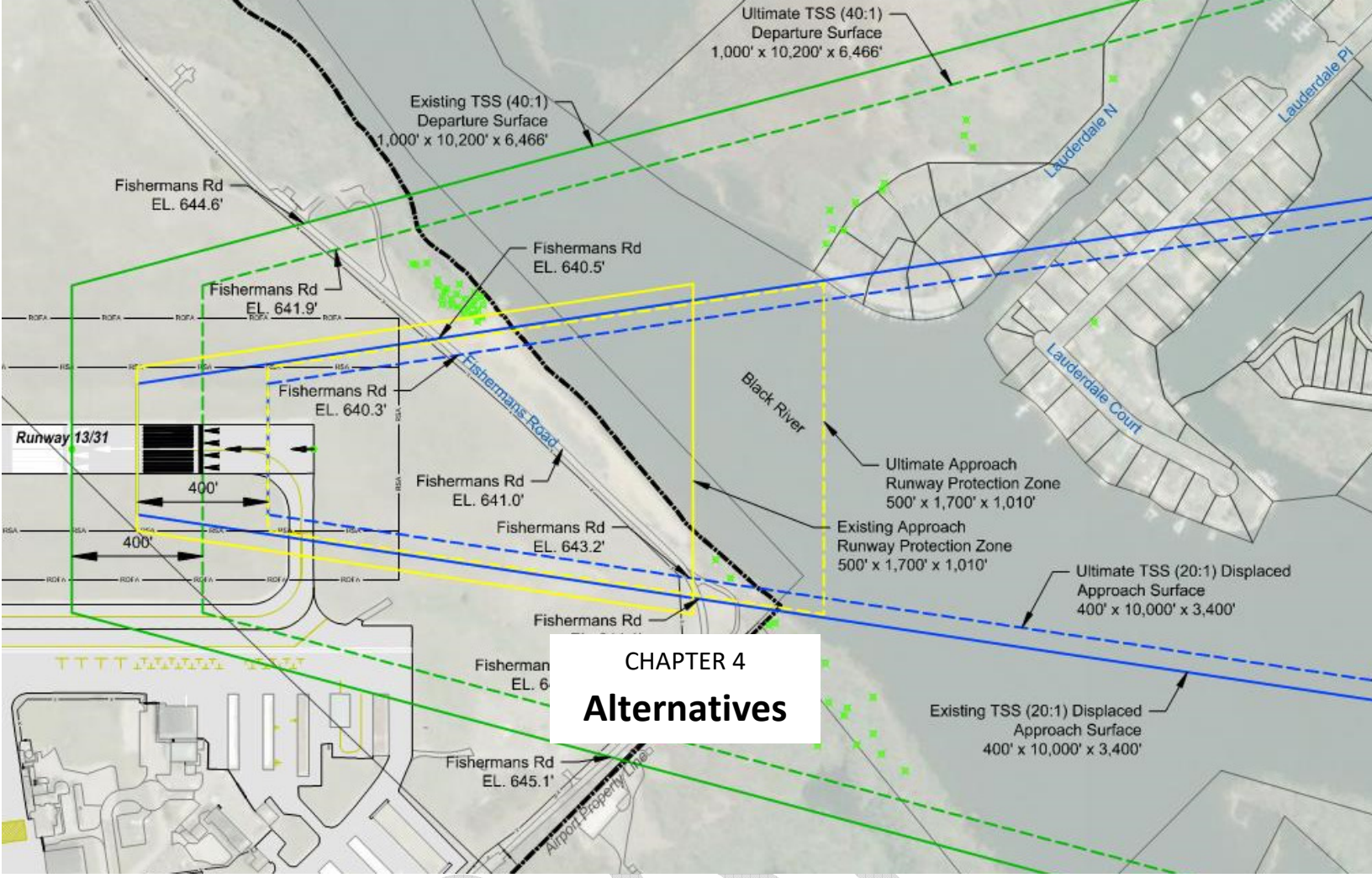

CHAPTER 4

Alternatives

4.1. Introduction

This chapter presents and analyzes alternatives developed to meet needs identified in the facility requirements chapter. The alternatives take into consideration long-term development at LSE while addressing near-term needs, with various scenarios for each need identified. Alternatives are presented and analyzed in the following sections:

- Runway 04/22 Alternatives
- Runway 13/31 Alternatives
- Taxiway & Apron Alternatives
- Instrument Approach Alternatives
- South General Aviation (GA) Area Alternatives
- Aeronautical Development Area Alternatives
- Non-Aeronautical Development Area Alternatives
- Snow Removal Equipment (SRE) Facility Alternatives
- Aircraft Rescue and Firefighting (ARFF) Facility Alternatives
- Passenger Terminal Alternatives
- Solar Feasibility Study
- Summary

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4.2. Runway 04/22 Alternatives

As discussed in previous chapters, Runway 04/22 is aging but not needed for wind coverage or airfield capacity purposes. This section presents and compares alternatives for the ultimate disposition of Runway 04/22 and recommends a preferred alternative.

Runway 04/22 is currently 5,199 feet long and 150 feet wide. As discussed in Chapter 3, *Facility Requirements*, aircraft that use Runway 04/22 are primarily general aviation (GA) aircraft with a maximum gross weight of 12,500 pounds or less. Weighing 12,500 pounds or less classifies these aircraft as *small aircraft* as defined by Federal Aviation Administration (FAA) Advisory Circulars (AC) 150/5300-13A, *Airport Design*, and 150/5325-4B, *Runway Length Requirements for Airport Design*. The GA fleet mix using Runway 04/22 has a runway design code (RDC) of A-I/B-I (Chapter 3, Sections 3.3.1 and 3.3.2). The key A-I/B-I design standards for Runway 04/22 are summarized in **Table 4-1**.

Table 4-1: Ultimate Runway Design Standards for Runway 04/22 – B-I Small Aircraft

Type	Dimensions (feet)	
Runway Width	60	
Runway Safety Area (RSA)	Length beyond departure end	240
	Length prior to threshold	240
	Width	120
Runway Object Free Area (ROFA)	Length beyond departure end	240
	Length prior to threshold	240
	Width	250
Runway Protection Zone (RPZ)	Length	1,000
	Inner Width	250
	Outer Width	450

Source: Figure 3-5, AC 150/5300-13A, Airport Design

The critical aircraft for Runway 04/22 length are small propeller-driven aircraft with fewer than 10 passenger seats and were analyzed under guidelines in AC 150/5325-4B. Based on the critical aircraft, the AC recommends a length of 3,200 feet for Runway 04/22. This length was determined using field elevation and temperature (mean day maximum hot month), as shown in Figure 2-1 from AC 150/5325-4B (see Chapter 3, Figure 3-6).

Many GA users would prefer to keep Runway 04/22 active due to its convenient location near the GA hangar area and the separation it provides between GA and air carrier traffic. As discussed in Chapter 3, Runway 04/22 serves a purpose for GA users, but is not absolutely necessary to operations at LSE. As a result, these four alternatives for Runway 04/22 address scenarios for maintaining or decommissioning the runway:

- Reconstruct Runway 04/22
- Shorten on the Runway 04 End
- Shorten on Both Ends of Runway 04/22
- Decommission and Remove Runway 04/22

4.2.1. Alternative 1: Reconstruct Runway 04/22

As discussed in Chapter 1, *Inventory*¸ during a pavement condition survey done at LSE in 2015, portions of Runway 04/22 received PCI scores ranging from the 20 to 60 (poor to fair condition). Due to the deteriorating pavement and foreign object debris (FOD) present across the entire length of the runway, it will soon require complete reconstruction. **Figure 4-1** illustrates the standards associated with reconstructing Runway 04/22 at its existing width and length, replacing the existing high intensity runway edge lights (HIRL) with light emitting diode (LED) medium intensity runway edge lights (MIRL), and repairing the existing PAPIs. The estimated cost for design and construction is $3.3 million. Because the runway is not necessary for wind coverage or capacity purposes according to FAA criteria, without a change in FAA criteria, these costs will be borne entirely by the Airport. This alternative also would not resolve geometry and runway incursion issues associated with the five-way intersection of Taxiways A, A3, and B.

4.2.2. Alternative 2: Shorten on the Runway 04 End

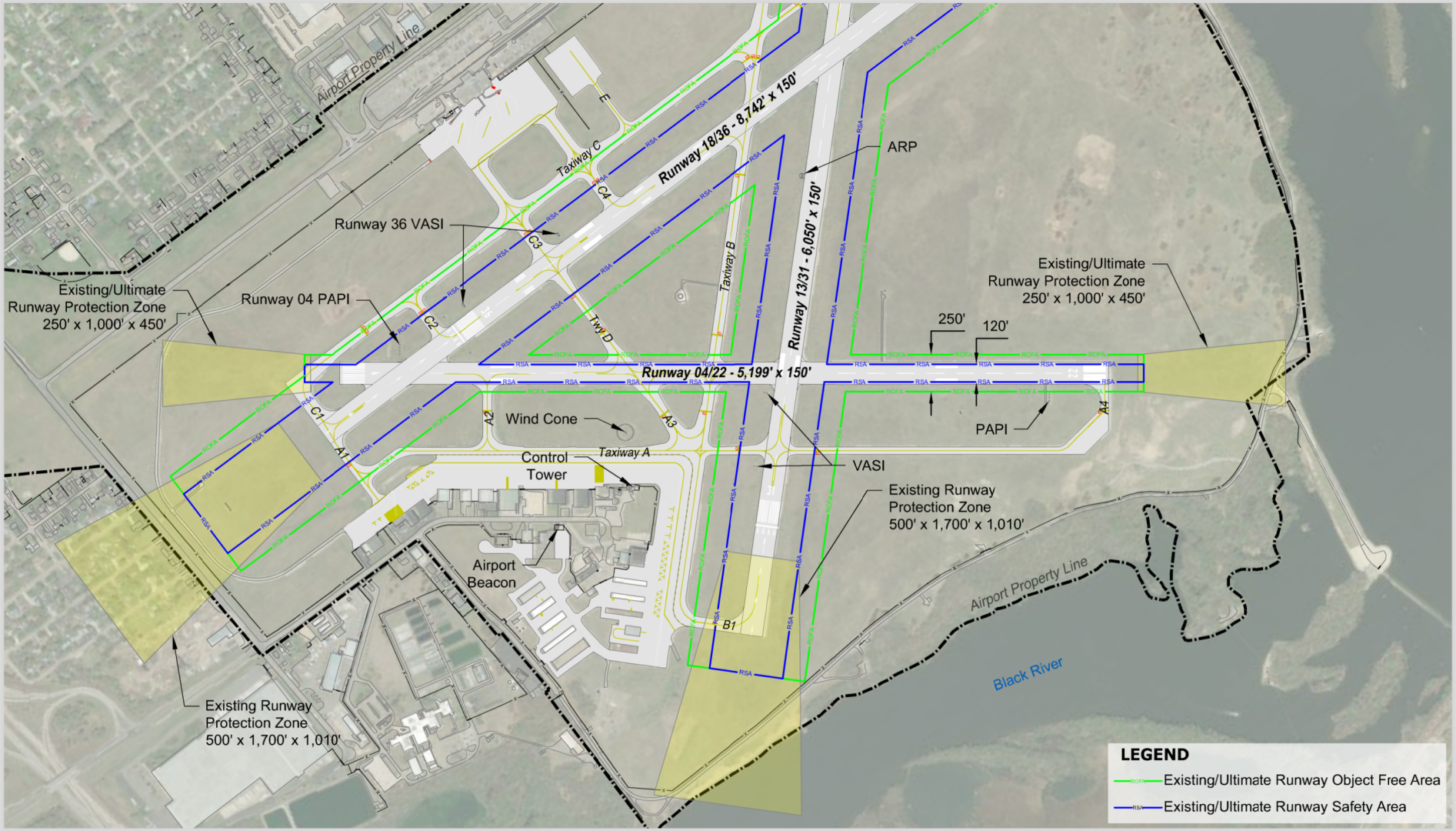
Alternative 2 would shorten Runway 04/22 to 3,200 feet by removing 1,999 feet of pavement on the Runway 04 end and narrow the runway to 60 feet by removing the outer 45 feet of pavement width on each side of the runway. This alternative would also remove the existing lighting from the runway to make it a daytime visual runway. Alternative 2 (**Figure 4-2**) meets runway length requirements and A-I/B-I design standards established in Chapter 3. The estimated cost for design and construction of this alternative is $2.7 million. This estimate includes removing Taxiways A2, A3, and D (see Section 4.4 for more information regarding removal of these taxiways) and replacing them with a 90-degree connector taxiway from Taxiway A to the relocated Runway 04 end. Because the runway is not necessary according to FAA criteria, without a change in FAA criteria, these costs will be borne entirely by the Airport.

4.2.3. Alternative 3: Shorten on Both Ends of Runway 04/22

Alternative 3 (**Figure 4-3**), a variation on Alternative 2, would relocate both runway thresholds, with approximately 1,375 feet removed on the Runway 04 end, approximately 625 feet removed on the Runway 22 end, and the runway width reduced to 60 feet. Consideration was given to co-locating the Runway 04 threshold with existing Taxiway A2; however, this concept was dismissed because Taxiway C would be in the Runway 04 RPZ. Reducing length on each runway end as proposed by this alternative would prevent the runway protection zones (RPZ) from crossing Taxiway C to the southwest and Fishermans Road to the northeast. This alternative would also remove the existing lighting from the runway to make it a daytime visual runway. The estimated cost for design and construction of this alternative is $3.2 million. This estimate includes removing Taxiways A2, A3, A4, and D (see Section 4.4 for more information), removing the northeastern portion of Taxiway A, and constructing new connector taxiways from Taxiway A to the relocated runway ends. Because the runway is not necessary per FAA criteria, without a change in FAA criteria, these costs will be borne entirely by the Airport.

4.2.4. Alternative 4: Decommission and Remove Runway 04/22

Alternative 4 (**Figure 4-4**) would close and decommission Runway 04/22. This alternative would remove all runway pavement, Taxiways A2 and A4, and the northeastern portion of Taxiway A.



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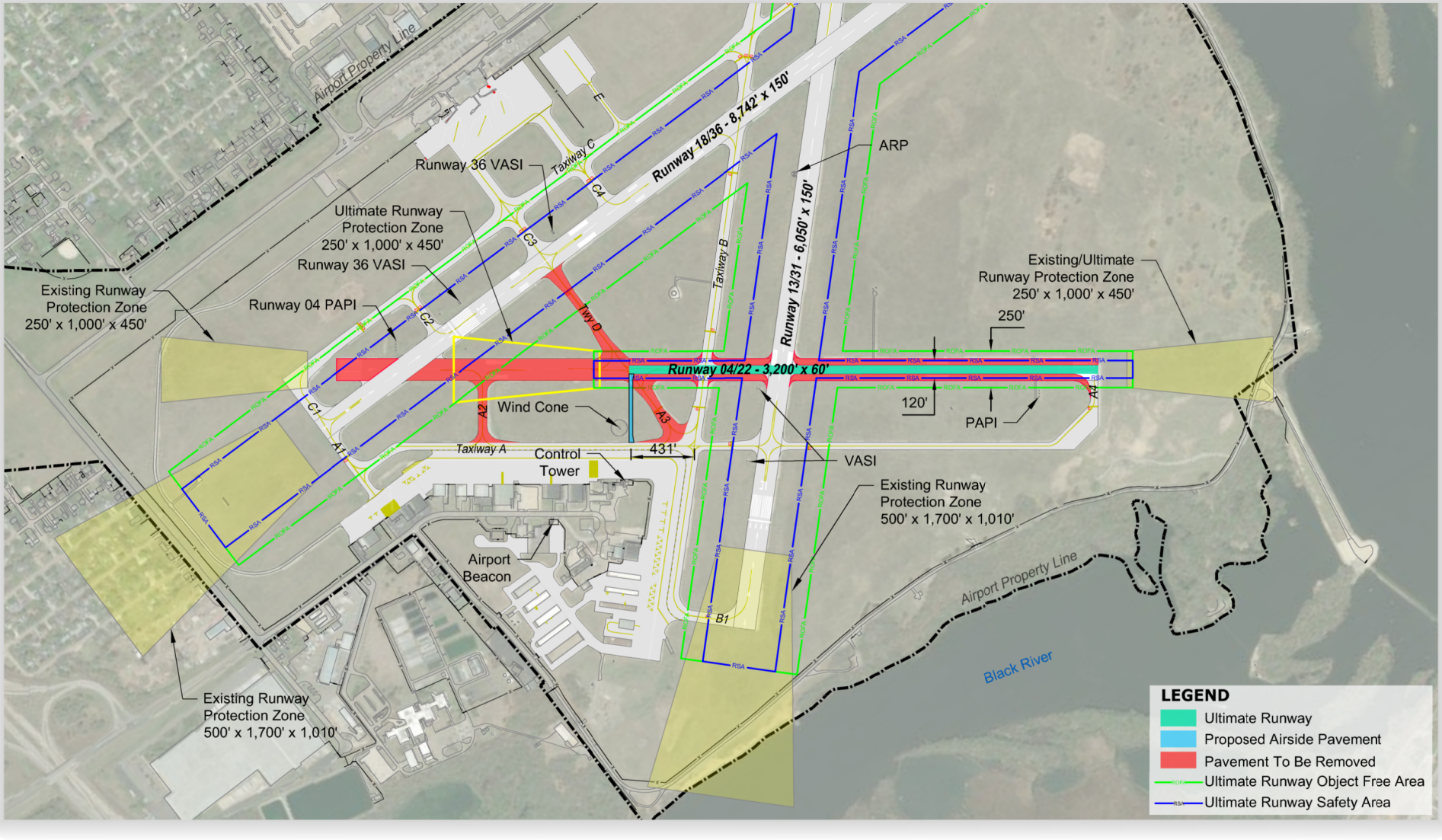
Graphic Scale in Feet

Figure 4-1: **Runway 04/22: Existing Conditions**

Source: *USGS Earthstar Geographics*



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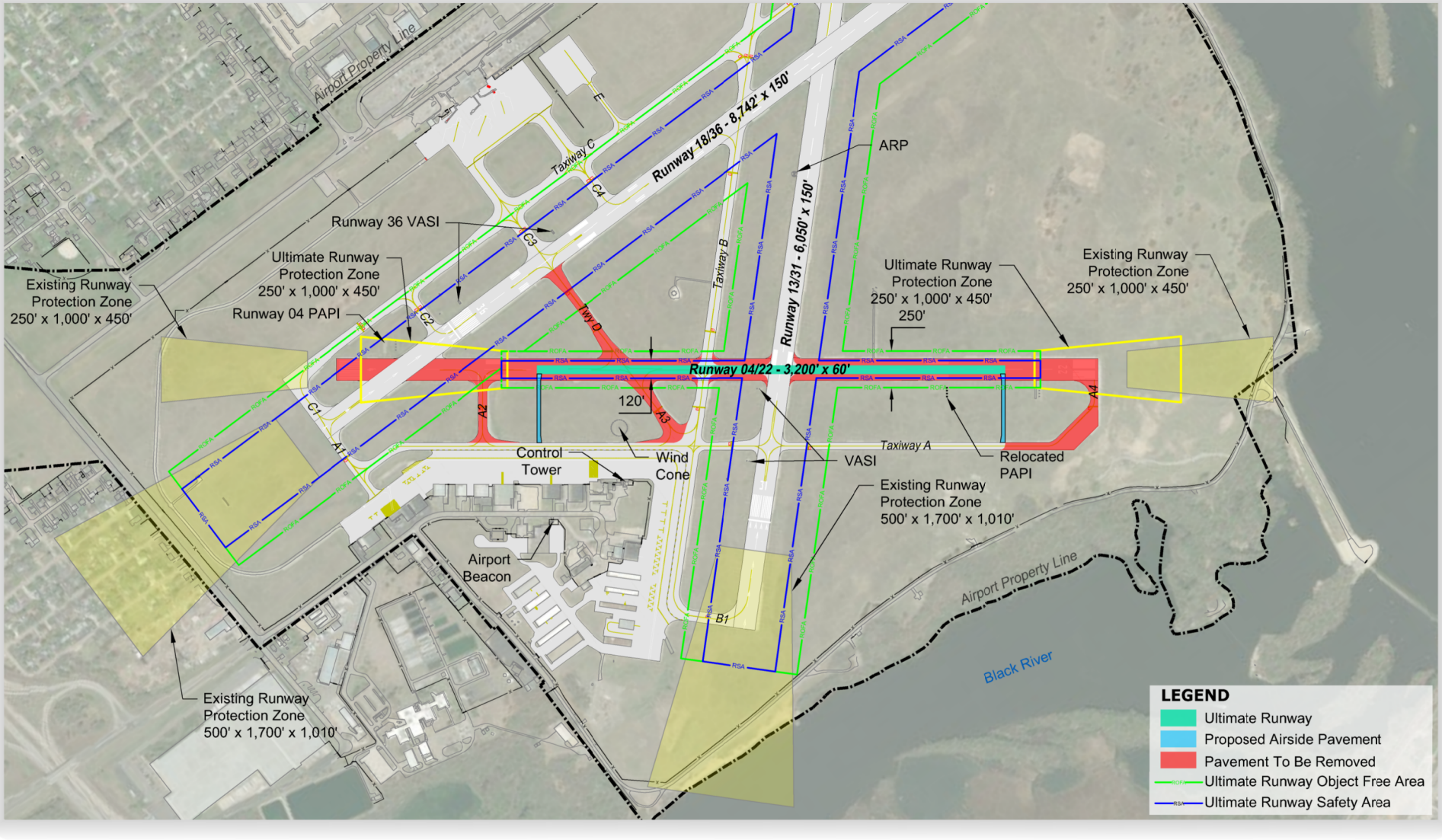
Graphic Scale in Feet

Figure 4-2: **Runway 04/22: Alternative 2: Shorten On Runway 04 End**

Source: *USGS Earthstar Geographics*



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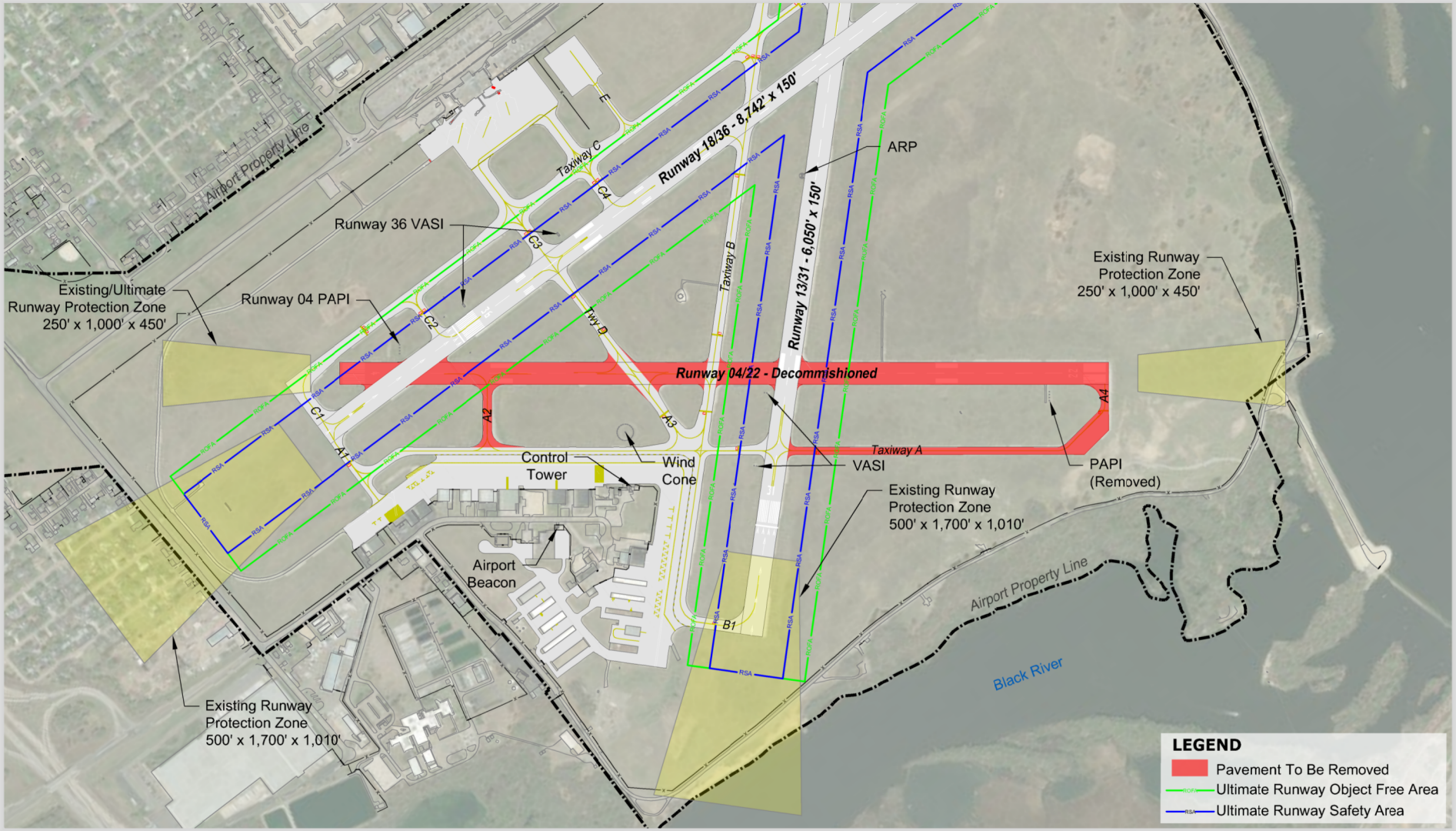
Graphic Scale in Feet

Figure 4-3: **Runway 04/22: Alternative 3: Shorten On Both Runway Ends**

Source: *USGS Earthstar Geographics*



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Graphic Scale in Feet

Figure 4-4: **Runway 04/22: Alternative 4: Decommission And Remove Runway 04/22**

Source: *USGS Earthstar Geographics*

The estimated cost for design and construction of this alternative is $2.5 million. This estimate includes removing Taxiways A2 and A4 and removing the northeastern portion of Taxiway A. Although the costs to remove the runway and taxiways are of a similar magnitude to reconstructing or shortening/narrowing the runway as proposed by the previous alternatives, runway removal should be eligible for financial assistance from the FAA because it would simplify the airfield layout and prevent wrong runway landings and departures, thereby enhancing airfield safety. At current Airport Improvement Program (AIP) participation rates, the FAA would provide 90 percent funding and the State of Wisconsin would likely contribute an additional 5 percent. The Airport would then only be responsible for 5 percent of the project cost, or approximately $125,000.

This alternative would not eliminate the five-way intersection of Taxiways A, B, and A3; options for resolving issues associated with this intersection are considered in Section 4.4.

4.2.5. Recommended Alternative

Although reconstruction or shortening/narrowing of Runway 04/22 as proposed by Alternatives 1, 2, and 3 would satisfy the desires of the based GA community at LSE, the financial investment required from the Airport for each alternative would come at the expense of other projects with a greater importance to the larger La Crosse region. For this reason, the Master Plan recommends that Runway 04/22 be decommissioned before its deteriorating pavement renders it unsafe to use. The decommissioned runway pavement could remain in place until such time that the FAA and Wisconsin Department of Transportation Bureau of Aeronautics (WisDOT BOA) commit funds for its removal. Decommissioning and removal of Runway 04/22 will be shown in the year 2030 of the Master Plan Capital Improvement Program (CIP).

4.3. Runway 13/31 Alternatives

As discussed in Chapter 3, Runway 13/31 provides superior wind coverage to Runway 18/36 and functions as a secondary air carrier runway at LSE. Due to published declared distances, takeoff and landing lengths are considerably restricted on Runway 13/31 when compared to the needs of the existing and future air carrier fleet mix. Furthermore, data collected over a four-month period in 2018 shows that Runway 13/31 is used for air carrier takeoffs and landings when crosswinds prevent use of Runway 18/36. Inadequate runway length directly contributes to reduced useful loads on air carrier aircraft that translates to less fuel, passengers, and/or cargo. In general, factors that reduce useful loads for air carriers may negatively affect air carrier profit margins.

Due to the complex nature of declared distances and the affected runways, this section is divided into four subsections, including:

- **Runway 13/31 Alternatives Criteria** – This subsection summarizes the criteria to analyze the alternatives.
- **Runway 13/31 Alternatives** – This subsection presents the alternatives developed for the Master Plan.
- **Preferred Alternative** – This subsection presents a matrix comparing the alternatives and recommends a preferred alternative.

4.3.1. Runway 13/31 Alternatives Criteria

To effectively develop and compare Runway 13/31 alternatives, several factors are considered including design standards, declared distances, airport utility, environmental effects, and feasibility. These factors are explained in this section.

Design Standards

As discussed in Chapter 3, the recommended ultimate RDC for Runway 13/31 is C-III. Using guidance from AC 150/5300-13A, Table 3-5, **Table 4-2** identifies key C-III-5000 design standards. All alternatives considered by this section meet runway width, Runway Safety Area (RSA), Runway Object Free Area (ROFA), and Runway Obstacle Free Zone (ROFZ) standards. However, the degree to which each alternative meets runway protection zone (RPZ) and threshold siting surface (TSS) standards varies. The alternatives will be compared with respect to these design standards, as the Airport's ability to increase available runway length on Runway 13/31 is significantly affected by the RPZ and the TSS locations.

Table 4-2: Ultimate Runway 13/31 Design Standards (C-III-5000)

Standard	Dimensions (feet)	
Runway Width	150	
Runway Safety Area (RSA)	Length Beyond Departure End	1,000
	Length Prior to Threshold	600
	Width	500
Runway Object Free Area (ROFA)	Length Beyond Departure End	1,000
	Length Prior to Threshold	600
	Width	800
Runway Obstacle Free Zone (ROFZ)	Length Beyond Runway End	200
	Width	400
Runway Protection Zone (RPZ)	Length	1,700
	Inner Width	500
	Outer Width	1,010
Approach Threshold Siting Surface (TSS)	Length	10,000
	Inner Width	400
	Outer Width	3,400
	Slope	20:1
Departure Threshold Siting Surface (TSS)	Length	10,200
	Inner Width	1,000
	Outer Width	6,466
	Slope	40:1

Source: AC 150/5300-13A, Table 3-5; FAA Engineering Brief 99

Runway Protection Zone (RPZ) – The RPZ is a trapezoidal-shaped area that is centered on the extended runway centerline. In general, the RPZ starts 200 feet beyond the runway end but in certain circumstances can start elsewhere. In these cases, two RPZs are often employed: a departure RPZ and an approach RPZ. When two RPZs exist, the approach RPZ begins 200 feet from the landing threshold while the departure RPZ begins 200 feet beyond the far end of the Takeoff Run Available (TORA).

According to the FAA Memorandum "Interim Guidance on Land Uses Within a Runway Protection Zone," dated September 27, 2012, the FAA expects airport sponsors to take all possible measures to protect against and remove or mitigate incompatible land uses in RPZs. Consultation with FAA is required whenever incompatible land uses would enter the limits of the RPZ as the result of an airfield project, a change in the critical design aircraft that increases the RPZ dimensions, a new or revised instrument approach procedure that increases the RPZ dimensions, or a local development proposal in the RPZ (either new or reconfigured). Land uses requiring coordination with FAA include buildings and structures, recreational land uses, transportation facilities including public roads, and above-ground utility infrastructure, among others. Existing incompatible land uses in the Runway 13/31 RPZs include Lakeshore Drive on the Runway 13 end and Fishermans Road on the Runway 31 end.

Threshold Siting Surfaces (TSS) – The TSS includes sloping approach and departure surfaces that should be clear of objects to protect aircraft arriving and departing the runway. Chapter 1, Section 1.5, discusses TSS dimensions for each runway at LSE. If there is no displaced threshold, the approach TSS begins 200 feet before the physical runway end. When a displaced threshold is used, the approach TSS begins 200 feet before the start of the Landing Distance Available (LDA). Unless the runway has a designated clearway, the departure surface begins at the end of the Takeoff Distance Available (TODA) and extends along the extended runway centerline at a slope of 40:1.

When the RSA, ROFA, approach RPZ, and TSS requirements are met, the threshold is placed at the beginning of the runway. When these requirements are not met, the threshold may be located further down the runway to avoid or mitigate obstacles that would otherwise prevent meeting the requirements. This is known as a displaced threshold. Runway 31 has a displaced threshold located 740 feet from the runway end to provide 1,000 feet of RSA and ROFA prior to the threshold. The Runway 31 approach TSS is currently clear of obstructions, but there are obstacles on the bluffs further out in the runway approach that severely restrict the visibility and cloud ceiling conditions in which an aircraft can land on this runway.

There are currently numerous trees that penetrate the departure TSS for both ends of the runway. These obstructions require that aircraft climb at a steeper angle than the standard 200 feet per nautical mile in instrument meteorological conditions (IMC, less than 3-statute-mile visibility and/or less than 1,000 feet cloud ceiling above ground level [AGL]). Aircraft departing Runway 13 in IMC must climb 420 feet per nautical mile, and aircraft departing Runway 31 in IMC must climb 340 feet per nautical mile.

Declared Distances

Impacts to declared distances should be considered for each alternative. As discussed in Chapter 3 (Section 3.3.3), declared distances are those available on a specific runway for a turbine-powered aircraft's takeoff run, takeoff distance, accelerate-stop distance, and landing distance requirements. The Takeoff Run Available (TORA) is the runway length available and suitable for the ground run of an aircraft taking off.

The TODA is the TORA plus the length of any remaining runway beyond the far end of the TORA. The TODA can be reduced to mitigate for obstacles in the departure area. The Accelerate-Stop Distance Available (ASDA) is the runway plus stopway length available and suitable for acceleration and deceleration of an aircraft aborting a takeoff. The LDA is the runway length available and suitable for landing an aircraft.

Airport Utility

Airport utility is the ability of an airport to safely and efficiently accommodate aircraft activity. Airport utility is largely dictated by the length of its runways, as length can be a limiting factor that restricts the ability of an aircraft to use an airport. For instance, the current design aircraft for Runway 13/31, the CRJ200, cannot land using the Runway 13/31 LDA of 5,310 feet with greater than 60 percent useful load (see Chapter 3, Section 3.3.3, Figure 3-2). When the landing distance is restricted in this way, air carriers using the CRJ200 are adversely affected as they must land with less than a desirable load or divert to an alternate airport.

Information gathered by control tower staff from August through December of 2018 supports air carrier use of Runway 13/31. Aircraft categorized by air traffic control (ATC) as large commuter aircraft (i.e., aircraft weighing more than 41,000 pounds and up to 255,000 pounds) make limited use of Runway 13/31. For Runway 13/31, these aircraft include large business jets and air carrier regional jet aircraft such as the CRJ200, CRJ700 and EMB145. These jets used Runway 13/31 a total of 1.5 percent of the time, when both arrival and departure operations are considered, despite the better wind coverage offered on this runway compared to Runway 18/36.

In addition to runway length, adequate crosswind coverage aids in safe and efficient accommodation of aircraft activity. Crosswind coverage was covered in depth in Chapter 3, Section 3.3.2. Runway 13/31 provides greater than 95 percent wind coverage at 10.5 knots in all weather conditions. In the event there is a crosswind, it is preferred that an aircraft operate into the wind. For LSE, the prevailing wind is such that takeoff and landing on Runway 13 is typically preferred during crosswind conditions.

Environmental Effects

Whenever possible, alternatives should attempt to avoid, then minimize, and then mitigate environmental impacts. LSE is located on French Island, which is bounded by the Mississippi River, the Black River, and Lake Onalaska. The airfield is on dry land, and no wetlands would be negatively impacted by runway alternatives considered by this Master Plan. Selection of a preferred alternative should consider environmental factors, such as required tree removal and impacts to surrounding land uses including residences, recreational areas, and wildlife refuges.

Feasibility

Each alternative is evaluated based on factors that may affect its feasibility. These factors include implementation cost, construction and funding timelines, and impacts to surrounding infrastructure. Runway 13/31 is bounded by Lakeshore Drive to the northwest and Fishermans Road to the southeast. Feasibility of alternatives will consider effects to these bounding features.

4.3.2. Runway 13/31 Alternatives

This subsection presents two alternatives for Runway 13/31 at LSE. These alternatives consider the criteria discussed in Chapter 3 and Section 4.3.1 above. The alternatives include the following:

- Alternative 1: Maximize Declared Distances for Runway 13/31
- Alternative 2: Extend Runway 13 by 663 feet

Alternative 1: Maximize Declared Distances for Runway 13/31

This alternative examines the current declared distances for Runway 13/31 and identifies which declared distances could be theoretically modified without extending the runway. This alternative was developed to identify all potential means for increasing available takeoff and landing distances, and to demonstrate that extending the runway is the only prudent alternative for doing so. For reference, the criteria that affect the start and end points of each declared distance are summarized in **Table 4-3**.

Table 4-3: Declared Distances Controlling Surfaces

Declared Distance	Criteria Affecting Start Point	Criteria Affecting End Point
Take Off Run Available (TORA)	Start of Takeoff	Departure RPZ, TODA
Take Off Distance Available (TODA)	Start of Takeoff	Departure Surface
Accelerate Stop Distance Available (ASDA)	Start of Takeoff	RSA, ROFA
Landing Distance Available (LDA)	RSA, ROFA, Approach RPZ, TSS	RSA, ROFA

Note: Start of takeoff typically occurs at the beginning of the designated runway pavement.
Source: FAA AC 150/5300-13A, Airport Design

This alternative considers the declared distances for each runway end separately to determine whether they could be lengthened without a physical extension to the runway. Potential increases to declared distances using the existing runway length are shown in **Table 4-4** and **Figure 4-5**.

Table 4-4: Runway 13/31 Declared Distances

Runway	TORA	TODA	ASDA	LDA
Current Published Declared Distances				
13	5,310'	5,310'	5,310'	5,310'
31	6,050'	6,050'	6,050'	5,310'
Longest Possible Declared Distances				
13	**5,710'**	**5,710'**	5,310'	5,310'
31	6,050'	6,050'	6,050'	**5,710'**
Note: Highlighted declared distances are those that are different from the current published declared distances.				
TORA = Takeoff Runway Available		ASDA = Accelerate Stop Distance Available		
TODA = Takeoff Distance Available		LDA = Landing Distance Available		
Source: FAA Form 5010-1 Airport Master Record (accessed January 9, 2019)				

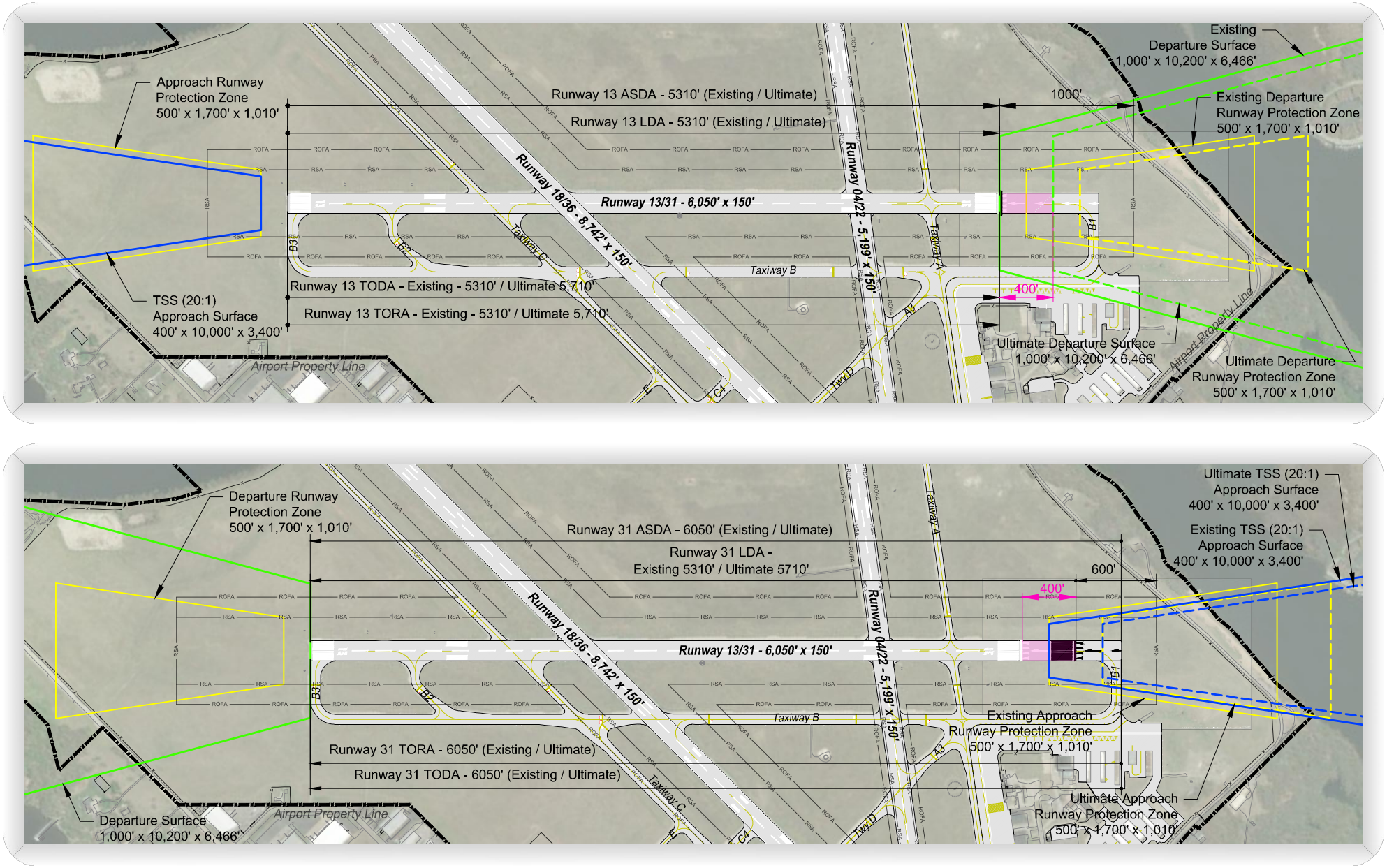


Figure 4-5: **Runway 13/31 Alternative 1: Maximize Declared Distances**

Source: *USGS Earthstar Geographics*

As shown in Figure 4-5, the Runway 13 TORA/TODA and Runway 31 LDA are the only distances that could theoretically be lengthened; however, lengthening these distances would have significant trade-offs in terms of approach and departure obstructions and incompatible land uses. The following describes the analysis conducted to reach these conclusions.

Alternative 1 – Runway 13 Declared Distances

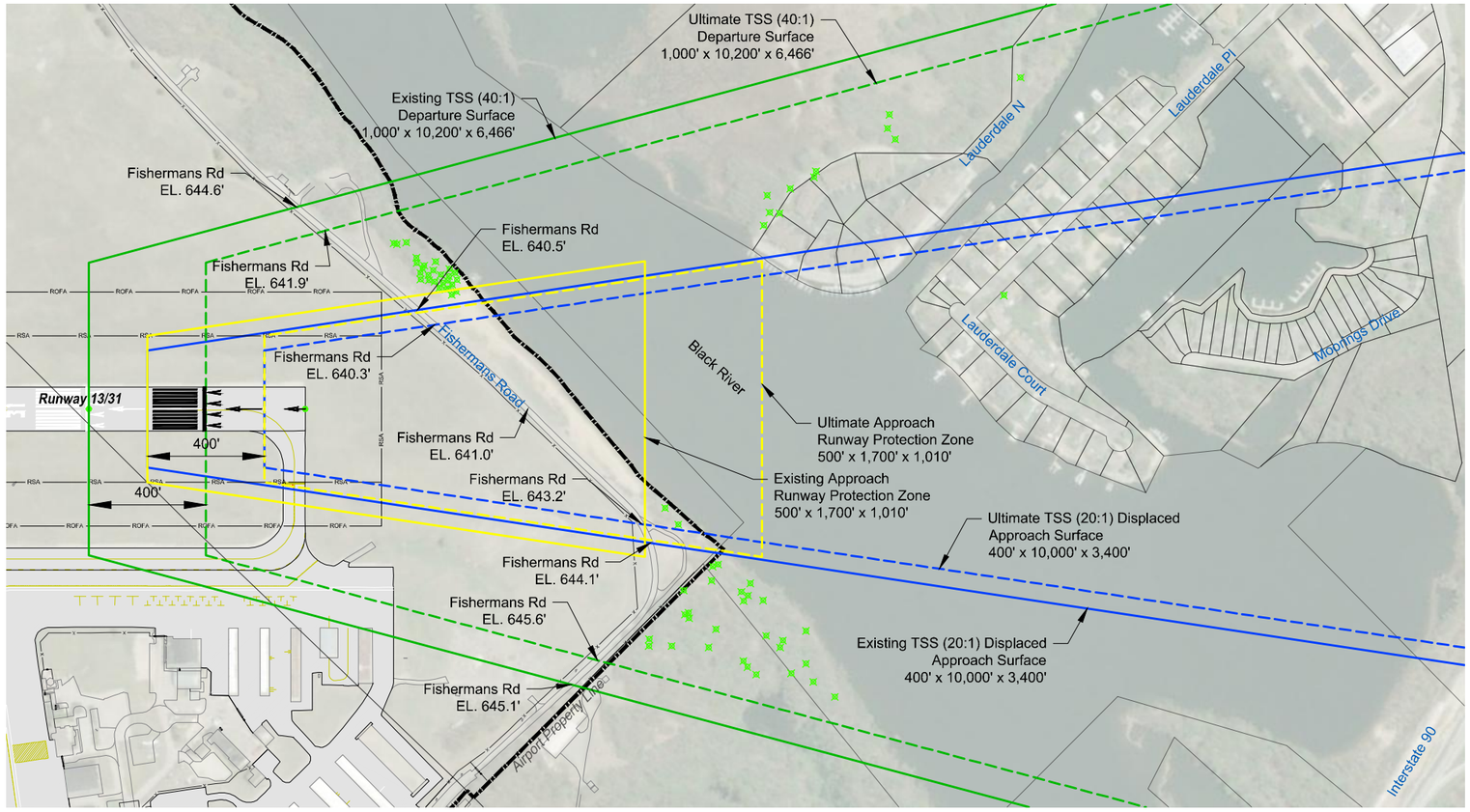
Design Standards – The current Runway 13 TORA, TODA, ASDA, and LDA are all 5,310 feet, leaving 740 feet of unusable pavement on the southeast end of the runway for Runway 13 operations. The two declared distances that could be theoretically changed for Runway 13 are the TORA and the TODA. Extending the TORA would require shifting the departure RPZ, and extending the TODA would require shifting the departure surface.

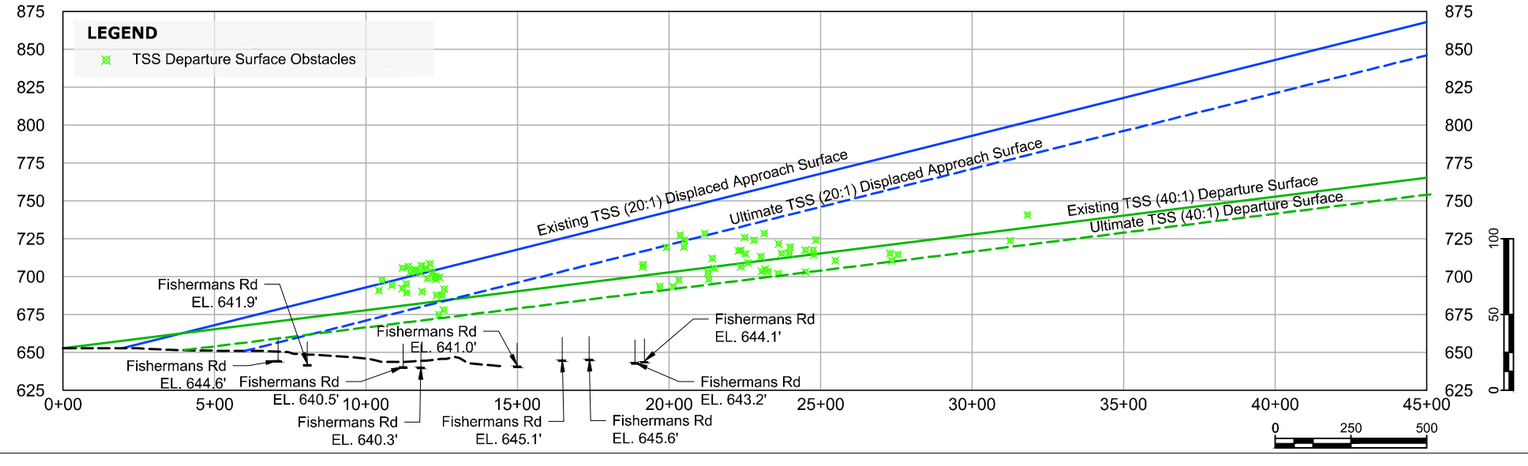
As shown in **Table 4-3,** the TORA start point is the start of takeoff while the end point is dependent on the departure RPZ and TODA. As the start of takeoff begins at the physical end of the runway and cannot be moved without extending the runway, moving the end point is the only option for increasing the TORA. Shifting the Runway 13 departure RPZ to the southeast would allow for extending the TORA if the TODA were also extended the same distance but would exacerbate existing incompatible land use issues beyond the Runway 31 end. This potential shift is depicted in **Figure 4-6**. The overall length of Fishermans Road within the departure RPZ would be reduced slightly from 1,150 feet to 1,100 feet.

The TODA begins at the start of takeoff, and the TODA end point is determined by the departure surface. If the departure surface is shifted further southeast, the TODA end point could be shifted as well. The TODA could be extended approximately 400 feet to a total of 5,710 feet while also providing more than 15 feet of departure surface clearance over Fishermans Road. However, shifting the departure surface would increase the extent and degree of object penetrations to the departure surface. Based on obstruction data collected in 2018, there are approximately 50 trees currently penetrating the Runway 13 departure surface, 20 of which are off-Airport. If the departure surface were shifted 400 feet to the southeast, an additional 20 trees would penetrate the surface, 16 of which are off-Airport. Removing these trees could allow a change in the TODA without requiring increases to instrument departure minimums and climb gradients. The locations of the trees are shown in **Figure 4-6**.

The ASDA start point is the start of takeoff and cannot be changed without extending the runway. The end point is dependent on meeting RSA and ROFA standards beyond the ASDA. According to AC 150/5300-13A, if RSA and ROFA standards are not met, additional RSA and ROFA length can be obtained by reducing the ASDA. The Runway 31 ASDA is currently reduced to provide the required 1,000 feet of RSA and ROFA beyond the ASDA end point. If the ASDA end point were relocated to the southeast, the RSA and/or ROFA would extend over Fishermans Road. For this reason, the current Runway 13 ASDA end point cannot be changed without violating RSA and/or ROFA design standards.

Lastly, LDA is affected by a combination of design standards previously mentioned. The LDA start point is affected by the RSA, ROFA, approach RPZ, and approach TSS. As the LDA begins at the Runway 13 end, the LDA start point cannot be moved without extending the runway. The LDA end point is dependent on meeting RSA and ROFA standards beyond the LDA. As with the ASDA, the LDA end point cannot be changed without violating RSA and/or ROFA design standards.





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La Crosse Regional AIRPORT

Figure 4-6: **Runway 13/31 Alternative 1: Runway 31 Detail**

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Airport Utility – Maximizing the TORA and TODA would allow aircraft to depart Runway 13 in a wider range of scenarios. The CRJ700 could depart Runway 13 at 100 percent useful load, but all other existing and potential future air carrier aircraft identified by Chapter 3 would continue to be weight-limited when departing Runway 13.

Environmental Effects – The affected environmental resources are primarily trees in the Runway 13 departure surface. As noted above, approximately 70 trees would penetrate the departure surface if the TODA were extended to the southeast. Approximately half of these trees are located off-Airport on private residential lots and federal government property.

Feasibility – For trees located off airport property, LSE would need to coordinate with the affected property owners. Off-airport tree removal can be expensive if compensation is provided to the property owner. The FAA would also have to approve the shift of the departure RPZ, as moving the end point of the TORA would change the road length in the RPZ.

Alternative 1 – Runway 31 Declared Distances

Design Standards – For operations on Runway 31, the only declared distance limited to less than the full runway length is the LDA. The Runway 31 LDA is currently limited to 5,310 feet with 740 feet of unusable pavement prior to the displaced threshold. According to AC 150/5300-13A, the FAA will consider displacing a threshold to:

- Provide proper clearance for landing aircraft over existing obstacles while on approach to landing;
- Obtain additional RSA and/or ROFA prior to the threshold;
- Locate the RPZ such that incompatible land uses are mitigated; or
- Mitigate environmental impacts, including noise impacts.

As discussed previously, the LDA start point is affected by the RSA, ROFA, Approach RPZ, and TSS. The current Runway 31 displaced threshold location provides 1,000 feet of RSA and ROFA prior to the threshold. However, the C-III-5000 design standards in AC 150/5300-13A require only 600 feet of RSA and ROFA prior to the threshold. As the RSA and ROFA design standards are exceeded, both could be reduced by relocating the displaced threshold by 400 feet to the southeast. However, there are several items that should be considered carefully with respect to potential relocation of the Runway 31 threshold, including the Runway 31 approach TSS, the approach RPZ, impacts to existing Runway 31 Lateral Navigation (LNAV) approach minimums, and the potential for a future vertically-guided instrument approach procedure to Runway 31.

Runway 31 Future Approach TSS – The location and elevation of Fishermans Road and trees southeast of the Runway 31 threshold should be considered when evaluating placement and clearing of the approach TSS. If the Runway 31 approach TSS were shifted 400 feet to the southeast, it would be clear of any trees in the approach and provide 15 feet of clearance over Fishermans Road as shown in Figure 4-6. Therefore, a 400-foot shift of the approach TSS is not expected to prevent extending the Runway 31 LDA by 400 feet.

Runway 31 Future Approach RPZ – Incompatible land uses such as public roads and places of public assembly should be considered when evaluating placement of the approach RPZ. Fishermans Road is

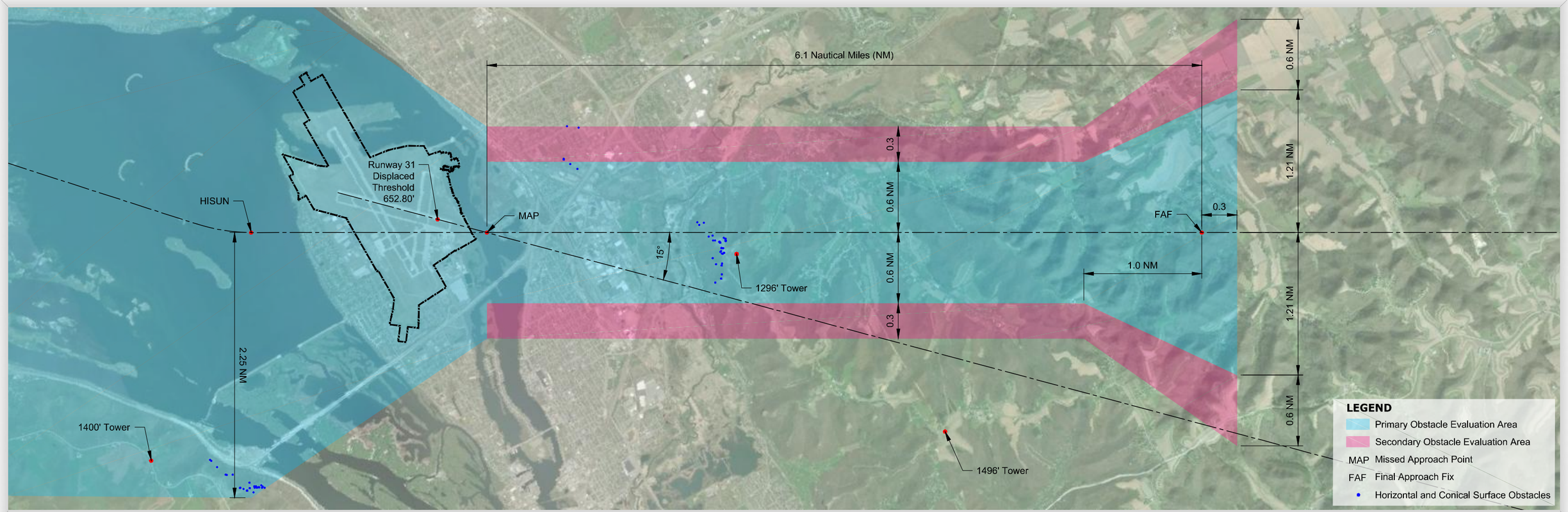
approximately 1,500 feet from the current Runway 31 displaced threshold and would be only 1,100 feet from the relocated displaced threshold. However, the overall length of Fishermans Road within the departure RPZ would be reduced slightly from 1,150 feet to 1,100 feet.

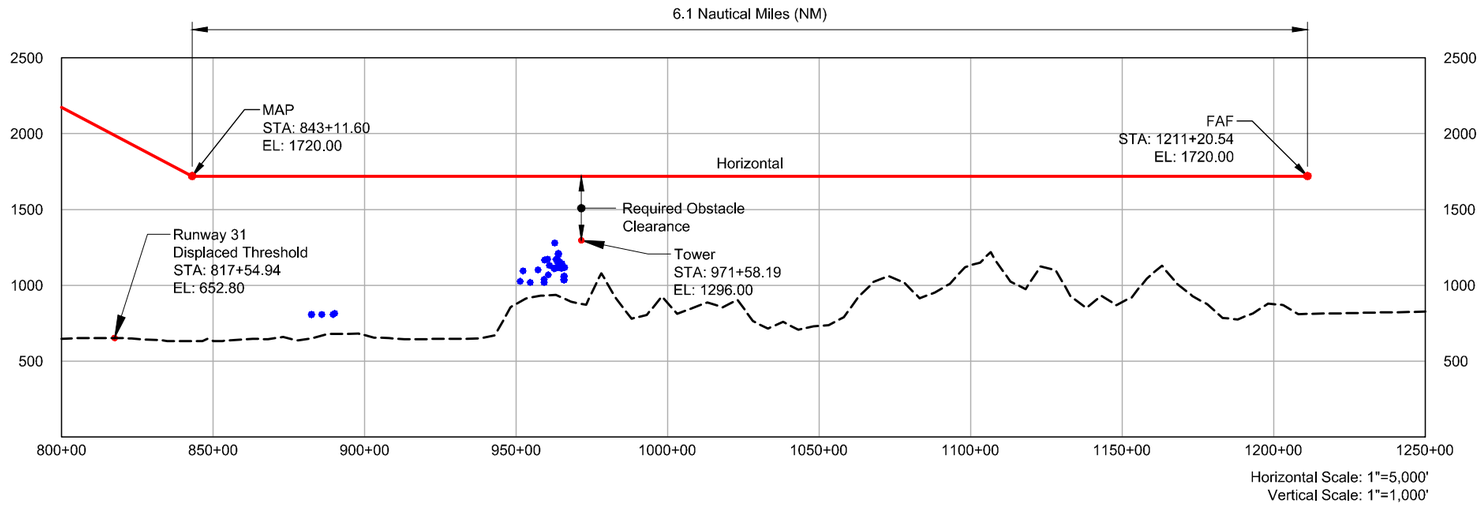
Runway 31 Existing LNAV Minimums – Relocating the Runway 31 threshold may have negative impacts to the existing non-precision Global Positioning System (GPS) LNAV instrument approach procedure. The Runway 31 LNAV approach currently has a Category C visibility minimum of 3 statute miles and a decision height of 1,100 feet above the threshold. As shown in **Figure 4-7**, the LNAV approach is currently offset from the runway centerline at an angle of 15 degrees. There are several obstacles in the offset final approach area, including a tower located approximately 3 miles away and naturally occurring terrain. There are two applicable surfaces in this area that, if penetrated, limit the visibility minimums for a runway. These surfaces are shown in **Figure 4-8** and include a 34:1 surface that, if penetrated, limits visibility to not lower than 3/4 mile, and a 20:1 surface that, if penetrated, limits visibility to not lower than 1 mile. While the 20:1 surface is currently clear, shifting it to the southeast by shifting the Runway 31 threshold location would increase the likelihood of future penetrations to this surface as well as the 34:1 surface. Therefore, a 400-foot shift of the displaced threshold may limit future improvements in LNAV approach minimums.

Airport Utility – Control tower staff at LSE has indicated that Runway 13/31 is often used by local and itinerant aircraft operations during crosswind conditions because it has superior wind coverage to Runway 18/36. Therefore, airport utility is restricted when the LDA is less than the full runway length. However, as discussed previously, prevailing winds and lower approach visibility minimums usually dictate landing on Runway 13. While maximizing the Runway 31 LDA would positively impact airport utility, it would not meet the needs of critical design aircraft users that prefer landing on Runway 13.

Environmental Effects – Relocating the Runway 31 displaced threshold would not require off-Airport obstruction removal to clear the approach TSS. While it would move the Runway 31 displaced threshold closer to Fishermans Road and off-Airport land uses, this should not create any new incompatible land use issues.

Feasibility – Relocating a displaced threshold requires a very complex and time-consuming planning, design, and coordination effort on the part of both the Airport and the FAA. Pavement markings and lighting systems would need to be reconfigured, and instrument approach procedures would need to be redesigned. The benefits to critical design aircraft users are not expected to offset the cost and effort required to relocate the displaced threshold, as these users prefer to land on Runway 13. The FAA would also have to approve the shift of the approach RPZ, as moving the start point of the LDA would change the road length in the RPZ.





0 2,500 **5,000** 7,500
Graphic Scale in Feet

Figure 4-7: **Runway 31 LNAV Final Approach Plan and Profile**

Source: *USGS Earthstar Geographics*

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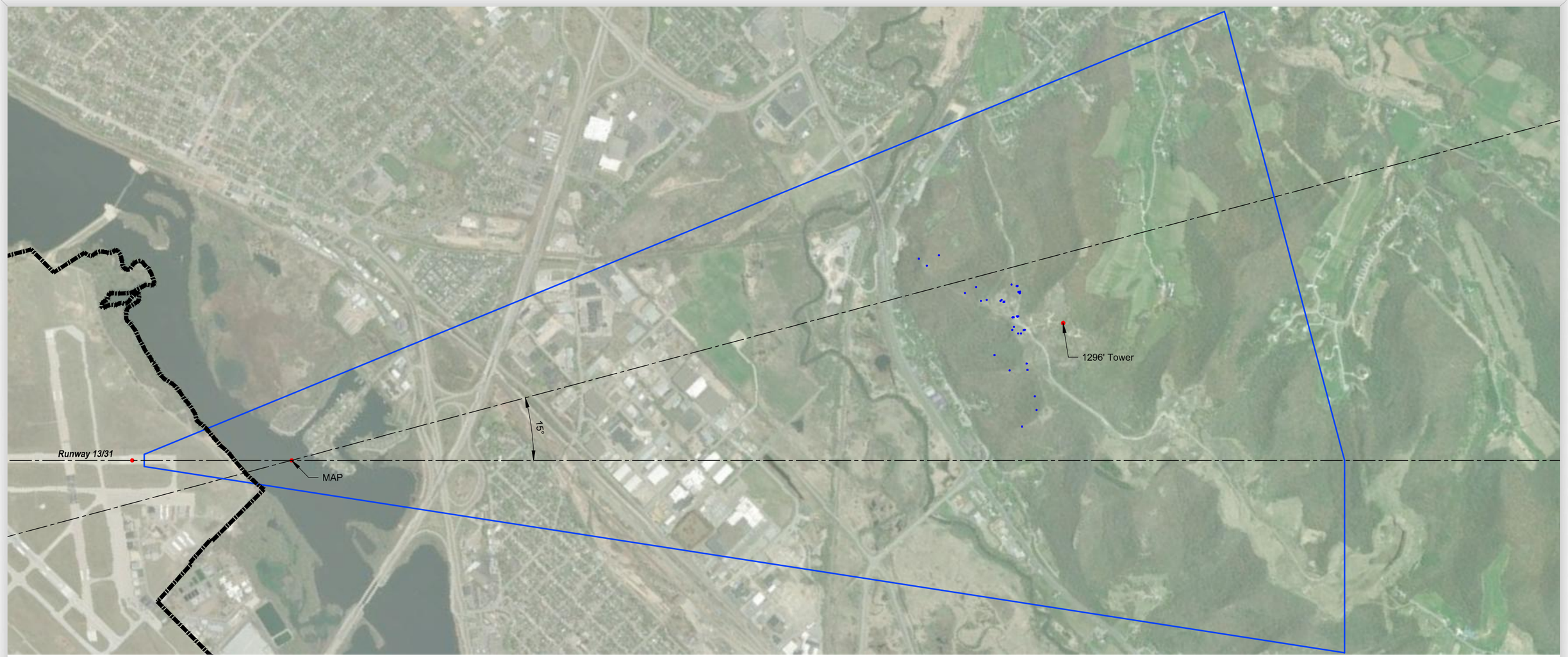

0 800 1,600 2,400
Graphic Scale in Feet

Figure 4-8: **Runway 31 Visual Approach Surface**

Source: *USGS Earthstar Geographics*

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Alternative 2: Extend Runway 13/31 by 663 feet

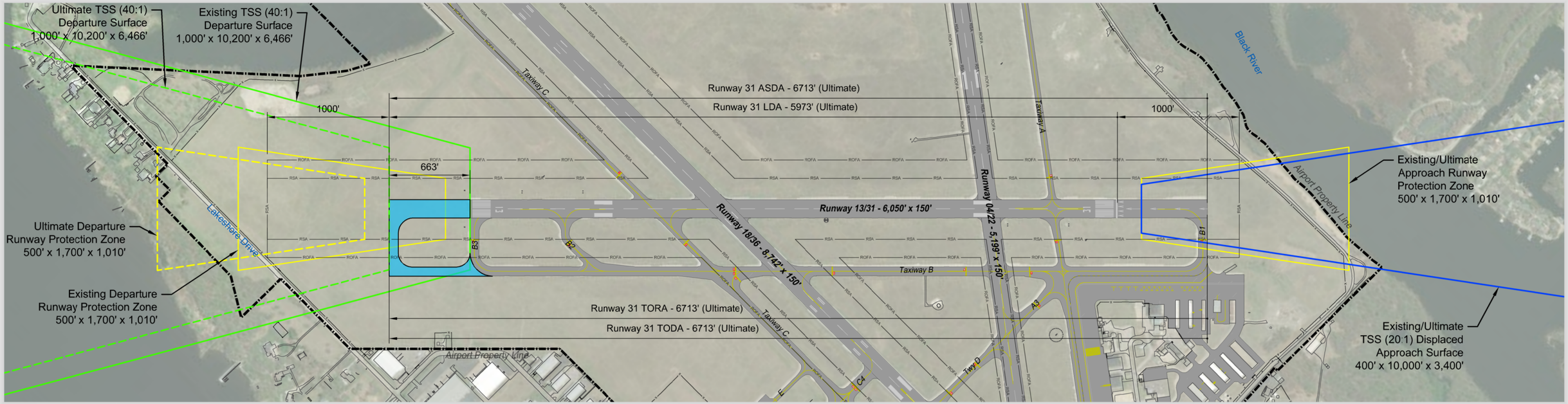
The 2015 Airport Layout Plan (ALP) for LSE shows a planned 663-foot extension to the Runway 13 end for a total length of 6,713 feet. **Figure 4-9** shows the new declared distances under this alternative, and **Figure 4-10** shows a detail view of the proposed extension to and design surfaces for the Runway 13 end.

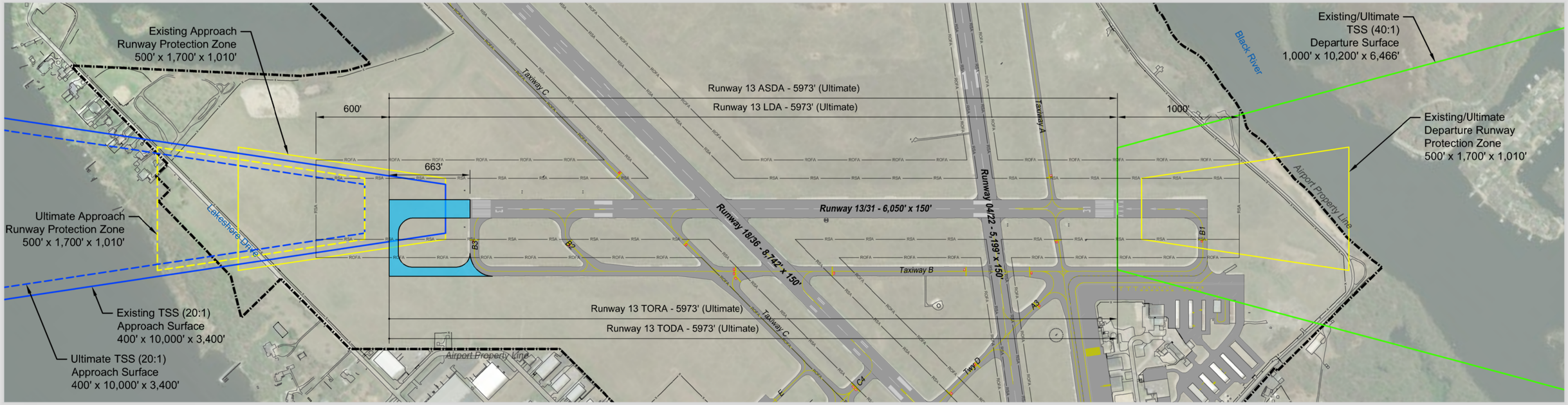
Design Standards – Extending Runway 13 affects several design standards, including the RSA, ROFA, approach/departure RPZ, and approach/departure TSS. Extending Runway 13 as proposed by this alternative maximizes potential runway length while still meeting RSA and ROFA standards on Airport property. Shifting the approach/departure RPZs and approach/departure TSS would affect Lakeshore Drive and trees beyond the relocated runway end. **Figure 4-10** shows the existing and ultimate RSA, ROFA, approach/departure RPZs, and approach/departure TSS beyond the Runway 13 end under this alternative.

The proposed Runway 13 extension could potentially be used for all declared distances. However, there are important implications to consider specifically for the Runway 13 LDA and Runway 31 TORA/TODA.

As noted previously, the start point for the LDA is affected by the RSA, ROFA, approach RPZ and TSS. The proposed extension keeps the RSA and ROFA inside the Airport fence and on Airport property; therefore, these standards would be met.

Incompatible land uses such as public roads and places of public assembly should be considered when evaluating placement of the RPZs. If the entire runway extension was used for Runway 13 LDA and Runway 31 TORA, the approach and departure RPZs would shift to the northwest and increase the RPZ area outside the Airport fence. This would increase the length of Lakeshore Drive within the RPZ from approximately 350 feet to approximately 1,200 feet. Lakeshore Drive is approximately 2,100 feet from the current Runway 13 end and would be only 1,400 feet from the relocated Runway 13 end. However, this is further than the 1,100-foot distance of Fishermans Road from the Runway 13 TORA end point and Runway 31 LDA start point proposed under Alternative 1. Although no detailed traffic counts have been conducted, the general type and frequency of use for both roads are comparable. The RPZ changes for Alternative 2 are expected to present fewer safety concerns than the RPZ changes for Alternative 1, due to the increased distance of the road from the TORA end point and LDA start point, as well as proposals to raise and widen Fishermans Road considered by this Master Plan (see Section 4.8 for more information regarding this proposal). Relocating Lakeshore Drive out of the RPZ is not an option as the shoreline of Lake Onalaska is just 750 feet west of the road.



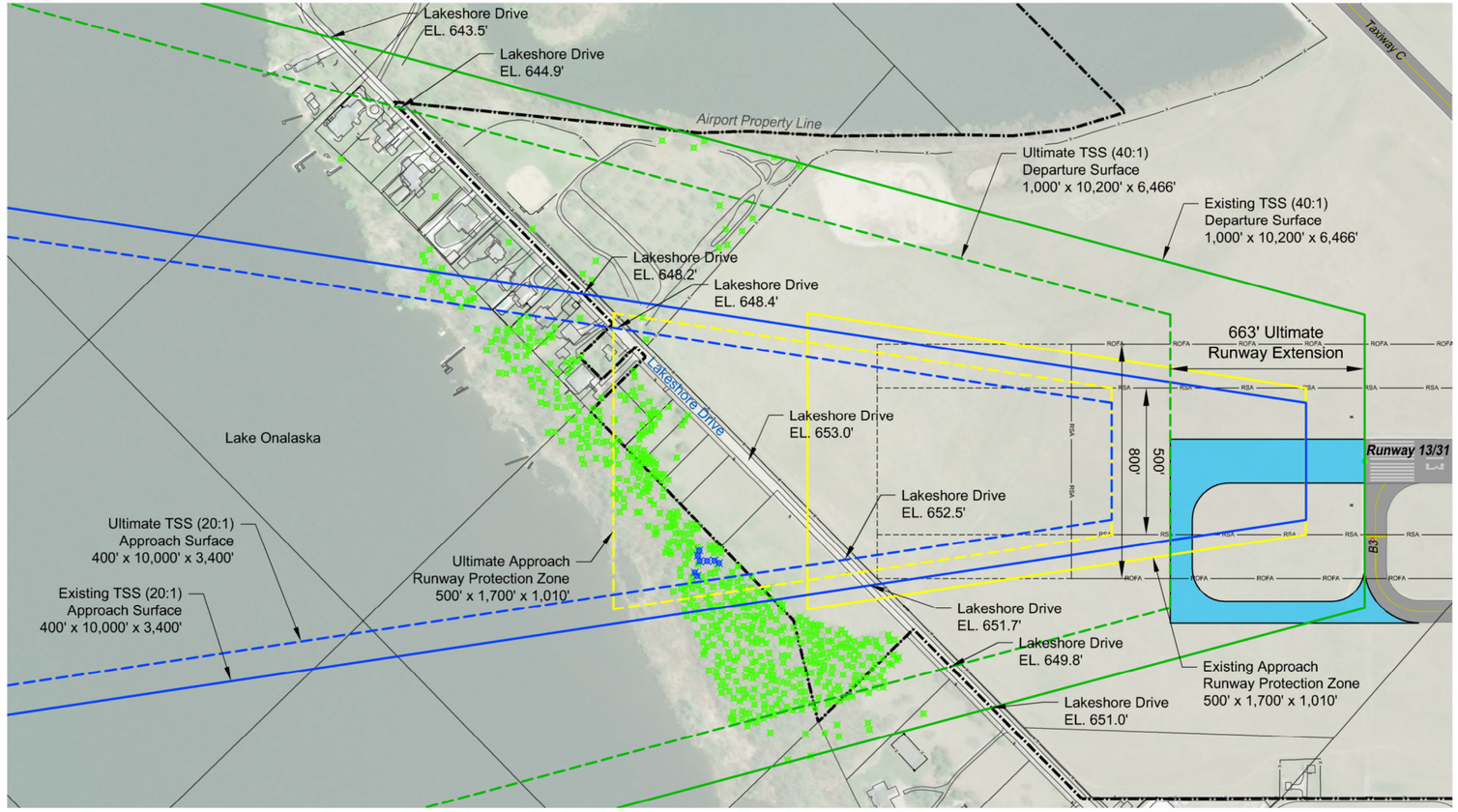


0 500 **1000** 1500
Graphic Scale in Feet

Figure 4-9: **Runway 13/31 Alternative 2: Extend By 663 Feet**

Source: *USGS Earthstar Geographics*

La Crosse Regional AIRPORT | Mead & Hunt



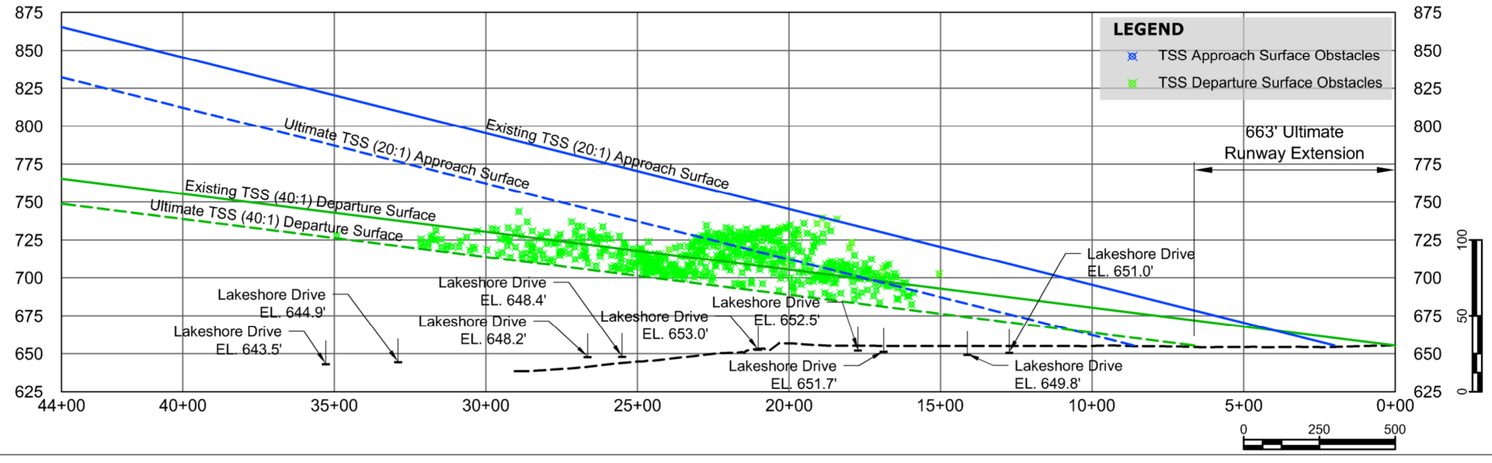


Figure 4-10: **Runway 13/31 Alternative 2: Runway 13 Detail**

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The approach and departure TSS would also need to be cleared for the entire 663-foot extension to be used for Runway 13 LDA and Runway 31 TODA. Both distances could utilize the full runway extension while also providing more than 15 feet of approach and departure TSS clearance over Lakeshore Drive. However, this would increase the number of penetrations to both surfaces. The Runway 13 approach TSS is currently clear of object penetrations, but if the approach TSS were shifted 663 feet to the northwest, four off-Airport trees would penetrate the relocated approach TSS proposed by this alternative. There are approximately 210 trees currently penetrating the Runway 31 departure surface, 184 of which are off-Airport. If the departure TSS were shifted 663 feet to the northwest, an additional 428 trees would penetrate the surface, 280 of which are off-Airport. Removing these trees could allow a change in the TODA without requiring increases to instrument departure minimums and climb gradients. The locations of the trees are shown in **Figure 4-10**.

Airport Utility – Extending Runway 13/31 would increase landing and takeoff distances in both directions. This would greatly increase airport utility and benefit air carrier and corporate users due to limitations associated with the existing runway length and declared distances.

The existing design aircraft for Runway 13/31, the Bombardier CRJ200, is expected to be phased out soon. The CRJ900 is the ultimate design aircraft, with the CRJ700 expected to operate at LSE in the interim. The takeoff and landing lengths required for these aircraft are discussed in Section 3.3.3. The CRJ200 must currently operate at less than 60 percent useful load to land on Runway 13/31. If the runway were extended 663 feet (6,713 feet total), the CRJ200 would be able to operate at over 80 percent useful load, which would be a significant improvement. Furthermore, the CRJ700 is currently limited to less than 60 percent useful load and the CRJ900 is limited to approximately 80 percent useful load when landing in either direction on Runway 13/31. The runway extension would allow these aircraft to operate greater useful loads that better reflect air carrier needs. Similarly, the takeoff distance required is affected as the Runway 13 TORA and TODA are both less than the existing runway length. With no extension to Runway 13, CRJ200, CRJ700, and CRJ900 departures would continue to be limited to less than 80, 100, and 60 percent useful load, respectively. If Runway 13 was extended 663 feet, each aircraft would be able to operate at greater useful loads that better reflect air carrier needs. The declared distances proposed by this alternative are compared to the critical design aircraft requirements in **Table 4-5**.

Table 4-5: Alternative 2 Declared Distance Improvements and Critical Design Aircraft Requirements

	TORA/TODA		LDA	
Declared Distances	**Runway 13**	**Runway 31**	**Runway 13**	**Runway 31**
Current Declared Distances	5,310'	6,050'	5,310'	
Proposed Declared Distances	5,973'	6,713'	5,973'	
	Takeoff Distance		**Landing Distance**	
Critical Design Aircraft Requirements	**60% Useful Load**	**100% Useful Load**	**60% Useful Load**	**100% Useful Load**
Bombardier CRJ200	4,800'	6,800'	5,350'	6,050'
Bombardier CRJ700	4,200'	5,700'	5,950'	6,700'
Bombardier CRJ900	5,200'	7,500'	5,100'	5,500'

Sources: Airport Planning Manuals, Mead & Hunt Inc.

Environmental Effects – The proposed extension to Runway 13 would be entirely on Airport property. No wetlands would be affected. The extension and associated taxiway extension would require that proper National Environmental Policy Act (NEPA) environmental documentation to be completed, which is expected to include an Environmental Assessment. While it would move the Runway 13 end closer to Lakeshore Drive and off-Airport land uses, this should not create any new incompatible land use issues, such as homes in the RPZ. The affected environmental resources are primarily trees in the Runway 31 departure surface. As noted above, over 600 trees would penetrate the departure surface if the entire runway extension was used for TODA. Approximately two-thirds of these trees are located off-Airport on private residential lots and federal government property.

Feasibility – Feasibility challenges for this extension include FAA approval of the approach/departure RPZ shift and possible required easements, the cost of construction, and the effect on off-Airport trees. Extending the runway would also require relocating airfield lights, including the Runway End Identifier Lights (REILs) and Visual Approach Slope Indicator (VASI), as well as installing new runway and taxiway lighting with the extension. A parallel taxiway extension would also be needed for aircraft to access the relocated Runway 13 threshold. The estimated total for this project, including these supporting efforts, is $6.0 million.

4.3.3. Runway 13/31 Alternatives Comparison

Table 4-6 summarizes and compares the runway length improvements associated with the two Runway 13/31 alternatives discussed above. Alternative 2 is clearly superior in terms of the additional runway length it would provide for takeoff and landing operations in both directions on Runway 13/31. Although Alternative 2 would be more expensive than Alternative 1, it would introduce fewer feasibility challenges than Alternative 1, as it does not involve any changes to the Runway 31 displaced threshold location. Alternative 2 also avoids potential future issues related to obstructions in the approach and departure areas beyond the Runway 31 end. For these reasons, Alternative 2 is recommended as the preferred alternative for this Master Plan and will be included in the intermediate-term CIP.

Table 4-6: Runway 13/31 Alternatives Declared Distances Comparison

	Alternative 1		Alternative 2	
	RW 13	**RW 31**	**RW 13**	**RW 31**
Total Published Runway Length	6,050 feet		6,713 feet	
Declared Distances				
Takeoff Run Available (TORA)	5,710 feet	6,050 feet	5,973 feet	6,713 feet
Takeoff Distance Available (TODA)	5,710 feet	6,050 feet	5,973 feet	6,713 feet
Accelerate-Stop Distance Available (ASDA)	5,310 feet	6,050 feet	5,973 feet	6,713 feet
Landing Distance Available (LDA)	5,310 feet	5,710 feet	5,973 feet	5,973 feet
Feasibility				
Description of Challenges	RPZ Shift FAA Coordination		RPZ Shift Cost of Construction NAVAID Relocations	

4.4. Taxiway & Apron Alternatives

The following four taxiway alternatives were studied for the Master Plan and are presented below:

- Remove Taxiways A3 and D
- Relocate Taxiway A
- Convert Runway 04/22 into a Taxiway
- Extend Taxiway from A1 to D
- Relocate Taxiways C3 and C4
- Construct Mid-field Runway 13/31 Exit Taxiway

4.4.1. Alternative 1: Remove Taxiways A3 and D

This alternative would remove Taxiways A3 and D to simplify the intersection of Taxiways A and B into a four-way intersection. As discussed in Chapter 3, Section 3.4, taxiways that directly connect an apron to a runway are undesirable as a pilot might inadvertently taxi onto the runway when expecting a parallel taxiway. The LSE Runway Safety Action Team (RSAT) identified a five-way intersection between Taxiway A, A3, and B at the apex of the GA aprons as a contributing factor for runway incursions. AC 150/5300-13A recommends all taxiway intersections use a three-node design concept so that a pilot is presented with no more than three choices at an intersection. Ideally, the options should be left, right, and straight ahead. The five-way Taxiway A/A3/B intersection is of heightened concern because it combines a four-node intersection with two direct apron-to-runway connector taxiways.

However, the functions and usefulness of Taxiways A3 and D should be considered prior to deciding to remove them. These taxiways are located such that their primary functions are to provide:

- An exit taxiway option for aircraft landing Runway 18
- A direct route across the airfield for aircraft taxiing between the air carrier apron and Runway 31,
- A direct route across the airfield for ARFF vehicles transiting between the ARFF station and air carrier apron.

An exit taxiway utilization study was conducted for this Master Plan using guidance in AC 150/5300-13A, Section 409, to determine whether Taxiways A3 and D are required for aircraft left turns when landing on Runway 18. **Table 4-7** compares the Runway 18 exit taxiway locations to the cumulative utilization percentages shown in Section 409, Table 4-13. Based on the information in this table, Taxiways A3/D are not needed for aircraft left turns on landing during dry conditions but are often needed for larger aircraft during wet conditions when aircraft require additional landing distance due to reduced runway friction.

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Table 4-7: Runway 18 Exit Taxiway Analysis							
Taxiway	**Distance from RW 18 Threshold**	**Turn Direction**	**Taxiway Angle**	**Aircraft Type Utilization**			
				Small Single Engine	**Small Twin Engine**	**Large**	**Heavy**
Dry Runway Cumulative Utilization							
C5	1,600'	Right turn only	Right angle	39%	0%	0%	0%
B	5,150'	Both ways	Acute angle	100%	100%	76%	55%
C4	6,200'	Right turn only	Right angle	100%	100%	92%	71%
C3/D/A3	6,800'	Both ways	Right angle	100%	100%	98%	90%
C2	7,700'	Right turn only	Right angle	100%	100%	100%	100%
C1/A1	8,650'	Both ways	Right angle	100%	100%	100%	100%
Wet Runway Cumulative Utilization Percentages							
C5	1,600'	Right turn only	Right angle	23%	0%	0%	0%
B	5,150'	Both ways	Acute angle	100%	100%	12%	0%
C4	6,200'	Right turn only	Right angle	100%	100%	48%	10%
C3/D/A3	6,800'	Both ways	Right angle	100%	100%	71%	35%
C2	7,700'	Right turn only	Right angle	100%	100%	97%	84%
C1/A1	8,650'	Both ways	Right angle	100%	100%	100%	99%

Source: FAA Advisory Circular 150/5300-13A
Note: Small aircraft = 12,500 lbs or less, Large aircraft = 12,500 lbs to 300,000 lbs, Heavy aircraft = greater than 300,000 lbs

The impact of removing Taxiways A3/D on cross-field aircraft taxiing and ARFF emergency response is summarized in **Figure 4-11**. If Taxiways A3/D were removed, the taxi distance from the air carrier apron to the Runway 31 end would increase nearly 50 percent, from 4,570 feet to 6,660 feet. Removing the taxiways would not affect the Airport's mandate for ARFF response vehicles to reach each runway midpoint within three minutes of a fire emergency alarm, as the taxiways are not used as part of the shortest route from the ARFF station to the runway midpoints. However, removing the taxiways would increase the distance ARFF vehicles would have to travel to reach the air carrier apron nearly 50 percent from 3,700 feet to 5,510 feet.

4.4.2. Alternative 2: Relocate Taxiway A

This alternative would relocate Taxiway A to provide adequate separation from parked aircraft on the south GA apron. As stated in previous chapters, the existing south GA apron is often congested due to parked aircraft during peak events. Military charter aircraft and large corporate jets use this area for staging, and when they are parked on the apron, it is difficult for other aircraft to circulate through the area. A portion of Taxiway A adjacent to the apron often must be closed because adequate separation cannot be provided between Taxiway A and the wingtips of large narrow-body jet aircraft parked or maneuvering on the apron. Relocating Taxiway A would allow aircraft to navigate the area without closing the taxiway or reducing aircraft parking capacity. To determine the lateral distance that Taxiway A should be relocated from its current position, the demands of a parked B737-800 on the apron were considered. The proposed layout is shown in **Figure 4-12A** and discussed below.

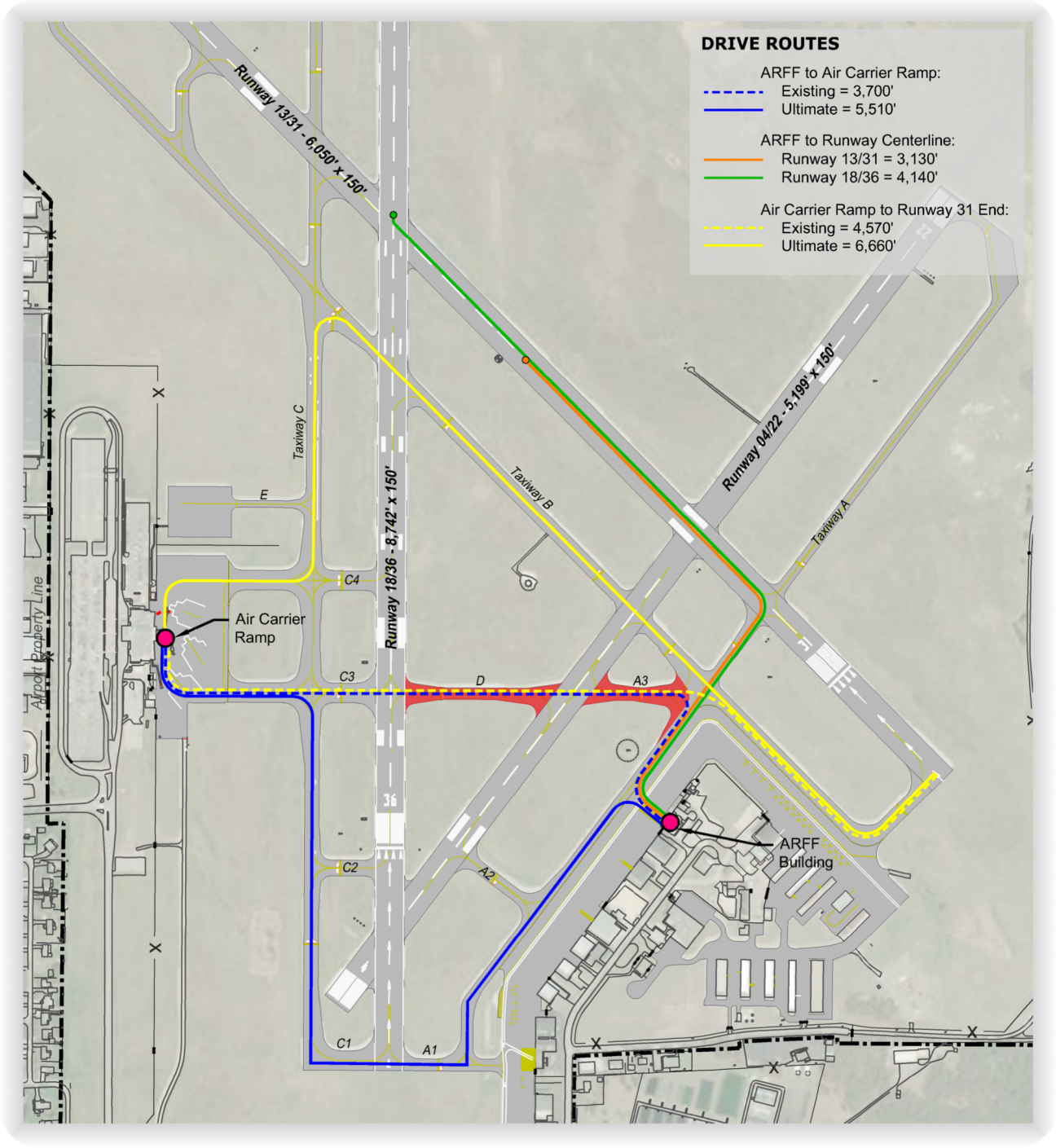
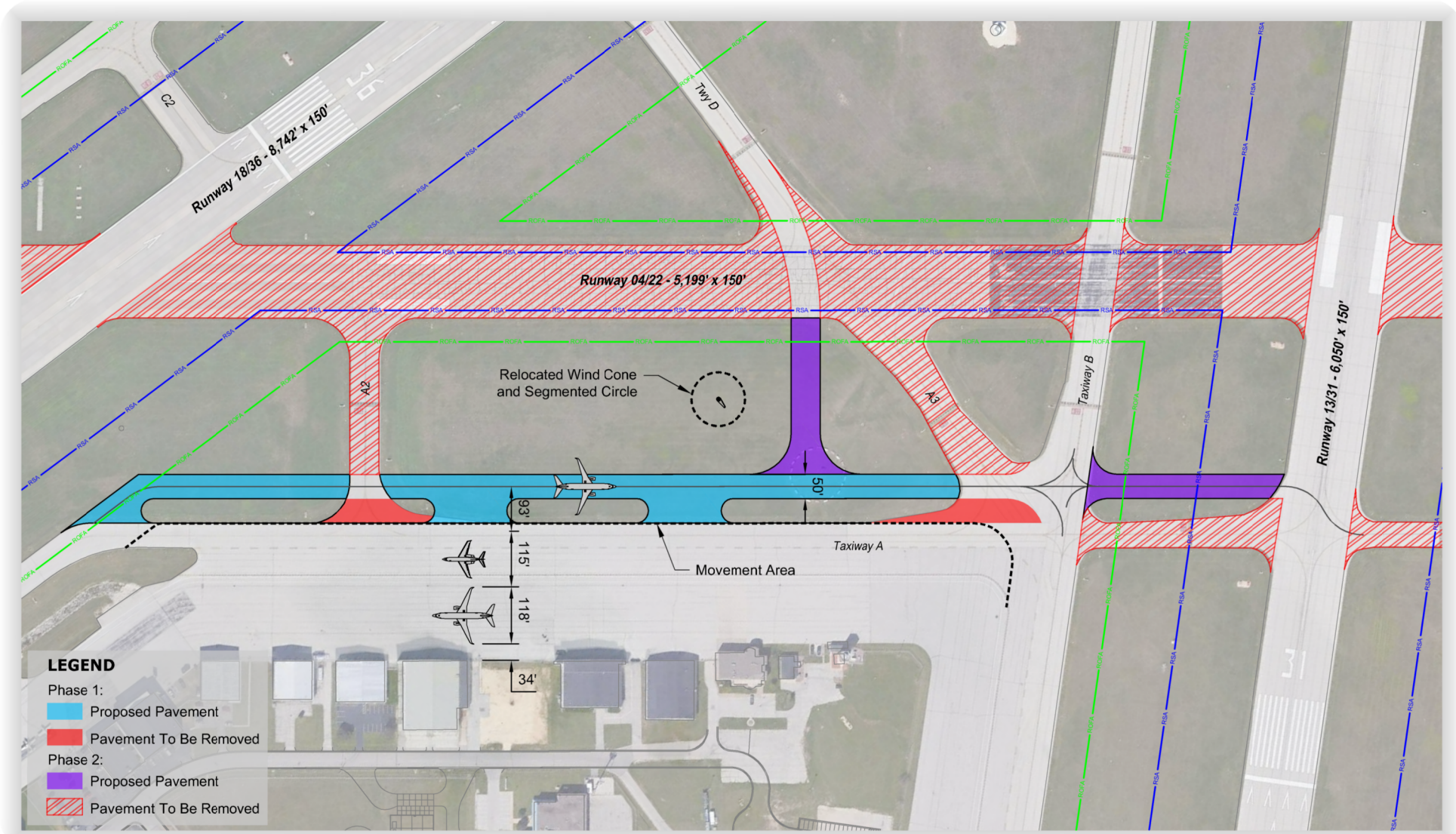


Figure 4-11: **Taxiway A3/D Utilization Study**

Source: *USGS Earthstar Geographics*



0 150 300 450

Graphic Scale in Feet

Figure 4-12A: **Taxiway Alternative 2**

Source: *USGS Earthstar Geographics*

The proposed layout assumes a 34-foot separation between the wingtip of a parked B737-800 aircraft to the nearby hangars. This is a conservative estimate based on the wingtip clearance required for parallel taxilanes for aircraft of this size. On the Taxiway A side of the B737-800, a standard ADG II TOFA of 115 feet is reserved to provide passage for small turbine aircraft without entering the movement area controlled by the tower. This would allow corporate jets to taxi past the apron without needing to contact the tower, as they would not need to cross the movement line to maneuver around a parked aircraft. This would reduce ATC workload and improve aircraft circulation efficiency. Taxiway A would be relocated so that another B737-800 aircraft could simultaneously move past the expanded apron under direction from ATC. The relocated Taxiway A concept is designed to minimize unnecessary pavement between the apron and Taxiway A to reduce stormwater and maintenance impacts while separating the taxiway from the apron. This alternative also includes relocating Taxiway A3 and the portion of Taxiway A between the south GA apron and Runway 13/31 to reduce the complexity of the five-way intersection of Taxiways A, A3, and B.

In summary, this configuration would allow a parked B737-800, a corporate jet in the ADG II category, and another B737-800 on Taxiway A to simultaneously pass each other with ATC only managing the B737-800 in transit. The estimated cost of relocating Taxiway A under this alternative is $4.5 million. This estimate does not include relocation of Taxiway A3 and the portion of Taxiway A between the south GA apron and Runway 13/31. This would occur during a future project phase to be completed following decommissioning and removal of Runway 04/22, and would cost an estimated additional $3.0 million.

4.4.3. Alternative 3: Convert Runway 04/22 into a Taxiway

This alternative assumes that Runway 04/22 would be closed and decommissioned and seeks to make use of its existing configuration and pavement as a taxiway, as shown in **Figure 4-12B**. The westernmost segment of Taxiway A would be extended north to connect with the edge of Runway 04/22, which would be reduced in width consistent with FAA taxiway standards. This narrowed portion of Runway 04/22 would be reconstructed and converted to a taxiway to provide an alternative path for aircraft to circulate through the area during taxiway and apron closures.

There are some challenges to this approach. Runway 04/22 pavement is in poor condition and the existing pavement would need to be completely removed and replaced to prepare it for larger aircraft. This means that there would be a minimal cost savings even though the proposed taxiway utilizes the footprint of Runway 04/22, with an estimated cost of $5.4 million. In addition, as Runway 04/22 is an established use, the conversion of a runway to taxiway may be confusing to pilots, particularly if they visit LSE infrequently and could mistake the taxiway for a runway. In conclusion, while this alternative would partially maintain the existing footprint of the Airport, it would result in an unusual layout without any significant cost savings compared to Alternative 2.

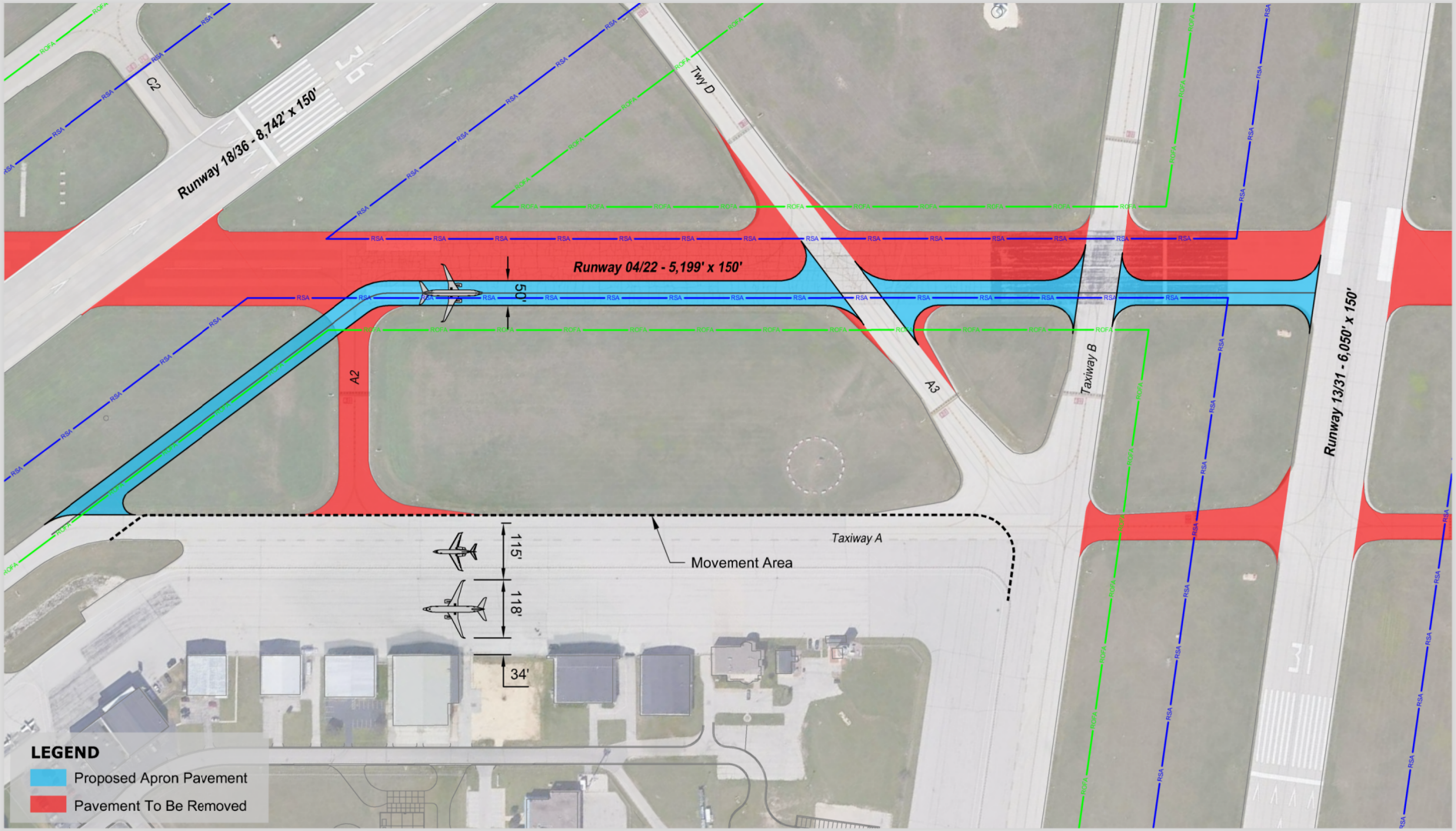


Figure 4-12B: **Taxiway Alternative 3**

Source: *USGS Earthstar Geographics*

4.4.4. Alternative 4: Extend Taxiway from A1 to D

This alternative would extend the westernmost segment of Taxiway A to the north, connecting with Taxiway D as shown in **Figure 4-12C**. This new taxiway segment would provide a shorter taxi route with fewer runway crossings during Taxiway A and south GA apron closures, using a typical taxiway design by paralleling Runway 18/36. The estimated cost of extending the taxiway as proposed by this alternative is $3.1 million. While this alternative provides an improved route compared to existing conditions, it adds complexity to the taxiway system that would need to be mitigated. For instance, the proposed taxiway would cross Runway 04/22 and Taxiway A2 would need to be removed in order to prevent the creation of a complex intersection. This alternative also would not provide access to all portions of the south GA apron during peak events and would not provide significant cost savings compared to Alternative 2.

4.4.5. Alternative 5: Relocate Taxiways C3 and C4

This alternative would relocate the portions of Taxiway C3 between the terminal apron and Taxiway C, and remove the portion of Taxiway C4 between Taxiway C and Runway 18/36, so that neither of these taxiways would provide a direct connection from the terminal apron to Runway 18/36, as shown in **Figure 4-13**. The estimated cost of this alternative is $3.4 million. AC 150/5300-13A, Section 401b.(5)(g) states that taxiways should not "lead directly from an apron to a runway without requiring a turn. Such configurations can lead to confusion when a pilot typically expects to encounter a parallel taxiway but instead accidently enters a runway." Although Taxiways C3 and C4 do not currently require a turn between the terminal apron and Runway 18/36, pilots must cross Taxiway C before entering the runway.

4.4.6. Alternative 6: Construct Mid-field Runway 13/31 Exit Taxiway

This alternative would add a mid-field exit taxiway from Runway 13/31 to Taxiway B located approximately 2,400 feet from the Runway 31 displaced threshold, as also shown in **Figure 4-13**. The estimated cost of this alternative is $1.1 million. Aircraft landing on Runway 31 currently cannot exit the runway until reaching Taxiway C approximately 3,800 feet from the Runway 31 displaced threshold. As a result, small GA aircraft must land and hold short of Runway 18/36, then either cross Runway 18/36 twice, or turn around and back-taxi on Runway 13/31, to reach the south GA hangar area. This alternative would eliminate the need for these additional runway crossings, as well as back-taxiing on Runway 13/31.

4.4.7. Recommended Alternatives

Removing Taxiways A3 and D as proposed by Alternative 1 would eliminate an important Runway 18/36 exit taxiway, increase the taxi distance from the terminal apron to Runway 31 by approximately 50 percent, and increase the distance ARFF vehicles would have to travel to reach the air carrier apron nearly 50 percent. Therefore, these taxiways perform several important functions and should be maintained.

Relocating Taxiway A as proposed by Alternative 2 would allow a parked B737-800, a corporate jet in the ADG II category, and another B737-800 on Taxiway A to simultaneously pass each other with ATC only managing the B737-800 in transit. This alternative is better than Alternatives 3 and 4 because it provides continuity with existing taxi procedures at a similar cost, while avoiding creation of new situational awareness issues. Alternative 2 will be included in the near-term Master Plan CIP.

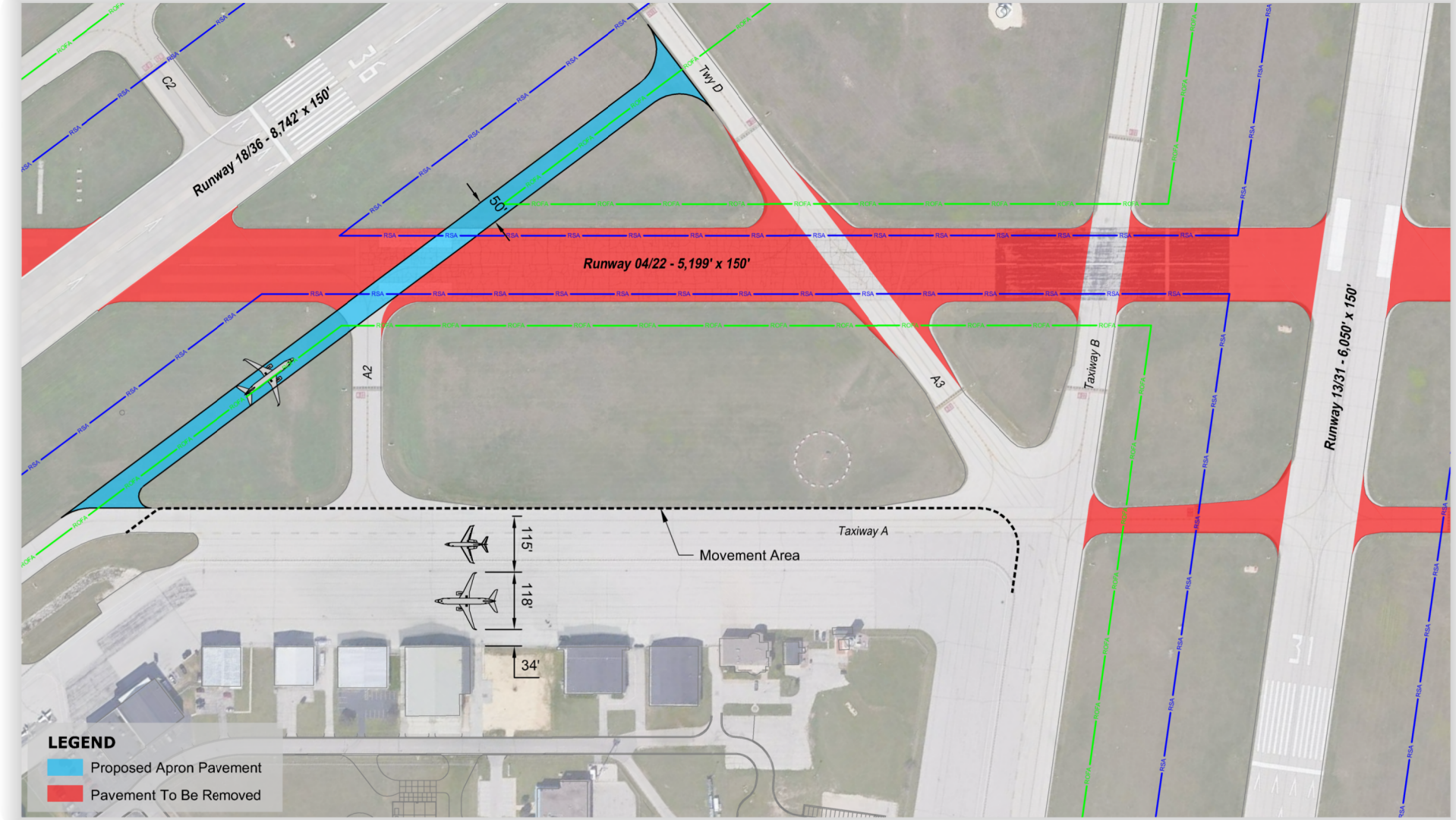


Figure 4-12C: **Taxiway Alternative 4**

Source: *USGS Earthstar Geographics*

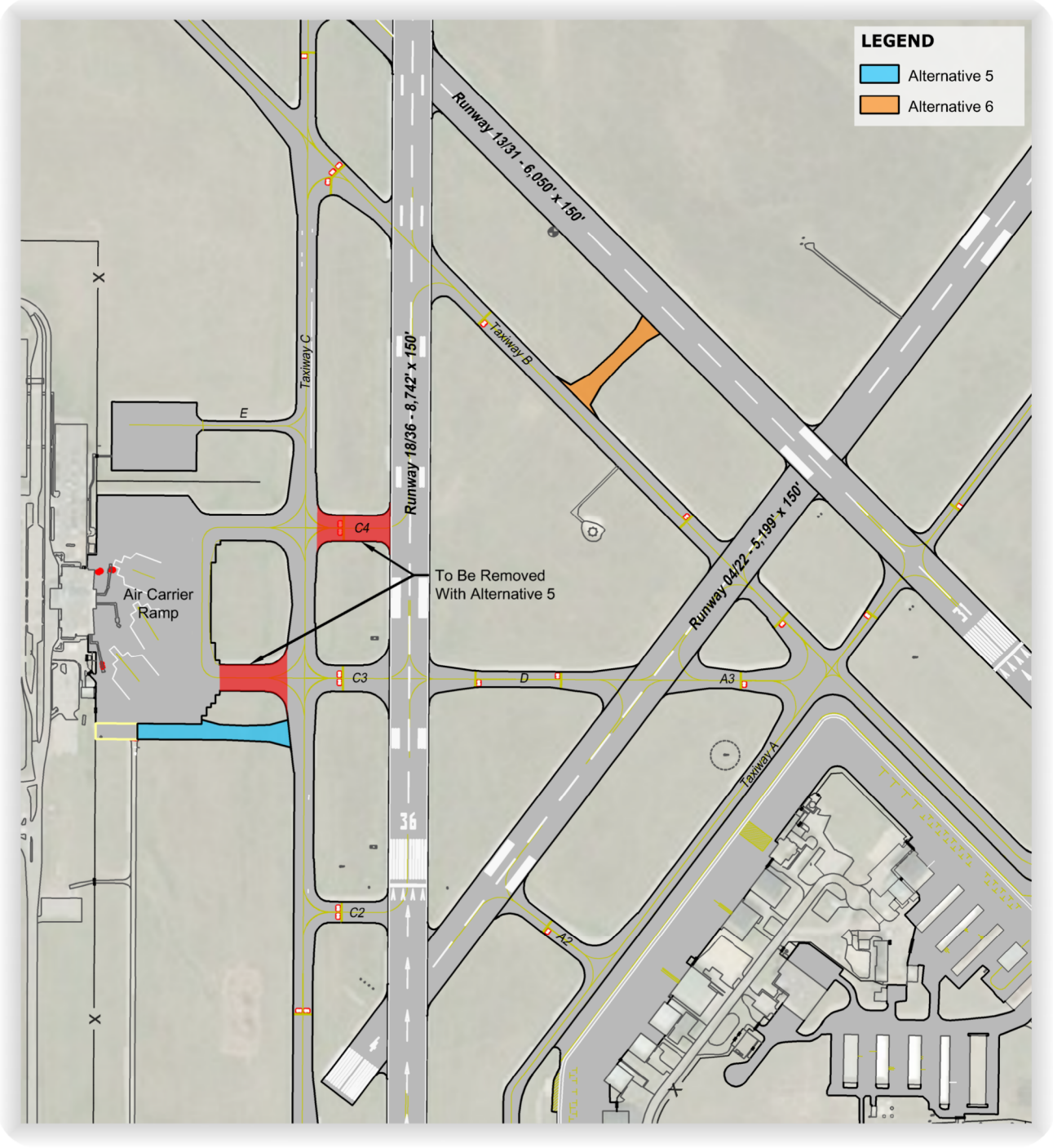


Figure 4-13: **Taxiway Alternatives 5 & 6**

Source: *USGS Earthstar Geographics*

Relocating a portion of Taxiway C3 and removing a portion of Taxiway C4 as proposed by Alternative 5 would eliminate direct apron-to-runway connections. However, pilots currently must cross Taxiway C before entering the runway, which provides adequate situational awareness. Therefore, relocating these taxiways is not necessary to airfield safety.

Constructing a mid-field Runway 13/31 exit taxiway as proposed by Alternative 6 would reduce Runway 18/36 crossings, as well as back-taxiing on Runway 13/31, for aircraft landing Runway 31. Alternative 6 will be included in the near-term Master Plan CIP.

4.5. Instrument Approach Alternatives

Instrument approaches allow aircraft to operate at an airport during inclement weather and are also used to aid navigation during clear weather conditions. When conducting instrument approaches, pilots fly predetermined routes to navigate around potentially hazardous terrain or obstacles until establishing visual contact with the runway, at which point they can descend and land. This section examines the instrument approaches at LSE for potential improvements.

4.5.1. Instrument Approaches Overview

Approaches at LSE rely on three types of instrument approach technologies: Instrument Landing Systems (ILS), Area Navigation (RNAV) with GPS, and Very High Frequency Omni-Directional Range (VOR). ILS approaches require considerable on-site equipment, including localizer and glideslope antenna systems. Although still used regularly at airports nationwide, very few ILS systems are being installed due to the advent of GPS systems with comparable performance and lower establishment and maintenance costs. VOR approaches use radio beacons strategically located nationwide to provide approach navigation. The FAA is actively removing VORs across the country to reduce maintenance costs. For these reasons, any improvements to LSE approaches in the near-term would likely be through improvements to RNAV (GPS) approaches. While RNAV (GPS) refers to the type of approach, there are several methods of establishing minimums for these approaches. Relevant RNAV approach minimum types with required equipment and available guidance are shown in **Table 4-8**.

Table 4-8: RNAV Instrument Approach Minimum Types

Short Name	Full Name	Vertically Guided	Additional Aircraft Equipment
LPV	Localizer Performance with Vertical Guidance	Yes	WAAS*
LNAV/VNAV	Lateral Navigation / Vertical Navigation	Yes	WAAS*
LP	Localizer Performance w/o Vertical Guidance	No	WAAS*
LNAV	Lateral Navigation	No	None

*Note: *WAAS = Wide Area Augmentation System*

In practice, regardless of the RNAV (GPS) approach type, aircraft descend from altitudes specified in the approach procedure until they establish visual contact with the runway. However, each approach type offers varying level of precision, may or may not offer vertical guidance along a specified flight path, or may simply offer a minimum safe altitude for each stage of the approach. Many of these approaches also require the use of specialized equipment aboard the aircraft. The RNAV (GPS) approach that requires no additional equipment, but does not provide vertical guidance, is the LNAV approach. Due to the accessibility of this approach, it is one of the most common in the United States. As of February 2016, there were over 6,000 LNAV approaches at 2,747 airports nationwide. Therefore, improvements to one of the LNAV approaches at LSE would offer the greatest improvement for most Airport users.

4.5.2. Preferred Runway Approach

When considering which runway end to improve the existing instrument approaches for, each end should be evaluated. Runway 4/22 is not used by larger aircraft and is used almost exclusively in visual meteorological conditions (VMC), and therefore was not considered. For large business jets and air carrier aircraft, Runway 18/36 already has ILS and RNAV (GPS) approaches with ½-mile visibility minimums to its north end and an RNAV (GPS) approach with 1-mile visibility minimums to its south end. Meanwhile, Runway 13/31 approaches are limited to RNAV (GPS) approaches with a 1-mile visibility minimum to the 13 end and a 3-mile visibility minimum to the 31 end. Runway 31 is a prime candidate for an improved approach due to its poor approach capabilities compared to its length.

One of the first considerations for runway usage is wind coverage. As wind coverage impacts the frequency with which an aircraft may safely use a runway, runways with higher wind coverage are generally the most useful. Wind coverage for Runways 13 and 31 is compared to Runways 18 and 36 in **Table 4-9**. Medium sized aircraft, such as large business jet and regional air carrier aircraft, have FAA crosswind tolerance of 16 knots; therefore, a 16-knot crosswind component was considered for this analysis.

Table 4-9: Crosswind Coverage (16 knots)

Weather Condition	Runway 18	Runway 36	Runway 13	Runway 31
All Wx	60.80%	51.70%	60.48%	52.57%
VFR	65.93%	57.16%	64.81%	58.77%
IFR	84.20%	83.15%	86.33%	81.19%

Although maximizing wind coverage plays an important role in airfield planning, IFR wind patterns can vary significantly from normal conditions based on the local terrain and weather patterns. IFR weather that limits visibility, such as fog or heavy rain, is often accompanied by less sustained wind. High pressure weather systems are often associated with clear skies, cold air, and strong wind, while low pressure systems, such as those that usually bring IFR weather, are associated with stable cloud layers, warmer air, and calmer wind. This trend is evident in **Table 4-10,** which shows IFR wind velocity frequency at LSE over the past ten years. In 98.9% of IFR conditions, wind velocity is less than 16 knots at LSE. Therefore, user trends are more relevant than IFR crosswind coverage when considering potential approach improvements.

Table 4-10: IFR Wind by Velocity (knots)							
Weather Condition	**0-3**	**4-6**	**7-10**	**11-16**	**17-21**	**22-27**	**>28**
All Wx Conditions	21.7%	38.7%	19.4%	17.0%	2.9%	0.3%	0.0%
VFR Conditions	30.6%	33.4%	17.6%	15.7%	2.6%	0.2%	0.0%
IFR Conditions	72.3%	16.3%	5.8%	4.4%	0.9%	0.2%	0.0%
Notes: Percentages shown account only for that weather condition, i.e., 72.3% of IFR weather observations, not all weather observations, reflect wind velocities of less than 3 knots. *Source: Station: LSE ASOS, Period of Record: 2007 – 2016, Mead & Hunt*							

Activity data was gathered to determine which runway ends are used most frequently by flights conducted under IFR flight plans. As large narrow-body jet aircraft like the Boeing 737 or A320 cannot use Runway 13/31 for most operations due to inadequate length, only business jet aircraft like the Citation Sovereign or Dassault Falcon 2000 and regional air carrier aircraft like the CRJ 700 or EMB 145 are referenced in this section. Data gathered from August to December 2018 and shown in **Table 4-11** indicate that more IFR approaches are conducted to Runway 31 than Runway 13. This is the case even though Runway 13 already has lower visibility minimums and better wind coverage than Runway 31. Therefore, Runway 31 approach improvements would be most beneficial for Airport users. However, potential improvements to Runway 31, 13, and 36 approaches are discussed below.

Table 4-11: IFR Approach by Runway End	
Runway End	**Arrival**
Runway 18	60.5%
Runway 36	35.2%
Runway 31	2.6%
Runway 13	1.4%
Runway 22	0.3%
Runway 04	0.0%
Source: LSE ATCT Counts	

4.5.3. Runway 31 Instrument Approach Improvements

There are two primary factors to consider when evaluating the utility of potential LNAV approach improvements. One is the minimum altitude an aircraft may descend to while conducting the approach, known as the Minimum Descent Altitude (MDA). The second is the visibility minimum, which is the minimum visibility distance required to successfully conduct the approach. Visibility minimums are most often measured in quarter-mile increments. To improve a given LNAV approach, reducing the MDA and/or visibility minimums is required. To better frame this discussion, the existing Runway 31 RNAV (GPS) instrument approach plate is shown in **Figure 4-14**. As shown in the figure for approach category C/D aircraft, the current MDA is 1100 feet above touchdown and the current visibility minimum is 3 miles.

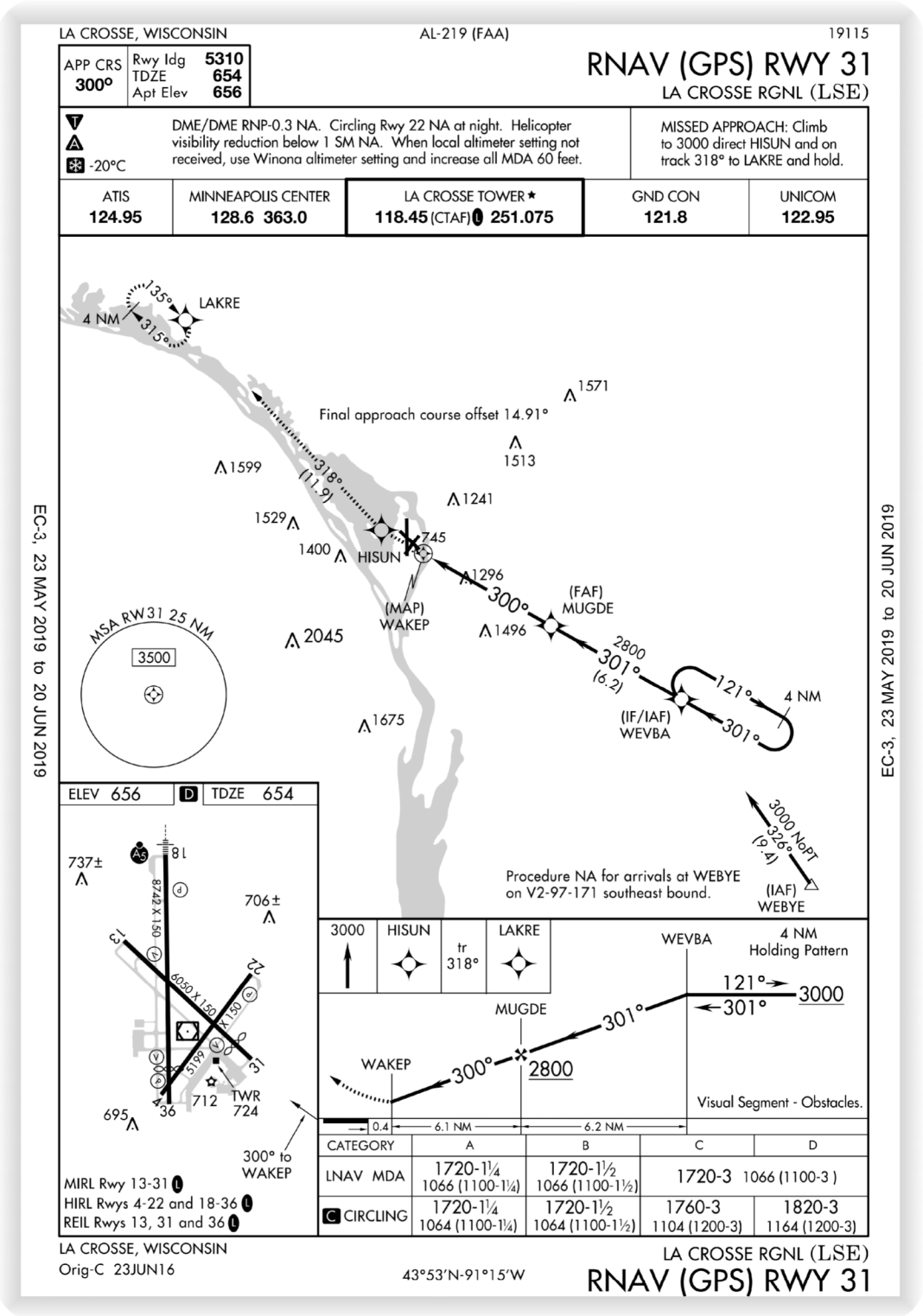


Figure 4-14: **Runway 31 LNAV Approach**

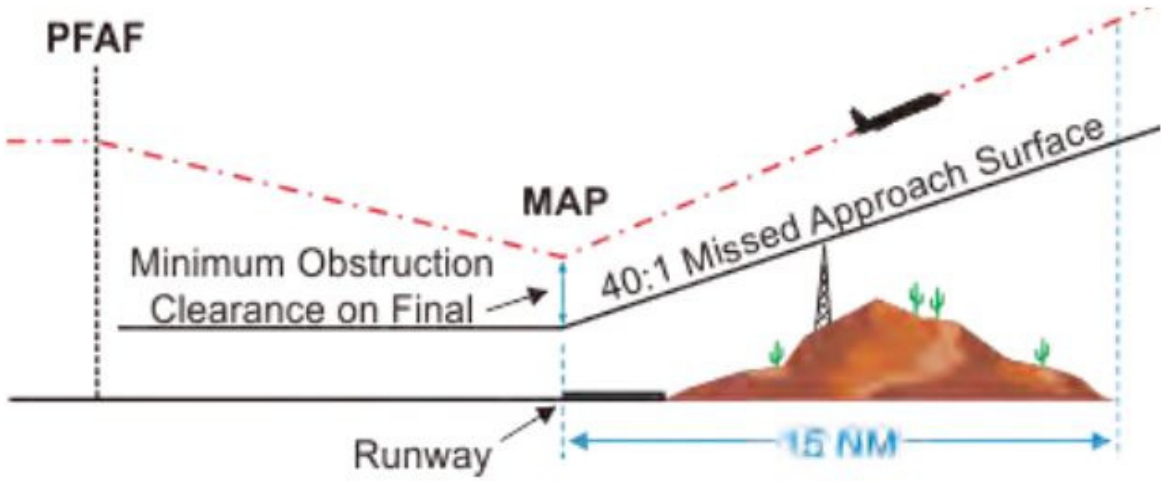
Source: *United States Department of Transportation - Federal Aviation Administration*

4.5.3.1. Minimum Descent Altitude

There are two primary considerations that impact the location of the MDA. The first consideration is the required height above any obstacles during the final approach segment from the Final Approach Fix (FAF) to the Missed Approach Point (MAP), which must be located after the FAF. Aircraft flying under IMC are often greatly limited in their ability to see and avoid surrounding obstacles. Therefore, adequate separation must be provided between aircraft and significant obstacles in the approach area. The required separation between the prescribed altitude of aircraft on approach and obstacles in the approach area is known as the Required Obstacle Clearance (ROC). For the final approach segment, the ROC height above obstacles is between 250 and 500 feet. In practice, this means that aircraft must fly the final approach between 250 to 500 feet above obstacles in the area.

The second consideration is the missed approach surface that accounts for aircraft that cannot land following the approach and must begin climbing again. Similar to the 40:1 departure surface for runway departures, a 40:1 surface also protects the go-around procedure during a missed approach. A clear 40:1 surface must be clear from the MAP, at an altitude that includes the appropriate ROC beneath the MAP, along the flight path until an altitude of 1,000 less than the final missed approach altitude is established. This is illustrated below**.** For example, as the existing missed approach requires climbing to 3,000 feet above mean sea level for the current RNAV (GPS) RWY 31 approach, then the 40:1 surface would terminate at 2,000 feet above mean sea level.

These two factors must be considered in combination to provide in the lowest possible MDA while maintaining the necessary ROC above obstacles. This is illustrated in **Figure 4-7** with prominent obstacles labeled.



Source: Figure 2-8-2 FAA Order 8260.3D, United States Standard for Terminal Instrument Procedures (TERPS)

4.5.3.2. Visibility Minimums

Visibility minimums for a straight-in instrument approach procedure are determined by evaluating five relevant factors and picking the most conservative value. This section summarizes each of these factors and identifies the most limiting factors.

1) The first factor considers available facilities for the runway in question as shown below in **Table 4-12.** In this case, most existing facilities on Runway 31 are appropriate for visibility minimums as low as ¾-mile and the only two factors presented in this table at LSE that would require improvement are the runway markings and a survey to support vertical guidance, both of which are minor challenges. However, obstacles in the approach and other factors present additional challenges that result in visibility minimums higher than what Runway 31 could otherwise achieve with these improvements, as explained below.

Table 4-12: Minimum Visibility Based on Available Runway Facilities

Facilities Consideration	Lowest Possible Visibility Minimum (Statute Miles)
Runway does not have a full-length parallel taxiway	1
Edge lighting is not HIRL or MIRL	1
Surface is not asphalt or concrete	3/4
Does not have precision runway markings	3/4
Length is less than 4,200 feet	3/4
Runway survey does not support vertical guidance	3/4

Source: FAA Order 8260.3D, United Sates Standard for Terminal Instrument Procedures, Table 3-3-6

2) The second factor is the distance from the landing point to the MAP. For Runway 31, this distance is 2,626 feet. This distance is then rounded up and converted to statute miles. The applicable visibility minimum for this factor is also ¾-mile. Again, this is lower than the current minimums.
3) The third factor is only applicable if the decision altitude, which is used for LPV approaches, is greater than 3 miles from the landing threshold point. As LPV minimums are not applicable to LNAV approaches, and the distance is less than 3 miles, this factor is not relevant.
4) The fourth factor is the visual obstacle clearance surface, which begins near the end of the runway and provides a protected area for aircraft using visual flight rules to complete the approach to land. There are two applicable surfaces in this area that, if penetrated, limit the visibility minimums for a runway. These surfaces are shown in **Figure 4-8** and include a 34:1 surface that, if penetrated, limits visibility to not lower than ¾ mile, and a 20:1 surface that, if penetrated, limits visibility to not lower than 1 mile. As shown in **Figure 4-8**, the 34:1 surface is penetrated by the 1,296-foot tower as well as several trees in the area. Therefore, visibility minimums are limited by this factor to 1 mile. Potential obstacle mitigation related to this surface is discussed later in this section.
5) The final factors to consider are the achievable MDA and available approach lighting system type for the runway. The Height Above Threshold (HAT) is the MDA minus the Touch Down

Zone Elevation (TDZE). The TDZE often cannot be changed, as it is limited by the runway elevation. However, decreasing the MDA would reduce the HAT and corresponding visibility minimums. Based on existing conditions without an approach lighting system and a HAT value of 1,066 feet, the achievable visibility minimum for large business jet and air carrier aircraft is 3 statute miles. The high HAT and lack of an approach lighting system are currently the most limiting factors for Runway 31 approach visibility minimums. **Table 4-13** identifies achievable visibility minimums based on the HAT and available approach lighting system.

Table 4-13: Minimum Visibility Values (statute miles)

HAT (feet)	Full ALS (FALS)	Intermediate ALS (IALS)	Basic ALS (BALS)	No ALS (NALS)
200	1/2	3/4	3/4	3/4
201 – 210	1/2	3/4	3/4	3/4
211 – 220	1/2	3/4	3/4	3/4
221 – 230	1/2	3/4	3/4	3/4
231 – 240	1/2	3/4	3/4	3/4
241 – 250	1/2	3/4	3/4	3/4
251 – 260	1/2	3/4	3/4	3/4
261 – 280	1/2	3/4	3/4	7/8
281 – 300	1/2	3/4	3/4	7/8
301 – 320	1/2	3/4	3/4	7/8
321 – 340	1/2	3/4	7/8	1
341 – 360	5/8	3/4	7/8	1
361 – 380	5/8	3/4	1	1
381 – 400	5/8	7/8	1	1 1/8
401 - 420	3/4	1	1	1 1/8
421 – 440	3/4	1	1 1/8	1 1/4
441 – 460	7/8	1	1 1/8	1 3/8
461 – 480	1	1 1/8	1 1/4	1 3/8
481 – 500	1	1 1/8	1 1/4	1 3/8
501 – 520	1	1 1/4	1 3/8	1 3/8
521 – 540	1	1 1/4	1 3/8	1 1/2
1,066 (Existing)	**2 1/2**	**2 1/2**	**3**	**3**

Notes: Standards apply to all procedures and category of aircraft except A and B non-precision approach, SA CAT I/II, CAT II/III and helicopters.
NALS: No approach lights or an ALS less than 700 feet in length
IALS: MALSF, MALS, SSALF, SSALS, SALS/SALSF
BALS: ODALS
FALS: ALSF-1, ALSF-2, SSALR, MALSR
Source: FAA Order 8260.3D, United States Standard for Terminal Instrument Procedures (TERPS)

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The prescribed HAT for the approach and the availability of an approach lighting system have the greatest impact on Runway 31 approach visibility minimums. Reducing the MDA, which would in turn lower the HAT, and installing an approach lighting system are the most effective strategies for improving the Runway 31 approach. However, each of these strategies have their challenges.

An intermediate approach lighting system (IALS) for Runway 31, such as a Medium-intensity Approach Lighting System with Sequenced Flashing lights (MALSF), could be installed inside the Airport fence as shown in **Figure 4-15**. Due to the displaced threshold, this system would require in-pavement lighting, which would add to the cost and require additional maintenance considerations.

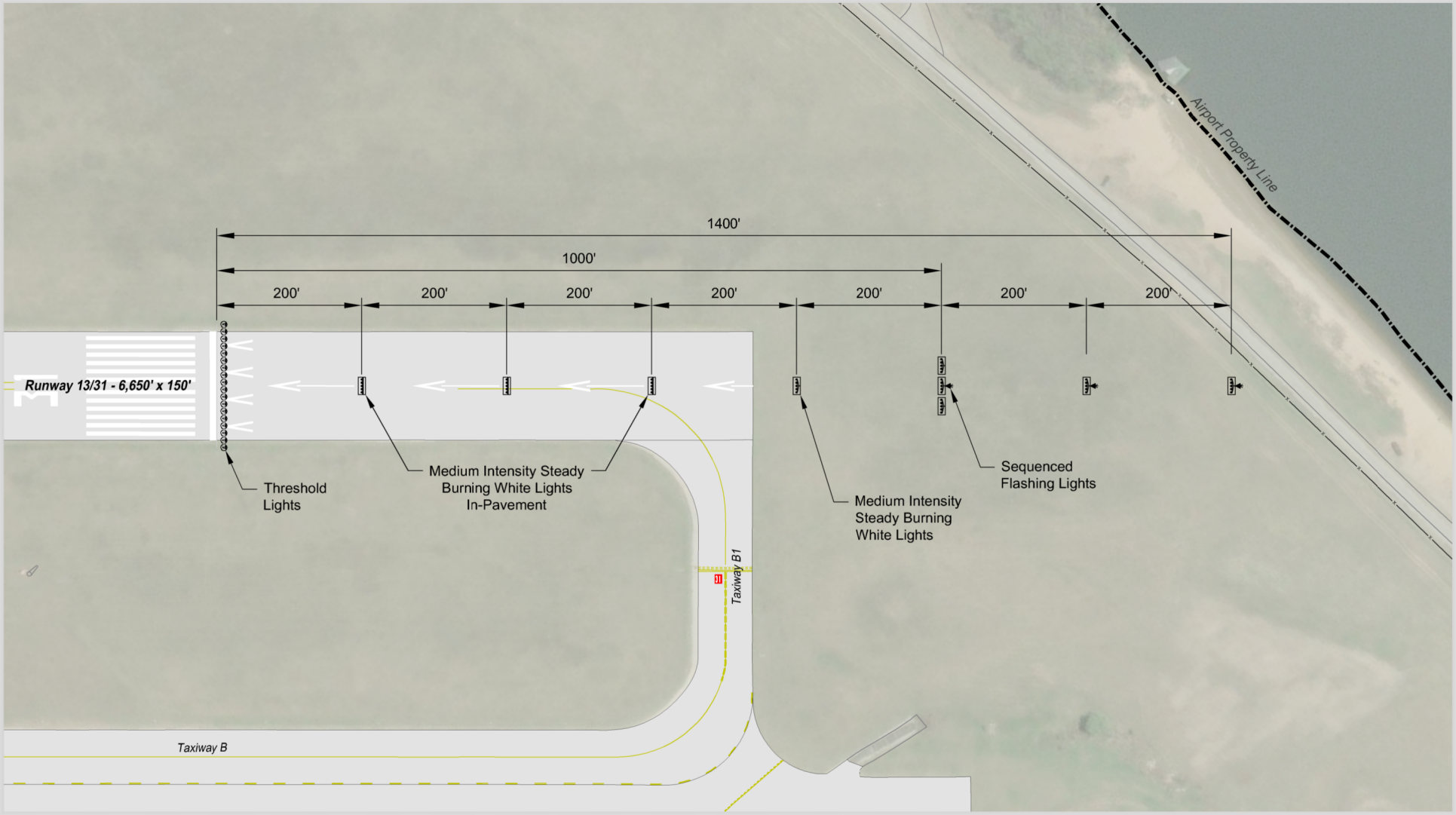
Lowering the MDA could be potentially achieved by removing the 1,296-foot tower and surrounding trees in the Runway 31 approach area shown in **Figure 4-7**. However, the high terrain in the area is expected to prevent meaningful reductions in the MDA, as removal of these obstacles would likely lower the MDA by approximately 75 feet at best. Terrain in this area would need to be further investigated to verify this conclusion.

The combination of lowering the MDA and installing a MALSF would allow for a marginally improved visibility minimum of 2.5 miles for large business jet and air carrier aircraft. Coordination with the FAA is encouraged to determine the feasible of approach improvements discussed in this section. The costs of this coordination effort and financial investment would likely outweigh the benefits of the marginal improvement in minimums. However, the Master Plan recommends that the Airport protect for a future MALSF because it is likely to be the only viable alternative for reducing Runway 31 minimums.

4.5.4. Runway 13 Instrument Approach Improvements

As discussed previously in Chapter 3, Runway 13 currently has an RNAV (GPS) approach with an LPV enhancement. The minimums for the approach are more restrictive than those for Runway 18/36, but less restrictive than those for Runway 31, with a HAT of 400 feet AGL and visibility minimums of 1 statute mile. Although the non-LPV minimums are higher than the LPV minimums, they are lower than the corresponding minimums for Runway 36.

Airport staff has indicated that Runway 13 approach improvements are desirable. As Runway 13/31 provides superior wind coverage, its approach should have similar capabilities to Runway 18/36. However, the only option for improving minimums to this runway end is to install an approach lighting system (see **Figure 4-16** for a standard MALSF layout for the existing Runway 13 end). Installing an approach lighting system for this runway would be challenging because it would not fit inside the Airport fence if Runway 13 were extended as proposed earlier in this chapter. The ALS may extend near the shore of Lake Onalaska and into areas under the jurisdiction of the federal government. This poses challenges related to environmental clearance and long-term maintenance of the ALS. Furthermore, approach counts provided by the Airport Traffic Control Tower (ATCT) indicate that Runway 13 is not a preferred runway approach for large business jets and regional air carrier aircraft and installation of an ALS on this runway would likely have limited benefits for these users. For these reasons, planning for a Runway 13 ALS is not recommended by this Master Plan.



0 100 200 300

Graphic Scale in Feet

Figure 4-15: **Runway 31 MALSF Conceptual Layout**

Source: *USGS Earthstar Geographics*

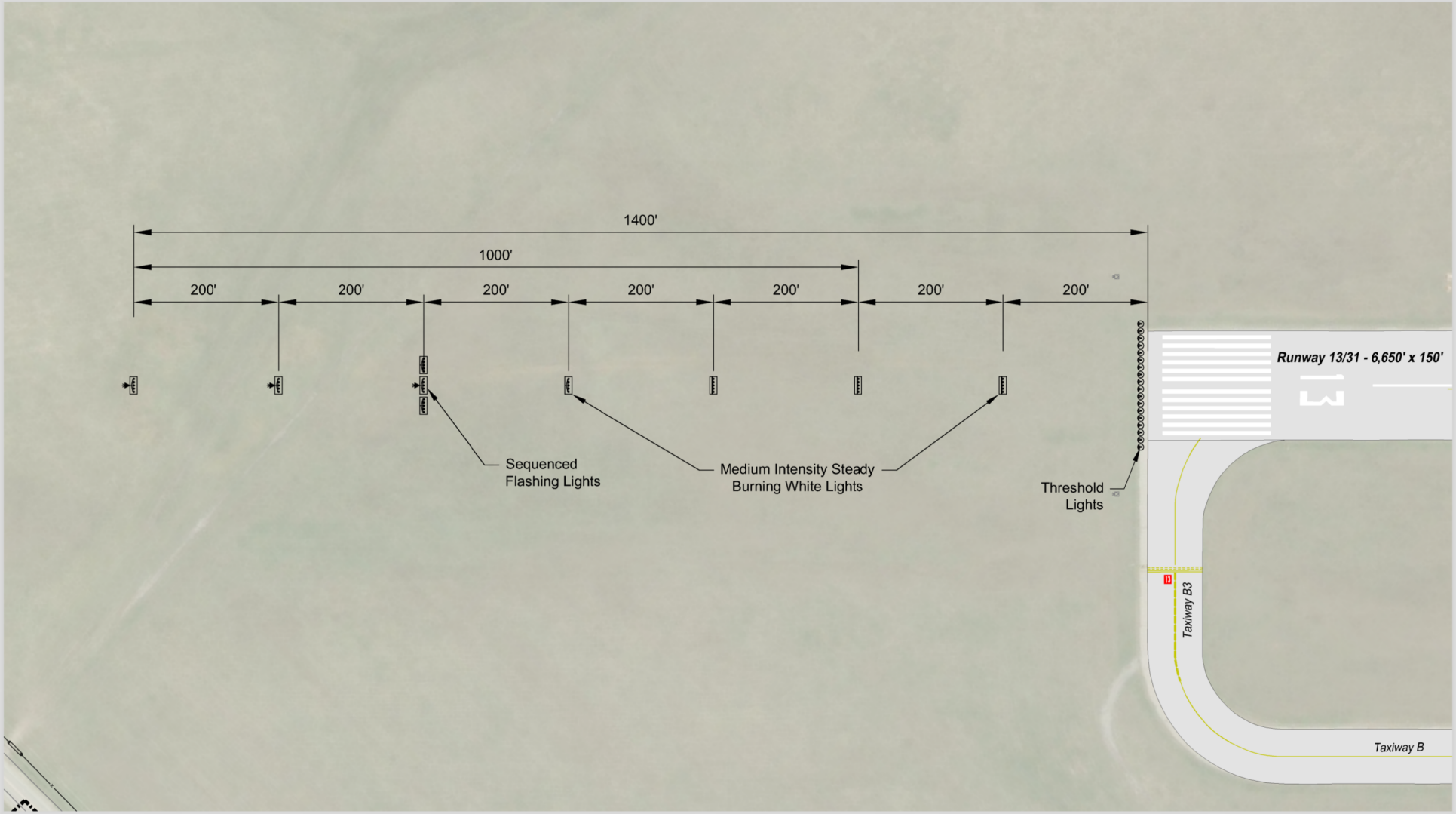


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Figure 4-16: **Runway 13 MALSF Conceptual Layout**

Source: *USGS Earthstar Geographics*

Runway 13 currently has a VASI installed which is outdated and is no longer being replaced by the FAA. A Precision Approach Path Indicator (PAPI) should be installed to improve vertical guidance for the approach. However, this is unlikely to improve approach minimums to this runway.

4.5.5. Runway 36 Instrument Approach Improvements

As previously discussed in Chapter 3, Runway 36 has two non-precision approaches: an RNAV (GPS) approach and a VOR approach. The Runway 36 RNAV (GPS) approach has an LPV enhancement, the highest precision GPS approach currently available. The current Runway 36 LPV minimums include a HAT of 300 feet AGL and visibility of 1 statute mile. The non-LPV minimums are much higher; for example, the LNAV/VNAV minimums include a HAT of 600 feet AGL and visibility of 2 statute miles. A full approach lighting system (FALS) for Runway 36, such as a Medium-Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR), could be installed inside the Airport fence as shown in **Figure 4-17**. Due to the displaced threshold, this system would require in-pavement lighting, which would add to the cost and require additional maintenance considerations. However, the achievable visibility minimums shown in Table 4-13 indicate that a FALS could potentially reduce the LPV visibility minimum to ½ statute mile, which would be a significant improvement. Visibility minimum reductions of this magnitude would require more restrictive FAR Part 77 and threshold siting surfaces. These more restrictive surfaces will be evaluated as part of the ALP update.

4.6. South General Aviation (GA) Development Area Alternatives

The GA area between the Runway 04 and Runway 31 thresholds supports several types of GA and other aviation-related uses including large corporate traffic, small recreational piston traffic, an ATCT, and Airport support facilities, such as the ARFF and SRE facilities. Alternatives should meet the individual demands of each facility type while also promoting an efficient layout throughout the entire area. As any expansion to one area will likely have impacts to the surrounding facilities, alternatives in this area will be considered as a whole.

This section focuses on facilities south of the GA aprons and potential lateral expansion of the GA aprons. Existing issues in this area include poor circulation of GA aircraft, lack of hangar capacity, and aging hangars. Due to the constrained nature of facilities in this area, proposed layouts are considered in stages, with each stage considering long-term build-out of future facilities while also meeting relevant needs in the near term.

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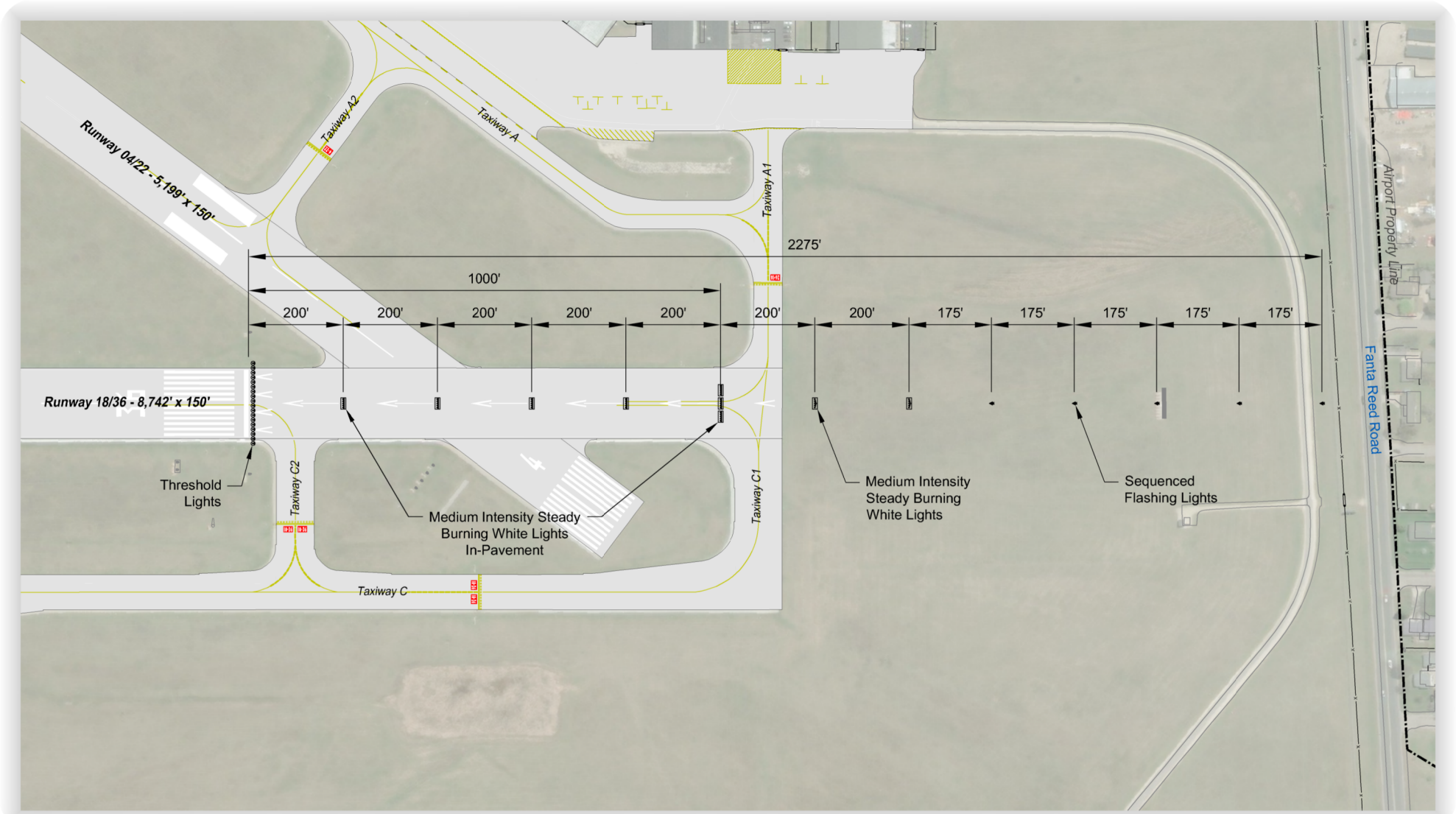

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Graphic Scale in Feet

Figure 4-17: **Runway 36 MALSR Conceptual Layout**

Source: *USGS Earthstar Geographics*

4.6.1. South GA Development: Near-Term Conceptual Layout

The most pressing concern in the south GA area is to provide hangar capacity for larger aircraft, while also removing aging buildings and improving circulation to alleviate existing issues and prepare for additional facilities. The proposed near-term layout for immediate build-out is shown in **Figure 4-18**. Additional landside access points to the hangar area would be made by extending Fanta Reed Road and providing a vehicle turn-around at the end of the road. Vehicles could reach dedicated parking areas near the proposed development areas for future hangars. There are two main development areas. The one east of extended Fanta Reed Road would be available after the two existing T-hangars are removed and could house a large hangar capable of serving regional jets or large corporate aircraft. The development area to the west is intended for smaller 80-by-80-foot hangars for corporate tenants.

Aircraft in these hangars could access the airside using an improved taxiway system. A new taxilane would be constructed around the northern edge of the SRE apron to provide aircraft with access from the corporate hangars to the airside. To further improve airside access, the taxilane to the north of the existing T-hangars would be expanded to allow for ADG II aircraft, which includes aircraft with a wingspan of less than 79 feet, such as the Cessna Citation X, to transit through this area. Both taxilanes would have small temporary bends to maneuver around the sand storage building and existing T-hangar on the southeast edge of the apron, although these would be removed in the intermediate term as discussed in the following section.

4.6.2. South GA Development: Intermediate-Term Conceptual Layout

This alternative would build on the near-term layout as shown in **Figure 4-19**. Although corporate hangars would be added west of Fanta Read Road, the main changes in this phase are additional hangars and taxilanes near the existing T-hangars. Four box hangars would be constructed to the west of the T-hangars, and the pavement would be expanded to accommodate an additional taxilane designed for ADG II aircraft. To the east, a T-hangar would be added with a taxilane on either side designed for ADG I aircraft. The taxilane that supports the corporate hangars and T-hangar area would be improved by the removal of the sand storage building and the T-hangar on the southeast portion of the apron. This would allow for the taxilane to be straightened and simplify aircraft maneuvering. Finally, Fishermans Road would be relocated to the south to provide additional room for future expansion in this area, and two dry retention ponds would be added to account for stormwater retention due to the additional pavement.

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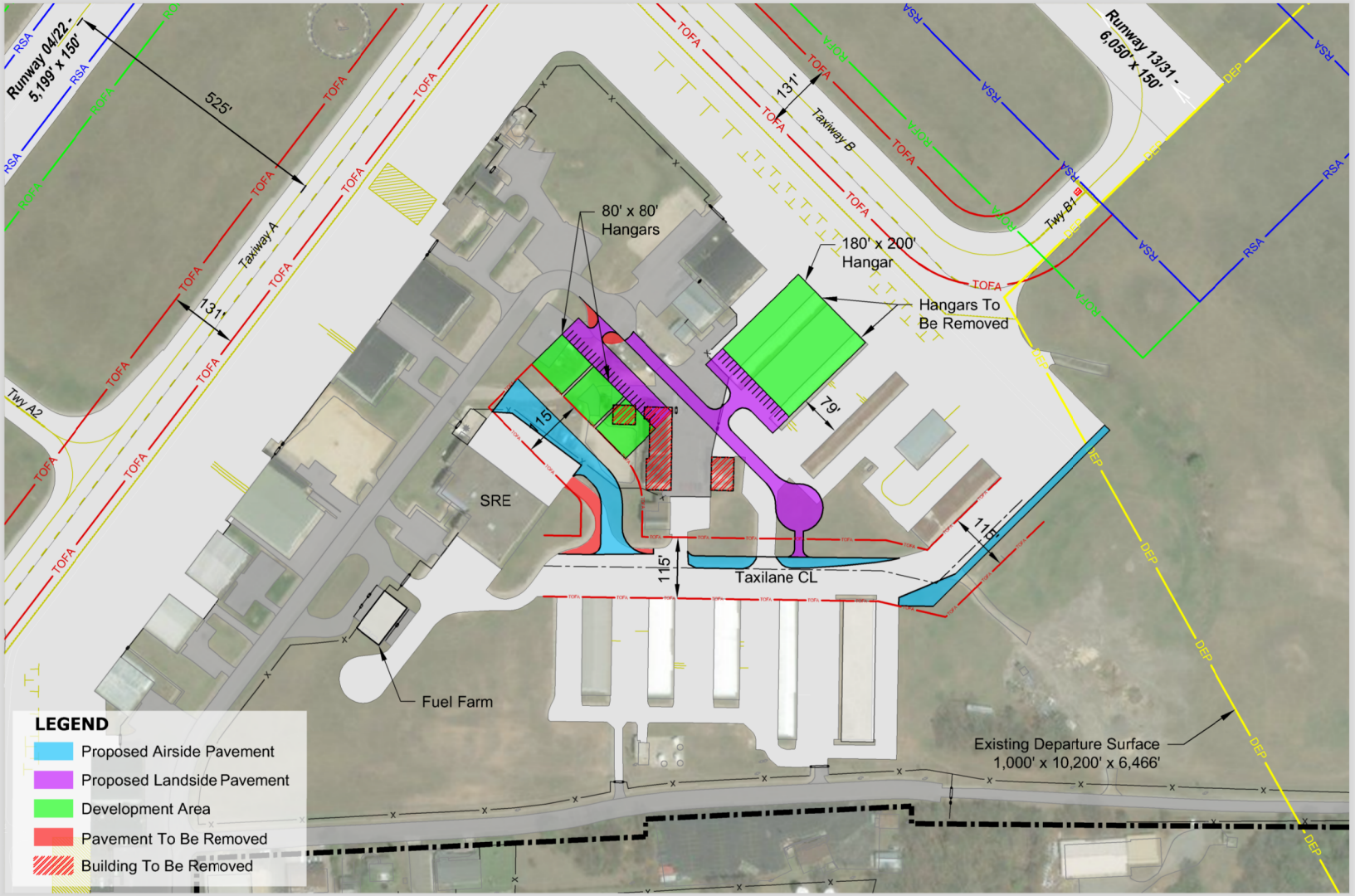

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Graphic Scale in Feet

Figure 4-18: **South GA Near-Term Conceptual Layout**

Source: *USGS Earthstar Geographics*

Figure 4-19: **South GA Intermediate-Term Conceptual Layout**

Source: *USGS Earthstar Geographics*

4.6.3. South GA Development: Long-Term Conceptual Layout

The long-term development phase would focus on expanding the southernmost section of the south GA hangar area, as shown in **Figure 4-20**. Box hangars would be added to the southwest while the empty area to the east would be developed for large corporate or air carrier hangars. To efficiently accommodate the increase in overall use of the hangar area by different aircraft types, an additional taxilane suited for ADG I aircraft would be constructed south of the T-hangars. This would be possible due to the space created by relocating Fishermans Road in the intermediate term. This taxilane would allow for small aircraft to circulate through the area and reduce congestion for larger aircraft located in the area. This final build-out would also include non-aeronautical development in the southwest corner of this area. This site is not needed or suitable for aeronautical development due to its distance from the apron and the considerable amount of space available elsewhere for aeronautical development. The non-aeronautical development in this area would also benefit from increased visibility at the corner of Fanta Reed Road and Fishermans Road.

4.7. Aeronautical Development Area Alternatives

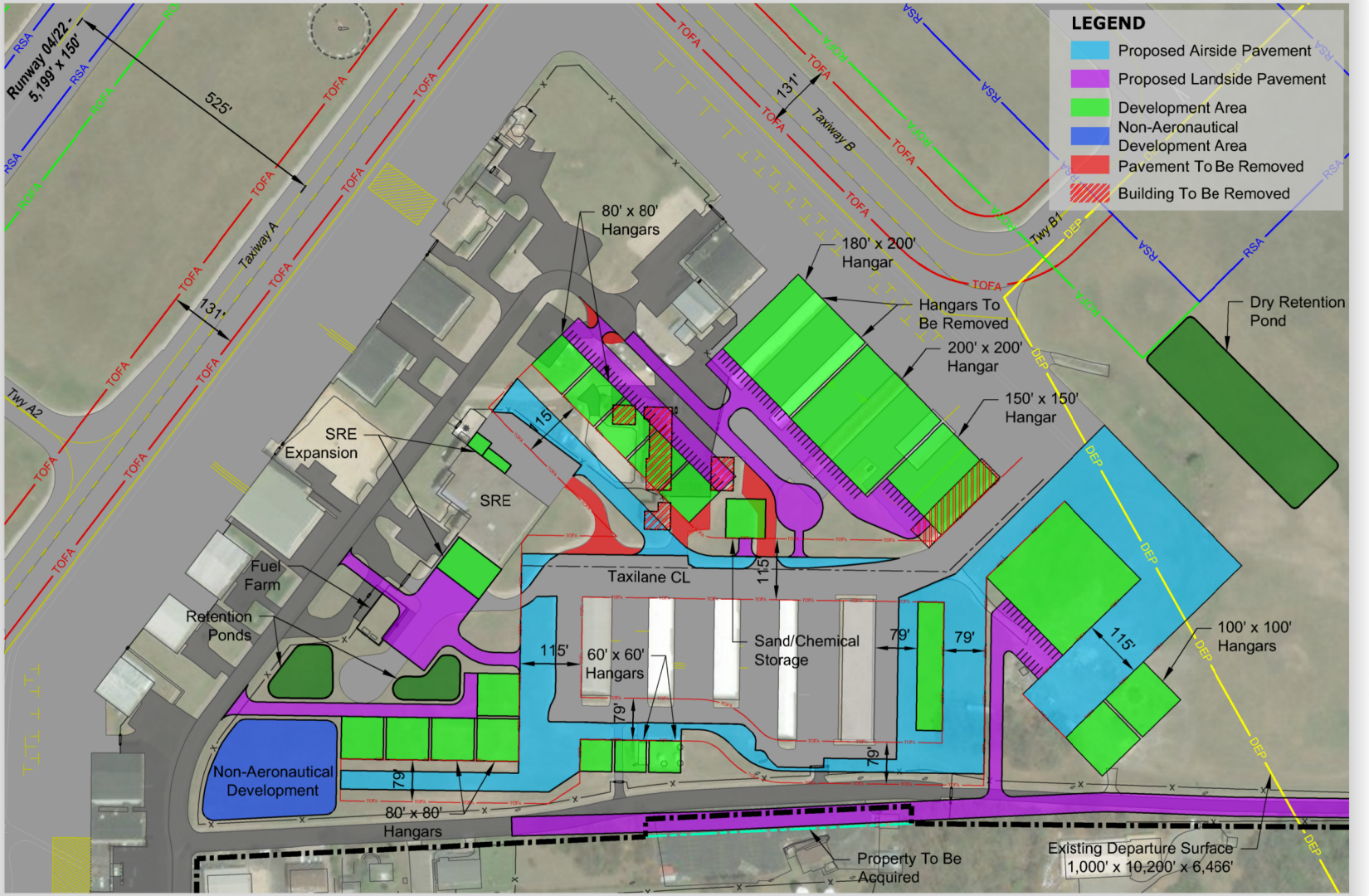
There is a considerable amount of undeveloped land on the Airport, and the Airport desires to utilize these areas in a way that maximizes revenue while also complementing surrounding land uses. To this end, Explorer Solutions conducted a Highest and Best Land Use (HBLU) study (contained in **Appendix E**) to examine how to best utilize available Airport land. To provide congruity between this Master Plan and the HBLU study, each of the land areas discussed in this section are referred to by the parcel identifiers used in that report.

The proposed land use types within each parcel are shown in **Figure 4-21**. These uses were selected to maximize utility of Airport land and complement nearby land uses. While this figure shows the general type of land use, the specific layouts described below require additional consideration based on the needs of the Airport and potential tenants, once identified. Long-term strategic planning should be conducted to attract meaningful aeronautical uses that further develop and bolster the community's aviation industry talent and connect it with local educational opportunities.

Concepts for parcels identified as aeronautical use in Figure 4-19 are discussed in this section, with non-aeronautical concepts discussed in a subsequent section. For convenience, the alternatives developed for the HBLU study are shown in relevant sections. Additional information on each alternative is available within that report.

4.7.1. Parcels P3 and P3B – South of Terminal

These two parcels are situated approximately a quarter of a mile to the south of the terminal. Parcel P3 is located near the terminal and Runway 31 threshold, a prominent area with easy access from Airport Road. The HBLU study identifies this area for aeronautical development and proposes several 40,000-square-foot hangars with dedicated aircraft parking apron. Hangars of this size could accommodate a CRJ 900 or B737 for maintenance, repair, or other services. This layout is shown in **Figure 4-22**.



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Graphic Scale in Feet

Figure 4-20: **South GA Long-Term Conceptual Layout**

Source: *USGS Earthstar Geographics*

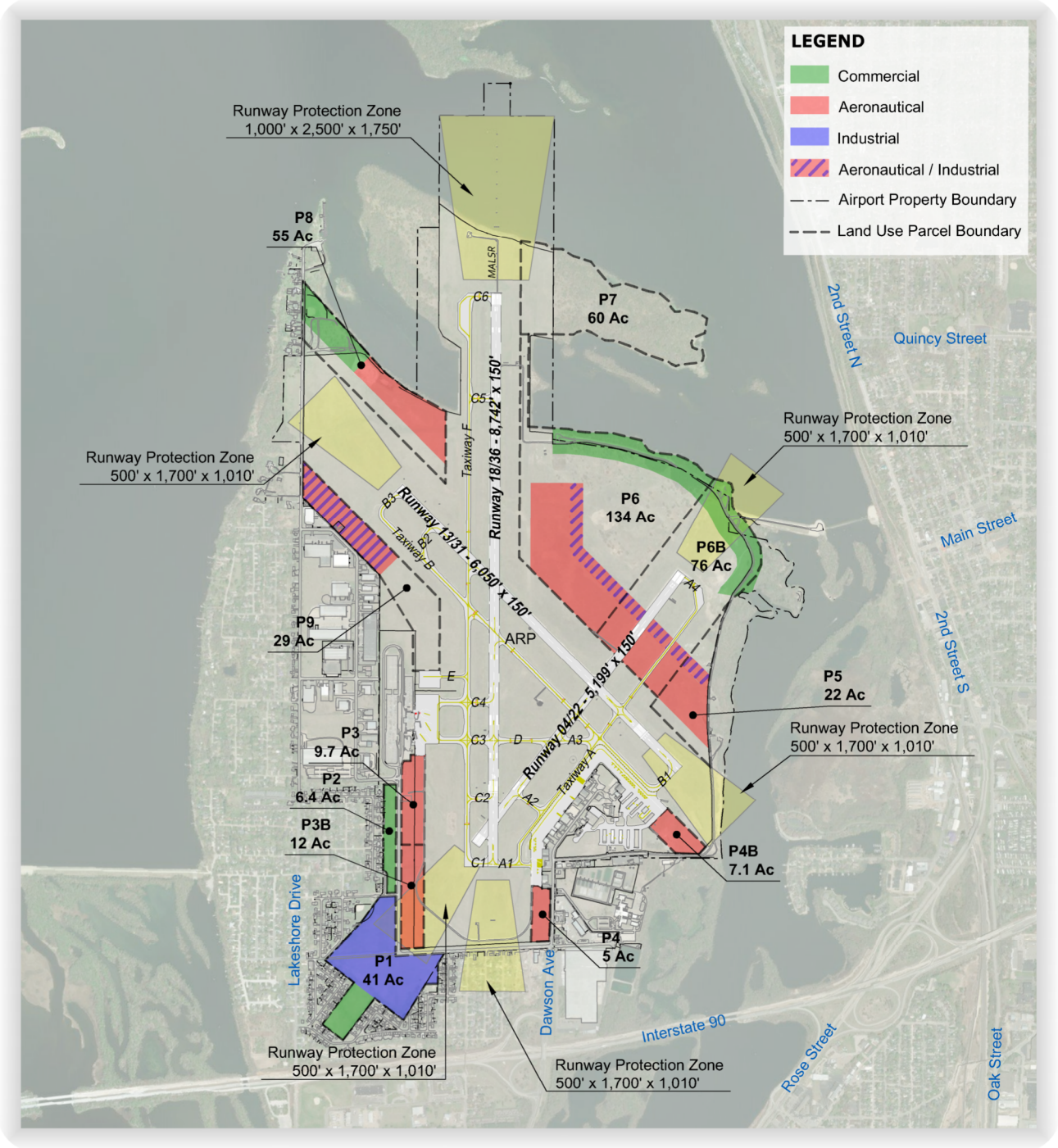
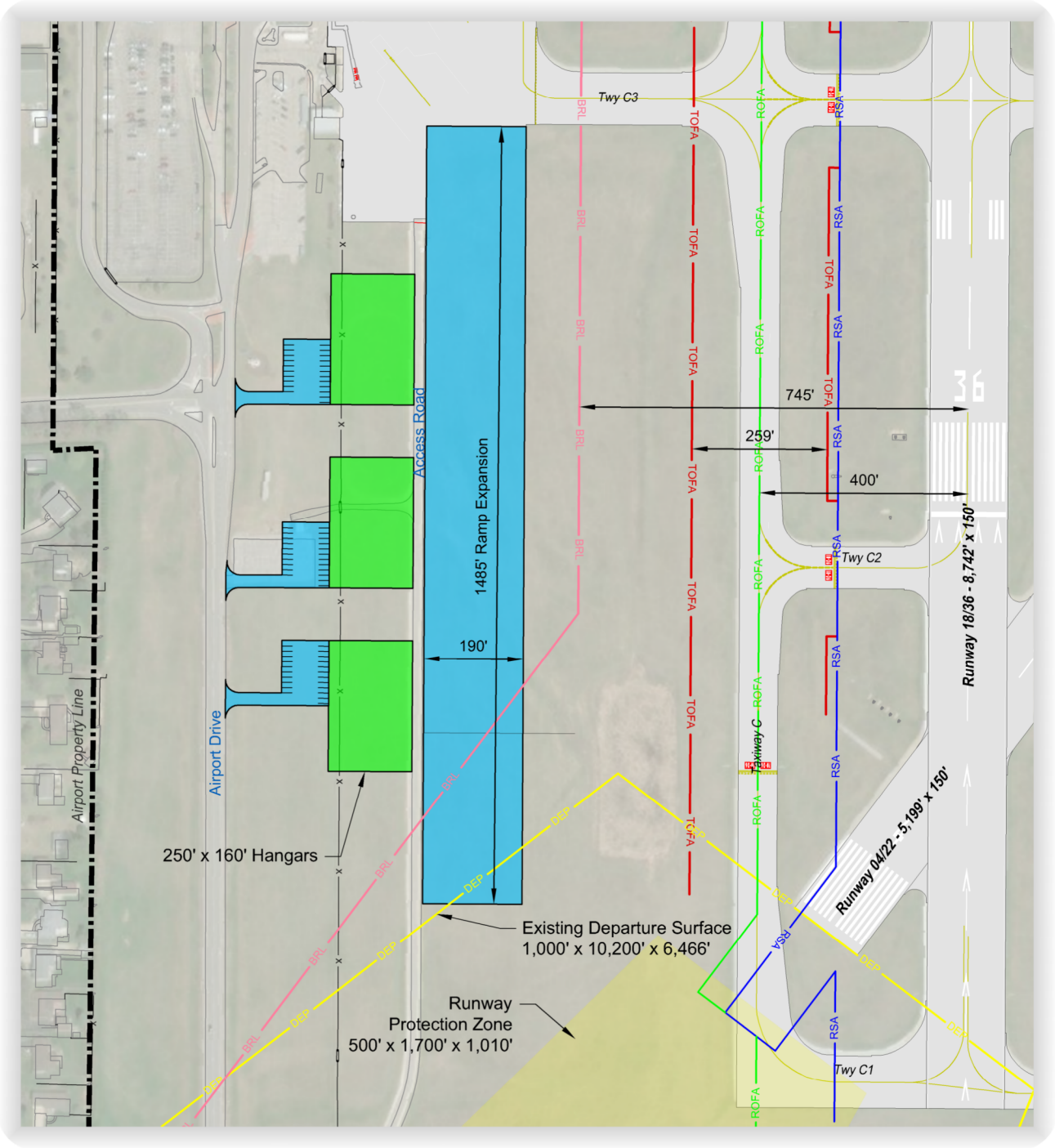


Figure 4-21: **Airport Development Areas**

Source: *USGS Earthstar Geographics*



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Graphic Scale in Feet

Figure 4-22: **P3 Alternative 1**

Source: *USGS Earthstar Geographics*

Another option for Parcel P3 is to reduce the size of hangars to accommodate business jet use. Several 100-by-100-foot hangars could accommodate large business jet aircraft with additional space on the hangar landside for a public business presence. Ground vehicles would have a dedicated entrance with a gate on either side of the hangars to allow access to the airside for passenger boarding or other services. This undeveloped site would allow adequate apron space for aircraft to be hangared and parked on the adjacent dedicated apron. The size of the apron would depend on the type of aircraft serviced here. Suggested apron sizes based on aircraft lengths are as follows:

- ADG II (up to most corporate/regional jets): 175 feet
- ADG III (up to large corporate/regional jets & many narrow-body jets): 270 feet
- ADG IV (up to large narrow-body jets & some wide-body jets): 350 feet

It is unlikely that ADG IV aircraft would utilize the area, and therefore apron dimensions for ADG II and III are shown in **Figure 4-23**. Two taxiway connections to Taxiway C from the proposed apron would allow for aircraft circulation, and the existing access road would be modified to connect to the end of the apron to allow Airport personnel to transit the area.

Parcel P3B is south of P3, with much of P3B inside the Runway 04 RPZ. Development options for Parcel P3B are dependent on the future disposition of Runway 04/22 but would likely involve an extension of the land use on Parcel P3. If the runway were decommissioned or closed, this parcel could be developed similarly to Parcel P3. If the runway remains in its current configuration, this parcel is likely undevelopable due to airspace zoning and RPZ development restrictions.

4.7.2. Parcels P4 and P4B – South GA Area Addition

Parcels P4 and P4B are located southwest and southeast of the existing south GA development area, respectively. Future development for Parcel P4B was already discussed in Section 4.6. The P4 concept shown in **Figure 4-24** extends the existing hangar frontage line along the south GA apron onto Parcel P4. Due to the visibility and accessibility from Fanta Reed Road, this would be a natural expansion for aeronautical businesses or corporate hangars. While limited by the Runway 18 departure surface and Runway 36 RPZ, there would be adequate space to construct three hangars with business fronts and vehicle parking although specific layouts may vary based on tenant needs.

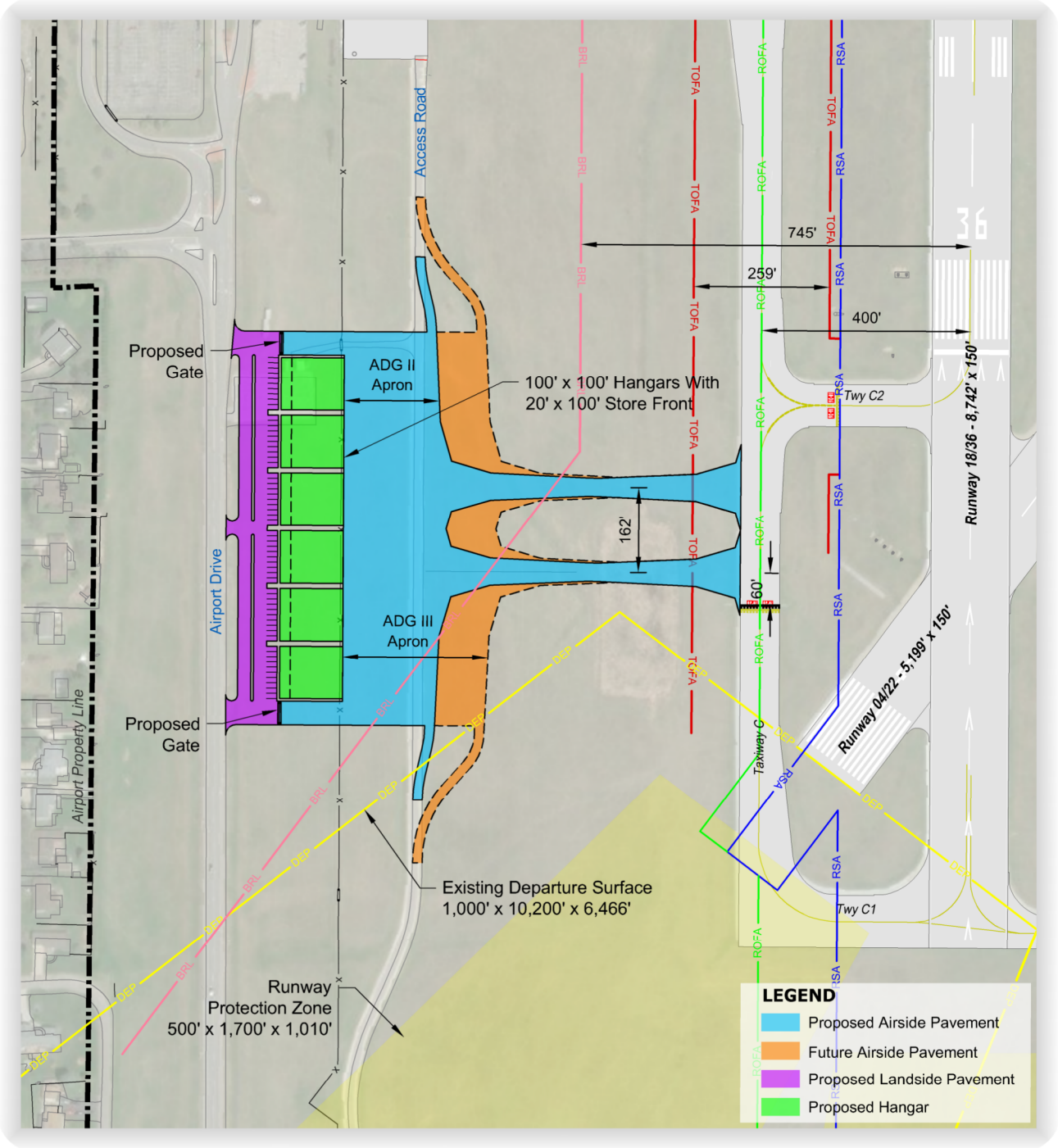
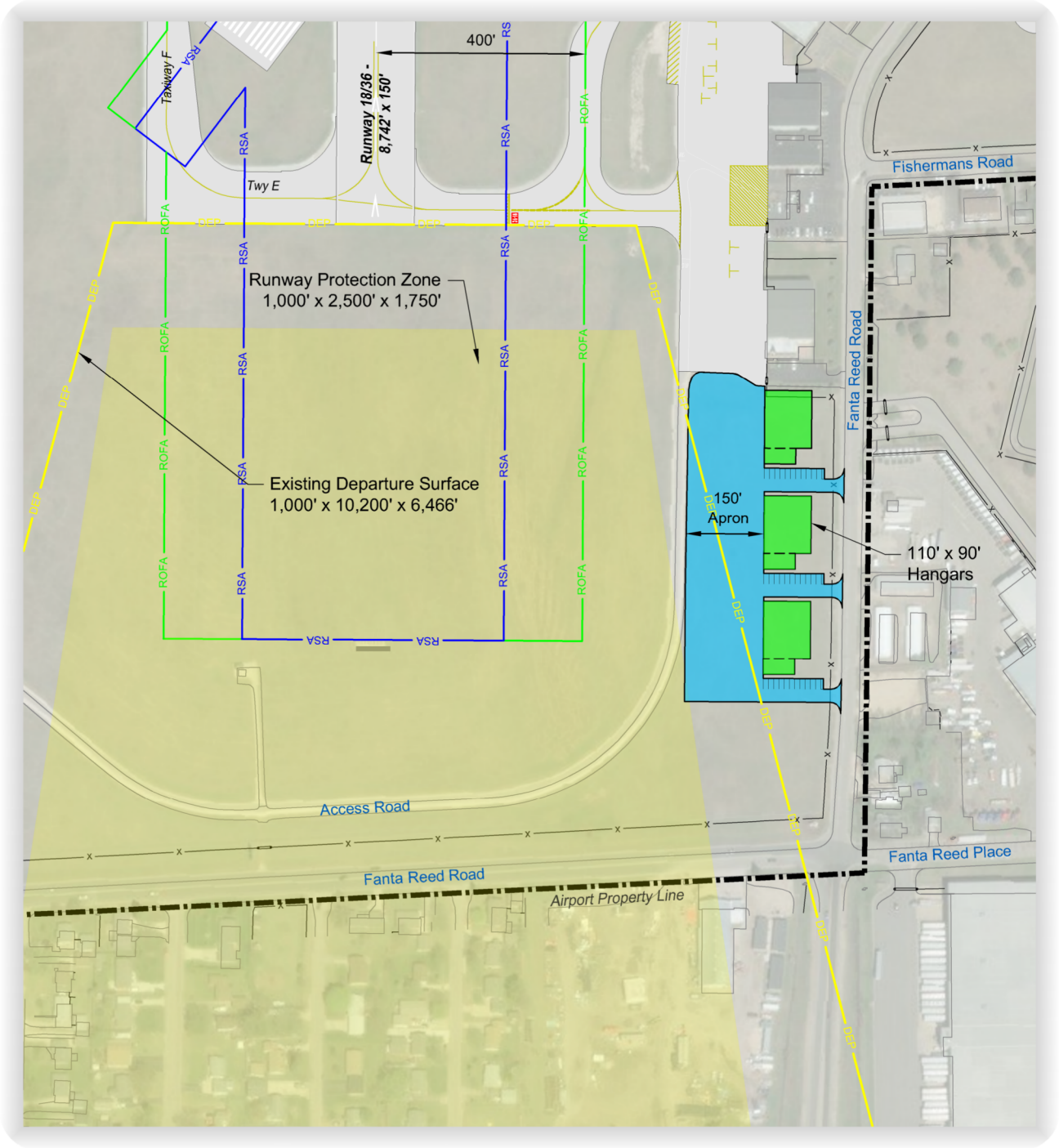


Figure 4-23: **P3 Alternative 2**

Source: *USGS Earthstar Geographics*



0 150 300 450

Graphic Scale in Feet

Figure 4-24: **P4 Conceptual Layout**

Source: *USGS Earthstar Geographics*

4.7.3. Parcels P5, P6 and P6B – Northeast Greenspace

These parcels are largely unoccupied but have access from Fisherman's Road and are partially occupied by Runway 04/22. Similar to other parcels, the future disposition of Runway 04/22 would impact the potential layout of facilities on these parcels. Due to other areas available for aeronautical development, it is unlikely that this space would be needed for hangars within the 20-year planning period. These parcels should be reserved for aeronautical use beyond the planning period with specific layouts to be developed based on the needs at that time. These land uses are shown in **Figure 4-25**. It is anticipated that these parcels would be used primarily for small GA activity. Therefore, space is reserved for an apron measuring 175 feet deep, as previously determined for this aircraft size. An area 400 feet deep could be used for aeronautical development, like hangars and supporting taxilanes. While the ultimate depth may vary, it is limited to 400 feet in Figure 4-23 as too many hangars on a single taxilane can lead to congestion. The remainder of the area could be used for non-aeronautical use with ample buffer from aeronautical uses.

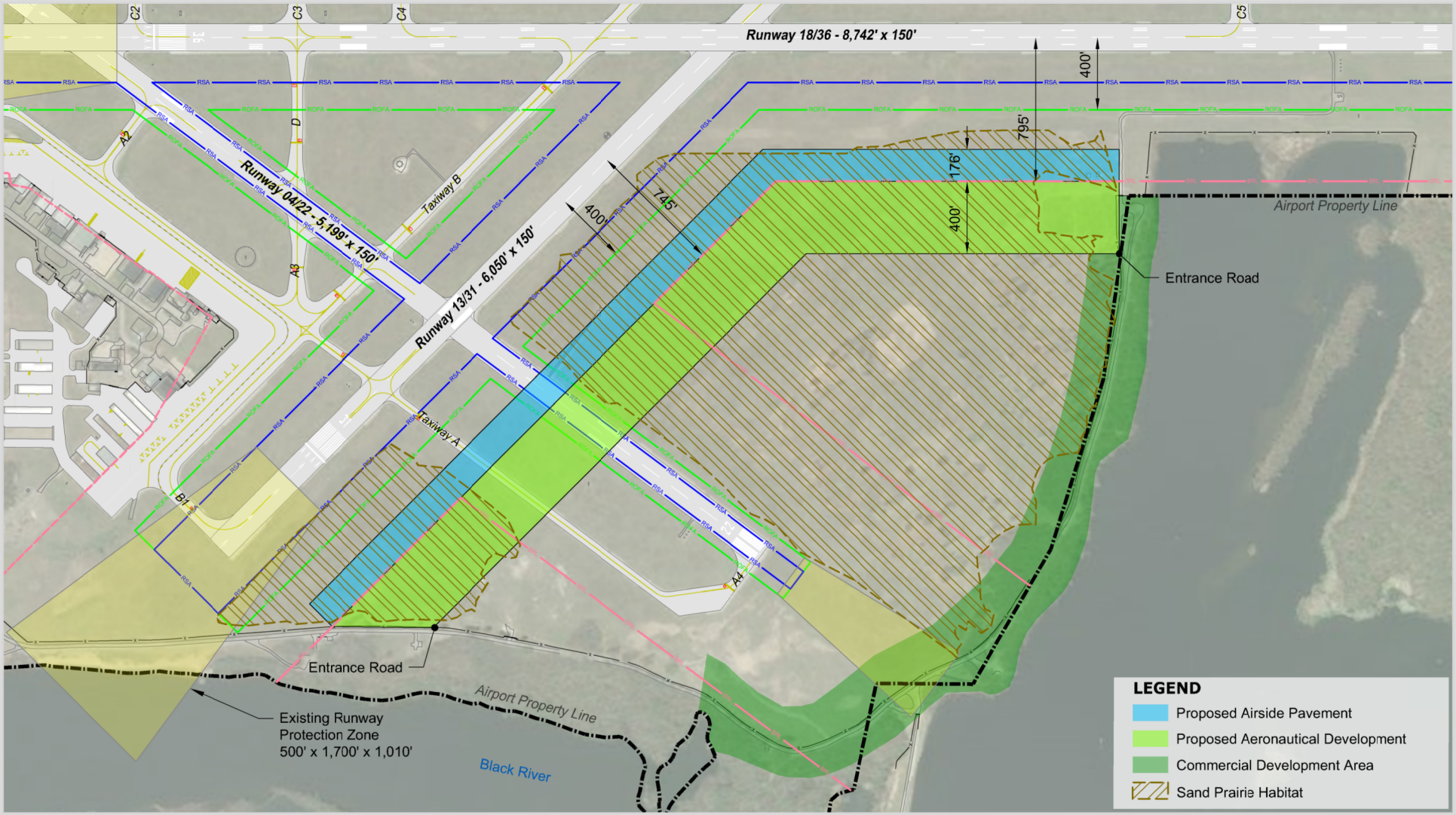
Portions of Parcels P5, P6, and P6B are currently occupied by areas designated by the Wisconsin DNR as ecologically sensitive sand prairie. According to the DNR, sand prairie habitat is "imperiled in Wisconsin because of rarity or because of some factor(s) making it very vulnerable to extirpation from the state." The proposed uses shown in Figure 4-23 would be developed along the perimeter of this sensitive area. Although not protected under special statutes, regulations implementing the National Environmental Policy Act (NEPA) specifically require consideration of impacts to sensitive habitats. While the degree of protection offered this habitat is unclear, design should carefully consider the relationship of proposed uses to the habitat with potential synergy in mind.

4.7.4. Parcel P8 – North of Runway 13 Threshold

Parcel P8 is located north of the Runway 13 threshold and could be accessible from Lakeshore Drive. Similar to the northeast greenspace area by the existing Runway 22 threshold, it is unlikely that this area would be needed to satisfy aeronautical demand within the 20-year planning period. The area further south, closer to the runway threshold, could be used for aeronautical development although the specific layout will depend on the needs of tenants at the time.

4.7.5. Parcel P9 – North of Terminal

Parcel P9 is located north of the existing terminal and near the northern end of Airport Drive. Airport land in this area is unoccupied but adjacent land is occupied by light industrial land uses, such as shipping and manufacturing. Complementary aeronautical use on this parcel could include hangars and facilities oriented toward airborne shipping and receiving. The HBLU concept is shown in **Figure 4-26**, and an alternate conceptual layout developed specifically for this Master Plan is shown in **Figure 4-27**. Although both alternatives have similar land uses, the layouts have some differences. The alternative developed for the Master Plan (**Figure 4-25**) would include shipping facilities readily accessible from both the landside by truck and airside by plane with aircraft parking nearby. Nearby hangars would allow for aircraft storage and taxilanes would provide access to the apron, which would be 147 feet wide and have easy access to the Runway 13 threshold. Additional information on the HBLU alternative is available within that document.



0 400 800 1200

Graphic Scale in Feet

Figure 4-25: **P5 / P6 / P6B Aeronautical Reserve Area**

Source: *USGS Earthstar Geographics*

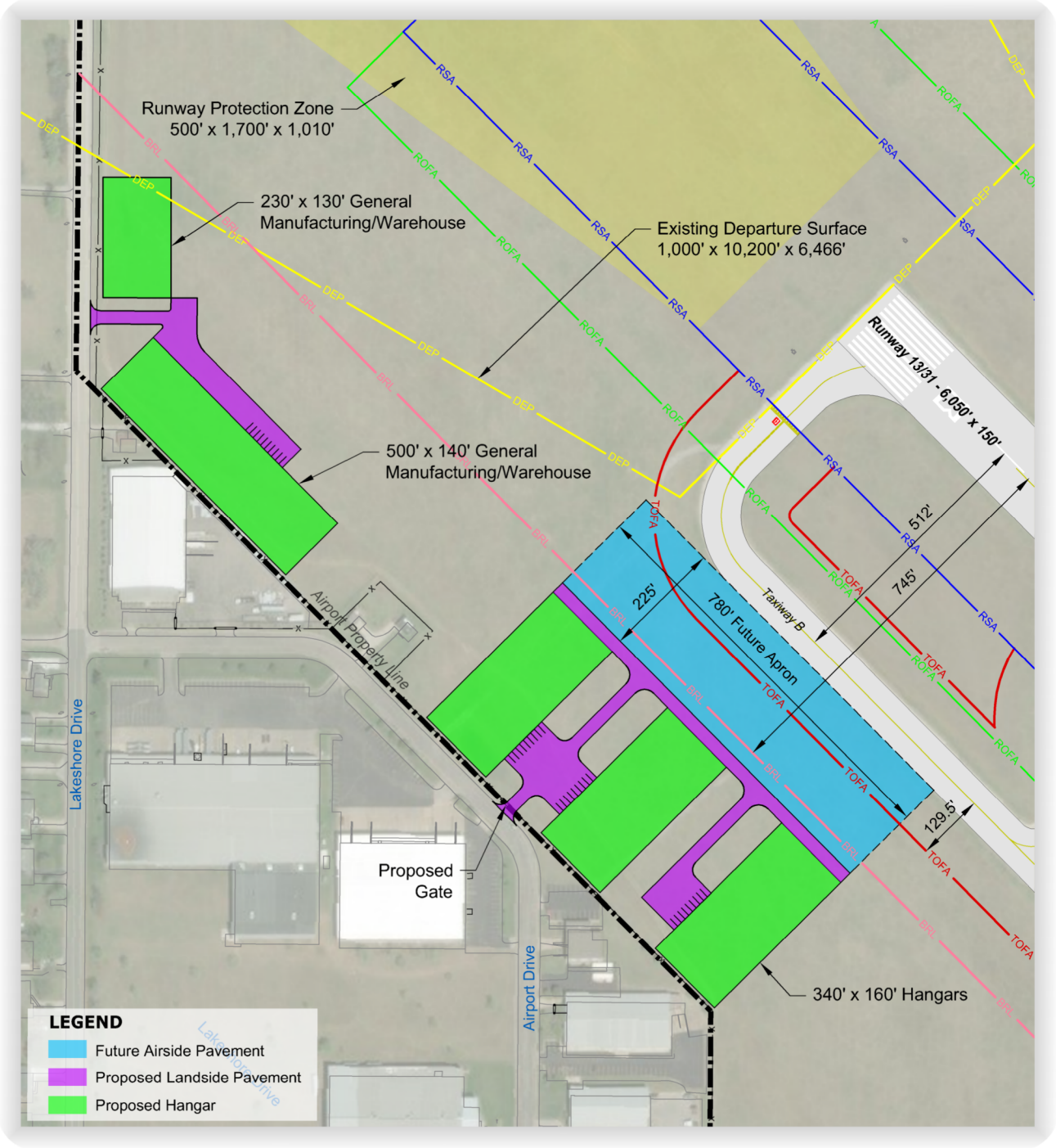


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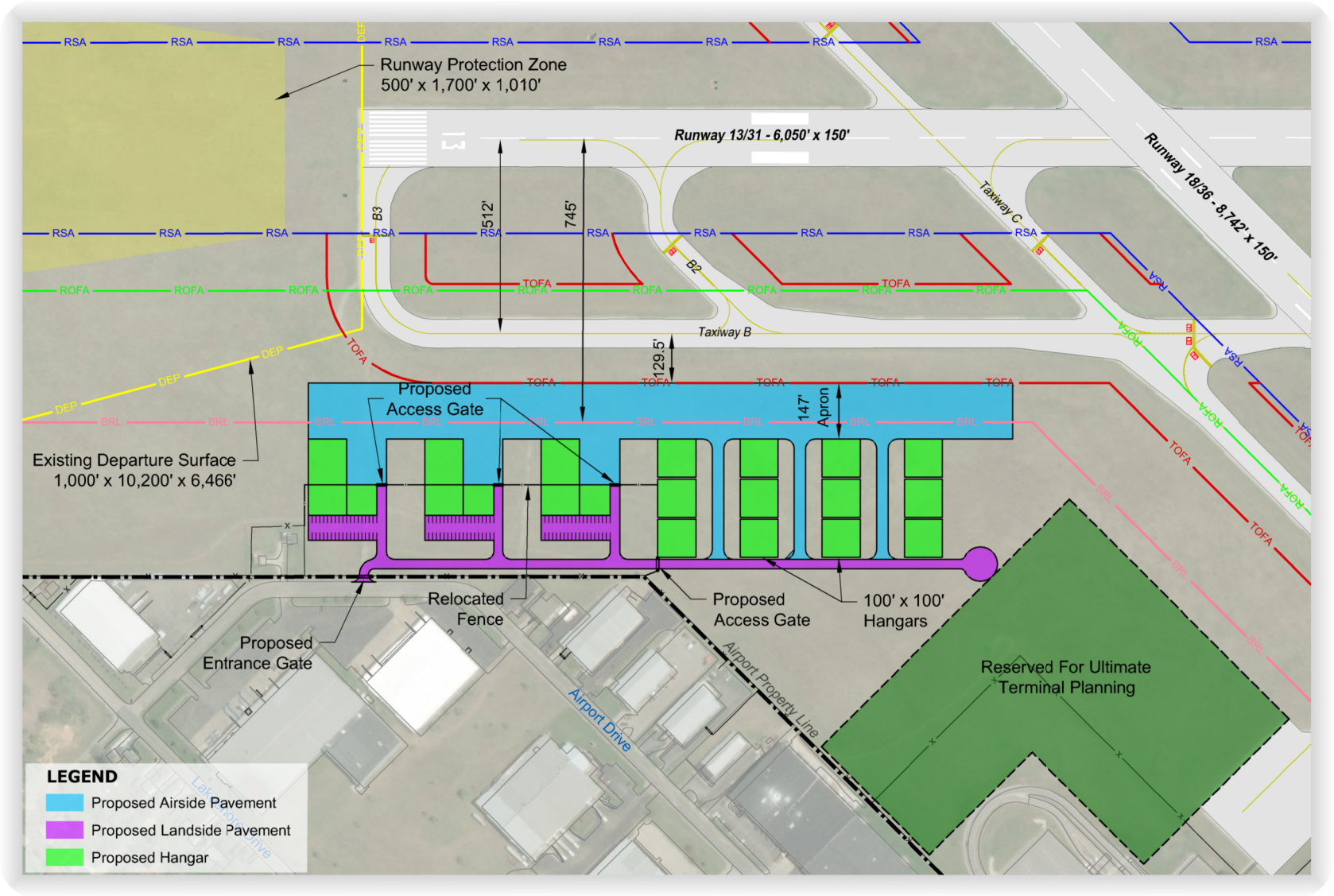
Figure 4-26: **P9 Alternative 1**

Source: *USGS Earthstar Geographics*



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Graphic Scale in Feet

Figure 4-27: **P9 Alternative 2**

Source: *USGS Earthstar Geographics*

4.8. Non-Aeronautical Development Area Alternatives

When an Airport has more land than is needed to meet anticipated aeronautical demand, some of that land can be used for non-aeronautical use with FAA approval. At LSE, this would generate additional revenue and use land that would otherwise not be utilized. This section discusses areas of the Airport suitable for non-aeronautical development and identifies potential land uses based on their locations. Although discussed in the HBLU study, Parcel P7 on Bell Island is too isolated for development and is not discussed in this section. The concepts presented in this section are preliminary and will likely require changes to City zoning designations. The concepts would be further refined prior to construction to consider context sensitive design so that proposed industrial and commercial uses recognize neighboring residential uses and are designed accordingly.

4.8.1. Parcel P1 – South of Fanta Reed Road

Parcel P1 is southwest of Runway 04/22 across Fanta Reed Road and is currently vacant. If the runway were decommissioned or shortened, the restrictions imposed by the approach and departure surfaces would be reduced such that development could occur in this area. The HBLU study proposes developing this area into an industrial park, with a commercial park on the southwest portion to provide a buffer from the surrounding residential area. In the industrial area, warehouses could act as a distribution center for a convenient shipping location near the Airport. Although the HBLU study did not identify specific types of commercial use for the southwest portion of Parcel P1, this area could be used for local businesses, cafes, or other commercial uses compatible with the surrounding residences. The conceptual layout developed for the HBLU study is shown in **Figure 4-28**.

The nearby area surrounding Parcel P1 is in the Town of Campbell. Although this area consists mainly of private residences, a baseball field is in the northwest corner Parcel P1. A portion of the baseball outfield is on Airport property. The Town of Campbell has expressed interest in acquiring a portion of Airport property to fully incorporate the baseball field into the Town's property. This would reduce the available space to develop for industrial use, as proposed in the HBLU study.

4.8.2. Parcel P2 – West of Airport Drive

Parcel P2 is a 7-acre vacant area west of Airport Road on Airport property and is in a prominent, highly visible location near the terminal with easy access from Airport Road. The HBLU study proposes an office building and hotel in this location, as shown in **Figure 4-29**. All hotels in the area are located away from the Airport, either south of Interstate 90 or east of the Black River. In addition, the HBLU study found that office vacancy rates in La Crosse are very low. Local real estate experts indicate that most recent office development has been concentrated in the downtown area with limited space for further development. This suggests that additional office space will be needed away from the city center, and Parcel P2 is well-positioned for this type of use.

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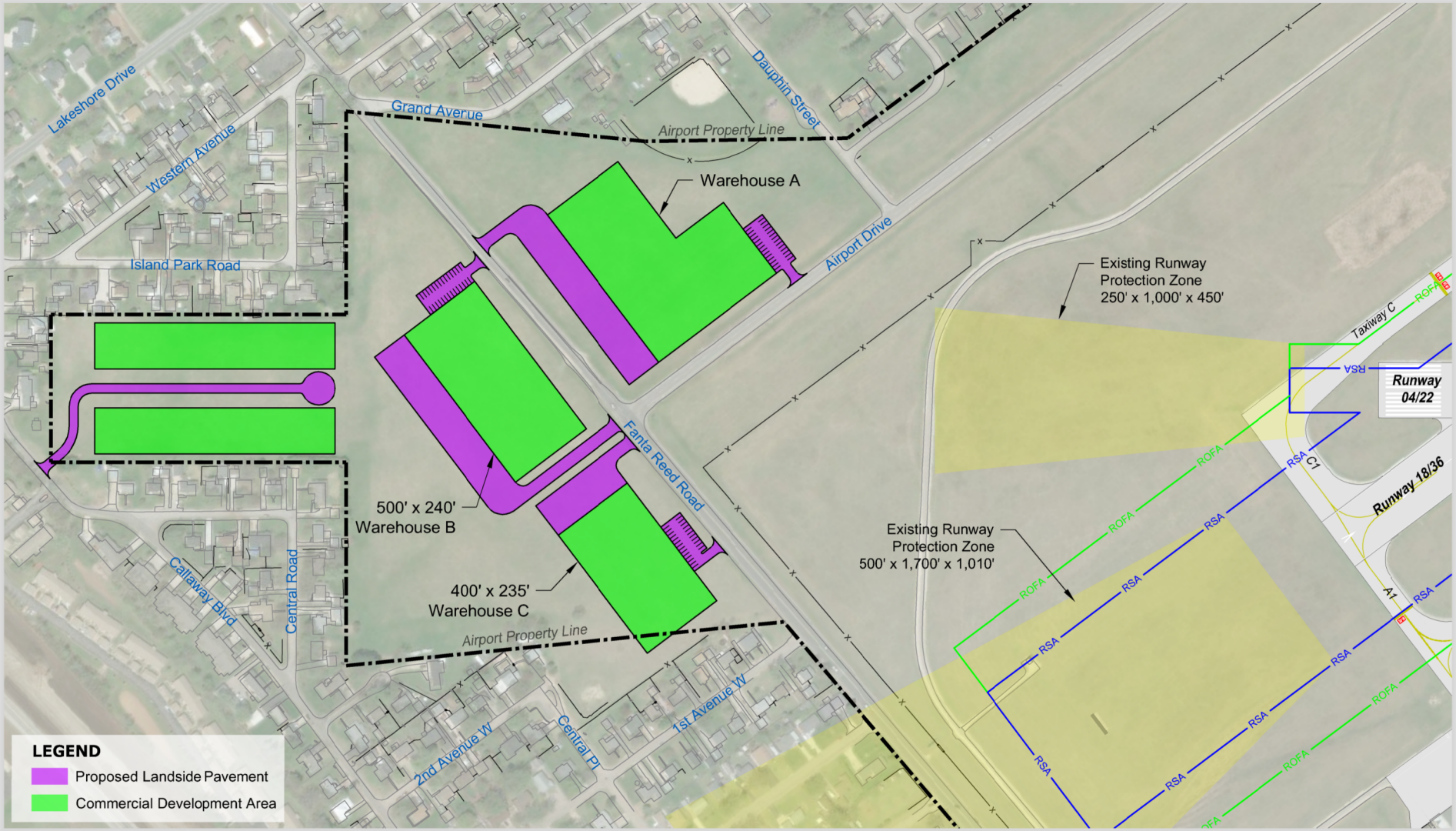

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Graphic Scale in Feet

Figure 4-28: **P1 Non-Aeronautical Use Conceptual Layout**

Source: *USGS Earthstar Geographics*

0 100 200 300
Graphic Scale in Feet

Figure 4-29: **P2 Non-Aeronautical Use Conceptual Layout**

Source: *USGS Earthstar Geographics*

4.8.3. Parcels P5, P6 and P6B – North East Greenspace

The HBLU study proposes developing the area near the water's edge on the east side of Airport property for a complex of commercial, recreational, and entertainment-related uses. This development would align with the City of Onalaska's desire to provide a pathway from near downtown Onalaska to French Island. While this proposed use would provide a variety of attractions to people in the area, it would require a significant infrastructure investment as detailed in the HBLU study. Part of this investment would be the improvement of Fishermans Road, which is in poor condition and does not provide adequate capacity for the increased use likely with this type of development. Necessary road improvements would include raising Fishermans Road to prevent flooding from nearby bodies of water and increasing the road width to support additional traffic while adhering to WisDOT standards. Two conceptual cross-sections for this road are shown in **Figure 4-30**. Both concepts would require widening Fishermans Road to accommodate a standard two-way street with turning lanes, bicycle lanes, sidewalks, and/or planting strips. Developing attractions on French Island would bolster the Airport's presence in the community while also increasing Airport revenues. However, the high cost of investment means that pursuing this option will require a long-term commitment and extensive coordination with potential developers and local officials.

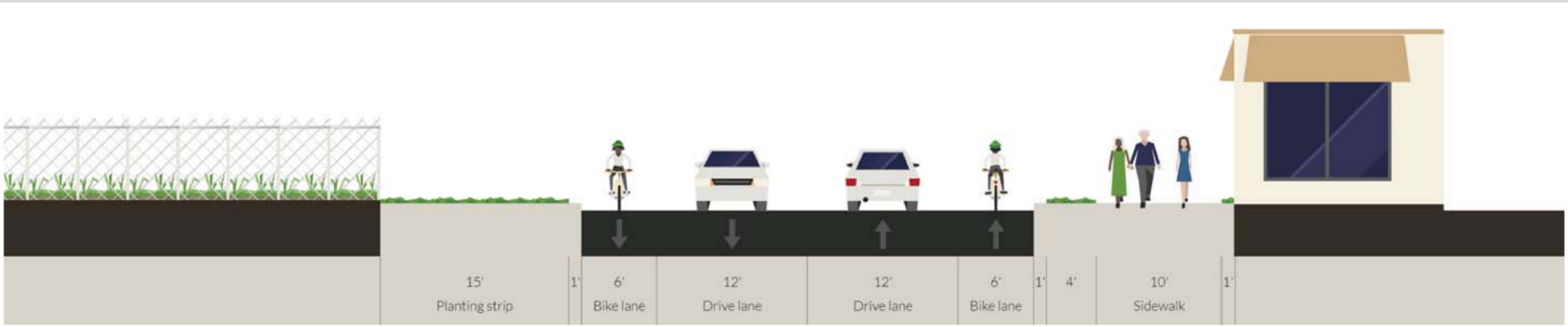
4.9. Snow Removal Equipment (SRE) and Maintenance Facility Alternatives

SRE is stored in a 22,800-square-foot facility nested within the south GA hangar area with immediate access to the unsecure landside area through an access gate near the building. To access runways and taxiways, SRE vehicles transit through the T-hangar area.

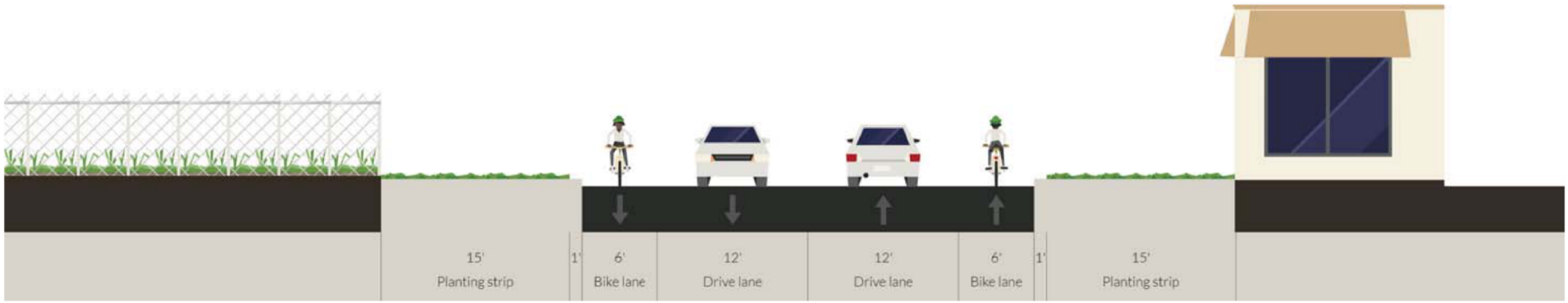
Appendix H includes a detailed space analysis for the SRE and maintenance facility at LSE. The analysis concluded that the existing facility requires expansion due to the inadequate size and layout of the vehicle storage and circulation area. The analysis also identified deficiencies in the maintenance shop, wash bay, and other areas in the existing facility. While there are many areas in the facility that could be expanded to meet the current needs of the Airport, alternatives will focus on expanding areas that are the most time critical and financially feasible for LSE. Opportunities for expanding the existing facility to accommodate these needs should be considered, and construction of a brand-new facility is not necessary, given current capabilities. Three alternatives were considered for the SRE and maintenance facility at LSE and are discussed below.

4.9.1. Alternative 1: Relocate the SRE and Maintenance Facility

The existing SRE and maintenance facility is site-constrained to the north and south due to existing development and space reserved for future development. If a new replacement facility were constructed in an alternate location with fewer site constraints, it would have to be near the passenger terminal because there is not a suitable location in the south GA complex. Relocating the facility to the terminal area would be undesirable for two reasons: 1) available space near the terminal is reserved for long-term passenger terminal and other aeronautical development (**Sections 4.7 and 4.11**) and 2) relocation of the SRE and maintenance facility would be costly for the Airport. For those reasons, relocating the SRE and maintenance facility was considered but is not the preferred alternative for this Master Plan.



Fisherman's Road - Multi-Use Trail



Fisherman's Road - No Trail

Figure 4-30: **Fisherman's Road Design Options**

Source: *Streetmix*

4.9.2. Alternative 2: Expand the Existing Facility and Relocate Sand and Chemical Storage

Appendix H discusses several areas of the SRE and maintenance facility that are undersized for Airport needs or inefficient due to their design. Alternative 2 focuses on an intermediate-term conceptual layout for the facility expanding the following areas: wash bay, maintenance bay, vehicle storage, and vehicle circulation. **Figure 19** depicts the proposed expansion of the wash and maintenance bay, in addition to the vehicle storage and circulation area. Vehicle circulation would be modified to provide dual drive-through aisles expanded for the existing equipment and includes additional vehicle access doors. Alternative 2 also includes removal of the existing standalone sand storage building and replacing it with a new heated facility to store sand and chemicals during the winter months. **Figures 4-19** and **4-20** identify a new heated sand and chemical sand storage facility location, in addition to the proposed expansion of the existing SRE and maintenance facility. Alternate locations for the sand and chemical storage building were considered that are closer to the existing SRE and maintenance facility but were ruled out because an adequately sized building cannot be provided while also meeting taxiway wingtip clearance requirements.

4.9.3. Alternative 3: Expand SRE and Maintenance Facility for Additional Space Needs

Alternative 3 would further expand the SRE and maintenance facility to include additional space needs identified in **Appendix H**. Expansion to meet additional space needs would include adding office and personnel support space in addition to parts and equipment storage. **Appendix H** identified approximately 1,400 square feet of space needed in these areas to meet existing Airport needs.

While expansion of the office and personal support spaces along with the parts and equipment storage are desirable, it is recommended that the preferred alternative for this master plan focus on immediate space constraints the Airport is experiencing. While expansions to personnel support space and parts and equipment storage will be necessary long-term, the Airport is more constrained in the areas identified in Alternative 2.

4.9.4. Recommended Alternative

Due to the immediate needs and existing site constraints to the SRE and maintenance facility, Alternative 2 is the preferred alternative of this master plan. Expanding the existing facility to accommodate more vehicle storage, circulation, wash, maintenance, and sand and chemical areas will aid the Airport in meeting its most pressing space needs. **Figures 4-19** and **4-20** show the proposed expansion under Alternative 2.

A detailed cost estimate for expanding the existing SRE facility concurrent with Alternative 2 was not developed for this Master Plan. However, the CIP presented in Chapter 6 includes a near-term rehabilitation and expansion project for the existing SRE facility given its age and shortcomings to handle modern equipment.

4.10. Aircraft Rescue and Firefighting (ARFF) Facility Alternatives

LSE currently has two ARFF trucks to meet Index B standards (Chapter 3, Section 3.11). The trucks are stored in the ARFF station located just south of the ATCT. As discussed in Chapter 3, there are no recommendations for expanding to the current ARFF facilities within the planning period. However, the CIP presented in Chapter 6 includes a near-term rehabilitation project for the existing ARFF station. The planned

rehabilitation project includes correcting water leakage issues in the exterior walls, replacement of the apparatus bay doors and emergency notification systems, and improvements to bring plumbing and HVAC systems up to current building code requirements.

4.11. Passenger Terminal Alternatives

LSE completed a major terminal renovation project in 2015 that relocated secured seating to the second floor, expanded the capacity of the secure area, connected the secure and non-secure restaurant, and updated the interior of the building. Additionally, two jet bridges were moved to the second floor to accommodate larger aircraft, while access to the third gate was improved by relocating a nearby security screening area. Due to these recent improvements, detailed alternatives for terminal building expansion or relocation were not developed for this Master Plan. If LSE should need to expand or relocate the terminal building during the planning period, a separate study should be conducted to better assess needs at the time of the expansion.

As discussed in Chapter 3, a terminal facility space assessment was conducted considering forecasts for enplaned passengers and air carrier operations as compared to the current number of security lanes, amount of concourse space, number of gates, and other factors. The terminal can currently accommodate two regional jets up to a CRJ900 at the two passenger gates located on the north side of the secure area. A third gate located on the south side of the terminal can accommodate a Boeing 737-800 or similarly sized narrow-body jet aircraft. The terminal space assessment indicates that a fourth boarding gate and approximately 6,000 square feet of secure concourse hold room space may be required by the end of the 20-year planning period. Airport staff also indicate that the layout of the outbound baggage room makes it difficult to utilize the full bag belt due to inadequate turning radii for baggage tugs.

The following sections present alternatives for addressing the outbound baggage room circulation issues in the near term and expanding or relocating the existing terminal building in the long term to address potential secure concourse and gate deficiencies.

4.11.1. Near-Term Passenger Terminal Alternatives

Near-Term Passenger Terminal Alternative 1: Relocate Administrative Space and Expand Outbound Baggage Room

This alternative would relocate the Airport administration space from the passenger terminal to a standalone 4,000-square-foot office building south of the terminal (**Figure 4-31**). The administration space in the terminal could then be repurposed to lengthen the outbound baggage tug drive so that the full length of the baggage belt could be utilized. Total cost for the new administration building is estimated at $1.6 million, and total cost for remodeling the existing 2,000-square-foot administration area as an outbound baggage tug drive is estimated at $350,000. The remodeling estimate includes general demolition, adding overhead doors, infill construction for existing interior and exterior walls, and minor structural modifications. The existing airline ticket offices, baggage screening area, and outbound baggage area would be unaffected. The remodel would need to be designed to avoid impacting structural columns in the current administration space that cannot be removed.

0 30 60 90
Graphic Scale in Feet

Figure 4-31: **Terminal Office Space / Outbound Baggage Alternative 1**

Source: *USGS Earthstar Geographics*

Near-Term Passenger Terminal Alternative 2: New Outbound Baggage Room

This alternative would add approximately 2,300 square feet to the terminal building by expanding to the east with a one-story addition for a new outbound baggage room as shown in **Figure 4-32**. The addition could be structured to accept a second floor in the future that would accommodate expansion of the secure concourse hold room above the new outbound baggage room. To minimize costs, the eastern exterior wall of the terminal would remain in place, and the baggage belt would be relocated outside the existing wall. The existing outbound baggage room could then be re-purposed for general storage, airline ticket office expansion, or some other purpose. The total cost for this alternative is estimated at $1.0 million, which does not include remodeling of the existing outbound baggage room for a different use. The existing airline ticket offices and baggage screening room would be unaffected, there would be minimal changes required for the existing outbound baggage room, and some apron lighting would need to be relocated. This alternative is recommended as the preferred alternative because it is less expensive and provides the added benefit of providing the structural foundation for a future expansion to the secure concourse hold room.

4.11.2. Long-Term Passenger Terminal Alternatives

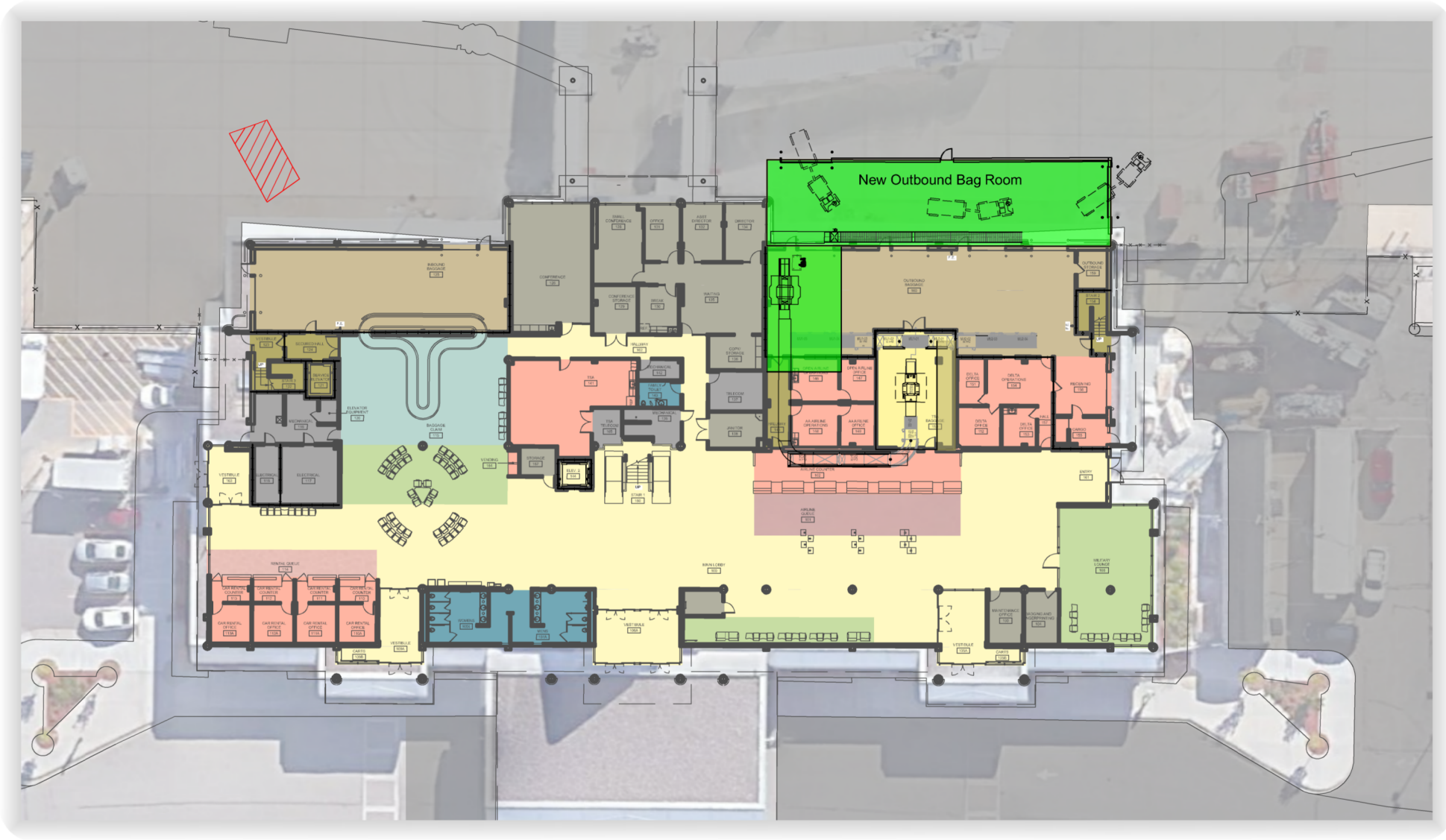
Long-Term Passenger Terminal Alternative 1: Expand Existing Terminal Building

This alternative would add 8,400 square feet to the secure concourse hold room and add a fourth passenger boarding gate capable of accommodating a Boeing 737-800 or similarly sized narrow-body jet aircraft as shown in **Figure 4-33**. The hold room expansion would be accomplished by adding 2,400 square feet above the new outbound baggage room proposed by Near-Term Passenger Terminal Alternative 2 and adding 6,000 square feet with a northerly extension of the existing concourse that accommodates the proposed fourth gate. The northerly extension would take advantage of existing unused terminal apron north of the existing gates but would require relocation of some utility infrastructure and a portion of the rental car parking lot.

The previous ALP showed adding a pier to the concourse, projecting east of the existing building, and accommodating four total gates. This Master Plan recommends amending the ALP concept to reflect this alternative, as it would reduce costs and provide more flexibility for accommodating a wider range of aircraft sizes and types.

Long-Term Passenger Terminal Alternative 2: Relocate Terminal Building

This alternative considers relocating the terminal building to the undeveloped area north of the existing terminal building highlighted in green on **Figure 4-33**. This would allow the Airport to design a terminal building that meets the community's unique needs relatively unencumbered by existing structures and other Airport facilities. Supporting facilities would need to be added and/or significantly reconfigured, including access roads, parking lots, and terminal apron. A detailed layout for a future relocated terminal complex was not developed for this Master Plan because it is not expected to be needed within the 20-year planning period. However, the area shown in Figure 4-32 will be reserved on the ALP for future terminal facility development.



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Graphic Scale in Feet

Figure 4-32: **Terminal Office Space / Outbound Baggage Alternative 2**

Source: *USGS Earthstar Geographics*

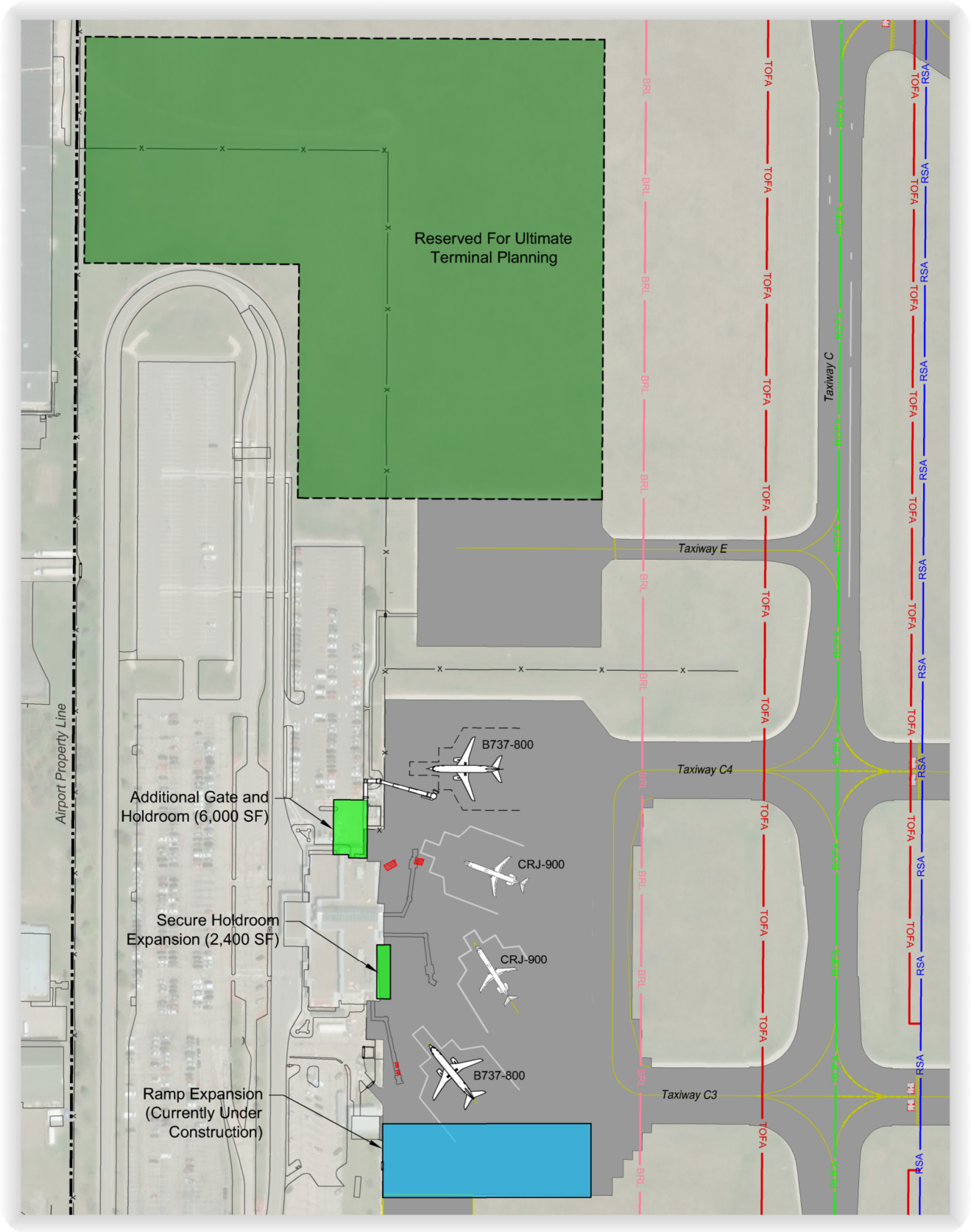

Figure 4-33: **20 Year Terminal Area Plan**

Source: *USGS Earthstar Geographics*

4.12. Solar Feasibility Study

In early 2018, Sustainable Engineering Group (SEG) completed a solar feasibility study for LSE as part of this Master Plan. This study is included in **Appendix F**. The study reviewed the Airport's historical energy usage, as well as space availability and site considerations for installing solar electric generation facilities in various locations on Airport property. The study considered industry-standard guidance, including the FAA Interim Policy on Solar Siting, ACRP Report 108, and the Solar Glare Hazard Analysis Tool (SGHAT). Based on the study findings, SEG proposed three options: a 100-kilowatt (kW) terminal roof-mounted system, a 100-kW short-term parking canopy system, and a 100-kW long-term parking canopy system. In order to obtain FAA Airport Improvement Program (AIP) funding for implementing these proposed systems, SEG recommends that the Airport conduct a Comprehensive Airport-Wide Energy Planning and Assessment Study. The three options will be depicted as future conditions on the ALP.

4.13. Summary

The following preferred alternatives (see **Figure 4-34**) will be depicted on the ALP and considered during development of the 20-year Master Plan CIP:

- Decommission and remove Runway 04/22 as proposed by Runway 04/22 Alternative 4.
- Extend Runway 13/31 by 663 feet as proposed by Runway 13/31 Alternative 2.
- Relocate Taxiway A as proposed by Taxiway Alternative 2.
- Construct a mid-field Runway 13/31 exit taxiway as proposed by Taxiway Alternative 6.
- Install a Runway 31 MALSF system as proposed under Section 4.5.3.
- Install a Runway 36 MALSR system as proposed under Section 4.5.5.
- Expand and reconfigure the south GA hangar area as proposed under Section 4.6.
- Update the Airport Land Use Plan to reflect proposed aeronautical and non-aeronautical development areas identified in Section 4.7 and 4.8.
- Construct a new outbound baggage room as proposed by Near-Term Passenger Terminal Alternative 2.
- Expand the secure terminal concourse and add a fourth passenger gate as proposed by Long-Term Passenger Terminal Alternative 1.
- Reserve space for a future passenger terminal building and supporting facilities as proposed by Long-Term Passenger Terminal Alternative 2.
- Install solar electricity generation systems mounted on the terminal roof and parking lot canopies.

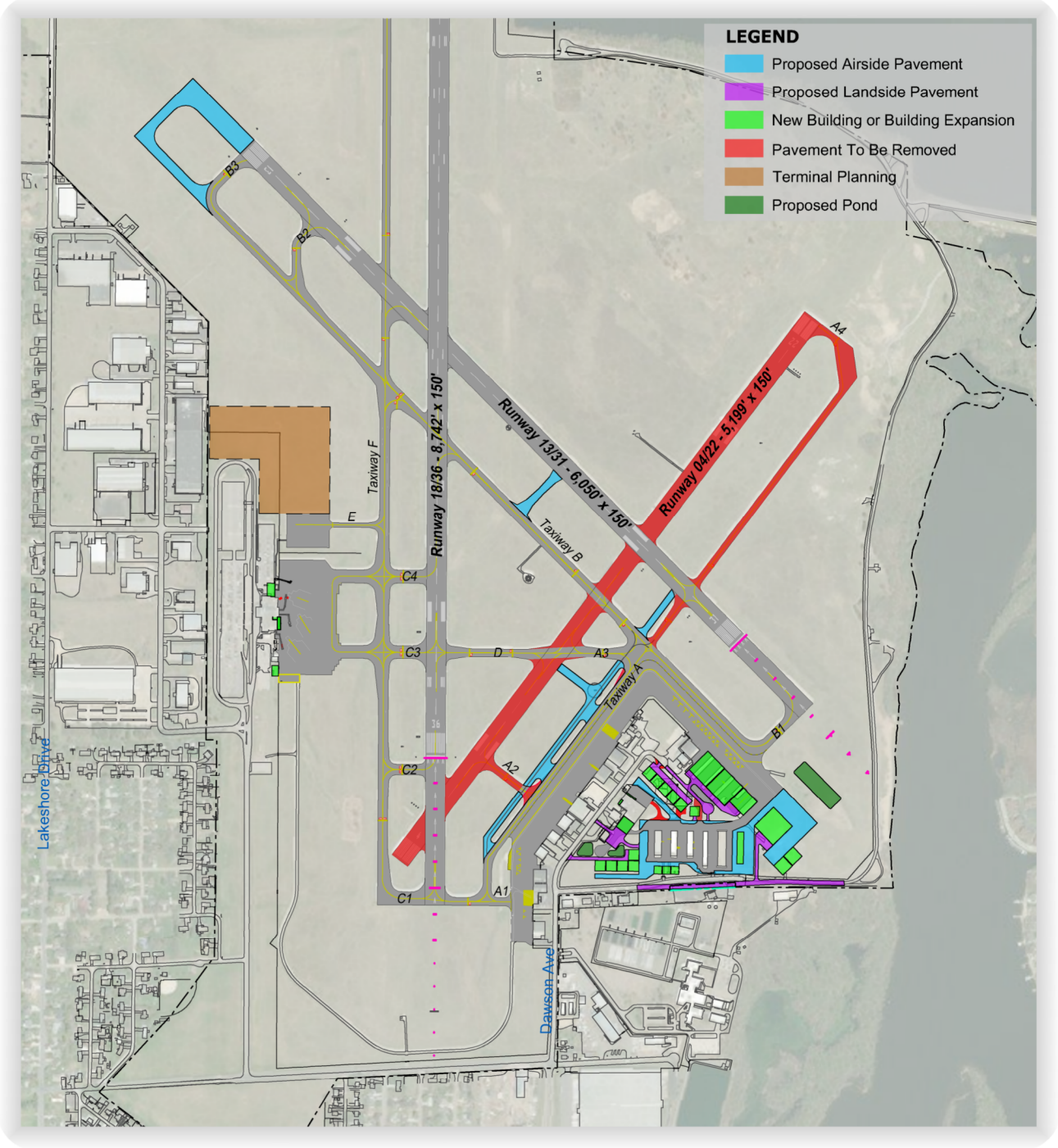

Figure 4-34: **Preferred Alternatives**

Source: *USGS Earthstar Geographics*