CHAPTER 4

IDENTIFICATION AND EVALUATION OF ALTERNATIVES

V2.0

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4.1 INTRODUCTION

This chapter identifies and evaluates facility development alternatives for Salt Lake City International Airport based on the facility requirements determined in **Chapter 3, Facility Requirements**. The primary purpose behind identifying and evaluating various alternative development options is to ensure airport facilities are capable of meeting projected activity demand levels, are making efficient and effective use of available airport land and are meeting FAA airfield design standards. Every potential alternative in this chapter has been thoroughly analyzed, refined, and vetted through the stakeholder involvement process in order to develop a plan which reflects stakeholder and community values and preferences, and integrates well with the unique operational nature and role of Salt Lake City International Airport.

A hierarchy of priority is required when analyzing airport facilities and developing alternatives. Components of the airport are broken down into leading elements and trailing elements, with leading elements considered first. Leading elements are primary facilities that require significant amounts of land and/or capital investment to implement, and whose placement and configuration must take precedence when formulating alternatives. At Salt Lake City International Airport, these facilities include runways, primary taxiways, passenger terminal facilities, and air cargo facilities. Trailing elements are those whose placement and configuration are influenced by, and dependent on, the decisions made for primary facilities. Trailing elements at the airport include aviation support facilities such as airline maintenance, airport maintenance, and fuel storage. The division between leading and trailing elements allows the initial focus of analysis to be on determining solutions for those high cost, more demanding leading elements. The placement and decisions surrounding the leading elements influence the location and layout of the trailing elements.

4.2 BALANCED AIRPORT ANALYSIS

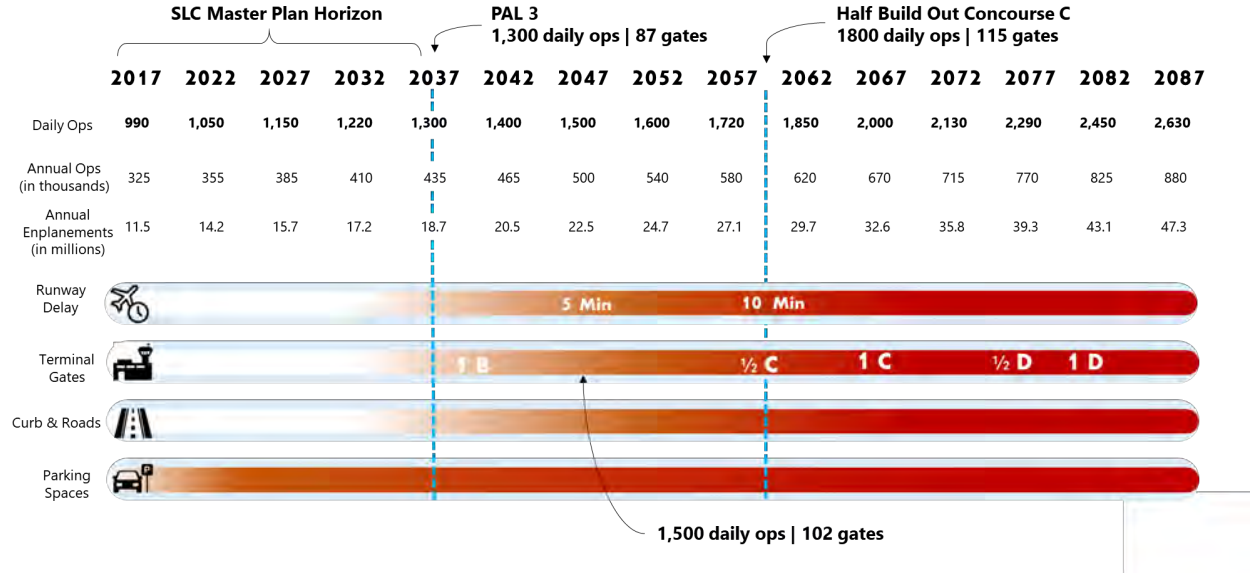
The SLC terminal program includes a full build out of Concourse A and a partial build out of Concourse B. Current planning for ultimate terminal development includes a Concourse C which would increase the total gate count at SLCIA to approximately 140 gates. To account for long-range land use preservation, a Concourse D was also considered in this master plan. Adding a Concourse D would provide up to 186 gates. An initial survey of large hub airports with gate counts ranging between 100 to 190 indicated that SLC airfield capacity may not be able to support a Concourse D. Analysis was completed to verify a reasonable level of gate buildout that should be planned considering long-term airfield and landside capacity.

When the Airport reaches planning activity level (PAL) 3 with 32 million annual passengers, it is expected that SLC will accommodate roughly 1,300 daily operations and require 87 gates. A full build out of Concourse B will provide the Airport a total of 93 gates, which is expected to be required a few years beyond PAL 3. At PAL 3, gate demand is in balance with runway capacity and the terminal landside components (curbs, roads, and vehicle parking), as illustrated in **Figure 4-1.**

If Concourse C is required in the future, a half build-out of Concourse C will take the airport to approximately 115 total gates. With that many gates, SLC could be expected to experience 10 minutes of annualized average delay. As noted in the Facility Requirements chapter, the industry accepted threshold

of annualized runway delay is 5 minutes. Thus, capacity enhancement will be required before Concourse C is developed to maintain a balanced airport. Additionally, parking, terminal curb, and roadway enhancements will be required to support a partial Concourse C build out, but these are feasible expansions.

FIGURE 4-1
BALANCED AIRPORT ANALYSIS



Source: RS&H Analysis, 2020
Note: Existing vehicle parking areas combined with available land to the south of those parking facilities are estimated to be sufficient for parking demand beyond PAL 3. Though not all Concourse B gates are built today, plans are in place for full build-out as needed. Concourse C will require further planning and development of taxilanes, taxiways, and apron.

Demand levels that would require breaking ground on a partial concourse C are not expected until beyond PAL 3. Considering that factor, some existing facilities within the future Concourse C footprint may not require relocation during their useful life. However, new areas must be preserved through the future for relocation of these facilities when they need replacement. The alternatives development for this study accounted for the need to plan for a fully built future Concourse C beyond PAL 3 and considered the need to eventually relocate and provide expansion opportunities for the fuel farm, airline support/maintenance, Fire Station #12, and airport maintenance facilities.

Additionally, the analysis indicated a Concourse D may not ever be able to be supported by the runway capacity, airspace capacity, and terminal systems at SLC. A fully built Concourse D would bring the total number of gates up to 186, which is roughly the same as Hartsfield-Jackson Atlanta International Airport (ATL) in 2020. While the alternatives development in this master plan accounted for a Concourse D within the planned terminal envelope, the land area required for a future Concourse D is better used as developable land within the planning period. If airspace and runway capacity are increased to the point of supporting construction of a Concourse D, by that time it can be expected that any building placed within the area needed for the concourse would have reached the end of its useful life and need replacement. Considering these factors, this study assumes the land within the Concourse D footprint is available through the planning period for development of other facilities.

4.3 RUNWAY ALTERNATIVES

This section discusses the alternatives generated to address the Airport's need for a long-haul runway extension, enhancements for Runway 17-35, and to resolve Runway 14-32 design issues and adjacent hot spots.

4.3.1 Runway Extension for Long Haul Routes

The Aviation Activity Forecast (Chapter 2) indicates market support for flights to Asia direct from SLC. These flights would entail larger and heavier passenger aircraft which, coupled with the high elevation and maximum mean temperatures at SLC, necessitate additional runway length to meet aircraft performance requirements. The required runway length determination for SLC is based on the future critical aircraft, the Airbus A350, and its departure performance. In general, departure operations require longer runway lengths than arrival operations. The runway length requirement for SLC to accommodate the Airbus A350 on long-haul routes was determined to be 14,500 feet. Today, the primary parallel runways are roughly 12,000 feet in length.

The 1996 Master Plan recommended Runway 16L-34R be extended to the north to a final length of 14,302 feet. The 2006 Airport Layout Plan Update recommended Runway 16L-34R be extended to the north to a final length of 15,100 feet. The difference in runway length requirements determined within the two studies was due to the critical aircraft being planned for, but both studies carried forward Runway 16L-34R as the runway to extend to the north. The primary reason for reexamination of these alternatives within this master plan is to ensure due diligence is taken in examining any option that could be more beneficial, or have fewer implementation impacts, than extending Runway 16L-34R to the north.

This master plan study includes a validation of the previous two studies findings. An examination of possible extension to the other runways, including a realigned Runway 17-35 as an alternative, is illustrated in **Figure 4-2**.

Alternatives 1, 2, and 3 include extensions to the north of existing runways to a final length of 14,500 feet. Extension to the south is constrained by airspace requirements and Interstate 80, and thus was not explored further. Alternative 4 assumes that Runway 17-35 would be realigned in parallel with the 16-34 runways and built to 14,500 feet. Alternative 4 was included in this evaluation as proof-of-concept to determine whether that runway is the best runway for long-haul aircraft departures should the runway complex be realigned.

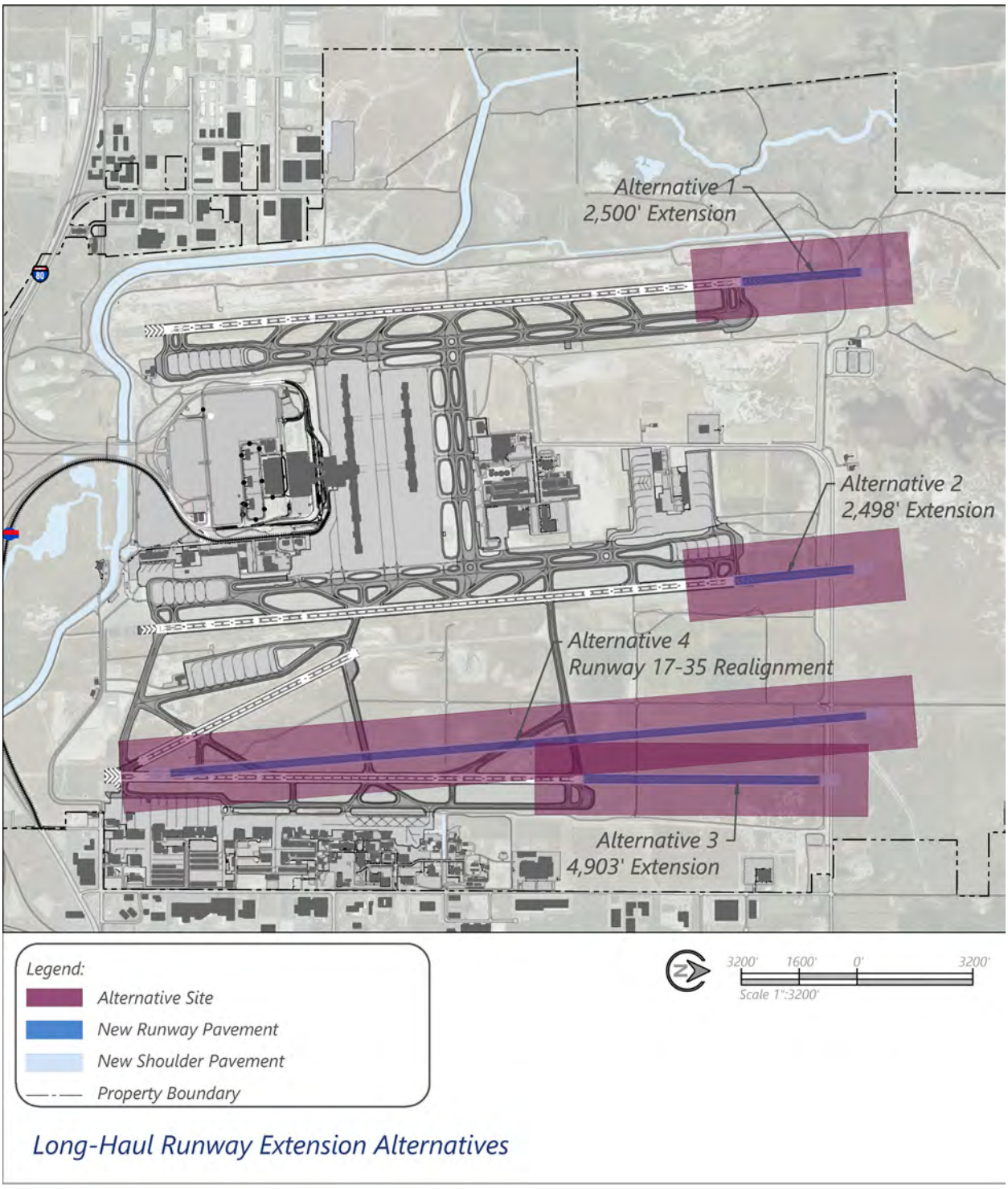
One critical consideration for a north runway extension is the high-tension power lines located immediately north of the airport. The lines run east-west and are furthest from the airport north of Runway 17-35 and closest north of Runway 16R-34L. Today, the power lines impact one-engine inoperative (OEI) requirements for airlines under certain circumstances on the 16-34 runways.

Because long-haul and larger aircraft require a longer runway length than is provided by Runway 17-35 and the lines are furthest from this runway, power line related constraints do not impact Runway 17-35 in its current configuration. Of the four alternatives, power line related impacts are greatest for Alternative 1 where the lines are the closest to the runway, and the least for Alternative 3 where the lines are the

furthest north from the runway. The previous studies recognized these lines as an implementation hurdle for extending Runway 16L-34R to the north and is one reason this study included evaluation of Alternative 3 and 4. Moving or burying the power lines is a feasible but costly option that was accounted for in the evaluation.

The timeframe for implementation was also considered in the evaluation. As noted, market support for a flight to Asia direct from SLC was found likely to materialize in the near-term. At the time of this writing in 2020, COVID-19 had reduced demand for domestic and international travel, but it is expected that as the industry recovers, market demand will materialize for a direct Asian flight. Alternative 4, which is a complete realignment of Runway 17-35, is not needed to support capacity in the near-term and thus would not be programmed until the tail end of PAL 3. This factor eliminated Alternative 4 from being included as a viable alternative. Further description of the realigned runway evaluation is provided in **Section 4.3.3**.

FIGURE 4-2
LONG-HAUL RUNWAY EXTENSION ALTERNATIVES



Source: SLCDA; RS&H Analysis, 2020

The evaluation criteria developed for this analysis are described below along with a summary of associated findings and considerations. Review of the alternatives with SLCDA management and SLC FAA ATCT controllers resulted in Alternative 2 being chosen as the preferred alternative.

Evaluation Criteria and Assessment:

» Climb Gradients/Airspace: How does the option integrate with the airspace and does it work to support minimal climb gradients required by heavy aircraft?

- Heavy aircraft departures today are conducted on Runway 16L-34R as the departure path is straight out down the valley. This departure avoids the need to climb rapidly to avoid mountainous terrain. Additionally, no turn is needed for heavy aircraft on climb out from 16L-34R. This is a benefit as large heavy aircraft on climb out have less maneuverability than narrow body aircraft in the initial phase of flight.
- High-tension power lines exist north of the airfield and create obstructions. Mitigation of the power lines is needed for all options but less so as the departure path is moved east. Alternative 3 has the least impact on the power lines and Alternative 1 has the greatest impact.

» Runway Usage and Integration: Does the option fit with how ATCT controllers operate the airfield and the airspace?

As noted above, heavy aircraft at SLC generally require a straight-out departure. It would be possible to depart a heavy aircraft on the west or east runway (including a realigned east runway), however the departure would need to fly down the valley along the course used for Runway 16L and 34R departures. This would disrupt operations of the center runway, essentially shutting down that runway for departures while the heavy aircraft departs. This is the primary deciding factor to support Alternative 2 as the preferred option.

» Wetlands Impacts: What is the extent of wetlands impact of the option?

- The estimated wetlands impact of a runway extension and associated parallel taxiway complex extension for each option is:
  - Alternative 1 - 10 acres
  - Alternative 2 - 1 acre
  - Alternative 3 - 13 acres
  - Alternative 4 - 20 acres

» Constructability: The runway extension is assumed to be needed within the near-term. How does the option work to allow near-term implementation?

- As noted, Alternative 4 is unfeasible for implementation in the near-term. The other three options perform relatively equally based on the feasibility of their construction in the near-term.

» Cost Factors: How does the option perform on a basis of cost compared to the other options?

  - Alternative 4 will be far more expensive than the other options, while the other three options are estimated to be similar in ROM costs.

» Carbon Footprint: Does the option effectively reduce or increase carbon emissions?
  - Alternatives 1 and 2 were found to perform equally, as both Runway 16L-34R and Runway 16R-34L are adjacent to the terminal and do not require an excessively longer taxi to the new threshold than is required currently. Alternatives 3 and 4 require taxi across the center runway and in general, a longer taxi. The increased taxi time for all aircraft needing to depart on the longer runway correlates with greater carbon emissions.

» Safety: How does the option maintain a safe operating environment?
  - Alternatives 3 and 4 require aircraft to cross the center runway whereas Alternative 1 and 2 do not require a runway crossing. Avoiding a runway crossing is preferred. An end around taxiway, considered in this study, could alleviate runway crossing but increases taxi distance and cost.
  - Alternatives 3 and 4 require aircraft to conduct a longer taxi and more turning maneuvers prior to take-off than Alternatives 1 and 2. On taxi-out, an aircraft is fully burdened with fuel and is at its heaviest weight during the operation. Best practices[1] are for heavy aircraft not to exceed 3 miles in taxi distance and to minimize turns in effort to reduce tire heat build-up. Alternatives 3 and 4 both require less than 3 miles of taxi if not taxiing via a new end around taxiway, but both have a greater taxi distance than Alternatives 1 and 2.

Overall, the evaluation of the options validated that Runway 16L-34R should be the runway extended to allow greater flexibility for long-haul routes. That runway is the only runway that can accommodate heavy aircraft departures without impacting departure and arrival operations of the adjacent runways. ATCT controllers validated this assessment.

Table 4-1 visually summarizes the evaluation and conclusions of SLC management and the planning team. Further alternative analysis was conducted to determine how to best mitigate the power line obstructions and determine ROM costs for mitigation. That analysis is provided in **Appendix A.**

[1] ICAO Aerodrome Design Manual, Part 2 Taxiways, Aprons and Holding Bays. Fourth Edition 2005

TABLE 4-1
LONG HAUL RUNWAY EXTENSION ALTERNATIVES EVALUATION

Criteria	Alternative 1 Extend Runway 16R-34L	Alternative 2 Extend Runway 16L-34R	Alternative 3 Extend Runway 17-35	Alternative 4 New Realigned Runway
Climb Gradients / Airspace	Fair	Good	Fair	Fair
RWY Usage and Integration	Poor	Good	Poor	Poor
Wetlands Impacts	Fair	Good	Fair	Poor
Constructability	Fair	Fair	Fair	Poor
ROM Costs	Fair	Fair	Fair	Poor
Carbon Footprint	Good	Good	Poor	Poor
Safety	Good	Good	Fair	Fair

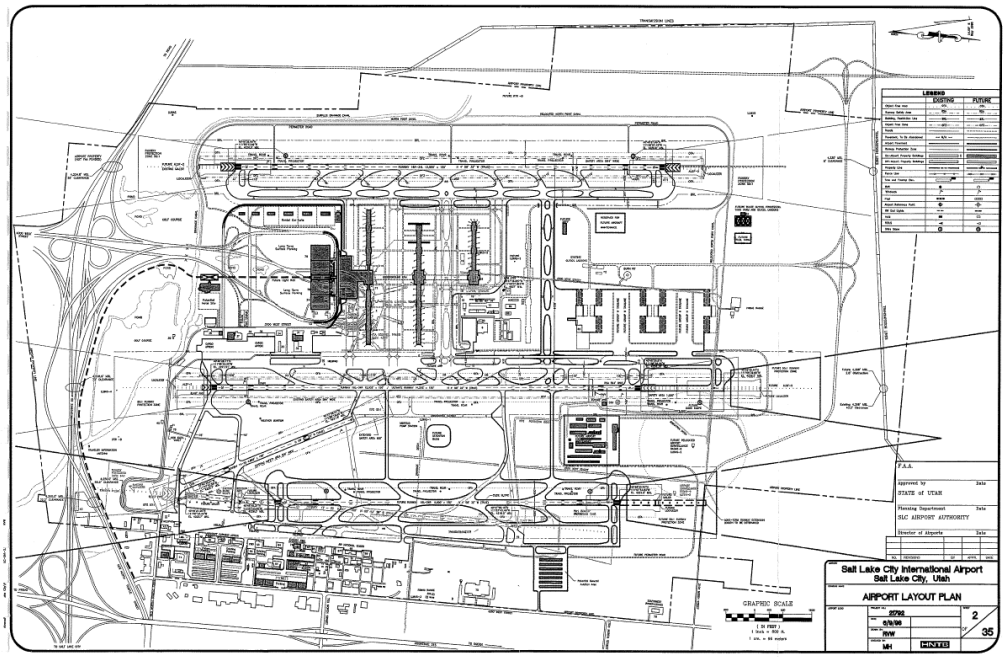
Performance Legend

Good | Fair | Poor

4.3.2 Prior Planning for New West Runway and Runway 17-35 Realignment

Since the development of the *1998 Salt Lake City Airport Master Plan*, Runway 17-35 has been analyzed for realignment and a new west runway complex was examined for potential future integration. However, the 1998 Master Plan only brought forward a realigned concept for Runway 17-35 into the Airport Layout Plan, as shown in **Figure 4-3**. The decision to move forward with a realigned Runway 17-35 was based on the cost/benefit compared to building a new west runway complex.

FIGURE 4-3
1998 MASTER PLAN AIRPORT LAYOUT PLAN SHEET



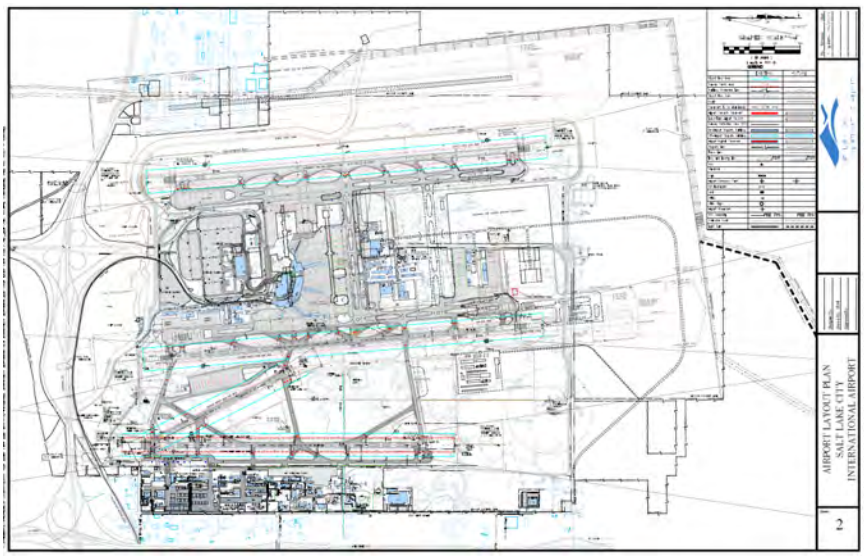
Source: 1998 Salt Lake City Airport Master Plan

The next planning study at SLC was the *2006 Airport Layout Plan Update*. That study completed further analysis and examination of a realigned Runway 17-35 and a new west runway complex. As shown in **Figure 4-4**, the concept of a new west runway was further defined, as was the location and length of a realigned Runway 17-35. The narrative report of the 2006 Update recommended that both a new west runway and a realigned Runway 17-35 be preserved for long term development. The report indicated that the realigned runway should be implemented before the new west runway. However, as show in **Figure 4-5**, the current ALP last updated in 2012, a realigned Runway 17-35 is not shown, but instead a new west runway is depicted.

FIGURE 4-4
2006 AIRPORT LAYOUT PLAN UPDATE FOUR-RUNWAY CONCEPT

Source: 2006 Airport Layout Plan Update, Figure 2-2 *Four-Runway Consideration*

FIGURE 4-5
SLC AIRPORT LAYOUT PLAN UPDATED 2012



Source: Existing Airport Layout Plan last updated in 2012

The planning rationale is not clear as to why the west runway was depicted on the current ALP and the realigned Runway 17-35 was removed. However, it is important to note that both the 1998 Study and the 2006 Update found advantage to a realigned Runway 17-35 and a new west runway. Both studies also recognized the significant facilities work required to implement a new west runway and concluded that work is greater than what would be required for a realigned runway.

The facility requirements found that no additional runway capacity is needed at SLC within the 20-year planning period. Thus, the need for major runway improvements isn't required immediately. However, as the balanced airport analysis indicated, additional capacity is needed prior to expanding into a Concourse C. Planning and programming for that capacity increase could be required within this study's planning period. For this reason, this study built upon the prior two decades of planning and further examined the potential benefit of a realigned runway and a new west runway.

Analysis conducted in this study determined that a realigned Runway 17-35 would provide more benefit to the SLC system than a new west runway. The airspace analysis concluded that overall, a new west runway would not provide independent operations due to the other parallel runways missed approach requirements and the surrounding terrain. The 2006 Study recommendation that a realigned runway should be programed before a new west runway was validated. The following sub-section describes the comprehensive analysis conducted on a Runway 17-35 realignment to further define an ideal separation, and length to be planned for, based on today's airspace technologies.

Although a new west runway was not explored further in this study, it is recommended the concept be carried forward on the updated ALP, like that on the 2012 ALP. A new west runway may provide some benefit over the life of the Airport and depending on technology and airspace redesigns in the future, could be more beneficial than currently identified. The preservation of the west runway concept on the ALP will help ensure future actions make a new west runway more, and not less, feasible as an option in the future.

4.3.3 Runway 17-35 Alternatives

As noted above, Runway 17-35 was studied extensively in the 1996 Master Plan and the 2006 Airport Layout Plan Update. The focus of those studies was on the capacity improvements a realigned Runway 17-35 may provide as a third parallel runway. Air traffic separation rules, instrument procedure design criteria, and fleet mix at SLC have changed since those studies were completed, and this master plan study re-analyzed the ideal separation from Runway 16L-34R as well as the capacity and operational benefits that could be realized with that separation.

Parallel runway separation requirements, detailed in **Table 4-2**, are correlated with different levels of dependency and independency for parallel runway operations under visual (VMC) and instrument meteorological conditions (IMC). The 2006 Airport Layout Plan Update recommended the realigned runway be sited between 2,500 and 4,300 feet from existing Runway 16L-34R. At a minimum of 2,500 feet, simultaneous dependent approach operations between runways in IMC can be provided. As separation between runways increases beyond 3,000 feet, additional ATC and capacity benefits may be realized, but

there are substantial impacts to existing ground facilities and additional potential restrictions to the instrument approach procedures needed to fully realize the benefits of a realigned runway.

TABLE 4-2
RUNWAY SEPARATION REQUIREMENTS

Runway Separation Requirements					
Runway Separation	**VMC**		**IMC**		**Comment**
	Approach	**Departure**	**Approach**	**Departure**	
700'	See Comment	See Comment	Dependent	Dependent	Independent operations for ADG-I through IV aircraft
1,200'	See Comment	See Comment	Dependent	Dependent	Independent operations for ADG-I through IV aircraft
2,500'	Independent	Independent	Dependent	See Comment	Simultaneous radar departures only
3,500'	Independent	Independent	Dependent	Independent	Simultaneous radar and non-radar departures
3,600'	Independent	Independent	See Comment	Independent	PBN instrument dual approach to an offset final approach course (FAC) or a procedure paired with an offset FAC.
3,900'	Independent	Independent	See Comment	Independent	PBN instrument triple approach to an offset final approach course (FAC) or a procedure paired with an offset FAC.
4,300'	Independent	Independent	See Comment	Independent	Dual simultaneous precision instrument approaches
5,000'	Independent	Independent	See Comment	Independent	Triple simultaneous precision instrument approaches for airports below 1,000 feet MSL.
9,000	Independent	Independent	See Comment	Independent	Triple approaches requires identification and clearances of No Transgression and Normal Operating Zones. No PRM required.

Source: FAA Order 711065Y Air Traffic Control, FAA Order 8260.3D United States Standard for Terminal Instrument Procedures (TERPS), FAA AC 150/5300-13A Change 1 Airport Design, 2020

Notes:

1) Table values assume runways have a true parallel alignment.
2) Values and conditions provided are general planning values. Actual operating conditions may vary and upon FAA review and approval.
3) When runway thresholds are staggered and the approach is to the near threshold, separation can be reduced by 100 feet for each 500 feet of threshold stagger.
4) When runway thresholds are staggered and the approach is to the far threshold, separation must be increased by 100 feet for each 500 feet of threshold staggered.
5) The minimum runway centerline separation distance recommended for ADG-V and VI runways is 1,200 feet. Air Traffic Control (ATC) practices, such as holding aircraft between the runways, frequently justify greater separation distances. Runway with centerline spacings under 2,500 feet are normally treated as a single runway by ATC when wake turbulence is a factor.
6) Operations less than 9,000 feet require a No Transgression Zone (NTZ).
7) PRM approach must be assigned when conducting instrument approaches to dual and triple parallel runways centerlines spaced by less than 4,300 feet.

As part of this master plan, a comprehensive airspace analysis was conducted which included flight procedure redevelopment concepts and a study of the existing airspace. The baseline for separation analysis began with 2,500 feet from Runway 16L-34R, as that separation is the minimum required for independent simultaneous departures, and mixed departure/arrival operations in IMC conditions between the center runway and a realigned Runway 17-35.

The analysis provided a deeper understanding of the potential performance characteristics of a realigned Runway 17-35 using current and emerging Performance Based Navigation (PBN) technologies. In evaluating the potential of a realigned runway with various separations from Runway 16L-34R, a *carte blanche* approach was taken assuming an entirely new set of instrument approach procedures would be developed to support the new runway and, where necessary, missed approach procedures to Runway 34R could be modified to achieve 8260.3D (TERPS) triple simultaneous procedure criteria.

The analysis also examined geospatial considerations, including obstacle and terrain impacts from the perspective of TERPS procedure design criteria, as well as resulting approach procedure minima for all relevant runway separations for various types of applicable instrument procedures. The flight procedure analysis assessed the viability and potential utility of instrument approaches, missed approaches, and departure procedures that must integrate with operations on the other runways in ways that maximize the benefits of—a now parallel—Runway 17-35.

Table 4-3 details at a high level the arrival and departure capability determined with a realigned Runway 17-35 in IMC at various levels of separation. Current technologies influence the capabilities within each level of separation and can sometimes provide performance benefits attributed to higher levels of separation within a lower level. **Appendix B** details the specific findings of the comprehensive analysis and describes flight procedure and air traffic control considerations for each level of separation.

TABLE 4-3
DEPARTURE AND ARRIVAL CAPABILITIES FOR REALIGNED RUNWAY 17-35

Runway Separation	North Flow		South Flow	
	Arrival Capability	Departure Capability	Arrival Capability	Departure Capability
2,500 Feet to < 3,600 Feet	Triple simultaneous approaches *may* be feasible with CSPO	• Simultaneous departures from two runways • Possibility to conduct simultaneous departures from three runways depending on safety study	Dual simultaneous approaches feasible with center runway	Simultaneous departures from two runways
3,600 Feet to <3,900 Feet	Triple simultaneous approaches feasible with PRM and may be possible under EoR in the future	Simultaneous departures from three runways	Dual simultaneous approaches feasible with center runway	Simultaneous departures from two runways
3,900 Feet to <4,300 Feet	Triple simultaneous approaches feasible under EoR and PRM	Simultaneous departures from three runways	Dual simultaneous approaches feasible with center runway	Simultaneous departures from two runways
4,300 Feet to <5,000 Feet	Triple simultaneous approaches feasible with PRM	Simultaneous departures from three runways	Dual simultaneous approaches feasible with center runway	Simultaneous departures from two runways
5,000 Feet *Plus*	Triple simultaneous approaches feasible (likely limited to CAT I on Runway 35)	Simultaneous departures from three runways	Dual simultaneous approaches feasible with center runway	Simultaneous departures from two runways

Source: LEAN Corp, 2020. Prepared by RS&H, 2020
Notes: CSPO refers to closely spaced runway operations detailed in FAA Order 7110.308. PRM is precision runway monitor. EoR refers to an Established on RNP approach.

Table 4-4 details the findings of the approach and departure capabilities at each level of separation. It was found that all separation levels provide ILS CAT I/II/III approaches in north and south flows. This would be an enhancement over the approach capability offered by Runway 17-35 today, providing the Airport greater all-weather capability and redundancy.

TABLE 4-4
PROCEDURE CAPABILITIES FOR REALIGNED RUNWAY 17-35

Runway Separation	North Flow		South Flow	
	Arrival	Departure	Arrival	Departure
2,500 Feet to < 3,600 Feet	ILS CAT I/II/III APP CAT A - E and all PBN options 2.5 - 3.0 Degree offset approaches possible Triple Simultaneous Approach	Standard departure	ILS CAT I/II/III APP CAT A - E and all PBN options 2.5 - 3.0 Degree offset approaches possible Dual Simultaneous Approach	Standard departure
3,600 Feet to <3,900 Feet	ILS CAT I/II/III APP CAT A - E and all PBN options 2.5 - 3.0 Degree offset approaches possible Triple Simultaneous Approach	Standard departure	ILS CAT I/II/III APP CAT A - E and all PBN options 2.5 - 3.0 Degree offset approaches possible Dual Simultaneous Approach	Standard departure
3,900 Feet to <4,300 Feet	ILS CAT I/II/III APP CAT A - E and all PBN options Triple Simultaneous Approach	Standard departure	ILS CAT I/II/III APP CAT A - E and all PBN options Dual Simultaneous Approach	Standard departure
4,300 Feet to <5,000 Feet	ILS CAT I/II/III APP CAT A - E and all PBN options Triple Simultaneous Approach	Increased climb gradient requirement	ILS CAT I/II/III APP CAT A - E and all PBN options Dual Simultaneous Approach	Increased climb gradient requirement
5,000 Feet *Plus*	ILS CAT I/II/III APP CAT A - E and all PBN options Triple Simultaneous Approach	Increased climb gradient requirement	ILS CAT I APP CAT A - E and all PBN options Dual Simultaneous Approach	Increased climb gradient requirement

Source: LEAN Corp, 2020. Prepared by RS&H, 2020

The results of the analysis found the recommended level of separation to site the runway to be between 3,000 and 3,600 feet. Separation below 3,000 feet introduces ATC challenges and dependencies that do not exist today and would substantially reduce the achievable capacity benefits. Overall, 3,000 feet separation was found to provide the best balance between benefit and impact to east side facilities.

The next higher category of separation, 3,600 to 3,900 feet, may allow for Established on RNP (EoR) approaches. However, this is a marginal advantage when compared to the substantial impacts to east side facilities at that level of separation. Additionally, this category of separation only provides additional benefit during north flow operations. South flow operations cannot be further improved due to the configuration of the mountains flanking the Salt Lake Valley. Considering that SLC is nearly evenly split between time in north flow and south flow, the potential benefit of gaining an EoR approach is diminished by the fact that it can only be applied for use in north flow.

The 4,300 to 5,000 feet separation window was found to present substantial challenges with obstacle avoidance and procedure design. The analysis indicated that flight procedures may be designed to standard at this separation, but the complexity and extremity of the procedures would not be recommended for implementation. Thus, the 4,300 to 5,000 feet separation window and beyond are considered unfeasible at SLC.

A 3,000-foot separation provides the minimum 9,000 feet separation between the realigned runway and Runway 16R-34L, which prevents the need for additional monitor controllers for simultaneous operations between the west (16R-34L) and east runways (realigned 17-35)[2]. A preferred concept, illustrated in **Figure 4-6**, was developed assuming the center runway was extended to 14,500 feet in length, and a realigned runway designed to 12,000 feet in length. That concept assumed the southern thresholds would be aligned to minimize impacts to the east facilities. With the 2,500 feet of runway stagger presented in this concept, a separation of 3,000 feet is required.

[2] Runways separated by at least 9,000 feet prevent the need from having precision radar monitoring (PRM) for simultaneous operations. At SLC this equates to a minimum of 2,845 feet of separation between the center runway and a realigned Runway 17-35. Separation of parallel runways must also account for differences in runway threshold alignments. Thresholds that are not aligned are considered staggered. For every 500 feet of threshold stagger, runways must be further separated by 100 feet. The realigned runway was studied at a length of 12,000 feet. That length was determined suitable to accommodate the commercial fleet mix at SLC. Considering Runway 16L-34R is recommended for extension to 14,500 feet, a total of 2,500 feet of stagger would exist between Runway 16L-34R and the realigned Runway 17-35 if either the north or south thresholds are aligned. Thus, 3,000 feet of separation would be required to account for the 2,500 feet of stagger.

FIGURE 4-6
RUNWAY 17-35 REALIGNMENT PREFERRED ALTERNATIVE

Source: SLCDA; RS&H Analysis, 2020

4.3.4 Runway 14-32 and Adjacent Hot Spot Alternatives

As discussed in Chapter 3 Facility Requirements, FAA hot spots HS1 and HS2 locations have had runway incursions in number and frequency to also be listed on the FAA Runway Incursion Mitigation (RIM) list. As a RIM location, these hot spots require changes in airfield geometry to enhance safety and mitigate chances of runway incursions.

The FAA has categorized airfield geometry that has been found to increase chances of runway incursions (RI) as geocodes. The geocodes applicable to HS1 and HS2 are detailed below in **Table 4-5**. Alternatives have been developed that work to eliminate the geocodes associated with the existing airfield geometry. Additionally, other airfield geometry changes are introduced that would be required in implementation of the alternatives to conform to FAA design standards. This includes Runway 14-32 and its dedicated entrance taxiways being designed to ADG II standards, which supports the critical aircraft designated for that runway.

An analysis of historical runway incursions at HS1 and HS2 between 2013 and 2019 was completed to gain a deeper understanding of which geocodes specifically were creating issues. At HS1, it was found that the typical RI's included deviations by pilots of small general aviation aircraft crossing the hold-short line at Taxiway K1 without clearance or departing from the incorrect runway. The Airport has implemented enhanced signage, lighting, and painted markings at Taxiway K1; however, it is likely that pilots may find the intersection confusing due to the need to denote two runways at one intersection.

The analysis of historical RI's at HS2 indicates most were related to aircraft crossing Runway 16L-34R from Taxiway H5, proceeding on Taxiway Q, then missing their directed right turn onto Taxiway L and subsequently crossing the hold-short marking for Runway 14-32. Geocodes found to significantly influence runway incursions at HS2 include Geocode 3 and 7. The distance required to cross Runway 16L-34R from Taxiway H5 to Taxiway Q is longer than typical perpendicular runway crossings which allows, and sometimes requires, pilots to increase taxi speed. The increase in speed and distance is compounded by the short distance between hold-short markings on Taxiway Q and the wide expanse of pavement at the junction of Taxiway L and entrance to Runway 14-32.

TABLE 4-5
RUNWAY 14-32 APPLICABLE GEOCODES

HS1 Geocodes	Description
Geocode 2	Wrong runway events
Geocode 6	Two runway thresholds in proximity
Geocode 7	Short taxiway (stubs) between runways
Geocode 8	Direct taxiing access to runways from ramp areas
Geocode 12	Taxiway connection to V-shaped runways
Geocode 14	Short taxi distance from ramp/apron area to runway
Geocode 16	Taxiway coinciding with the intersection of two runways
HS2 Geocodes	**Description**
Geocode 3	Wide expanses of taxi pavement entering runway
Geocode 4	Convergence of numerous taxiways entering a runway
Geocode 7	Short taxiway (stubs) between runways
Geocode 13	Taxiway intersect at other than a right angle

Source: FAA Runway Incursion Mitigation Program , RS&H Analysis, 2020

Alternative 1 – Bring Geometry Up to Standards

This alternative is based on maintaining Runway 14-32 at its current length and reconfiguring the runway end entrance taxiways to an alignment that meets FAA standards and eliminates the associated geocodes. The HS2 hot spot, at the location of Taxiway Q and the Runway 14 threshold, is mitigated with a reconfigured Taxiway Q. The configuration eliminates the straight-in alignment of the current crossing with Runway 14-32 and requires a multitude of 90 degree turns to access Runway 14-32.

Most of the HS1 hotspot geocodes are mitigated as the existing Taxiway J, which is aligned with Runway 34, is removed and runway access is provided with a future Taxiway J built to FAA standards. This eliminates the potential for aircraft to line up and depart from the wrong runway. Geocodes related to the position of Taxiway K1 and the apron remain. These include Geocodes 8 and 14, which are direct access and short taxi distance from the apron to runway, respectively. Options exist to mitigate geocodes at Taxiway K1 but will require a large reduction in apron space. However, it is expected that the removal of signage at the intersection related to Runway 14-32 will reduce clutter and pilot confusion.

This option also includes geometry changes to Taxiways P and N to correct for the wide expanse of pavement created by the taxiways converging on the runway, and the runway crossing at other than a 90-degree angle.

The estimated construction cost for this alternative is $18,100,000. Soft costs, including mobilization, environmental documentation, design, and project administration are estimated to be approximately $4,700,000 for a total project ROM cost of $22,800,000. This does not include escalation or contingency costs.

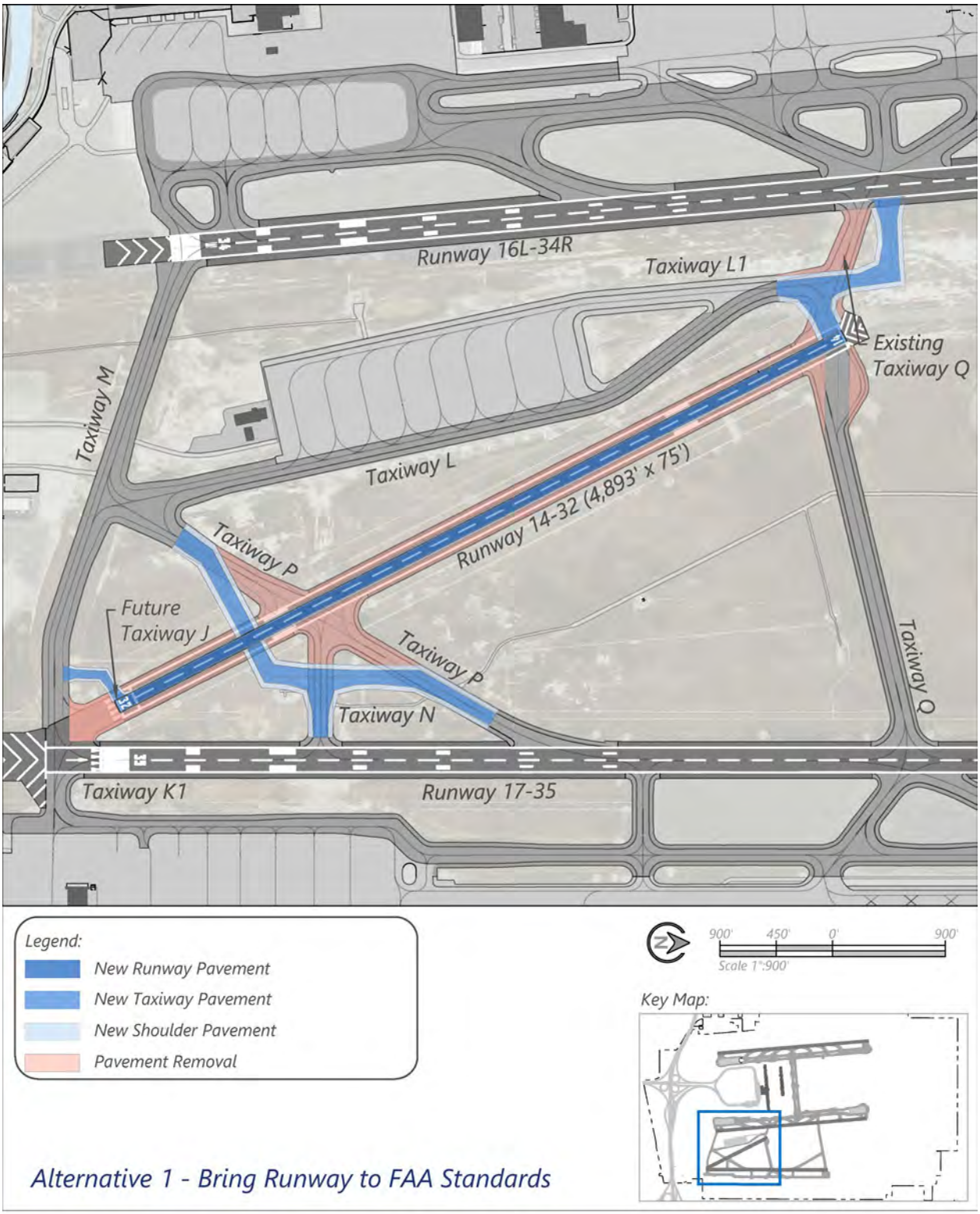
Advantages of this alternative include:

- Runway 14-32 remains at its current length of 4,893 feet.
- HS2 hotspot geocodes are fully mitigated.
- HS1 hotspot geocodes are mitigated to the fullest extent possible without impacting the aircraft apron area adjacent to Taxiway K1.

Disadvantages of this alternative include:

- Taxi flows of commercial passenger aircraft landing Runway 17-35 are slowed due to the geometry changes required for Taxiways P and N, thereby increasing taxi times.
- A non-standard holding position marking on Runway 14-32 must remain due to the runway's proximity to Runway 17-35.
- The option requires significant investment.

FIGURE 4-7
RUNWAY 14-32 ALTERNATIVE ONE



Source: SLCDA; RS&H Analysis, 2020

Alternative 2 – Shorten Runway 14-32

This alternative proposes that Runway 14-32 be shortened to 3,510 feet, which is sufficient to support that runway's critical aircraft. Taxiway Q is designed similar to that in Alternative 1, albeit, in this alternative a separate taxiway entrance off Taxiway Q will access the Runway 14 threshold. The reduction in runway length allows for ADG III aircraft to taxi on Taxiway M and Taxiway Q independently of Runway 14-32 operations. Additionally, the Runway 32 threshold is further separated from Runway 35, which provides enhanced safety and simplicity as any taxiing aircraft or snow removal equipment on Runway 14-32 will not interfere with Runway 17-35 operations. Like Alternative 1, Geocodes 7 and 16 remain for HS1 due to the configuration of Runway 17-35, Taxiway K1, and the aircraft parking apron.

The estimated construction cost for this alternative is $19,300,000. Soft costs, including mobilization, environmental documentation, design, and project administration is estimated to be approximately $5,000,000 for a total project ROM cost of $24,300,000. This does not include escalation or contingency costs.

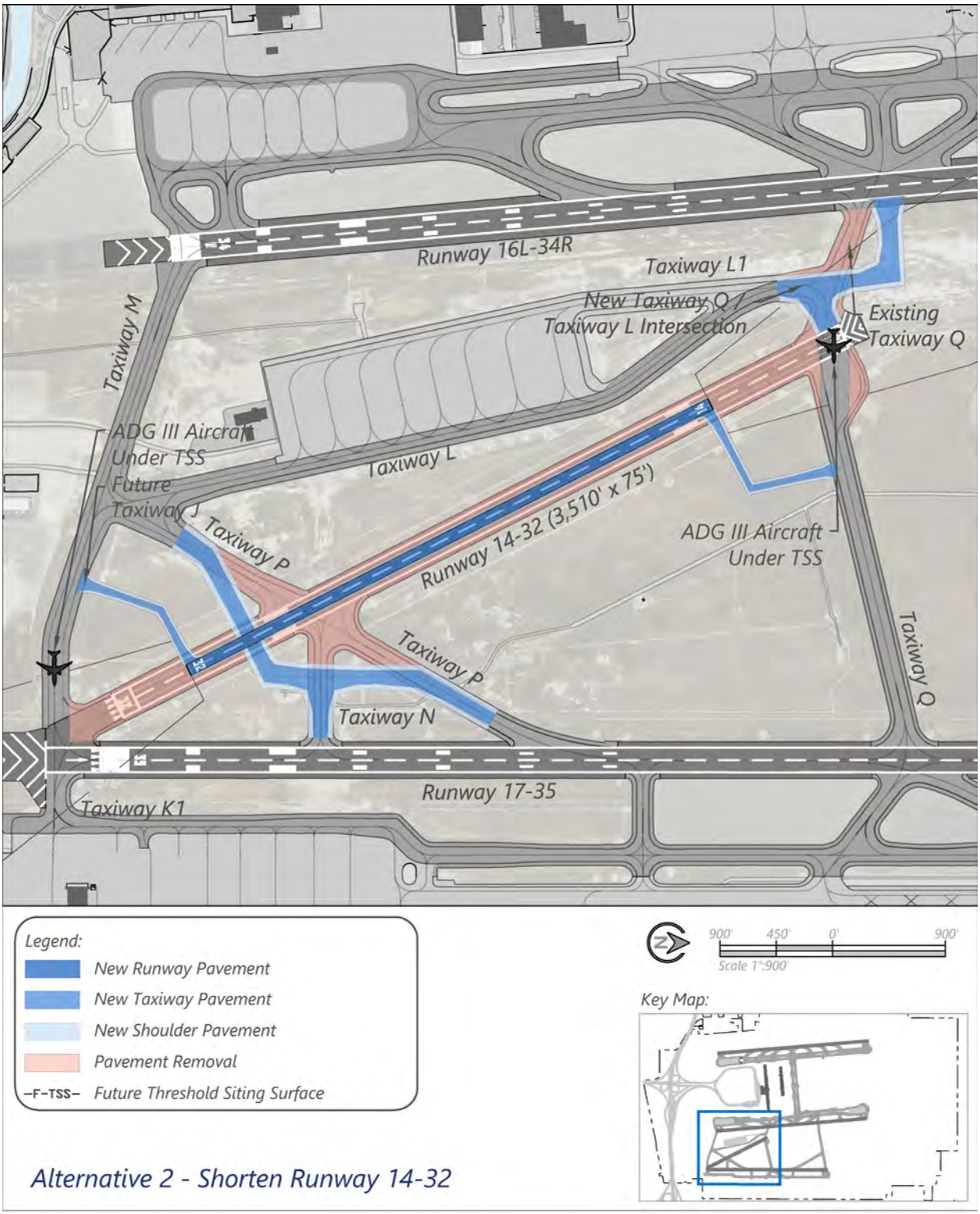
Advantages of this alternative include:

- HS2 hotspot geocodes are fully mitigated.
- HS1 hotspot geocodes are mitigated to the fullest extent possible without impacting the aircraft apron area adjacent to Taxiway K1.
- Runway 14-32 operations are fully independent and are not affected by aircraft taxiing on Taxiway Q and M.
- A non-standard hold marking on Runway 14-32 is not needed because there is enough separation from Runway 17-35 that aircraft on the pavement of Runway 14-32 will not interfere with Runway 17-35 operations.

Disadvantages of this alternative include:

- Taxi flows of commercial passenger aircraft landing Runway 17-35 are slowed due to the taxiway geometry changes, thereby increasing taxi times.
- The option requires significant investment.

FIGURE 4-8
RUNWAY 14-32 ALTERNATIVE TWO



Source: SLCDA; RS&H Analysis, 2020

Alternative 3 – Close Runway 14-32

This alternative includes the closure of Runway 14-32 and removal of the runway from the SLC system. Portions of the runway would be converted to taxiway to keep Taxiway Q and Taxiway P functional. Geocodes 7 and 16 remain at HS1 due to the configuration of Runway 17-35, Taxiway K1 and the aircraft parking apron.

The estimated construction cost for this alternative is $2,200,000. Soft costs, including mobilization, environmental documentation, design, and project administration is estimated to be approximately $500,000 for a total project ROM cost of $2,700,000. This does not include escalation or contingency. It is possible the project cost could be reduced if the project is value engineered to a minimum effort that sufficiently meets FAA standards and provides a high level of safety.

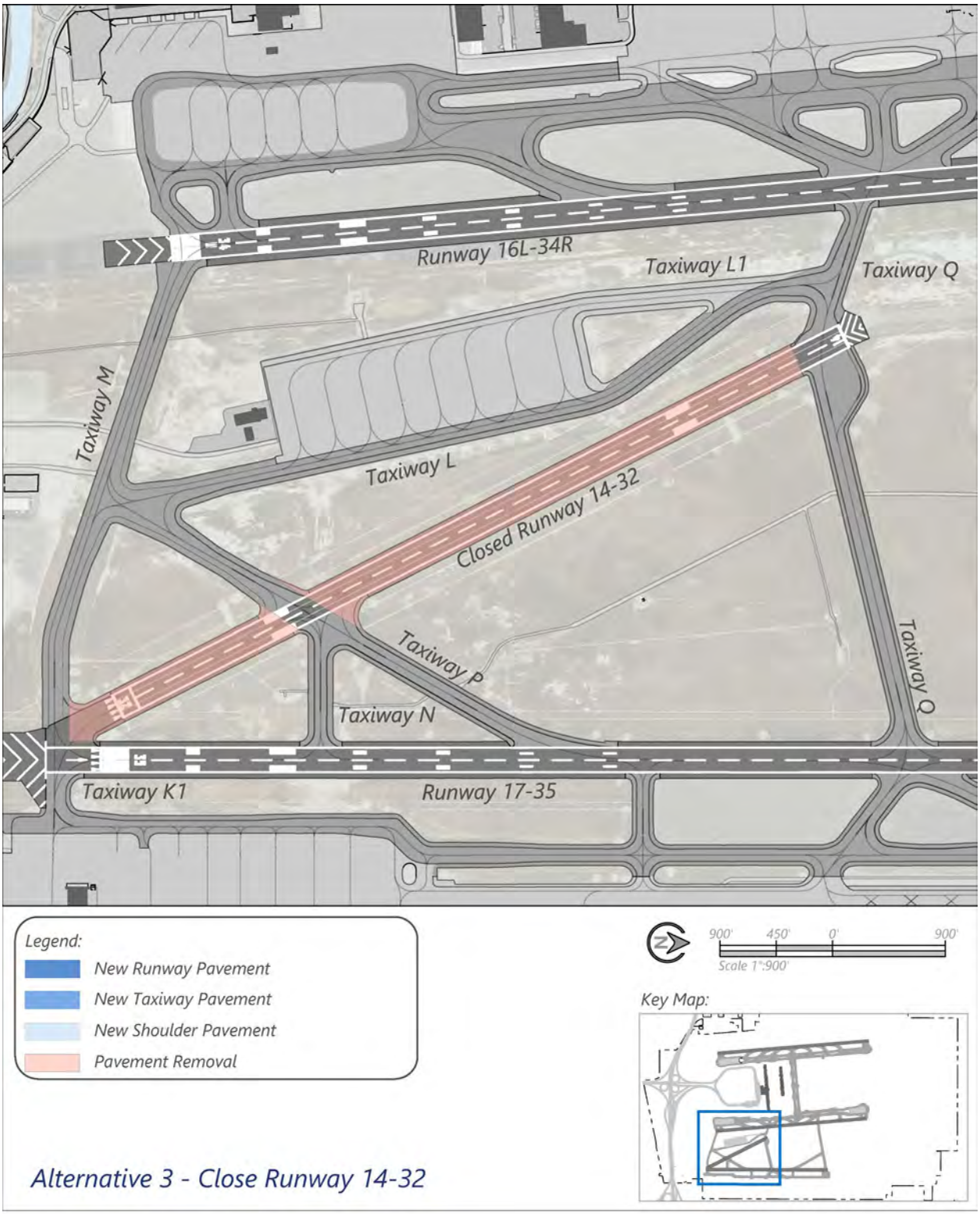
Advantages of this alternative include:

- HS2 hotspot geocodes are fully mitigated.
- HS1 hotspot geocodes are mitigated to the fullest extent possible without impacting the aircraft apron area adjacent to Taxiway K1.
- Removal of Runway 14-32 allows expedited taxi of commercial passenger aircraft landing Runway 17 and transitioning to the terminal area.
- Minimal capital investment required.

Disadvantages of this alternative include:

- Runway 14-32 is primarily used by ATCT controllers to land small cargo feeder aircraft during the evening peak hours. The runway would not be available for that purpose and those aircraft would need to sequence into arrival streams for the primary runways.

FIGURE 4-9
RUNWAY 14-32 ALTERNATIVE THREE



Source: SLCDA; RS&H Analysis, 2020

4.3.4.1 Runway 14-32 Hot Spot Alternatives Evaluation

The alternatives developed all work to remove the geocodes related to the configuration of Runway 14-32 at HS1 and HS2. Geocode 8 and Geocode 14 remain in place in these alternatives due to the configuration of Runway 17-35, Taxiway K1, and the proximity of the aircraft parking apron. The master plan team and Airport management anticipate that with implementation of any of the alternatives, the Taxiway K1 intersection will become less confusing as signage and markings will be focused on alerting pilots of only one runway, as opposed to two. This is expected to help reduce the number, and likelihood, of future incursions. Options exist to mitigate geocodes at Taxiway K1 but they require a large reduction in apron space. Thus, a "wait and see" approach is recommended after implementation of the preferred option. If incursions continue, a more refined approach can be developed based on data gathered after the elimination of the other geocodes.

Evaluation of the alternatives required consideration of how Runway 14-32 is used within the SLC system of runways. Historical data indicated that in 2018, there were 3,350 annual operations on Runway 14-32 conducted almost exclusively by small cargo feeder aircraft landing in the evening. In north flow during VMC conditions, ATCT controllers explained they use Runway 32 to land small cargo aircraft, allowing them to separate the slow aircraft out from the arrival flows of the primary runways. This was found to be the main benefit of Runway 14-32 within the SLC runway system.

Examination of cargo schedules for December 2017 and February 2018, in conjunction with the 2018 commercial airline schedules, indicated that during the evening commercial passenger aircraft arrival peak, which occurs between 1900 and 2000, four small cargo aircraft arrive at SLC. The primary role of SLC is to serve commercial cargo and passenger airlines and large corporate jet activity. Runway 14-32 supports this role by enabling ATCT controllers to separate small, slow, commercial cargo feeders from arrival streams of commercial passenger jet traffic during evening peak arrival flows. However, changes required to Taxiway P for compliance with FAA standards, as shown in Alternatives 1 and 2, will increase taxi times for the thousands[3] of commercial passenger aircraft that land each year on Runway 17 and use Taxiway P to transition to the terminal area.

The taxi time increase of Alternatives 1 and 2 is quantifiable, but the impacts associated with integrating slow cargo aircraft into the primary north flow arrival streams, associated with Alternative 3, is difficult to quantify due to the dynamic nature of the airspace. Therefore, a comparison of delay or fuel burn was not completed within this analysis. Instead, known factors were accounted for including: surplus capacity is available through the planning period; and slow cargo aircraft are effectively being integrated into the primary arrival streams during south flow and IMC conditions. These factors indicate that Runway 32 is not essential within the SLC runway system, but it is very convenient and provides a tool for ATCT to enhance efficiency.

The evaluation criteria developed for this analysis are described below along with a summary of how each alternative performed. Review of the alternatives with SLC management resulted in Alternative 3

[3] 2018 data indicated 13,131 passenger airline aircraft landed Runway 17. The predominate runway exit and flow for these aircraft is Taxiway P to either Taxiway L or Taxiway M.

being chosen as the preferred alternative. The rationale for Alternative 3 being carried forward is predominantly related to cost versus overall benefit. Runway 14-32 is not needed at SLC to provide wind coverage and does not have an operational level to be supported by FAA AIP funding as a secondary runway. Yet, the runway deficiencies noted in this evaluation must be corrected in the near term. Because the runway is not AIP eligible, it is unlikely that FAA will fund the improvements Alternatives 1 and 2 propose to correct the deficiencies. This means SLCDA would need to fund 100 percent of the project components in either Alternative 1 or 2 to keep the runway.

While it is desirable to keep Runway 14-32 to provide ATCT an effective tool for filtering slow cargo aircraft in north flow VMC conditions, SLC staff determined it was impractical from a cost/benefit perspective. The large capital investment required to implement Alternatives 1 or 2 can instead be leveraged toward FAA AIP eligible projects where that money can allow for larger projects.

Table 4-6 visually summarizes the evaluation and conclusions of SLC management and the planning team.

Evaluation Criteria and Assessment:

- FAA Design Standards: Does the alternative correct all related deficiencies and conform to FAA Design standards?
  - All three alternatives perform equally.
- General Safety Considerations: Does the alternative have any remaining safety concerns?
  - Alternative 1 maintains the non-standard hold position bar on Runway 14-32 due to the proximity of Runway 17-35.
- Airfield/Airspace Efficiencies: How well does the alternative work to enhance operational efficiency measured by taxi time and delay?
  - Alternatives 1 and 2 create additional taxi time for commercial passenger aircraft landing on Runway 17 as design standards require additional turns to taxi across and around Runway 14-32. However, they aid airspace efficiency during VMC north flow operations by allowing the separation of slow cargo aircraft from the primary arrival flows.
  - Alternative 3 maintains efficient taxi procedures on Taxiway P but prevents separation of slow cargo aircraft during VMC north flow operations.
- Long Term Development/Vision: How well does the alternative integrate with long-term development and the ultimate vision of SLC?
  - Keeping Runway 14-32 in place reduces the efficiency of moving commercial aircraft to and from Runway 17-35 and the terminal area. An end around taxiway (discussed later in this chapter) is proposed in this master plan around the Runway 34R threshold. Efficiencies of that enhancement cannot be fully realized with Alternatives 1 or 2.
- Cost/Return on Investment: How do rough order magnitude costs compare between alternatives, and is the return on the investment equal to, or greater than, the investment itself?
  - Alternatives 1 and 2 are significantly more expensive than Alternative 3. The investment required for Alternatives 1 or 2 was deemed to be better spent on other airfield enhancements that could further reduce taxi times and delay.

TABLE 4-6
RUNWAY 14-32 HOT SPOT EVALUATION

Criteria	Alternative 1 Bring to FAA Standards	Alternative 2 Shorten Runway	Alternative 3 Close Runway
FAA Design Standards			
General Safety Considerations			
Airfield/Airspace Efficiencies			
Long Term Development/Vision			
Cost & Return on Investment			

Performance Legend

Good | Fair | Poor

4.3.5 South End Around Taxiway

At the onset of the master plan, during initial visioning sessions, interest in studying the potential for end around taxiways (EATs) around Runway 16L-34R was expressed by Airport staff and stakeholders. An end around taxiway allows aircraft to taxi around a runway end without interfering with operations on the runway. Airports construct end around taxiways to improve aircraft operational flows on the ground. Airports in the United States that currently have end around taxiways include Dallas Fort Worth International Airport (DFW), Detroit Metropolitan Airport (DTW), and Atlanta International Airport (ATL).

End around taxiways are implemented to reduce runway crossings and the risk of an incursion, reduce air traffic controller workload, provide for more timely and predictable gate arrivals, reduce fuel consumption and emissions, and to increase runway capacity and hourly throughput. EATs can be effective in reducing delay due to their capabilities in enabling free-flow taxiing that does not require an aircraft to slow down or stop and wait to cross a runway.

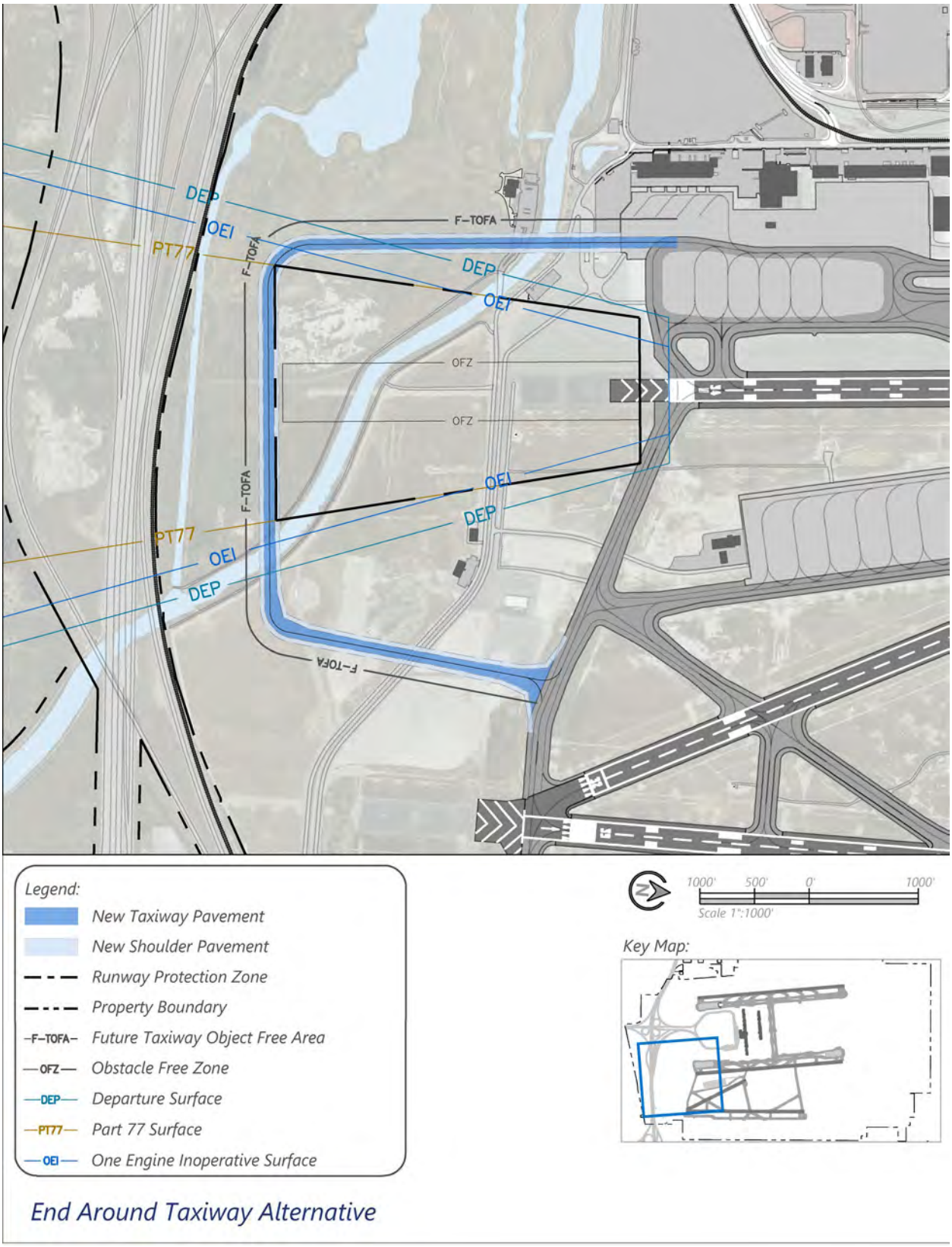
An EAT was evaluated in this master plan study for application to both the north and south ends of Runway 16L-34R. The primary purpose of the EATs in this configuration would be to allow commercial passenger aircraft landing or departing on Runway 17-35 to taxi without restriction to and from the terminal area. Additionally, a south EAT would provide access to the L Deice Pad without requiring runway crossings. Initial analysis of EAT placement and function indicated that an EAT placed on the north end of Runway 16L-34R would not be justified when considering the future extension of the runway to 14,500 feet. At that length, aircraft landing Runway 35 or departing Runway 17 would require roughly the same amount of taxi distance to the terminal using a north EAT as they would using a south EAT. For that reason, a north EAT was eliminated from further consideration.

A south EAT was brought forward in the study for further analysis. Additionally, the option of shifting Runway 16L-34R to north to allow similar traffic flow benefits as provided by a south EAT was explored. However, it was determined that option would be highly impractical, if not infeasible, as it creates numerous issues. To provide independent taxi and runway operations, the runway complex would need to be shifted more than 2,500 feet to the north. This would create airspace conflicts with the south deice

pads and adjacent buildings, dramatically increase cumulative taxi time to the Runway 16L threshold for departures and require changes to the airspace procedures at the airport which may not be feasible. Additionally, the shift of the runway north would place it into wetland areas and closer to Great Salt Lake, increasing environmental impacts. For these reasons, that option was discarded, and final analysis was focused entirely on a south EAT (SEAT) designed to conventional FAA standards.

The design intent of the SEAT was to provide fully independent taxi and runway operations in all weather conditions. This requires the SEAT be designed to ensure the tail of the design aircraft does not penetrate TERPS surfaces, approach surfaces for Runway 34R, and the departure surface and one-engine-inoperative (OEI) surface for Runway 16L. It was determined that the SEAT should be designed to accommodate ADG III aircraft (as well as Boeing 757 aircraft which are ADG IV aircraft with tail heights just over 45 feet). Accommodating larger aircraft tail heights requires the SEAT to be placed further to the south, which increases overall taxi time. In examining historical data, it was found only a few ADG V aircraft or larger ADG IV aircraft transition between the terminal area and Runway 17-35 (or the GA area) per year. Thus, accommodating up to ADG III commercial passenger aircraft provides the maximum needed flexibility for unrestricted operations. That said, design of the pavement to accommodate the Airport's ADG V design aircraft is recommended by the Airport staff to provide flexibility for those aircraft to operate on the SEAT, albeit with restricted runway operations. The proposed concept is illustrated in **Figure 4-10**.

FIGURE 4-10
SOUTH END AROUND TAXIWAY ALTERNATIVE



Source: SLCDA, RS&H Analysis, 2020

Two options were brought forward for final evaluation. A "do-nothing" option, and the option that proposes implementation of the SEAT as described. Specific evaluation criteria were developed for this analysis. Each are described below along with a summary of how each alternative performed. Review of the alternatives with SLC management resulted in the option that implements the SEAT as the preferred alternative. **Table 4-7** visually summarizes the evaluation and conclusions of SLC management and the planning team.

Evaluation Criteria and Assessment:

» Safety: How does the option work to provide a safe operating environment?
- The do-nothing option maintains the status quo and requires crossings of Runway 16L-34R in all weather conditions and during peak hours. Crossing a runway is not an unsafe practice. However, reducing runway crossings reduces chances of runway incursion.
- The SEAT dramatically reduces runway crossings on Runway 16L-34R. In practical application, some crossings will still be conducted during off-peak times when use of the SEAT is not needed. However, during peak hours and weather events requiring deicing operations, the SEAT can eliminate the need to cross Runway 16L-34R.
- Analysis of average day peak month operations indicated roughly 85 daily crossings in 2018 and up to 165 daily crossings in PAL 3 could be eliminated with use of a SEAT. Respectively, this equates to roughly 27,000 annual crossings in 2018, and 55,000 annual crossings by PAL 3.

» Efficiency: How does the option increase operational efficiency?
- The SEAT allows ATCT controllers to reduce radio communications and workload, thereby minimizing chances for miscommunication between aircraft taxiing between the terminal area and the east runway. Taxi operations will not require coordination with runway operations. Additionally, a streamlined process of taxi operation can be developed using the SEAT which can reduce the need for ATCT ground control to monitor and guide aircraft over extended periods of time.

» Delay Impacts: Does the option work to decrease delay?
- Viewed holistically as part of the SLC airport and its integration into the NAS, the SEAT will provide enhanced "gate-to-gate" performance. It works well to reduce potential taxi delays which creates more predictable operational outcomes for aircraft on the ground and in the air.

» Land Use and Wetland Impacts: Does the option make good use of future land areas and are there wetland impacts?
- The area required to build the SEAT consists of previously disturbed land, portions of the abandoned golf course, and the canal system that circulates portions of the airport. The highest and best use of this land is to serve airport operations, and the SEAT in this location is a highly qualified use. Minimal wetland areas exist, besides those related to the

canal. As compared to the option of moving the runway complex to the north, which is unviable, the SEAT has minimal environmental impacts and land use constraints.

» Cost Factors: Qualitatively, what are the cost factors of the option and is it feasible?
- The cost of implementing the SEAT can be weighed first by its ability to increase efficiency, and second by fuel savings from decreased taxi time. The latter is difficult to quantify due to the dynamic nature of ground operations and decision making by pilots and ATC controllers. However, qualitative estimates of the SEAT's ability to provide free flow taxi operations and enhance gate-to-gate performance indicate potential for a positive rate of return on investment to construct and maintain.

While the current condition requiring runway crossings for aircraft transitioning between the terminal and Runway 17-35 is a safe, common-place operation, minimizing runway crossings is beneficial as it reduces the chance for runway incursion. During peak times when radio communication is the highest and planes are positioning for departure and/or landing, the SEAT alleviates otherwise necessary coordination of taxi operations with runway operations. This helps to streamline operations at the airport which, in turn, reduces risks of miscommunication, pilot deviations, and runway incursions.

Overall, the safety enhancements and efficiencies gained with a SEAT support carrying forward the option with recommendation for near-term implementation.

TABLE 4-7
SOUTH END AROUND TAXIWAY EVALUATION

Criteria	Alternative 1 Do Nothing	Alternative 2 SEAT
Safety - Runway Crossings		
Operational Efficiency		
Delay Impacts		
Land and Wetland Impacts		
Cost Factors		

Performance Legend

Good | Fair | Poor

4.4 AIRFIELD ENHANCEMENTS

This section describes other airfield enhancements brought forward in this master plan including future deicing pads, highspeed taxiways, parallel taxiways, and removal of pavements to correct for non-standard conditions. The configuration, shown in **Figure 4-11**, builds on the alternatives described to this point, and incorporates the south end around taxiway, Runway 16L-34R extension, and the removal of Runway 14-32. Also shown is the ultimate relocation for 2100 N and N 4000 W roadways. A relocation of 2100 N is required to accommodate the extension of Runway 16L-34R. The ultimate concept places 2100 N on the northern perimeter of Airport property adjacent to the power lines and has connection to the development west of the Airport. The roadway would conceivably be the northern limit of Airport development. The relocation of N 4000 W was originally proposed in previous studies, and as determined in the cargo analysis described in **Section 4.6**, was validated for its benefit in allowing future cargo expansion.

4.4.1 New and Removed Taxiways

New taxiways were required to support the preferred alternatives identified in this study, as well as to replace taxiways that require removal to meet FAA standards. Additionally, the crossfield Taxiways U and V were carried forward from the existing ALP. The placement of those taxiways was validated through analysis of future requirements for concourse and cargo expansion. The following bullets detail the considerations for the other taxiway improvements.

- A full length inboard parallel taxiway for Runway 16L-34R, extending north from the L Deice Pad, was incorporated for future implementation. This taxiway, Taxiway L, will serve multiple functions including allowing aircraft deiced on L Deice Pad to taxi to Runway 17 or Runway 16L without a runway crossing. It also will provide additional flexibility and connection for aircraft transferring between the terminal area and Runway 17.
- Taxiway Q serves as a third option for crossing aircraft between the terminal area and the east side facilities. However, Taxiway Q intersects Runway 17-35 in the middle of the runway's high energy zone which contradicts FAA design standards and must be remedied. FAA ATCT controllers noted a need to keep the functionality of Taxiway Q as a third crossfield option. The solution identified includes removing Taxiway Q and adding a new crossfield connection to the south, outside the runway's high energy zone.
- Highspeed exits K5 and H6 were identified for future removal. The configuration of Taxiway K5 creates a wide expanse of pavement on Runway 17-35, does not meet highspeed taxiway geometry standards, and is not optimally positioned to serve the corporate jet fleet landing Runway 17. As such, it is recommended for removal with a replacement highspeed K5 to be built to the south to also replace K4.

  H6 creates a wide expanse of pavement on the Runway 16L-34R where it meets H5 and H4. Of the three taxiway exits in that location, H6 was identified as not required as it does not serve the

exit needs of the commercial fleet landing on Runway 34R. In effort to simplify the area and reduce the expanse of pavement next to the runway, H6 is recommended for removal.

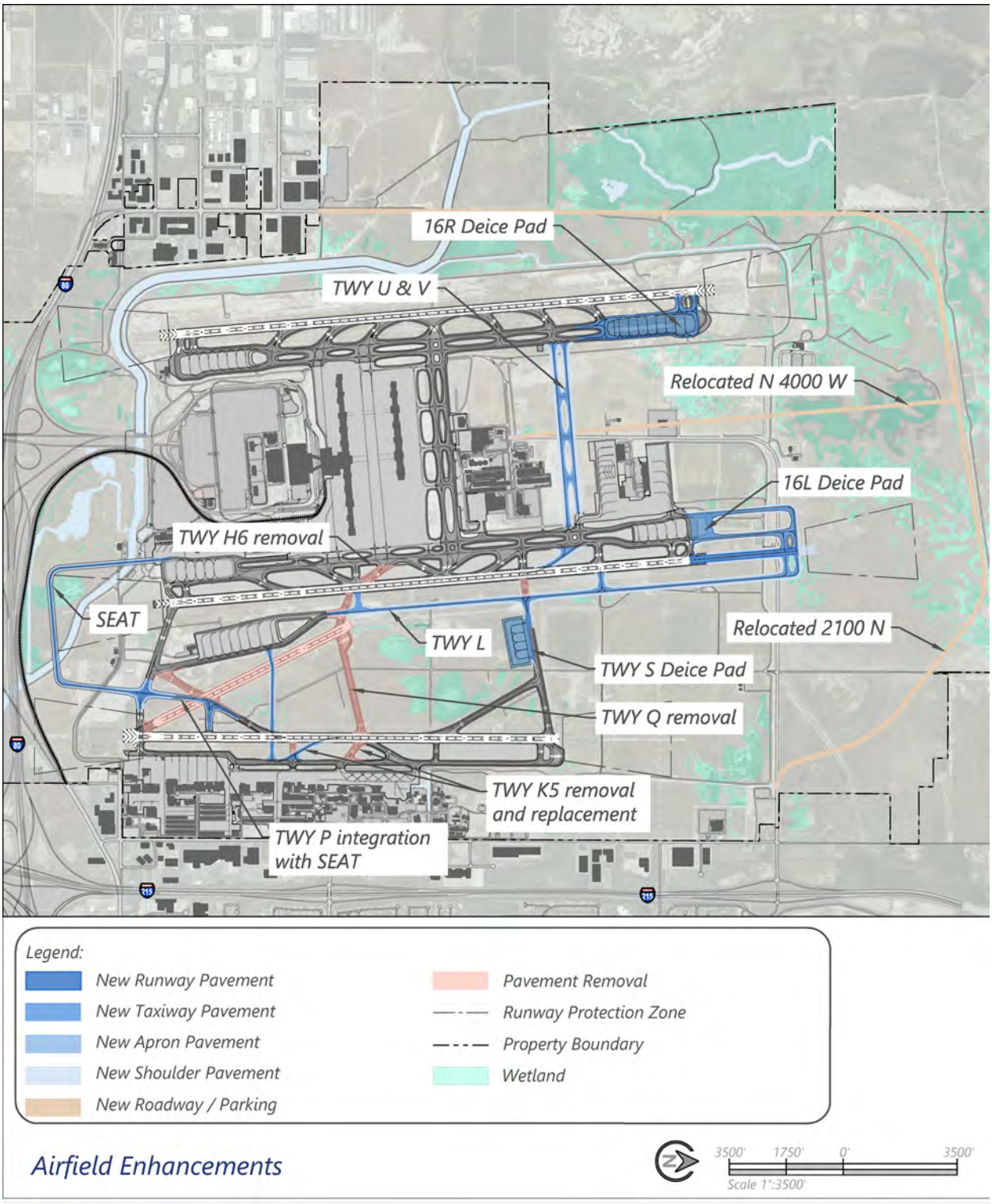
- One new highspeed exit is recommended on Runway 16L-34R, between H10 and H11. This highspeed would feed into the new Taxiway U and V crossfield connectors. The highspeed exit usage on Runway 16L-34R is expected to change slightly with the new terminal configuration coming on-line. When the runway is extended, major shifts in usage can be expected, and runway exits may need to be modified to ensure that runway occupancy time (ROT) is optimal. It is recommended that prior to implementation of the runway extension, a comprehensive study be conducted to determine potential impacts and new requirements for runway exits to support the extension.
- The intersection of the SEAT with Taxiway M was vetted by ATCT controllers and SLCDA airport management. The location was found to balance access to Runway 35 and the L Deice Pad. Additionally, the location provides opportunity to directly tie Taxiway P into the SEAT. For this purpose, the portion of Taxiway P on the west side of Runway 14-32 will be removed, which will reduce the chance pilots might miss the connection to the SEAT.

4.4.2 Deicing Facilities

Through discussions with SLC management, deicing improvements and future facilities were identified to be carried forward on the airport layout plan and implementation plan. The conclusions brought forward in this study are as follows:

- Deice truck refill and deice personnel facilities are needed at the 16L Deice Pad to ensure that pad can remain operational through extended deice operations. These facilities are recommended for implementation as soon as possible.
- A new eight-position runway-end deice pad will be planned for Runway 16R.
- An expansion to the 16L Deice Pad of two positions will be planned for implementation when Runway 16L-34R is extended.
- A new five position deice pad between Runway 16L-34R and the Runway 17 threshold will be reserved along Taxiway S. The previous ALP depicted this facility on the north side of Taxiway S. This study found benefit in placing the new pad on the south side of Taxiway S to maximize the land available for other uses on the north side of the taxiway.
- The runway-end deice pads serving Runway 16L-34R were considered for relocation to the west to allow greater separation between Runway 16L-34R and Taxiway H. As noted in the facility requirements, current separation between the runway and the stretches of Taxiway H adjacent the deice pads is such that there are taxi restrictions on Taxiway H when ADG V aircraft are landing in low visibility conditions. These events are rare, and taxiway impacts were deemed to be insignificant. Thus, the deice pads are planned to remain in their current location.

FIGURE 4-11
AIRFIELD ENHANCEMENTS



Source: RS&H, 2020

4.5 TERMINAL CONCOURSE EXPANSION ALTERNATIVES

The evaluation of terminal concourse expansion was needed to determine the maximum footprint that should be reserved for passenger terminal facilities though the planning period and beyond. Spacing for future concourses ultimately determines where Taxiway U and Taxiway V, future crossfield taxiway connectors, should be located.

The planning team and Airport management identified the following planning parameters used for this analysis:

- SLCIA will not plan for a second terminal processor on the north side of the airport. Land use analysis determined that terminal landside functions would expand to the south and terminal airside functions would extend north.
- Future Concourse C and Concourse D would represent maximum build out. The balanced airfield analysis determined the airfield may not be able to ever support operations related to building out of Concourse D. However, that is based on current operational characteristics. Thus, for ultimate planning purposes, planning for a Concourse D was considered, but with the understanding that other facilities with a useful life of roughly 50 years could be built within its footprint.
- The crossfield circulation provided today by Taxiway E and Taxiway F must be maintained. The circulation can be provided via taxilane, but unimpeded flow from push back operations was deemed vital.

The intent of the alternatives exercise was not to determine one preferred layout, but rather to understand the room required to develop flexible options. Concourse layout alternatives were developed using spacing suggested in the 2013 *Program Validation & Preliminary Planning Update*, and 2017 *NCP Program and Preliminary Planning Update* developed by HOK. Those alternatives aided in understanding the limits of full Concourse D buildout, and a refined ultimate alternative was identified. The alternatives and key takeaways from the analysis are described below.

Concourse Alternative 1 - Spacing from 2013 Program and Preliminary Planning Update

The 2013 *Program Validation & Preliminary Planning Update* document reflects concourse spacing that Airport management initially intended to apply between Concourse A and Concourse B. That spacing was later valued engineered to a different standard, but the initial design incorporated dedicated push back areas that allow unimpeded flow of aircraft on the parallel taxilanes. Specifically, the initial design allows taxi and apron depth for ADG V aircraft on one side and ADG IV variants on the other side of each corridor. Dedicated push back area was sized to allow all ADG III (and some ADG IV) on the ADG IV side, and for all ADG IV (and some ADG V) on the ADG V side.

Figure 4-12 illustrates an alternative that applies the 2013 spacing between Concourses B and C, and Concourses C and D. Appling this spacing between concourses proved the currently planned positioning of Taxiway U and V could remain unchanged. However, it was found that the north side of Concourse D would be limited to only ADG III aircraft but would have the ability to have some dedicated push back area adjacent to the ADG III taxilane.

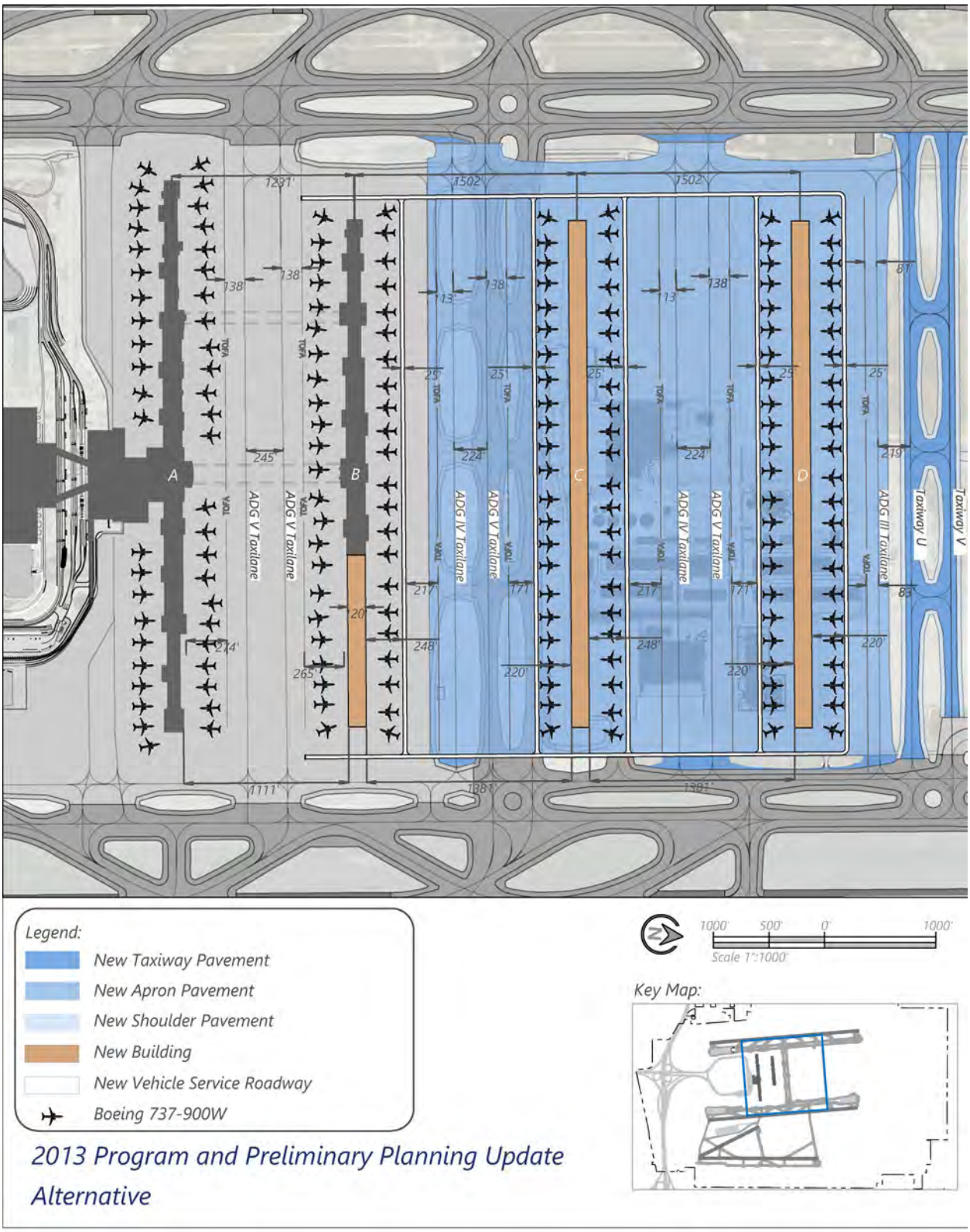
Advantages found in this alternative include:

- Unimplemented crossflow functionality of Taxiway E and F is maintained, albeit taxiway connection to the parallel runways and taxiway complexes would require modification.
- All future concourses have flexibility to serve aircraft in size up to ADG V.
- Location of Taxiway U and V do not require a future siting to the north which would infringe upon the cargo area.
- Dedicated pushback area is provided for all new concourses.
- Although ADG IV aircraft may become less frequent in commercial use, planning for such provides additional flexibility for wider spans.

Disadvantages found in this alternative include:

- The north side of Concourse D is limited to only ADG III aircraft and depending on final design, may not have enough dedicated pushback area for all ADG III aircraft variants.
- Although not a disadvantage, it was recognized that planning for dedicated push back between Concourse C and D may be deemed by some to be excessive. Airlines are using value engineered solutions, such as what was applied between Concourse A and B, successfully today and that trend may continue.

FIGURE 4-12
2013 PROGRAM AND PRELIMINARY PLANNING UPDATE ALTERNATIVE



Source: SLCDA; RS&H Analysis, 2020

Concourse Alternative 2 – Spacing from 2017 Program and Preliminary Planning Update

The 2017 *Program and Preliminary Planning Update* document defined the final layout between Concourses A and B and included a spacing concept between Concourse B and Concourse C (or what was then defined within that document as the "North-North Concourse"). That spacing was intended to keep Taxiway E and Taxiway F fully intact as independent taxiways. This master plan concept uses that spacing, and the spacing chosen between Concourses A and B was used between Concourses C and D.

As can be seen in **Figure 4-13,** the alternative proved that Concourses C and D can fit within the future terminal envelope without requiring Taxiway U and V to be moved. This was achieved with similar spacing applied between Concourses C and D, as is used between Concourses A and B. Additionally, the north side of Concourse D would be restricted to ADG III aircraft and push back would be onto the taxilane. Lastly, by keeping Taxiways E and F, parallel taxilanes are needed north of Concourse B and south of Concourse C.

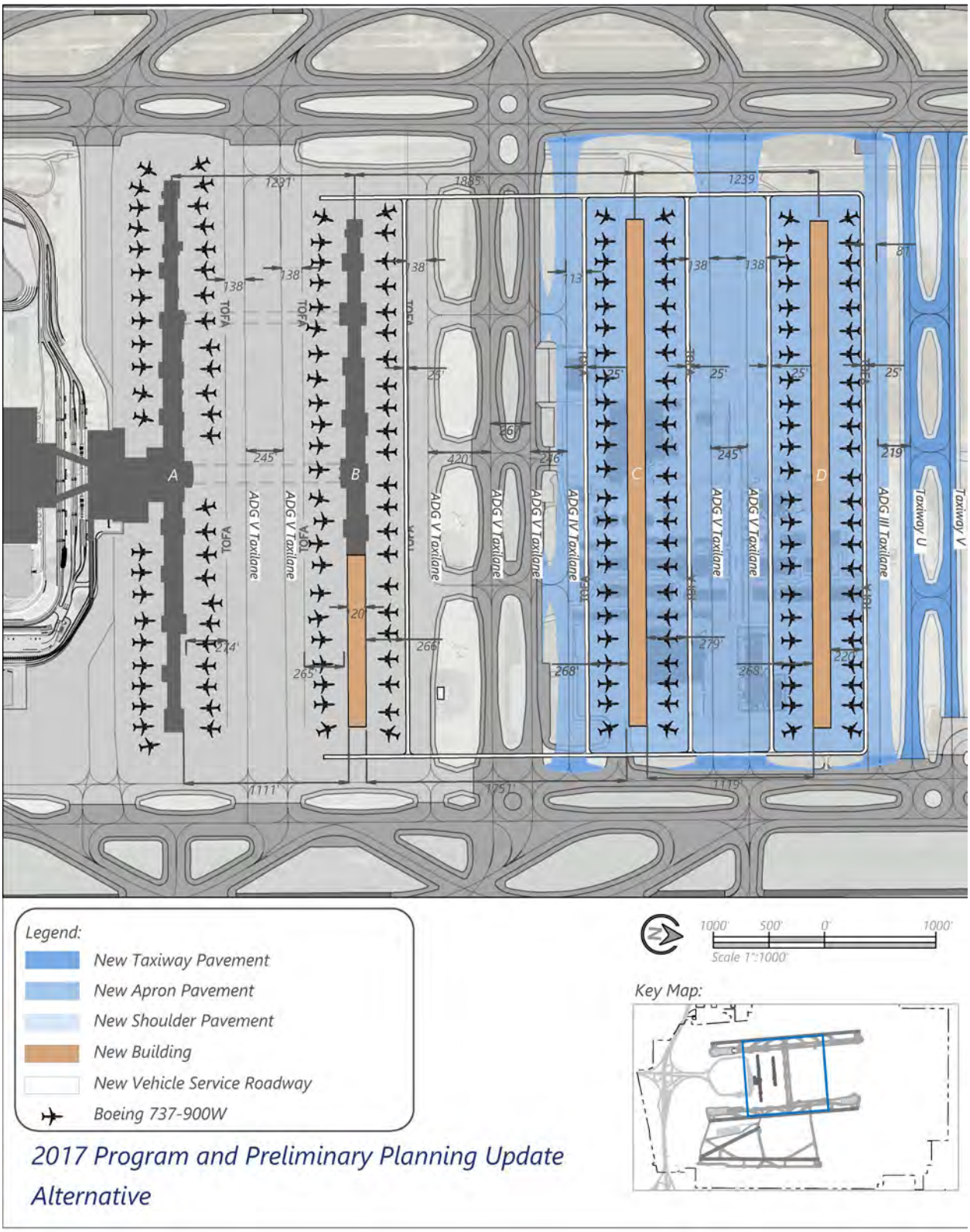
Advantages found in this alternative include:

- Unimplemented cross flow functionality of Taxiway E and F is maintained.
- Location of Taxiway U and V do not require a future siting to the north which would infringe upon the cargo area.
- Dedicated pushback area is provided between Concourse B and C.
- Though ADG IV aircraft may become less frequent in commercial use, planning for such provides additional flexibility for wider spans.

Disadvantages found in this alternative include:

- The north side of Concourse D is limited to only ADG III aircraft and no push back area is provided.
- Apron depth on the north side of Concourse C and south side of Concourse D is less than that proposed in the 2013 layout.
- By placing Concourse C to the north such that Taxiway E and F remain untouched, additional automated people mover (APM) structure will be needed which increases cost and passenger connection times between concourses.
- Concourse C location is pushed further into the north support facility area, requiring more infrastructure relocation than if it was sited further south.
- The layout of taxiways and taxilanes between Concourses B and C is not an efficient use of space. Aircraft must push back onto taxilanes and taxi to connectors to access the east/west taxiways.

FIGURE 4-13
2017 PROGRAM AND PRELIMINARY PLANNING UPDATE ALTERNATIVE

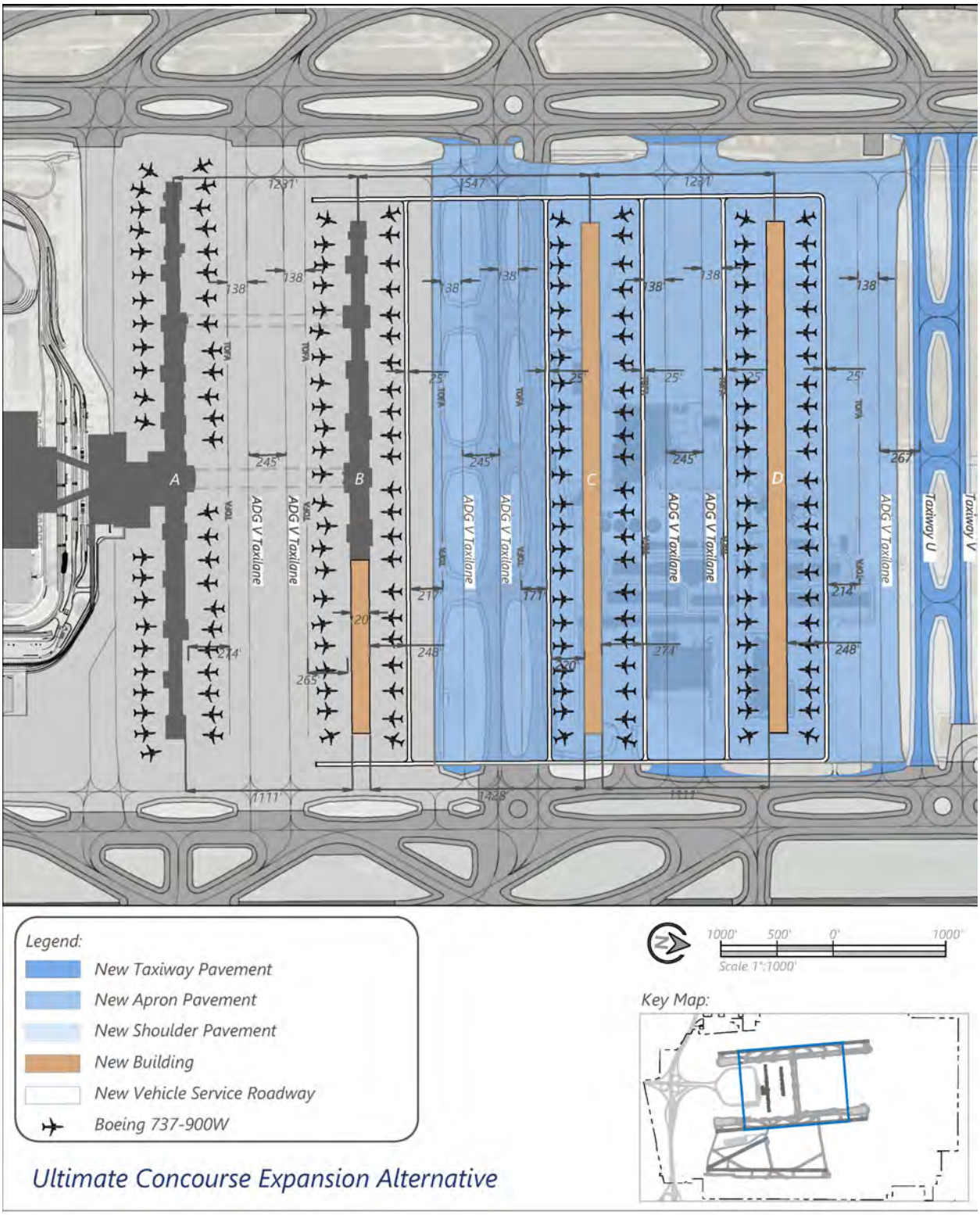


Source: SLCDA; RS&H Analysis, 2020

Ultimate Concourse Alternative

Through evaluation of Alternatives 1 and 2 and discussions with Airport management, additional parameters were defined for a final preferred alternative. It was determined that Taxiway U and Taxiway V should remain in their currently planned future location. That location provides an adequate envelope for future and ultimate terminal concourse build out. Airport management expressed the desire to ensure both north and south sides of every future concourse could accept up to ADG V aircraft. It was also noted that the spacing between Concourses A and B would be acceptable between Concourses C and D. These parameters are reflected in the Ultimate Concourse Alternative illustrated in **Figure 4-14.**

FIGURE 4-14
ULTIMATE CONCOURSE EXPANSION ALTERNATIVE



Source: SLCDA; RS&H Analysis, 2020

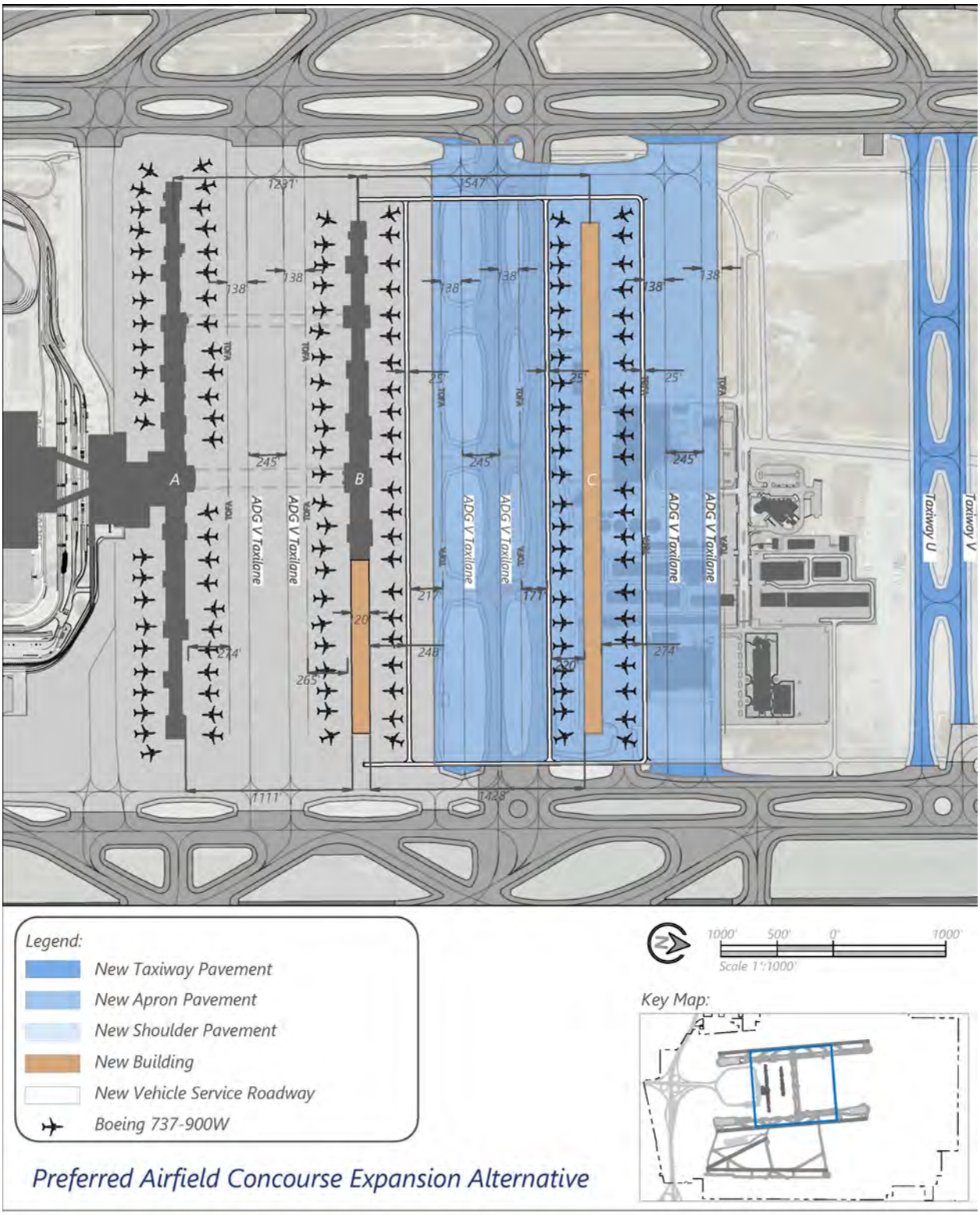
Preferred Airfield Concourse Alternative

The balanced airfield analysis indicated SLC will reach peak, or slightly beyond peak capacity, at roughly 1,800 daily operations. The analysis indicated that level of operations would equate to a gate requirement of roughly half that of Concourse C. It is expected that Concourse B will serve demand through and beyond PAL 3, and that a portion of Concourse C may be needed immediately beyond this study's planning period. Thus, the need for Concourse D is well beyond PAL 3 and may never be realized due to existing airspace limitations of the Salt Lake City valley.

A balance between long-range land preservation and facility relocation must be matched with a pragmatic estimation of future growth. With this in mind, only Concourse C is being brought forward as a future condition. The open land area within the Concourse D footprint can be developed with an understanding that most buildings have no more than a 50-year useful life and could be demolished and relocated if ever a Concourse D is needed.

Figure 4-15 illustrates the Preferred Airfield Concourse Alternative. The alternative informs what facilities will need to be relocated to accommodate a full build out of Concourse C.

FIGURE 4-15
PREFERRED AIRFIELD CONCOURSE EXPANSION ALTERNATIVE



Source: SLCDA; RS&H Analysis, 2020

4.6 NORTH AIR CARGO ALTERNATIVES

The facility requirements analysis determined existing operators in the north cargo area will require expansion of their facilities within the planning period. Additionally, e-commerce driven cargo operations were recognized as potentially requiring significant land area for future air cargo facility development.

The alternatives analysis for the north cargo facilities includes consideration of the expansion needs of existing operators within the planning period, as well as land requirements necessary to accommodate future large-scale facilities. A site analysis was conducted to validate the location of the north cargo campus and determine if it fits the Airport's long-term vision. Areas depicted in **Figure 4-16** were assessed and vetted with Airport staff and stakeholders. Sites 2 and 3 flank the existing cargo area, and either would allow cargo to expand into the site. Sites 1 and 4 are proposed as greenfield developments where all cargo operations would eventually be relocated.

An evaluation of the development sites was conducted against set evaluation criteria. **Table 4-8** illustrates the conclusions of the evaluation. The evaluation criteria developed for this analysis are described below along with a summary of how each site performed.

Evaluation Criteria and Assessment:

- Operational efficiency: How well can efficiency for cargo operations be maintained at each site?
  - The existing cargo area, and Sites 2 and 3 are centered between the parallel runways, which allows the shortest taxi to either runway. This is ideal as taxi times are minimized.
  - Sites 1 and 4 flank one of the two parallel runways. Thus, depending on traffic flows, aircraft may require further taxi to/from the opposite side of the airfield. Site 4 has an advantage over Site 1 as it sits between Runway 16L-34R and 17-35.
- Flexibility and expansion potential: Does the site provide room to grow and flexibility to accommodate different/multiple cargo operators?
  - Sites 2 and 3 offer the ability for cargo to expand in place. Independently, each site is limited when compared to the other sites. Together, however, they provide room for expansion by existing operators and can provide space for a large-scale cargo facility.
  - Sites 1 and 4 both offer ample area for future expansion.
- Financial feasibility: Is development in the site feasible when considering investment requirements?
  - Sites 1 and 4 both lack taxiway access to the runways and would incur significantly higher development costs.
  - Development in Site 1 would entail a very large investment due to the wetland mitigation, utility infrastructure, roadway, and taxiway connections required. Site 2 shares these financial implications though they are estimated to be at a lesser degree.
  - Development in Sites 2 and 3 is the least costly because utility, roadway, and taxiway infrastructure is already in place.
- Environmental/sustainability: What implications does development in the site have related to environmental impacts and long-term sustainability?
  - Sites 2 and 3 are near to, and can be tied into, the existing glycol recovery system.

  - Site 1 is in an area extensively occupied by wetlands.
  - Sites 1 and 4 may require greater taxi distances for aircraft arriving and departing depending on runway use, which would correlate to higher emission outputs.

» Ease of implementation: Can the site be ready for development in the near-term or are multiple enabling projects required?
  - Site 2 and most of Site 3 are relatively build-ready.
  - Sites 1 and 4 both lack taxiway access to the runway end and would require extensive taxiway development.
  - Site 1 would require multiple phases of enabling projects, including extensive environmental mitigation and assessment.
  - Site 4 also would require multiple phases of enabling projects.

» Meets near/long-term requirements: Will the site meet today's need and satisfy future spatial requirements?
  - Sites 2 and 3 can meet near-term requirements, but independently they fail to meet long-term requirements. Combined, they meet long-term requirements.
  - Sites 1 and 4 meet long-term requirements but fail to meet near-term expansion requirements due to the lead time required for the site to be ready to accommodate cargo operations.

Overall, Site 4 was found to provide no more benefit than the current location. Site 1, while closer to the Salt Lake City Inland Port and the ground cargo operations located in that vicinity, was found to have sizable implementation challenges. Wetlands impacts, taxiway infrastructure, Surplus Canal, and roadway access all posed challenges beyond the potential benefit offered by the location. As such, the option was discarded. Sites 2 and 3 were both carried forward, as it was determined both sites should be preserved for long-term cargo development.

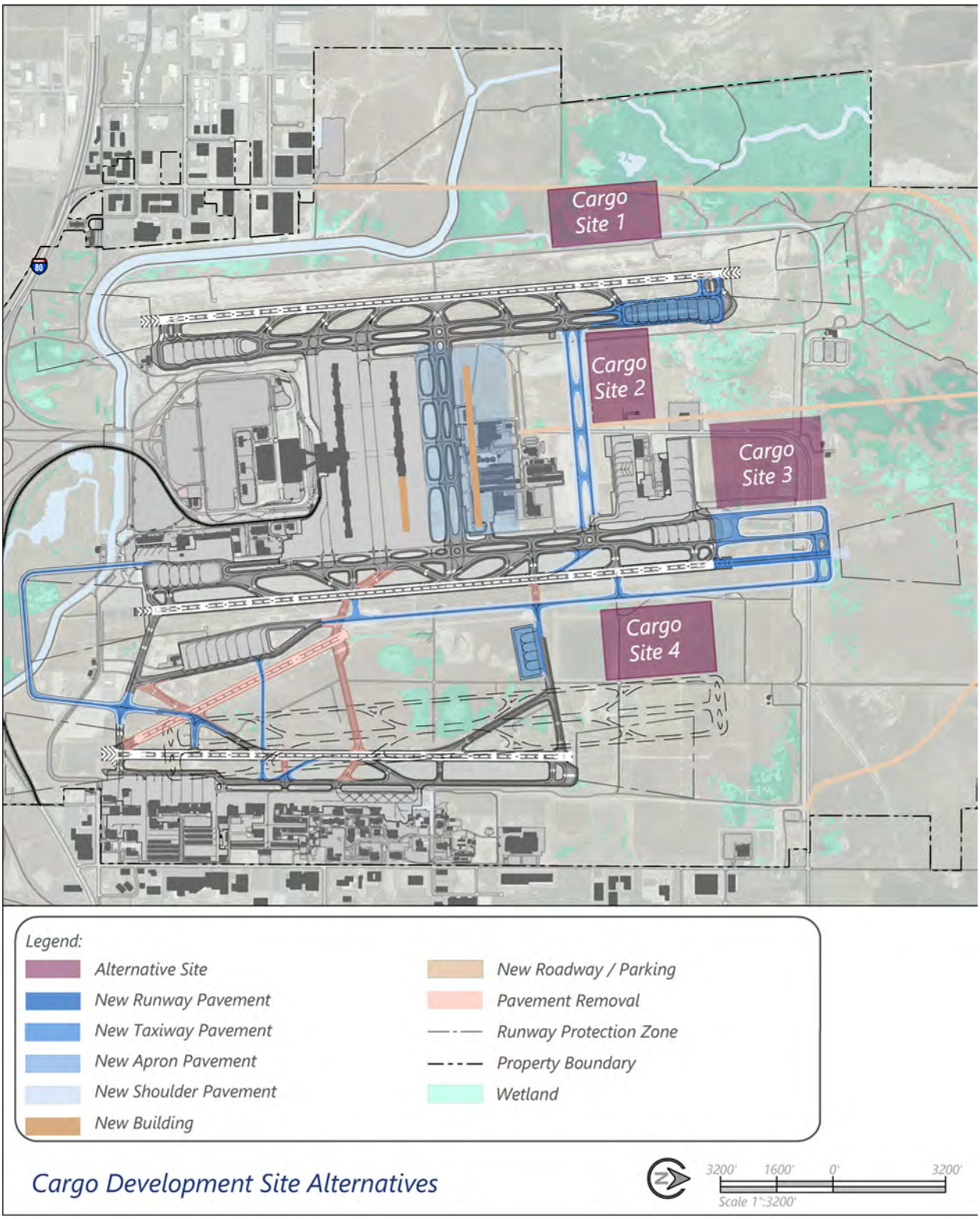
TABLE 4-8
NORTH AIR CARGO EVALUATION

Criteria	Site 1	Site 2	Site 3	Site 4
Operational efficiency				
Flexibility and expansion potential				
Financial feasibility				
Environmental/sustainability				
Ease of implementation				
Meets near/long-term requirements				

Performance Legend

Good **Fair** **Poor**

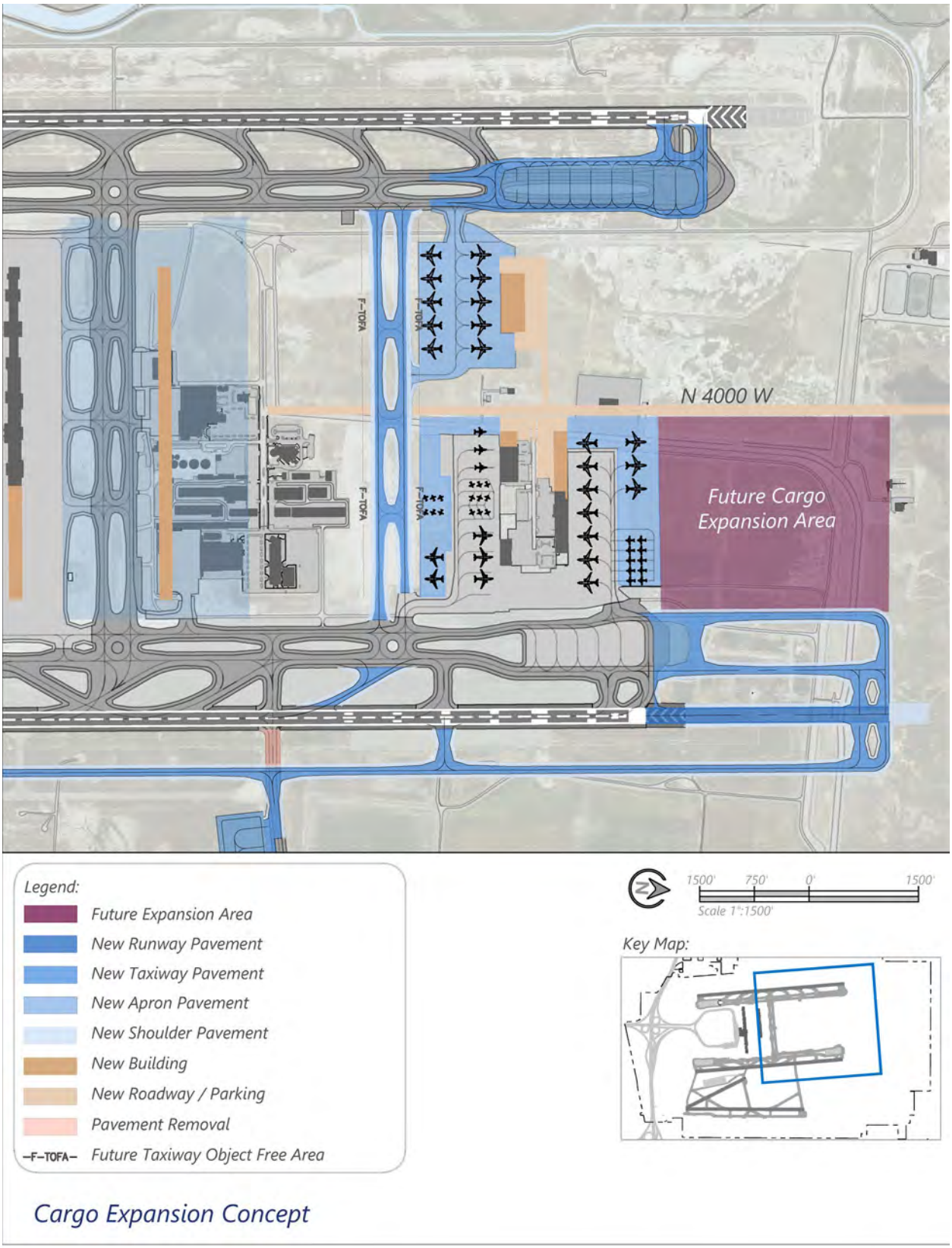
FIGURE 4-16
CARGO SITE ALTERNATIVES



Source: SLCDA; RS&H Analysis, 2020

Spatial programming analysis determined the existing cargo area has enough room to accommodate future expansion needs of current operators. This assumes the apron would be expanded to the north and south and vehicle parking and maneuvering areas would be reconfigured. However, it was determined the cargo area must also be able to expand to the west of the area to ensure improvements are efficient and not cramped. This requires relocation of 4000 W to the west. **Figure 4-17** illustrates an expansion concept including expansion of the existing north cargo facilities, the relocation of 4000 W to the west, and a potential layout for future cargo development on the west side of the area. The north side of the area is preserved for additional future expansion or a new large-scale facility.

FIGURE 4-17
CARGO EXPANSION CONCEPT



Source: SLCDA; RS&H Analysis, 2020

4.7 LANDSIDE ALTERNATIVES

This section describes alternatives generated to address the Airport's landside needs over the planning period. These alternatives were developed according to landside planning objectives and guiding principles determined and refined with input from SLCDA and key stakeholders. The alternatives development process also considered airport highest and best land uses, facility function and intent, and a series of constraining factors such as geography, environmental impact, and FAA airfield design guidance. After considering a variety of concepts to address facility requirements for each specific landside facility, two comprehensive alternatives were developed and evaluated. This section describes that process and the resulting preferred comprehensive landside development plan.

4.7.1 Landside Planning Objectives and Guiding Principles

The landside system consists of trailing planning elements, whose location is driven by the orientation and design of the terminal building, as well as other physical and environmental constraints. The landside facility requirements analysis focused on meeting customer level of service standards established by the Airport and stakeholders during the planning process. That analysis determined a need to provide additional space for public parking, rental car facilities, and employee parking.

Secondary issues to be addressed through landside alternatives development include facility organization and design improvements that meet safety, efficiency, and overall customer ease of use. Airport terminal curb roadways were analyzed and determined to be adequate to serve vehicular demand over the planning period.

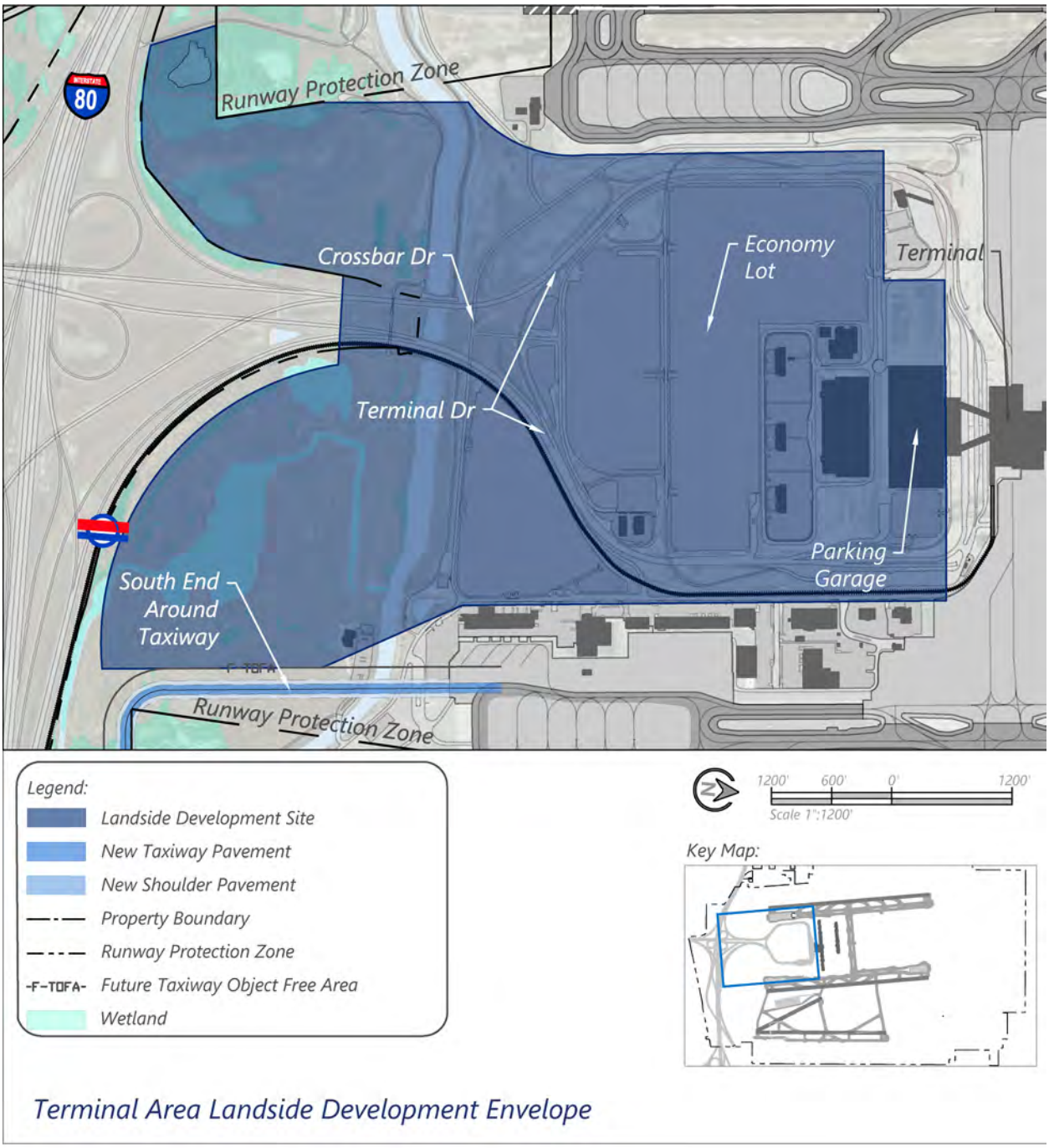
The SLC landside area is land constrained and fits within a defined envelope bounded by the terminal building, I-80, and the two surrounding runways and adjacent aeronautical land uses (shown in **Figure 4-18**). The Airport Redevelopment Plan includes a new terminal and supporting landside elements which fit within this same envelope. The organization of the landside elements was developed approximately 20 years ago in the preliminary planning for what became the ARP. The landside envelope is largely filled with the Terminal Drive loop which surrounds an infield containing most public landside elements. A band of service roadways (Crossbar, 3700 West, et al.) provides a secondary network of interconnections mainly for use by employees and contractors. This overall existing landside system was based on certain landside planning principles developed during the early planning for the ARP. Those planning principles were reconfirmed in this effort, as they remain relevant to guiding the landside development over the planning period. The landside planning principles are as follows:

- Provide a common approach experience to all landside destinations.
- Keep all terminal-related traffic on the right of the airport entry roadway.
- Keep all parking and rental car traffic on the left of the airport entry roadway.
- Provide an intuitive wayfinding system with visual cues for confirmation.
- Create binary choices at all decision points.
- Provide safe decision and maneuvering distances between sequential decision points.
- Avoid bypass traffic on any terminal curb roadway.
- Keep highest value landside functions closest to the terminal building.
- Minimize walking distances for the greatest number of passengers/customers.

- Provide a simple range of public parking options that provide the highest level of customer service and the maximum net revenue.
- Minimize parking shuttle circulation distance, time, and cost.
- Keep service vehicle traffic on independent roadways.

The SLCIA landside is organized in a way that already fulfills many of these principles. This helped provide a solid starting point for developing concepts to correct areas of deficiency and enhance landside functions already performing well.

FIGURE 4-18
TERMINAL AREA LANDSIDE DEVELOPMENT ENVELOPE



Source: SLCDA; RS&H Analysis, 2020

4.7.2 2100 North Roadway Realignment

Access to the North Support Area of the Airport is provided by 2100 North, via Interchange 25 on I-215. A mile west of 2200 West, 2100 North passes through the RPZ for Runway 16L-34R. The airfield alternatives analysis indicates that this runway could be extended to the north across the existing roadway,

necessitating the roadway realignment. The roadway realignment must stay out of the future RPZ of the extended runway, and its alignment should be set to best serve the evolving land uses in the North Support Area, particularly the expansion of cargo facilities.

Today, approximately 1.7 miles to the west of Interchange 25, 2100 North transitions to 4000 West at a large radius horizontal curve. To connect the realigned 2100 North with 4000 West opens the question as to whether to keep 4000 West in its current north-south alignment, or whether to modify it to be parallel to the runways. A realignment to be parallel to the runways and extend out to the realigned 2100 North would likely incur greater impacts on the existing wetlands than would simply extending it on its current alignment but aligning the road with the runways does have the advantage of creating better parcel uniformity in the North Support Area. Either alignment of 4000 West works with the proposed realignment of the east-west roadway and can be accommodated in this plan if the environmental issues are not constraining. The only change would be the location of the horizontal curve that would join the two perpendicular roads. Ultimately, determination of a preferred roadway realignment is dependent upon a combination of the previously mentioned considerations and a final preferred land use plan for the northern area of the airport. The final preferred roadway realignment is represented on the Airport Layout Plan.

4.7.3 Employee Parking

While there are scattered employee parking lots contiguous with various employment sites around the Airport, the bulk of employee parking is provided in two lots at the terminal campus. These two lots accommodate Airport and tenant employees working in the SLCIA terminal area. According to landside planning principles, which desire to keep the highest revenue generating and valued land uses closest to the terminal and provide the highest level of customer service to passengers, the location of employee parking should not take precedence over customer-oriented facilities in the passenger terminal area. Therefore, it is best to locate employee parking as close and operationally efficient to the terminal as possible without disrupting or displacing customer-focused services. The distance of employee parking from the terminal at SLC necessitates shuttling operations for terminal area employees.

Terminal area employees are categorized as primarily working in either the non-secure area or the secure area. While employees can, and often do, serve roles in both areas of the terminal, their workday typically begins in a specific location on either the non-secure or secure side and thereby necessitates security screening for only a segment of the employee population entering the terminal and concourses. There are two possible methods that can be used to perform these screening requirements, including:

- Option One - Screen employees requiring secure-side access at a TSA security screening checkpoint (SSCP) in the terminal building.
- Option Two - Screen employees requiring secure-side access at the employee parking lot prior to entering a secure shuttle bus and drop off in a secure location at the terminal or on the ramp.

Screening at the terminal building TSA SSCP for airport and tenant employees is a routine practice and there are already facilities and procedures in place to perform this process. The procedures for screening employees at the employee parking lot would be the same although the equipment may differ. Employees screened prior to entering a secure shuttle bus would remain within the secure bus as it

transitions from the non-secure employee lot through access gates to the secure airside environment to the final secure terminal/apron drop off/pickup destination.

Each employee screening option differs in how it may be implemented through the employee shuttling operation. If screening occurs at a designated terminal building TSA SSCP, secure and non-secure employees can co-mingle on a single shuttle bus from the employee lot until they are dropped off on the non-secure side where only secure-side employees will use the TSA SSCP to enter the sterile area.

When screening occurs at a single shared employee parking lot (secure and nonsecure-side employee), employees must be split between two shuttles, one dedicated to screened employees to be dropped off on the secure-side of the terminal, and one dedicated to unscreened employees to be dropped off on the nonsecure-side of the terminal building. Operational costs do increase when two dedicated shuttles are used, however, designated shuttle buses do allow the Airport to separate non-secure and secure employees into separate parking areas.

Understanding that employee lot location(s) options are dependent upon preferred shuttling operations, a series of alternatives were developed which are flexible enough to implement under any comprehensive landside configuration. The primary differentiators between each analyzed option are vehicle miles traveled (VMT) for shuttling operations, operating cost, and vehicle emissions resulting from the shuttles.

The three operationally feasible alternatives for locating and operating employee parking include:

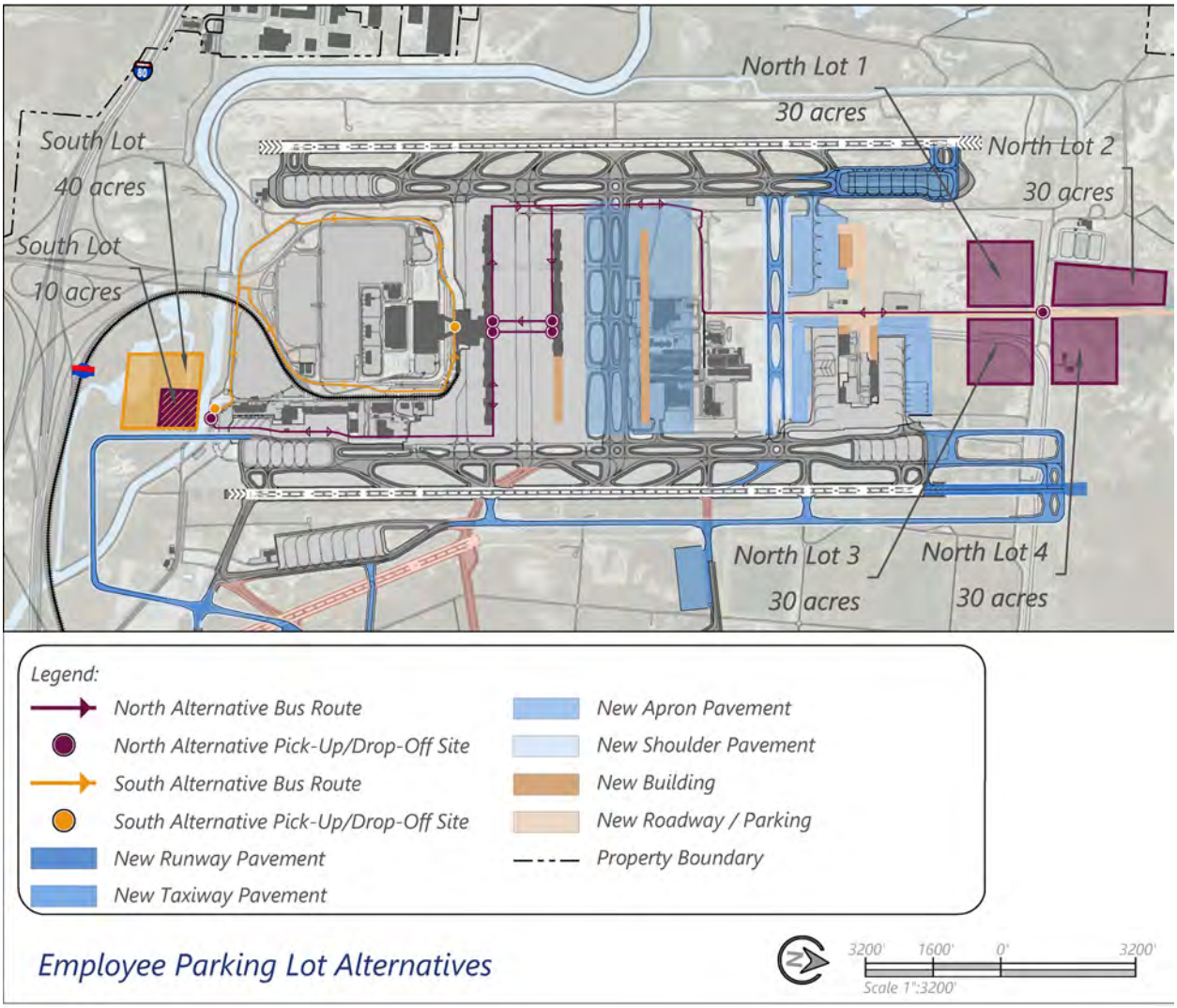
- Single lot south of the terminal complex with one shuttle route to the non-secure side. This is how the employee shuttle has worked historically.
- Single lot south of the terminal complex with two dedicated shuttle routes, one for secure and one for non-secure drop-offs and pickups.
- Segregated secure and non-secure employee parking lots. The south lot would be for non-secure employees to be dropped off and picked up in the non-secure area of the terminal building. The secure employee lot would be located north of the terminal complex and dedicated for secure-side only employees.

A fourth option exists but early analysis showed it would be operationally inefficient. It is possible to create a single lot north of the terminal complex with two dedicated shuttle routes (secure and non-secure), however, this option requires non-secure employees to be unnecessarily screened. This is operationally inefficient and adds unnecessary cost. Therefore, this option was not moved forward as a viable alternative.

Figure 4-19 shows the employee lot location alternatives and the associated shuttle routes for each option. A total of 40 acres will be necessary to meet parking space requirements at 380 square feet per stall. This planning factor accounts for additional parking lot elements such as two-way circulation aisles, lighting, and end-of-aisle space for sightlines, bus stops, safe vehicle movements, and perimeter landscaping.

Only one of the four lots shown in the north area is required to meet space needs over the planning period. In terms of operations, each site is equally as viable as the next with negligible differences in operating cost and efficiency. Selection of a north lot site is dependent upon whether an alternate site has a higher and better land use, the degree of environmental impacts, and by overall cost to implement. Of the four sites, Sites 1 and 3 have the lowest environmental impacts and costs to implement but may well be in locations with higher and better uses over the planning period. Alternatively, Sites 2 and 4 have a lower likelihood of being used for a higher land use but have the highest environmental impact and overall cost to implement.

FIGURE 4-19
EMPLOYEE PARKING AND BUSING ROUTE OPTIONS



Source: RS&H and Curtis Transportation Consulting, 2020
Notes: The sites shown in maroon correlate to the segregated parking option, with the secure lot on the north side of the airport, and non-secure lot on the south side. The 10-acre south lot combined with one of the north lot site options will meet the 40-acre parking requirement.

To evaluate the employee parking alternatives, certain logical planning assumptions were built into the analysis. For the north area, it is assumed that:

- 75 percent of employees require security screening and would therefore park in the North Lot. This means that 30 acres, accommodating approximately 3,400 spaces (PAL 3), would be required.
- All secure-side employees will be screened at the lot prior to riding the sterile shuttle bus to the terminal.
- The busing route for secure-side employees follows 4000 West to the west airside access gate or the closest airport service road on the airfield via a new secure access point. For the 4000 West route, this gate is positioned to best serve the terminal and mid-field portions of the concourses where employees will be dropped off/picked up.

For the south area, it is assumed that:

- If all employees (secure and non-secure) park in a single south lot, 40 acres accommodating approximately 4,600 spaces (PAL 3), will be required. This lot can be served by two bus routes (secure and non-secure). The secure bus would enter and exit the airside area via Gate 8 located on 3700 West near the intersection of North Temple Street.
- 25 percent of the employees do not require security screening and can therefore park in the South Lot. This means that 10 acres, accommodating approximately 1,200 spaces would be required, with the remaining secure employee parking provided in a North Lot. The shuttle bus for these non-secure employees would drop off/pick up at the terminal building on the commercial vehicle curb.

To better understand the operational, financial, and environmental impacts of these alternatives, three key factors were evaluated, including:

- Shuttle bus trip distances and times
- Annual shuttle system vehicle miles traveled (VMT)
- Annual employee journey-to-work change in VMT

The following sections describe the three alternative employee parking scenarios in greater detail. **Table 4-9** shows analysis of the evaluated factors for each alternative.

TABLE 4-9
EMPLOYEE PARKING LOT ALTERNATIVES KEY ANALYSIS FACTORS

Factor	North & South			South			
	North	South	Total	Secure	Non-secure	1 Bus	2 Buses
Bus route roundtrip length (mi.)	5.7	4.4	-	4.4	4.4	4.4	-
Bus travel roundtrip time (min.)	30	23	-	26	23	23	-
Fleet size (7 min. headway)	4	3	7	4	3	3	7
Total Annual Miles	312,075	240,900	552,975	240,900	240,900	240,900	481,800
Bus System Cost ($8/mi.)	$2,496,600	$1,927,200	$4,423,800	$1,927,200	$1,927,200	$1,927,200	$3,854,400
Added Employee Trip Length (mi.)							
from West (1.3%)	6.3	0.4	-	0.4	0.4	-	-
from South/East (69.1%)	2.5	0.4	-	0.4	0.4	-	-
from North (29.6%)	-4.0	0.4	-	0.4	0.4	-	-
Overall	0.6	0.4	-	0.4	0.4	-	-
Annual	4,344,000	927,000	5,271,000	2,781,000	927,000	3,708,000	3,708,000

Note: Employee trip lengthening analysis based Airport badging records.
Source: RS&H and Curtis Transportation Consulting, 2020

4.7.3.1 Employee Parking Alternative One – Single South Lot Served by One Shuttle Bus

The first option for employee parking is operationally the simplest and most cost-effective solution. Providing employee parking in a single location with no on-site screening prior to busing is how SLCDA currently operates. The only difference between this concept and the current situation is that the lot is moved approximately one quarter mile away in order to give locational preference to customer parking.

Employee Lot Alternative One has the lowest annual shuttle VMT, headway, fleet size requirement, and overall system cost. The lot entry point is very close to the current employee lot site so changes in employee trip lengths are negligible. Employee shuttling patterns remain as they are in the current lot, therefore the TSA SSCP would continue to host screening responsibilities in the terminal. One major downside to this configuration is travel times for secure-side terminal employees who must now traverse longer distances in the new terminal building.

4.7.3.2 Employee Parking Alternative Two – Single South Lot Served by Two Shuttle Buses

The second option for employee parking is an operational modification of the first alternative. In this concept, all employee parking is located in a single lot south of the existing employee lot, but employees are shuttled to/from the lot via two dedicated shuttle routes. The first route serves unscreened, non-secure side employees, and drops off/picks up on the nonsecure side of the terminal building. The second shuttle bus system provides transportation for secure-side employees screened at the employee lot prior to entering the sterile bus. These secure-side employees can remain sterile for return to the employee lot via the same shuttle, or they could exit the sterile area of the terminal, at which time they would either need to be rescreened at the TSA SSCP to reenter the sterile area or use the non-secure side shuttle bus to reach the single south employee lot.

For this alternative, the non-secure shuttling remains the same as Employee Parking Alternative One, and the new secure-side shuttling travels roughly the same distance to drop off secure-side employees in the sterile area. **Table 4-9** demonstrates how the overall bus system VMT remains the same as the fleet is split

between the two employee groups. Employee trip lengths still remain comparable to the current employee lot.

4.7.3.3 Employee Parking Alternative Three – North-South Split Lots Served by Separate Shuttle Buses

The third option explored for employee parking separates the non-secure and secure employee lot locations. Non-secure employees would park in a 10-acre lot south of the terminal area and would be shuttled to the terminal building without screening requirements. The secure-side employees would park in a lot north of the terminal complex accessed via 2100 North. Secure-side employees would be screened prior to boarding a sterile shuttle bus and dropped off/picked up at secure-side terminal locations.

As shown in **Table 4-9**, the key factor analysis of this alternative estimates shuttle bus system VMT and operating costs are roughly 15 percent higher than the single south lot alternative using dedicated shuttles. Employee trip lengths to reach a north lot also increase by an estimated 1,500,000 miles annually.

4.7.4 Employee Parking Evaluation

Employee parking options were evaluated for their ability to meet Master Plan established performance criteria. This evaluation is shown in **Table 4-10**. Each concept performed equally well in its ability to meet near-term and long-term facility requirements, meet objectives and planning principles, and provide a targeted level of service for airport customers. The key differentiators between the three alternatives lie within operational performance, financial feasibility, and environmental/sustainability impacts.

TABLE 4-10
EMPLOYEE PARKING ALTERNATIVES EVALUATION

Criterion	South Only		North & South
	1 bus	2 buses	2 buses
Operational efficiency and ease of use	Good	Fair	Poor
Flexibility and expansion potential	Fair	Fair	Good
Financial feasibility	Good	Fair	Poor
Environmental/sustainability	Good	Fair	Poor
Ease of Implementation	Good	Good	Good
Meets near/long-term facility requirements	Good	Good	Good
Meets objectives and planning principles	Good	Good	Good
Provides targeted level of service	Good	Good	Good
Operational and public safety	Good	Good	Good

Performance Legend

Good | Fair | Poor

Source: RS&H and Curtis Transportation Consulting, 2020

Operational efficiency for the alternatives is determined by overall bus route lengths and travel times, required shuttle fleet size, and changes in the time and distance employees make in their journey to work. Alternative One performs the best for operational efficiency, primarily because it defers all employee screening to the TSA SSCP which optimizes employee shuttling operations; however, this does come at

the cost of impacts to terminal TSA screening capacity. Alternative Two operational efficiency is reduced as TSA screening at the employee lot introduces complexity to the system with a secondary SSCP location and necessitates two dedicated busing routes. Alternative Three performs the worst for operational efficiency in large part due to the segregation of secure and non-secure facilities into two completely separate locations on the Airport.

The flexibility and expansion potential of the alternatives depends highly on the availability of adjacent land that can be used for future employee parking. All alternatives are flexible enough to allow future expansion as necessary for all employee lot locations. The key differentiator that ranks Alternative Three above the other two alternatives is the geographic limitation placed by the canal and the proposed South End Around Taxiway. Without relocation of the canal and ponds in the proposed South Lot area, future expansion would be unnecessarily complex and laid out in an inefficient configuration.

Financial feasibility of each alternative is determined by the overall capital and annual operating costs of the shuttle bus system. Alternative One is the least costly to build and operate. Alternative Two is more expensive due to dedicated employee busing routes and the initial capital cost to build a security screening checkpoint. Alternative Three is the highest cost to operate due to the initial capital cost to build a security screening checkpoint and the increase in secure-side employee travel distance by 1.3 miles roundtrip from the other options.

Environmental and sustainability impacts are governed by the increase or decrease of VMT by the bus system and by employees traveling to/from the employee parking lot(s). The rankings shown in **Table 4-10** reflect increases in required VMT for busing and employee journey to work travel distances.

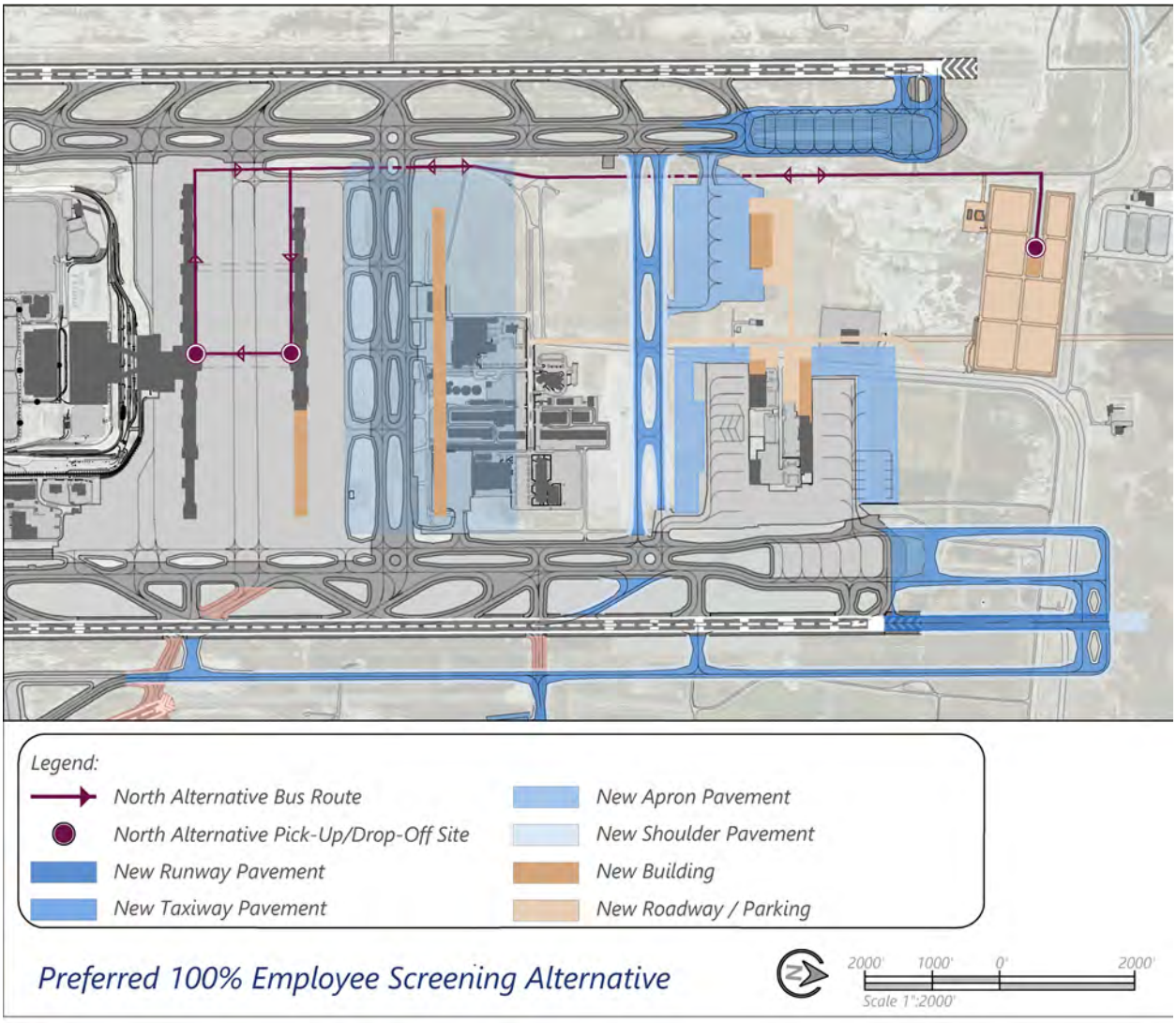
Ease of implementation for the alternatives is driven by the site(s) ability to quickly begin construction. When NEPA requirements initiate further review of environmental impacts at a site, implementation schedules need to account for that process time. Locating employee parking at sites where construction cannot easily access necessary utilities also impacts cost and could impact schedule. All alternative sites provide adequate land to meet employee parking needs through the planning period. It should be noted that two of the four optional employee lot sites in the north area likely impact wetlands and the options in the south area would likely impact the surplus canal and ponds. Any project impacting these wetlands would require an Environmental Assessment.

4.7.5 Preferred Employee Parking Alternative

There are two preferred employee parking alternatives and implementation of each is dependent upon potential employee screening requirements instituted by TSA. Under current TSA screening requirements, the preferred employee parking lot location is on the eastern half of the former golf course site, south of Crossbar Road and the canal (see **Figure 4-25**, *Preferred Comprehensive Landside Alternative*). As demonstrated in **Section 4.7.3, Employee Parking**, the south employee parking lot using a 1-bus system performs the best under all evaluation criteria. However, in the wake of the 2015 incident at Hartsfield-Jackson Atlanta International Airport (ATL) involving an airline employee gun-smuggling ring, TSA has studied and considered implementing 100 percent physical employee screening.

If 100 percent employee screening is instituted, this has significant operational and facility impacts on terminal and employee parking facilities. This is a primary reason that the four additional locations were studied north of the SLC terminal complex. Airport staff working group sessions indicated that locating employee parking and screening in the northern portion of the airfield offers the ability for secure employee buses to remain inside the Secure Identification Display Area (SIDA). Employees would be screened prior to entering the SIDA (and therefore the bus) at which point the bus could shuttle the employees to sterile terminal destinations. **Figure 4-20** shows the preferred north employee parking lot location and the secure busing route to Concourse A and Concourse B. Note the ultimate relocation of 4000 W would traverse though the eastern portion of the lot. That portion of the lot would be the third phase built required at the end of the planning period. By that time, it can be determined if the roadway realignment will affect the lot within its useful life, and if so, the lot expansion can be reconfigured and/or potentially expanded to the west.

FIGURE 4-20
PREFERRED 100 PERCENT EMPLOYEE SCREENING ALTERNATIVE



Source: RS&H and Curtis Transportation Consulting, 2020

4.7.6 Landside Facility Alternatives Dismissed from Further Consideration

A number of facility alternatives were eliminated from consideration during early analysis and evaluation because they did not adequately meet landside planning objectives and guiding principles. This section reviews those facilities not carried forward for further evaluation and describes areas where they fell short of meeting long-term planning goals for SLCIA.

4.7.6.1 Park 'n' Wait Lot and Service Center

When considering alternatives for the Park 'n' Wait Lot and the adjacent Service Center, the option of leaving them in their current locations over the long-term was assessed. This alternative was dismissed because the current shared location fails to meet the following landside planning principles:

- Keep all terminal destinations on the right of the airport entry roadway.
- Create binary choices at all decision points.
- Keep all parking and rental car destinations on the left of the airport entry roadway.
- Provide an intuitive wayfinding system with visual clues for confirmation.
- Provide a simple range of public parking options that provide the highest level of customer service and the maximum net revenue.
- Minimize parking shuttle circulation distance, time, and cost.

The current location of the Park 'n' Wait Lot and Service Center complicates the customer wayfinding experience by placing an additional service (other than customer-oriented public parking and rental car) within the terminal loop roadway. Users waiting to pick up arriving passengers are then required to follow an exit pathway leading away from the terminal, which can confuse and cause anxiety to drivers unfamiliar with the airport because it is counter-intuitive to take a route leading away from their final destination, the terminal curb. The two lots placement creates a non-binary choice (left to Park 'n' Wait and the service center, right to 3700 West) and secondly, the locations complicate the major weave which takes place in that section of Terminal Drive. Cars enter on the left from Crossbar Road and the return-to-terminal ramp, and cars exit left to the Park 'n' Wait and Service Center, while others exit right to 3700 West. Simply put, there is too much happening in the same small area, so the decision points are neither sequenced nor binary.

Finally, having these ancillary services within the terminal loop roadway eliminates the space from use as passenger parking. This pushes passenger parking space further from the terminal building which results in higher operational costs and lower customer level of service.

4.7.6.2 Employee Parking

One employee parking option that was dismissed during alternatives analysis was a concept which keeps the lot in its current location. The current employee parking lot location fails to meet the following landside planning principles:

- Keep highest value landside functions closest to the terminal building.
- Minimize parking shuttle circulation distance, time, and cost.

The land currently serving employee parking is located north of the canal and within a relatively close proximity of the airport terminal building. Comprehensive land use analysis showed that this land could be better used for customer-oriented landside airport facilities. Public parking demand at SLC has grown

and is projected to further increase to a level requiring all reasonable available space within the landside facilities area north of the canal. While the lot was an appropriate land use at the time of its construction, keeping the employee parking lot in its current location now would prioritize a secondary parking use over the Airport's primary purpose of providing a high level of service to customers.

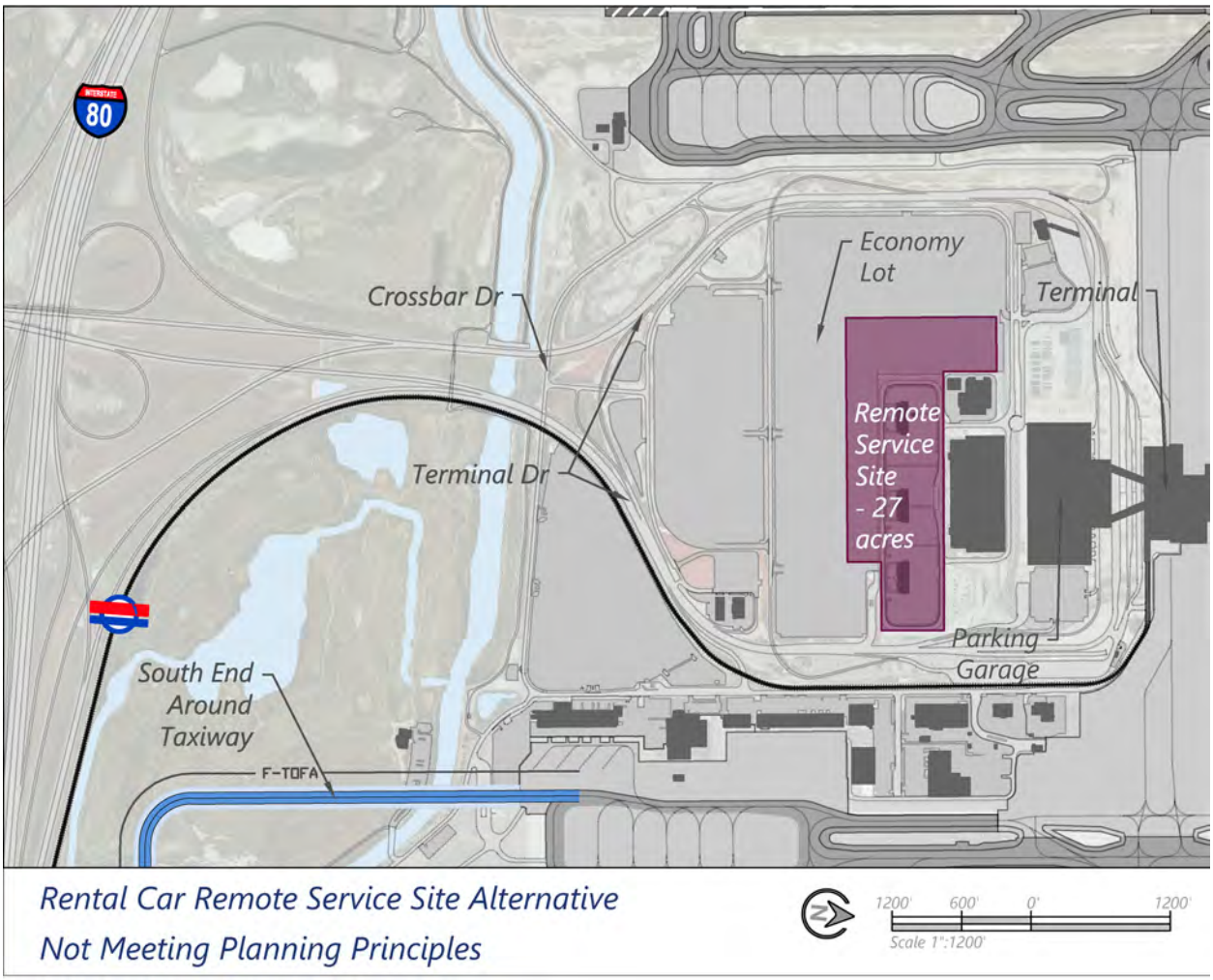
4.7.6.3 Rental Car Remote Service Site

It is possible to replace economy parking spaces with an expansion of the existing rental car Remote Service Site (RSS), as shown in **Figure 4-21**. This option was dismissed as inadequate because it fails to meet important landside planning principles including:

- Keep highest value landside functions closest to the terminal building.
- Minimize parking shuttle circulation distance, time, and cost.

To its detriment, this option prioritizes "back of house" rental car service activities that do not immediately serve airport customers. Given how the RSS is used, having it proximate to the ready-return area does not improve car availability for customers. Instead, its presence removes a large area of convenient, customer-oriented parking spaces. Displacing customer parking from inside the Terminal Drive to outside the loop roadway complicates the overall Airport parking wayfinding system, increases parking shuttle route distance, times, and operating cost, and degrades the customer experience. At the surface, this option appears to have the lowest capital costs to implement as it simply replaces surface parking spaces with new rental car space. However, operational costs to conduct parking operations would increase as costs to shuttle passengers increases. For these reasons, this alternative was eliminated from further consideration.

FIGURE 4-21
RENTAL CAR REMOTE SERVICE SITE ALTERNATIVES NOT MEETING PLANNING PRINCIPLES



Source: RS&H and Curtis Transportation Consulting, 2020

4.7.7 Comprehensive Landside Alternatives

Unlike most airport master plans, this one was prepared while a significant new development program, the ARP, was in final stages of construction. For the landside elements of the ARP, their planning and significant portions of their construction took place nearly two decades ago. The roadway system with a place for garage parking, economy parking, and rental car facilities located within the Terminal Drive loop set the stage for all alternative concepts developed in this master plan update.

The following two comprehensive landside concepts are naturally compatible with and supportive of the concepts of the facilities related to the ARP. The two alternatives are designed to continue the general landside concept that exists today, while addressing the facility needs over the planning period. Because these concepts adhere to the general landside planning guidelines which led to the current configuration, they work in harmony with the new SLCIA terminal to organize and maximize use of the limited landside area near the Airport terminal. The ultimate goal of these concepts is to organize airport resources (land, financial, and otherwise) to provide a safe, efficient, and high-quality customer experience.

At the core of the two concepts is the idea that the land inside the loop be allocated to the uses which best serve the customers and provide the highest quality service for the most customers. Ancillary supporting facilities are therefore moved outside the loop if there is no room for them inside it. Thus, in both concepts, the convenience/service center is moved to the northeast corner of the current employee parking lot on 3700 West, to provide for more Economy Parking. This location also places these services where they can better serve their primary users, who are employees, tenants, commercial drivers, and contractors.

As well, in both concepts, the Park 'n' Wait is relocated back to its previous location. Not only does this free up more spaces for Economy Parking inside the loop, it also:

- Eliminates the traffic congestion and safety issue of the major weaving area on inbound Terminal Drive.
- Greatly improves the visibility of, access to, and egress from the lot, thereby enhancing its utilization.
- Reintroduces the potential use of the lot for security screening under a Code Red condition, as requested by the police.

With the current employee parking, service/convenience center, and Park 'n' Wait all relocated, the development of concepts centered around how best to utilize the available area within the Terminal Drive loop. Facility requirements suggested the need to maximize Economy Parking. Alternatively, the overall public parking program could be met with more walkable (structured) parking, and less surface parking. The tradeoff is in customer service levels and the customers' collective willingness to pay for the higher quality of service. These trade-offs are explored in the two comprehensive landside concepts.

4.7.7.1 Comprehensive Landside Alternative One

The first comprehensive landside alternative features the additional garage parking in lieu of the full program of economy parking. In doing so, it permits non-customer-oriented facilities (the rental car RSS) to remain inside the loop, as it was originally planned 20 years ago. This concept contains all landside facilities within the existing landside programmed land area, with the exception of the employee parking lot which is located south of the existing lot in the former golf course area. The facility layout for this concept is shown in **Figure 4-22.** The summary of required land area for each facility and the estimated total space allocations is shown in **Table 4-11**. The following description of this alternative is organized to provide a logical flow and order of how the facilities could be implemented.

TABLE 4-11
COMPREHENSIVE LANDSIDE ALTERNATIVE ONE SUMMARY

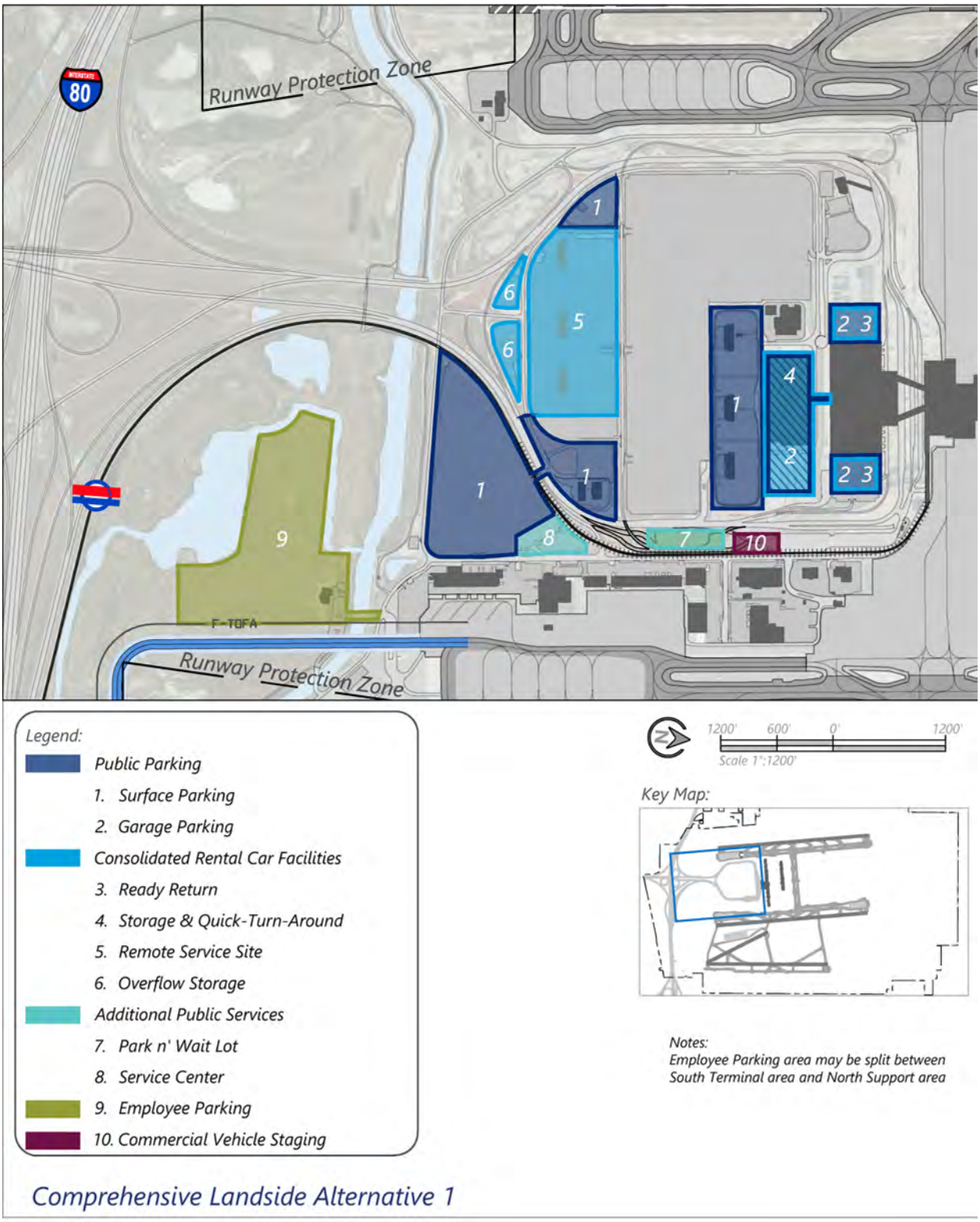
Land Use	Land Area (sf)	Projected Spaces	PAL 3 Required Spaces	Surplus / (Deficiency)
Public Parking				
Economy Parking	4,998,000	13,279	16,931	(3,652)
Garage Parking	585,000	7,370	3,884	3,486
Total Public Parking	5,583,000	20,649	20,815	(166)
Employee Parking[1]				
Single South Lot Option	1,589,370	4,589	4,589	0
Split North-South Lots Option	1,664,370	4,589	4,589	0
Rental Car				
RAC Ready Return	585,000	2,004	1,958	46
RAC Storage	444,600	5,142	3,005 [2]	2,137
RAC QTA Positions	430,000	115	115	0
RAC RSS	1,176,120	-	-	-
Park 'n' Wait	78,200	95	95	0
Service Center	77,400	58	58	0
Commercial Vehicle Staging	160,000	141	141	0

Notes: 1) Land available to accommodate either employee parking option. 2) RAC storage requirements based on off-airport shuttling requirement.

Source: Curtis Transportation Consulting and RS&H Analysis, 2020

Employee parking requirements show an immediate need for additional space. Beginning with design and construction of new employee parking allows the existing lot to accommodate needed public parking as other landside facilities are implemented. This concept is flexible to incorporate any of the previously described employee lot configurations but shows the recommended single south employee lot option. Access to the south lot is provided via 3700 West by a new bridge over the existing canal. Alterations to the canal should consider the impacts to the proposed south employee parking lot bridge.

FIGURE 4-22
COMPREHENSIVE LANDSIDE ALTERNATIVE ONE



Source: RS&H and Curtis Transportation Consulting, 2020

The existing public parking configuration has a ratio of 2.9:1 surface parking spaces to garage spaces. Landside Alternative One incorporates more vertical garage parking spaces to meet overall parking demand within the landside envelop and decreases that ratio to 1.8:1. This means that, in the future under this concept, a higher percentage of overall parking at SLCIA would be provided by the parking garage. Increasing the ratio of garage parking provides an opportunity to incorporate hourly parking spaces close to the terminal to serve short-term parkers. This is important because analysis showed that roughly 68 percent of garage parkers stayed for less than 1.5 hours and proves that there is customer demand for this type of parking space.

New vertical parking in this concept is provided by two equally sized expansions on the east and west ends of the garage. Each expansion is five bays and five levels. Vehicle parking space estimates (shown in **Table 4-11)** incorporate 60-foot bays, akin to those in the existing garage, for light and air penetration into the structure. Each expansion footprint is approximately 117,000 square feet for an expanded area footprint of 234,000 square feet and a total garage footprint of 585,000 square feet. Public parking is provided on levels 2 through 5 of the garage and the entire ground level is dedicated to rental car ready return functions. In this alternative, additional public garage parking is provided on the 5th level of a rental car quick turnaround (QTA) and storage garage, which will be described in more detail in the rental car facilities discussion to follow. In total, at a planning factor of 360 square feet per space, an estimated total of 7,370 garage parking spaces will be provided in this concept. For surface parking, a planning factor of 330 square feet per space was used, providing a total of 13,279 surface parking spaces over the planning period. Exact locations for these surface parking spaces will be described throughout this section. In total, although this alternative shows a slight deficiency of 166 parking spaces (0.8 percent deficient) to meet total parking demand over the planning period, this estimated total is within the errors of our estimates and the concept meets overall needs of the parking program.

Comprehensive Landside Alternative One meets on-airport rental car storage requirements through construction of a new 5-level rental car garage. QTA functions are located on the ground level and rental car storage takes place on levels 2 through 4. Level 5 in the QTA garage is dedicated to public parking. Public garage parkers would access the top level of the QTA via a bridge connecting to the primary public parking garage. This bridge would be best positioned central to the terminal gateway building to create a movement corridor capable of automating passenger movements and reducing overall walking distances.

The new QTA garage would likely be constructed in three phases as follows:

- Construct a new wing east of the existing QTA garage.
- Demolish and replace the west portion of the existing QTA garage with new construction matching the new east wing.
- Demolish and replace the remaining center portion of the existing QTA garage to tie into the previously constructed new QTA garage portions.

Phasing the new QTA garage construction this way would allow continued operations while the new facility is being built.

In this alternative, the rental car RSS is relocated to the south end of the existing surface parking lot. The new RSS absorbs 24 acres of land used for surface parking, equating to a loss of roughly 3,100 parking spaces. An additional three acres is available for rental car overflow storage in the areas immediately south of the new RSS location. Once the RSS is relocated, the old RSS site can be reconstructed for surface parking. This recovers approximately 2,076 of the surface parking spaces lost by the RSS relocation for a net loss of 1,024 spaces. As the RSS is designed, any ability to reduce the overall RSS surface space would help lessen the overall loss of surface parking under this concept.

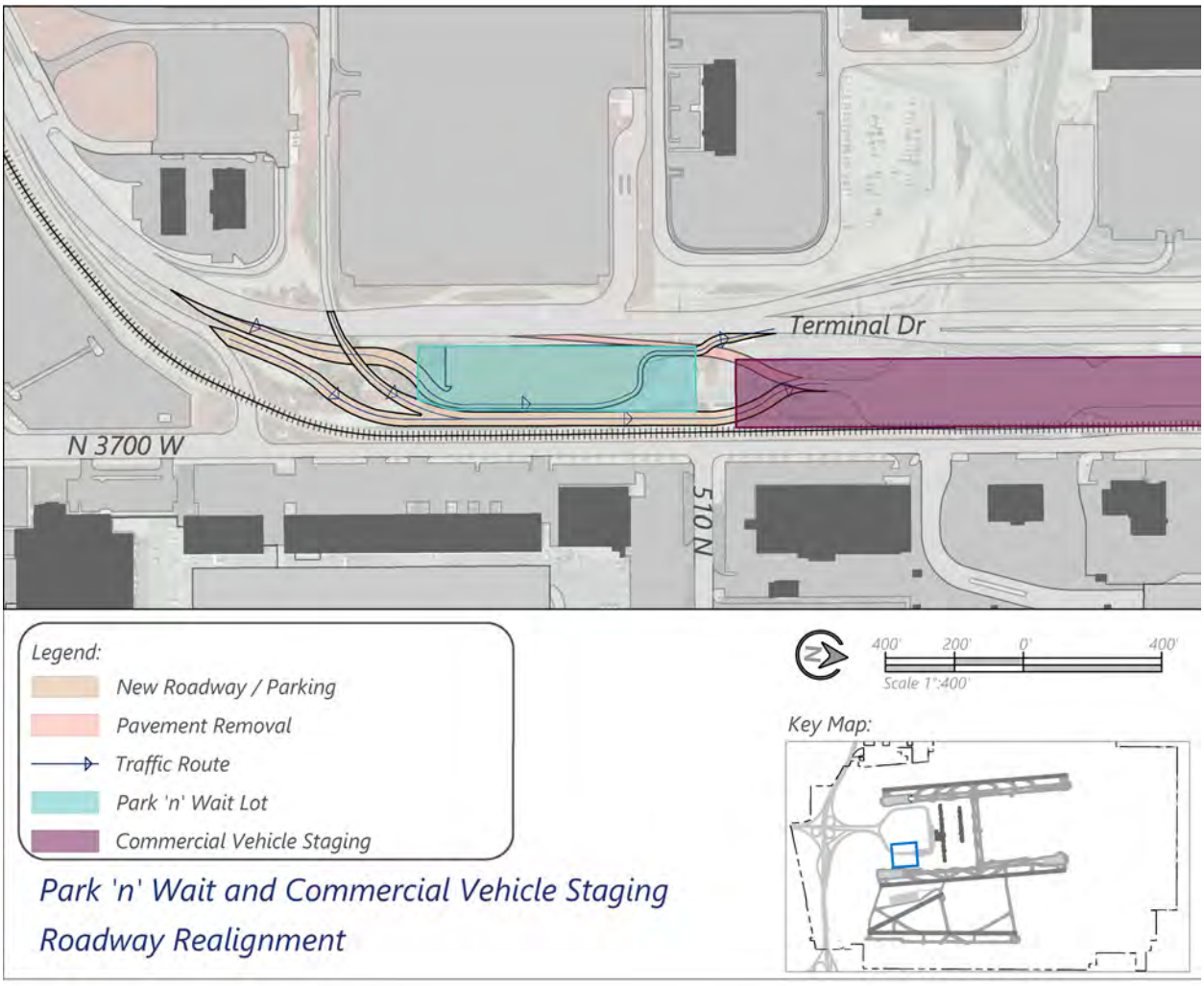
The Service Center and the Park 'n' Wait lot are currently located inside the terminal loop roadway (Terminal Drive). As previously noted, this concept relocates both facilities to new locations along the right side of the terminal entry (outside the terminal loop roadway). The Service Center is separated from the Park 'n' Wait lot and located on approximately 80,000 square feet of the northeast corner of the current employee parking lot. This area is accessed by the existing Terminal Drive exit to 3700 West where the entry/exit to the Service Center would be located. The Park 'n' Wait lot is relocated back to the site of the former Park 'n' Wait lot and covers approximately 80,000 square feet, which includes 25,000 square feet for entry, exit, and landscaping. Entry to the relocated Park 'n' Wait lot would also be accessed by the exit from Terminal Drive to 3700 West and the exit would reenter vehicles into the stream of traffic nearing the terminal curb roadway. Each new location is highly visible, safely accessible, intuitive to users, and adheres well to landside planning principles.

Relocating the Service Center and Park 'n' Wait lot allows for redevelopment of those sites for additional surface parking that remains contiguous with the existing surface parking area. Additionally, unused space west of the relocated RSS site can be incorporated into the surface parking lot.

The commercial vehicle staging lot remains in its present location but expands into open land to the south in order to meet the 141 space requirements. Total land area for the commercial vehicle staging area is approximately 160,000 square feet.

A common aspect of both alternative concepts is that the entry to the commercial vehicle staging would revert back to its original location prior to when the Park 'n' Wait lot was moved, as an exit left from the ramp from Terminal Drive to 3700 West. The location of the entry to the staging area was built in that location in order to separate out larger, slower commercial vehicles from POVs and rental cars at the earliest opportunity. Not only does this reduce traffic on the terminal approach lanes, it improves driver visibility (wayfinding and orientation) by taking out the larger vehicles, and thus also improves safety as inbound drivers look to find where they need to go, and maneuver to get there. Relocating the entry to the staging area back to its former location off the exit ramp to 3700 West will also reduce the volume on the terminal approach lanes enough to avoid having to widen that roadway during the planning period. **Figure 4-23** shows the roadway configuration for the Park 'n' Wait lot and the commercial vehicle staging area entry.

FIGURE 4-23
PARK 'N' WAIT LOT AND COMMERCIAL VEHICLE STAGING LOT ROADWAY REALIGNMENT



Source: SLCDA; RS&H Analysis, 2020

During emergency operations defined by Airport police as "Code Red", vehicles entering the terminal curb area must be rerouted away from the terminal curb. The configuration of the commercial vehicle staging area allows this to occur, but the existing road (located immediately north of the staging lot and south of the light rail station) crossing the light rail tracks to 3700 West must be either preserved or replaced. This rail crossing is the critical link that allows inbound vehicular traffic to flow away from the terminal curb on 3700 West during a Code Red exercise.

4.7.7.2 Comprehensive Landside Alternative Two

Comprehensive Landside Alternative Two provides for significantly more public parking than Alternative One by removing the rental car RSS from inside the Terminal Drive Loop. This increases the number of available economy parking spaces and reduces the number of required garage spaces. Otherwise, the landside facilities are located in the same general areas as in Alternative One.

Public parking in Comprehensive Landside Alternative Two is provided more so by surface parking in this concept than in Alternative One. Alternative Two provides total parking at a rate of 2.6 surface spaces per 1 garage space. This ratio is higher than Alternative One and nearly as high as the current allocation ratio (2.9:1). The reason this alternative maintains a higher surface space to garage space ratio is because, in this concept, the rental car RSS is relocated to the vacant land south of the Surplus Canal and northwest of the I-80 and Bangerter Highway interchange. Developing a new RSS in this location provides more land for SLCIA to provide surface parking demand throughout PAL 3 than Alternative One. The facility layout for this concept is shown in **Figure 4-24**. **Table 4-12** shows a summary of facility land areas and vehicle spaces provided in Comprehensive Landside Alternative Two.

Similar to Alternative One, the current employee parking lot is converted to public parking. However, a bridge is constructed over Terminal Drive to connect the inner loop surface parking to the converted employee lot. This bridge connects all surface parking together seamlessly, therefore providing singular access and egress points for public parkers and connecting the lots for shuttle operation efficiency.

TABLE 4-12
COMPREHENSIVE LANDSIDE ALTERNATIVE TWO SUMMARY

Land Use	Land Area (sf)	Projected Spaces	PAL 3 Required Spaces	Surplus / (Deficiency)
Public Parking				
Economy Parking	4,998,000	16,316	16,931	(615)
Garage Parking	585,000	6,275	3,884	2,391
Total Public Parking	5,583,000	22,591	20,815	1,776
Employee Parking[1]				
Single South Lot Option	1,589,370	4,589	4,589	0
Split North-South Lots Option	1,664,370	4,589	4,589	0
Rental Car				
RAC Ready Return	585,000	2,004	1,958	46
RAC Storage	444,600	5,142	3,005 [2]	2,137
RAC QTA Positions	430,000	115	115	0
RAC RSS	1,176,120	-	-	-
Park 'n' Wait	78,200	95	95	0
Service Center	77,400	58	58	0
Commercial Vehicle Staging	160,000	141	141	0

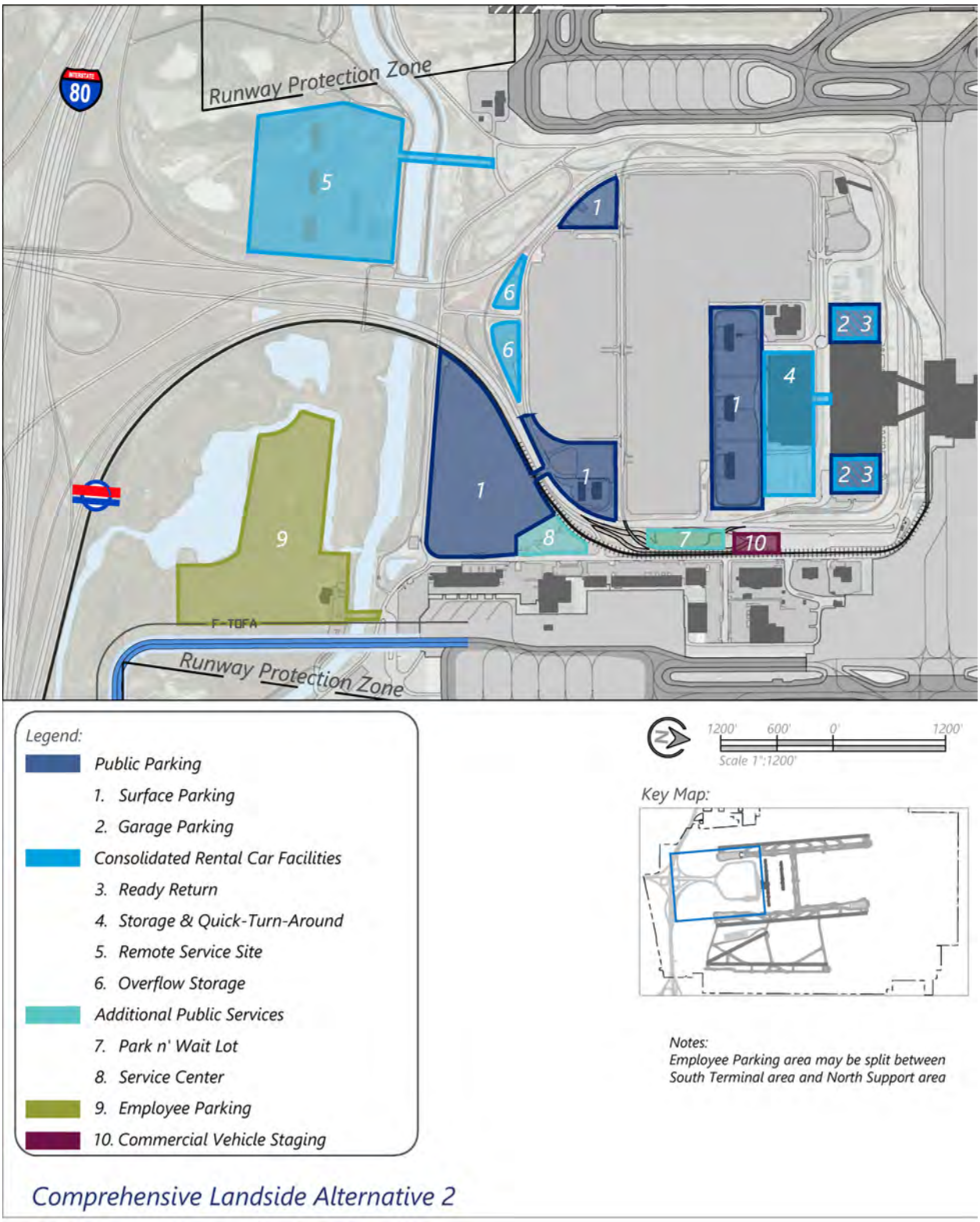
Notes: 1) Land available to accommodate either employee parking option. 2) RAC storage requirements based on off-airport shuttling requirement.

Source: Curtis Transportation Consulting and RS&H Analysis, 2020

Under this concept, the rental car QTA and storage garage is 4 levels on a 444,600 square feet footprint (same as Alternative One) but it does not incorporate a 5th level for additional public garage parking. The rental car RSS is located on the former golf course site and, unlike Alternative One, does not decrease the surface parking area. However, the new RSS in Alternative Two is 0.5 miles further by service roads than the RSS proposed in Alternative One.

Aside from those key differences, the other proposed facility elements are identical. These include the Park 'n' Wait lot, the Service Center, commercial vehicle staging expansion, and the areas inside the terminal loop roadway to be filled in as surface parking and rental car storage overflow.

FIGURE 4-24
COMPREHENSIVE LANDSIDE ALTERNATIVE TWO



Source: RS&H and Curtis Transportation Consulting, 2020

4.7.8 Landside Alternatives Evaluation

The landside alternatives were developed to achieve each landside planning principle and perform well with regard to evaluation criteria. Criteria used to evaluate each option are as follows:

- Meets near-and long-term facility requirements
- Meets objectives and planning principles
- Provides targeted level of service
- Operational efficiency / ease of use
- Operational and public safety
- Flexibility and future expansion potential
- Financial feasibility (capital/operating cost, net revenue)
- Environmental / sustainability
- Ease of implementation

Each landside facility is located and designed to meet the particular needs of the customer it serves. Therefore, different factors influenced each facility's degree of success in meeting specific evaluation criteria. Overall, both landside alternatives perform well. **Table 4-13** shows how each facility performed relative to each criterion. It should be noted that, while many of the criteria graded as "fair" performed well, they did not perform as well as the other alternative. To differentiate an alternative performing better to meet certain evaluation criteria, the better performing concept was graded "good" and the weaker concept was graded as "fair". The key differentiators as to why one alternative performed better than the other are identified in **Table 4-13** as well.

The key differences between the two alternatives are, 1) How much surface versus garage parking is provided to meet demand, and 2) Where the rental car RSS is sited. Public parking and rental car facilities are competing for limited space in the terminal landside area and trade-offs occur when one is prioritized above the other. If more surface parking is desired, then the RSS must be located outside the terminal loop road. If slightly closer proximity for the RSS is desired, then more vertical parking must be provided to meet customer demand. Landside best planning principles place public parking within the loop road as the higher priority therefore making the RSS location in Alternative Two the better option from a customer-service perspective. These two elements, public parking and rental car RSS, are the differentiating factors in evaluating the two landside alternatives.

TABLE 4-13
COMPREHENSIVE LANDSIDE ALTERNATIVES EVALUATION

Evaluation Criteria	Comprehensive Alternatives	
	One	Two
Meets near/long-term facility requirements	Fair	Good
Meets objectives/follows planning principles	Fair	Good
Provides targeted level of service	Good	Good
Operational efficiency/ease of use	Fair	Fair
Operational and public safety	Fair	Good
Flexibility and expansion potential	Fair	Good
Financial feasibility	Fair	Fair
Environmental/sustainability	Good	Fair
Ease of implementation	Good	Good

Performance Legend

Good | Fair | Poor

Source: RS&H and Curtis Transportation Consulting, 2020

Each landside facility serves a specific purpose within the overall landside system and each facility is influenced by a different set of factors that must be quantified and analyzed individually in order to assign an appropriate performance grade. These factors vary by facility but include both qualitative and quantitative elements. Qualitative factors considered included pedestrian walking distance, estimated capital and operating costs, impact to vehicle miles traveled, shuttling time and distance, and distance to/from dependent facilities.

Pedestrian walking distance relates primarily to the garage parking. Alternative Two limits passenger walking distances from parking to the gateway building to a maximum of 1,300 feet while Alternative One increases that maximum distance from parking to the terminal building to approximately 1,850 feet. Those factors aside, it is possible to overcome this challenge with automated passenger movement systems that can quickly move people to the terminal without requiring considerable walking.

VMT is a factor that mostly relates to rental car shuttling to the RSS and to storage. Because both concepts provide storage parking in adequate quantities and in the same location as they currently exist, each alternative performs equally as well. Both alternatives are a vast improvement over current circumstances which require shuttling to off-airport storage locations. The RSS in Alternative Two is 0.5 miles further along service roads than Alternative One so it does have a lower overall VMT which quantified, would depend on the annual number of cars shuttled to the RSS for service or storage. Assuming 2 percent of the rental car fleet would require shuttling for service at the RSS, at PAL 3 projected demand levels, this could create roughly 28,590 additional annual miles traveled in Alternative Two verses Alternative One. This additional mileage is very minor when considering the scale of rental car operations occurring at SLCIA.

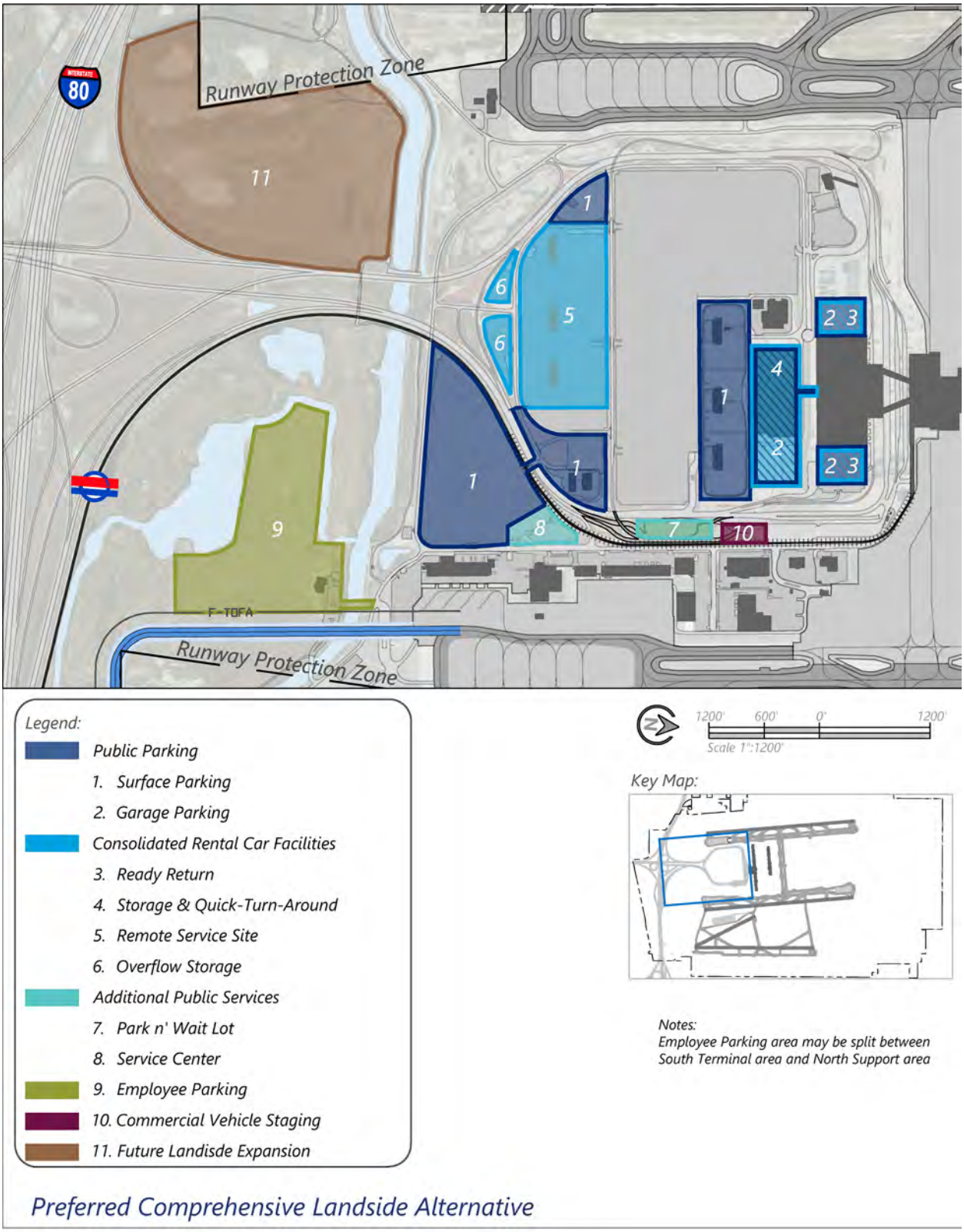
Shuttling time and distances relate to the surface parking lot shuttles and employee lot shuttles. Employee lot comparisons are made in **Section 4.7.3, Employee Parking**. Both alternatives have a degree of surface parking and will require shuttling operations. The cost of shuttling is less dependent upon the spaces provided by both concepts and more dependent upon the number of routes scheduled and the headways offered by the Airport to meet a preferred service standard. Alternative One requires two separate routes to service the two surface parking lots and Alternative Two can be serviced by one route because the surface lots are connected by an overpass. Therefore, between the two concepts, Alternative One is likely to have the higher operating cost (shuttling) but the initial lower capital costs (no overpass to build). The rental car RSS in Alternative One also takes surface parking spaces farthest from the terminal, further reducing shuttling distances and times. Overall, Alternative One would reduce shuttling times and distances, but this is due to the fact that less surface parking is provided in favor of more garage parking.

4.7.9 Preferred Comprehensive Landside Development Plan

The preferred comprehensive landside development, shown in **Figure 4-25** is the result of stakeholder feedback about the two concepts. The preferred landside development is, essentially, Comprehensive Landside Alternative One with the western portion of the former golf course (where Alternative Two proposes a replacement rental car RSS) preserved for ultimate landside use. Preserving this land for future landside uses alleviates many of the concerns that resulted in lower evaluation scores for Alternative One when compared to Alternative Two, especially as it relates to meeting long-term requirements, following planning principles, and flexibility and expansion potential.

The rationale behind placing the rental car RSS within the terminal loop road farthest from the terminal is that the closer the RSS is to the QTA, storage, and ready-return, the less distance companies have to travel to perform maintenance and store additional vehicles. This compromise balances keeping rental car operating costs low while still providing a high level of service to airport customers through on-airport surface parking near the terminal. It is anticipated that rental car operating costs will substantially benefit from an expanded ready-return area and the ability to service and store the majority of needed cars within close proximity of ready-return in the expanded QTA. The preferred RSS location also avoids the requirement for rental car employees to shuttle cars on public roadways, as it did in Alternative Two, since there is right-of-way currently established solely for this purpose. Finally, while this option does not provide the amount of public surface parking spaces to meet forecast demand levels, it offsets this shortage with walkable structured parking which offers a higher customer level of service. The key to maximizing customer use of structured parking, and the subsequent revenues will be setting a simple program and rate structure that encourages airport patrons to use the new garage spaces as opposed to parking in economy shuttle lots or with off-airport providers.

FIGURE 4-25
PREFERRED COMPREHENSIVE LANDSIDE ALTERNATIVE



Source: RS&H and Curtis Transportation Consulting, 2020

4.8 SUPPORT FACILITY ALTERNATIVES

The facility requirements analysis identified specific support facilities that will require relocation and/or expansion in the future at SLC. These include airline maintenance, airport maintenance, ARFF Station #12, the commercial service fuel farm, and general aviation facilities. Except for GA, these facilities are all within the planned envelope for a future Concourse C. While the actual construction of a Concourse C is outside the planning period, the site of any planned concourse construction must be cleared prior to implementation. As noted in **Section 4.2**, a full Concourse C build out may not be needed until beyond the planning period. However, it is recommended that new and replacement facilities be placed outside the Concourse C site envelope.

This section begins with an overview of the site analysis conducted for airline maintenance, airport maintenance and ARFF facilities. The fuel facility was examined separately as its location is more flexible. Finally, the GA related alternatives are discussed.

4.8.1 Airline Maintenance, Airport Maintenance, and ARFF Sites

Four new sites, illustrated in **Figure 4-26**, were examined for their ability to accommodate relocation and expansion needs of airline maintenance, airport maintenance, and the ARFF Station. Sites 1, 3, and 4 are large enough to support a full relocation and varying levels of expansion of airline and airport maintenance, while Site 2 is large enough to support relocation or partial relocation and expansion.

Site 2 was found to be the only site suitable for relocation of ARFF Station #12 due to the response time requirements to Runway 16L-34R and 16R-34L. The other sites were further examined for their ability to support airline maintenance and airport maintenance facilities. The evaluation of the sites is illustrated in **Table 4-14**.

TABLE 4-14
AVIATION SUPPORT DEVELOPMENT SITE EVALUATION

Criteria	Site 1	Site 2	Site 3	Site 4
Operational efficiency				
Flexibility and expansion potential				
Financial feasibility				
Environmental/sustainability				
Ease of implementation				
Meets near/long-term requirements				

Performance Legend

Good | Fair | Poor

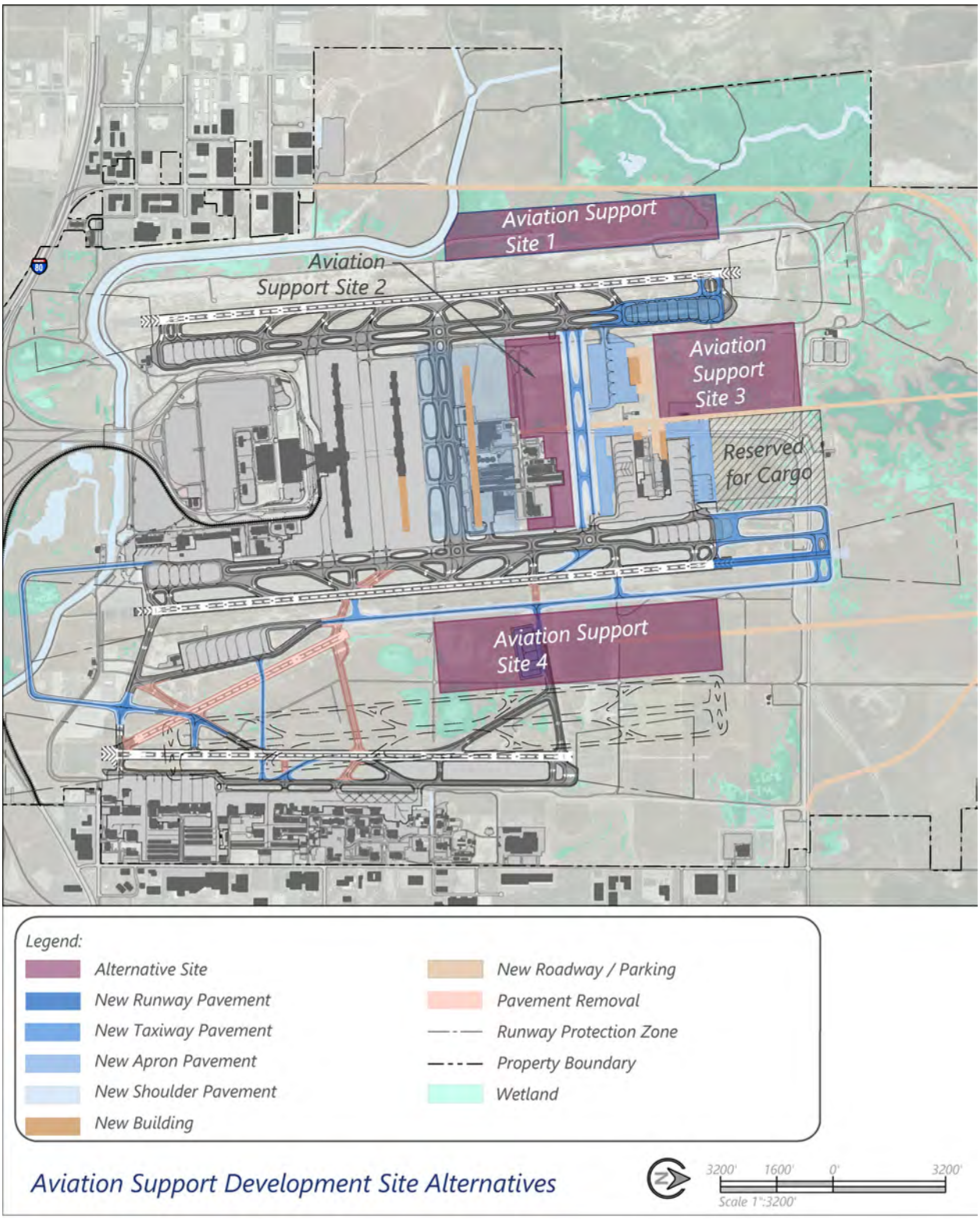
Site 1 performed the worst, primarily due to its location in an area that contains large amounts of wetlands and no utility infrastructure nearby making implementation for any new facility very difficult. Site 1 and Site 4 both would require new taxiways to support airline maintenance which increases cost and decreases ease of implementation. Additionally, airline maintenance in Sites 1 or 4 are furthest from the terminal area, requiring longer drive and aircraft tow distances, which increases emissions and operating costs. Site 1 was deemed incompatible overall for airline maintenance as aircraft would need to be towed

across an active runway, whereas in Site 4, aircraft in tow could utilize the SEAT (although, because of the very long distance, this is also impractical).

Sites 2 and 3 both performed well. The only areas where these sites underperformed Sites 1 and 4 was in relation to the space for future expansion and meeting long term requirements. However, if combined, the space constraints are mitigated. Thus, both Site 2 and Site 3 were carried forward as the preferred location for airline maintenance, airport maintenance, and the eventual ARFF Station #12 relocation.

Airport maintenance was planned in the last master plan to be eventually relocated into Site 4. Site 4 would accommodate that facility well, although it would require new utility and roadway infrastructure. This study found that existing airport maintenance facilities are a mix of old, dilapidated buildings that require replacement and some newer buildings in good condition. As opposed to fully relocating the maintenance facility into Site 4 as a greenfield development, which would require significant expense, replacement infill development within Site 2 was found to be more practical. Replacement buildings could be developed near existing buildings, keeping the maintenance campus consolidated. Additionally, keeping the maintenance function near the terminal building provides greater efficiency for workers who service that facility.

FIGURE 4-26
AVIATION SUPPORT SITE ALTERNATIVES



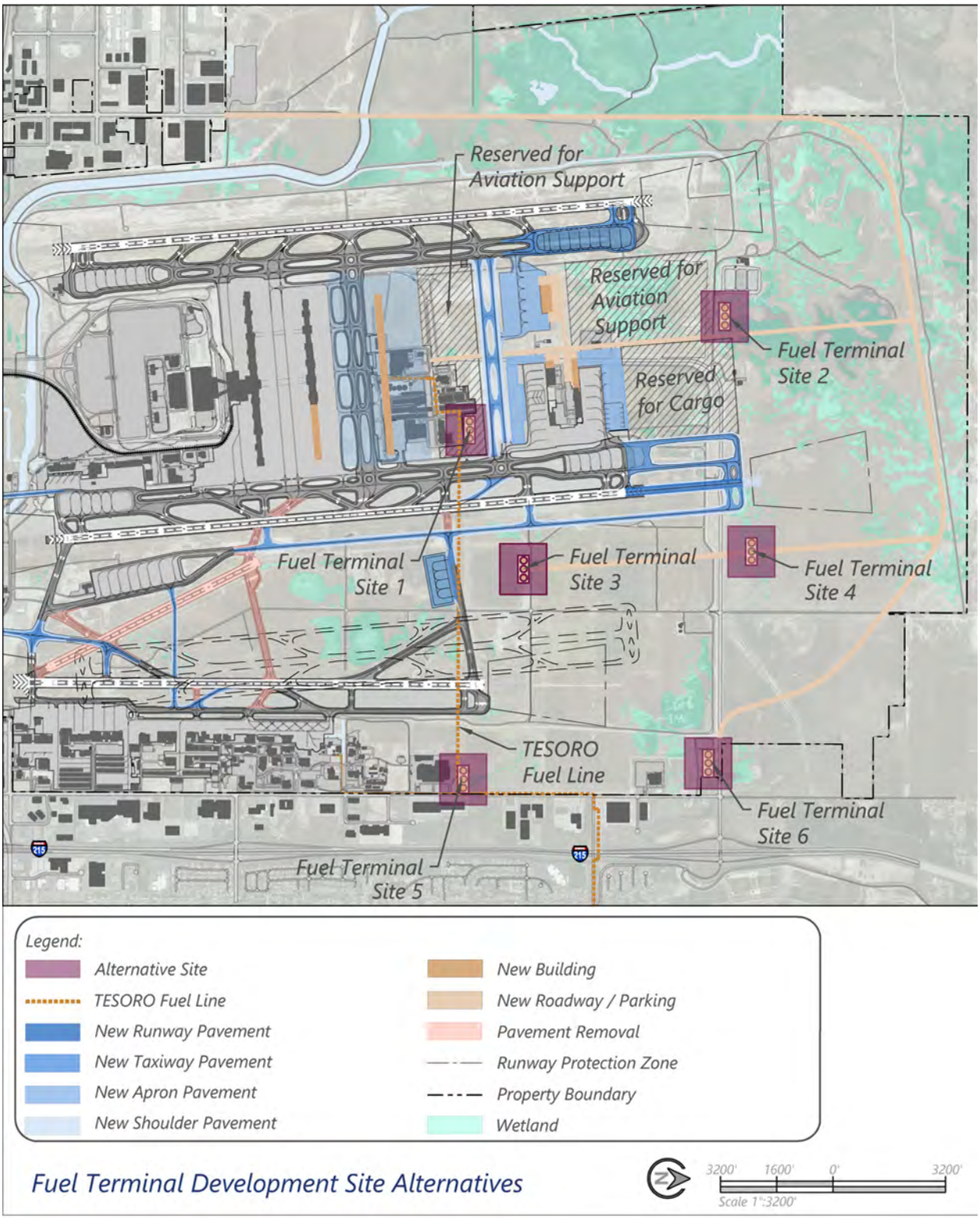
Source: SLCDA; RS&H Analysis, 2020

4.8.1 Commercial Service Fuel Farm

The current commercial service fuel farm facility is located with other north support facilities and lies within the footprint of the future Concourse C. As discussed in the balanced airport analysis, build out of a partial Concourse C is not expected to be needed until the end, or beyond, the planning period. Additionally, airfield capacity enhancements would be required to accommodate operational levels that would be associated with even a half Concourse C build out. Thus, it is likely that the commercial service fuel farm will be able to remain in its current location though the planning period, and depending on initial Concourse C construction, for many years beyond. However, to account for any change that may require relocation of the commercial service fuel farm earlier than expected, relocation sites were analyzed.

Six sites were identified, as shown in **Figure 4-27**. Considerations for each site include the need for non-secure landside access for fuel tanker trucks and other personnel to access the facility. The new facility must tie into the existing pipeline infrastructure that connects to the terminal concourses and to the oil refinery north of SLC. The farther the new site is from the existing pipeline, the greater the cost and complexity of connection.

FIGURE 4-27
COMMERCIAL FUEL TERMINAL RELOCATION SITES



The results of the evaluation, shown in **Table 4-15**, determined that Site 3 should be reserved for the relocation of the fuel facility. Sites 2, 4, and 6 all have wetland impacts greater than the others, and being further from the existing pipeline, will require greater infrastructure and incur more cost. Site 1 may be the easiest to implement, but the site is constrained for future growth and is better suited for other aviation related purposes such as airport maintenance facilities. Although Site 5 performed well in the evaluation, the land is valuable real estate for future aeronautical facilities because it has roadway and taxiway access, and thus should not be used for a fuel farm.

TABLE 4-15
COMMERCIAL FUEL FARM RELOCATION EVALUATION

Criteria	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Operational efficiency						
Flexibility and expansion potential						
Project cost considerations						
Wetlands impacts						
Ease of implementation						
Meets near/long-term requirements						

Performance Legend

Good | Fair | Poor

Overall, Site 3 is identified as the preferred site since it is close to the existing pipeline, has little or no wetland impact, has room for expansion, and is an appropriate use of the land in that area. Ease of implementation is the only challenge as a roadway and utilities would need to be built to serve the site. Future consideration is required for crossfield connection to a realigned Runway 17-35. The site may need to be adjusted and/or a roadway tunnel may be required if future crossfield taxiways are built to the north.

4.8.2 General Aviation

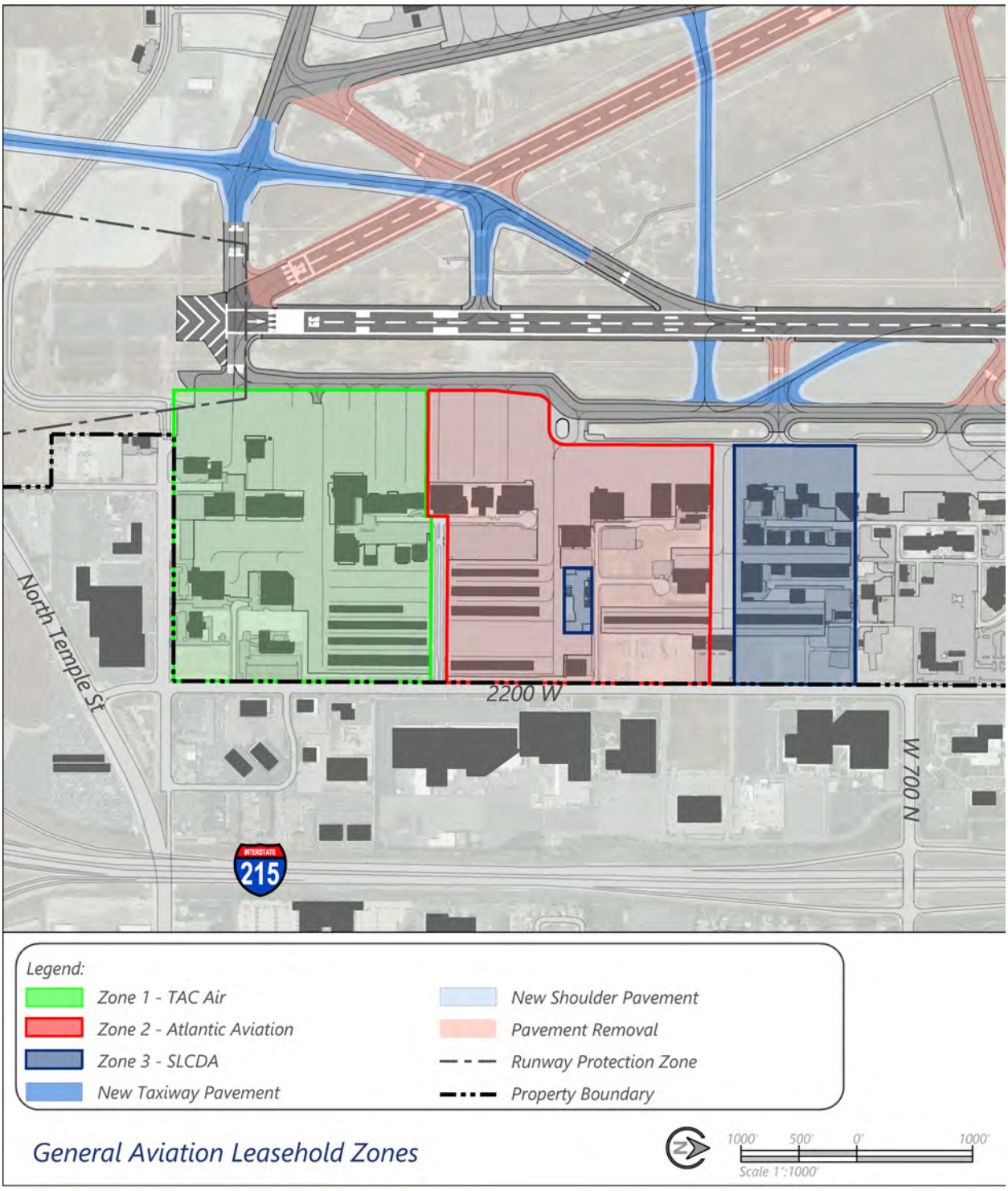
The facility requirements chapter identifies a transition in required general aviation (GA) facilities over the planning period, as jet-oriented growth, combined with a decline in the number of smaller aircraft, results in a surplus of T-hangars and shade hangars. and a significant deficiency of box hangars. In addition to the facility requirements, a *General Aviation Strategy Plan* exists for the SLCDA airport system. The strategy plan develops a methodology to use the three airports within the system to maximize efficiency by providing enhanced facilities at South Valley Regional Airport and Tooele Valley Airport.

The strategy plan finds that enhanced facilities at reliever airports, combined with adjusting lease rates to fair market values, can result in an even further decrease in the demand for market rate T-hangar and shade facilities at SLC than what is forecasted in the Master Plan. This is expected to result in a surplus of existing T-hangar facilities that can be redeveloped to meet demand for box hangars over the course of the planning period. The Recommended Action Plan proposed in the strategy plan is being carried forward in this study. Through implementation of the action plan, unneeded T-hangar and shade hangar

facilities can be redeveloped to accommodate forecasted demand of box hangars through the planning period.

SLCDA has adopted a general aviation management policy that divides the land within the GA area into zones of control to consolidate leaseholds and future development which will allow independent management of general aviation facilities by the existing FBOs at SLC(i.e., TAC Air and Atlantic Aviation). The policy will allow the FBOs to develop the types of facilities needed to satisfy market demand. Although, this system is designed to reduce the involvement of SLCDA in the overall management and future development of GA hangars at the Airport, it does retain a smaller zone as an area of control for the SLCDA. The future development required to meet the facility demands of GA will predominately occur by the FBOs in Zone 1 and Zone 2. **Figure 4-28** shows the three GA leasehold zones for TAC Air, Atlantic Aviation, and SLCDA.

FIGURE 4-28
GENERAL AVIATION LEASEHOLD ZONES

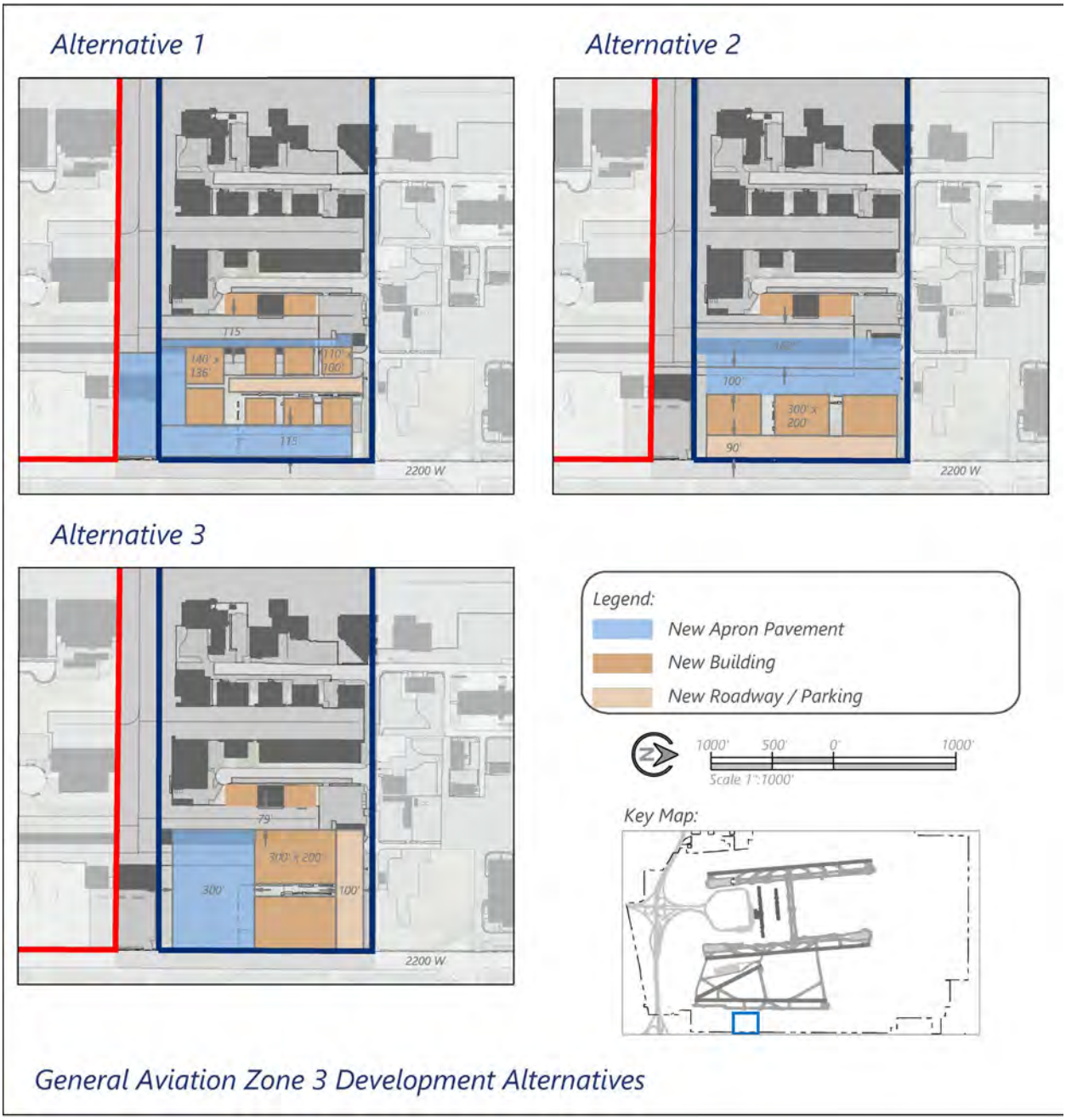


Source: SLCDA; RS&H Analysis, 2020

With Zone 1 and Zone 2 being managed by the respective FBOs, Zone 3 is the only section of the GA area not currently within an FBO lease area and is the zone for which SLCDA will have direct development control. Zone 3 encompasses roughly 1.2 million total square feet, including approximately 280,000

square feet of developable land in its eastern portion, including a T-hangar ultimately slated for demolition due to structural deficiencies. To examine the development potential of this area, a total of three high-level concepts were analyzed including concepts for development of a cluster of small box hangars, development of 30,000 square feet hangars, and development of large 60,000 square feet hangars. These three concepts are shown in **Figure 4-29**. These concepts are based on the primary objective of having an area of land under SLC control (and not FBOs) that would allow leases and private development of individual corporate hangars for larger aircraft. Since the *General Aviation Strategy Plan* recommends that services and facilities for small general aviation aircraft be provided at its reliever airports, no small hangar development is proposed in these concepts.

FIGURE 4-29
GENERAL AVIATION ZONE 3 DEVELOPMENT ALTERNATIVES



Source: SLCDA; RS&H Analysis, 2020

Ultimately business demands will drive the specific sizing and development of Zone 3, but larger hangar sizes such as shown in these alternatives are preferred and would provide viable hangar layouts.

4.8.3 ARFF Training Facility

An ARFF training facility is a location which provides realistic, repeatable, and safe training for aircraft rescue and firefighting operations. For more than 20 years an ARFF training center existed at SLC until the facility was closed in 2018 due to the significant costs to operate what had become an aging facility. However, the benefits of having an ARFF training facility remain for the ARFF staff at SLC, as well as firefighters throughout the region who would use the facility. This Master Plan will preserve a site for potential development in case the financial case becomes practicable for an ARFF training facility in the future.

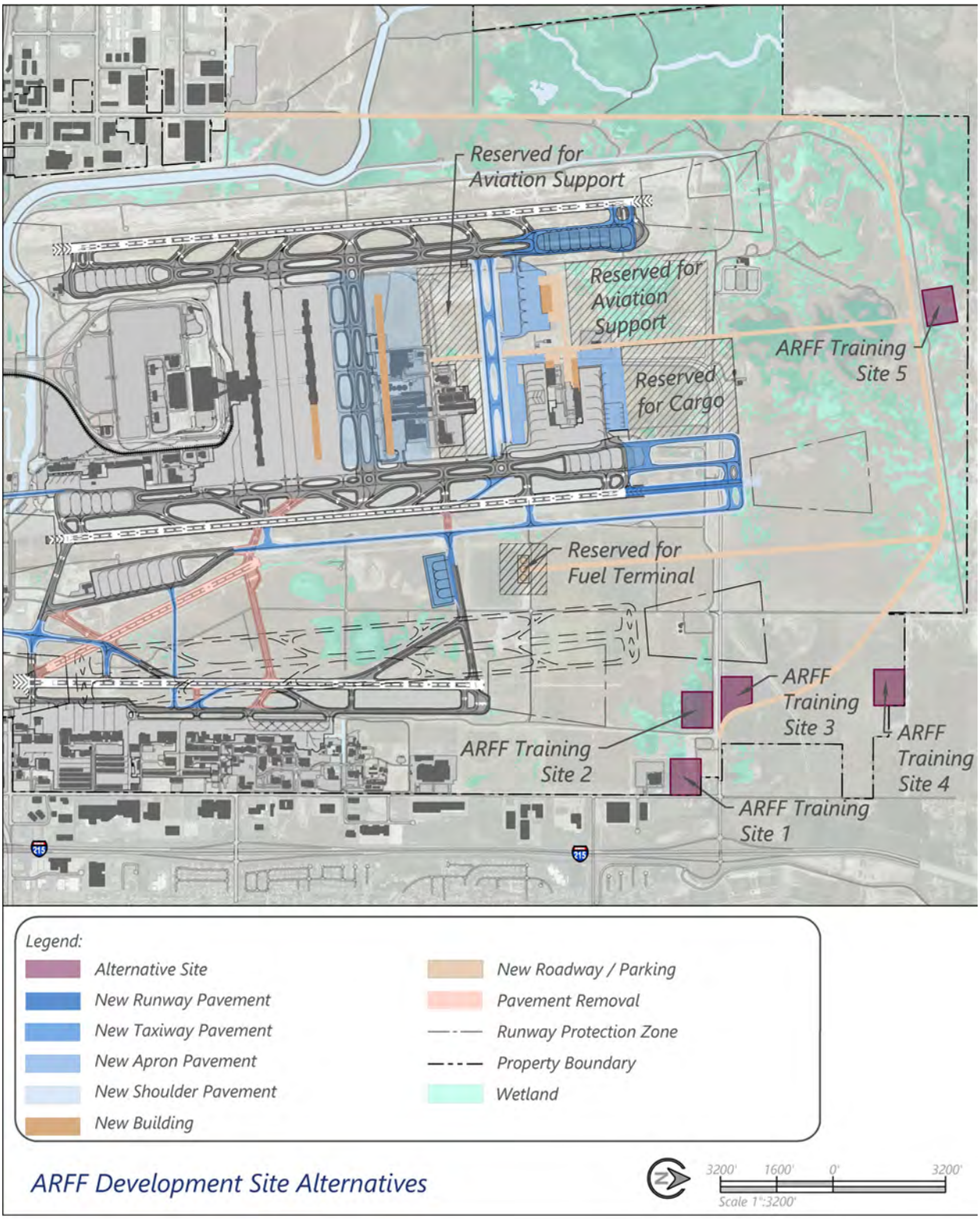
The previous facility encompassed approximately nine acres and provided live-fire training. For a future facility, the reserved site will incorporate space for both live-fire and classroom training. This site is forecasted to necessitate approximately 11.5 acres and considers sufficient space for a burn area, maneuvering area, pavement for additional special use ARFF equipment, parking for three ARFF vehicles with airside access, classroom space with associated furnishings, and landside parking.

In coordination with ARFF staff, five sites were identified, as shown in **Figure 4-27**. The evaluation process, summarized in **Table 4-15**, considers operational efficiency, flexibility and expandability, costs, impacts to wetlands, ease of implementation, and the ability of the site to accommodate space required. Operational efficiency analysis considers airside access for ARFF vehicles, landside access and parking, public viewshed, and compatibility with *Advisory Circular 150/5220-17B, Aircraft Rescue and Fire Fighting (ARFF) Training Facilities* siting requirements including:

- Outside of all restricted areas noted in AC 150/5300-13, *Airport Design*.
- Where smoke and the associated thermal plume will not hinder aircraft operations or ATC surveillance of the movement area.
- Where the aircraft mockup (e.g., tail height) and support components (e.g., buildings) will not interfere with navigational aids.
- Greater than 1,000 ft from residential areas and 300 feet from airport buildings and public vehicle parking lots.

To increase controllability of the impact of smoke plumes and reduce environmental impacts, a propane-fired system is recommended. The preferred site location should also not be sited in a location desirable for other usage, such as aviation-related or non-aeronautical development and above the 100-year floodplain.

FIGURE 4-30
ARFF TRAINING FACILITY SITE ALTERNATIVES



Source: RS&H, 2020

TABLE 4-16
ARFF TRAINING FACILITY SITE EVALUATION

Criteria	Site 1	Site 2	Site 3	Site 4	Site 5
Operational efficiency					
Flexibility and expansion potential					
Project cost considerations					
Wetlands impacts					
Ease of implementation					
Meets near/long-term requirements					

Performance Legend

Good | Fair | Poor

Sites 4 and 5 were discarded due to challenges in providing airside access across a public roadway and the distance of the sites from existing utility infrastructure. Sites 1, 2, and 3 were determined to be viable alternatives, but all lack the ideal combination of airside vehicle service road and landside access while still preserving future development potential. Although each of the sites are outside of the ATCT line of sight for the airfield and the flight path of a realigned Runway 17-35, Sites 2 and 3 would be on the flight path of the existing runway if a facility is constructed prior to the runway being realigned. Existing wetlands at Sites 1 and 2 would also require mitigation prior to construction.

After evaluation, a hybrid alternative was created roughly between Sites 1 and 2, behind the SLCDA Airport Training and Activities Center. The hybrid location allows ideal connection to the airfield and VSR and requires only a short connection to 2200 W or 2100 N roadways. Although an access road will be needed from the site to 2200 W or 2100 N, the site itself is remote which preserves opportunities for development better suited for roadway frontage. It is important to note that the live-fire training facility must remain more than 300' from any other parking area or building, which can be met by the hybrid site. The proposed location for the replacement ARFF training facility is also shifted further from both the existing and realigned runway centerline of Runway 17-35 than Sites 2 and 3.

4.9 NON-AERONAUTICAL LAND USE OPPORTUNITIES

As part of this master plan, undeveloped landside parcels were assessed for their ability to serve as future development opportunity sites able to accommodate near- and long-term non-aeronautical development without impacting the future aeronautical needs of the Airport. The results of the analysis identified approximately 140 acres of land that is located within the northeast quadrant of airport property, illustrated in **Figure 4-31**.

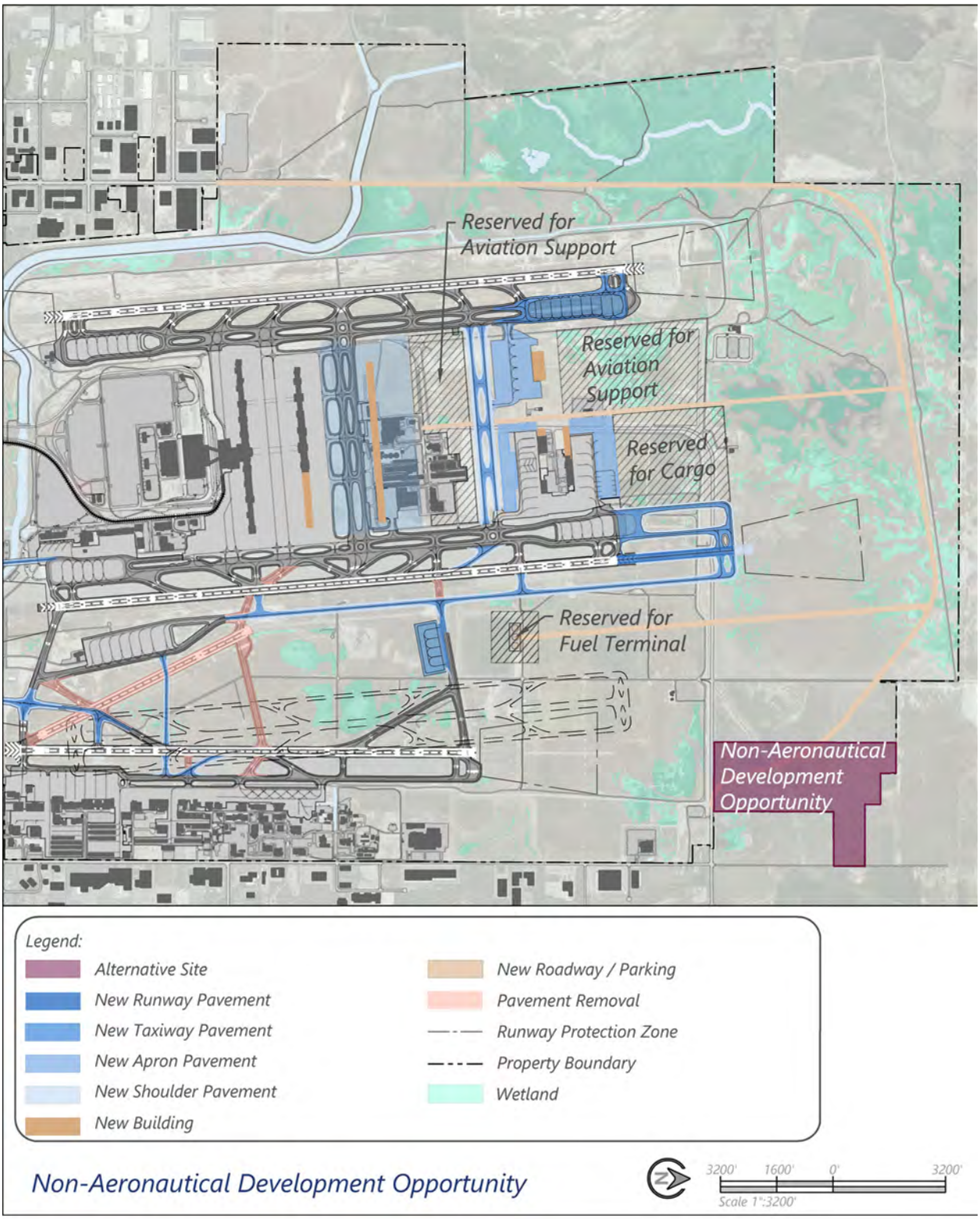
Other sites were investigated, including the area between I-80 and the passenger terminal area, and the area north of the Air National Guard base on the east side of the Airport. The facility requirements determined the area between I-80 and the passenger terminal would be required to remain available for aeronautical purposes, namely for the SEAT and future terminal related parking infrastructure. The area

north of the Air National Guard is ripe for future development and should remain preserved for aeronautical purposes.

The size of the site can accommodate many large-scale uses including large manufacturing facilities, a research and development campus, or Airport support facilities. These types of facilities are compatible with the Airport and could be designed to coexist with airspace limitations. Additionally, the location and configuration of the site accounts for the reservation of land for a realigned Runway 17-35 northern RPZ. Utility and roadway infrastructure exist in proximity to the site, although not within the site itself. However, the proximity of utilities and roadway access is advantageous for initial development. With consideration of these factors combined, it is recommended that the site be designated as non-aeronautical land use.

The reality of achieving development at the Airport will require inducing the market to act. This requires a proactive, planned, and executed marketing and implementation effort be undertaken by the Airport; otherwise, this area may remain undeveloped into the future. Forming public/private partnerships, mutually beneficial relationships with institutions such as universities and non-profit organizations, creating financial and economic benefit programs and packages, and targeting solicitation efforts aimed at attracting the most synergistic landside development partners for the Airport are all ways the Airport can catalyze development.

FIGURE 4-31
NON-AERONAUTICAL LAND USE



Source: Strategy 5 LLC, RS&H, 2020

APPENDIX A
OVERHEAD POWER LINE ALTERNATIVES

v2.0

MEMORANDUM

Date:	March 13, 2020
To:	Salt Lake City International Airport / Rocky Mountain Power
From:	RS&H Technical Planning Team
Subject:	Overhead Power Line Alternatives

Salt Lake City International Airport (Airport or SLCIA) must extend their center long-haul runway (Runway 16L-34R) to accommodate the larger, heavier aircraft that travel to intercontinental destinations. Due to airspace and infrastructure limitations to the south of the airport, the runway extension must be to the north. The overhead power lines directly north of the airport impact navigable airspace surfaces, and must be mitigated to allow future runway extension. The purpose of this technical memorandum is to provide background on the existing powerlines and describe the alternatives identified and examined.

Existing Overhead Power Lines

On the north side of the airport are four high voltage lines that run east to west in a near perpendicular configuration to the runways. The lines, owned and operated by Rocky Mountain Power, extend around the northwest corner of the airport and connect to a substation in the development area west of Runway 16R-34L. These lines are supported by poles and three conductors for three phase power. There are four different voltage lines. The two most northern lines are 345 KV (two circuits) and 230 KV (two circuits) that are at an approximate height of 107 feet above the ground. The two southern lines are 138 KV (three circuits) and 46 KV (one circuit) lines that are at an approximate height of 85 feet above the ground.

As the lines run from east to west the two northern lines separate from the southern and head northeast. The southern lines continue east for approximately 4,000 feet before turning northeast and eventually connecting with the northern lines. Reviewing the existing alignment, poles are spaced approximately every 600 feet. Additional space appears to be added between poles when there is a change in direction.

Record drawings were pulled and examined from the 1992 Environmental Assessment to identify existing easements. The drawings depict a 300-foot easement for all circuits when side by side. The easement width drops down to 150 feet where the four lines split. Additional cost and coordination may be needed for purchasing utility easements if a proposed solution is outside the existing alignment.

The existing alignment of the powerlines impacted wetlands and water features when they were originally constructed. To account for the water table and support the load of the poles and high voltage cables, man-made islands were constructed. These islands are approximately 275 feet long by 50 feet wide.

A graphic showing the existing power lines are shown in the Appendix section at the end of this technical memorandum.

Runway Extension and Navigable Airspace Surfaces

Currently, the power lines impact operations on the center runway and a 2,500 foot (approximate) extension is needed on Runway 16L-34R to the north to accommodate long-haul aircraft. An airspace evaluation was conducted to determine how far the power lines would need to be relocated to avoid adverse impacts to operations for long-haul aircraft. The airspace evaluation identified and examined sloping surfaces from the following regulations and FAA guiding documents.

- CFR 14 Part 125 / FAA Advisory Circular 120-91 *One Engine Out, Two Engine Aircraft*
- CFR 14 Part 77 *Imaginary Surfaces*
- FAA Order 8260.3D *United States Standard for Terminal Instrument Procedures (TERPS)*

A presumed structure height was applied to determine the distance needed from the future runway threshold to clear these evaluation surfaces. The structural height of the overhead power lines is assumed to be 100 feet tall, or 4,350 feet above means sea level. A trapezoidal area was drawn and defined as the critical zone. The critical zone dimensions are defined by the height of the future pole and the slope associated with each airspace surface. Each alternative examined relocating the power lines outside of this critical zone.

Each airspace surface and the critical zone is highlighted and is shown in each alternative in the Appendix.

Planning Objectives and Parameters

To effectively develop alternatives for relocating the overhead power lines, planning objectives and parameters were established. As previously stated, the overhead power lines need to be routed outside of all airspace surfaces or buried. Consideration was given to reduce impact to the environment. Each alternative aimed to minimize impacts to wetlands and water features by using existing man-made islands to support the load of each pole. Each alternative minimized the length for new high voltage cables and looked to diminish the need for new structures.

The following sections describe each of the alternatives that were identified and examined.

Alternative No. 1

This alternative relocates the 138 KV (three circuit) and 46 KV (one circuit) lines to be parallel with the existing 345 KV (two circuit) and 230 KV (two circuit) lines. At the point of divergence just east of the extended runway centerline the 138 KV and 46 KV high voltage lines supported by poles would parallel the existing alignment to a point approximately 7,200 feet from the proposed runway end. At this point, the 345 KV and 230 KV lines along with the relocated 138 KV and 46 KV line would extend to the farthest north boundary of the critical zone and run due east for approximately 3,000 feet. The four lines would then run on the existing alignment northeast and reconnect to existing infrastructure. It is anticipated that approximately 50 acres of right-of-way easement would need to be purchased.

Alternative No. 1 requires building and expanding existing mad-made islands and constructing an access road composed of fill material. The construction of these supporting components could impact wetlands and water features in the area. From discussions with Rocky Mountain Power, the rough cost of a mile of overhead high voltage line was approximately one million dollars. Multiplying this value by the miles of additional line needed for this alternative, the total project cost is anticipated to be $5.4 million dollars.

A graphic showing Alternative No. 1 is shown in the Appendix section at the end of this technical memorandum.

Alternative No. 2

This alternative would bury approximately 5,000 feet of 138 KV (three circuit) and 45 KV (one circuit) lines. Additionally, the 345 KV (two circuit) and 230 KV (two circuit) lines to the north would be further extended to avoid the critical zone. The relocation of these lines would start approximately 7,200 feet from the proposed runway end and extend due east for approximately 3,000 feet. At this point the 345 KV and 230

KV lines would tie into the existing infrastructure. It is anticipated that approximately ten acres of right-of-way easement would need to be purchased.

Alternative No. 2 would require the construction of an access road and modifying the man-made islands to support the load of the new poles. The anticipated island width is expected to be smaller, compared to Alternative No.1, as less poles would be needed. From discussions with Rocky Mountain Power, the rough cost of a mile of overhead high voltage line was approximately one million dollars. The rough cost provided for a buried high voltage line was ten million dollars per mile. Multiplying these values by the presumed quantities and installation methods needed for this alternative, the total project cost is anticipated to be $21.2 million dollars.

A graphic showing Alternative No. 2 is shown in the Appendix section at the end of this technical memorandum.

Alternative No. 3

This alternative relocates the 138 KV (three circuit) and 46 KV (one circuit) lines to parallel the existing 345 KV (two circuit) and 230 KV (two circuit) lines. At the point of divergence just east of the extended runway centerline the 138 KV and 46 KV high voltage lines supported by poles would parallel the existing alignment to a point approximately 7,200 feet from the proposed runway end. At this point the power lines would continue their existing northeast alignment. Prior to approaching the critical zone, all four lines would be buried for an approximate distance of 2,000 feet and continue as overhead lines in the current alignment. It is anticipated that approximately 40 acres of right-of-way easement would need to be purchased.

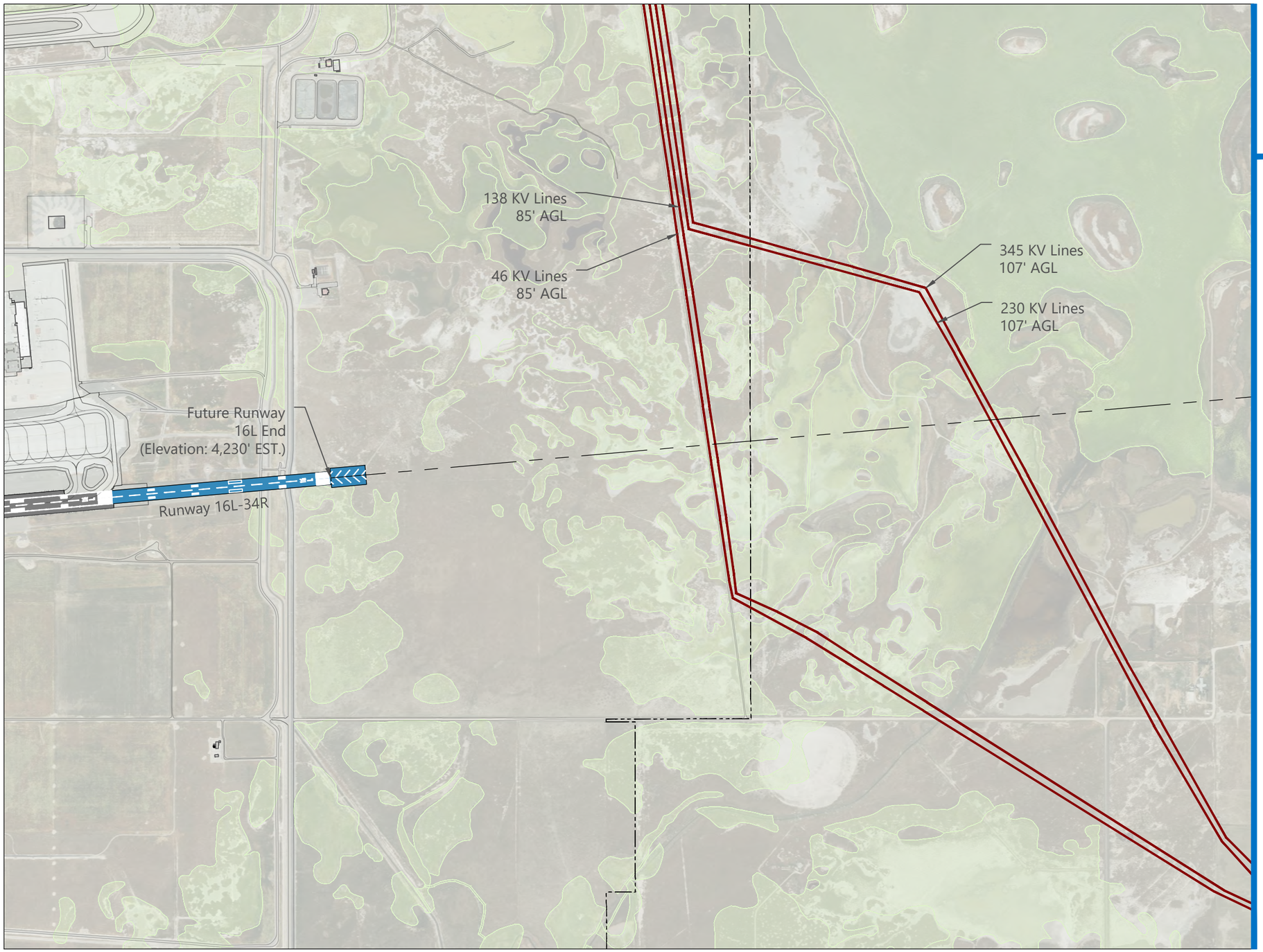
From discussions with Rocky Mountain Power, the rough cost of a mile of overhead high voltage line was approximately one million dollars. The rough cost provided for a buried high voltage line was ten million dollars per mile. Multiplying these values by the presumed quantities and installation methods needed for this alternative, the total project cost is anticipated to be $15.6 million dollars.

A graphic showing Alternative No. 3 is shown in the Appendix section at the end of this technical memorandum.

Conclusions

Each alternative would require the purchase of additional right-of-way easements, utility access roads, site improvements and impact wetlands. Comparing the three alternatives, Alternative No. 1 and 3 requires the least amount of capital investment compared to Alternative No. 2. The placement of overhead power lines directly relates to the operational performance of Runway 16L-34R. It is recommended when SLCIA conducts an advanced planning effort on the extension for Runway 16L-34R, the alternatives and conclusions made in this technical memorandum be refined as part of that effort.

Appendix Graphics



Existing Overhead Power Line Alignment

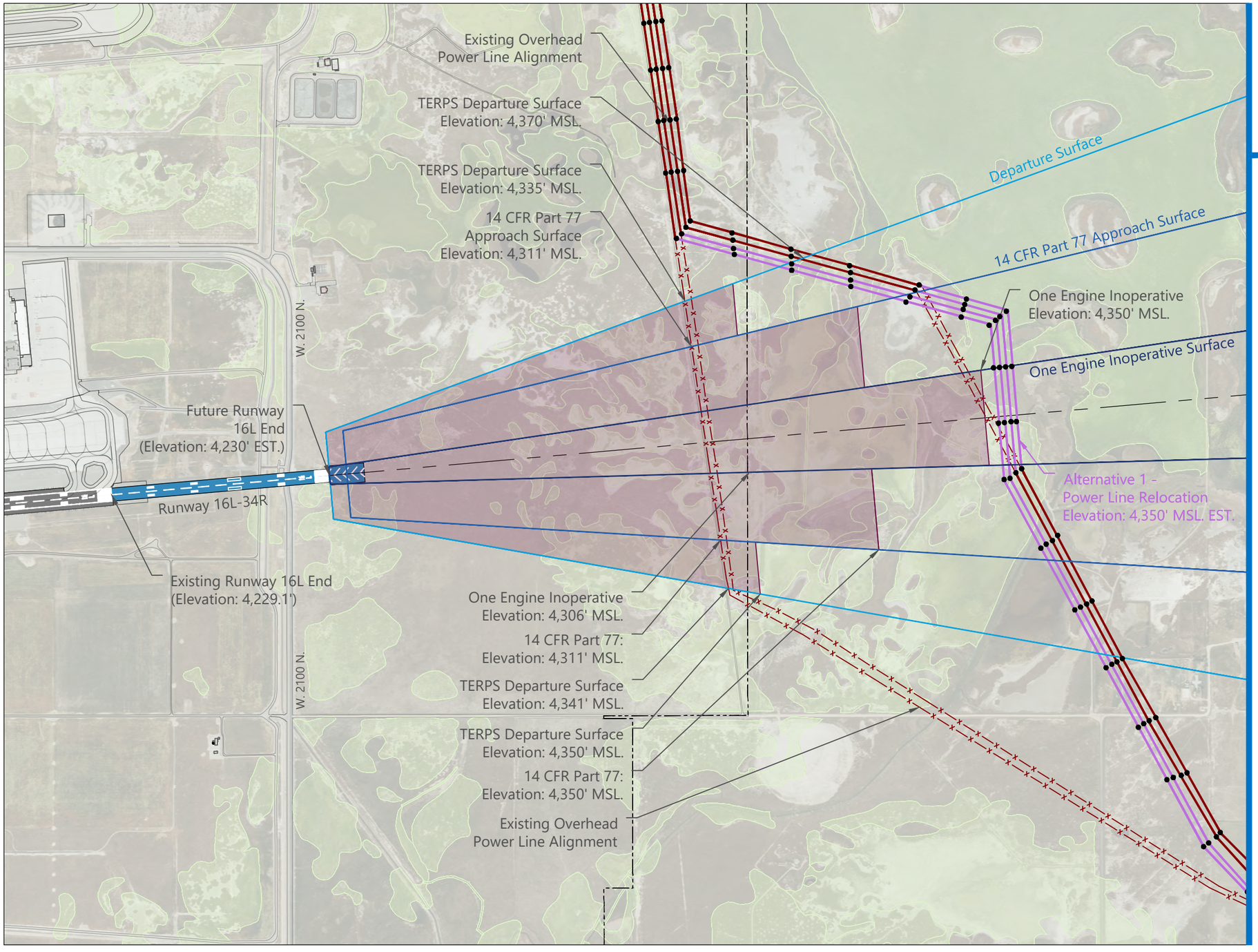
- Property Line
- Existing Runway Pavement
- Future Runway Pavement
- Wetlands
- Existing Overhead Power Line

Notes:

1) Wetlands delineations provided by Salt Lake City International Airport.

1,200' 600' 0' 1,200'

Scale 1":1,200'



Overhead Power Line Relocation Alterative 1

- Property Line
- Existing Runway Pavement
- Future Runway Pavement
- Wetlands
- TERPS Departure Surface
- 14 CFR Part 77 Approach Surface
- One Engine Inoperative Surface
- Critical Airspace Surfaces
- Existing Overhead Power Line
- Removed Overhead Power Line
- Future Overhead Power Line (Relocation)
- Future Overhead Power Line (Buried)
- Overhead Pole Structure / Island

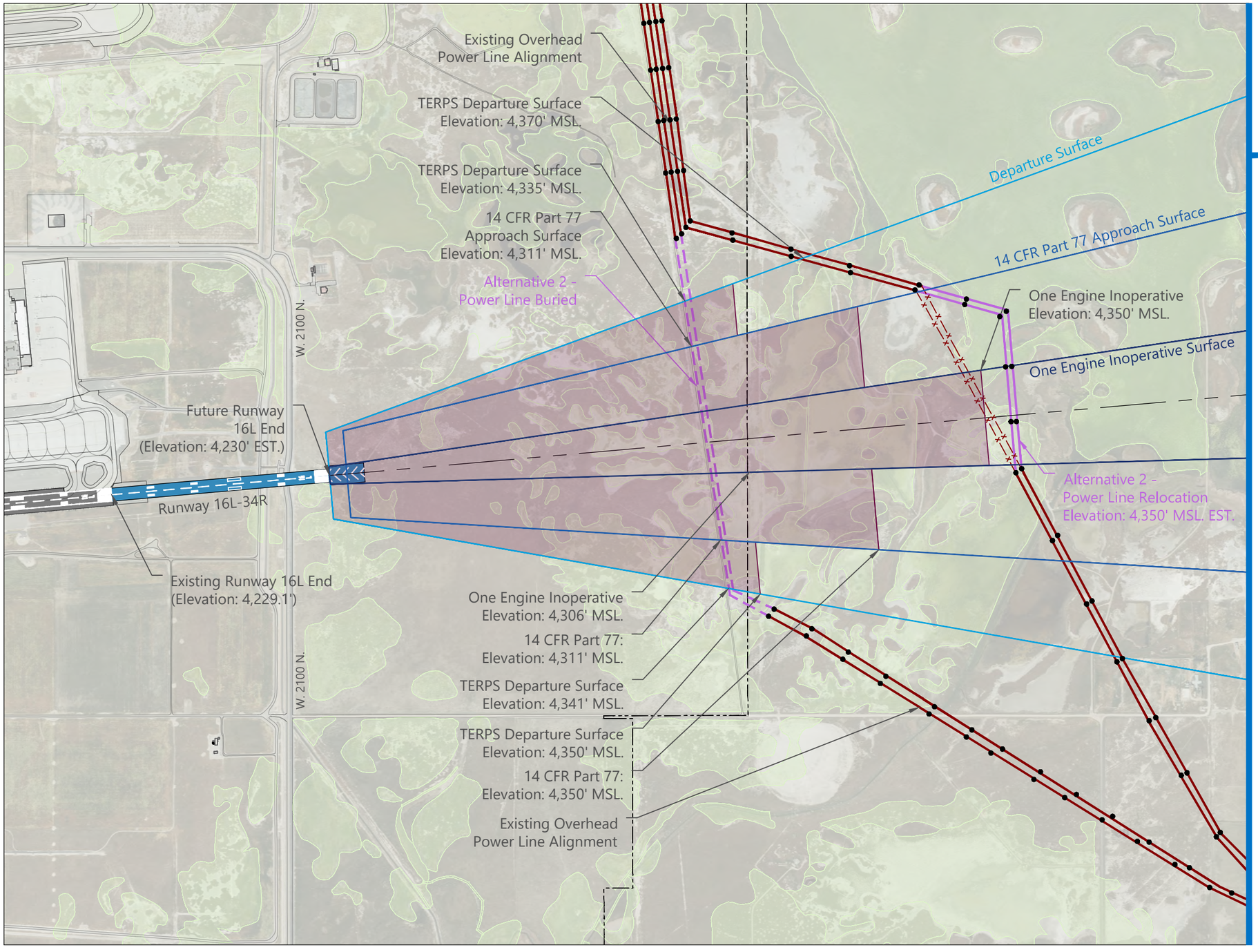
Notes:

1) Assumed structure height for relocated power lines is 4,350' MSL. Actual height may vary.
2) One engine inoperative surface was evaluated at a 62.5:1 sloping surface.
3) Wetlands delineations provided by Salt Lake City International Airport.

N

1,200' 600' 0' 1,200'

Scale 1":1,200'



Overhead Power Line Relocation Alterative 2

- Property Line
- Existing Runway Pavement
- Future Runway Pavement
- Wetlands
- TERPS Departure Surface
- 14 CFR Part 77 Approach Surface
- One Engine Inoperative Surface
- Critical Airspace Surfaces
- Existing Overhead Power Line
- Removed Overhead Power Line
- Future Overhead Power Line (Relocation)
- Future Overhead Power Line (Buried)
- Overhead Pole Structure / Island

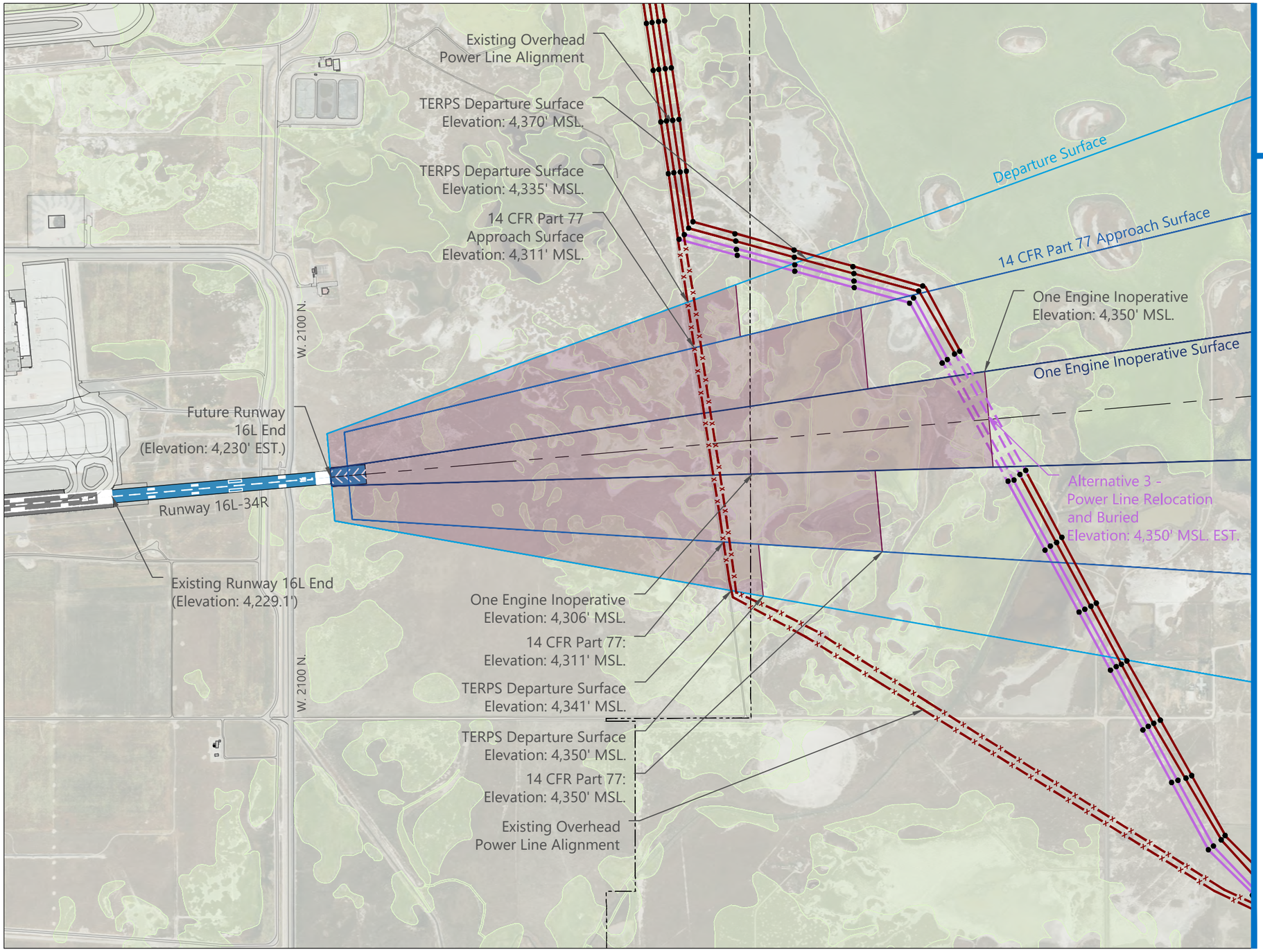
Notes:

1) Assumed structure height for relocated power lines is 4,350' MSL. Actual height may vary.
2) One engine inoperative surface was evaluated at a 62.5:1 sloping surface.
3) Wetlands delineations provided by Salt Lake City International Airport.

N

1,200' 600' 0' 1,200'

Scale 1":1,200'



Overhead Power Line Relocation Alterative 3

- Property Line
- Existing Runway Pavement
- Future Runway Pavement
- Wetlands
- TERPS Departure Surface
- 14 CFR Part 77 Approach Surface
- One Engine Inoperative Surface
- Critical Airspace Surfaces
- Existing Overhead Power Line
- Removed Overhead Power Line
- Future Overhead Power Line (Relocation)
- Future Overhead Power Line (Buried)
- Overhead Pole Structure / Island

Notes:

1) Assumed structure height for relocated power lines is 4,350' MSL. Actual height may vary.
2) One engine inoperative surface was evaluated at a 62.5:1 sloping surface.
3) Wetlands delineations provided by Salt Lake City International Airport.

N

1,200' 600' 0' 1,200'

Scale 1":1,200'

APPENDIX B
RUNWAY 17-35 REALIGNMENT

v2.0

1.0 REALIGNED RUNWAY 17-35 ANALYSIS AND EVALUATION

Runway 17-35 was studied extensively in the 1996 Master Plan and the 2006 Airport Layout Plan Update. The focus of those studies was on the capacity improvement a realigned Runway 17-35 could potentially provide as a third parallel runway. Air traffic separation rules, instrument procedure design criteria and fleet mix at SLC have changed since those studies were completed, and this master plan study re-analyzed the ideal separation from Runway 16L-34R and the capacity and operational benefits that could be realized with that separation.

Parallel runway separation requirements, detailed in **Table 4-1**, are correlated with different levels of dependency and independency for parallel runway operations under visual (VMC) and instrument meteorological conditions (IMC). The 2006 Airport Layout Plan Update recommended the realigned runway be sited between 2,500 and 4,300 feet from existing Runway 16L-34R. At a minimum of 2,500 feet, simultaneous dependent approach operations between runways in IMC conditions can be provided. As separation between runways increases beyond 3000 feet additional ATC and capacity benefits may be realized but there are substantial impacts to existing ground facilities and additional potential restrictions to the instrument approach procedures needed to fully realize the benefits of a realigned runway.

TABLE 4-1
RUNWAY SEPARATION REQUIREMENTS

Runway Separation Requirements					
Runway Separation	**VMC**		**IMC**		**Comment**
	Approach	**Departure**	**Approach**	**Departure**	
700'	See Comment	See Comment	Dependent	Dependent	Independent operations for ADG-I through IV aircraft
1,200'	See Comment	See Comment	Dependent	Dependent	Independent operations for ADG-I through IV aircraft
2,500'	Independent	Independent	Dependent	See Comment	Simultaneous radar departures only
3,500'	Independent	Independent	Dependent	Independent	Simultaneous radar and non-radar departures
3,600'	Independent	Independent	See Comment	Independent	PBN instrument dual approach to an offset final approach course (FAC) or a procedure paired with an offset FAC.
3,900'	Independent	Independent	See Comment	Independent	PBN instrument triple approach to an offset final approach course (FAC) or a procedure paired with an offset FAC.
4,300'	Independent	Independent	See Comment	Independent	Dual simultaneous precision instrument approaches
5,000'	Independent	Independent	See Comment	Independent	Triple simultaneous precision instrument approaches for airports below 1,000 feet MSL.
9,000	Independent	Independent	See Comment	Independent	Triple approaches requires identification and clearances of No Transgression and Normal Operating Zones. No PRM required.

Source: FAA Order 711065Y Air Traffic Control, FAA Order 8260.3D United States Standard for Terminal Instrument Procedures (TERPS), FAA AC 150/5300-13A Change 1 Airport Design, 2020

Notes:

1) Table values assume runways have a true parallel alignment.
2) Values and conditions provided are general planning values. Actual operating conditions may vary and upon FAA review and approval.
3) When runway thresholds are staggered and the approach is to the near threshold, separation can be reduced by 100 feet for each 500 feet of threshold stagger.
4) When runway thresholds are staggered and the approach is to the far threshold, separation must be increased by 100 feet for each 500 feet of threshold staggered.
5) The minimum runway centerline separation distance recommended for ADG-V and VI runways is 1,200 feet. Air Traffic Control (ATC) practices, such as holding aircraft between the runways, frequently justify greater separation distances. Runway with centerline spacings under 2,500 feet are normally treated as a single runway by ATC when wake turbulence is a factor.
6) Operations less than 9,000 feet require a No Transgression Zone (NTZ).
7) PRM approach must be assigned when conducting instrument approaches to dual and triple parallel runways centerlines spaced by less than 4,300 feet.

As part of this master plan, a comprehensive airspace analysis was conducted which included flight procedure redevelopment concepts and a study of the existing airspace. This analysis provided a deeper understanding of the potential performance characteristics of a realigned Runway 17-35 using current and emerging Performance Based Navigation technologies. In evaluating the potential of a realigned runway with various separations from Runway 16L-34R, a carte blanche approach was taken assuming an entirely new set of instrument approach procedures would be developed to support the new runway and, where necessary, missed approach procedures to 34R could be modified to achieve 8260.3D triple simultaneous procedure criteria.

The analysis examined geospatial considerations, including obstacle and terrain impacts from the perspective of TERPS procedure design criteria, as well as resulting approach procedure minima for all relevant runway separations for various types of applicable instrument procedures. The flight procedure analysis assessed the viability and potential utility of instrument approaches, missed approaches, and departure procedures that must integrate with operations on the other runways in ways that maximize the benefits of a now parallel Runway 17-35.

The baseline for separation analysis began with 2,500 feet from Runway 16L-34R, as that separation is the minimum required for independent simultaneous departures, and mixed departure/arrival operations between the center runway and a realigned Runway 17-35.

Separation requirements for runways are based on what is termed for the purpose of this report as a "separation window." The separation window is the range of runway centerline to centerline separation distances, starting from the baseline separation up to the next separation category, where a new level of FAA and ATC rules are applied. Each window provides different levels of runway independence from adjacent parallel runways. Current technologies influence the capabilities within these windows and can sometimes provide performance benefits attributed to higher levels of separation within a lower window. Thus, additional separation required to account for threshold stagger between the center and realigned runway falls within each separation window. Below, flight procedure considerations and ATC considerations for each runway separation window are described.

2,500 to <3,000 Feet Separation Window:

- Flight Procedure Considerations
  - Realignment of the runway allows for straight-in instrument approach procedures to a realigned runway 17 and 35 that would both be capable of CAT III ILS instrument approach minimums supporting CAT A – E.
  - Realignment of the runway does not change the current departure procedure climb gradients or capabilities in this separation window.
  - Missed approach procedures for runways 34L, 34R and a now parallel 35 can be successfully reconfigured to deconflict the airspace and allow for simultaneous approaches during north flow.
  - Missed approach procedures to 16L, 16R and a now parallel 17 can be reconfigured to allow simultaneous usage during south flow.
  - A realigned Runway 17 missed approach, or the existing 16L missed approach, cannot achieve 45 degree separation from each other due to terrain limitations resulting in excessive missed approach climb gradients and/or EGPWS warnings.
  - A wider variety of ILS, RNAV and RNP approaches with minimums below those of existing procedures are available to Runway 17-35 in this configuration due to the elimination of the LDA/GS and establishment of higher performance NAVAIDs and approach lighting on 17 and 35.
  - In the event that ATC wanted to persist with 2.5 – 3.0 degree longitudinal aligned procedures, this separation window would continue to support that alignment, but it would come at the cost of ILS CAT II/III

» ATC Considerations
- Simultaneous IMC departures are achievable at runway separations down to 2,500 feet however achieving this requires diverging departure paths which may only be achievable for north flow.
- If the center runway is to be extended to 14,500 feet, additional dependencies will be introduced in mixed approach and departure south flow with runway separations less than 3,000 feet, which will reduce the overall benefit of the runway realignment.
- Runway separations less than 3,000 feet provide approach spacing less than that of the existing configuration in both north and south flow. Both Tower and TRACON have expressed concerns over TCAS events and any reduced spacing may exacerbate such situations. However, it may be possible that straight-in, aligned approach procedures would alleviate centerline deviations and thus reduce TCAS events despite tighter centerline spacing. At a minimum, initial approach segments would likely need to be redesigned to reduce TCAS during altitude transition and runway alignment.
- Within this separation window when the two outboard runways do not achieve 9,000 feet separation, they will not be considered independent runways in IMC conditions. Additional approach monitor controllers would be required for simultaneous approach operations.

» Other Considerations/Analysis Results
- SLC could consider the usage of CSPO (FAA Order 7110.308) to achieve simultaneous approach operations between 16L/34R and a realigned 17/35, but it would come at significant operational and ATC acceptance and may require additional High Update Radar investment and FAA simulation.
- It is possible to create/modify instrument approach procedures to minimize changes to areas that might be impacted by noise. In some situations, this could result in CATEX for approaches to a realigned Runway 35.
- The possibility of achieving EoR approaches from the west downwind/STAR paths to a shortened IF is not likely to occur to a realigned Runway 17-35 in this separation window.

3,000 to <3,600 Feet Separation Window:

» Flight Procedure Considerations
- Realignment of the runway allows for straight-in instrument approach procedures to a realigned Runway 17 and 35 that would both be capable of CAT III ILS instrument approach minimums supporting CAT A – E.
- Realignment of the runway does not change the current departure procedure climb gradients or capabilities in this separation window.
- Missed approach procedures for runways 34L, 34R and a now parallel 35 can be successfully reconfigured to deconflict the airspace and allow for simultaneous approaches during north flow.
- Missed approach procedures to 16L, 16R and a now parallel 17 can be reconfigured to allow simultaneous usage during south flow.

- A realigned Runway 17 missed approach, or the existing 16L missed approach, cannot achieve 45 degree separation from each other due to terrain limitations resulting in excessive missed approach climb gradients and/or EGPWS warnings.
- A wider variety of ILS, RNAV and RNP approaches with minimums below those of existing procedures are available to Runway 17-35 in this configuration due to the elimination of the LDA/GS and establishment of higher performance NAVAIDs and approach lighting on 17 and 35.
- In the event that ATC wanted to persist with 2.5 – 3.0 degree longitudinal aligned procedures, this separation window would continue to support that alignment, but it would come at the cost of ILS CAT II/III.
- As runway separation approaches 3,600 feet, terrain requires some adjustment to the intermediate approach segment for an ILS approach to Runway 17 but no waivers or non-standard procedure design is required.

» ATC Considerations
- Simultaneous IMC departures are achievable, however this may require diverging departure paths which may only be achievable for north flow.
- Runway separations of 3,000 feet or more provide 9,000 feet of separation between the two outboard runways which allows ATC to conduct dual simultaneous approaches in IMC with no additional controllers.
- Separations beyond 3,000 feet begin to provide additional spacing for approaches when compared to today's configuration. That, when combined with the newly available straight-in approaches, should provide additional reduction in TCAS events in north flow.
- At separations of 3,400 feet or more simultaneous approaches between the 34R and 35 could be conducted with the introduction of a PRM system and appropriate missed approach procedure divergence.

» Other Considerations/Analysis Results
- It may be possible to create/modify instrument approach procedures to minimize changes to areas that might be impacted by noise. In some situations, this could result in CATEX for approaches to a realigned Runway 35.
- The possibility of achieving EoR approaches from the west downwind/STAR paths to a shortened IF is not likely to occur to a realigned Runway 17-35 in this separation window.

3,600 Feet to <3,900 Separation Window:

» Flight Procedure Considerations
- Realignment of the runway allows for straight-in instrument approach procedures to a realigned Runway 17 and 35 that would both be capable of CAT III ILS instrument approach minimums supporting CAT A – E.
- Realignment of the runway does not change the current departure procedure climb gradients or capabilities in this separation window.
- Missed approach procedures for runways 34L, 34R and a now parallel 35 can be successfully reconfigured to deconflict the airspace and allow for simultaneous approaches during north flow.

- Missed approach procedures to 16L, 16R and a now parallel 17 can be reconfigured to allow simultaneous usage during south flow.
- A realigned Runway 17 missed approach, or the existing 16L missed approach, cannot achieve 45 degree separation from each other due to terrain limitations resulting in excessive missed approach climb gradients and/or EGPWS warnings.
- A wider variety of ILS, RNAV and RNP approaches with minimums below those of existing procedures are available to Runway 17-35 in this configuration due to the elimination of the LDA/GS and establishment of higher performance NAVAIDs and approach lighting on 17 and 35.
- Terrain requires some adjustment to the intermediate approach segment for an ILS approach to Runway 17 but no waivers or non-standard procedure design is required.

» ATC Considerations

- At 3,600 foot spacing the airport may be able to leverage new rules for dual simultaneous approaches utilizing Established on RNP (EoR) criteria. These criteria are applicable for RNP or RNP to ILS instrument approaches.
- Simultaneous IMC departures are achievable, however this may require diverging departure paths which may only be achievable for north flow.
- Runway separations of 3,000 feet or more provides 9,000 feet of separation between the two outboard runways which allows ATC to conduct dual simultaneous approaches in IMC with no additional controllers.
- At separations of 3,400 feet or more simultaneous approaches between 34R and 35 could be conducted with the introduction of a PRM system and appropriate missed approach procedure divergence.
- At this separation window, the likelihood of TCAS RA events is considered to decrease significantly over what the airport and S56 may experience today. However, this would only be related to TCAS RAs associated with aircraft flying approaches to Runway 17 or 35.

» Other Considerations/Analysis Results

- The likelihood of achieving a CATEX for possible noise impacts related to instrument approach procedure changes is no longer considered feasible in this separation window
- The possibility of achieving EoR approaches from the west downwind/STAR paths to a shortened IF to a realigned Runway 17-35 is possible in this separation window but may require historical wind application and non-standard bank-angle/speed restrictions.

3,900 Feet to <4,300 Separation Window:

» Flight Procedure Considerations

- As separation increases in this window a pure ILS approach to Runway 17 is not possible under the current criteria without restricting the LOC course width or without making significant altitude changes to the intermediate segment which would reduce aircraft altitudes below those in use today. A possible alternative in this scenario is to utilize an RNAV to ILS approach to achieve the same minima.

- Intermediate segments for approaches to Runway 35 are beginning to be affected by the terrain but no criteria deviations are required.
- Realignment of the runway allows for straight-in instrument approach procedures to a realigned Runway 17 and 35 that would both be capable of CAT III ILS instrument approach minimums supporting CAT A – E.
- Realignment of the runway does not change the current departure procedure climb gradients or capabilities in this separation window.
- Missed approaches procedures for runways 34L, 34R and a now parallel 35 can be successfully reconfigured to deconflict the airspace and allow for simultaneous approaches during north flow.
- Missed approach procedures to 16L, 16R and a now parallel 17 can be reconfigured to allow simultaneous usage during south flow.
- A realigned Runway 17 missed approach, or the existing 16L missed approach, cannot achieve 45 degree separation from each other due to terrain limitations resulting in excessive missed approach climb gradients and/or EGPWS warnings
- A wider variety of ILS, RNAV and RNP approaches with minimums below those of existing procedures are available to Runway 17-35 in this configuration due to the elimination of the LDA/GS and establishment of higher performance NAVAIDs and approach lighting on 17 and 35.

» ATC Considerations

- At a 3,900 foot separation, triple simultaneous EoR approaches become possible.
- Simultaneous IMC departures are achievable, however this may require diverging departure paths which may only be achievable for north flow.
- Runway separations of 3,000 feet or more provides 9,000 feet of separation between the two outboard runways which allows ATC to conduct dual simultaneous approaches in IMC with no additional controllers.
- At separations of 4,300 feet or more simultaneous approaches between the 34R and 35 could be conducted with the introduction of a PRM system and appropriate missed approach procedure divergence.
- At this separation window, the likelihood of TCAS RA events is considered to decrease significantly over what the airport and S56 may experience today. However, this would only be related to TCAS RAs associated with aircraft flying approaches to Runway 17 or 35.

» Other Considerations/Analysis Results

- The likelihood of achieving a CATEX for possible noise impacts related to instrument approach procedure changes is not feasible in this separation window.
- The possibility of having to lower intermediate segment altitudes for approaches to Runway 17 may also create additional noise analysis challenges for areas north of the airport (15 – 20 nautical miles).
- The possibility of achieving EoR approaches from the west downwind/STAR paths to a shortened IF to a realigned Runway 17-35 is possible in this separation window

4,300 Feet to <5,000 Separation Window:

- Flight Procedure Considerations
  - RNAV to ILS approaches to Runway 17 will be required (no pure ILS/Radar approaches would likely work) in this separation window and may still require modifications to altitudes.
  - Intermediate segments for approaches to Runway 35 are affected by the terrain but no criteria deviations are required.
  - Realignment of the runway allows for straight-in instrument approach procedures to a realigned Runway 17 and 35 that would both be capable of CAT III ILS instrument approach minimums supporting CAT A – E.
  - Realignment of the runway does not change the current departure procedure climb gradients or capabilities in this separation window, but it would begin to have small impacts on the required departure climb gradients.
  - Missed approach procedures for runways 34L, 34R and a now parallel 35 can be successfully reconfigured to deconflict the airspace and allow for simultaneous approaches during north flow.
  - Missed approach procedures to 16L, 16R and a now parallel 17 can be reconfigured to allow simultaneous usage during south flow.
  - A realigned Runway 17 missed approach, or the existing 16L missed approach, cannot achieve 45 degree separation from each other due to terrain limitations resulting in excessive missed approach climb gradients and/or EGPWS warnings.
  - A wider variety of ILS, RNAV and RNP approaches with minimums below those of existing procedures are available to Runway 17-35 in this configuration due to the elimination of the LDA/GS and establishment of higher performance NAVAIDs and approach lighting on 17 and 35.
- ATC Considerations
  - At 4,300 foot separation the airport may be able to achieve dual simultaneous approaches between Runway 34R and 35 without the use of a PRM system. As SLCIA is more than 1,000 feet above sea level, an aeronautical study would need to be conducted in order to realize this benefit and a Final Monitor Aid is still required.
  - Within this separation window, triple simultaneous EoR approaches become possible.
  - Simultaneous IMC departures are achievable, however this may require diverging departure paths which may only be achievable for north flow departures.
  - At this separation window, the likelihood of TCAS RA events is considered to decrease significantly over what the airport and S56 may experience today. However, this would only be related to TCAS RAs associated with aircraft flying approaches to Runway 17 or 35.
- Other Considerations/Analysis Results

- The likelihood of achieving a CATEX for possible noise impacts related to instrument approach procedure changes is not feasible in this separation window
- The possibility of having to lower intermediate segment altitudes for approaches to Runway 17 may also create additional noise analysis challenges for areas north of the airport (15 – 20 nautical miles).
- The possibility of achieving EoR approaches from the west downwind/STAR paths to a shortened IF to a realigned Runway 17-35 is possible in this separation window.

5,000 Feet and Greater:

» Flight Procedure Considerations
- Flight procedures in both directions become severely constrained and certain procedures are either not possible or require increased minima to be developed.

» ATC Considerations
- As the airport is above 1,000 feet MSL, triple simultaneous instrument approaches may be possible at this spacing with an aeronautical study.

» Other Considerations/Analysis Results
- The possibility of achieving EoR approaches from the west downwind/STAR paths to a shortened IF to a realigned Runway 17-35 is possible.

3.0.1 Analysis Conclusion and Alternative Evaluation

The results of the analysis found the baseline window of separation to site the runway is the 3,000 to 3,600 feet separation window. This separation window provides the maximum potential for capacity improvement, and balances enhanced approach performance characteristics with impacts to existing facilities. Separation below 3,000 feet introduces ATC challenges and dependencies that do not exist today and would reduce the achievable capacity benefits substantially.

The next higher category of separation, 3,600 to 3,900 feet, may allow for EoR approaches. However, this is a marginal advantage when compared to the substantial impacts to east side facilities at that level of separation. The 4,300 to 5,000 feet separation window presents substantial challenges with obstacle avoidance and procedure design. The analysis indicated that flight procedures may be designed to standard at this separation, but the complexity and extremity of the procedures would not be recommended for implementation. Thus, the 4,300 to 5,000 feet separation window and beyond are considered unfeasible at SLC.

The 3,000 foot separation provides the minimum 9,000 feet separation between the realigned runway and Runway 16R-34L, which prevents the need for additional monitor controllers for simultaneous operations between the west (16R-34L) and east runways (realigned 17-35).

At 3,000 feet of separation, it is expected that TCAS alerts will occur on occasion. In discussions with ATCT TRACON and SLCDA planning staff, questions around TCAS arose as to whether marginal increases in separation up to a few hundred feet would help resolve these issues. Analysis of flight paths indicate that

TCAS alert potential would not be eliminated with separation of 3,200 or 3,300 feet, but the impacts to east facilities on the airfield would be greater.

The project team engaged in a brief independent review of historical TCAS situations, available via the NASA ASRS, and discovered that several of the TCAS RA issues noted between 2018 – 2020 resulted from aircraft on initial approach. It is expected that by the time a realigned Runway 17-35 is implemented at SLC, technology enhancements and possible airspace redesign (via an upcoming FAA PBN FWG) will allow further precision, and/or the airlines and FAA will create new feeder and initial approach routes that alleviate some of the existing issues.

At 3,000 feet separation, noise contours related to the realigned runway will not deviate much from those created by the runway's current alignment. Thus, it can be expected that a CATEX would be feasible as it relates to off airport impacts. If the runway is separated more than 3,000 feet, an EIS is expected to be triggered as noise patterns would be placed over residential areas that currently are outside of noise contours and current flight paths.