty percent is the 'break-even' load factor as reported by SkyWest Airlines in its 2013 Annual Report.

The 80% load factor was then examined with the most demanding aircraft being the CRJ200. This load factor would require a runway length of 5,500 feet, but airline operations could continue at this length. A summary of the calculations for the four different aircraft examined can be found in **Table 5**.

Table 5 – Summary of Displaced Threshold Impact*

	# of Passengers	Load Factor	Runway Length
CRJ-200 DIK to MSP	27 of 50 passengers	54%	4,700
	40 of 50 passengers	80%	5,500
Embraer 135 DIK to DEN	26 of 37 passengers	70%	4,700
	37 of 37 passengers	100%	5,500
Embraer 145 DIK to DEN	29 of 50 passengers	58%	4,700
	48 of 50 passengers	96%	5,500

** Calculations based upon ISA +15°C*

Source: Bombardier and Embraer Airport Planning Manuals, KLJ Analysis

Project Cost

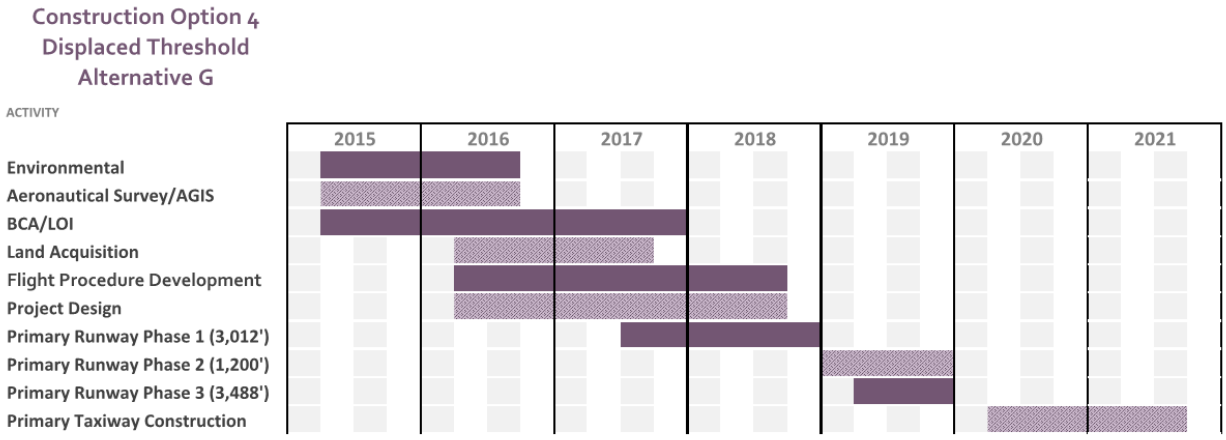
The construction cost estimate for this option ranges from $43,602,000 to $69,194,000 for Alternative G, Option 4. **Table 6** contains a cost estimate for the displaced threshold analysis. A detailed cost estimate is included in **Appendix H**.

Table 6 – Alternative G – Option 4: Displaced Threshold Project Costs				
Item	Costs for Regional Aircraft		Costs for Narrow Body	
	Asphalt	Concrete	Asphalt	Concrete
Primary Runway				
Land Acquisition	$531,000	$531,000	$531,000	$531,000
Airport Wildlife Fence	$556,000	$556,000	$556,000	$556,000
Construct Phase 1 (3,012')	$11,770,000	$16,648,000	$13,793,000	$19,148,000
Construct Phase 2 (1,200')	$6,058,000	$8,341,000	$6,891,000	$9,356,000
Construct Phase 3 (5,488')	$12,253,000	$17,933,000	$14,614,000	$20,828,000
High Intensity Runway Lighting and PAPIs	$976,000	$976,000	$976,000	$976,000
Total Primary Runway =	$32,144,000	$44,985,000	$37,361,000	$51,395,000
Primary Parallel Taxiway Phase =	$11,458,000	$15,667,000	$13,189,000	$17,799,000
Total Project =	$43,602,000	$60,652,000	$50,550,000	$69,194,000

Project Phasing

The estimated timeline for this construction option is detailed in **Figure 5**. The displaced threshold option will take two years to complete the primary runway construction. The first phase will extend the runway by 3,012 feet. The second phase is reconstruction of the first 1,200 feet of Runway 32. The third phase is reconstruction of the remaining 3,488 feet of runway which will require full runway closure for a period of three months. The primary runway would be operational after five years, and an additional two years to complete the parallel taxiway resulting in a total of seven years of construction.

FIGURE 5 – DISPLACED THRESHOLD OPTION PROJECT TIMELINE



Economic Impact on Airport and Local Economy of Closure

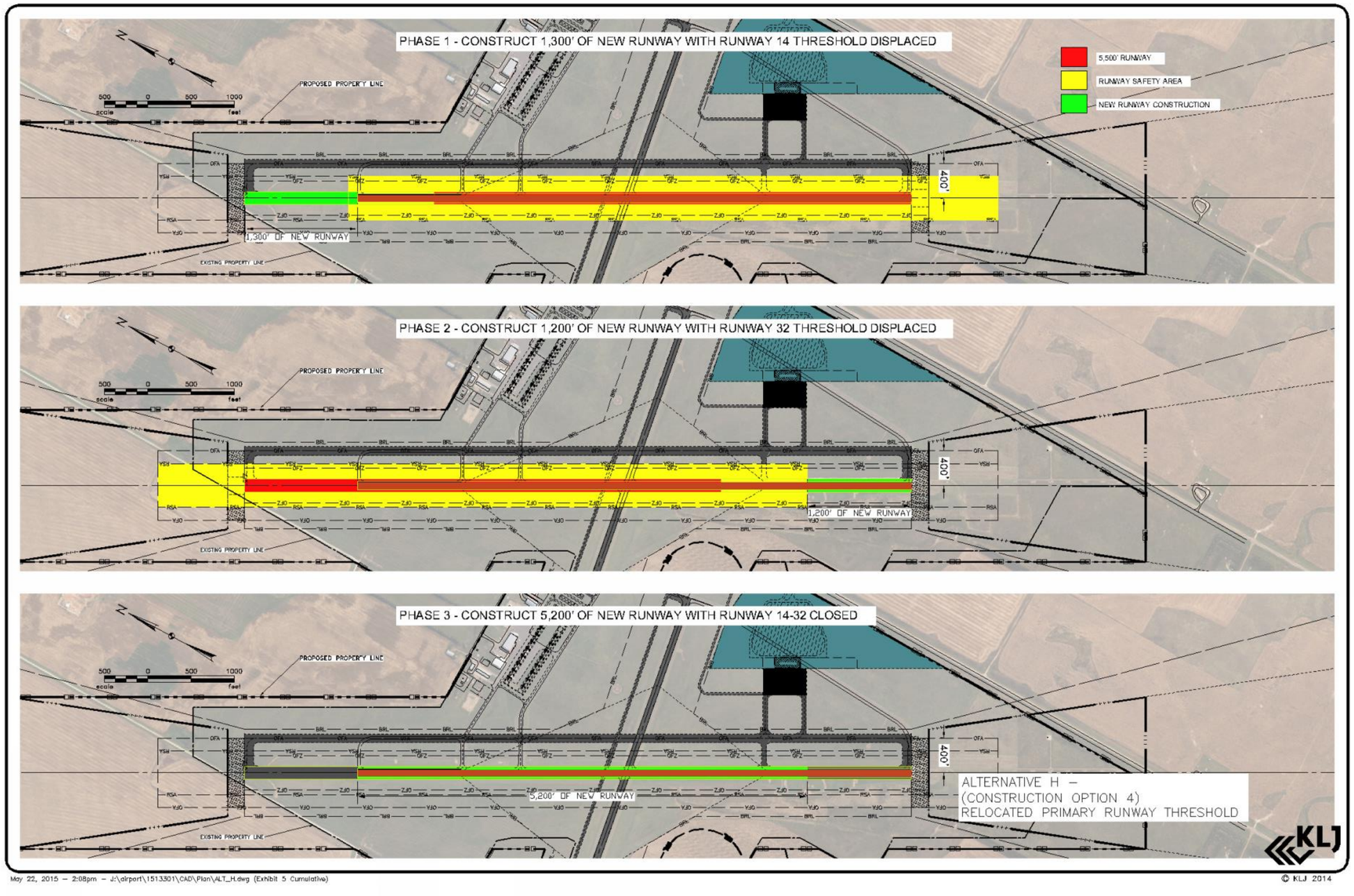
An economic impact analysis was completed based on the current level of activity at Dickinson Theodore Roosevelt Regional Airport and information obtained from the 2010 North Dakota Economic Impact of Aviation. This impact includes loss of income to the airport, airport tenants, local businesses, local tax income and cost to passengers. For the displaced threshold option, the estimated economic impact from a three-month closure for Alternative G – Option 4 is a loss of **$17,705,309**. Further information can be found in **Appendix F – Economic Impact of Airport Closure**.

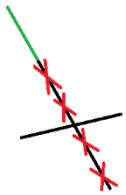
Viability of Relocated Primary Runway Threshold Option for Dickinson

Given that 5,500 feet is needed for airline operations at a minimum and the existing primary runway is 6,400 feet long, portions of the existing runway could be used during this phased construction option. However, due to construction activities and runway safety areas, it would require a closure of the runway to construct the middle 3,488 feet as depicted in **Exhibit 10**.

The airlines would operate with weight restrictions during the time of the displaced threshold allowing 37 to 48 passengers per departure. The displaced threshold operation and mixture of construction equipment near the runway would require a high level of coordination to assure that the airport continues to meet the requirements of Federal Aviation Regulation (FAR) Part 139 throughout the construction period.

EXHIBIT 10 – ALTERNATIVE G – OPTION 4 – PROJECT PHASING WITH DISPLACED THRESHOLD





Alternative G: Construction Option 5 – Closure of Primary Runway

Project Description

Another option analyzed to reconstruct the primary runway is to completely close this runway to all operations and construct the runway with an expedited scheduled. The closure of Runway 14-32 will result in suspension of airline service and most general aviation jet traffic since the crosswind Runway 7-25, at 4,700 feet long, would not be sufficient to continue these operations. This option is rarely considered at commercial service airport, unless an alternative airport capable of handling commercial service aircraft, is within a short distance – such as a military base. In analysis of this option, other airports were queried to determine how complete primary runway reconstruction was handled at their airports. The findings of this research are in **Appendix G**.

In regards to constructability of this option, the work could be pursued on an expedited schedule. The elements which would need to be completed include:

- Grading of Runway Safety Areas
- Excavation of Existing Runway
- Reconstruction and widening of 4,688 feet of existing runway (including 150 feet within the existing Runway 7-25 safety area)
- Construction of 3,012 feet of new runway
- Installation of High Intensity Runway Lights
- Installation of Approach Lighting System and PAPIs
- Installation of Glide Slope Antenna
- Installation of Localizer
- Publication of Instrument Approaches (requires flight check of completed runway)[2]

[2] New Instrument Approach Procedures require an 18-24 month time period for full development of the procedure. The final stage of this will require flight check of the completed runway and then publication of the approach.

Project Cost

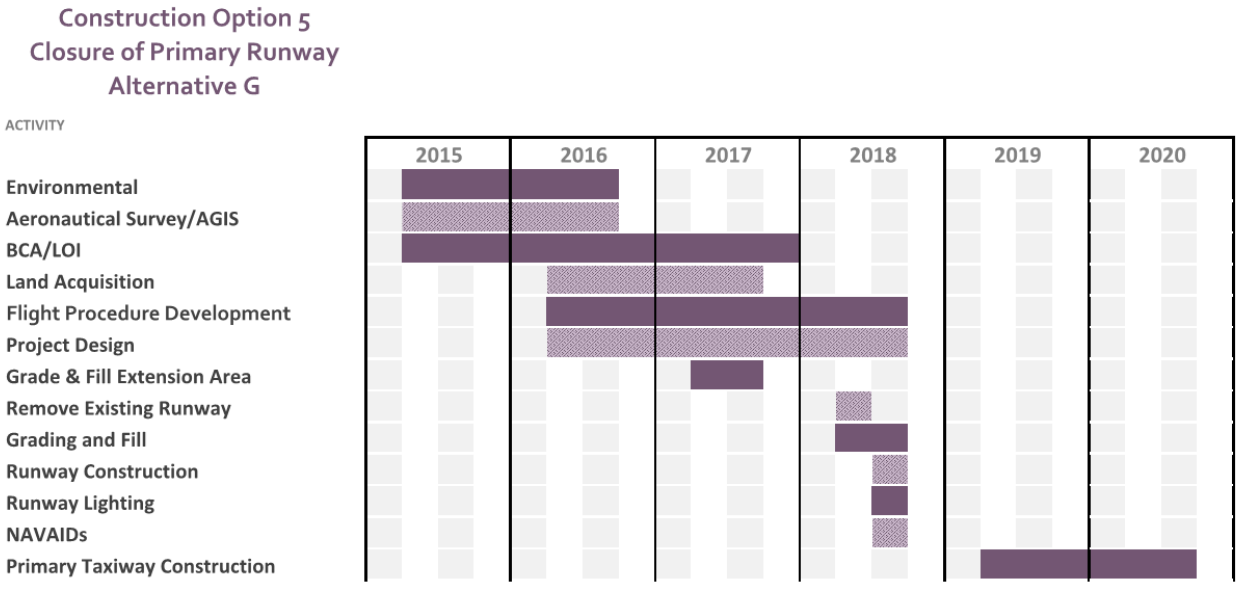
The construction cost estimate with the full closure option ranges from $39,459,000 to $64,748,000 for Alternative G, Option 5. **Table 7** provides a summary of these costs. **Appendix H** includes the detailed cost estimates for these alternatives.

Table 7 – Alternative G – Option 5: Full Closure Project Costs				
Item	Costs for Regional Aircraft		Costs for Narrow Body	
	Asphalt	Concrete	Asphalt	Concrete
Primary Runway				
Land Acquisition	$531,000	$531,000	$531,000	$531,000
Airport Wildlife Fence	$556,000	$556,000	$556,000	$556,000
Construct 7700' x 150' Runway Pavement	$25,938,000	$38,488,000	$31,132,000	$44,886,000
High Intensity Runway Lighting and PAPIs	$976,000	$976,000	$976,000	$976,000
Total Primary Runway =	$28,001,000	$40,551,000	$33,195,000	$46,949,000
Parallel Taxiway Phase =	$11,458,000	$15,667,000	$13,189,000	$17,799,000
Total Project =	$39,459,000	$56,218,000	$46,384,000	$64,748,000

Project Phasing

Experience has indicated that completion of all these elements, even when expedited, would require an entire construction season. **Figure 6** provides the detailed timeline for construction and have the runway fully operational in four years and parallel taxiway complete in six years.

FIGURE 6 – ALTERNATIVE G – FULL CLOSURE DETAILED TIMELINE



Economic Impact on Airport and Local Economy of Closure

A financial impact analysis was completed based on the current level of activity at Dickinson Theodore Roosevelt Regional Airport and information obtained from the 2010 North Dakota Economic Impact of Aviation, conducted by the North Dakota Aeronautics Commission. This impact includes loss of income to the airport, airport tenants, local businesses, local tax income and cost to passengers. For this option, the estimated financial impact to the community from a nine-month closure is a loss of **$53,115,928**. Further information can be found in **Appendix F – Economic Impact of Airport Closure**.

Viability of Primary Runway Closure Option for Dickinson

A full closure option is usually considered for two primary reasons. An attempt to achieve substantial costs savings or to achieve substantial time savings while minimizing the impact on travelers and local business. In the case of Alternative G, Option 5 – Full Closure would cost **$39.4** to **$64.7** million but also would have economic cost to the airport, tenants, customers and community of **$53.1** million for the **9-month closure**. The total time to construct a functional runway would be the same as other options.

Alternative G – Summary Analysis

Outlined below is a summary of the evaluation factors that have been detailed previously for Alternative G. This section will indicate factors which make Alternative G either more or less preferable. **Table 16** provides a summary of this information for all three alternatives F, G and H.

Evaluation factors that make Alternative G more preferable:

- Due to the northern shift of Runway 14/32 onto more level terrain, will require the least amount of grading of any of the three alternatives.
- Runway Protection Zone for Runway 32 will be completely clear of incompatible land uses and in compliance with FAA policy guidance.
- Acreage for Terminal Area development is sufficient at 38.8 acres (recommended area for terminal area development during the planning period is 24.2 acres).

Evaluation factors that make Alternative G less preferable:

- Requires construction of a temporary runway prior to completion of Primary Runway.
- Requires the construction of a new primary parallel taxiway.

ALTERNATIVE H

This alternative, found in **Exhibit 11**, has the following features:

Runway 14-32	Extend runway 7,700 x 150 feet while maintaining the current 32 threshold which will leave approximately 1,300 feet of State Highway 22 in the runway protection zone and 11 acres of the runway protection zone off of airport property
Runway 7-25	Maintain as existing
GA Apron	Expand to the west, south and east [add 29,000 sy (18,200 sy additional space for parking and apron taxilanes)]
Hangars	T-Hangars east of expanded apron
Property	Acquire an additional 202 acres

Advantages:

- All required development identified in this plan can be accommodated in this layout.
- The amount of additional land to be acquired would be the least of all three alternatives.
- The amount of land available for landside terminal area development (39.1 acres) would be sufficient to handle forecast activity during this planning period.

Disadvantages:

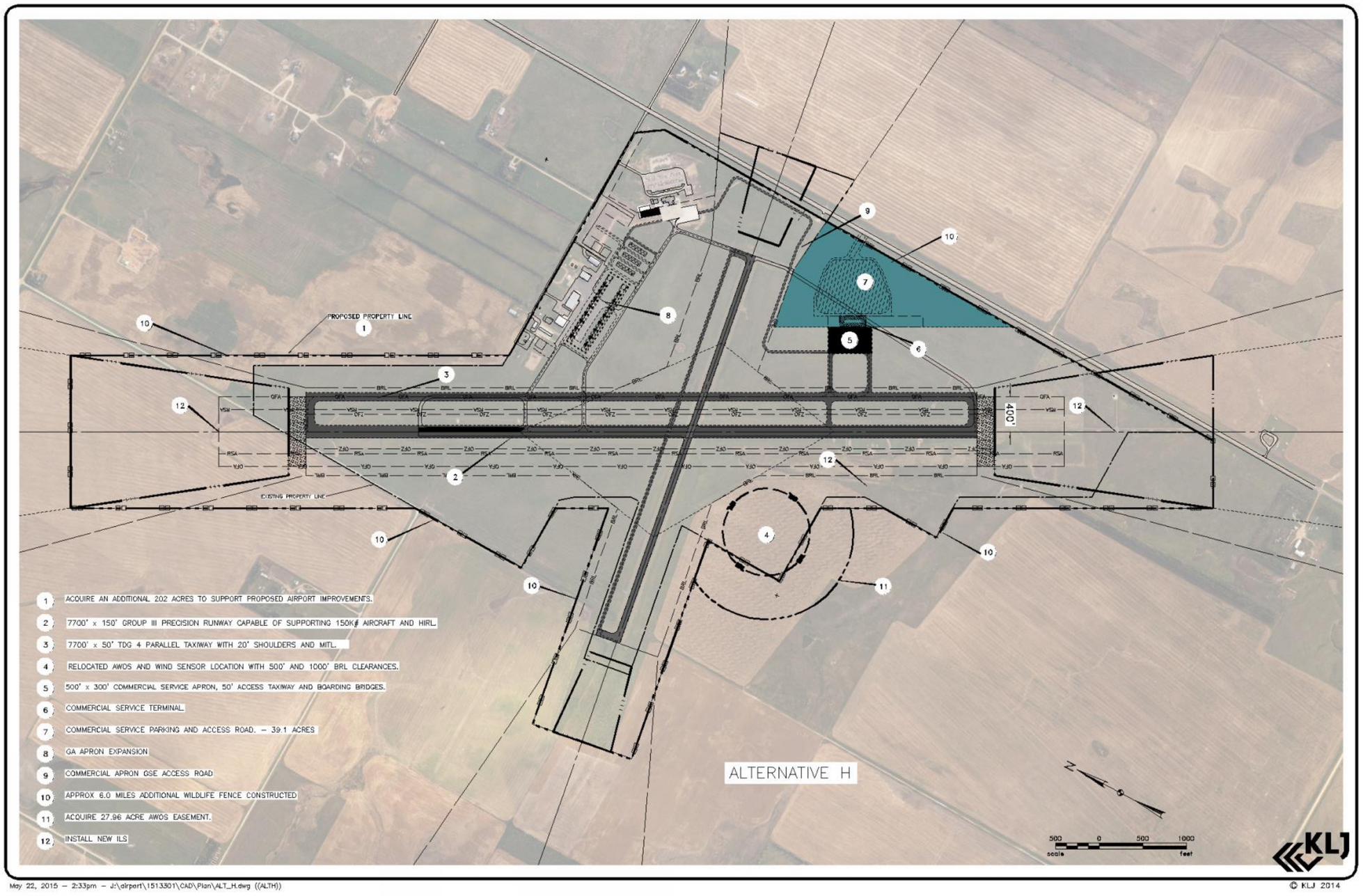
- This alternative leaves approximately 1,300 linear feet of State Highway 22 in the RPZ and 11 acres of the Runway 32 RPZ outside of airport property.
- The runway safety area for Runway 32 would require significant fill to meet safety standards.
- This configuration would likely require complete reconstruction of the runway and construction of a parallel taxiway. This will have a significant impact on airport operations during construction. The impact on airport operations will be addressed as construction phasing is considered.

Operational Performance

Alternative H involves retaining the Runway 32 threshold at its current location and extending the runway by 1,300 feet to the north. The FAA has indicated that while this alternative still includes North Dakota Highway 22 inside the Runway 32 RPZ[3], it will meet the interim land use policy regarding RPZs dated September 27, 2012, because the location of the runway threshold will not be changing. Alternative H would provide 39.1 acres available for terminal area development. All other features of this alternative are identical to Alternatives F and G.

[3] FAA Interim Guidance on Land Uses Within a Runway Protection Zone – Memorandum September 27, 2012 identifies Public Roads/Highways as a land use requiring specific mitigation efforts. If mitigation efforts are not able to remove the incompatible land use from the RPZ, then coordination with the FAA National Airport Planning and Environmental Division, APP-400 is required.

EXHIBIT 11 – ALTERNATIVE H



Alternative H: Construction Option 2 – Construct Parallel Taxiway as a Temporary Runway

Description of Project

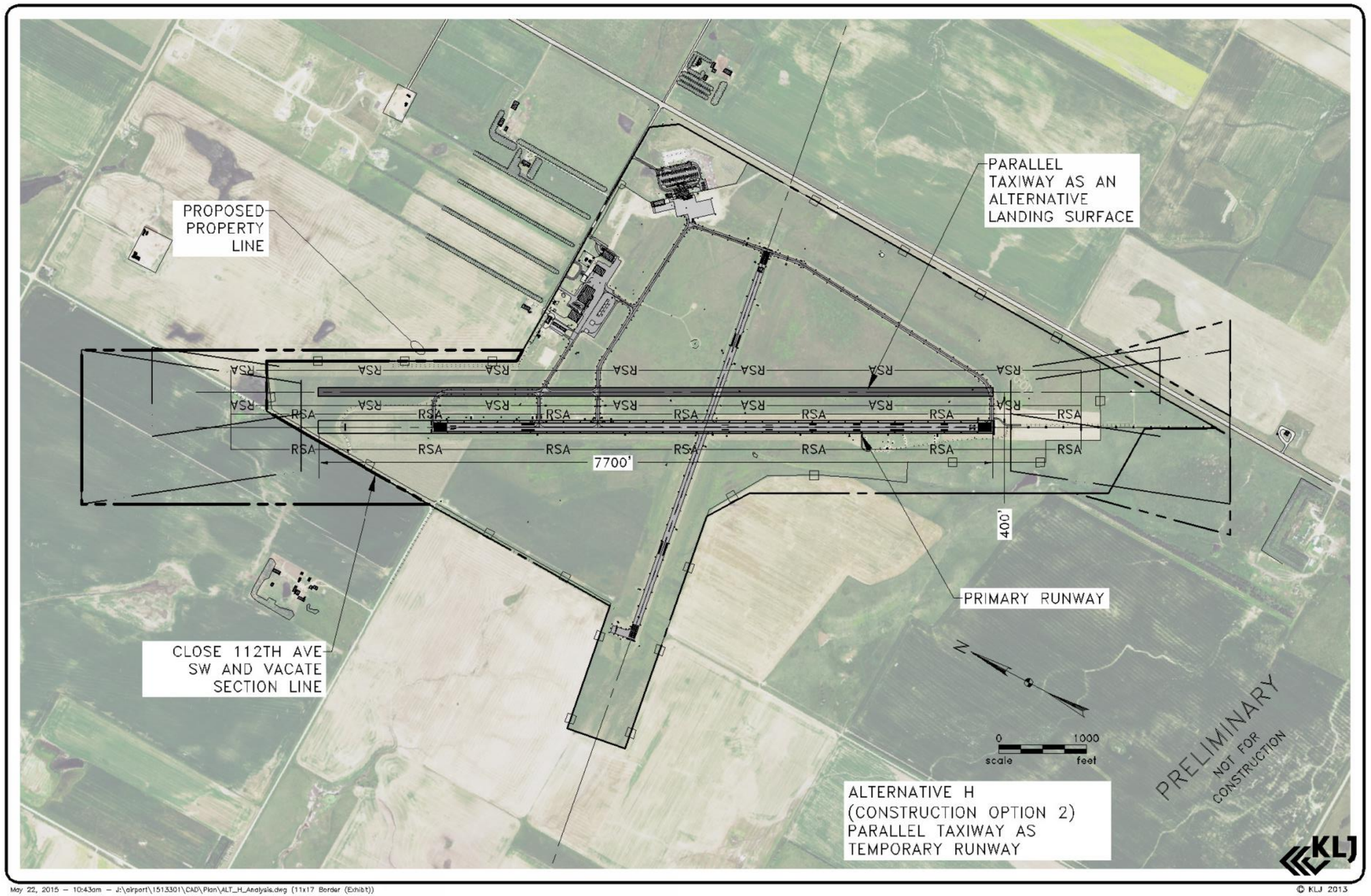
Another option to maintain service to current aircraft serving Dickinson during runway construction is to construct a full length parallel taxiway to Runway 14-32 which is capable of operating as a runway. This "super" taxiway could be constructed as a 7,700 foot long by 100 foot wide runway and used as a landing surface while the primary runway is being reconstructed. The design requirements for the parallel taxiway call for Taxiway Design Group 4 which is a 50 foot taxiway with 20 foot shoulders on each side. This results in 90 feet of pavement required for the new parallel taxiway, only 10 feet short of the 100 feet required for it to serve as a temporary runway.

The taxiway pavement could be constructed as a 50 foot taxiway with 25 foot shoulders on each side and thus have marking and lighting reconfigured to serve as the full parallel taxiway after its use as a temporary runway. For cost analysis purposes, the 25 foot shoulders have been designed to last a minimum of 5 years, and therefore have a slightly thinner pavement section, and thereby a reduced cost.

When the taxiway is initially constructed, both runway and taxiway light cans would be installed. The runway light positions would be used while it is in use as a runway, following that period, taxiway fixtures could be installed at the 50 foot taxiway width.

Exhibit 12 shows the layout for the extended and reconstructed parallel taxiway for Alternative H.

EXHIBIT 12 – ALTERNATIVE H – PARALLEL TAXIWAY FOR TEMPORARY RUNWAY



Project Costs

The construction cost estimate for this option ranges from $50,430,000 to $79,665,000. This cost estimate is for the completed primary runway and full parallel taxiway being utilized as a temporary runway only. This will provide for a temporary runway with approach visibility minimums of not lower than 1 mile which is Runway Type 5 from AC 150/5300-13A Table 3-2. **Table 8** contains a cost estimate for the parallel taxiway as temporary runway for Alternate G and H. Complete cost estimates are included in **Appendix H**.

Table 8 – Alternative H – Option 2: Parallel Taxiway Project Costs

Item	Costs for Regional Aircraft		Costs for Narrow Body	
	Asphalt	Concrete	Asphalt	Concrete
Temporary Runway				
Construct 7700' x 100' Runway Pavement	$17,112,000	$25,257,000	$20,572,000	$27,396,000
Medium Intensity Runway Lighting and PAPIs	$923,000	$923,000	$923,000	$923,000
Convert Temporary Runway back to Taxiway	$1,095,000	$1,095,000	$1,095,000	$1,095,000
Total Temporary Runway =	$19,130,000	$27,275,000	$22,590,000	$29,414,000
Primary Runway				
Land Acquisition	$498,000	$498,000	$498,000	$498,000
Airport Wildlife Fence	$616,000	$616,000	$616,000	$616,000
High Intensity Runway Lighting and PAPIs	$976,000	$976,000	$976,000	$976,000
Construct 7700’ x 150’ Primary Runway	$29,210,000	$41,763,000	$34,403,000	$48,161,000
Total Primary Runway =	$31,300,000	$43,853,000	$36,493,000	$50,251,000
Total Project =	$50,430,000	$71,128,000	$59,083,000	$79,655,000

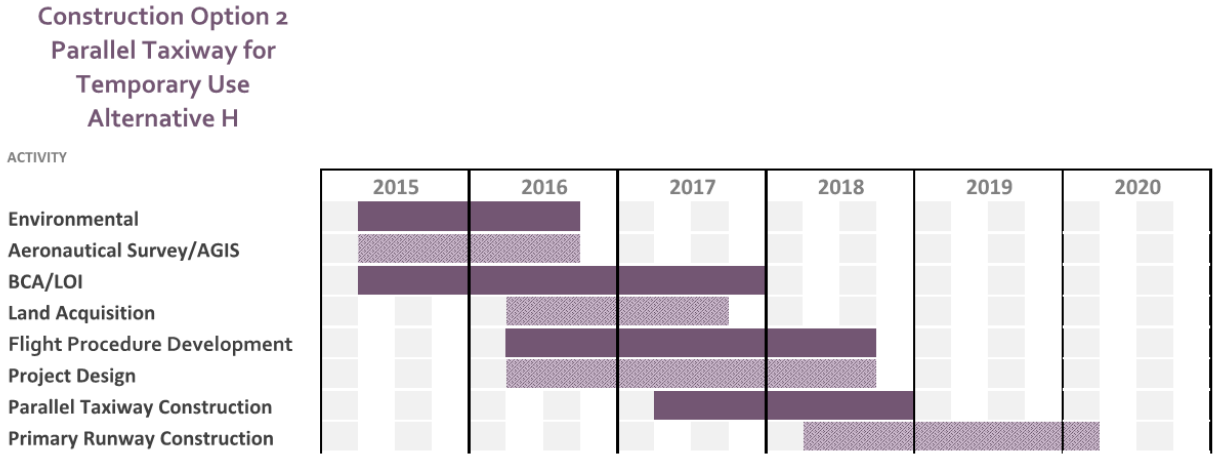
Project Phasing

Because of the airport configuration and the need to keep the airport open to the traveling public, it will be necessary to complete the construction of the temporary runway/parallel taxiway in multiple segments. The segmenting of the work will enable access to the active primary runway by at least one taxiway.

There is a portion of the parallel taxiway construction that will occur in the existing approach and departure surfaces. In order to limit airspace obstructions during construction, this 600 foot portion of the runway can be completed at nighttime with the airport closed or the Runway 14 threshold displaced. This requirement will also hold true for the New Runway option as well since it has the same separation distance from the existing primary runway. The construction of this 600 foot portion of temporary runway/parallel taxiway could be completed at night time with the airport closed or the Runway 14 threshold displaced.

The estimated timeline for this construction option is detailed in **Figure 7**. Because the parallel taxiway will need to be completed prior to proceeding with the primary runway phase, it is estimated that the runway would be operational within five years.

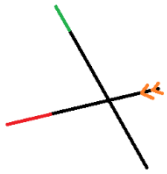
FIGURE 7 – ALTERNATIVE H – PARALLEL TAXIWAY PROJECT TIMELINE



A drawback of this option is that when aircraft are using the temporary runway as a landing surface there will only be GPS and VOR circling approaches to the runway, and no precision instrument landing system (ILS). Additionally, the lack of a parallel taxiway will require aircraft to back taxi more than 1,300 feet for this construction option.

Viability of Parallel Taxiway as a Temporary Runway Option for Dickinson

This construction option is potentially viable but requires an increased level of safety and phasing during construction periods. This option requires a greater expense upfront because of the requirement to construct the taxiway prior to the primary runway.



Alternative H: Construction Option 3 – Shift, Extend and Widen Crosswind Runway for Temporary Runway

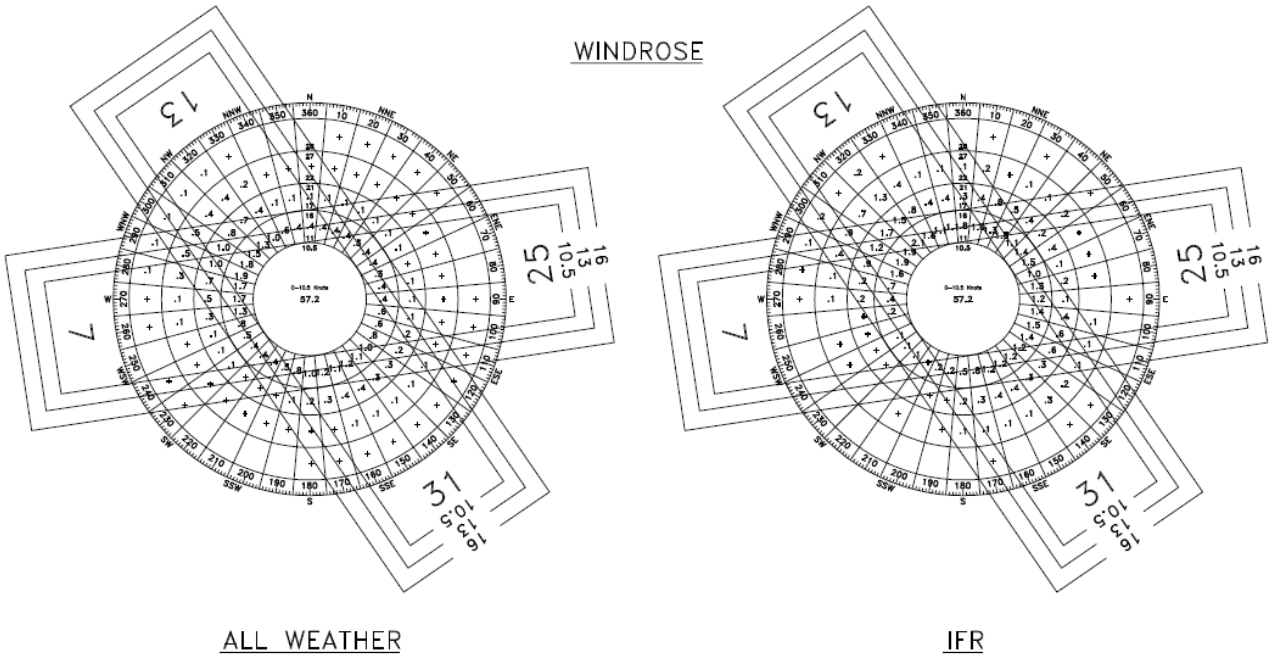
Description of Project

When a commercial service airport closes one runway to allow for major pavement rehabilitation they often transfer aircraft operations to a secondary runway, which is typically a parallel or crosswind runway. Dickinson Theodore Roosevelt Regional Airport does not have a parallel runway so the option of expanding the crosswind runway to handle commercial operations was analyzed. The crosswind runway (Runway 7-25) in Dickinson is currently 4,700 feet long and 75 feet wide. This runway is rated at a pavement strength of 16,000 pounds single wheel load/20,000 pound dual wheel load and meets the FAA design standards for Runway Design Category B-II. The length and pavement strength limitations make this runway unusable to both commercial airlines as it is currently configured. The runway protection zones are also currently sized at 500 feet wide at the inner end by 700 feet wide at the outer end and 1000 feet long.

If Runway 7-25 were modified to handle the current commercial service aircraft it would need to be upgraded to meet the needs of the current critical aircraft, the CRJ200, a D-II design aircraft with a 53,000 pound dual wheel load. To accommodate this critical aircraft, the runway would need to be 7,200 feet long and 100 feet wide based on current stage length flights for this aircraft. The runway protection zones would also be sized at 500 feet wide at the inner end by 1,010 feet wide at the outer end and 1,700 feet long. Since this is an increase in RPZ size, the threshold must be displaced by 1,190 feet to the west to comply with the FAA Interim Guidance on land use within RVZ.

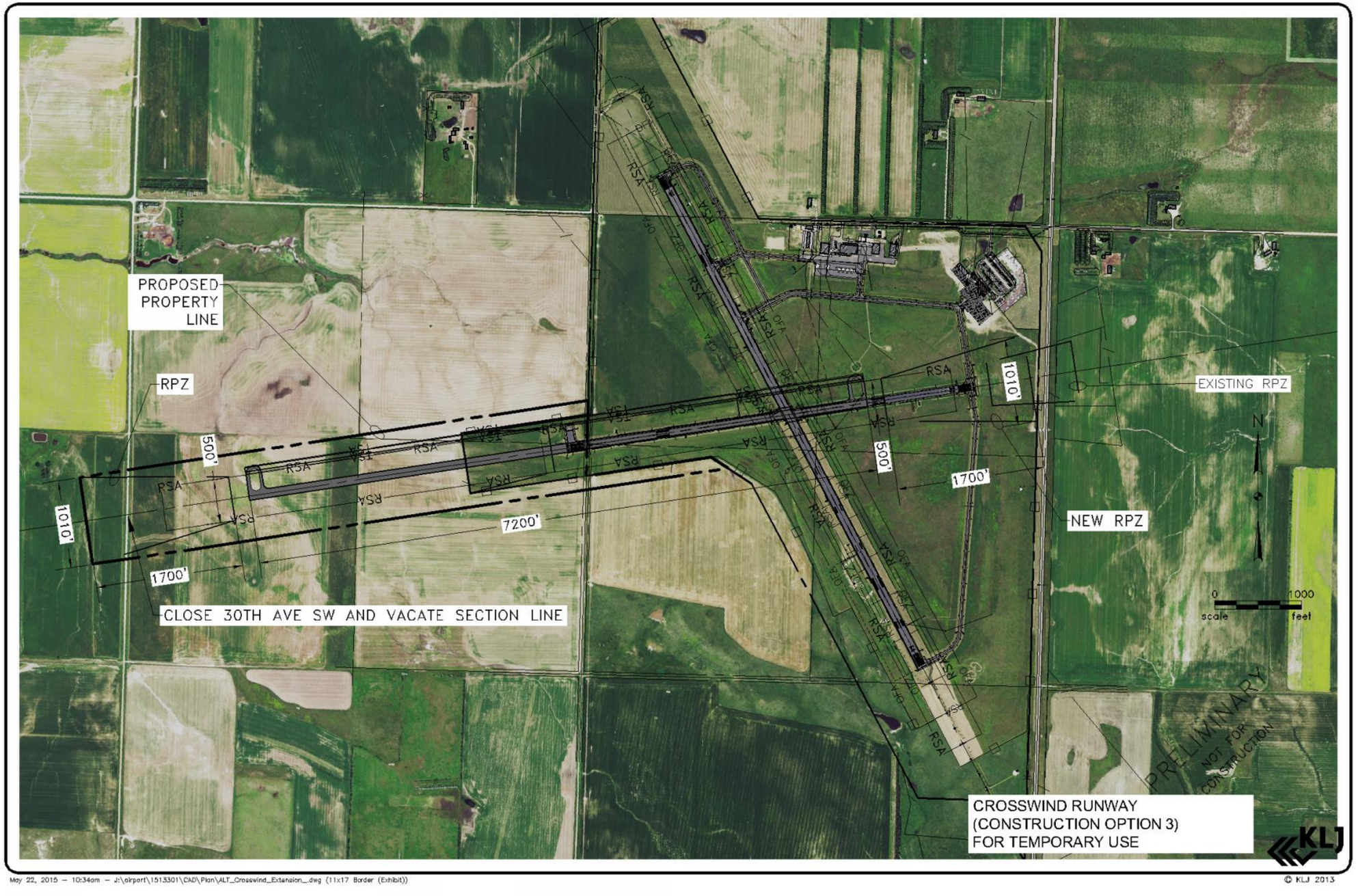
One aspect of using Runway 7-25 as the primary runway during reconstruction of Runway 14-32 is the fact that the wind coverage, particularly in IFR conditions is below the 95% coverage for 16 knots, (see **Figure 8**) which is used to determine functionality for D-II aircraft. **Exhibit 12** shows the layout for the expanded crosswind runway analysis.

FIGURE 8 – CURRENT WIND DATA – DICKINSON



	All Weather Windrose Data			IFR Weather Windrose Data		
Runway	**10.5 Knots**	**13.0 Knots**	**16.0 Knots**	**10.5 Knots**	**13.0 Knots**	**16.0 Knots**
Runway 14 - 32	84.27%	91.43%	97.10%	79.52%	88.70%	96.15%
Runway 7 - 25	78.21%	86.59%	94.27%	66.56%	77.85%	88.88%
Combined	96.19%	98.86%	99.76%	92.58%	97.14%	99.34%
Source: National Climatic Data Center						
All Weather - 83,919 Observations IFR – 6,257 Observations						
Dickinson Theodore Roosevelt Regional Airport - Station Number 72764						
2000 To 2009						
+ = Less than 0.05%						

EXHIBIT 13 – CROSSWIND RUNWAY FOR TEMPORARY USE



Project Costs

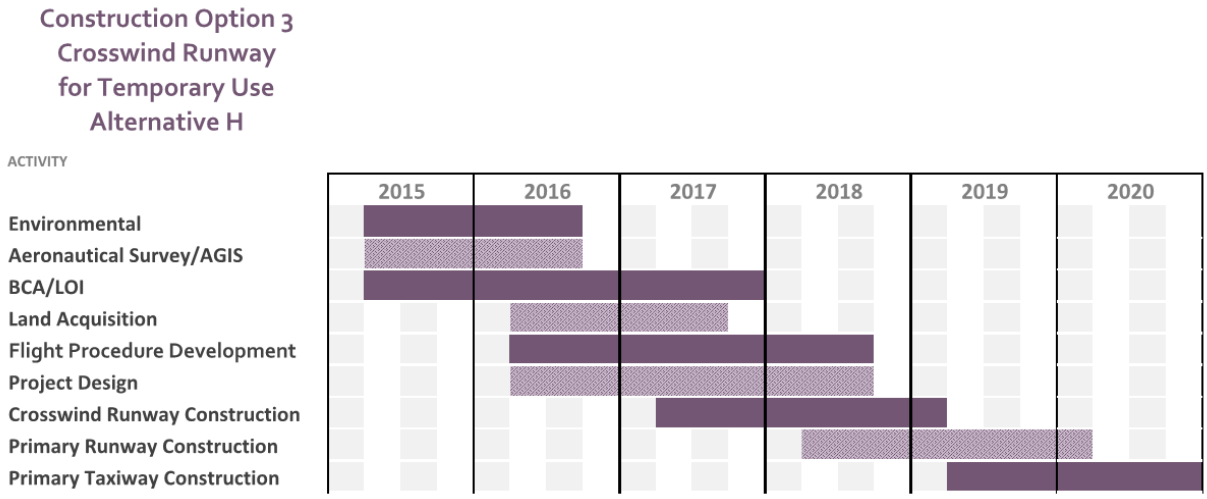
The construction cost estimate for the upgrades to Runway 7-25 to meet D-II standards would be $19,475,000. This option still requires construction of the primary runway and taxiway and would range from $63,170,000 to $88,493,000 for Alternative H – Option 3. **Table 9** contains a cost estimate for the crosswind runway expansion analysis. A detailed cost estimate is included in **Appendix H**.

Table 9 – Alternative H – Option 3: Crosswind Runway Project Costs				
Item	Costs for Regional Aircraft		Costs for Narrow Body	
	Asphalt	Concrete	Asphalt	Concrete
Temporary Runway				
Land Acquisition	$440,000	$440,000	$440,000	$440,000
Airport Wildlife Fence	$293,000	$293,000	$293,000	$293,000
Construct 7200' x 100' Runway Pavement with Turnouts on Runway Ends	$17,821,000	$17,821,000	$17,821,000	$17,821,000
Medium Intensity Runway Lighting and PAPIs	$921,000	$921,000	$921,000	$921,000
Total Temporary Runway =	$19,475,000	$19,475,000	$19,475,000	$19,475,000
Primary Runway				
Land Acquisition	$498,000	$498,000	$498,000	$498,000
Airport Wildlife Fence	$616,000	$616,000	$616,000	$616,000
Construct 7700’ x 150’ Primary Runway	$29,210,000	$41,763,000	$34,403,000	$48,161,000
Construct High Intensity Runway Lights with PAPIs	$976,000	$976,000	$976,000	$976,000
Total Primary Runway =	$31,300,000	$43,853,000	$36,493,000	$50,251,000
Primary Parallel Taxiway Phase =	$12,083,000	$16,317,000	$13,833,000	$18,455,000
Total Project =	$62,858,000	$79,645,000	$69,801,000	$88,181,000

Project Phasing

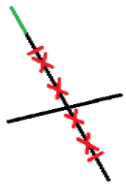
The estimated timeline for this construction option is detailed in **Figure 9**. Because the crosswind runway construction would need to be completed prior to proceeding with the primary runway phase it is estimated that the primary runway would be operational within five years. Added to that timeline is the parallel taxiway which means that the primary runway with full parallel taxiway would be operational within six years.

FIGURE 9 – CROSSWIND RUNWAY OPTION PROJECT TIMELINE



Viability of Extending Crosswind Runway Option

There are significant drawbacks to this option. First, the runway would need to be displaced by 1,190 feet to accommodate the D-II aircraft which means an additional 1,190 feet of new runway would need to be constructed on the other end. Second, the runway would need to be 7,200 feet long to accommodate the existing airline traffic which is far beyond the justifiable length of 4,700 feet for the crosswind runway at Dickinson Theodore Roosevelt Regional Airport. Lastly, to fully complete the project, the primary parallel taxiway must still be completed which will take additional money and time in comparison to other options.



Alternative H: Construction Option 4 – Displaced Primary Runway Threshold

Description of Project

It has been determined that aircraft used by the current airlines at Dickinson Theodore Roosevelt Regional Airport require a runway length of 7,200 feet for existing destinations. Additional calculations were made to determine if a shorter portion of the current 6,400 foot runway could be used temporarily and therefore allow the remainder to be reconstructed. In the calculations it was found that the most critical aircraft is the CRJ200 used daily by Delta to Minneapolis. United uses the Embraer 135 and 145 aircraft between Dickinson and Denver. See **Table 10** for a summary and **Appendix E** for details of the calculations.

Even though the crosswind runway is weight rated at 20,000 pounds (dual wheel) and is only 75 feet wide, the runway length of 4,700 feet was examined to determine if airlines could reduce the passenger load sufficiently to operate from a runway this short. The results of the analysis is summarized in **Table 10**. The load factors resulting from using a 4,700 foot runway would be 54% for a CRJ200, 70% for an Embraer 135 and 58% for an Embraer 145. This load factor is below the 80% 'break even' load factor and therefore a 4,700 foot runway would be too short to meet the airline's needs as a temporary runway during construction. Eighty percent is the 'break-even' load factor and is an 'average' based upon all arrivals and departures for SkyWest Airlines in 2013.

The 80% load factor was then examined with the most demanding aircraft being the CRJ200. An 80% load factor would be 40 of 50 passengers and the runway would be required to be 5,500 feet long. A summary of the calculations for the four different aircraft examined can be found in **Table 10**.

Table 10 – Summary of Displaced Threshold Impact*

	# of Passengers	Load Factor	Runway Length
CRJ-200 DIK to MSP	27 of 50 passengers	54%	4,700
	40 of 50 passengers	80%	5,500
Embraer 135 DIK to DEN	26 of 37 passengers	70%	4,700
	37 of 37 passengers	100%	5,500
Embraer 145 DIK to DEN	29 of 50 passengers	58%	4,700
	48 of 50 passengers	96%	5,500

** Calculations based upon ISA +15°C*

Source: Bombardier and Embraer Airport Planning Manuals, KLJ Analysis

Project Cost

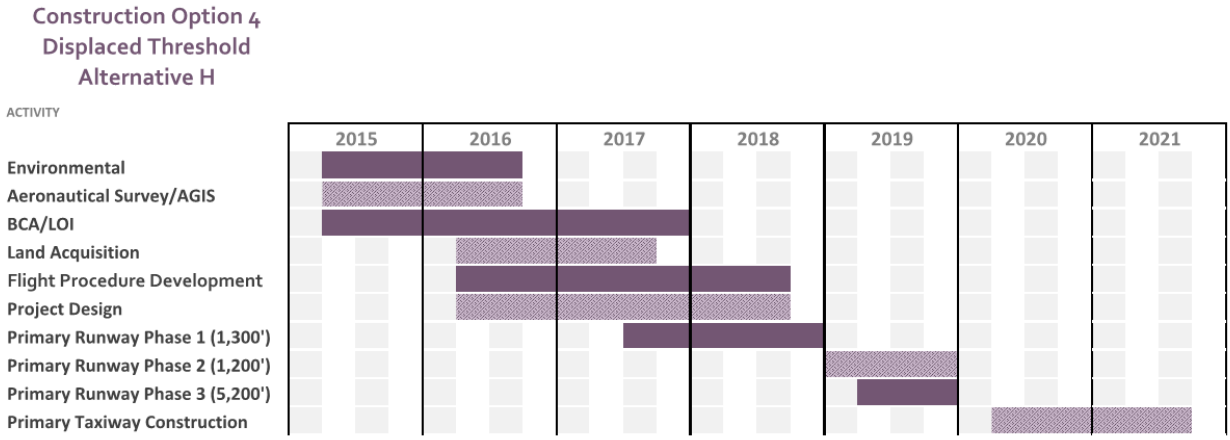
The construction cost estimate for this option ranges from $50,630,000 to $73,650,000 for Alternative H – Option 4. **Table 11** contains a cost estimate for the displaced threshold analysis. A detailed cost estimate is included in **Appendix H**.

Table 11 – Alternative H – Option: Displaced Threshold Project Costs				
Item	Costs for Regional Aircraft		Costs for Narrow Body	
	Asphalt	Concrete	Asphalt	Concrete
Primary Runway				
Land Acquisition	$498,000	$498,000	$498,000	$498,000
Airport Wildlife Fence	$616,000	$616,000	$616,000	$616,000
Construct Phase 1 (3,012')	$7,120,000	$9,220,000	$7,994,000	$10,302,000
Construct Phase 2 (1,200')	$7,803,000	$9,734,000	$8,621,000	$10,731,000
Construct Phase 3 (5,488')	$21,534,000	$27,777,000	$26,699,000	$32,072,000
High Intensity Runway Lighting and PAPIs	$976,000	$976,000	$976,000	$976,000
Total Primary Runway =	$38,547,000	$48,821,000	$45,404,000	$55,195,000
Primary Parallel Taxiway Phase =	$12,083,000	$16,317,000	$13,833,000	$18,455,000
Total Project =	$50,630,000	$65,138,000	$59,237,000	$73,650,000

Project Phasing

The estimated timeline for this construction option is detailed in **Figure 10**. The displaced threshold option will take two years to complete the primary runway construction. The first phase will extend the runway by 1,300 feet. The second phase is reconstruction of the first 1,200 feet of Runway 32. The third phase is reconstruction of the remaining 5,200 feet of runway which will require full runway closure for a period of five months. The primary runway would be operational after five years, and an additional two years to complete the parallel taxiway resulting in a total of seven years of construction.

FIGURE 10 – DISPLACED THRESHOLD OPTION PROJECT TIMELINE



Economic Impact on Airport and Local Economy of Closure

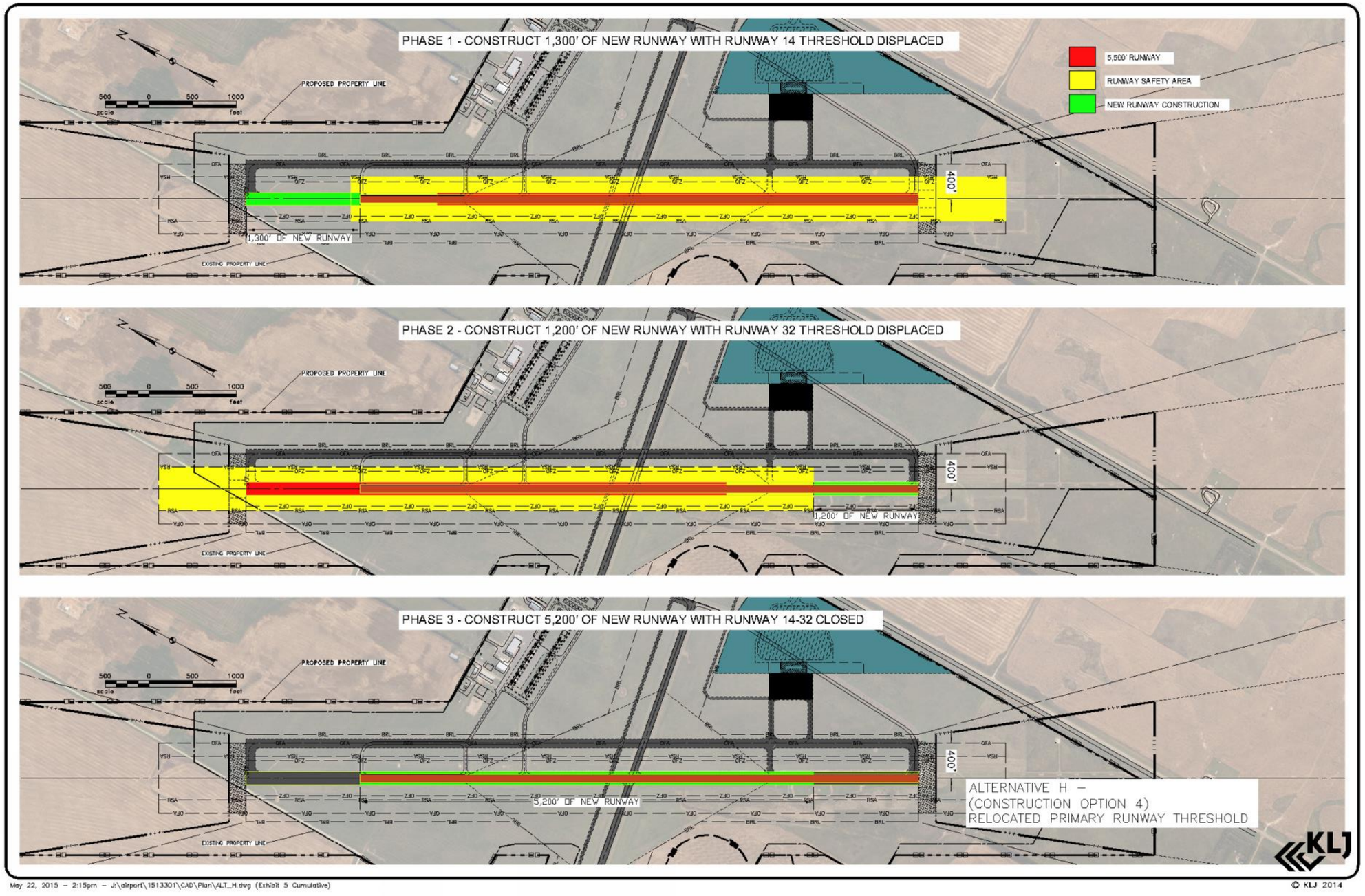
An economic impact analysis was completed based on the current level of activity at Dickinson Theodore Roosevelt Regional Airport and information obtained from the 2010 North Dakota Economic Impact of Aviation. This impact includes loss of income to the airport, airport tenants, local businesses, local tax income and cost to passengers. For the displaced threshold option, the estimated economic impact from a five-month closure for Alternative H – Option 4 is a loss of **$29,508,849**. Further information can be found in **Appendix F – Economic Impact of Airport Closure**.

Viability of Relocated Primary Runway Threshold Option for Dickinson

Given that 5,500 feet is needed for airline operations at a minimum and the existing primary runway is 6,400 feet long, portions of the existing runway could be used during this phased construction option. However, due to construction activities and runway safety areas, it would require closure of the runway to construct the middle 5,500 feet as depicted in **Exhibit 14**.

The airlines would operate with weight restrictions during the time of the displaced threshold allowing 37 to 40 passengers per departure. The displaced threshold operation and mixture of construction equipment near the runway would require a high level of coordination to assure that the airport continues to meet the requirements of Federal Aviation Regulation (FAR) Part 139 throughout the construction period.

Exhibit 14 – Alternative H – Project Phasing with Displaced Threshold



Alternative H: Construction Option 5 – Closure of Primary Runway

Project Description

Another option analyzed to reconstruct the primary runway is to completely close this runway to all operations and construct the runway within an expedited schedule. The closure of Runway 14-32 will result in suspension of airline service and most general aviation jet traffic since the crosswind Runway 7-25, at 4,700 feet long, would not be sufficient to continue these operations. This option is rarely considered at commercial service airports, unless an alternative airport capable of handling commercial service aircraft is within a short distance – such as a military base. In analysis of this option, other airports were queried to determine how complete primary runway reconstruction was handled at their airports. The findings of this research are in **Appendix G**.

In regards to constructability of this option, the work would be pursued on an expedited schedule. The elements which would need to be completed include:

- Grading of Runway Safety Areas
- Excavation of Existing Runway
- Reconstruction and widening of 6,400 feet of existing runway (including 150 feet within the existing Runway 7-25 safety area)
- Construction of 1,300 feet of new runway
- Installation of High Intensity Runway Lights
- Installation of Approach Lighting System and PAPIs
- Installation of Glide Slope Antenna
- Installation of Localizer
- Publication of Instrument Approaches (requires flight check of completed runway)[4]

[4] New Instrument Approach Procedures require an 18-24 month time period for the full development of the procedure. The final stage of this development will require flight check of the completed runway and then publication of the approach.

Project Cost

The construction cost estimate with the full closure option ranges from $43,383,000 to $68,706,000 for Alternative H – Option 5. **Table 12** provides a summary of these costs. **Appendix H** includes the detailed cost estimates for these alternatives.

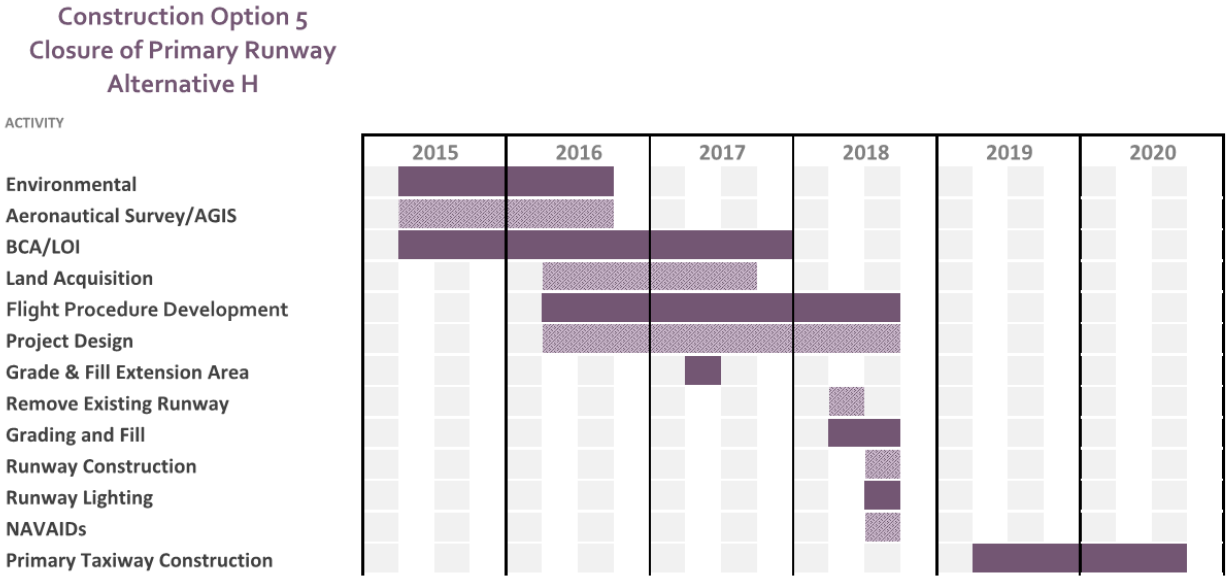
Table 12 – Alternative H – Option 5: Full Closure Project Costs

Item	Costs for Regional Aircraft		Costs for Narrow Body	
	Asphalt	Concrete	Asphalt	Concrete
Primary Runway				
Land Acquisition	$498,000	$498,000	$498,000	$498,000
Airport Wildlife Fence	$616,000	$616,000	$616,000	$616,000
Construct 7700' x 150' Runway Pavement	$29,210,000	$41,763,000	$34,403,000	$48,161,000
High Intensity Runway Lighting and PAPIs	$976,000	$976,000	$976,000	$976,000
Total Primary Runway =	$31,300,000	$43,853,000	$36,493,000	$50,251,000
Parallel Taxiway Phase =	$12,083,000	$16,317,000	$13,833,000	$18,455,000
Total Project =	$43,383,000	$60,170,000	$50,326,000	$68,706,000

Project Phasing

Experience has indicated that completion of all these elements, even when expedited, would still require an entire construction season. **Figure 11** provide the detailed timeline to complete the construction and have the runway fully operational with parallel taxiway in six years.

FIGURE 11 – FULL CLOSURE OPTION DETAILED TIMELINE



Economic Impact on Airport and Local Economy of Closure

A financial impact analysis was completed based on the current level of activity at Dickinson Theodore Roosevelt Regional Airport and information obtained from the 2010 North Dakota Economic Impact of Aviation conducted by the North Dakota Aeronautics Commission. This impact includes loss of income to the airport, airport tenants, local businesses, local tax income and cost to passengers. For the full closure option, the estimated financial impact from a nine-month closure is a loss of **$53,115,928**. Further information can be found in **Appendix F – Economic Impact of Airport Closure**.

Viability of Primary Runway Closure Option for Dickinson

A full closure option is usually considered for two primary reasons: an attempt to achieve substantial costs savings or to achieve substantial time savings, while minimizing the impact on travelers and local business. In the case of Alternative H, Option 5 - Full Closure would cost **$43.3** to **$68.7** million but also would have economic cost to the airport, tenants, customers and the community of **$53.1** million for the **9-month closure**. The total time to construct a functional runway would be the same as other options.

Alternative H – Runway Overlay Costs for Construction Options 2 and 5

For Alternative H, the FAA requested the analysis of constructing the alternative by overlaying the existing runway pavement. The overlay option was not analyzed for Alternative G. For comparative purposes, Construction Option 2 – Construct Parallel Taxiway as Temporary Runway and Construction Option 5 – Full Closure was utilized in the analysis of constructing each with an overlay. For Alternative H, the 6,400 feet by 100 feet of the existing runway would be overlaid and a 1,300 foot by 150 foot extension would be added. To meet the design aircraft requirements, the existing runway will also need to be widened 25 feet on either side of the existing runway for a total width of 150 feet. Since the primary runway will be overlaid, there will also be the need to overlay/reconstruct a portion of the intersection with the crosswind runway to allow a proper transition. This was also included in the analysis.

When an existing pavement section is overlaid adjacent to full depth construction of another pavement section, there often will be reflective cracks in the surface as a result of differential movement of the pavement sections. The base materials will be different and will eventually result in the pavement surface performing differently in the long term. The same is true for the concrete overlay option which could result in movement and cracking between the overlay and full depth construction. These cracks or movement for both the asphalt and concrete overlay could extend 6400 feet on both sides of the existing runway at the existing width of 100 feet or 25 feet from the proposed runway edge. **Exhibit 14** depicts the area that would be overlaid for Alternative H and the area that would be new pavement.

The overall project timeline for completing the work by overlay with Construction Option 2 is estimated to be the same as full reconstruction which is detailed in **Figure 7**. The costs of the overlay for Construction Option 2 – Parallel Taxiway is listed in **Table 13**.

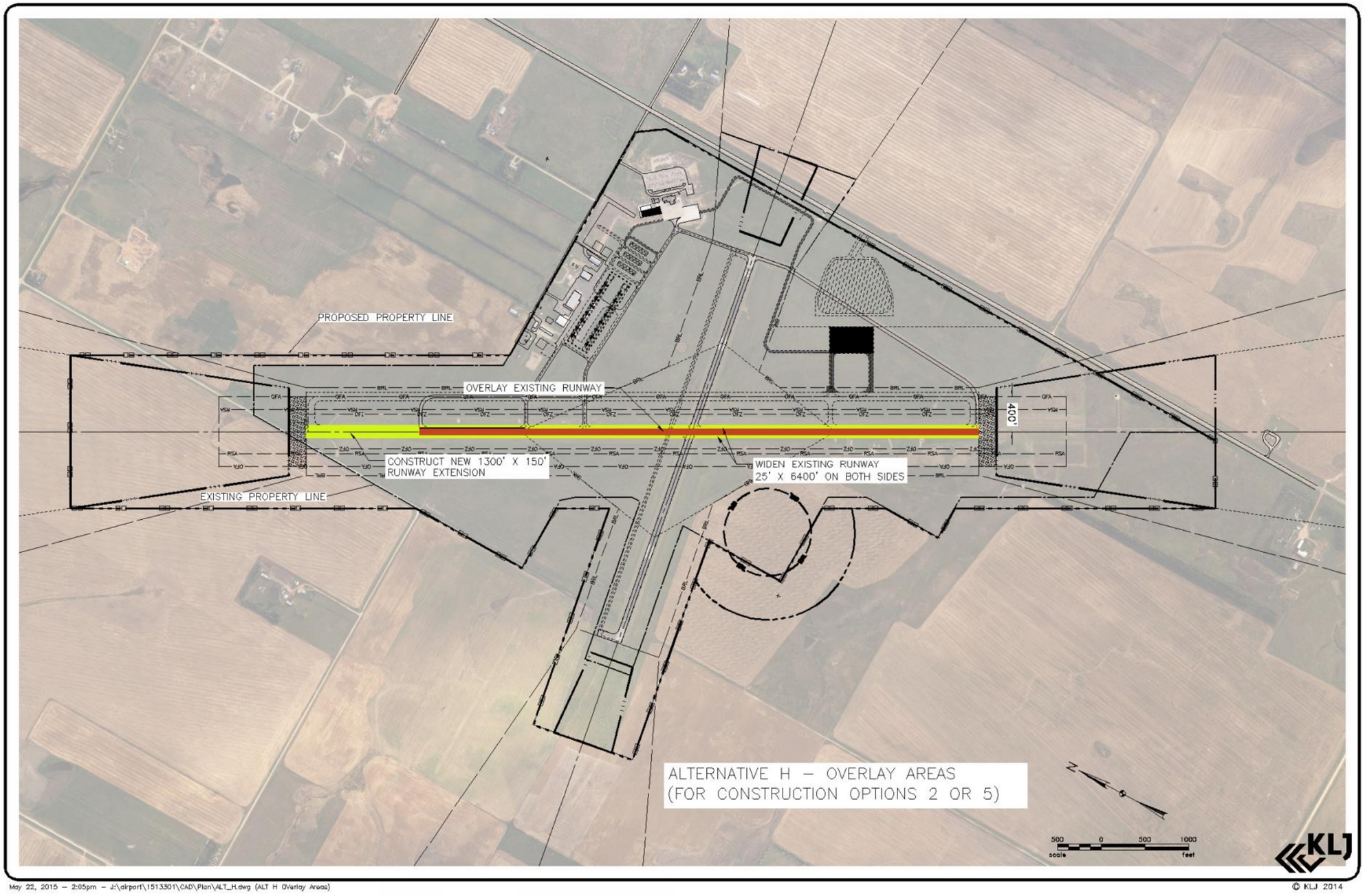
Table 13 – Alternative H – Option 2: Parallel Taxiway Project Costs - Overlay

Item	Costs for Regional Aircraft		Costs for Narrow Body	
	Asphalt	Concrete	Asphalt	Concrete
Temporary Runway				
Construct 7700' x 100' Runway Pavement	$17,112,000	$25,257,000	$20,572,000	$27,396,000
Medium Intensity Runway Lighting and PAPIs	$923,000	$923,000	$923,000	$923,000
Convert Temporary Runway back to Taxiway	$1,095,000	$1,095,000	$1,095,000	$1,095,000
Total Temporary Runway =	$19,130,000	$27,275,000	$22,590,000	$29,414,000
Primary Runway				
Land Acquisition	$498,000	$498,000	$498,000	$498,000
Airport Wildlife Fence	$616,000	$616,000	$616,000	$616,000
High Intensity Runway Lighting and PAPIs	$976,000	$976,000	$976,000	$976,000
Overlay 6400’ x 100’ Primary Runway	$6,716,000	$11,652,000	$9,501,000	$14,310,000
Construct 1300’ x 150’ and 6400’ x 25’ Widening Pavements	$6,926,000	$20,053,000	$9,198,000	$22,905,000
Total Primary Runway =	$15,732,000	$33,795,000	$20,789,000	$39,305,000
Total Project =	$34,862,000	$61,070,000	$43,379,000	$68,719,000

Construction Option 5 could also use the overlay option and thus the costs were projected. The overall project timeline for using the overlay option is estimated to be the same as detailed in **Figure 11**. The costs of the overlay for Construction Option 5 – Full Closure are listed in **Table 14**.

Table 14 – Alternative H – Option 5: Full Closure Project Costs - Overlay				
Item	Costs for Regional Aircraft		Costs for Narrow Body	
	Asphalt	Concrete	Asphalt	Concrete
Primary Runway				
Land Acquisition	$498,000	$498,000	$498,000	$498,000
Airport Wildlife Fence	$616,000	$616,000	$616,000	$616,000
Overlay 6400' x 100' Runway Pavement	$6,716,000	$11,652,000	$9,501,000	$14,310,000
Construct 1300’ x 150’ and 6400’ x 25’ Widening Pavements	$6,926,000	$20,053,000	$9,198,000	$22,905,000
High Intensity Runway Lighting and PAPIs	$976,000	$976,000	$976,000	$976,000
Total Primary Runway =	$15,732,000	$33,795,000	$20,789,000	$39,305,000
Parallel Taxiway Phase =	$12,083,000	$16,317,000	$13,833,000	$18,455,000
Total Project =	$27,815,000	$50,112,000	$34,622,000	$57,760,000

Exhibit 15 – Alternative H – Pavement Overlay and New Paving Area



Alternative H – Summary Analysis

The following information will indicate factors which make Alternative H either more or less preferable. **Table 16** provides a summary of this information for all three alternatives F, G and H.

Evaluation factors that make Alternative H more preferable:

- Requires only 202 acres, the least amount of land acquisition of any of the three alternatives.
- Overlaying the existing runway to construct the runway would provide the lowest construction cost option of any of the alternatives.
- Acreage for Terminal Area development is sufficient at 39.1 acres (recommended area for terminal area development during the planning period is 24.2 acres).

Evaluation factors that make Alternative H less preferable:

- RPZ for Runway 32 will still have an incompatible land use with 1,300 linear feet of North Dakota Highway 22 inside the RPZ.
- Runway Safety Area requires the greatest amount of grading of the three alternatives, potentially disrupting additional archaeological artifacts, which have been found in previous projects in that area of the airport.
- Requires Temporary Runway construction prior to completion of the Primary Runway.
- Alternative H would cost $27.8[5] to $88.1 million as compared to Alternative F at $39.5 to $62.8.

[5] Lowest cost without airport closure is $34.8 million. Economic Loss to the Community of $53.1 million for 9-month full closure.

SUMMARY CONCLUSION FOR ALTERNATIVES

This document has examined the existing conditions at the Dickinson Theodore Roosevelt Regional Airport, completed an extensive aviation forecast study to determine the future aviation activity at the airport, developed concepts and requirements necessary to support the forecast activity and analyzed three alternatives to evaluate their ability to accommodate the forecast aviation activity.

Various construction options for each of those alternatives were analyzed to determine the feasibility and challenges with each alternative and begin initial design on each of the options to determine the constructability and cost estimates for each.

The level of analysis used in this master plan to look at the three alternatives is much more detailed in examining construction issues than is typically conducted in a master plan. There are 44 different options that have been identified, including detailed cost estimates for the various construction options for the three evaluated alternatives. This effort was for the purpose of completely vetting each option to determine if there was significant savings in time or money could be achieved in a particular option.

Table 15 – Summary of Alternatives

Alternatives	Construction Options	Costs	Timeline
F	Option 1	$39.5 to $62.8 million	7 years
G	Options 2 through 5	$39.4[6] to $84.2 million	5 to 7 years
H	Options 2 through 5	$27.8[7] to $88.1 million	5 to 7 years

RECOMMENDED & PREFERRED ALTERNATIVE

Following the detailed analysis of Alternatives F, G and H, in the fall of 2014, multiple cultural features were discovered during a construction project unrelated to this Master Plan around the approach end of Runway 32. Additional surveys discovered additional features south of the threshold, west of runway 14-32, south of the crosswind runway. The area of these cultural features is within the grading limitations area of Alternatives F and H but is outside of the grading limitations area for Alternative G. See **Exhibits 16, 17, 18** and **19** which show area of avoidance and the grading limitations of each of the three Alternatives.

As a conclusion to this alternative chapter and as a result of discovery of cultural features, the only alternative that can be pursued without impacting these environmentally sensitive features is **Alternative G with the use of Construction Option 2**. This option will construct a full length parallel taxiway to be used as a runway, while the existing runway is reconstructed and extended to the north. It is recommended that this option be constructed to accommodate narrow body aircraft. The summary of costs and project phasing are provided in **Table 16** and **Figure 12** following. In summary, **Table 17 – Evaluation Criteria for Alternatives** is provided which summarizes the three Alternatives F, G and H.

[6] Lowest cost without airport closure is $47.1 million. Economic Loss to the Community with Option 5 is $53.1 million (9-month full closure) or Option 4 loss is $17.1 million (3-month closure).

[7] Lowest cost without airport closure is $34.8 million. Economic Loss to the Community with Option 5 is $53.1 million (9-month full closure) or Option 4 loss is $29.5 million (5-month closure).

Table 16 – Alternative G – Option 2: Parallel Taxiway Project Costs				
Item	Costs for Regional Aircraft		Costs for Narrow Body	
	Asphalt	Concrete	Asphalt	Concrete
Temporary Runway/Parallel Taxiway				
Construct 7700' x 100' Runway Pavement	$17,203,000	$25,631,000	$20,646,000	$27,762,000
Medium Intensity Runway Lighting and PAPIs	$890,000	$890,000	$890,000	$890,000
Convert Temporary Runway back to Taxiway	$1,095,000	$1,095,000	$1,095,000	$1,095,000
Total Temporary Runway/Parallel Taxiway =	*$19,188,000*	*$27,616,000*	*$22,631,000*	*$29,747,000*
Primary Runway				
Land Acquisition	$531,000	$531,000	$531,000	$531,000
Airport Wildlife Fence	$556,000	$556,000	$556,000	$556,000
High Intensity Runway Lighting and PAPIs	$976,000	$976,000	$976,000	$976,000
Construct 7700’ x 150’ Primary Runway	$45,902,000	$38,488,000	$31,132,000	$44,949,000
Total Primary Runway =	*$28,001,000*	*$40,551,000*	*$33,195,000*	*$46,949,000*
Total Project =	**$47,189,000**	**$68,167,000**	**$55,826,000**	**$76,696,000**

FIGURE 12 – ALTERNATIVE G – PARALLEL TAXIWAY PROJECT TIMELINE

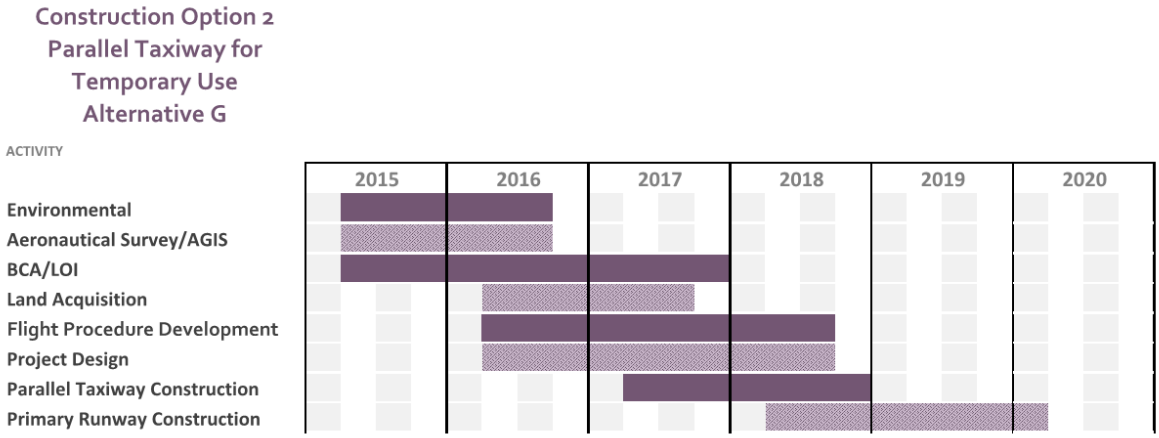


EXHIBIT 16 – CULTURAL FINDINGS

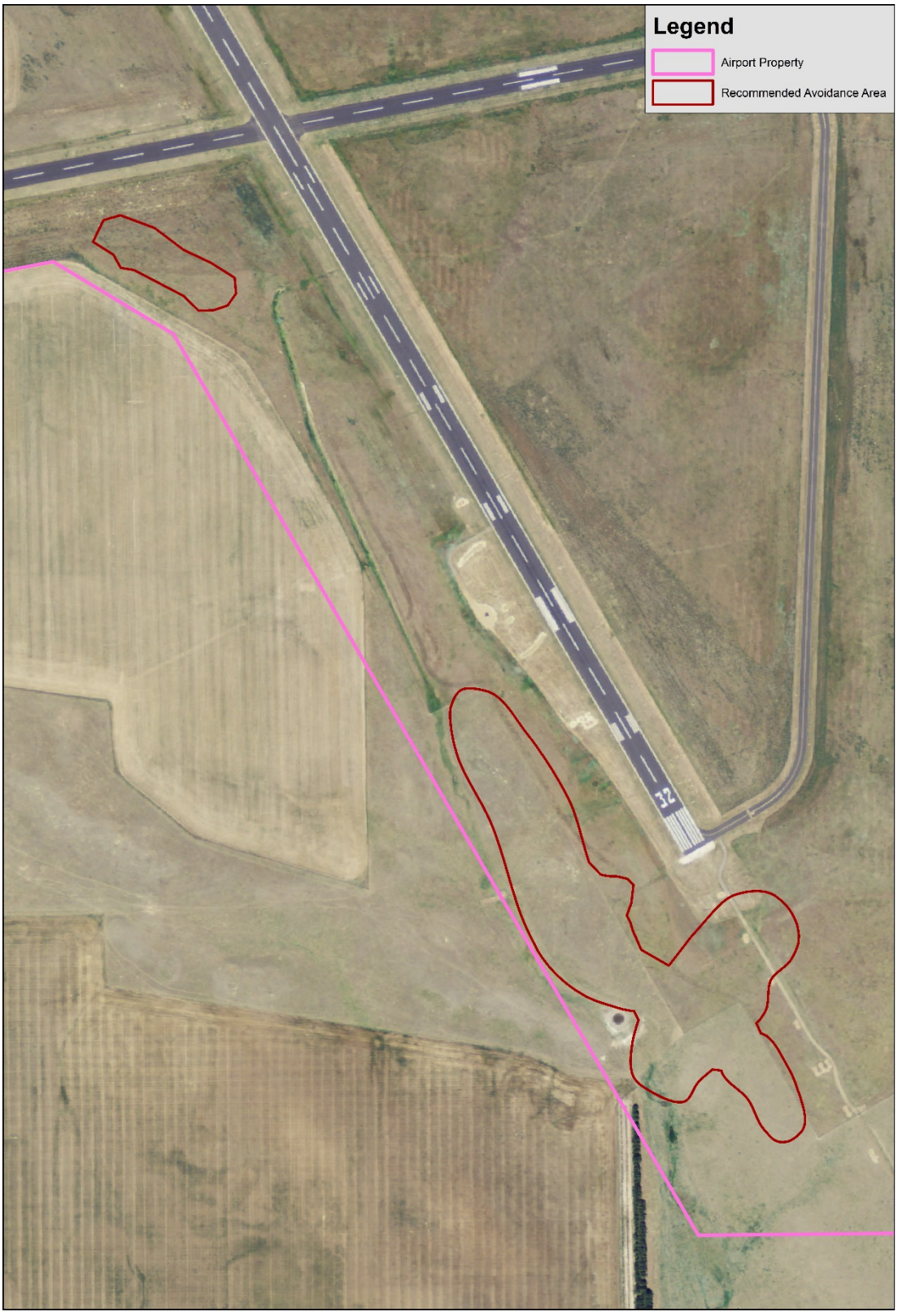


EXHIBIT 17 – CULTURAL FINDINGS AND ALTERNATIVE F GRADING LIMITATIONS

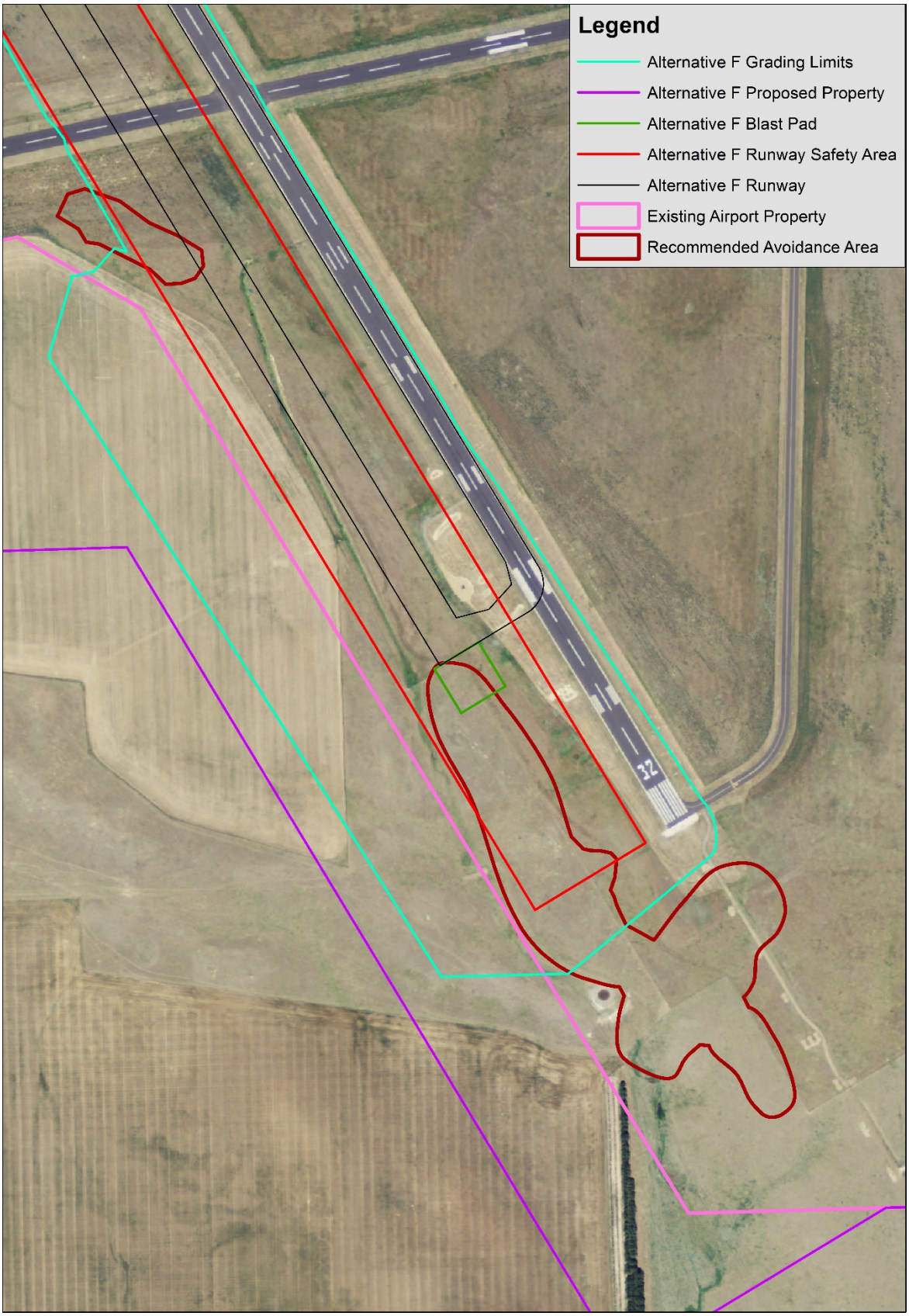


EXHIBIT 18 – CULTURAL FINDINGS AND ALTERNATIVE G GRADING LIMITATIONS

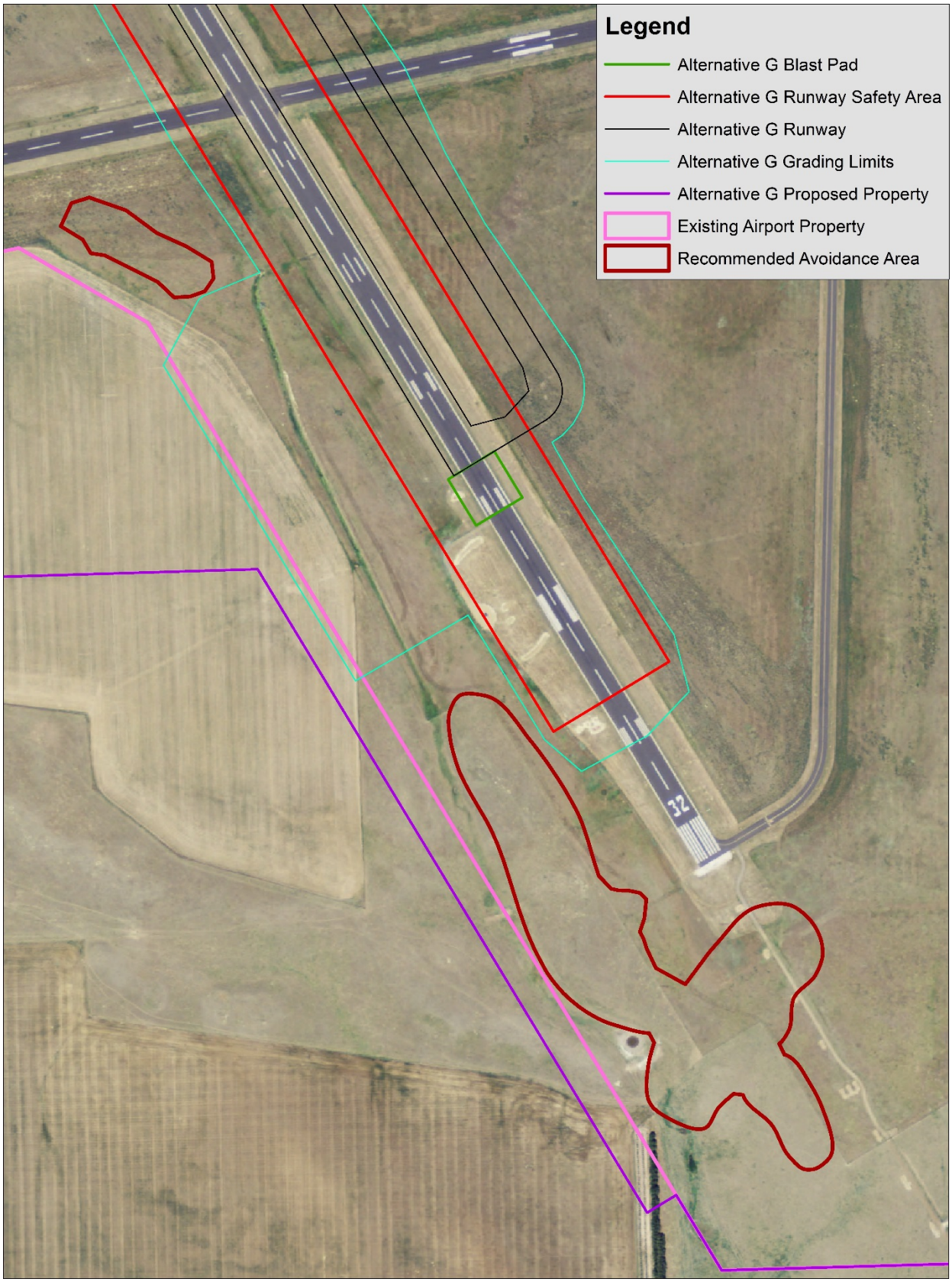


EXHIBIT 19 – CULTURAL FINDINGS AND ALTERNATIVE H GRADING LIMITATIONS

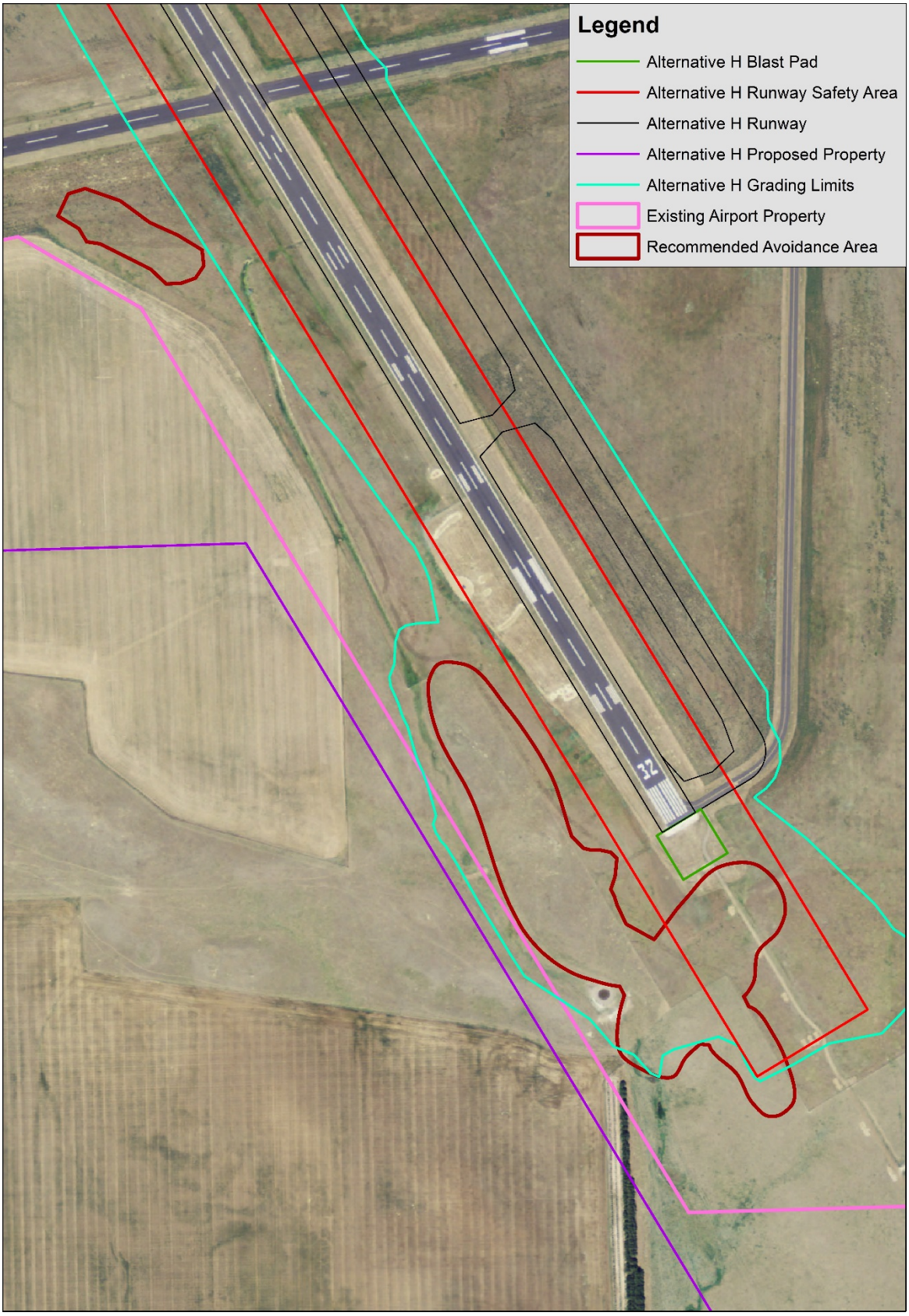


Table 17 – Evaluation Criteria for Alternatives				
Criteria	**Recommended**	**F**	**G**	**H**
Operational Performance				
Primary Runway ***Current 6,400' x 100'***	7,700' x 150'	Meets	Meets	Meets
Parallel Taxiway ***Current Partial Parallel 35'***	7,700' x 50'	Meets	Meets	Meets
Crosswind Runway ***Current 4,700' x 75'***	4,700' x 75'	Meets	Meets	Meets
Parallel Taxiway ***Current None***	4,700' x 35'	Meets	Meets	Meets
Terminal Facilities	See Requirements Matrix Chapter 4	Meets	Meets	Meets
Airline Terminal Area ***Current 17.6 acres***	24.2 acres	76.7 acres	38.8 acres	39.1 acres
General Aviation Facilities	See Requirements Matrix Chapter 4	Meets	Meets	Meets
Land Acquisition Required	Acquire as Necessary	297 acres	232 acres	202 acres
FAA Design Standards – Pertinent to Alternatives Analysis				
Runway Protection Zone (Runway 32)	Meet FAA Standards	No Incompatible Land Uses	No Incompatible Land Uses	1,300 linear feet of ND Highway 22 remains inside RPZ as an Incompatible Land Use (20.5 acres of Runway 32 RPZ [east of Hwy 22] will not be airport property)

Table 17 – Evaluation Criteria for Alternatives				
Criteria	**Recommended**	**F**	**G**	**H**
Runway Safety Area (Runway 32)	Meet FAA Standards	D-III Some Grading and Fill Required	D-III Limited Grading and Fill Required	D-III Substantial Grading and Fill Required
Environmental Factors				
All factors as prescribed by FAA to consider	Meet FAA Standards	Preliminary cultural findings were found within the grading limitations of the construction work and resulted in the Alternative no longer being feasible.	Preliminary cultural findings were found outside of the grading limitation of the construction work and resulted in this Alternative being the only one feasible.	Preliminary cultural findings were found within the grading limitations of the construction work and resulted in the Alternative no longer being feasible.
Construction Options				
1 Construct New Runway – 400' West		**Total Cost** - $39.5 to $62.8 million	Not Applicable	Not Applicable
2 Parallel Taxiway for Temporary Runway		Not Applicable	**Total Cost** - $47.1 to $76.6 million	**Total Cost** - $50.4 to $79.6 million **Overlay Option** - $34.8 to $68.7 million
3 Crosswind Runway for Temporary Runway		Not Applicable	**Total Cost** - $58.9 to $84.2 million	**Total Cost** - $62.8 to $88.1 million
4 Displaced Threshold		Not Applicable	**Total Cost** - $43.6 to $69.1 million **Economic Cost of 3 Month Closure** $17.7 million	**Total Cost** - $50.6 to $73.6 million **Economic Cost of 5 Month Closure** $29.5million
5 Full Runway Closure		Not Applicable	**Total Cost** - $39.4 to $64.7 million **Economic Cost of 9 Month Closure** $53.1 million	**Total Cost** - $43.3 to $68.7 million **Overlay Option** - $27.8 to $57.7 million **Economic Cost of 9 Month Closure** $53.1 million