Appendix H-7
LAX SPECIFIC PLAN AMENDMENT STUDY REPORT

Runway Safety Area Practicability Study
Runways 6L-24R & 6R-24L

April 2010

Prepared for:

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Los Angeles World Airports

Runway 6L-24R & 6R-24L Safety Area (RSA) Practicability Study

for Los Angeles International Airport

Prepared for:
Airports Facilities and Planning Division
Los Angeles World Airports

April 9, 2010
FINAL

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I. Introduction

In June of 2006, the Los Angeles Airports Division Office (ADO), Western-Pacific Region, of the Federal Aviation Administration (FAA) completed a Runway Safety Area Evaluation and Analysis for Los Angeles International Airport (LAX or the Airport) in accordance with FAA Order 5200.8, *Runway Safety Area Program*. The objective of the *Runway Safety Area Program* is to determine if each Runway Safety Area (RSA) meets FAA standards outlined in its Advisory Circular (AC) 150/5300-13, *Airport Design*. If RSAs do not meet standards, the FAA provides recommendations that will allow them to meet standards "to the extent practicable."

As part of the FAA's *Runway Safety Area Evaluation and Analysis*[1] conducted for LAX, the FAA determined that all RSAs at the Airport did not meet standards but concluded it would be practicable to improve each RSA. The FAA also proposed various RSA improvement alternatives that have been assessed along with new improvement alternatives in Section IV of this report. The FAA did acknowledge that RSA improvements for Runway 7R-25L would be made with the "LAX Runway 25L Relocation and Center Taxiway Project." This project has since been completed.

Ricondo & Associates, Inc. was tasked to identify, evaluate, and select a preferred RSA improvement alternative for Runways 6L-24R, 6R-24L, and 7L-25R. This report discusses the analyses and recommendations specifically for Runways 6L-24R and 6R-24L. The analyses and recommendations for Runway 7L-25R are provided in a separate report.

At the onset of this study, the FAA acknowledged that long-range plans to potentially redevelop the north airfield are currently under study and thus interim fixes necessary to comply with RSA standards may not be practicable prior to the FAA target date of December 31, 2015. The FAA added that it is expected however, that incremental improvements of the safety areas can be implemented in the short-term. This report focuses on potential RSA improvement alternatives prior the redevelopment of the north airfield.

The alternatives presented in this study were developed following a review of the previous RSA determination by the FAA, several meetings with Los Angeles World Airports (LAWA) Airport representatives and the FAA, and the development of order of magnitude construction cost estimates for each of the alternatives. Additionally, the practicability of RSA improvements was considered based on a review of airport operating characteristics, runway-use configurations, weather data, and aircraft operational characteristics. The RSA improvement alternatives were ranked in order of magnitude of construction complexity and costs. Based on FAA guidance, those alternatives that were not deemed financially feasible or otherwise had a negative impact on aircraft operations were not considered a viable or a practicable alternative. Recommendations provided by the FAA Los Angeles ADO to improve the RSAs were included to the greatest extent practicable.

The discussion of the analyses and the evaluation process is organized in these following sections:

- Inventory of Existing Conditions
- FAA Guidelines for RSA Conceptual Alternatives
- RSA Improvement Alternatives
- Financial Feasibility of RSA Improvements
- Comparative Evaluation of RSA Alternatives

[1] The FAA's Runway Safety Area Evaluation and Analysis report for LAX is included in **Appendix A**.

II. Inventory of Existing Conditions

This section documents an inventory of existing conditions for the airfield layout, runway length, and runway use configurations. The existing RSAs are also documented and their deficiencies quantified to the extent that they do not meet RSA standards. RSA deficiencies are the basis for the RSA improvement alternatives developed and evaluated later in this report. As the scope of this study did not require additional field surveys, the inventory of existing conditions has been derived from previous LAX studies. Drawings used in this document are from the 2005 LAX Airport Layout Plan (ALP) and aerial photography information.

2.1 Runway Layout and Facilities

As illustrated in **Figure 2-1**, the Airport has four parallel runways oriented in an east-west direction. Two runways, 6L-24R and 6R-24L, are north of the passenger terminal area and are generally referred to as the north airfield. The other runways, 7L-25R and 7R-25L, are south of the passenger terminal area, and are generally referred to as the south airfield. All runways are equipped with an instrument approach lighting system (ALS) and other visual approach aids. **Table 2-1** identifies the basic dimensional and approach lighting data for each runway. All runways are equipped with High Intensity Runway Lights (HIRL).

Table 2-1

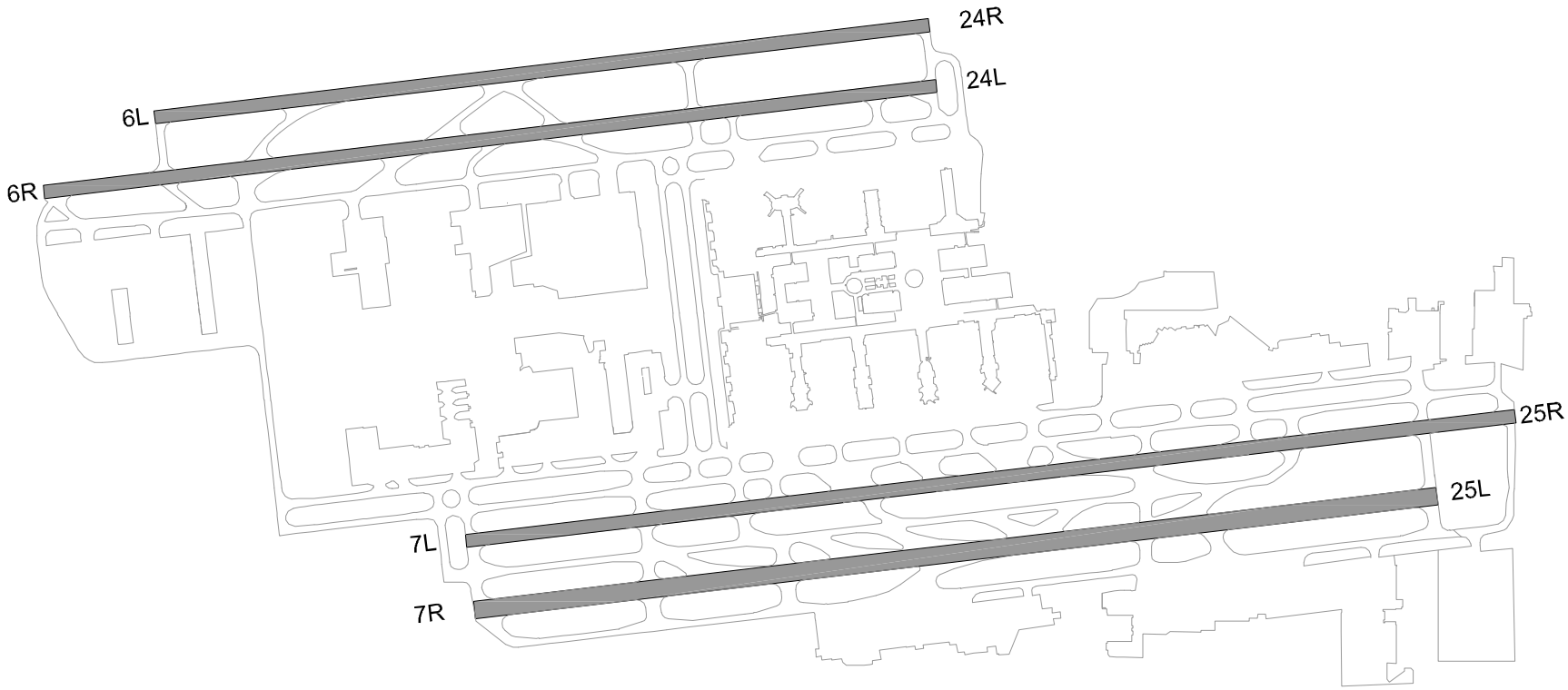
LAX Runway Data

Runway	Length x Width (ft)	Instrument Approach Lighting System (ALS)	Visual Approach Aids
6L	8,925 x 150	Medium-Intensity ALS (MALSR)	Precision Approach Path Indicator (PAPI) / Runway Visual Range (RVR)
24R		High Intensity ALS w/ Centerline Sequenced Flashers (ALSF-2)	Precision Approach Path Indicator (PAPI) / Runway Visual Range (RVR)
6R	10,285 x 150	Medium-Intensity ALS (MALSR)	Precision Approach Path Indicator (PAPI) / Runway Visual Range (RVR)
24L		Medium-Intensity ALS (MALSR)	Precision Approach Path Indicator (PAPI) / Runway Visual Range (RVR)
7L	12,091 x 150	Medium-Intensity ALS (MALSR)	Precision Approach Path Indicator (PAPI) / Runway Visual Range (RVR)
25R		Medium-Intensity ALS (MALSR)	Runway Visual Range (RVR)
7R	11,095 x 200	Medium-Intensity ALS (MALSR)	Precision Approach Path Indicator (PAPI) / Runway Visual Range (RVR)
25L		High Intensity ALS w/ Centerline Sequenced Flashers (ALSF-2)	Runway Visual Range (RVR)

Source: Airport/Facility Directory: Southwest U.S. Effective 0901Z 14 Feb, 2008 to 0901Z 10 Apr 2008. Published by the Department of Transportation, Federal Aviation Administration, And National Aeronautical Charting Office.

Prepared by: Ricondo & Associates, Inc.

Each runway at the Airport is equipped with a precision Instrument Landing System (ILS). The type of ILS and approach minimums for each runway is listed in **Table 2-2**.



Source: Los Angeles International Airport ALP, Landrum & Brown, 2005
Prepared by: Ricondo & Associates, Inc.

Figure 2-1

0 2,000 ft.
north

Airfield Layout

Table 2-2

LAX Runway Instrument Approach Minimums

Runway	ILS Category	Vertical Minimums (ft.)[1/]	Horizontal Minimums (ft.)[2/]
6L	CAT I	250	5,000
24R	CAT I	200	1,800
24R	CAT II	100	1,200
24R	CAT IIIa	0	700
24R	CAT IIIb	0	600
6R	CAT I	200	1,800
24L	CAT I	200	2,400
7L	CAT I	201	1,800
25R	CAT I	200	2,400
7R	CAT I	200	2,400
25L	CAT I	200	2,400
25L	CAT II	100	1,200
25L	CAT IIIa	0	700
25L	CAT IIIb	0	600

Notes:

1/ Denotes the decision altitude at which point the pilot must have the runway or its approach lights in sight to continue an approach.

2/ Denotes the horizontal visibility distance a pilot must have to continue an approach. For CAT I approach, the distance is from the pilot's perspective. For CAT II/III approaches, the distance is measured along the runway with instrumentation known as transmissometers that provide a runway visual range, or RVR distance.

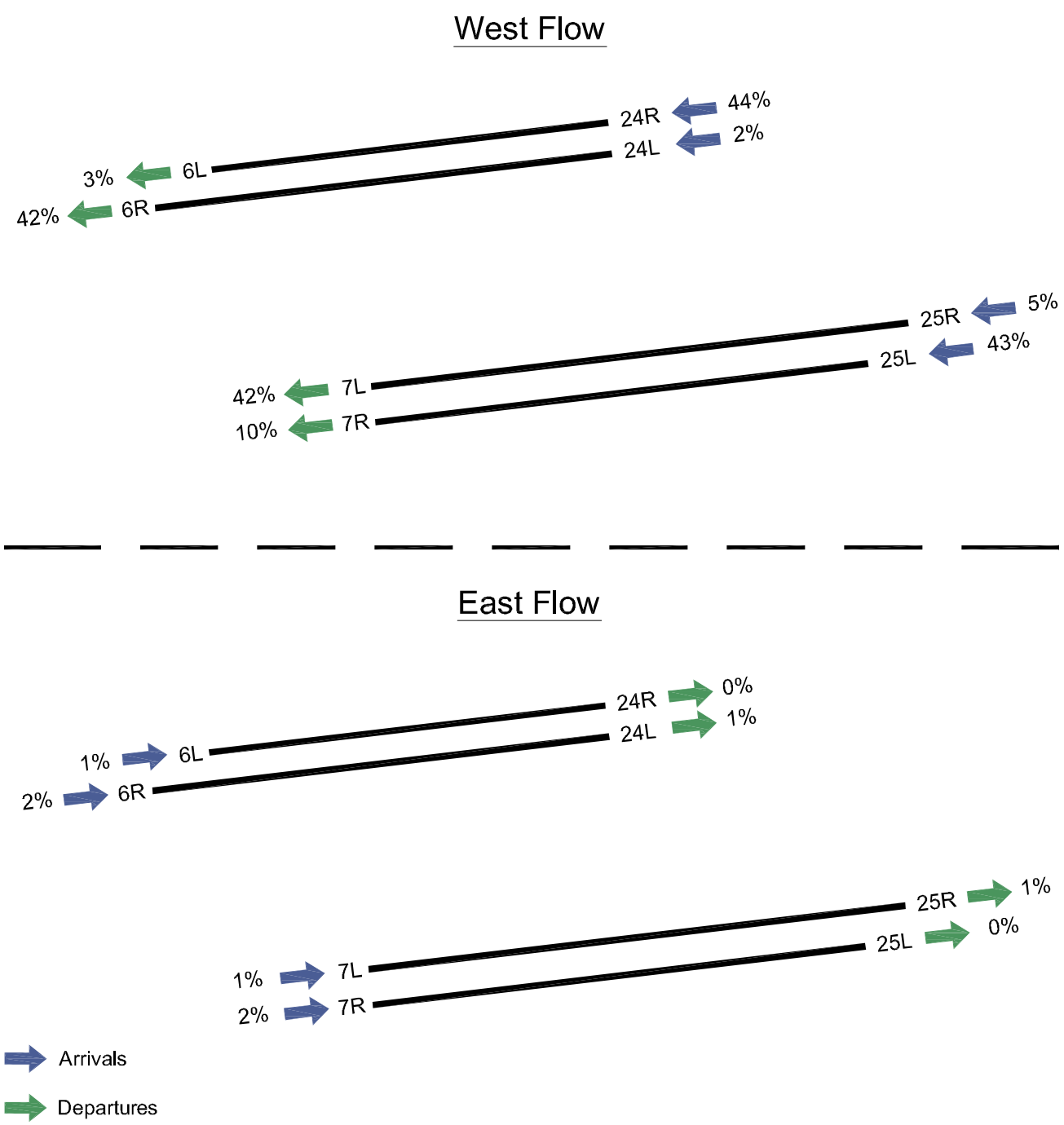
Source: ILS instrument approach procedures ("approach plates") for Los Angeles International Airport, Federal Aviation Administration, 2009.

Prepared by: Ricondo & Associates, Inc.

2.2 Runway Use

Standard Operating Procedures (SOPs) are in place at the LAX Air Traffic Control Tower (ATCT) and the Southern California Terminal Radar Approach Control (So Cal TRACON), which define runway assignment criteria for arrival and departure aircraft and their Standard Terminal Arrival (STAR) and Standard Instrument Departure (SID) assignment—the paths they take between the terminal and the enroute airspace when under instrument flight rules (IFR). The controller has the flexibility to balance traffic demand by dynamically metering runway assignments. The Airport has a waiver defined in FAA Order 8400.9, *National Safety and Operational Criteria for Runway Use Programs*, that permits operations with a tailwind component of up to 10 knots (the standard is 5 knots) and is applicable to wet and dry runways. Based on the criteria above, LAX airfield operations have been divided into four general configurations as shown in **Figure 2-2** and with the following percentage of use:

- VFR with visual approaches – West Flow (69.2%)
- VFR with simultaneous ILS approaches – West Flow (24.6)
- IFR with simultaneous ILS approaches – West Flow (4.1%)
- VFR with simultaneous ILS approaches – East Flow (2.1%)



Notes: 1. Operations data for the calendar year 2008.
2. Total percentages may not add up to 100% due to rounding.

Source: Los Angeles International Airport Noise Management.
Prepared by: Ricondo & Associates, Inc.

Figure 2-2

north

Runway Use Configurations

Due to the consistent weather conditions in the Los Angeles Basin, and the use of the tailwind component waiver, the Airport uses the more efficient West Flow arrival and departure operation 97.9 percent of the time between 06:30 (6:30 a.m.) and 23:59 (11:59 p.m.) local time.[2]

As illustrated in Figure 2-2, the primary arrival/departure runway configuration consists of arrivals on the outboard runways, Runways 6L-24R and 7R-25L, and departures on the inboard runways, Runways 6R-24L and 7L-25R. Weather conditions (ceiling height, visibility, and wind direction/speed) determine which configuration the FAA ATCT uses at a given time.

In addition to these normal operating configurations, LAX air traffic control is responsible for implementing noise abatement operating procedures and restrictions adopted by LAWA and the FAA[3] that mainly affect runway use and departure procedures:

- **Preferential Runway Use** - During the noise sensitive hours of 22:00 to 07:00, ATC is required to maximize use of inboard Runways 6R-24L and 7L-25R and Taxiways C and E. At all other times, the inboard runways have preference over the outboard runways for departures and, except for over-ocean operation procedures, the outboard runways are preferred over the inboard runways for arrivals.
- **Over-Ocean Operation** - over-ocean operation procedures are in effect between 24:00 and 06:30. Over-ocean operations consist of departures on Runway 24L and arrivals on Runway 7L.
- **Nighttime Standard Instrument Departure** - During the night hours, from approximately 21:00 until 07:00, the ocean departure (LAX TWO) is used for all IFR jet departures that would normally have been routed via San Diego, Seal Beach, or Loop SIDs. Between 24:00 and 07:00, the Ventura departure is used instead of the Gorman departures.
- **Departure Turns** - Unless specifically instructed otherwise by air traffic control, pilots of all aircraft departing toward the west are directed to maintain runway heading until past the shoreline before beginning any turns.
- **Intersection Departures** - Intersection departures are used only when it improves the overall efficiency of the traffic flow. The only intersections designated for intersection departures are Taxiways E8 and F for Runways 24L and 25R departures, respectively. There are no designated intersections for departures in east flow.

2.3 RSA Standards

As detailed in AC 150/5300-13, an RSA is defined as "an identified surface surrounding the runway prepared and suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway." The RSA has dimensional requirements as well as clearing, grading, and drainage requirements.

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[2] Aviation System Performance Metrics (ASPM), module Airport Efficiency (2000-2008), Accessed September 2008.

[3] *Aircraft Noise Abatement Operating Procedures And Restrictions*, LAX Rules and Regulations, LAWA, November 2008.

The dimensional requirements for an RSA reflect the design aircraft accommodated on the runway. As defined in AC 150/5300-13, both the Airplane Design Group (ADG), defined by an aircraft's wingspan, and the Aircraft Approach Category, defined by an aircraft's approach speed, are the basis for establishing RSA dimensions. RSA dimensions for the approach categories and ADG groupings are outlined in **Table 2-3**. Examples of Approach Category C aircraft generally consist of narrow-body jet aircraft, such as the Boeing 737. Approach Category D aircraft generally consist of wide-body aircraft, such as the Boeing B747-400 or the Airbus A380.

Grading requirements for RSAs mandate that the areas shall be cleared and graded with no potentially hazardous ruts, humps, depressions, or other surface variations. RSA grading must allow adequate drainage to prevent the accumulation of water. The installation of storm sewers is permissible within the RSA, but the elevation of the storm water inlets may not vary more than three inches from the surrounding surface elevation. The RSA limits for longitudinal and transverse grading are also outlined in Table 2-3.

Table 2-3

RSA Dimensional Requirements

Runway Safety Area (RSA) Dimensions and Grade Limitations	Approach Category C & D (ft)
RSA Width	500
RSA Length Prior to Landing	600
RSA Length Beyond the Runway	1,000

Distance Beyond Runway End	Transverse Grading
Initial 200 feet	1.5% to 5% grade, no positive
Beyond 200 feet [1/]	Maximum ± 5%

Notes:
1/ No penetration of approach surface permitted

Source: AC 150/5300-13, Airport Design, (Change 15)
Prepared by: Ricondo & Associates, Inc.

FAA standards also require that the terrain be *"…capable, under dry conditions, of supporting snow removal equipment, aircraft rescue and firefighting equipment, and the occasional passage of aircraft without causing structural damage to the aircraft; and free of objects, except for those that must be located in the runway safety area because of their function. Objects higher than three inches above grade should be constructed, to the extent practicable, on low impact resistant supports (frangible-mounted) at the lowest practical height with the frangible point no higher than three inches above grade."*

2.4 Existing Runway Safety Area

The primary focus of this report is to document the degree to which a RSA for Approach Category C & D aircraft exists relative to each runway end. The degree to which the existing available RSA differs from that required thereby frames the alternatives for improvement, which are subsequently developed and evaluated as described later in this document. The existing RSAs for Runways 6L-24R and 6R-24L are identified in the following paragraphs and figures.

2.4.1 Runway 6L-24R

As illustrated in **Figure 2-3**, the RSA for Runway 6L-24R is 500 feet wide for the full length of the runway; it extends 1,000 feet from the west end of the runway and 841 feet from the east end. The RSA at the west end meets all FAA requirements for arriving and departing aircraft operations. The RSA at the east end meets the 600-foot length requirement prior to the Runway 24R arrival threshold for landings, but it is 159 feet short of meeting the 1,000-foot requirement beyond the runway end for Runway 6L arrivals and departures. A service road and ditch located north of the runway are within the RSA dimension. Objects located east of the runway that would fall within the 1,000-foot RSA dimension include, but are not limited to, the Runway 6L localizer, a service road, a perimeter fence, a parking lot, and a portion of a public sidewalk along Lincoln Boulevard.

The FAA made a determination in 2006 that "the existing RSA does not meet standards but is practicable to improve." Furthermore, the FAA determined that the existing RSA could be incrementally improved at the east runway end by relocating the Runway 6L localizer, relocating the service road and perimeter fence, and using the application of declared distances.

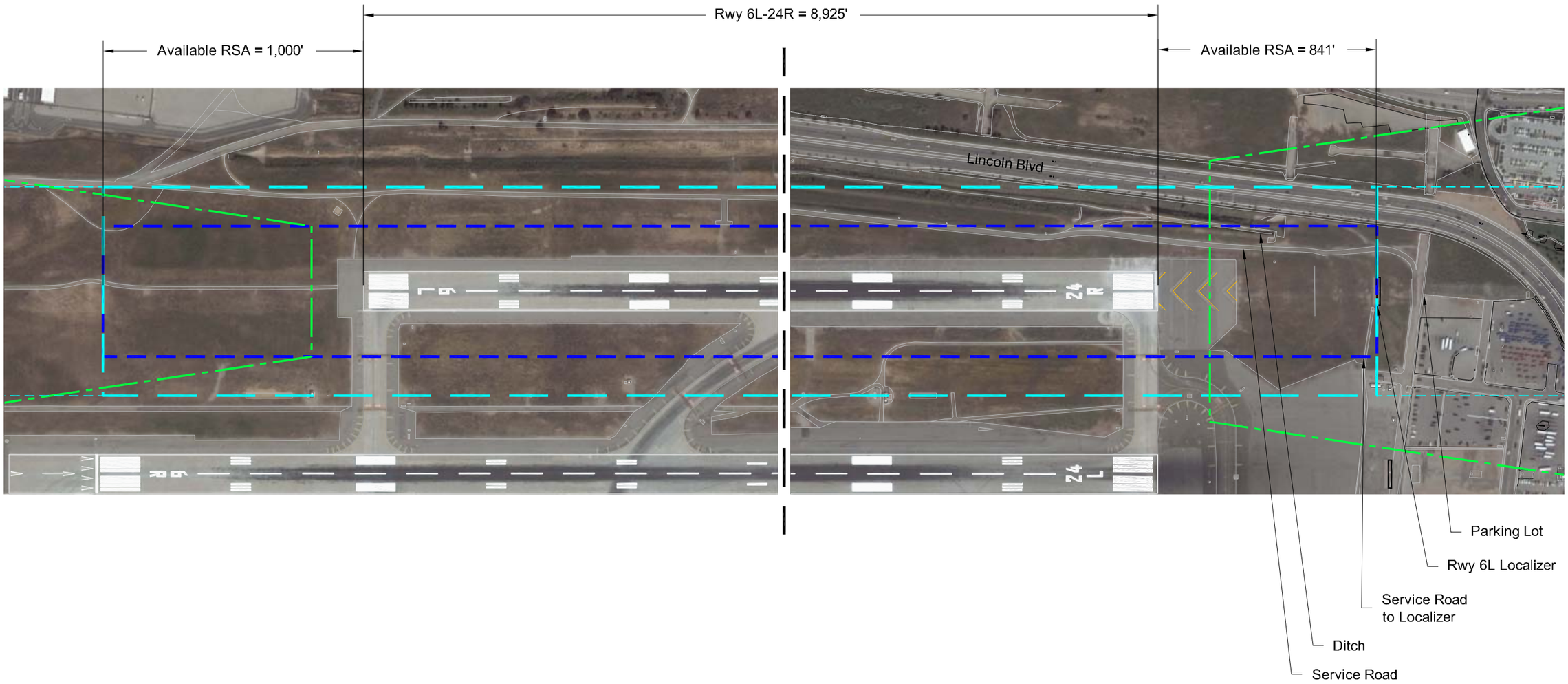
2.4.2 Runway 6R-24L

As illustrated in **Figure 2-4**, the RSA for Runway 6R-24L is 500 feet wide for the full length of the runway; it extends 165 feet from the west end of the runway and 885 feet from the east end. The RSA at the west end is 835 feet short of meeting the RSA standard beyond the runway end for Runway 24L arrivals and departures and 104 feet short of meeting the RSA 600-foot length requirement prior to the Runway 6R arrival threshold. At the east end, the RSA meets the 600-foot RSA length prior to the Runway 24L arrival threshold for landings, but it is 115 feet short of the 1,000-foot length requirement beyond the runway end for Runway 6R arrivals and departures. At the west end of the runway, objects that are within the standard RSA dimensions (1,000 by 500 feet) include, but are not limited to, a jet blast fence, a service road, a perimeter fence, a commercial roadway (Pershing Drive), and the dunes. At the east end of the runway, objects that are located with the standard RSA dimension (1,000 by 500 feet) include, but are not limited to, the Runway 6R localizer, portions of a service road and a parking lot, and perimeter fencing.

The FAA made a determination in 2006 that "the existing RSA does not meet standards but is practicable to improve." Furthermore, the FAA determined that the existing RSA may be incrementally improved by relocating the perimeter fence and installing an Engineered Materials Arresting System (EMAS) at the east runway end coupled with the application of declared distances.

III. FAA Guidelines for RSA Conceptual Alternatives

For developing the alternatives to improve the RSA of Runways 6L-24R and 6R-24L, considerations have been given to an appropriate balance of improvements allocated to their runway ends based on predominant direction of runway use, site constraints, environmental considerations, and implementation costs. The key FAA documents that have provided guidance in developing the conceptual alternatives include the FAA Order 5200.8 *Runway Safety Area Program*, FAA AC 150/5220-22A *Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns*, and FAA Order 5200.9 *Financial Feasibility and Equivalency of Runway Safety Area Improvements and Engineered Material Arresting Systems*. Consistent with the processes outlined in these documents, the conceptual alternatives for mitigating the RSA deficiencies include the following:



Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, Landrum & Brown, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

Figure 2-3

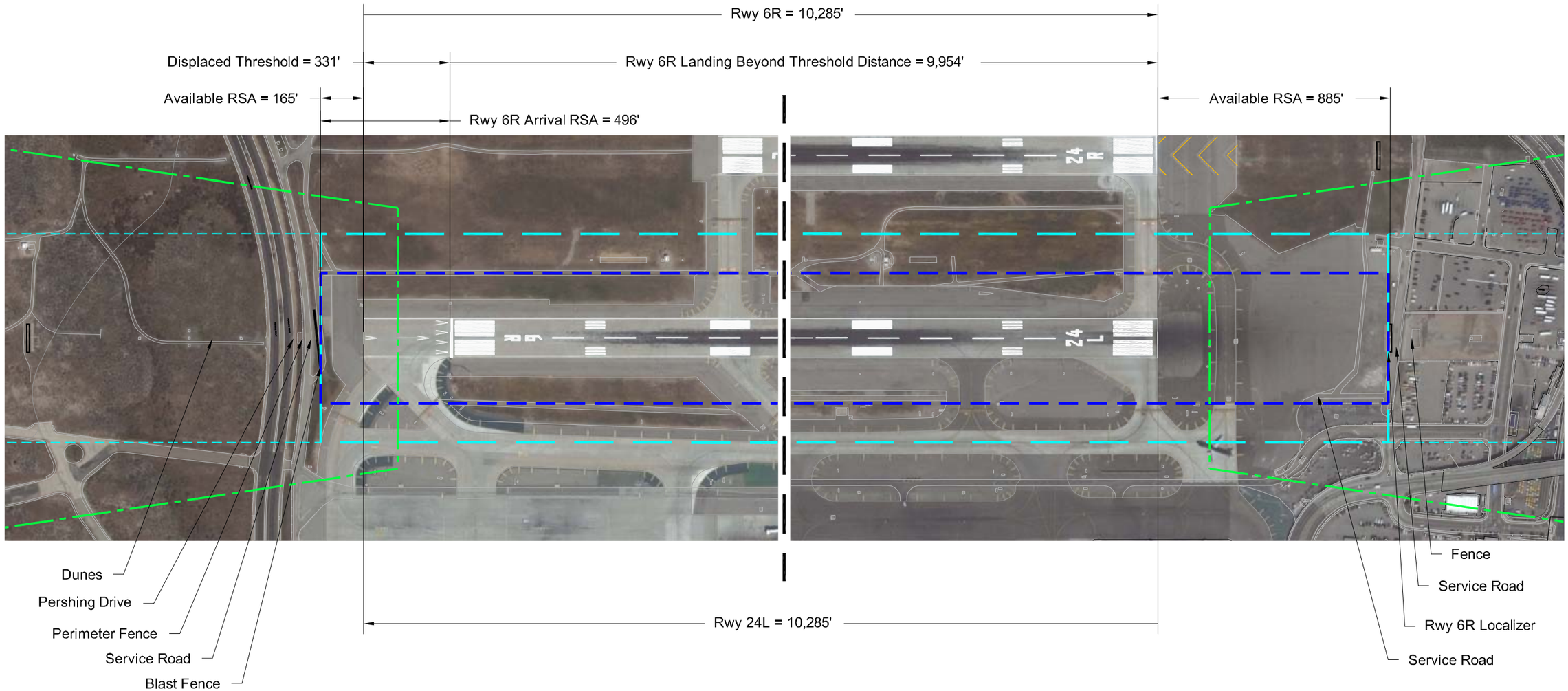
0 400 ft.

north

Legend:

- Runway Safety Area
- Runway Object Free Area
- Runway Protection Zone
- Central Portion of the RPZ

Runway 6L-24R
Existing Condition



Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

Figure 2-4

0 400 ft.

north

Acronyms:
TORA Take-Off Run Available
TODA Take-Off Distance Available
ASDA Accelerate-Stop Distance Available
LDA Landing Distance Available

Legend:
Runway Safety Area
Runway Object Free Area
Runway Protection Zone
Central Portion of the RPZ

Runway 6R-24L
Existing Condition

- Construct standard runway safety areas
- Reduce runway length
- Apply the use of declared distances—an FAA-approved exception to its standard runway requirements
- Relocate, shift, or realign the runway
- Install Engineered Materials Arresting System (EMAS)
- Develop a combination of alternatives to achieve a preferred alternative

3.1 Construct Standard RSAs

The first attempt at obtaining an RSA that meets the current standards—to the extent practicable— is investigating the possibility of traditional grading of the area surrounding the runway. Land acquisition, grading requirements, and environmental conditions must be examined.

3.2 Reduce Runway Length

Another alternative for meeting RSA standards is reducing the runway length. This is a feasible alternative if the current design aircraft requires less runway length than what is presently available, and the difference can accommodate the required RSA, or other runways, if available, can accommodate the larger aircraft without resulting in major impacts to airport operations.

3.3 Implement Declared Distances

Where it is impracticable to provide the clearances and dimensions for RSAs in accordance with FAA design standards, the implementation of declared distances is another alternative that may provide an acceptable means of providing an equivalent RSA. The FAA defines declared distances as "the distances the airport operator declares available and suitable for satisfying an aircraft's take-off run, take-off distance, accelerate-stop distance, and landing distance requirements." This approach requires a thorough understanding of user needs and views, since their cooperation is integral to selecting this alternative, although the Airport, in concert with the FAA, will determine the viability and final disposition of this alternative.

Declared distances are also used where different runway lengths are defined for each direction of operation (e.g., when displaced thresholds are present). Aircraft operators use these declared distances, along with weather data, aircraft performance characteristics, and market segments for flight planning, including the determination of payload and range restrictions. The application of declared distances at a specific airport requires prior FAA approval on a case-by-case basis. FAA approval will be secured through the ALP approval process set forth in the FAA Policy and Procedures Memorandum (PPM) 5300.2, *Guidance on Declared Distance Standards*[4]. The FAA defines four declared distances, which are described in the following subsections.

3.3.1 Take-off Run Available (TORA)

Take-Off Run Available (TORA) is defined as the runway length declared available and suitable for satisfying take-off run requirements. The TORA is measured from the start of take-off to a point 200 feet from the beginning of the departure Runway Protection Zone (RPZ). The RPZ is an area that extends from 200 feet beyond the runway end and that the FAA requires airports keep clear of

[4] Although declared distances are identified on the LAX ALP, LAWA officials have stated that the use of declared distances is not authorized for the airport operations at LAX.

incompatible objects and activities. The size and extent of the RPZ depend on the aircraft type and minimum visibility of the runway end. Thus, if land use constraints prevent an airport operator from positioning the departure RPZ 200 feet off the departure (lift-off) end of the runway, the TORA needs to be shorter than the length of the runway. The TORA therefore does not require a fully compliant, standard RSA at either runway end.

3.3.2 Take-Off Distance Available (TODA)

Take-Off Distance Available (TODA) is defined as the TORA plus the length of any remaining runway or clearway beyond the far end of the TORA. A clearway is defined as "an area beyond the runway, not less than 500 feet wide, centrally located about the extended centerline of the runway, and under the control of the airport authority. The clearway is expressed in terms of a clearway plane above which no object nor any terrain protrudes."[5] The plane extends upward from the end of the runway with a slope not exceeding 1.25 percent. Because the practical limit on clearway length is 1,000 feet, the TODA is typically no longer than the TORA plus 1,000 feet. The application of clearways for TODA is for turbine-powered aircraft only and cannot be applied to piston-powered aircraft. The TODA cannot be shorter than the TORA, and similar to TORA, the TODA does not require a fully compliant RSA at either runway end.

3.3.3 Accelerate-Stop Distance Available (ASDA)

Accelerate-Stop Distance Available (ASDA) is defined as the runway plus stopway length declared available and suitable for the acceleration and deceleration of an aircraft aborting its take-off. A stopway is an area beyond the take-off runway, no less wide than the runway and centered upon the extended centerline of the runway, able to support the airplane during an aborted take-off, without causing structural damage to the airplane. It is designated by the airport authorities for use in decelerating the airplane during an aborted take-off. If obstacles on the ground prevent the airport operator from providing standard RSAs or runway Object Free Areas[6] (OFAs) to meet runway design criteria beyond the runway end, an ASDA shall be applied.

3.3.4 Landing Distance Available (LDA)

Landing Distance Available (LDA) is defined as the runway length that is declared available and suitable for satisfying landing distance requirements. The LDA is measured from the arrival threshold of a runway, taking into account for arrivals that RSAs and OFAs must be provided behind the arrival threshold. The LDA is measured to the point where the RSA or OFA begins at the rollout end of the runway, or the runway end, whichever yields a shorter distance. The lengths of stopways are not included in the computation of the LDA. The LDA cannot be longer than the runway; however, if obstacles on the ground prevent the airport operator from providing standard RSAs or OFAs to meet runway design criteria beyond the runway end, an LDA shall be applied.

3.4 Relocate, Shift, or Realign the Runway

When obtaining a standard RSA is not practicable through traditional means (such as land acquisition, grading, and fill) or with the use of declared distances, other alternatives must be

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5 Federal Aviation Regulation (FAR), Part 1

6 An area on the ground centered on a runway, taxiway, or taxilane centerline provided to enhance the safety of aircraft operations by having the area free of objects, except for objects that need to be located in the runway OFA for air navigation or aircraft ground maneuvering purposes. FAA AC 150/5300-13 CHG 15, *Airport Design, 12/31/2009.*

explored. During some types of projects, it may be feasible to relocate, realign, shift, or change a runway in such a way that a standard RSA may be obtained.

3.5 Install Engineered Materials Arresting System (EMAS)

An Engineered Materials Arresting System (EMAS) consists of constructing an RSA that is made of high-energy materials that will crush and absorb the force of an aircraft, thereby arresting and decelerating its movement should it overrun the runway. In its description of this system, the FAA states that "a standard EMAS provides "a level of safety that is generally equivalent" to a full RSA built to the dimensional standards in AC 150/5300-13, *Airport Design*."[7] The EMAS must be designed to decelerate the design aircraft expected to use the runway at exit speeds of 70 knots without imposing loads in excess of aircraft design.[8] At any time, when it is not practicable to create a safety area that meets current standards, consideration should be given to enhancing the safety of the area beyond the runway end with the installation of EMAS.[9]

For purposes of installing an EMAS, the FAA defines the "design aircraft" as having at least 500 annual operations on the runway and having the most demand on EMAS. This is usually, but not always, the heaviest aircraft that regularly uses the runway.[10] For purposes of this study, the design aircraft for both Runways 6L-24R and 6R-24L is assumed to be the Airbus A380-800. In general, the maximum take-off weight (MTOW) for the design aircraft will be used for EMAS design; "however, there may be instances where less than MTOW will require a longer EMAS."[11] The aircraft sponsor, EMAS manufacturer, and the FAA Regional Airports Division/ADO should consult on the selection of the design aircraft best suited for the EMAS.[12] The FAA also notes the possibility that airports may consider designing the EMAS for a range of aircraft expected to use the runway rather than for a single design aircraft.[13] The engineered bed length will ultimately be determined during the design phase and could be different than what is assumed for this study.

To the extent that it may not be practicable to install a standard EMAS, a non-standard system having an EMAS bed length less than that required for the design aircraft may be installed if a standard RSA cannot otherwise be achieved. "When there is insufficient RSA available to provide a standard RSA, the EMAS must be designed to achieve the maximum deceleration of the design aircraft within the available RSA."[14]

3.6 Combination of RSA Alternatives

To the extent that any of the previous identified alternatives are not practicable on their own, although financially feasible, a combination of alternatives should be evaluated. For purposes of this study, these are also identified as refined alternatives.

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7 FAA AC 150/5220-22A; 4. *Application, 9/30/2005*.

8 Ibid. 8. *System Design Requirements*, g. *Entrance Speed*

9 FAA Order 5200.8, *Runway Safety Area Program* Appendix 2. Supporting Documentation for RSA Determinations; 4. Considerations in Assessing Alternatives, 10/01/1999.

10 FAA AC 150/5220-22A; 8. *System Design Requirements, c. Design Method*

11 Engineered Arresting Systems Corporation; FAA AC 150/5220-22A; 8. *System Design Requirements*

12 Ibid. 8. *System Design Requirements*, g. *Entrance Speed, 9/30/2005.*

13 Engineered Arresting Systems Corporation; FAA AC 150/5220-22A; 8. *System Design Requirements, 9/30/2005.*

14 FAA AC 150/5220-22A; 8. *System Design Requirement, c. Design Method.*

IV. RSA Improvement Alternatives

This section identifies potential RSA improvement alternatives for Runways 6L-24R and 6R-24L, which includes alternatives identified from the FAA's *Runway Safety Area Evaluation and Analysis* for LAX as well as alternatives identified during this study. The alternatives have been divided into two categories; 1) conceptual alternatives and, 2) refined alternatives. The conceptual alternatives were developed following the FAA guidelines listed in Sections 3.1 to 3.5, and the refined alternatives are additional RSA improvements based on a combination of the conceptual alternatives. The preliminary review and subsequent evaluation process for the alternatives were conducted by the Runway Safety Area Technical Team comprised of LAWA and FAA officials. The RSA Technical Team was responsible for identifying the pros and cons of the conceptual alternatives, providing suggestions for refined alternatives, and making final recommendations.

4.1 Runway 6L-24R

This section identifies and provides a preliminary review of all the RSA alternatives for Runway 6L-24R.

4.1.1 FAA Conceptual Alternatives

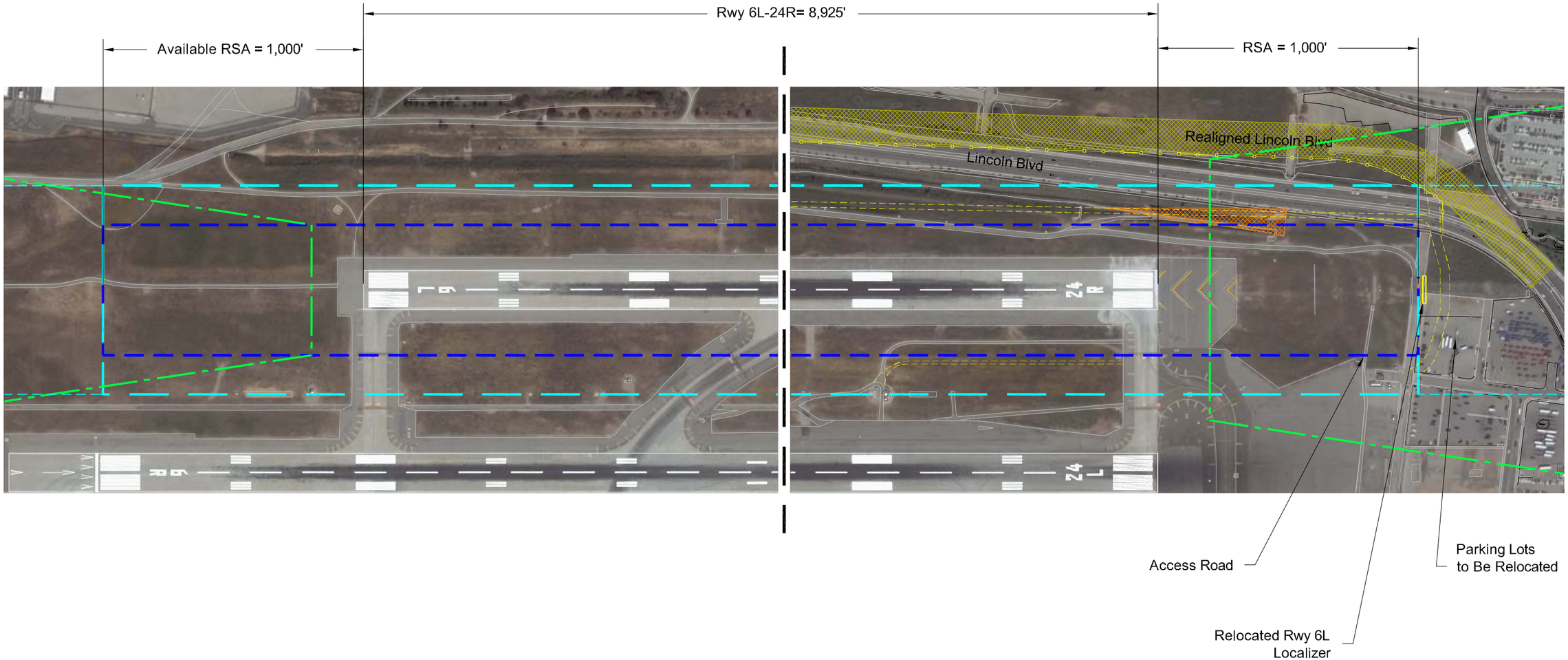
Based on the guidelines in FAA Order 5200.8, *Runway Safety Area Program*, the following five RSA conceptual alternatives were developed for Runway 6L-24R for comparative purposes.[15] These alternatives include the alternatives identified in the FAA's *Runway Safety Area Evaluation and Analysis* for LAX.

4.1.1.1 Construct Standard RSA

As depicted in **Figure 4-1**, this alternative proposes the construction of a standard RSA. It removes all objects within the RSA as defined by the 500-foot width and 1,000-foot length beyond the east end of the runway. At the east end, the Runway 6L localizer, an access road, and a perimeter fence would be relocated outside of the RSA. Additionally, the commercial vehicle holding lots located east of runway would require to be reconfigured to accommodate the relocation of the Runway 6L localizer and service road. Along the northern edge of the RSA, a service road would be relocated and the Argo Ditch would be covered. Lincoln Boulevard would be realigned to allow for the relocated service road and to remain clear of the runway OFA. This alternative maintains all current take-off and landing distances.

[15] Although the use of declared distances is not authorized by LAWA for airport operations, declared distance measurements have been added to all RSA alternatives for comparison purposes only.

Steps:
- Cover Ditch
- Relocate Service Roads
- Relocate Rwy 6L Localizer
- Relocate Parking Lots
- Realign Lincoln Blvd



Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, Landrum & Brown, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

Figure 4-1

0 400 ft. north

Legend:
- Runway Safety Area
- Runway Object Free Area
- Central Portion of the RPZ
- Realigned Lincoln Blvd
- Ditch to be Covered
- Runway Protection Zone
- Relocated AOA Fence
- Relocated Service Road

Runway 6L-24R
Standard Runway Safety Areas

4.1.1.2 Reduce Runway Length

As depicted in **Figure 4-2**, this alternative meets all RSA requirements by reducing the runway length to 7,532 feet. At the east end, the Runway 24R threshold is shown relocated west 1,393 feet to provide for 1,000 feet of RSA beyond the east end of the runway and allow Lincoln Boulevard to remain outside the OFA. The runway pavement east of the Runway 24R threshold and Taxiway V would be demolished and the service road relocated.

4.1.1.3 Implement Declared Distances

Figure 4-3 depicts the use of declared distances in meeting RSA requirements. This alternative proposes the covering of the Argo Ditch and the relocation of a service road along Lincoln Boulevard. The relocated service road would become the limiting object, providing for a 641-foot RSA beyond the Runway 24R end. In order to provide a 1,000-foot standard RSA on that end, declared distances would be implemented, reducing the Runway 6L ASDA and LDA by 359 feet, from 8,925 feet to 8,566 feet. This alternative would also provide the required minimum 600 feet of RSA prior to the Runway 24R landing threshold. No improvements are required on the Runway 6L end.

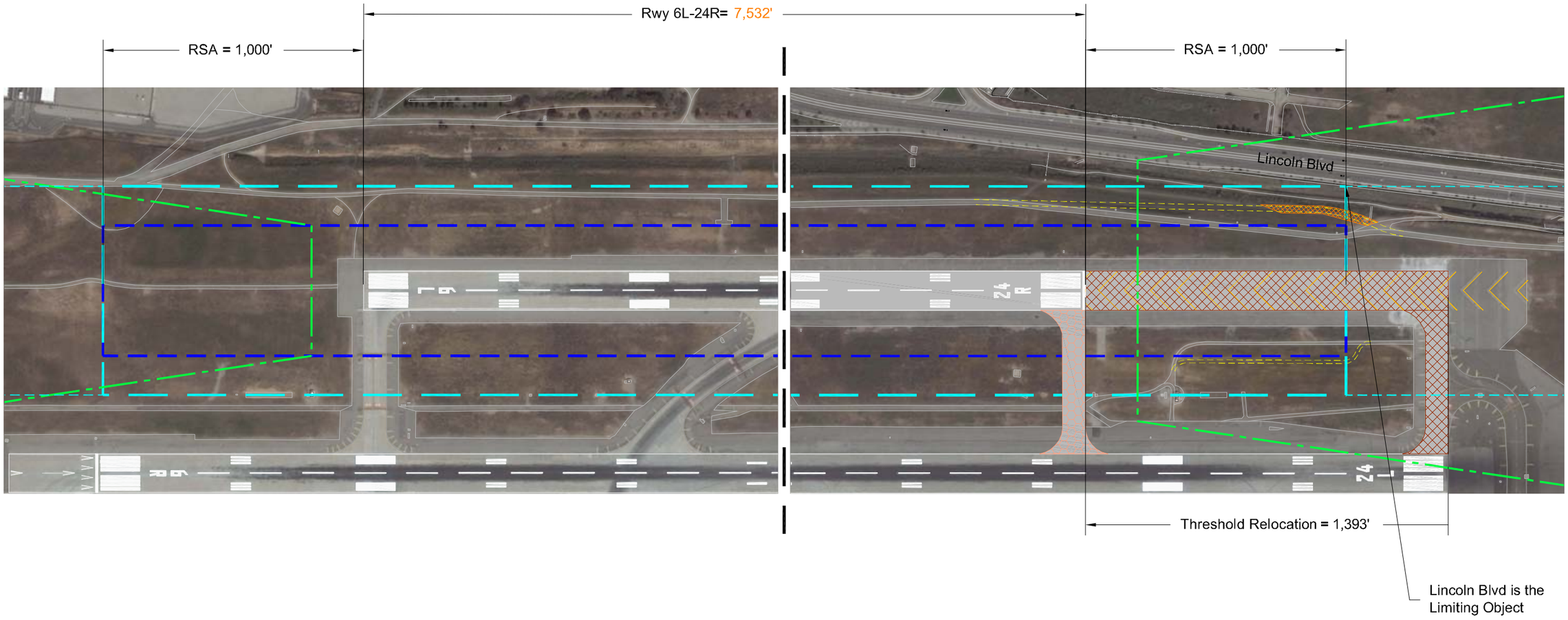
4.1.1.4 Shift Runway

As depicted in **Figure 4-4**, this alternative proposed the shift of the runway to the west to ensure all objects at the east end remain clear of the RSA. The service road around the west end of the runway would be relocated outside the RSA. The existing service road just east of Pershing Drive would become the limiting object and allow for a runway shift of 615 feet to the west. This would require 615 feet of new runway pavement at the west end and the demolition of 615 feet of runway pavement and a section of Taxiway V at the east end. New connector taxiways would be required at both ends of the shifted runway. At the east end, the north service road would be relocated outside the RSA and a portion of the Argo Ditch along Lincoln Boulevard would be covered. However, as shown, a section of Lincoln Boulevard would remain inside the OFA. This alternative would maintain all current take-off and landing distances.

4.1.1.5 Install Standard EMAS

As depicted in **Figure 4-5**, a standard 550-foot EMAS bed is proposed to be installed behind the Runway 24R end. This EMAS bed assumed a 50-foot setback from the Runway 24R threshold. Although the EMAS bed length is shown to be 550 feet, the ultimate length will be determined during the design phase and could be different than what is assumed for this study. Installation of a standard EMAS bed would require a 600-foot RSA on the east end, necessitating the covering of a portion of the Argo Ditch along Lincoln Boulevard and relocation of the service road. A portion of Lincoln Boulevard would remain inside the OFA. This alternative would maintain all current take-off and landing distances.

Steps:
- Relocate Rwy 24R Threshold
- Relocate Rwy 24R MALSR
- Reconfigure Taxiways
- Cover Ditch
- Relocate Service Roads



Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, Landrum & Brown, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

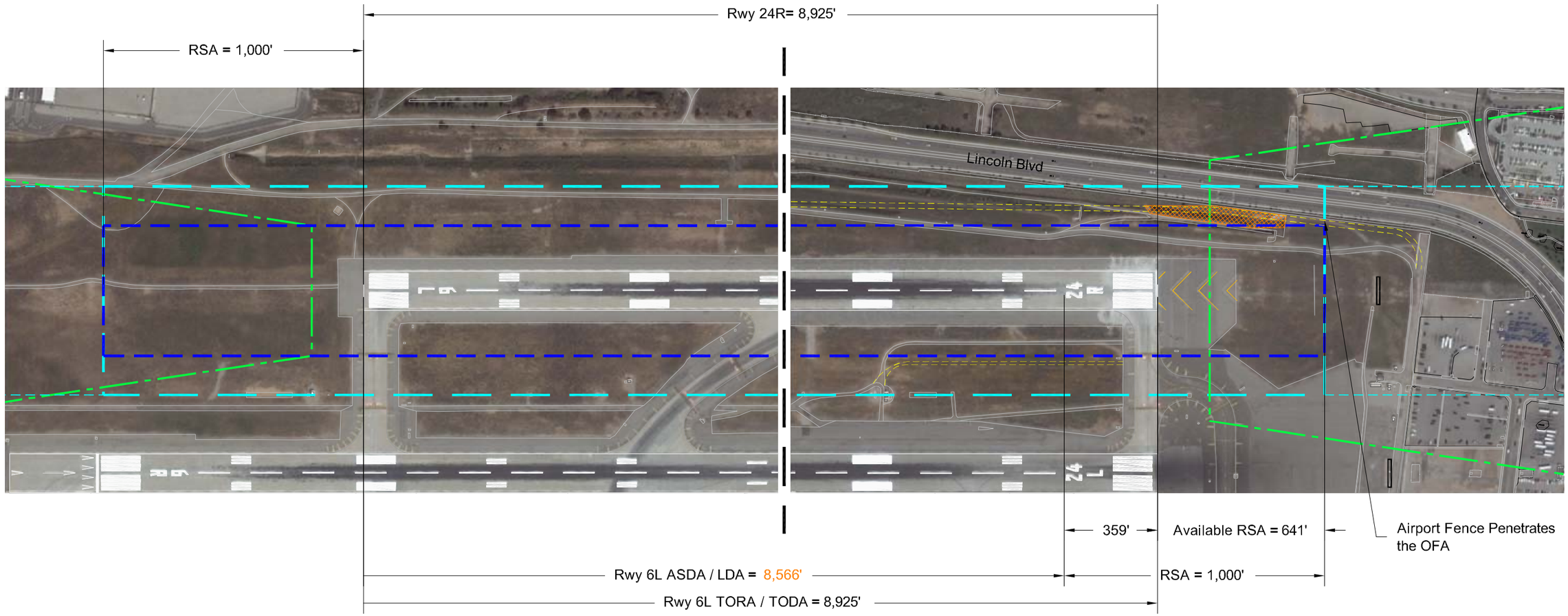
Figure 4-2

0 400 ft. north

Legend:
- Runway Safety Area
- Runway Object Free Area
- Runway/Taxiway Pavement to be Built
- Runway/Taxiway Pavement to be Demolished
- Relocated Service Road
- Runway Protection Zone
- Central Portion of the RPZ
- Ditch to be Covered

Runway 6L-24R
Reduce Runway Length

Steps:
- Cover Ditch
- Relocate Service Roads
- Implement Declared Distances



Note: The expected FAA determination resulting from this improvement is "the existing RSA does not meet standards but it is practical to improve the RSA so that it will meet current standards".

Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, Landrum & Brown, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

Figure 4-3

0 400 ft.

north

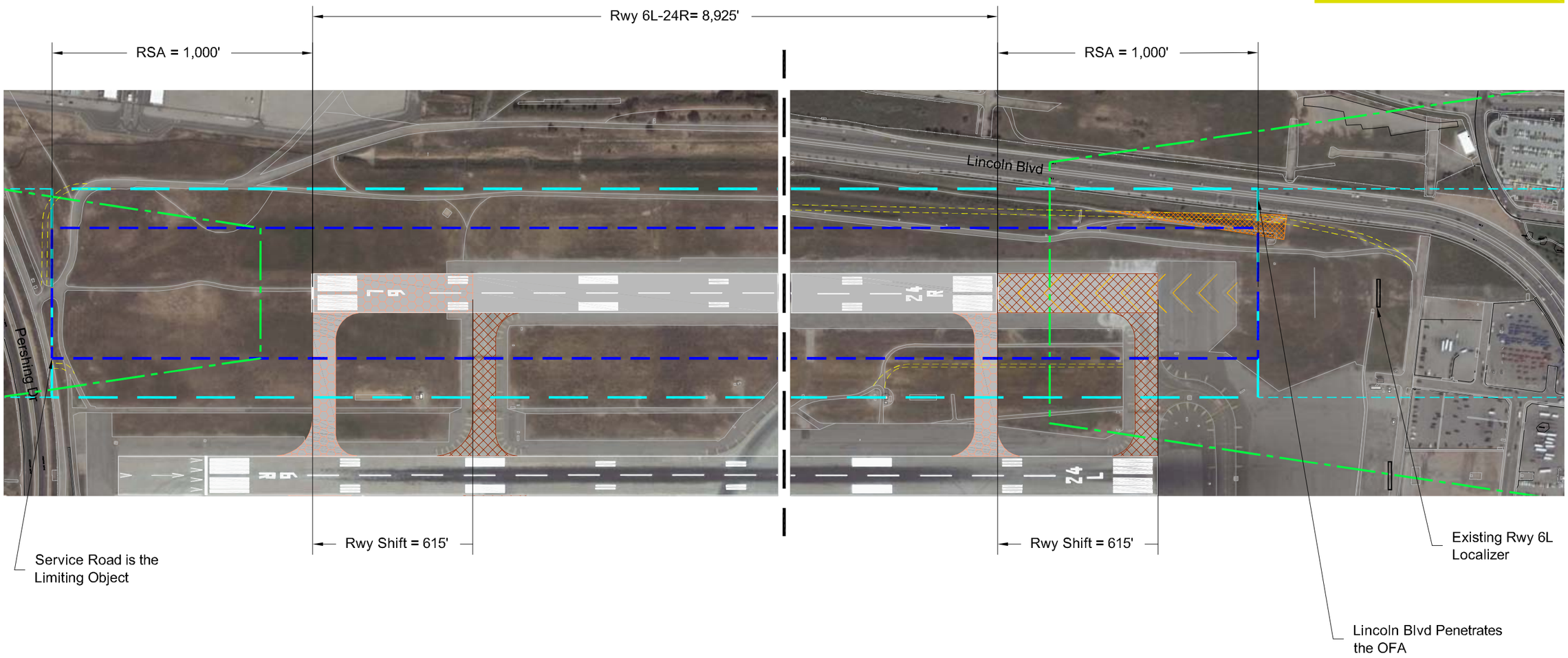
Acronyms:
- TORA Take-Off Run Available
- TODA Take-Off Distance Available
- ASDA Accelerate-Stop Distance Available
- LDA Landing Distance Available

Legend:
- Runway Safety Area
- Runway Object Free Area
- Central Portion of the RPZ
- Relocated Service Road
- Ditch to be Covered
- Runway Protection Zone

Runway 6L-24R Declared Distances

Drawing: Z:\LAWA\LAX RSA Study\CAD\Rwy 6L-24R\1-Basic Concepts_Runway 6L-24R.dwg, Layout: DD 11x17_Apr 09, 2010, 1:22pm

Steps:
- Shift Runway
- Cover Ditch
- Relocate Service Roads
- Reconfigure Taxiways
- Relocate Approach Lights Systems



Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, Landrum & Brown, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

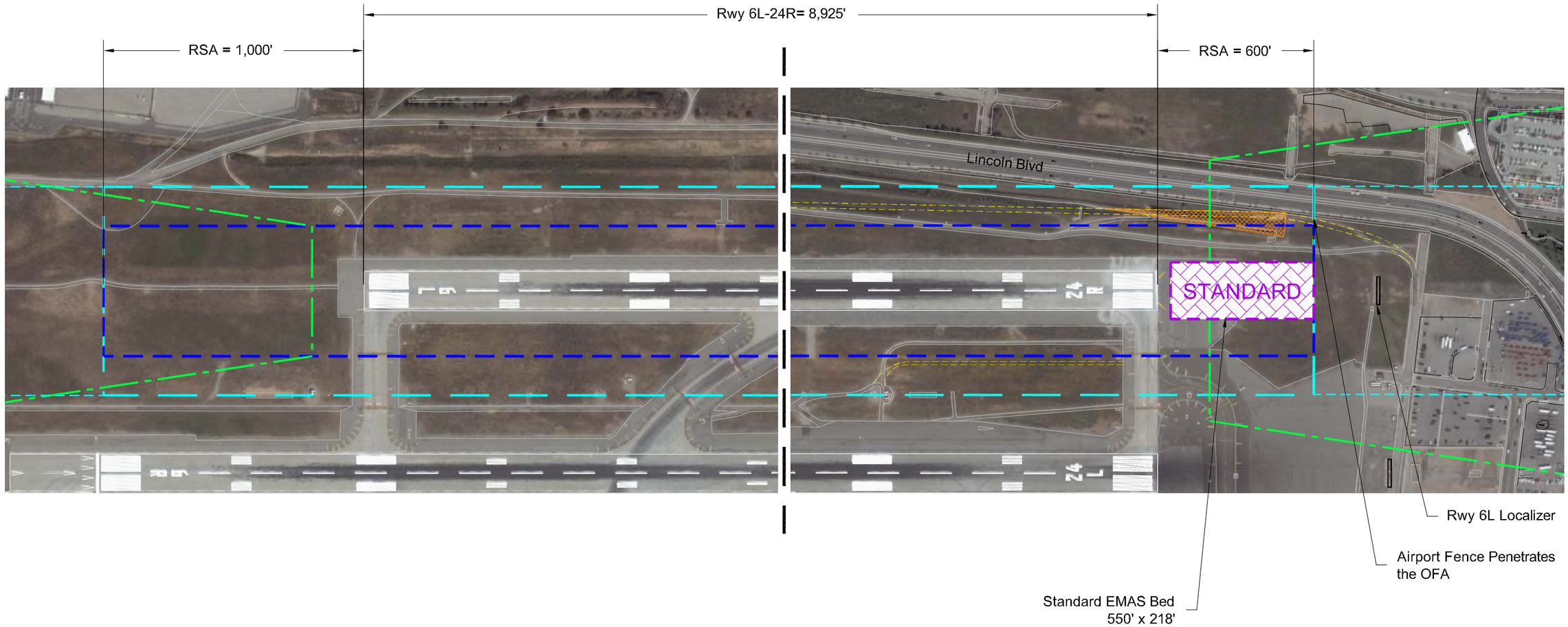
Figure 4-4

0 400 ft. north

Legend:
- Runway Safety Area
- Runway Object Free Area
- Central Portion of the RPZ
- Runway/Taxiway Pavement to be Built
- Runway/Taxiway Pavement to be Demolished
- Runway Protection Zone
- Relocated Service Road
- Ditch to be Covered

Runway 6L-24R
Shift Runway

Steps:
- Relocate Service Roads & Cover Ditch
- Install Standard EMAS on Rwy 24R End



Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, Landrum & Brown, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

Figure 4-5

0 400 ft.

north

Legend:
- Runway Safety Area
- Runway Object Free Area
- EMAS Bed
- Ditch to be Covered
- Central Portion of the RPZ
- Relocated Service Road
- Runway Protection Zone

Runway 6L-24R
Standard EMAS

Drawing: Z:\LAWA\LAX RSA Study\CAD\Rwy 6L-24R\1-Basic Concepts_Runway 6L-24R.dwg_Layout: EMAS 11x17_Apr 09, 2010, 1:20pm

4.1.2 Preliminary Review and Refinement of RSA Alternatives

Preliminary review of the five conceptual alternatives was conducted by the RSA Technical Team and consisted of a general evaluation of engineering practicability, site constraints, the extent for which the RSAs comply with standards, the benefits achieved, and potential costs incurred for each of the alternatives. The objective of the preliminary review was to identify key elements for eliminating alternatives and identifying the most feasible alternative(s) for satisfying RSA standards. During the review, FAA representatives stated that improvement alternatives included in the *Runway Safety Area Evaluation and Analysis* document for LAX were suggested solutions and were not necessarily required as long as the ultimate preferred RSA alternative could meet the RSA standard in accordance with FAA criteria. LAWA officials requested that the preferred alternative not reduce take-off length or airlines' operational capabilities.

Following are the RSA Technical Team's initial review comments for the conceptual alternatives:

- Construct Standard RSA and Reduce Runway - A consensus was reached by the Technical Team these two alternatives would not be practicable to implement. The Construct Standard RSA alternative is considered too costly and difficult because of the need to relocate a portion of Lincoln Boulevard, and the Reduce Runway alternative would likely increase operational restrictions to unacceptable levels.

- Shift Runway and Install Standard EMAS - The Technical Team recognized that although these two alternatives do not have any operational impacts, their development cost would likely be significantly higher than the Declared Distances alternative.

- Implement Declared Distances - The Technical Team recognized that the reduction of Runway 6L LDA from 8,925 feet to 8,566 feet in this alternative may have negligible operational impact since most commercial aircraft generally do not need more than 8,000 feet for landing operations.

- Combination - The Technical Team further agreed to consider for refinement a combination of specific elements from the Declared Distances, Shift Runway, and Standard EMAS alternatives.

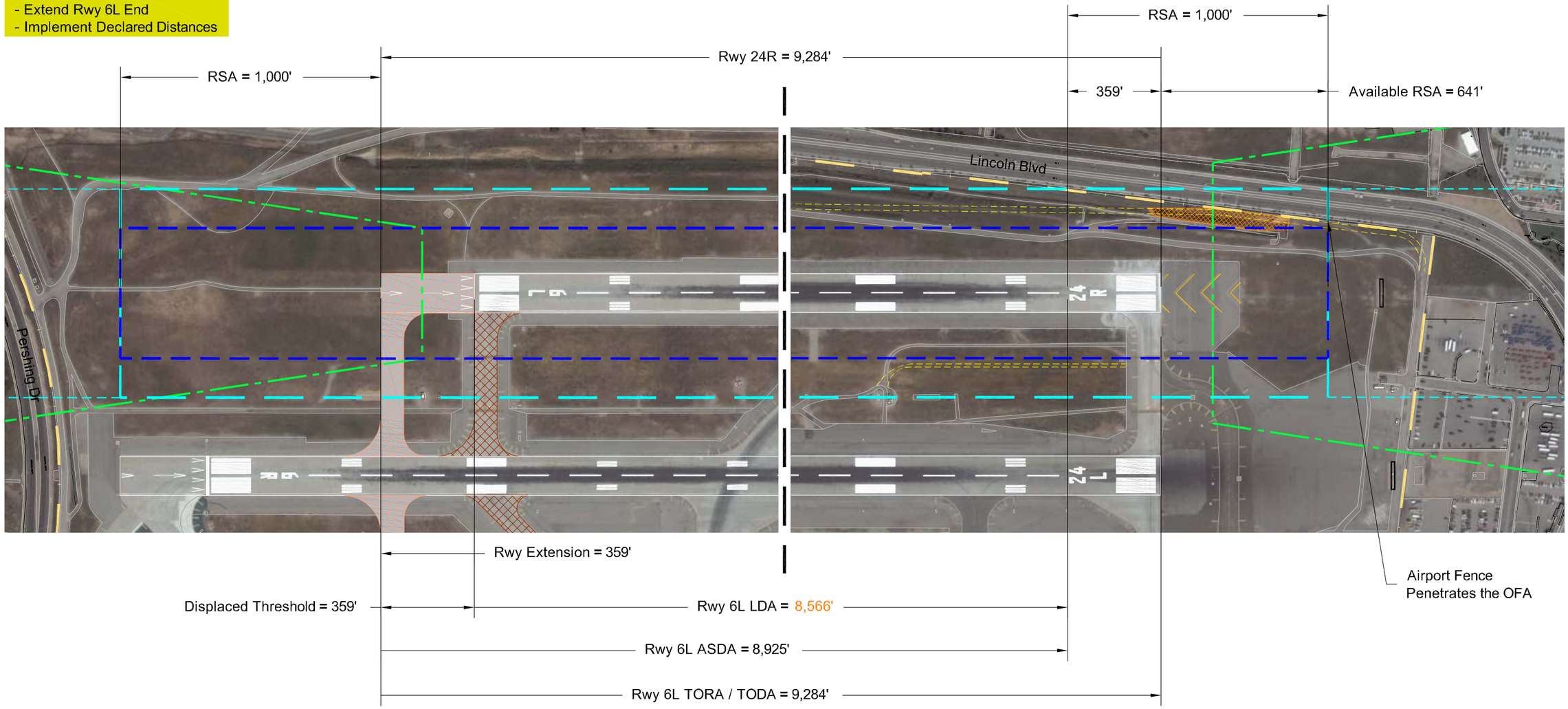
4.1.2.1 Refinement #1

As depicted in **Figure 4-6**, the Refinement #1 alternative is a combination of the Declared Distances and the Shift Runway alternatives. The RSA improvements to the east end would be identical to the Declared Distances alternative as described in Section 4.1.1.3. The improvements to the west end are similar to the Shift Runway alternative in Section 4.1.1.4, but require a runway extension of 359 feet rather than 615 feet. A section of Taxiway BB would also be demolished. This refined alternative increases the Runway 24R lengths by 359 feet to 9,284 feet. The Runway 6L ASDA would be retained, whereas the Runway 6L LDA would be reduced to 8,566 feet.

4.1.3 Conclusion of Preliminary Review

Based on preliminary review of all six Runway 6L-24R conceptual and refined improvement alternatives, the RSA Technical Team reached a consensus and selected the Declared Distances alternative (Figure 4-3) as the preferred alternative for Runway 6L-24R. Although this alternative reduces the Runway 6L landing length from 8,925 feet to 8,566 feet, the operational impact would likely be negligible because most commercial aircraft generally do not need more than 8,000 feet for landing operations.

Steps:
- Construct New Taxiway
- Cover Ditch
- Relocate Service Roads
- Extend Rwy 6L End
- Implement Declared Distances



Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, Landrum & Brown, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

Figure 4-6

0 400 ft. north

Legend:
- Runway Safety Area
- Runway Object Free Area
- Central Portion of the RPZ
- Runway Protection Zone
- Runway/Taxiway Pavement to be Built
- Runway/Taxiway Pavement to be Demolished
- Relocated Service Road
- Ditch to be Covered
- Airport Property Line

Runway 6L-24R
Refinement #1

4.2 Runway 6R-24L Alternatives

This section identifies and provides a preliminary review of all the RSA alternatives for Runway 6R-24L.

4.2.1 FAA Conceptual Alternatives

Based on the guidelines in FAA Order 5200.8, *Runway Safety Area Program*, the following five RSA conceptual alternatives were developed for Runway 6R-24L for comparative purposes.[16] These alternatives include the alternatives identified in the FAA's *Runway Safety Area Evaluation and Analysis* for LAX.

4.2.1.1 Construct Standard RSA

As depicted in **Figure 4-7**, this alternative proposes the construction of standard RSAs. It extends the RSA at the east end 115 feet and at the west end 835 feet to obtain a standard 1,000- by 500-foot RSA beyond each runway end. All objects that are in the current RSAs or that would fall within the extended RSAs would be relocated. At the east end, the Runway 6R localizer, a service road, a perimeter fence and parking facilities would be relocated outside the RSA. At the west end, a section of Pershing Drive would be tunneled under the RSA, and portions of the service road and perimeter fence would be relocated outside the RSA. An extensive amount of earthwork would be necessary in the dunes to comply with RSA grading standards. This alternative maintains all existing take-off and landing distances for Runways 6R and 24L.

4.2.1.2 Reduce Runway Length

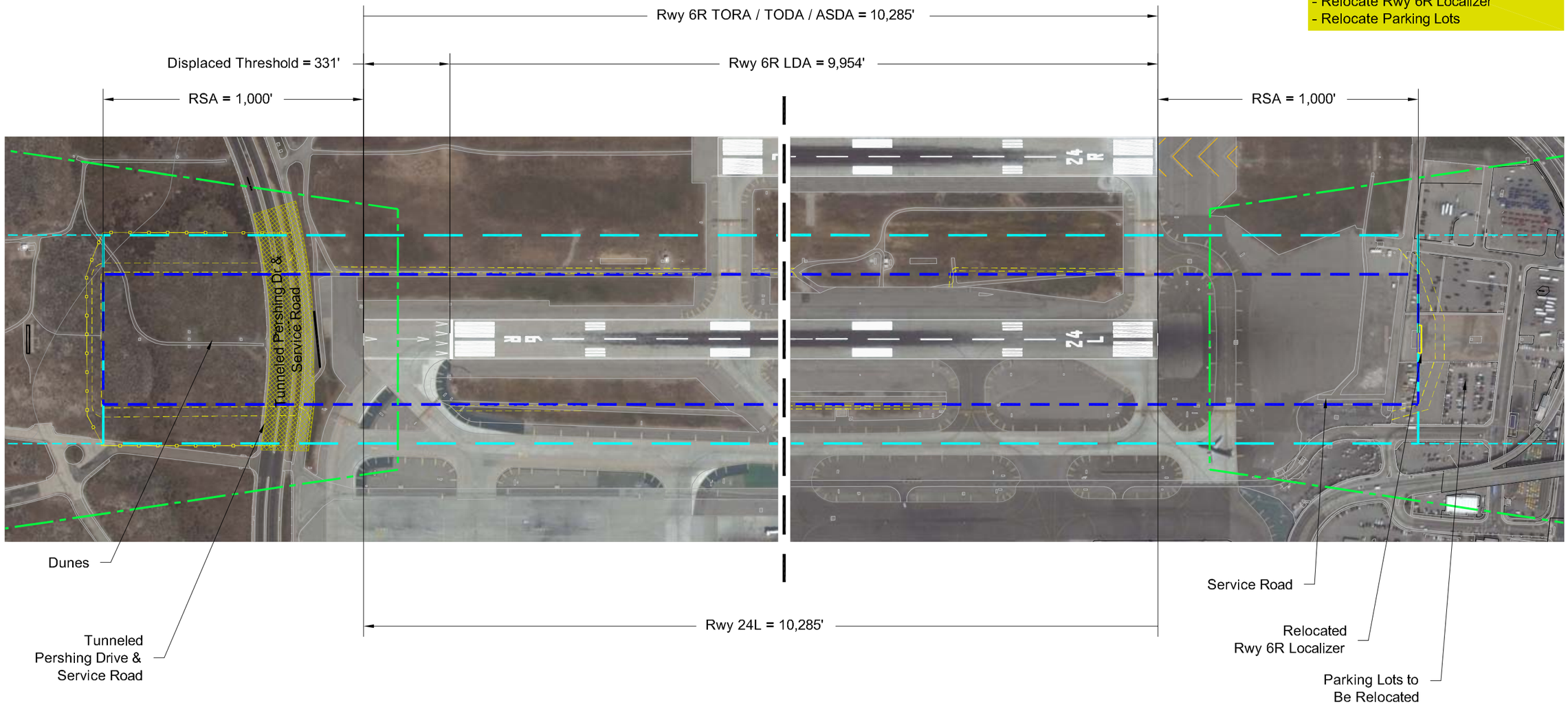
As depicted in **Figure 4-8**, this alternative meets all RSA requirements by reducing the length of the runway from 10,285 feet to 9,335 feet. At the east end, the Runway 24L threshold is relocated west 115 feet to provide 1,000 feet of RSA beyond the east end of the runway. At the west end, the Runway 6R threshold is relocated east 835 feet to provide 1,000 feet of RSA beyond the west end of the runway. The 835 feet of runway west of the relocated threshold would be demolished and graded to RSA standards. The Runway 6R and 24L approach lights would require relocation. This alternative reduces the overall length of Runway 6R-24L by 950 feet.

4.2.1.3 Implement Declared Distances

Figure 4-9 depicts the use of declared distances necessary to meet RSA requirements. A 1,000-foot RSA from the Runway 6R localizer on the east side reduces the Runway 6R ASDA by 115 feet from 10,285 feet to 10,170 feet, and the Runway 6R LDA by 115 feet from 9,954 feet to 9,839 feet.. A service road would also be relocated around the east end of the RSA. A 1,000-foot RSA from the blast fence on the west side reduces the Runway 24L ASDA and LDA by 835 feet from 10,285 feet to 9,450 feet.

[16] Although the use of declared distances is not authorized by LAWA for airport operations, declared distance measurements have been added to all RSA alternatives for comparison purposes only.

Steps:
- Tunnel Pershing Dr & Service Roads
- Relocate Service Roads
- Relocate Rwy 6R Localizer
- Relocate Parking Lots



Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

Figure 4-7

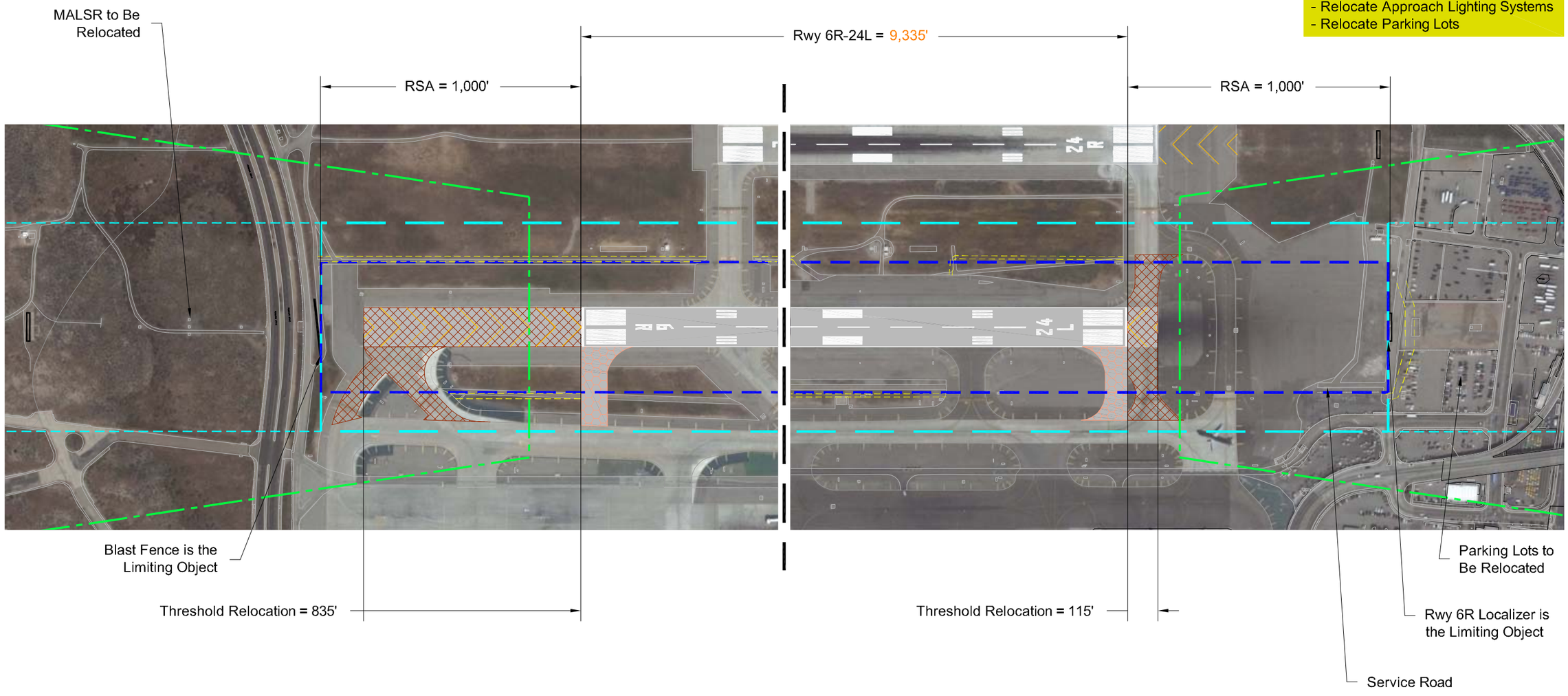
0 400 ft. north

Acronyms:
TORA Take-Off Run Available
TODA Take-Off Distance Available
ASDA Accelerate-Stop Distance Available
LDA Landing Distance Available

Legend:
Runway Safety Area
Runway Object Free Area
Central Portion of the RPZ
Tunneled Roads
Relocated Service Road
Relocated AOA Fence
Runway Protection Zone

Runway 6R-24L
Standard Runway Safety Areas

Steps:
- Relocate Thresholds
- Reconfigure Taxiways
- Relocate Service Roads
- Relocate Approach Lighting Systems
- Relocate Parking Lots



Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

Figure 4-8

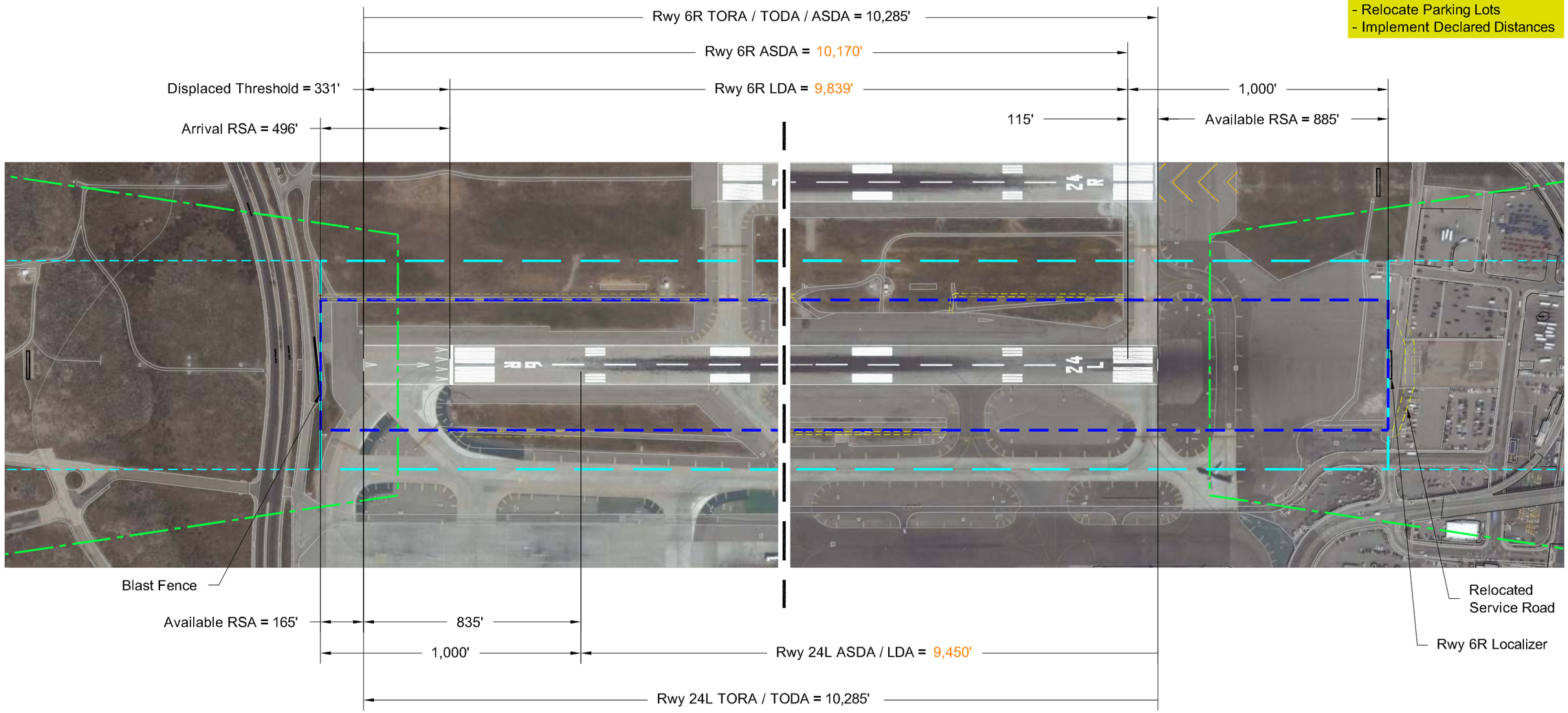
0 400 ft.

north

Legend:
- Runway Safety Area
- Runway Object Free Area
- Central Portion of the RPZ
- Runway/Taxiway to be Demolished
- Runway/Taxiway Pavement to be Built
- Relocated Service Road
- Runway Protection Zone

Runway 6R-24L
Reduce Runway Length

Steps:
- Relocate Service Roads
- Relocate Parking Lots
- Implement Declared Distances



Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

Figure 4-9

0 400 ft. north

Acronyms:
TORA Take-Off Run Available
TODA Take-Off Distance Available
ASDA Accelerate-Stop Distance Available
LDA Landing Distance Available

Legend:
Runway Safety Area
Runway Object Free Area
Runway Protection Zone
Central Portion of the RPZ
Relocated Service Road

Runway 6R-24L
Declared Distances

4.2.1.4 Shift Runway

As depicted in **Figure 4-10**, the existing blast fence at the west end is the limiting object and requires a runway shift 835 feet east to obtain a 1,000-foot standard RSA at the west end. The 835 feet of runway pavement west of the new Runway 6R threshold and Taxiways E-16 and E-17 would require being demolished and the Runway 6R approach lights relocated. The equivalent 835-foot shift of the east end would require the tunneling of Sepulveda Boulevard and the relocation of the Runway 6R localizer, as well as numerous commercial parking/staging lots, a service road and a fence. This alternative maintains all current take-off and landing distances.

4.2.1.5 Install Standard EMAS

As depicted in **Figure 4-11**, standard EMAS beds are proposed to be installed at both runway ends. Although the EMAS bed length is shown to be 550 feet, the ultimate length will be determined during the design phase and could be different than what is assumed for this study. These beds assume a 50-foot setback from the runway ends, requiring a total length of 600 feet for the RSA. The existing blast fence is the limiting object on the west end, requiring the Runway 6R threshold to be relocated east 455 feet to provide a 600-foot long area for the installation of the EMAS bed. The 455 feet of runway pavement west of the new Runway 6R threshold and Taxiways E-16 and E-17 would be demolished and the Runway 6R approach lights relocated. The existing Runway 6R localizer is the limiting object on the east end, allowing for a Runway 24R end shift of 265 feet to the east. A service road would be relocated to the east around the RSA. The Standard EMAS configuration for Runway 6R-24L results in a net runway length reduction of 190 feet from 10,285 feet to 10,095 feet.

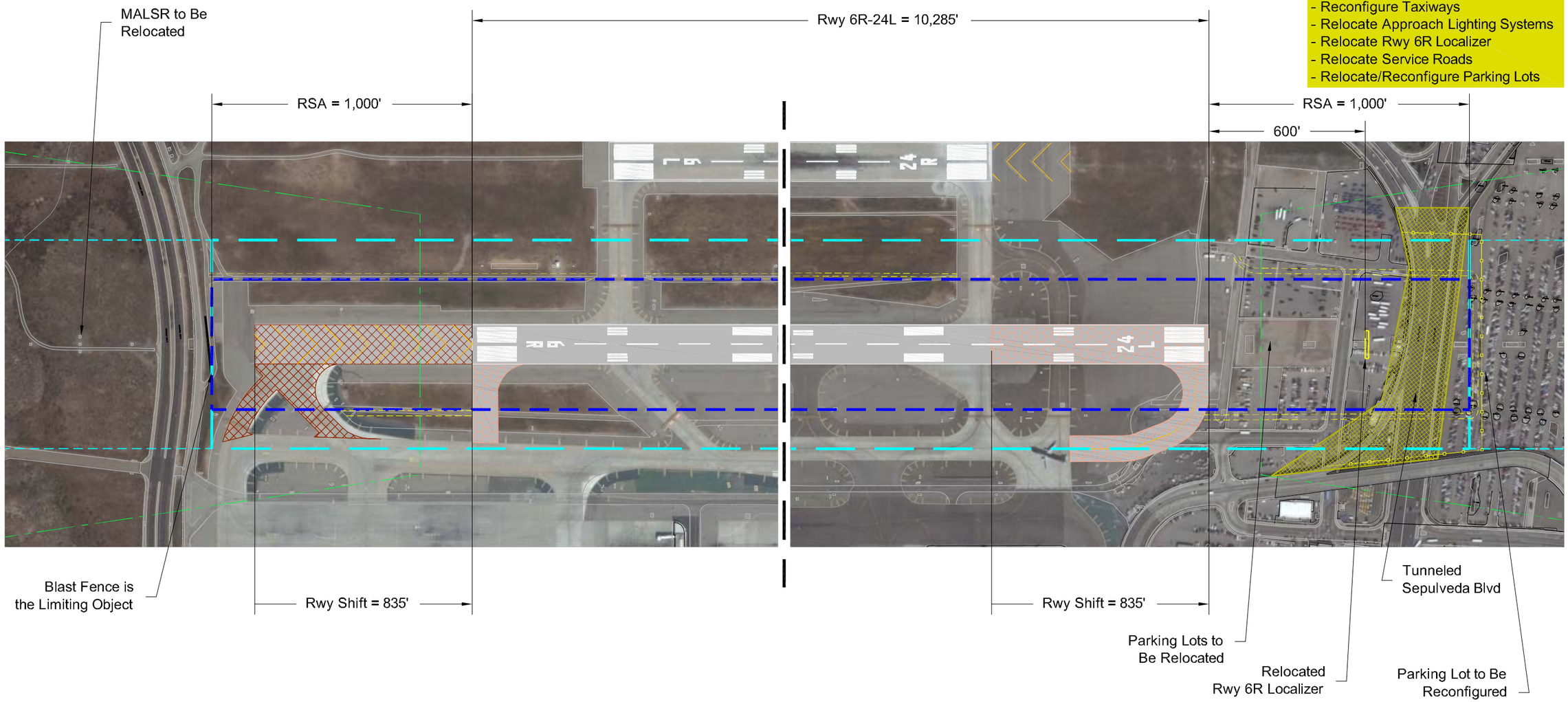
4.2.2 Preliminary Review and Refinement of RSA Alternatives

Similar to the Runway 6L-24R analyses, preliminary review of the five Runway 6R-24L conceptual alternatives was conducted by the RSA Technical Team and consisted of a general evaluation of engineering practicability, site constraints, the extent for which the RSAs comply with standards, the benefits achieved, and potential costs incurred for each of the alternatives. The objective of the preliminary review was to identify key elements for eliminating alternatives and identifying the most feasible alternative(s) for meeting RSA standards. During the review, FAA representatives stated that improvement alternatives included in the *Runway Safety Area Evaluation and Analysis* document for LAX were suggested solutions and were not necessarily required as long as the ultimate preferred RSA alternative could meet the RSA standard in accordance with FAA criteria. LAWA officials requested that the preferred alternative not reduce take-off length or airlines' operational capabilities.

Following are the RSA Technical Team's initial review comments for the conceptual alternatives:

- Construct Standard RSA - Due to the major off-airport infrastructure changes, construction costs and potential environmental impact to the dunes, this alternative was not considered to be practical to implement.
- Reduce Runway - Because this runway is primarily used for departures, this alternative would not be practical to implement without incurring additional operational restrictions. Since other conceptual alternatives and refinements could improve the RSA without incurring such restrictions, it was determined that this alternative should not be considered further.

Steps:
- Tunnel Sepulveda Blvd
- Shift Runway
- Reconfigure Taxiways
- Relocate Approach Lighting Systems
- Relocate Rwy 6R Localizer
- Relocate Service Roads
- Relocate/Reconfigure Parking Lots



Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

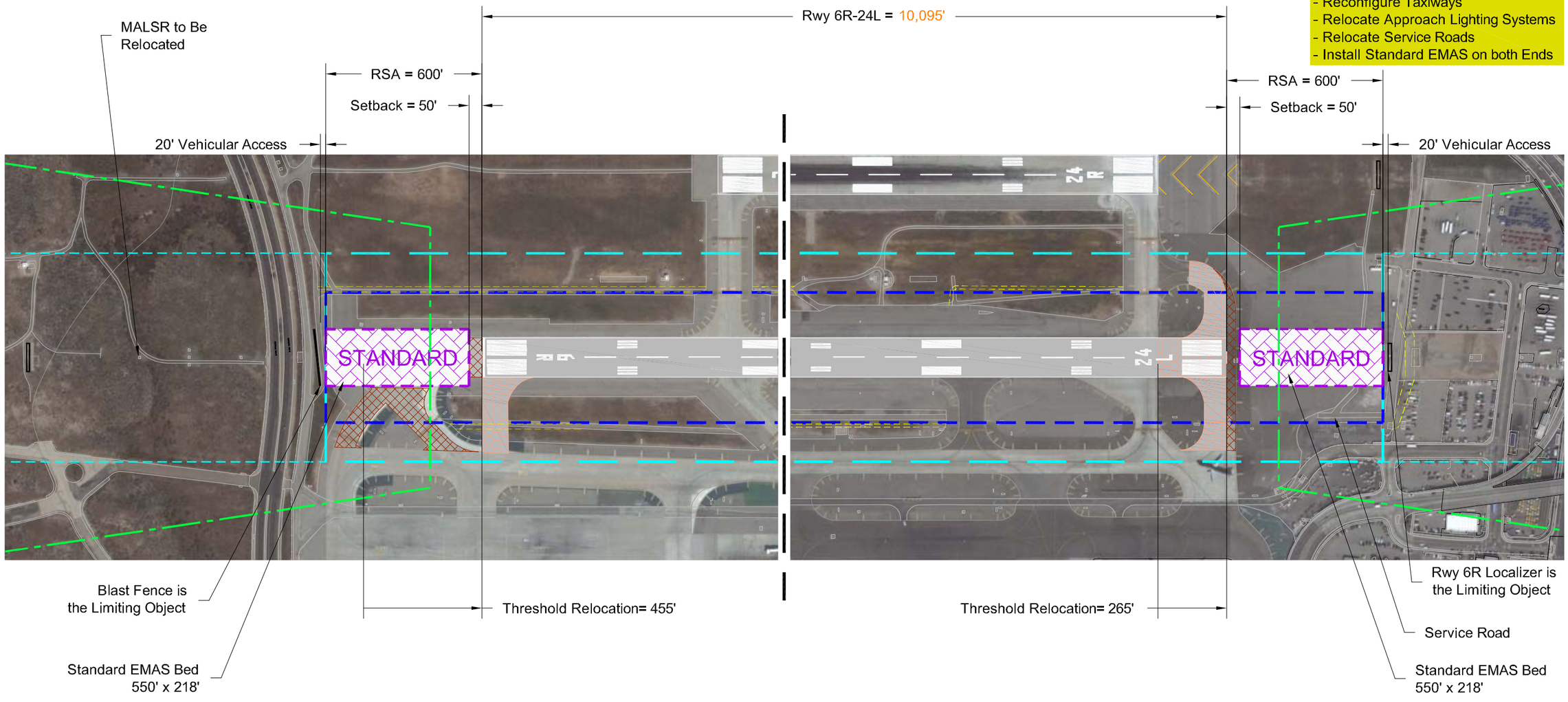
Figure 4-10

0 400 ft. north

Legend:
- Runway Safety Area
- Runway Object Free Area
- Central Portion of the RPZ
- Runway/Taxiway Pavement to be Demolished
- Runway/Taxiway Pavement to be Built
- Runway Protection Zone
- Tunneled Roads
- Relocated AOA Fence
- Relocated Service Road

Runway 6R-24L Shift Runway

Steps:
- Relocate Thresholds
- Reconfigure Taxiways
- Relocate Approach Lighting Systems
- Relocate Service Roads
- Install Standard EMAS on both Ends



Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

Figure 4-11

0 400 ft. north

Acronyms:
TORA Take-Off Run Available
TODA Take-Off Distance Available
ASDA Accelerate-Stop Distance Available
LDA Landing Distance Available

Legend:
Runway Safety Area
Runway Object Free Area
Central Portion of the RPZ
EMAS Bed
Runway/Taxiway Pavement to be Built
Relocated Service Road
Runway/Taxiway to be Demolished
Runway Protection Zone

Runway 6R-24L
Standard EMAS

- Implement Declared Distances - This alternative would not be practical to implement without incurring additional operational restrictions. Because other alternatives and refinements could improve the RSA without incurring operational restrictions, it was determined that this alternative should not be considered for further review. The Technical Team was open to a combination of conceptual alternatives or refinements that may include Declared Distances as long as the resultant alternative does not restrict operations.
- Shift Runway - Because this alternative would require the tunneling of Sepulveda Boulevard and result in significant off-airport infrastructure changes and construction costs, this alternative was not considered for further review.
- Install Standard EMAS - A practical modification of this alternative as shown may include a longer east runway extension and EMAS installation into a portion of the existing parking lot. This alternative would maintain existing runway length. An EMAS at the west end was not considered practicable because it would require reducing the runway length by 455 feet.

Based on the preliminary review of the conceptual alternatives, the Technical Team concluded that the impacts associated with the Standard RSA, Reduce Runway, and Shift Runway alternatives were too significant and that these conceptual alternatives were not practicable. However, the Technical Team was open to considering refined alternatives that include a combination of Declared Distances, Standard EMAS, or alternatives that take advantage of available property located east of Runway 6R-24L. The following sections describe the refined alternatives that have been developed.

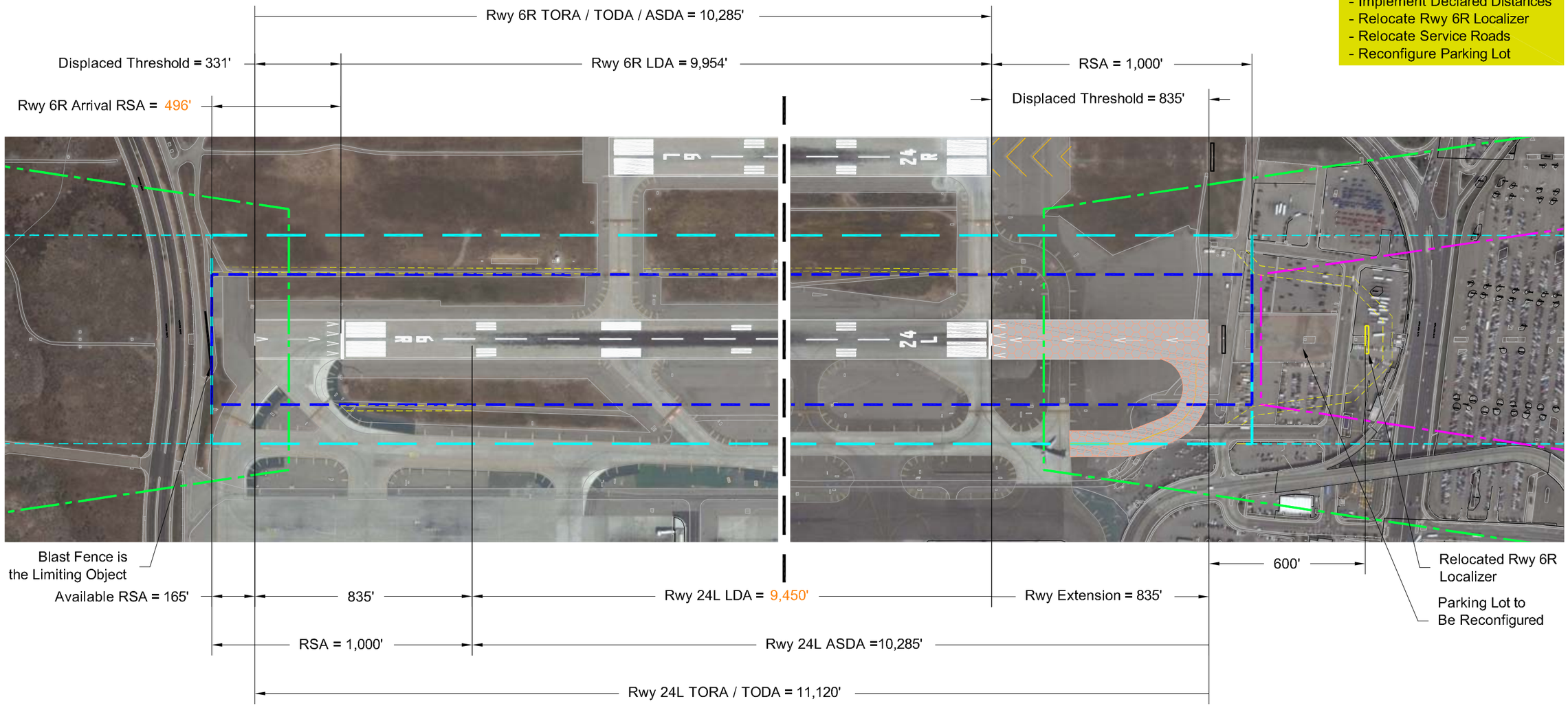
4.2.2.1 Refinement #1

As depicted in **Figure 4-12**, Refinement #1 uses a combination of declared distances and a runway extension to obtain standard RSAs and to maintain existing runway lengths. At the east end, the runway would be extended 835 feet east while the Runway 24L landing threshold would remain in its existing location. Portions of parking lots east of the runway would require reconfiguration or relocation. At the west end, a 1,000-foot RSA is obtained for Runway 24L landings and departures by implementing declared distances. However, the existing Runway 24L ASDA of 10,285 feet would be maintained as aircraft would depart from the new runway extension. A standard arrival RSA of 600 feet is not achieved on Runway 6R with this refinement because it would require a 104-foot relocation of the Runway 6R threshold and Approach Lights. The Runway 24L LDA is reduced from 10,285 feet to 9,450 feet. Runway 6R distances remain unchanged.

4.2.2.2 Refinement #2

This alternative is similar to Refinement #1 but includes a standard 600-foot Runway 6R arrival RSA. As depicted in **Figure 4-13**, the Runway 6R threshold is relocated 104 feet east to provide a standard RSA for Runway 6R arrivals. This refinement requires the Runway 6R approach lights to be relocated. Similar to Refinement #1, this alternative maintains the Runway 24L ASDA of 10,285 feet while reducing the Runway 24L LDA from 10,285 feet to 9,450 feet and the Runway 6R LDA from 9,954 feet to 9,850 feet. The Runway 6R take-off distances remain unchanged. The RSA Technical Team suggested that this refinement be carried forward for further consideration.

Steps:
- Extend Rwy 24L End
- Reinstall Rwy 24L MALSR
- Implement Declared Distances
- Relocate Rwy 6R Localizer
- Relocate Service Roads
- Reconfigure Parking Lot



Note: Rwy 6R Arrival RSA does not meet the 600' FAA requirement.

Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

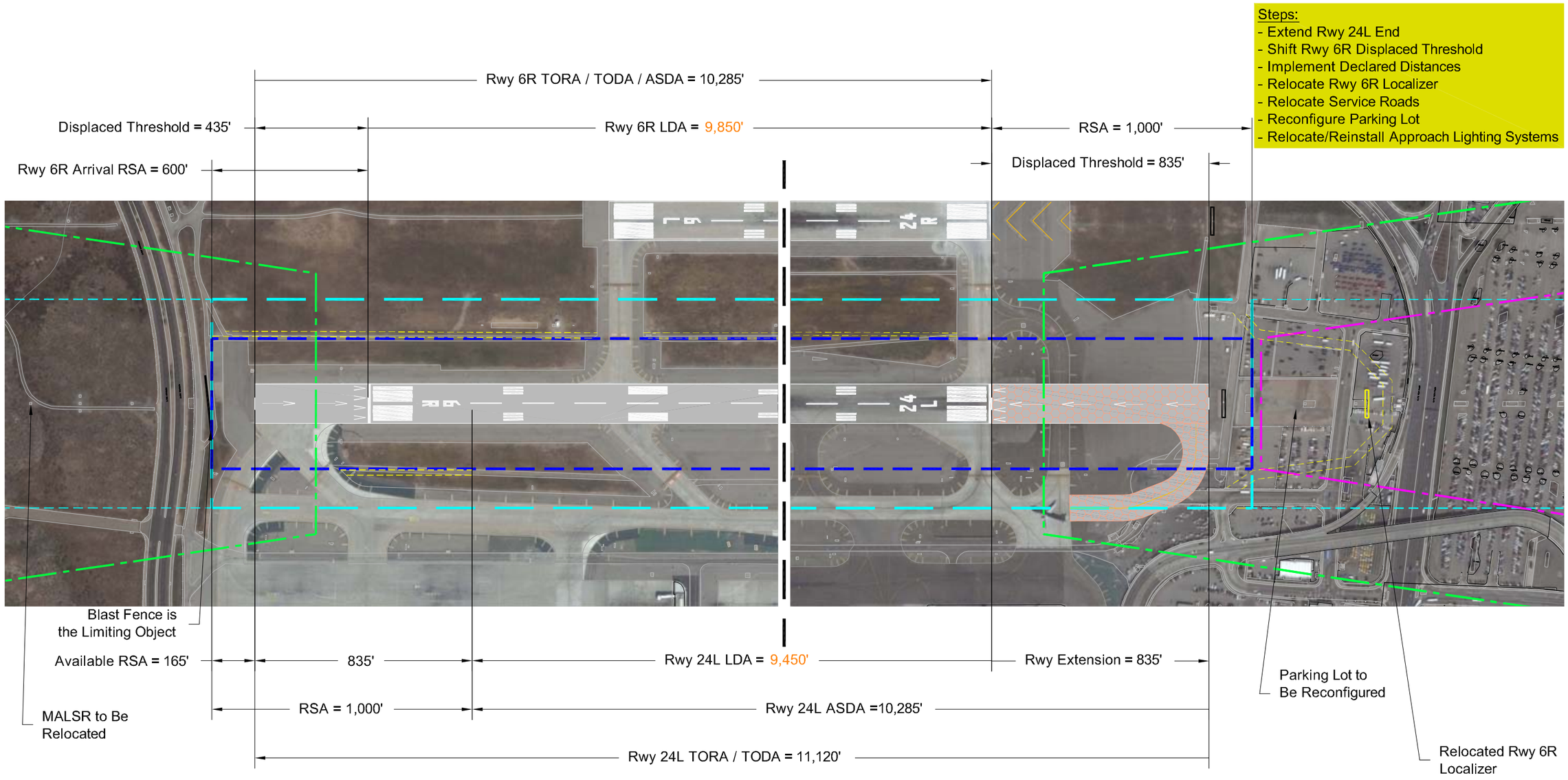
Figure 4-12

0 400 ft.

north

Legend:
- Runway Safety Area
- Runway Object Free Area
- Central Portion of the RPZ
- Approach Runway Protection Zone
- Departure Runway Protection Zone
- Runway/Taxiway Pavement to be Built
- Relocated Service Road

Runway 6R-24L Refinement #1



Note: The expected FAA determination resulting from this improvement is "the existing RSA does not meet standards but it is practical to improve the RSA so that it will meet current standards".

Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

Figure 4-13

0 400 ft.

north

Legend:

- Runway Safety Area
- Runway Object Free Area
- Central Portion of the RPZ
- Runway/Taxiway Pavement to be Built
- Approach Runway Protection Zone
- Departure Runway Protection Zone
- Relocated Service Road

Runway 6R-24L Refinement #2

4.2.2.3 Refinement #3

As depicted in **Figure 4-14**, this alternative uses a combination of installing standard EMAS beds, shifting the runway to the east, and implementing declared distances. The EMAS bed configuration at the west end is identical to the Standard EMAS conceptual alternative; the Runway 6R threshold would be relocated 455 feet to the east and a standard EMAS bed would be located between the new runway end and the existing blast fence. This alternative would require demolishing the runway pavement, connecting taxiways west of the new Runway 6R threshold, and relocating the approach lights. At the east end, the runway would be extended 455 feet, although the Runway 24L landing threshold would remain in its existing location. A standard EMAS bed would be installed between the new runway end and the relocated Runway 6R Localizer. Portions of parking lots would require relocation and the Runway 24L approach lights would need to be reinstalled. This alternative maintains all distances for Runway 6R and take-off distances for Runway 24L. The existing Runway 24L LDA is reduced from 10,285 feet to 9,830 feet.

4.2.2.4 Refinement #4

Similar to Refinement #3, this alternative proposes the installation of a standard EMAS bed and a runway extension to the east on the Runway 24L end to meet RSA standards and maintain as much take-off and landing length as possible. The key difference with Refinement #3 is that this alternative does not make any changes to the west end. As depicted in **Figure 4-15**, the east runway end would be extended 685 feet to the east, requiring the relocation of the Runway 6R localizer, a service road, and the parking lots and the reinstallation of the Runway 24L approach lights. The Runway 24L threshold would remain in its existing location. This alternative would increase the Runway 6R distances by 685 feet.[17] The Runway 24L ASDA would be reduced from 10, 285 feet to 10,135 feet and the Runway 24L LDA would be reduced from 10,285 feet to 9,450 feet.

4.2.2.5 Refinement #5

This alternative is the same as Refinement #4 at the east end of the runway but displaces the Runway 6R threshold 435 feet to the east to obtain a standard 600-foot Runway 6R arrival RSA, as show on **Figure 4-16**. The relocation of the Runway 6R arrival threshold would require the relocation of the Runway 6R approach lights. This alternative would increase the Runway 6R take-off distances by 685 feet and the Runway 6R LDA by 250 feet.[18] However, the Runway 24L ASDA would be reduced from 10, 285 feet to 10,135 feet and the Runway 24L LDA would be reduced from 10,285 feet to 9,450 feet.

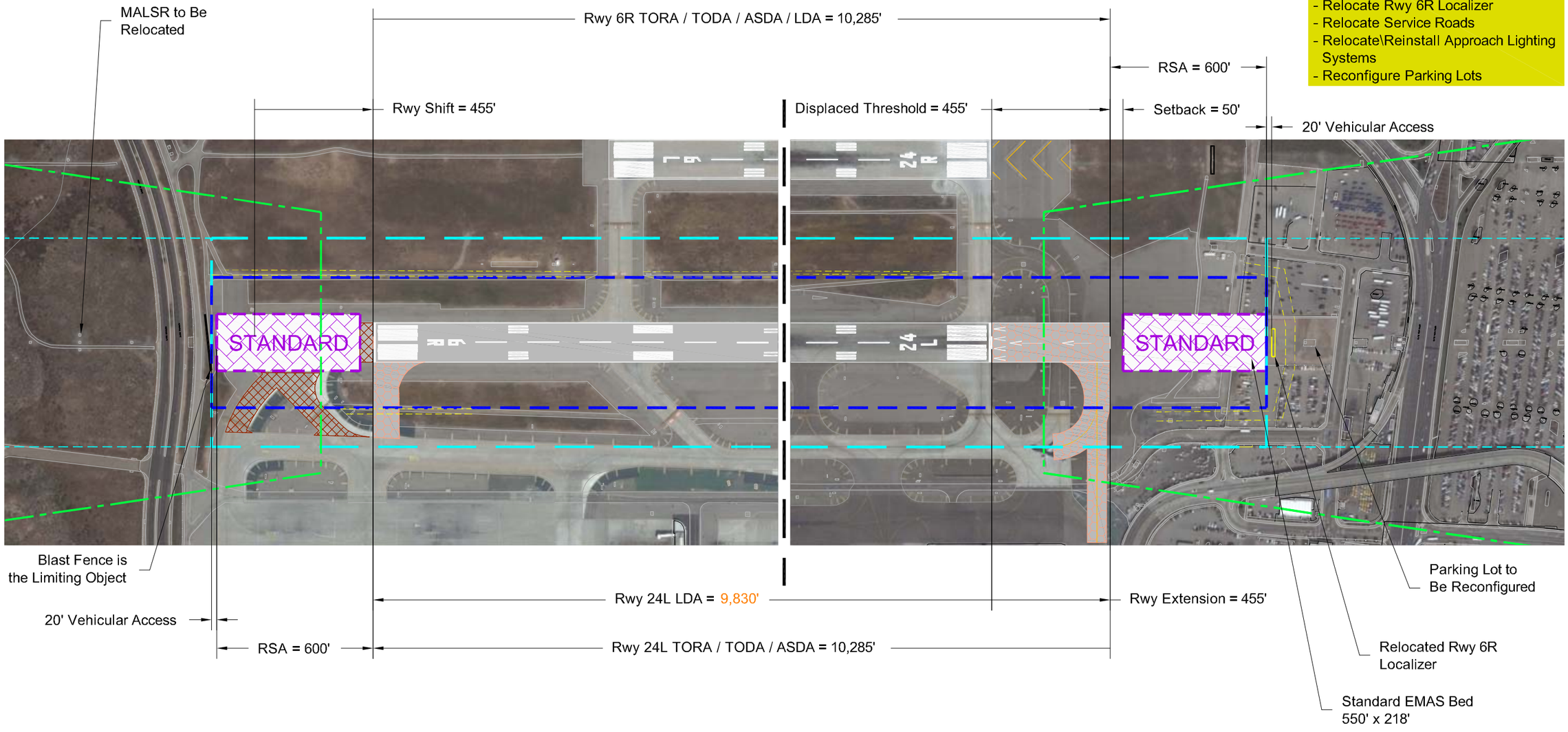
4.2.2.6 Refinement #6

As shown on **Figure 4-17,** this alternative is the same as the Declared Distances conceptual alternative at the east end of the runway but displaces the Runway 6R arrival threshold 435 feet east to obtain a standard 600-foot Runway 6R arrival RSA. Additionally, this would require the relocation of the Runway 6R approach lights. This alternative would decrease the Runway 6R ASDA from 10, 285 feet to 10,170 feet and the Runway 6R LDA from 9,954 feet to 9,735 feet. The Runway 24L ASDA and LDA would be reduced from 10,285 feet to 9,450 feet.

[17] An extension of the TORA, TODA will require an airspace study with respect to the relocation of the Title 14 Code of Federal Regulations (14 CFR) Part 77 surface and the Runway 6R departure surface with respect to Terminal Instrument Procedures (TERPS).

[18] Ibid.

Steps:
- Shift Rwy 455' to the east
- Install Standard EMAS on both ends
- Relocate Rwy 6R Localizer
- Relocate Service Roads
- Relocate\Reinstall Approach Lighting Systems
- Reconfigure Parking Lots



Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

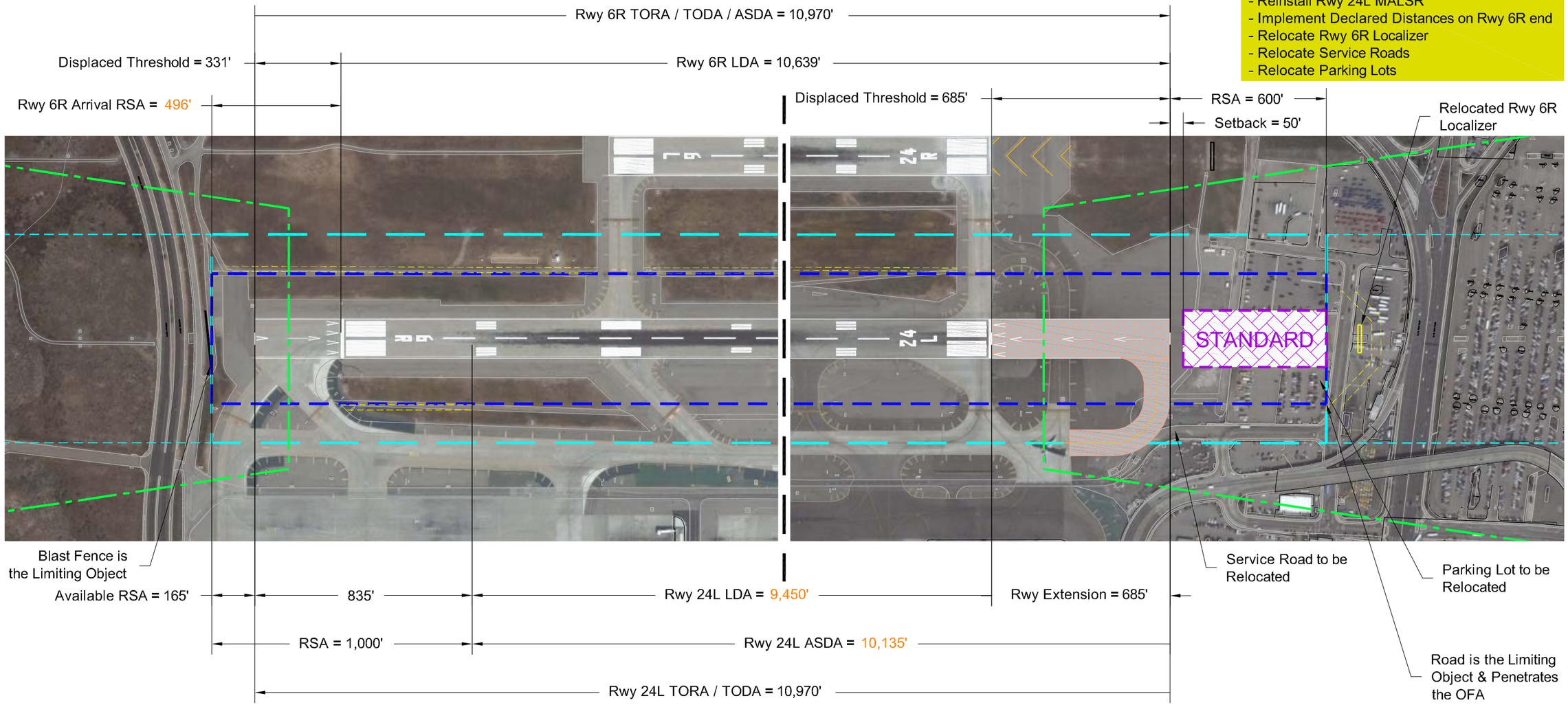
Figure 4-14

0 400 ft. north

Legend:
- Runway Safety Area
- Runway Object Free Area
- Central Portion of the RPZ
- Relocated Service Road
- Runway/Taxiway Pavement to be Built
- Approach Runway Protection Zone
- Departure Runway Protection Zone

Runway 6R-24L Refinement #3

Steps:
- Extend Rwy 24L end as far east as possible with Standard EMAS Installation
- Reinstall Rwy 24L MALSR
- Implement Declared Distances on Rwy 6R end
- Relocate Rwy 6R Localizer
- Relocate Service Roads
- Relocate Parking Lots



Note: Rwy 6R Arrival RSA does not meet the 600' FAA requirement.

Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

Figure 4-15

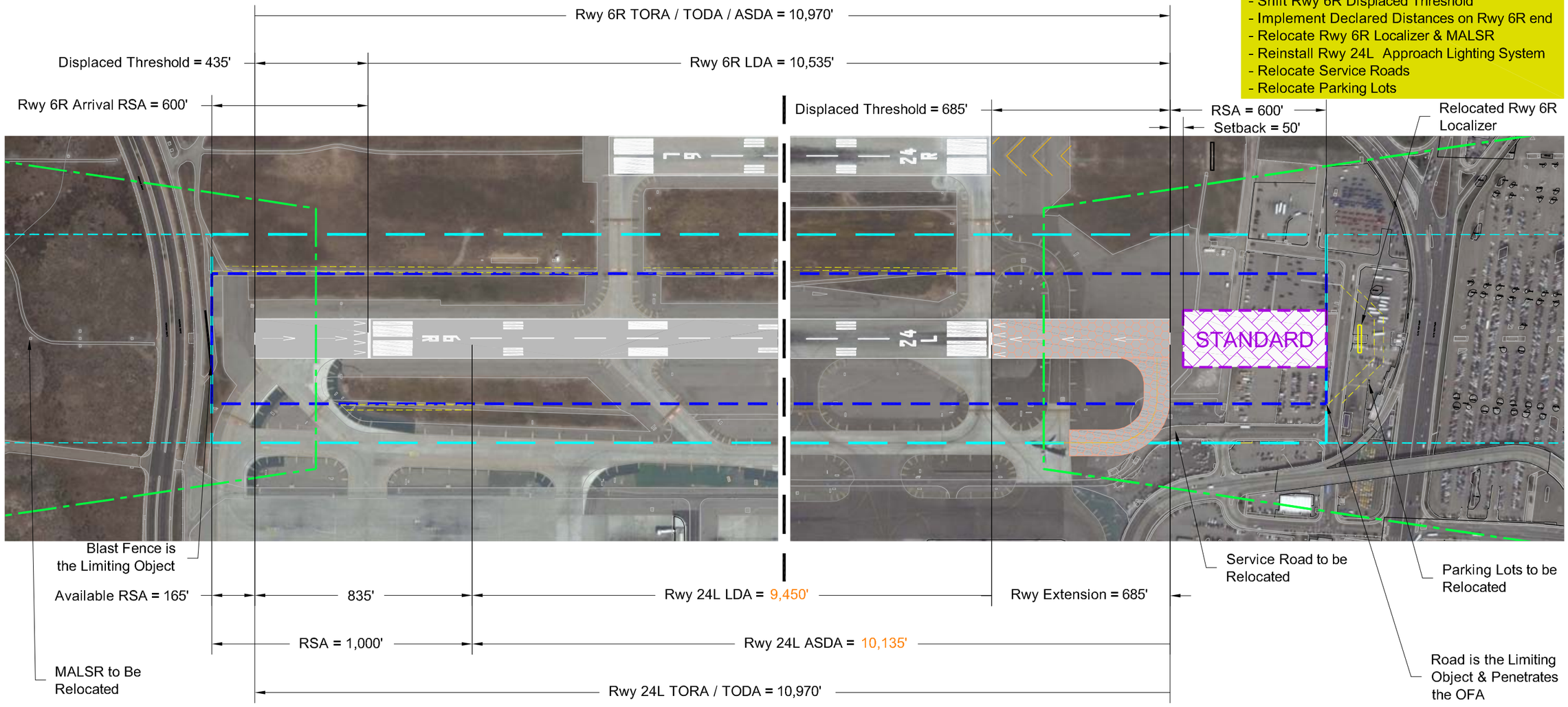
0 400 ft.

north

Legend:
- Runway Safety Area
- Runway Object Free Area
- Central Portion of the RPZ
- Relocated Service Road
- Runway/Taxiway Pavement to be Built
- Approach Runway Protection Zone
- Departure Runway Protection Zone

Runway 6R-24L Refinement #4

Steps:
- Extend Rwy 24L end as far east as possible with Standard EMAS Installation
- Shift Rwy 6R Displaced Threshold
- Implement Declared Distances on Rwy 6R end
- Relocate Rwy 6R Localizer & MALSR
- Reinstall Rwy 24L Approach Lighting System
- Relocate Service Roads
- Relocate Parking Lots



Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

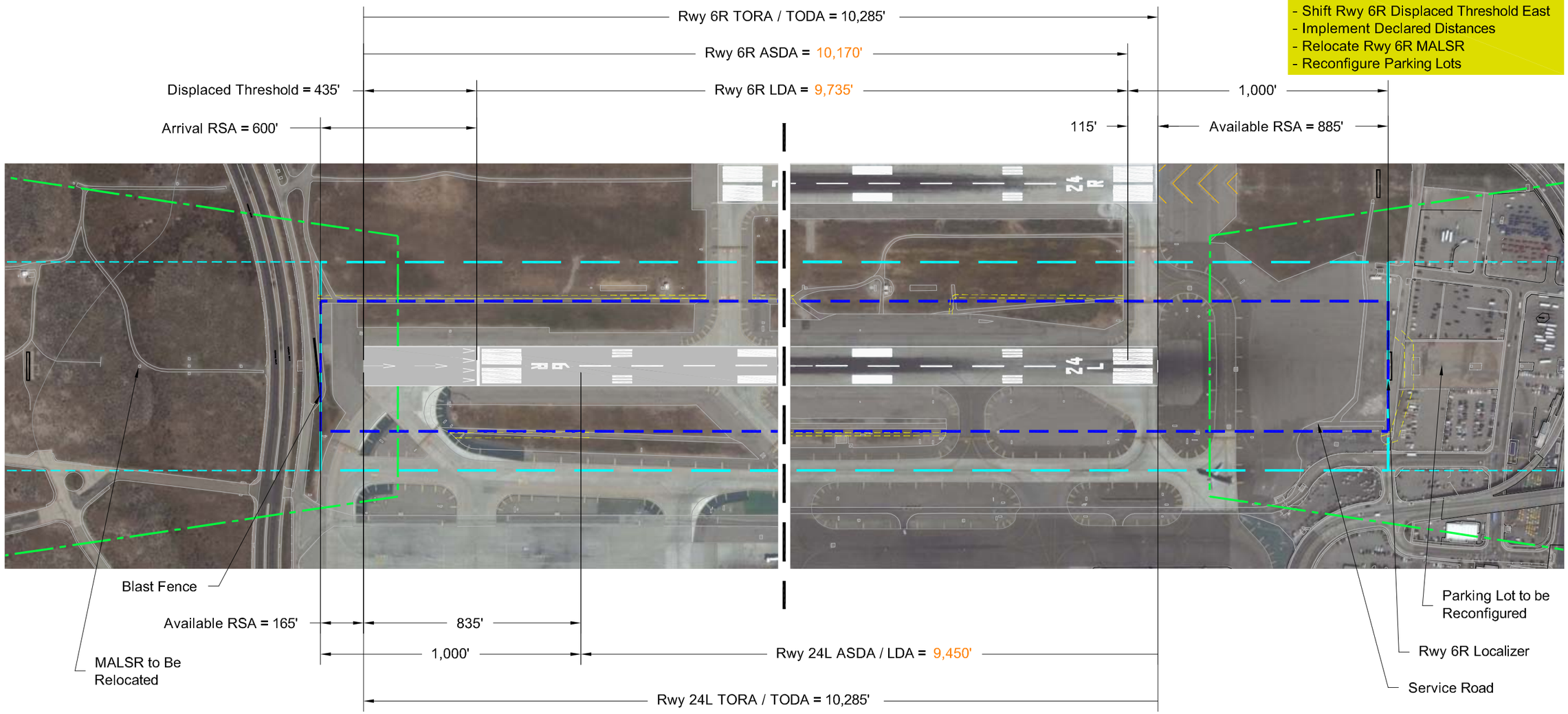
Figure 4-16

0 400 ft. north

Legend:
- Runway Safety Area
- Runway Object Free Area
- Central Portion of the RPZ
- Approach Runway Protection Zone
- Departure Runway Protection Zone
- Runway/Taxiway Pavement to be Built
- Relocated Service Road

Runway 6R-24L Refinement #5

Steps:
- Relocate Service Roads
- Shift Rwy 6R Displaced Threshold East
- Implement Declared Distances
- Relocate Rwy 6R MALSR
- Reconfigure Parking Lots



Note: Declared distances obtained from Airport Layout Plan, Landrum & Brown, 2005.

Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

Figure 4-17

0 400 ft. north

Acronyms:
TORA Take-Off Run Available
TODA Take-Off Distance Available
ASDA Accelerate-Stop Distance Available
LDA Landing Distance Available

Legend:
Runway Safety Area
Runway Object Free Area
Runway Protection Zone
Central Portion of the RPZ
Relocated Service Road

Runway 6R-24L Refinement #6

4.2.3 Conclusion of Preliminary Review

During the preliminary review of the five conceptual and six refined alternatives, the FAA stated that long-range plans at the Airport are currently under study and modifications necessary to comply with RSA standards may not be practicable before the FAA target date of December 2015. The FAA added that it is expected however, that incremental improvements of the RSAs can be implemented in the short term.

As noted in the review of the conceptual alternatives, the Technical Team eliminated the Standard RSA, Reduce Runway, and Shift Runway alternatives from further consideration, but was willing to consider the Declared Distances and the Standard EMAS alternatives in combination with other alternatives. At the conclusion of the preliminary review process for the refined alternatives, however, the consensus of the RSA Technical Team was that none of the refined alternatives appeared to be practicable.

The Technical Team initially considered the conceptual Declared Distances alternative as the preferred alternative. With the exception of the RSA for Runway 6R arrivals, this alternative provides standard safety areas at both ends of the runway with minimal implementation costs. The primary concern with this alternative, however, is the reduction in the Runway 24L ASDA from 10,285 feet to 9,450 feet and the potential adverse impact that the reduced runway length could have on aircraft operations. During 2008, there were approximately 120,000 departures from Runway 24L representing approximately 42 percent of all departures at the Airport. Similarly, Runway 25R also represented approximately 42 percent of all Airport departures.[19] Aircraft not able to depart Runway 24L, due to the shortened length available, would use Runway 25R, resulting in an inefficient and unbalanced airfield operation.

The final recommendation of the Declared Distances alternative, therefore, depends on completion of the quantitative operational impact assessment and a final comparative evaluation of all alternatives.

V. Financial Feasibility of RSA Improvements

Improving RSAs that do not meet current dimensional standards is often difficult. Compensating for terrain and environmental considerations can result in improvements that are not financially feasible. Analysis shows that for aircraft overruns, EMAS can provide a safety enhancement, while requiring less land disturbance and lower construction costs, thereby reducing significant overall costs. For these reasons, the FAA uses the cost of implementing a typical EMAS bed as a benchmark when considering RSA improvements. FAA Order 5200.9 establishes this benchmark as the maximum feasible expenditure for RSA improvements for both runway ends, whether the alternative includes EMAS or not. The costs of RSA alternatives (including the EMAS alternative) that exceed this benchmark are generally considered not financially feasible. Per FAA guidelines, the maximum feasible expenditure for a specific RSA is derived by identifying the design aircraft, determining the length of an EMAS bed necessary to safely stop the design aircraft, and calculating the cost for the typical EMAS installation.

[19] Los Angeles International Airport Noise Management Office

5.1 Design Aircraft

The design (or critical) aircraft is an aircraft that regularly uses the runway and that places the greatest demand on the EMAS. This is usually, but not always, the heaviest or largest aircraft that regularly uses the runway. EMAS performance depends not only on aircraft weight, but landing gear configuration and tire pressure. Normally, "regular use" for federal funding is at least 500 annual operations on the runway, but consideration is also given to projected trends in runway use before making a final determination of design aircraft. The design aircraft identified for Runways 6L-24R and 6R-24L, therefore, is the Airbus A380-800.

5.2 EMAS Bed Length Requirement

The EMAS bed length has to be such that it can safely stop the design aircraft traveling at 70 knots at Maximum Take-Off Weight (MTOW). As shown in **Figure 5-1,** the standard EMAS bed length for the design aircraft, as extrapolated from the graph, is between 500 feet and 600 feet. For purposes of this study, the standard EMAS bed length was assumed to be 550 feet. However, the engineered EMAS bed length will ultimately be determined during the design phase and could be different than what is assumed for this study.

As shown in **Figure 5-2**, and per FAA guidelines for calculating the costs for installing an EMAS bed, the maximum feasible expenditure for each runway's RSA improvements (Runways 6L-24R or 6R-24L) is estimated to be a total of approximately $25 million for both runway ends, whether the alternative includes EMAS or not.

5.3 Order of Magnitude Cost Estimates

Order of magnitude cost estimates were developed to determine if any alternatives exceeded the maximum feasible expenditure of $25 million for RSA improvements per FAA guidelines.

5.3.1 Runway 6L-24R

Order of magnitude cost estimates were developed for the Declared Distances, EMAS, and Refinement #1 alternatives. Although the Shift Runway alternative received additional consideration for refinement, the Technical Team determined that it was not desirable or necessary to demolish usable runway pavement. The estimated development costs for the three alternatives are as follows:

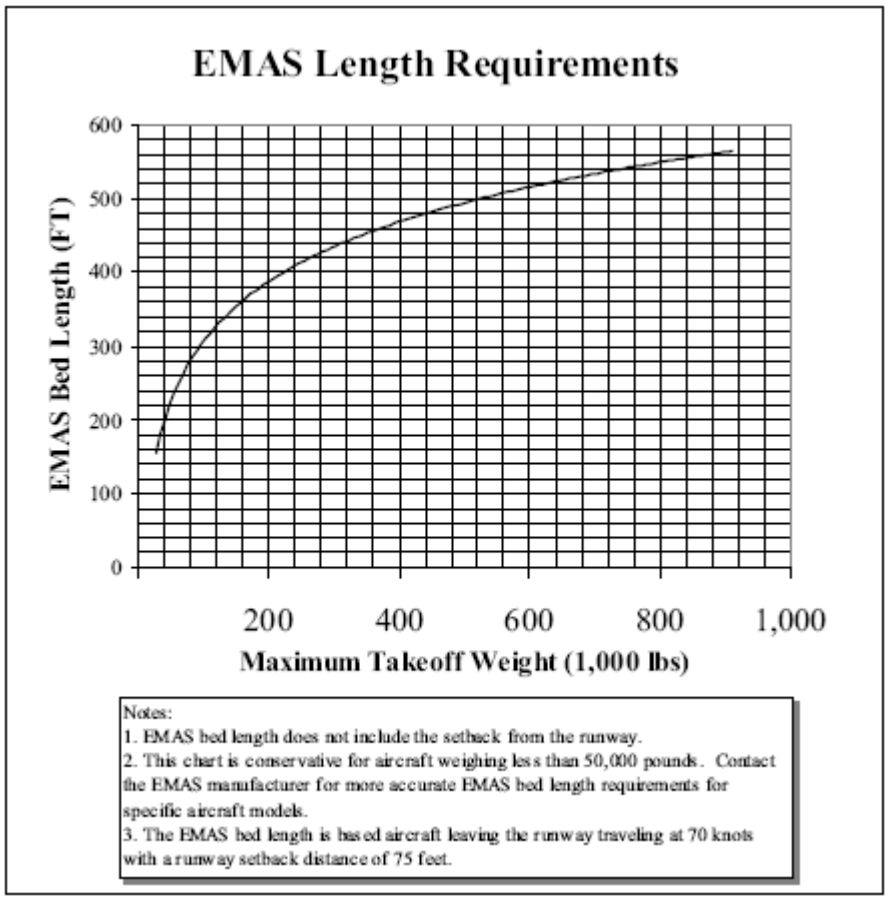
- Declared Distances = $4.5 million (approximate)
- Standard EMAS = $30.3 million (approximate) *
- Refinement #1 = $14.1 million (approximate) *

*Does not include the cost for relocating or reinstalling the approach lighting systems.

Additional details for these cost estimates are provided in **Appendix B**.

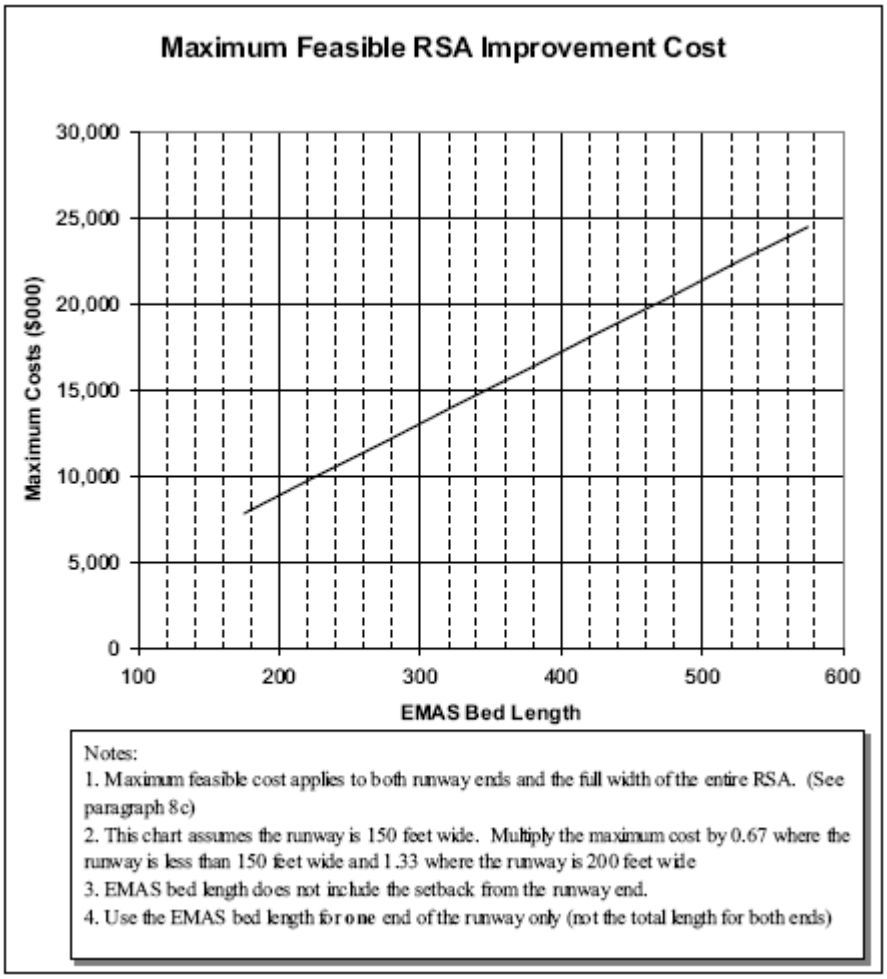
Figure 5-1

EMAS Bed Length Requirements *Los Angeles International Airport*



Source: FAA Order 5200.9 Financial Feasibility and Equivalency of Runway Safety Area Improvements and EMAS. April 2010

Prepared by: Ricondo & Associates, Inc. FINAL


Maximum Feasible RSA Improvement Cost
30,000
25,000
20,000
15,000
10,000
5,000
0
Maximum Costs ($000)
100
200
300
400
500
600
EMAS Bed Length
Notes:
1. Maximum feasible cost applies to both runway ends and the full width of the entire RSA. (See paragraph 8c)
2. This chart assumes the runway is 150 feet wide. Multiply the maximum cost by 0.67 where the runway is less than 150 feet wide and 1.33 where the runway is 200 feet wide
3. EMAS bed length does not include the setback from the runway end.
4. Use the EMAS bed length for one end of the runway only (not the total length for both ends)

5.3.2 Runway 6R-24L

Order of magnitude cost estimates were development for refinement alternatives #1 through #5. Although the conceptual Declared Distances alternative was identified during the preliminary review as the preferred alternative (contingent upon additional operational analysis), a detailed cost estimate was not provided for this alternative as development costs for declared distances are typically not significant. Refinement #6 was recognized to have significant operational impacts, so an order of magnitude cost estimate was not warranted. Of the five refinement alternatives estimated, only Refinements #1 and #2 are below the $25 million recommended maximum. All costs are approximate:

- Refinement #1 = $17.7 million
- Refinement #2 = $17.9 million*
- Refinement #3 = $68.2 million*
- Refinement #4 = $40.1 million
- Refinement #5 = $40.4 million*

*Does not include the cost for relocating or reinstalling the approach lighting systems.

Additional details for these order of magnitude cost estimates are provided in Appendix B.

VI. Comparative Evaluation of RSA Alternatives

The RSA improvement alternatives for Runways 6L-24R and 6R-24L were subjected to an evaluation process in accordance with FAA Order 5200.8, Runway *Safety Area Program* and FAA Order 5200.9, *Financial Feasibility and Equivalency of Runway Safety Area Improvements and Engineered Material Arresting System*. This guidance ensures that the preferred alternative is operationally sound, environmentally safe, and financially feasible.

The comparative evaluation in this section is based primarily on qualitative measures identified in the preliminary review. The criteria used in the comparative evaluation focuses on aircraft operational impacts during construction, operational impacts after construction (end state), potential cost impacts, and environmental impacts.

6.1 Impacts

The following section identifies the potential impacts of each alternative based on the evaluation criteria and concludes with a recommendation to the FAA for RSA improvements to Runways 6L-24R and 6R-24L.

6.1.1 Runway 6L-24R

Table 6-1 summarizes the qualitative comparison of the six RSA improvement alternatives for Runway 6L-24R.

Table 6-1

Runway Safety Area Study Comparative Matrix – Runway 6L-24R

Figure # Concept	Rwy End	Runway Shift / Extension	Displaced Threshold	Declared Distances	Standard RSA	Standard EMAS	Available Distances (Feet) TORA	TODA	ASDA	LDA	Operational (Construction)	Operational (end state)	Design & Construction Cost	Environmental
RUNWAY 6L-24R - RSA Improvement Alternatives														
Existing	6L				X		8,925	8,925	8,925	8,925				
	24R						8,925	8,925	8,925	8,925				
STD RSA	6L				X		8,925	8,925	8,925	8,925				
	24R				X		8,925	8,925	8,925	8,925			Lincoln Blvd	
Reduce Rwy	6L				X		7,532	7,532	7,532	7,532				
	24R	west 1393'			X		7,532	7,532	7,532	7,532		DEPARTURE		
Decl. Dist.	6L			X	X		8,925	8,925	8,925	8,566				
	24R				X		8,925	8,925	8,925	8,925				
Shift	6L	west 623'			X		8,925	8,925	8,925	8,925				
	24R	west 623'			X		8,925	8,925	8,925	8,925				
STD EMAS	6L				X	X	8,925	8,925	8,925	8,925				
	24R				X	X	8,925	8,925	8,925	8,925				
Refinement # 1	6L	west 359'	359'	X	X		9,284	9,284	8,925	8,566				
	24R				X		9,325	9,325	9,325	9,325				

Legend:

- Minimal impacts
- Moderate impacts
- Major impacts
- Preferred RSA Improvement Alternative

Source: U.S. Cost, Inc., 2009; Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

6.1.1.1 Operational Impacts (during construction)

Certain RSA improvement alternatives are likely to have a greater degree of operational impacts during construction, especially those that include a runway extension or construction that abuts existing runway pavement. This type of construction typically requires a temporary displaced threshold that reduces landing/take-off distances and potentially reduces overall operational capacity. As shown in Table 6-1, two of the six alternatives are expected to incur operational impacts during construction: the Shift Runway and Refinement #1 alternatives. No construction impacts are expected from the other alternatives.

6.1.1.2 Operational Impacts (end state)

Operational impacts after the completion of RSA improvements (end state) are related only to the alternatives that permanently reduce runway landing or take-off lengths. As shown in Table 6-1, only the Reduced Runway alternative has the potential for permanent operational impacts compared with existing conditions. This impact is considered major due to a runway reduction of 1,393 feet.

As requested by the Technical Team, an operational impact assessment for the Declared Distances alternative was completed and confirmed that no long-term impacts are associated with this alternative. The results of the operational impact assessment for Runway 6L-24R are provided in **Appendix C**.

6.1.1.3 Cost Impacts

The cost impacts for the RSA alternatives are compared in the matrix shown in Table 6-1. As shown, the Standard RSA alternative received a major impact rating due to the extensive relocation work necessary for Lincoln Boulevard and the service road. Four of the six alternatives received a moderate impact rating: the Declared Distances, Shift Runway, Standard EMAS, and Refinement #1 alternatives. These four alternatives received a moderate cost impact rating because costs will be incurred however, they are assumed to be less than the maximum feasible RSA improvement cost as determined in Figure 5-2. The Reduced Runway alternative received a minimal impact rating for cost because the only construction involved is demolishing existing pavement.

6.1.1.4 Environmental Impacts

Based on preliminary review of the refined RSA alternatives as well as previous environmental analysis from the LAX Master Plan, the RSA improvements for Runway 6L-24R could include these key potential impacts:

- Water Quality: Grading could potentially impact water quality; the level of impact depends on the limits of the grading. Any alternative that requires the relocation of Lincoln Boulevard, the service road, or the covering of the Argo Ditch could potentially have an impact on water quality. Additional analysis is necessary to determine the risk of any water quality impacts.
- Air Quality: Construction equipment emissions could potentially create impacts; the levels depend on the construction schedule. Additional analysis will be necessary to determine the extent of any impact from construction activities..

Based on the California Environmental Quality Act (CEQA), LAWA will need to conduct an initial study to identify the extent of these impacts. If additional environmental analysis is necessary, LAWA could conduct further environmental assessments to mitigate impacts. Based on federal

regulations, LAWA will also need to provide documentation as required under the National Environmental Policy Act (NEPA). If it is determined that all environmental concerns have been eliminated or mitigated, LAWA could request a Categorical Exclusion (CATEX) for RSA improvements. If some impacts require additional attention, an Environmental Assessment (EA) may be required.

Table 6-1 provides a qualitative comparison of environmental impacts for all six RSA improvement alternatives. As shown, five of the six alternatives are expected to have a moderate impact due to the level of grading and construction activity. Only the Reduced Runway alternative is expected to have minimal impacts since all its construction is associated with the demolition of runway/taxiway pavement.

6.1.2 Runway 6R-24L

Table 6-2 summarizes the qualitative comparison of the eleven RSA improvement alternatives for Runway 6R-24L.

6.1.2.1 Operational Impacts (during construction)

As shown in Table 6-2, only four of the alternatives would have minimal operational impacts during construction: the Standard RSA, Reduced Runway, Declared Distances, and Refinement #6 alternatives. The remaining seven alternatives are expected to have moderate operational impacts during construction.

6.1.2.2 Operational Impacts (end state)

As shown in Table 6-2, four alternatives would be expected to create major operational impacts because they permanently reduce runway landing or take-off lengths: the Reduce Runway, Declared Distances, Standard EMAS, and Refinement #6 alternatives. The Technical Team had eliminated the Reduce Runway alternative during the preliminary review process, and based on the major operational impacts rating, the Declared Distances, Standard EMAS, and Refinement #6 alternatives were also eliminated. As requested by the Technical Team, a quantitative operational impact assessment for the Declared Distance alternative was completed and identified that major impacts are associated with this alternative. Results of the detailed operational impact assessment for Runway 6R-24L are provided in Appendix C.

6.1.2.3 Cost Impacts

The cost impact comparisons for the RSA alternatives are provided in the matrix shown in Table 6-2. As shown, five alternatives received a major impact rating: the Standard RSA, Shift Runway, and Refinement Alternatives #3, #4, and #5. The order of magnitude development costs for these five alternatives are estimated to exceed the maximum feasible RSA improvement cost. The high development cost eliminates these alternatives from further consideration. Four of the alternatives received a moderate impact rating for development cost: the Standard EMAS, Refinement #1, Refinement #2, and Refinement #6. Only the Reduce Runway and Declared Distances alternatives received minimal impact ratings for development cost.

During the review process, the FAA raised the concern that it may not be financially practicable to extend Runway 6R-24L to the east considering the current LAX plan to reconfigure Runway 6R-24L. LAWA requested a "payback analysis" to determine the cost of temporary improvements prior to the redevelopment of the north airfield. The results of the "payback analysis" for a Runway 6R-24L extension is provided in **Appendix D**.

Table 6-2

Runway Safety Area Study Comparative Matrix – Runway 6R-24L

Figure #Concept	Rwy End	Runway Shift / Extension	Displaced Threshold	Declared Distances	Standard RSA	Standard EMAS	Available Distances (Feet) TORA	TODA	ASDA	LDA	Operational (Construction)	Operational (end state)	Design & Construction Cost	Environmental
RUNWAY 6R-24L - RSA Improvement Alternatives														
Existing	6R		331'	X			10,285	10,285	10,285	9,954				
	24L						10,285	10,285	10,285	10,285				
STD RSA	6R		331'	X	X		10,285	10,285	10,285	9,954			TUNNEL	
	24L				X		10,285	10,285	10,285	10,285				
Reduce Rwy	6R	east 835'			X		9,335	9,335	9,335	9,335		DEPARTURES		
	24L	west 115'			X		9,335	9,335	9,335	9,335				
Decl. Dist.	6R		331'	X	X		10,285	10,285	9,839	9,839		DEPARTURES		
	24L			X	X		10,285	10,285	9,450	9,450				
Shift	6R	east 835'			X		10,285	10,285	10,285	10,285			TUNNEL	
	24L	east 835'			X		10,285	10,285	10,285	10,285				
STD EMAS	6R	east 455'			X	X	10,095	10,095	10,095	10,095		DEPARTURES		
	24L	east 265'			X	X	10,095	10,095	10,095	10,095				
Refinement # 1	6R		331'	X	X		10,285	10,285	10,285	9,954				
	24L	east 835'	835'	X	X		11,120	11,120	10,285	9,450				
Refinement # 2	6R		435'	X	X		10,285	10,285	10,285	9,850				
	24L	east 835'	835'	X	X		11,120	11,120	10,285	9,450				
Refinement # 3	6R	east 455'			X	X	10,285	10,285	10,285	10,285				
	24L	east 455'	455'	X	X	X	10,285	10,285	10,285	9,830				
Refinement # 4	6R		331'	X	X		10,970	10,970	10,970	10,639				
	24L	east 685'	685'	X	X	X	10,970	10,970	10,135	9,450		DEPARTURES		
Refinement # 5	6R		435	X	X		10,970	10,970	10,970	10,535				
	24L	east 685'	685'	X	X	X	10,970	10,970	10,135	9,450		DEPARTURES		
Refinement # 6	6R		435	X	X		10,285	10,285	10,170	9,735				
	24L			X	X		10,285	10,285	9,450	9,450		DEPARTURES		

Legend:

- Minimal impacts
- Moderate impacts
- Major impacts
- Preferred RSA Improvement Alternative

Source: U.S. Cost, Inc., 2009; Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

6.1.2.4 Environmental Impacts

Based on preliminary review of the refined RSA alternatives, as well as previous environmental analysis from the LAX Master Plan, the RSA improvements for Runway 6R-24L could include these key potential impacts:

- Water Quality: Grading could potentially impact water quality; the level of impact depends on the limits of the grading. Any alternative that extends Runway 6R-24L to the east could have an impact on water quality in the area. Additional analysis will be necessary to determine the extent of any water quality impacts.
- Air Quality: Construction equipment emissions could potentially create impacts; the levels depend on the construction schedule. Additional analysis will be necessary to determine the extent of any impact from construction activities.
- Endangered Species: Additional analysis will be necessary to determine the extent of any potential impacts to the dunes area from construction activities.

Based on CEQA, LAWA will need to conduct an initial study to identify the extent of these impacts. If additional environmental analysis is necessary, LAWA could conduct further environmental assessments to mitigate impacts. Based on federal regulations, LAWA will also need to provide documentation as required under the NEPA. If it is determined that all environmental concerns have been eliminated or mitigated, LAWA could request a CATEX for RSA improvements. If some impacts require additional attention, LAWA could also conduct an EA for the FAA.

Table 6-2 provides a qualitative comparison of environmental impacts for all 11 RSA improvement alternatives. As shown, the Standard RSA and Shift Runway alternatives are expected to create major impacts due to extensive construction requirements. Six of the alternatives (Standard EMAS and Refinements #1 through #5) are expected to create moderate impacts due to limited grading and construction activity. Only the Reduce Runway, Declared Distances, and Refinement #6 alternatives are expected to have minimal impacts.

6.2 Evaluation Summary

6.2.1 Runway 6L-24R

Table 6-1 provides a comparative summary of all evaluation categories for the six RSA alternatives for Runway 6L-24R: the original five conceptual alternatives and one refined alternative.

As shown, the Standard RSA and Reduced Runway alternatives include major impacts for cost and operational impacts (end state), respectively. For these reasons, these alternatives were eliminated from further consideration. Although the Shift Runway alternative has only moderate impacts, the Technical Team determined that demolishing usable runway pavement was not desirable or necessary. Of the remaining three alternatives, the Declared Distances alternative has the least amount of impacts and the lowest anticipated construction cost.

6.2.2 Runway 6R-24L

Table 6-2 provides a comparative summary of all evaluation categories for the 11 RSA alternatives for Runway 6R-24L: the original five conceptual alternatives and six refined alternatives.

As shown, nine of the alternatives have been eliminated due to major operational or cost impacts: all five conceptual alternatives (Standard RSA, Reduce Runway, Declared Distances, Shift Runway, and Standard EMAS) and Refinement Alternatives #3 through #6. The only difference between Refinement Alternatives #1 and #2 was whether displacing the Runway 6R threshold was practicable and feasible due to the potential impact from the relocation of the Runway 6R approach lights in the dunes. A preliminary assessment from the consultant team reported that from an environmental aspect, it appears to be feasible to relocate the Runway 6R approach lights within the dunes.

6.3 Recommended RSA Improvement Alternative

6.3.1 Runway 6L-24R

Based on the analysis conducted in this study and the consensus of the RSA Technical Team, the Declared Distances alternative is the recommended practicable RSA improvement alternative for Runway 6L-24R. This alternative will allow Runway 6L-24R to comply with the RSA safety objectives within acceptable operational, environmental, and financial constraints.

The recommendation of the Declared Distances alternative is based on the information and facts obtained within the scope of this study. The environmental and order of magnitude cost impacts have been estimated and actual impacts and cost totals will require additional environmental and engineering studies (e.g., earthwork, drainage, and infrastructure).

6.3.2 Runway 6R-24L

Based on the analysis conducted in this study and the consensus of the RSA Technical Team, the Refinement #2 alternative is the recommended practicable RSA improvement alternative for Runway 6R-24L. This alternative will allow Runway 6R-24L to comply with the RSA safety objectives within acceptable operational, environmental, and financial constraints.

The recommendation of the Refinement #2 alternative is based on the information and facts obtained within the scope of this study. The environmental and order of magnitude cost impacts have been estimated and actual impacts and cost totals will require additional environmental and engineering studies (e.g., earthwork, drainage, infrastructure, runway line-of-sight and geometry).

The FAA stated that relocation of the Runway 6R displaced landing threshold and Runway 6R glide slope will require the development of new flight procedures to this runway.

Appendix A

FAA's Runway Safety Area Evaluation and Analysis For LAX

WORKSHEET FOR RSA DETERMINATION

LOS ANGELES INTN'L AIRPORT - LAX RWYS 6L/R/24R/L DATE: 10/26/2004

DETERMINATION: IN ACCORDANCE WITH FAA ORDER 5200.8 RUNWAY SAFETY AREA PROGRAM

[ ] EXISTING RSA MEETS THE CURRENT STANDARDS CONTAINED IN AC150/5300-13

[x] EXISTING RSA DOES NOT MEET STANDARDS BUT IS PRACTICABLE TO IMPROVE

[ ] RSA CAN BE IMPROVED TO ENHANCE SAFETY/WILL STILL NOT MEET STANDARDS

[ ] RSA DOES NOT MEET CURRENT STANDARDS/NOT PRACTICABLE TO IMPROVE RSA

EXISTING FRANGIBLE/NON-FRANGIBLE FAA OR A/P EQUIPMENT IN RSA [illegible] √ [illegible]

ITEMS TO BE RELOCATED OR MODIFIED (MADE FRANGIBLE)

ITEM	OWNER	RUNWAY	RELOCATE	MODIFY
1. LOCALIZER ANTENNA	FAA	6R	√	[ ]
2. LOCALIZER ANTENNA	FAA	6L	√	[ ]
3.			[ ]	[ ]
4.			[ ]	[ ]
5.			[ ]	[ ]
6.			[ ]	[ ]

ANALYSIS AND EVALUATION OF RSA ALTERNATIVES: FAA ORDER 5200.8 APPENDIX 2, "SUPPORTING DOCUMENTATION for RSA DETERMINATIONS" contains guidance re: Considerations in Evaluating Alternatives

RSA ALTERNATIVES:

[ ] ACQUIRE PROPERTY, GRADE AND COMPACT TO STRUCTURAL STANDARDS:

√ CONSTRUCT CUT/FILL EARTHWORK, GRADE/COMPACT TO STRUCTURAL STANDARDS:

[ ] ACQUIRE PROPERTY, CONSTRUCT CUT OR FILL EARTHWORK, GRADE AND COMPACT TO STRUCTURAL STANDARDS:

[ ] RELOCATE, SHIFT, OR REALIGN THE RUNWAY (INCLUDE WIND ROSE DATA):

[ ] REDUCE EXISTING RUNWAY LENGTH TO OBTAIN RSA STANDARDS CONSISTENT WITH EXISTING AND FUTURE DESIGN AIRCRAFT REQUIREMENTS:

√ RELOCATE, SHIFT, OR REALIGN THE RUNWAY WITH RWY LENGTH REDUCTION:

√ USE OF DECLARED DISTANCES* (WITH EXISTING RSA):

[ ] ENGINEERED MATERIALS ARRESTING SYSTEM (EMAS):

[illegible] should include the following:

a. Historical records of airport accidents/incidents.
b. The airport plans as reflected in current & forecast volume: pax/ops/design a/c, etc.
c. The extent to which the existing RSA complies with the standard.
d. Site constraints. Physical feasibility of alternatives. Environmental process costs.
e. Weather and climatic conditions.
f. Availability of visual and electronic aids for landing.

*THIS ALTERNATIVE MAY ALWAYS APPEAR TO BE THE MOST COST EFFECTIVE, HOWEVER CONSIDERATION MUST BE GIVEN TO DESIGN AIRCRAFT PERFORMANCE FEASIBILITY: (WILL DECLARED DISTANCES ALLOW HIGHER GROSS OPERATION WEIGHTS?)

TOTAL ESTIMATED COST: UNKNOWN PREPARED BY: William P. Long

SUPPORTING DOCUMENTATION STATEMENT

LOS ANGELES INTN'L AIRPORT - LAX RWYS 6L/R/24R/L DATE: 10/14/2004

DETERMINATION: IN ACCORDANCE WITH FAA ORDER 5200.8 RUNWAY SAFETY AREA PROGRAM

☒ EXISTING RSA DOES NOT MEET STANDARDS BUT IS PRACTICABLE TO IMPROVE

EXISTING FRANGIBLE/NON-FRANGIBLE FAA OR A/P EQUIPMENT [illegible]

ITEMS TO BE RELOCATED OR MODIFIED (MADE FRANGIBLE)

ITEM	OWNER	RUNWAY	RELOCATE	MODIFY
1. LOCALIZER ANTENNA	FAA	6R	√	☐
2. LOCALIZER ANTENNA	FAA	6L	√	☐
3.			☐	☐
4.			☐	☐
5.			☐	☐
6.			☐	☐

RSA/ALTERNATIVES:

√ CONSTRUCT CUT/FILL EARTHWORK, GRADE/COMPACT TO STRUCTURAL STANDARDS
√ RELOCATE, SHIFT, OR REALIGN THE RUNWAY WITH RWY LENGTH REDUCTION
√ USE OF DECLARED DISTANCES* (WITH EXISTING RSA)

SUPPLEMENTAL NARRATIVE: The 6L Localizer Antenna is 890' from the approach end of 24R. A service road traverses the RSA east of the LOC ANT at approximately 940' from the runway end. A small portion of the Lincoln Blvd. Sidewalk cuts off a corner of the RSA diagonally. The airport owns the parking lot just outside of the perimeter fence and could conceivably relocate the LOC ANT and roadway outside the RSA. The standard RSA width is impeded by the Argo Ditch (an environmentally sensitive drainage north of the runway), a portion of which runs parallel to the runway at approximately 200-235' from the runway centerline. A assessment regarding the percentage of standard RSA dimension met would need to be made to ensure a minimum of 90% attainment. One remote option would be to cover the Argo Ditch.

The Runway 6R Localizer Antenna is 890' from the approach end of 24L with a blast fence located 830' from the end of runway and a service road traversing the RSA. The LOC ANT and service road could be relocated and the runway shortened to obtain standard RSA dimensions. This option would result in the use of Declared Distances.

Improvements on the runway 6 approach ends (west) are precluded by a federally protected habitat of the El Segundo Blue Butterfly. Displacing the thresholds on the runway 6 ends would also necessitate relocation of MALSR equipment.

FEDERAL AVIATION ADMINISTRATION
WESTERN-PACIFIC REGION
CALIFORNIA STANDARDS SECTION, AWP-621, LOS ANGELES, CA.

RUNWAY SAFETY AREA EVALUATION AND ANALYSIS

Airport Name: Los Angeles International Airport	Airport Location: Los Angeles, CA.
Airport Type: Primary (Large Hub)	Airport Reference Code: D-V (B-747)

A. Runway and Associated Safety Area Dimensions

Runway	Actual Runway Dimensions	ARC	Standard RSA x Length Width	Actual RSA Length[1] x Width
6R/24L	10,285'X 150'	D-V	1000'L X 500'W	RW 6R -178'L X 500'W RW 24L -910'L X 500'W

A. 2. Category of Determination

DETERMINATION: IN ACCORDANCE WITH FAA ORDER 5200.8 RUNWAY SAFETY AREA PROGRAM

☐ EXISTING RSA MEETS THE CURRENT STANDARDS CONTAINED IN AC 150/5300-13

√ EXISTING RSA DOES NOT MEET STANDARDS BUT IS PRACTICABLE TO IMPROVE

☐ RSA CAN BE IMPROVED TO ENHANCE SAFETY/WILL STILL NOT MEET STANDARDS

☐ RSA DOES NOT MEET CURRENT STANDARDS/NOT PRACTICABLE TO IMPROVE RSA

B. Practicable Alternatives Proposed for RSA Improvements

☐ ACQUIRE PROPERTY, GRADE AND COMPACT TO STRUCTURAL STANDARDS:
√ CONSTRUCT CUT/FILL EARTHWORK, GRADE/COMPACT TO STRUCTURAL STANDARDS:
☐ ACQUIRE PROPERTY, CONSTRUCT CUT OR FILL EARTHWORK, GRADE AND COMPACT TO STRUCTURAL STANDARDS:
☐ RELOCATE, SHIFT, OR REALIGN THE RUNWAY (INCLUDE WIND ROSE DATA):
☐ REDUCE EXISTING RUNWAY LENGTH TO OBTAIN RSA STANDARDS CONSISTENT WITH EXISTING AND FUTURE DESIGN AIRCRAFT REQUIREMENTS:
☐ RELOCATE, SHIFT, OR REALIGN THE RUNWAY WITH RWY LENGTH REDUCTION:
√ USE OF DECLARED DISTANCES* (WITH EXISTING RSA):
√ ENGINEERED MATERIALS ARRESTING SYSTEM (EMAS):

C. Evaluation of Factors Affecting Alternatives

[1] Runway Safety Area length beyond end is measured from the approach end of the Runway

Runway 6R: The existing RSA does not meet the current standards contained in AC 150/5300-13, for an over the ocean approach that undershoots or overshoots the runway, and for aborted departures to the east. As practical alternatives, the existing RSA can be incrementally improved by applying declared distance for overshoots and aborted takeoffs to the east. Accelerate Stop Distance Available (ASDA) of 10195 and Landing Distance Available (LDA) of 9595 can be published in the Airport Facility Directory (AFD) to meet the RSA for an overshoot or an aborted takeoff on Runway 6R. LDA of 9595 will require displacing the threshold for Runway 6L by an additional 269 feet, from 331 feet to 600 feet. A 600 feet threshold displacement that includes shortening the runway length by approximately 300 feet will also allow the installation of EMAS beyond the displaced runway threshold. This reconfiguration on the west end will be necessary for overshoots or aborted takeoffs in the opposite direction, ie., on Runway 24L and provides a 600 feet long RSA for landings on Runway 6R. The RSA will still not meet current standards. The threshold is displaced 321' (pole). The ability to improve the RSA is impaired by an airport access road, a six lane public road (Pershing Blvd.) and the LAX/El Segundo Dunes and abrupt grade changes in terrain. The airport access road is 210' from the runway end. Pershing Blvd. is 270' from and is at a 21' lower grade (due to sharp terrain drop) than the runway end. The LAX/El Segundo Dunes, a federally listed endangered species habitat for the El Segundo Blue Butterfly, is 370' from the runway end. The general geography of the Dunes is of uniformed sloped type of terrain (a small hill or mound) of varying heights with dense vegetation type cover that is in general of higher elevation than that of the runway end.

Air carriers use Runway 6R for over the ocean arrivals and an occasional departure to the east. A MALSR, PAPI and a CAT I ILS serve the runway.

Runway 24L: The existing RSA does not meet the current standards contained in AC 150/5300-13, for approaches and departures to the west. As practical alternatives, the existing RSA can be incrementally improved to enhance safety. For aborted takeoffs and overshoots to the west, the existing RSA can be improved by taking approximately 300 feet of useable runway to allow the installation of EMAS. For undershoots, safety enhancing improvements include relocating the existing perimeter barrier fence further east of its present location. The ability to improve the RSA is impaired by a localizer antenna, a service road and a perimeter barrier fence. The localizer antenna is 910' from the runway end. The perimeter barrier fence, at its nearest point, is 970' from the runway end. A service road that turns to the south at about 946' south east of the runway approach end and passes between the localizer and the perimeter fence is in the RSA. Further, existing airport leaseholds located east of the existing perimeter barrier fence that provides passengers with taxi/transportation services for the airport, would have to be terminated. It is noted that a 600 feet undershoot safety area for landings currently exists. This would meet 75 percent not going beyond for undershoots and/or overruns under Figure A8-1, Appendix 8 of AC 150/5300-13.

Air carriers use Runway 24L predominantly for departure operations during both VFR and IFR conditions. Safety enhancements designed for

takeoffs or landings on Runway 24L may impact operations by the shift of large wide body aircraft departures to the South Runway Complex. The runway is served by a MALSR, TDZL and has an ILS, CAT I.

All of the major domestic air carriers, i.e., United, American, Southwest, serve the airport. In addition, most of the major foreign flag carriers serve the airport. Approximately 94 air carriers serve the airport.

D. Assessment of Alternatives Proposed

Runway 6R: As a practicable alternative to meeting current RSA standards for aborted takeoffs, undershoots and overshoots to the east is by applying declared distance. For landings, this will require a reduction of the present LDA by approximately 369 (279' from west end + 90' from east end), from 9964 to 9595. For takeoffs, this will require the reduction of ASDA by approximately 390 (300' from west end + 90' from east end), from 10285 to 9895.

Runway 24L: As practicable alternatives to meeting current RSA standards for landings and takeoffs to the west, install EMAS or apply declared distance. EMAS is preferred since it will require less of the useable runway. As practicable alternatives to making incremental improvements in meeting current RSA standards for landings, (1) relocate the localizer antenna, the service road and perimeter barrier fence outside of the RSA. The cost to reconfigure the Taxiways E16 and E17 and to relocate the localizer antenna and the perimeter barrier fence is estimated at $15 million. The service road can be relocated out of the RSA by force account. It is noted that a 600 feet undershoot safety area for landings currently exists. This would meet 75 percent not going beyond for undershoots and/or overruns under Figure A8-1, Appendix 8 of AC 150/5300-13.

Footnote: Another practical alternative to meeting current RSA standards for Runway 6R-24L is the feasibility of EMAS installed at both runway ends. This will require a 600 feet threshold displacement with shortening of the runway length at the west end. A 600 feet threshold displacement and a shortening of the runway length will not be required at the east end.

E. Summary of Determined Course(s) of Action

Runway 6R: The RSA can be improved to enhance safety and practical to meet standards by applying declared distance for takeoffs. The RSA can be incrementally improved to enhance safety by applying declared distance and displacing the threshold for landings.

Runway 24L: The RSA can be incrementally improved to enhance safety to meet standards. For example, for aborted takeoffs and overshoots to the west, the existing RSA can be improved by taking approximately 200-300 feet of useable runway to allow the installation of EMAS. For undershoots, safety enhancing improvements include relocating the existing perimeter barrier fence further east of its present location.

2

APPENDIX 1

SOURCE DOCUMENTS/MATERIALS USED IN THE PREPARATION OF RSA DETERMINATION

1. **AIRPORT LAYOUT PLAN:**
   The ALP used for this analysis was approved on June 23, 1993 and revalidated on May 3, 2000.

2. **OBSTRUCTION CHART:**
   OC 237 published in July 1996 was used for this analysis.

3. **AIRPORT MASTER RECORD:**
   The 5010 on file are based on the inspection that was performed on February 27, 1998.

4. **TERPS (APPROACH PLATES):**
   The approach plate used for this analysis is effective July 7, 2005 to September 1, 2005.

5. **SITE VISITS:**
   October 26, 2004.

6. **PHOTOGRAPHS:**
   October 26, 2004.

7 **PREVIOUS RSA DETERMINATION:**
   September 16, 2000.

Recommended by Ruben C. Cabalbag
Airports Program Engineer, AWP-631.5

5/8/06
Date

Concur

John P. Milligan
Supervisor, Standards Section, AWP-621

6/14/06
Date

Concur

George Aiken
Manager, Safety & Standards Branch, AWP-620

6/14/06
Date

FEDERAL AVIATION ADMINISTRATION
WESTERN-PACIFIC REGION
CALIFORNIA STANDARDS SECTION, AWP-621, LOS ANGELES, CA.

RUNWAY SAFETY AREA EVALUATION AND ANALYSIS

Airport Name: Los Angeles International Airport	Airport Location: Los Angeles, CA.
Airport Type: Primary (Large Hub)	Airport Reference Code: D-V (B-747)

A. Runway and Associated Safety Area Dimensions

Runway	Actual Runway Dimensions	ARC	Standard RSA x Length Width	Actual RSA Length[1] x Width
6L/24R	8,925'X 150'	D-V	1000'L X 500'W	RW 6L -1000'L X 500'W RW 24R -815'L X 500'W

A. 2. Category of Determination

DETERMINATION: IN ACCORDANCE WITH FAA ORDER 5200.8, RUNWAY SAFETY AREA PROGRAM

☐ EXISTING RSA MEETS THE CURRENT STANDARDS CONTAINED IN AC 150/5300-13

√ EXISTING RSA DOES NOT MEET STANDARDS BUT IS PRACTICABLE TO IMPROVE

√ RSA CAN BE IMPROVED TO ENHANCE SAFETY/WILL STILL NOT MEET STANDARDS

☐ RSA DOES NOT MEET CURRENT STANDARDS/NOT PRACTICABLE TO IMPROVE RSA

B. Practicable Alternatives Proposed for RSA Improvements

☐ ACQUIRE PROPERTY, GRADE AND COMPACT TO STRUCTURAL STANDARDS:
√ CONSTRUCT CUT/FILL EARTHWORK, GRADE/COMPACT TO STRUCTURAL STANDARDS:
☐ ACQUIRE PROPERTY, CONSTRUCT CUT OR FILL EARTHWORK, GRADE AND COMPACT TO STRUCTURAL STANDARDS:
☐ RELOCATE, SHIFT, OR REALIGN THE RUNWAY (INCLUDE WIND ROSE DATA):
☐ REDUCE EXISTING RUNWAY LENGTH TO OBTAIN RSA STANDARDS CONSISTENT WITH EXISTING AND FUTURE DESIGN AIRCRAFT REQUIREMENTS:
☐ RELOCATE, SHIFT, OR REALIGN THE RUNWAY WITH RWY LENGTH REDUCTION:
√ USE OF DECLARED DISTANCES* (WITH EXISTING RSA):
☐ ENGINEERED MATERIALS ARRESTING SYSTEM (EMAS):

[1] Runway Safety Area length beyond end is measured from the approach end of the Runway

C. Evaluation of Factors Affecting Alternatives

Runway 6L: The existing RSA does not meet the current standards contained in AC 150/5300-13, for an over the ocean approach that overshoots the runway, and for aborted departures to the east. As a practicable alternative, the existing RSA can be brought to standards by applying declared distance. Accelerate Stop Distance Available (ASDA) of 8740 and Landing Distance Available (LDA) of 8740 can be published in the Airport Facility Directory (AFD) to meet the RSA for an overshoot or an aborted takeoff on Runway 6L.

Air carriers use Runway 6L for over the ocean arrivals and an occasional departure to the east. A MALSR, PAPI and a CAT I ILS serve the runway.

Runway 24R: The existing RSA does not meet the current standards contained in AC 150/5300-13, for an approach from the east that undershoots the runway. The RSA can be incrementally improved to enhance safety but will not meet standards. Safety enhancing improvements include relocating the existing perimeter barrier fence further east of its present location. The ability to improve the RSA is impaired by a localizer antenna, a service road and a perimeter barrier fence. The localizer antenna is 815' beyond the approach end of the runway. The perimeter barrier fence, at its nearest point, is 800' from the runway end. A service road that turns to the south at about 940' south east of the runway approach end and passes between the localizer and the perimeter fence is in the RSA. The Argo Ditch north of the runway is in the RSA. In addition, the south sidewalk for Lincoln Blvd. cuts into the northeast corner of the RSA by a triangular area of 150'x 20'. Further, existing airport leaseholds that provides airport passengers with taxi/transportation services located east of the existing perimeter barrier fence, would have to be terminated. It is noted that a 600 feet undershoot safety area for landings currently exists. This would meet 75 percent not going beyond for undershoots and/or overruns under Figure A8-1, Appendix 8 of AC 150/5300-13.

Air carriers use Runway 24R predominantly for arrival operations during both VFR and IFR conditions. The runway is served by ALSF2, TDZL and has an ILS, CAT IIIb.

All of the major domestic air carriers, i.e., United, American, Southwest, serve the airport. In addition, most of the major foreign flag carriers serve the airport. Approximately 94 air carriers serve the airport.

D. Assessment of Alternatives Proposed

Runway 6L: For takeoffs and landings to the east, a practicable alternative to meeting current RSA standards is by applying declared distance for overshoots and aborted takeoffs. This will require a reduction of the present ASDA and LDA by 185, from 8925 to 8740.

Runway 24R: As practicable alternatives to making incremental improvements in meeting current RSA standards for landings, (1) relocate the localizer antenna, the service road and perimeter barrier

fence outside of the RSA. The cost to relocate the localizer antenna and the perimeter barrier fence is estimated at $12 million. The service road can be relocated out of the RSA by force account. It is noted that a 600 feet undershoot safety area for landings currently exists. This would meet 75 percent not going beyond for undershoots and/or overruns under Figure A8-1, Appendix 8 of AC 150/5300-13.

E. Summary of Determined Course(s) of Action

Runway 6L: The RSA meets standard for undershoots and with the application of declared distance will meet standards for overshoots and aborted takeoffs to the east.

Runway 24R: The RSA meets standard for overshoots or aborted takeoff. The RSA can be incrementally improved to enhance safety for undershoots, but will not meet RSA standards. The northeast corner of RSA ventures out of the airport boundary onto the south sidewalk for Lincoln Blvd., a CalTrans road, by a triangular area of sides of approximately 150'x 20'.

APPENDIX 1

SOURCE DOCUMENTS/MATERIALS USED IN THE PREPARATION OF RSA DETERMINATION

1. AIRPORT LAYOUT PLAN:
   The ALP used for this analysis was approved on June 23, 1993 and revalidated on May 3, 2000

2. OBSTRUCTION CHART:
   OC 237 published in July 1996 was used for this analysis.

3. AIRPORT MASTER RECORD:
   The 5010 on file are based on the inspection that was performed on February 27, 1998.

4. TERPS (APPROACH PLATES):
   The approach plate used for this analysis is effective July 7, 2005 to September 1, 2005.

5. SITE VISITS:
   October 26, 2004.

6. PHOTOGRAPHS:
   October 26, 2004.

7 PREVIOUS RSA DETERMINATION:
   September 16, 2000.

Recommended by Ruben C. Cabalbag
Airports Program Engineer, AWP-621.5

5/8/06
Date

Concur

John P. Milligan
Supervisor, Standards Section, AWP-621

5/9/06
Date

Concur

George Aiken
Manager, Safety & Standards Branch, AWP-620

6/14/06
Date

Concur

Mark McClardy
Manager, Airports Division, AWP-600

Date

Appendix B

Order of Magnitude Cost Estimates

Los Angeles World Airports
AIRPORTS DEVELOPMENT GROUP

Dated: December 02, 2009

RSA 6L-24R REFINEMENT SUMMARY

Refinement #	West End Im[provements	East End Improvements	Construction Cost	Estimating Allowance	Subtotal Construction Costs w/ Estimating Allowance	Project Soft Costs	Project Contingency	Total Project Costs
Basic Concept Implement Declared Distance	None Required	Cover Ditch Realign Service Road	$ 2,521,000	$ 756,000	$ 3,277,000	$ 885,000	$ 328,000	$ 4,490,000
Basic Concept Install Standard EMAS	None Required	Cover Ditch Realign Service Road Install Standard EMAS	$ 17,019,000	$ 5,105,700	$ 22,125,000	$ 5,974,000	$ 2,213,000	$ 30,312,000
Refinement 1	Extend Runway 359' West Build/Extend Connecting Taxiways	Cover Ditch Realign Service Road	$ 7,910,000	$ 2,373,000	$ 10,283,000	$ 2,776,000	$ 1,028,000	$ 14,087,000

Note: These estimated costs above are in 2009 Dollars, therefore exclude any escalation for future years.

Los Angeles World Airports
AIRPORTS DEVELOPMENT GROUP

Revised: December 1, 2009 by Gary Chase
Date: June 12, 2009
Estimator: David Tsao

RSA 6L-24R DECLARED DISTANCE

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
		Estimated Construction Costs are in 2009 Dollars, therefore excludes escalation for future years.					
All Areas	Clearing & Grubbing	1	Clearing & Grubbing	2	Acres	$ 3,000.00	$ 6,000
AOA Fence	Mon-Fri Normal Working Hours	2	Relocated AOA Fence	0	lf	$ 22.00	$ -
AOA Fence	Mon-Fri Normal Working Hours	3	Furnish & Install AOA Fence	0	lf	$ 51.00	$ -
Removal of Ex Service Rd & Shoulder	Mon-Fri Normal Working Hours	4	Asphalt Pavement, 2-inch to 8-inch thickness	4,900	sy	$ 4.00	$ 19,600
Unsuitable Excavation at Service Road	Mon-Fri Normal Working Hours	5	Unsuitable Excavation	2,350	cy	$ 24.00	$ 56,400
Ditch Area	Mon-Fri Normal Working Hours	6	Unclassified Excavation/Embankment	500	cy	$ 26.00	$ 13,000
Ditch Area	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	7	Earthwork-Fill w/ On-Site Material	8,800	cy	$ 10.00	$ 88,000
Subgrade Preparation Service Rd	Mon-Fri Normal Working Hours	8	Subgrade Preparation	8,800	sy	$ 2.00	$ 17,600
Ditch Area - 6" Subgrade Preparation	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	9	Subgrade Preparation	1,400	sy	$ 3.50	$ 4,900
12" TH CAB at Service Road	Mon-Fri Normal Working Hours	10	Crushed Agrregate Base Course (FAA Item P209)	1,650	cy	$ 72.00	$ 118,800
Ditch Area - 12" CAB	Mon-Fri Normal Working Hours	11	Crushed Agrregate Base Course (FAA Item P209)	500	cy	$ 72.00	$ 36,000
5" AC at Service Road	Mon-Fri Normal Working Hours	12	Asphalt Concrete Pavment, Class B (Greenbook)	1,400	ton	$ 93.00	$ 130,200
Ditch Area	Mon-Fri Normal Working Hours	13	Furnish & Install Precast Concrete Culvert	1,280	cy	$ 940.00	$ 1,203,200
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	14	Manhole	2	ea	$ 32,000.00	$ 64,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	15	Handhole	2	ea	$ 15,100.00	$ 30,200
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	16	Pullbox	2	ea	$ 2,100.00	$ 4,200
Service Road	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	17	Pavement Markings and Striping (2 Coats)	8,000	sf	$ 1.20	$ 9,600
	Mon-Fri Normal Working Hours	18	Install Runway 6L Localizer Antenna Foundation	1	ls	$ 65,500.00	$ 65,500
	Mon-Fri Normal Working Hours	19	Procure abd Install 6L Localizer Antenna	1	ls	$ 250,000.00	$ 250,000
	Mon-Fri Normal Working Hours	20	Install 6L Localizer Cables	1	ls	$ 57,000.00	$ 57,000
All Areas	Mon-Fri Normal Working Hours	21	Hydroseeding	2	Acre	$ 3,300.00	$ 6,600
	Subtotal 6L-24R Declared Distance						**$ 2,181,000**
	General Conditions				15.61%		**$ 340,000**
	Subtotal w/ General Conditions						**$ 2,521,000**

Los Angeles World Airports
AIRPORTS DEVELOPMENT GROUP

Revised: December 1, 2009 by Gary Chase
Date: June 12, 2009
Estimator: David Tsao

RSA 6L-24R DECLARED DISTANCE

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
		Estimated Construction Costs are in 2009 Dollars, therefore excludes escalation for future years.					
	Estimating Allownace				30.00%		**$ 756,000**
	TOTAL 6L-24R Declared Distance						**$ 3,277,000**

Los Angeles World Airports
AIRPORTS DEVELOPMENT GROUP

Dated: June 12, 2009
Estimator: David Tsao

6L-24R EMAS

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
			Estimated Construction Costs are in 2009 Dollars, therefore excludes escalation for future years.				
All Areas	Clearing & Grubbing	1	Clearing & Grubbing	2	Acres	$ 3,000.00	$ 6,000
AOA Fence	Mon-Fri Normal Working Hours	2	Relocated AOA Fence		lf	$ 22.00	$ -
AOA Fence	Mon-Fri Normal Working Hours	3	Furnish & Install AOA Fence		lf	$ 51.00	$ -
Removal of Ex Service Rd & Shoulder	Mon-Fri Normal Working Hours	4	Asphalt Pavement Removal, 2-inch to 8-inch thickness	7000	sy	$ 4.00	$ 28,000
Rough Grading at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	5	Unclassified Excavation/Embankment	18600	cy	$ 26.00	$ 483,600
Unsuitable Excavation at Service Road	Mon-Fri Normal Working Hours	6	Unsuitable Excavation	2350	cy	$ 24.00	$ 56,400
Ditch Area	Mon-Fri Normal Working Hours	7	Unclassified Excavation/Embankment	500	cy	$ 26.00	$ 13,000
Ditch Area	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	8	Earthwork-Fill w/ On-Site Material	8800	cy	$ 10.00	$ 88,000
Subgrade Preparation Service Rd	Mon-Fri Normal Working Hours	9	Subgrade Preparation	8800	sy	$ 2.00	$ 17,600
Ditch Area - 6" Subgrade Preparation	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	10	Subgrade Preparation	1400	sy	$ 3.00	$ 4,200
12" TH CAB at Service Road	Mon-Fri Normal Working Hours	11	Crushed Agrregate Base Course (FAA Item P209)	1650	cy	$ 72.00	$ 118,800
Ditch Area - 12" CAB	Mon-Fri Normal Working Hours	12	Crushed Agrregate Base Course (FAA Item P209)	500	cy	$ 72.00	$ 36,000
5" AC at Service Road	Mon-Fri Normal Working Hours	13	Asphalt Concrete Pavment, Class B (Greenbook)	1400	ton	$ 93.00	$ 130,200
Ditch Area	Mon-Fri Normal Working Hours	14	Furnish & Install Precast Concrete Culvert	1280	cy	$ 940.00	$ 1,203,200
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	15	Manhole	2	ea	$ 32,000.00	$ 64,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	16	Handhole	2	ea	$ 15,100.00	$ 30,200
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	17	Pullbox	2	ea	$ 2,100.00	$ 4,200
Service Road	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	18	Pavement Markings and Striping (2 Coats)	8000	sf	$ 1.00	$ 8,000
	Mon-Fri Normal Working Hours	19	Install Runway 6L Localizer Antenna Foundation	1	ls	$ 65,500.00	$ 65,500
	Mon-Fri Normal Working Hours	20	Procure abd Install 6L Localizer Antenna	1	ls	$ 250,000.00	$ 250,000
	Mon-Fri Normal Working Hours	21	Install 6L Localizer Cables	1	ls	$ 57,000.00	$ 57,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	22	Construction Barricades, Signs, and Construction Fencing to Accommodate Phasing	1	ls	$ 57,000.00	$ 57,000
Runway 6L- 24R	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	23	F & I EMAS	120000	sf	$ 100.00	$ 12,000,000

6L-24R EMAS

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
		Estimated Construction Costs are in 2009 Dollars, therefore excludes escalation for future years.					
	Subtotal 6L-25R Install Standard EMAS						**$ 14,721,000**
	General Conditions				15.61%		**$ 2,298,000**
	Subtotal w/ General Conditions						**$ 17,019,000**
	Estimating Allownace				30.00%		**$ 5,105,700**
	TOTAL 6L-25R Install Standard EMAS						**$ 22,125,000**

6L-25R REFINEMENT 1

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
		Estimated Construction Costs are in 2009 Dollars, therefore excludes escalation for future years.					
All Areas	Clearing & Grubbing	1	Clearing & Grubbing	2	Acres	$ 3,000.00	$ 6,000
AOA Fence	Mon-Fri Normal Working Hours	2	Relocated AOA Fence		lf	$ 22.00	$ -
AOA Fence	Mon-Fri Normal Working Hours	3	Furnish & Install AOA Fence		lf	$ 51.00	$ -
Removal of Ex Service Rd & Shoulder	Mon-Fri Normal Working Hours	4	Asphalt Pavement Removal, 2-inch to 8-inch thickness	16400	sy	$ 4.00	$ 65,600
Remove Ex TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	5	Remove and Crush PCC Pavement 18-inch thickness	10200	sy	$ 23.00	$ 234,600
Rough Grading at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	6	Unclassified Excavation/Embankment	3300	cy	$ 26.00	$ 85,800
Rough Grading at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	7	Earthwork-Fill w/ On-Site Material	4500	cy	$ 10.00	$ 45,000
Rough Grading at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	8	Earthwork-Fill w/ On-Site Material	2750	cy	$ 10.00	$ 27,500
Unsuitable Excavation at Service Road	Mon-Fri Normal Working Hours	9	Unsuitable Excavation	2350	cy	$ 24.00	$ 56,400
Ditch Area	Mon-Fri Normal Working Hours	10	Unclassified Excavation/Embankment	500	cy	$ 26.00	$ 13,000
Ditch Area	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	11	Earthwork-Fill w/ On-Site Material	8800	cy	$ 10.00	$ 88,000
6" Subgrade Preparation at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	12	Subgrade Preparation	8800	sy	$ 3.00	$ 26,400
6" Subgrade Preparation at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	13	Subgrade Preparation	9200	sy	$ 3.00	$ 27,600
Subgrade Preparation Service Rd	Mon-Fri Normal Working Hours	14	Subgrade Preparation	8800	sy	$ 2.00	$ 17,600
Ditch Area - 6" Subgrade Preparation	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	15	Subgrade Preparation	1400	sy	$ 3.00	$ 4,200
New TWY Connection	Mon-Fri Normal Working Hours	16	Mill AC Pavement	200	sy	$ 7.00	$ 1,400
New TWY Connection	Mon-Fri Normal Working Hours	17	Grind PCC Pavement	200	sy	$ 14.00	$ 2,800
8" TH CAB at Runway Shoulder	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	18	Crushed Agrregate Base Course (FAA Item P209)	2200	cy	$ 115.00	$ 253,000
12" TH CAB at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	19	Crushed Agrregate Base Course (FAA Item P209)	1900	cy	$ 115.00	$ 218,500
6" TH CB at Service Road	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	20	Crushed Agrregate Base Course (FAA Item P209)	550	cy	$ 115.00	$ 63,250
12" TH CAB at Service Road	Mon-Fri Normal Working Hours	21	Crushed Agrregate Base Course (FAA Item P209)	1650	cy	$ 72.00	$ 118,800
Ditch Area - 12" CAB	Mon-Fri Normal Working Hours	22	Crushed Agrregate Base Course (FAA Item P209)	500	cy	$ 72.00	$ 36,000
19" PMB at Runway Shoulder	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	23	Process Miscellaneous Base Course	5100	cy	$ 43.00	$ 219,300

6L-25R REFINEMENT 1

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
		Estimated Construction Costs are in 2009 Dollars, therefore excludes escalation for future years.					
12" Econocrete at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	24	12-inch Econocrete Base Course	5400	sy	$ 45.00	$ 243,000
4" AC at Runway Shoulder 25' Wide/Each Side	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	25	Asphalt Concrete Pavment, Class B (Greenbook)	2200	ton	$ 148.00	$ 325,600
3" AC at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	26	Asphalt Concrete Pavment, Class B (Greenbook)	550	ton	$ 93.00	$ 51,150
5" AC at Service Road	Mon-Fri Normal Working Hours	27	Asphalt Concrete Pavment, Class B (Greenbook)	1400	ton	$ 93.00	$ 130,200
19" PCC at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	28	19-inch PCC Pavement (650 psi-28-day)	5400	sy	$ 136.00	$ 734,400
17" PCC at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	29	17-inch PCC Pavement (650 psi-28-day)	5500	sy	$ 136.00	$ 748,000
Ditch Area	Mon-Fri Normal Working Hours	30	Furnish & Install Precast Concrete Culvert	1280	cy	$ 940.00	$ 1,203,200
Runway, TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	31	Airfield Painting w/ Refelctive Beads	12000	sf	$ 1.60	$ 19,200
TWY Shoulder Green Paint	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	32	Airfield Painting w/o Refelctive Beads	30000	sf	$ 0.75	$ 22,500
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	33	One 2-inch Conduit	5400	lf	$ 30.00	$ 162,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	34	Two 4-inch Conduit	1600	lf	$ 80.00	$ 128,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	35	Manhole	2	ea	$ 32,000.00	$ 64,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	36	Handhole	5	ea	$ 15,100.00	$ 75,500
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	37	Pullbox	10	ea	$ 2,100.00	$ 21,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	38	Airfield Lighting Cable #8 XLP for 6.6 amp circuit	9000	lf	$ 3.00	$ 27,000

6L-25R REFINEMENT 1

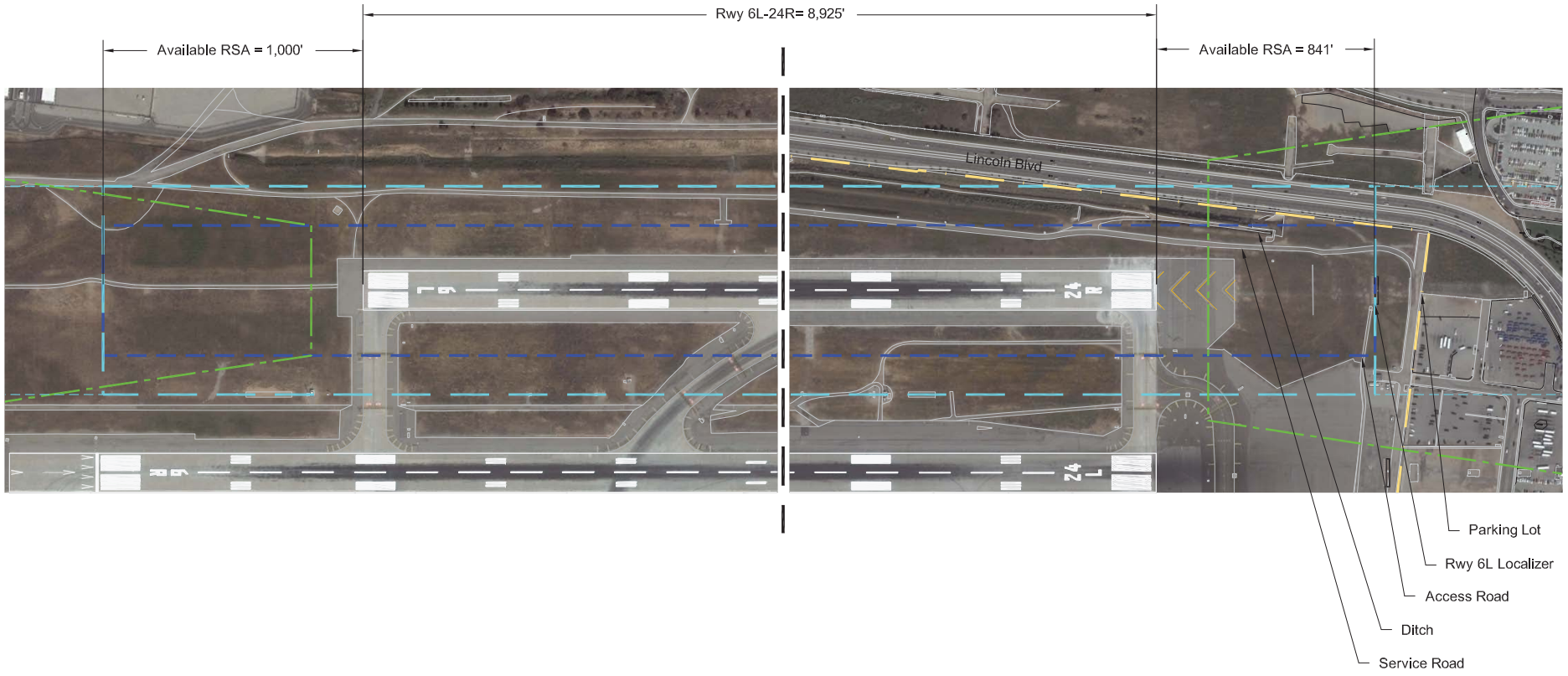
SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
			Estimated Construction Costs are in 2009 Dollars, therefore excludes escalation for future years.				
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	39	Airfield Lighting Cable #6 XLP for 20 amp circuit	15000	lf	$ 3.50	$ 52,500
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	40	New 10kw Regulator	1	ea	$ 54,300.00	$ 54,300
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	41	Diamond Leave Out	10	ea	$ 2,000.00	$ 20,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	42	Sonotube Leave Out	10	ea	$ 1,200.00	$ 12,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	43	Photometric Testing	1	ls	$ 22,000.00	$ 22,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	44	Regulator Ttesting	1	ls	$ 7,200.00	$ 7,200
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	45	Cable Meggar Testing	1	ls	$ 13,300.00	$ 13,300
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	46	Modifications to ALCMS	1	ls	$ 142,100.00	$ 142,100
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	47	LED L-810 Obstruction Light	2	ea	$ 5,200.00	$ 10,400
Service Road	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	48	Pavement Markings and Striping (2 Coats)	8000	sf	$ 1.00	$ 8,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	49	In-Pavement Runway Centerline Light w/ Base Can, Isolation Transformer in New PCC Pavement	10	ea	$ 3,800.00	$ 38,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	50	Elevated Runway Edge Light w/ Base Can, Isolation Transformer in New PCC Pavement	5	ea	$ 2,100.00	$ 10,500
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	51	In-Pavement TWY Centerline Light w/ Base Can, Isolation Transformer in New PCC Pavement	75	ea	$ 2,300.00	$ 172,500
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	52	Elevated TWY Edge Light w/ Base Can, Isolation Transformer in New PCC Pavement	30	ea	$ 1,200.00	$ 36,000

Los Angeles World Airports
AIRPORTS DEVELOPMENT GROUP

Dated: June 12, 2009
Estimator: David Tsao

6L-25R REFINEMENT 1

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
			Estimated Construction Costs are in 2009 Dollars, therefore excludes escalation for future years.				
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	53	In-Pavement Runway Touch Down Zone Light w/ Base Can, Isolation Transformer in New PCC Pavement	12	ea	$ 4,400.00	$ 52,800
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	54	In-Pavement Runway Guard Zone Light w/ Base Can, Isolation Transformer in New PCC Pavement	16	ea	$ 3,430.00	$ 54,880
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	55	Existing In-Pavement Runway Guard Light on New Base Can, at New Location	6	ea	$ 2,100.00	$ 12,600
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	56	Existing Elevated Runway Guard Light on New Base Can, at New Location	2	ea	$ 1,900.00	$ 3,800
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	57	Relocate Existing Airfield Signs	4	ea	$ 1,600.00	$ 6,400
TWY Edge Lights	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	58	Removal of Electrical items	1	ls	$ 160,000.00	$ 160,000
	Mon-Fri Normal Working Hours	59	Install Runway 6L Localizer Antenna Foundation	1	ls	$ 65,500.00	$ 65,500
	Mon-Fri Normal Working Hours	60	Procure abd Install 6L Localizer Antenna	1	ls	$ 250,000.00	$ 250,000
	Mon-Fri Normal Working Hours	61	Install 6L Localizer Cables	1	ls	$ 57,000.00	$ 57,000
Runway 6L-Remove Painted Pavement Markings, Runway Threshold	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	62	Remove Painted Pavement Markings	1700	sf	$ 5.00	$ 8,500
All Areas	Mon-Fri Normal Working Hours	63	Hydroseeding	2	Acre	$ 3,300.00	$ 6,600
	Subtotal 6L-25R Refinement 1						**$ 6,842,000**
	General Conditions				15.61%		**$ 1,068,000**
	Subtotal w/ General Conditions						**$ 7,910,000**
	Estimating Allownace				30.00%		**$ 2,373,000**
	TOTAL 6L-25R REFINEMENT 1						**$ 10,283,000**



Source: *FAA Advisory Circular 150/5300-13*; Los Angeles International Airport Layout Plan, Landrum & Brown, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

0 400 ft.

north

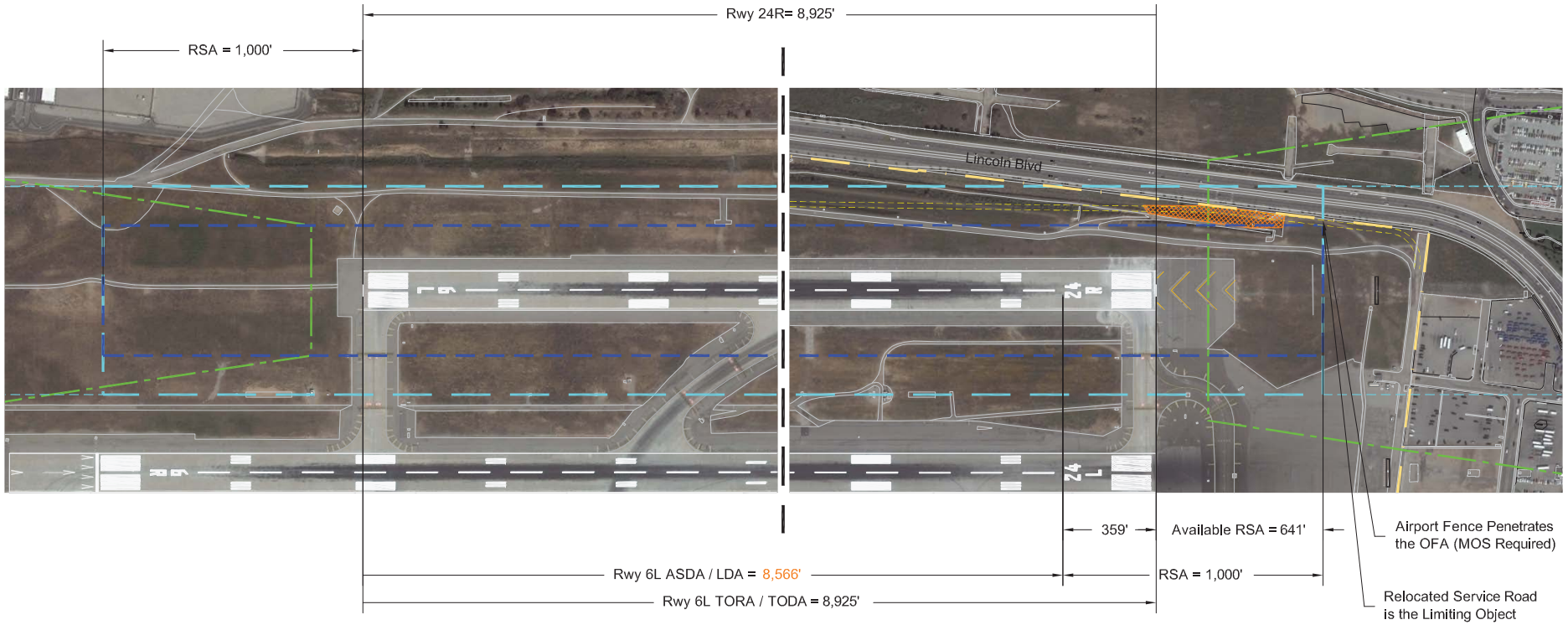
Legend:

- Runway Safety Area
- Runway Object Free Area
- Runway Protection Zone
- Central Portion of the RPZ
- Airport Property Line

Runway 6L-24R
Existing Condition

Drawing: Z:\LAWA\LAX RSA Study\CAD\Rwy 6L-24R\1-Basic Concepts_Runway 6L-24R.dwg, Layout: Existing 11x17, May 05, 2009, 9:15am

Steps:
- Relocate Ditch & Service Road
- Implement Declared Distances
- Obtain OFA MOS



Source: *FAA Advisory Circular 150/5300-13*; Los Angeles International Airport Layout Plan, Landrum & Brown, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

0 400 ft. north

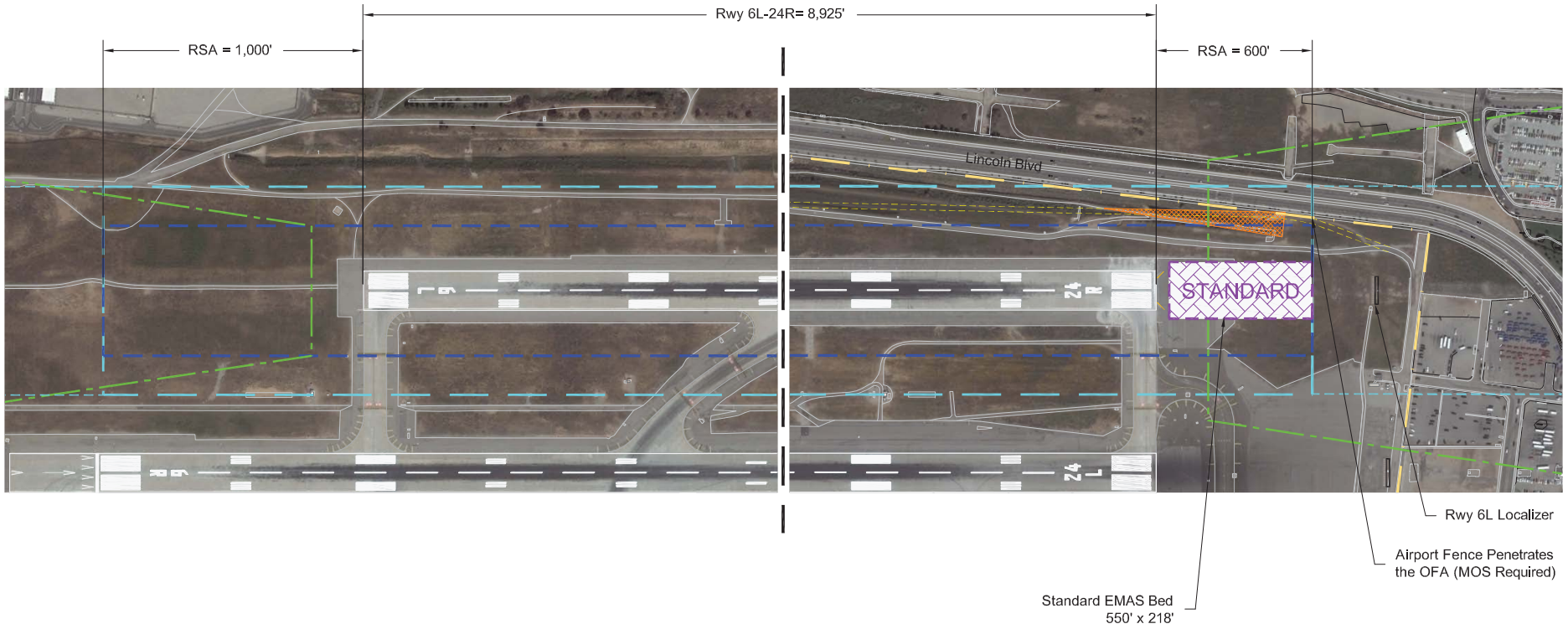
Acronyms:
TORA Take-Off Run Available
TODA Take-Off Distance Available
ASDA Accelerate-Stop Distance Available
LDA Landing Distance Available

Legend:
Runway Safety Area
Runway Object Free Area
Central Portion of the RPZ
Relocated Service Road
Ditch to be Covered
Runway Protection Zone
Airport Property Line

Drawing: Z:\LAWA\LAX RSA Study\CAD\Rwy 6L-24R\1-Basic Concepts_Runway 6L-24R.dwg, Layout: DD 11x17_May 11, 2009, 1:38pm

Runway 6L-24R Declared Distances

Steps:
- Relocate Ditch & Service Road
- Install Standard EMAS on Rwy 24R End
- Obtain OFA MOS



Source: *FAA Advisory Circular 150/5300-13*; Los Angeles International Airport Layout Plan, Landrum & Brown, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

0 400 ft.

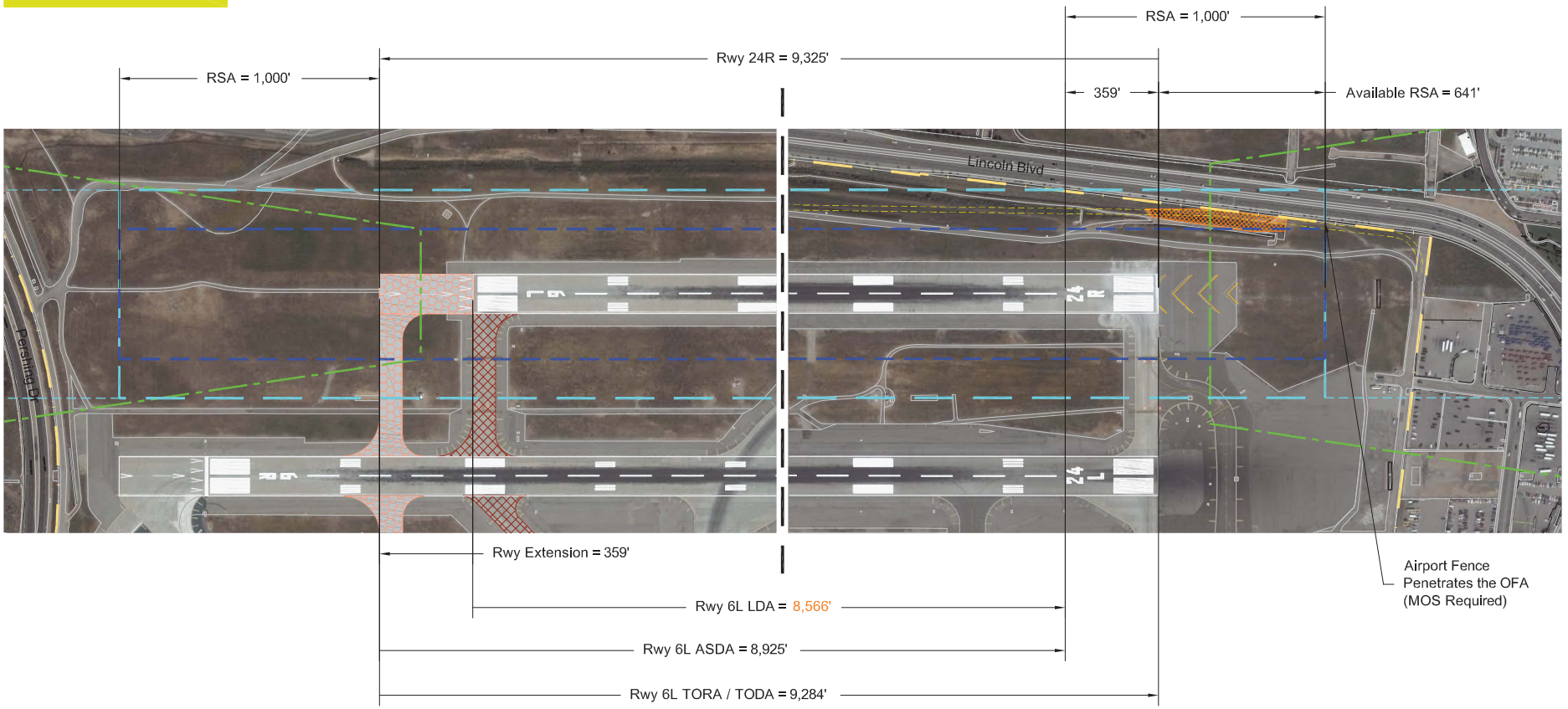
north

Legend:
- Runway Safety Area
- Runway Object Free Area
- EMAS Bed
- Ditch to be Covered
- Central Portion of the RPZ
- Relocated Service Road
- Runway Protection Zone
- Airport Property Line

Runway 6L-24R
Install Standard EMAS

Drawing: Z:\LAWA\LAX RSA Study\CAD\Rwy 6L-24R\1-Basic Concepts_Runway 6L-24R.dwg, Layout: EMAS 11x17, May 11, 2009, 1:24pm

Steps:
- Extend Rwy 6L End
- Implement Declared Distances
- Obtain OFA MOS



Source: *FAA Advisory Circular 150/5300-13* ; Los Angeles International Airport Layout Plan, Landrum & Brown, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

0 400 ft. north

Legend:
- Runway Safety Area
- Runway Object Free Area
- Central Portion of the RPZ
- Runway/Taxiway Pavement to be Built
- Runway/Taxiway Pavement to be Demolished
- Runway Protection Zone
- Relocated Service Road
- Ditch to be Covered
- Airport Property Line

Drawing: Z:\LAWA\LAX RSA Study\CAD\Rwy 6L-24R\2-Runway 6L-24R-Refinement 1.dwg, Layout: R1_May 11, 2009, 1:27pm

Runway 6L-24R
Refinement 1

Los Angeles World Airports
AIRPORTS DEVELOPMENT GROUP

Dated: December 02, 2009

RSA 6R-24L REFINEMENT SUMMARY

Refinement #	West End Im[provements	East End Improvements	Construction Cost	Estimating Allowance	Subtotal Construction Costs w/ Estimating Allowance	Project Soft Costs	Project Contingency	Total Project Costs
Refinement 1	None Required		$ 9,912,000	$ 2,974,000	$ 12,886,000	$ 3,479,000	$ 1,289,000	$ 17,654,000
Refinement 2	Shift Diplacment Threshold 104' East		$ 10,065,000	$ 3,020,000	$ 13,085,000	$ 3,533,000	$ 1,309,000	$ 17,927,000
Refinement 3	Shift Runway 455' East Install Standard EMAS Building Connectin Taxiway		$ 38,273,000	$ 11,482,000	$ 49,755,000	$ 13,434,000	$ 4,976,000	$ 68,165,000
Refinement 4 w/ EMAS	None Required		$ 22,536,000	$ 6,761,000	$ 29,297,000	$ 7,910,000	$ 2,930,000	$ 40,137,000
Refinement 5 w/ EMAS	Shift Displaced Threshold 104' East		$ 22,672,000	$ 6,802,000	$ 29,474,000	$ 7,958,000	$ 2,947,000	$ 40,379,000

Note: These estimated costs above are in 2009 Dollars, therefore exclude any escalation for future years.

RSA 6R-24L Refinement 1

Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
1	Clearing & Grubbing	9	Acres	$ 3,000.00	$ 27,000
2	Relocated AOA Fence	660	lf	$ 21.64	$ 14,000
3	Furnish & Install AOA Fence		lf	$ 50.60	$ -
4	Asphalt Pavement Removal, 2-inch to 8-inch	5500	sy	$ 4.01	$ 22,000
5	Remove and Crush PCC Pavement 18-inch thickness	1725	sy	$ 22.51	$ 39,000
6	Unclassified Excavation/Embankment	4100	cy	$ 26.26	$ 108,000
7	Earthwork-Fill w/ On-Site Material	2500	cy	$ 10.00	$ 25,000
8	Unclassified Excavation/Embankment	2300	cy	$ 16.41	$ 38,000
9	Earthwork-Fill w/ On-Site Material	7600	cy	$ 10.00	$ 76,000
10	Unclassified Excavation/Embankment	1100	cy	$ 16.41	$ 18,000
11	Unsuitable Excavation	2300	cy	$ 23.71	$ 55,000
12	Subgrade Preparation	3200	sy	$ 3.44	$ 11,000
13	Subgrade Preparation	2500	sy	$ 3.44	$ 9,000
14	Subgrade Preparation	1600	sy	$ 2.15	$ 3,000
15	Mill AC Pavement	100	sy	$ 6.86	$ 1,000
16	Grind PCC Pavement	100	sy	$ 14.14	$ 1,000
17	Crushed Agrregate Base Course (FAA Item P209)	1100	cy	$ 114.97	$ 126,000
18	Crushed Agrregate Base Course (FAA Item P209)	1300	cy	$ 114.97	$ 149,000
19	Crushed Agrregate Base Course (FAA Item P209)	1000	cy	$ 114.97	$ 115,000
20	Crushed Agrregate Base Course (FAA Item P209)	1600	cy	$ 71.86	$ 115,000
21	Crushed Agrregate Base Course (FAA Item P209)		cy	$ 71.86	$ -
22	Process Miscellaneous Base Course	2500	cy	$ 42.97	$ 107,000
23	12-inch Econocrete Base Course	14500	sy	$ 45.26	$ 656,000

RSA 6R-24L Refinement 1

Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
24	Asphalt Concrete Pavment, Class B (Greenbook)	1100	ton	$ 148.34	$ 163,000
25	Asphalt Concrete Pavment, Class B (Greenbook)	1000	ton	$ 92.71	$ 93,000
26	Asphalt Concrete Pavment, Class B (Greenbook)	1300	ton	$ 92.71	$ 121,000
27	19-inch PCC Pavement (650 psi-28-day)	14500	sy	$ 136.05	$ 1,973,000
28	17-inch PCC Pavement (650 psi-28-day)	9000	sy	$ 136.05	$ 1,224,000
29	Furnish & Install Precast Concrete Culvert		cy	$ 940.00	$ -
30	Airfield Painting w/ Refelctive Beads	21000	sf	$ 1.57	$ 33,000
31	Airfield Painting w/o Refelctive Beads	50000	sf	$ 0.67	$ 34,000
32	One 2-inch Conduit	8240	lf	$ 29.83	$ 246,000
33	Two 4-inch Conduit	6240	lf	$ 80.00	$ 499,000
34	Manhole	4	ea	$ 32,045.71	$ 128,000
35	Handhole	10	ea	$ 15,131.43	$ 151,000
36	Pullbox	20	ea	$ 2,137.14	$ 43,000
37	Airfield Lighting Cable #8 XLP for 6.6 amp circuit	17000	lf	$ 3.04	$ 52,000
38	Airfield Lighting Cable #6 XLP for 20 amp circuit	33500	lf	$ 3.35	$ 112,000

RSA 6R-24L Refinement 1

Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
39	4 Module Sign	3	ea	$ 17,600.00	$ 53,000
40	New 10kw Regulator	1	ea	$ 54,331.43	$ 54,000
41	Diamond Leave Out	20	ea	$ 1,955.89	$ 39,000
42	Sonotube Leave Out	10	ea	$ 1,206.17	$ 12,000
43	Photometric Testing	1	ls	$ 21,531.43	$ 22,000
44	Regulator Ttesting	1	ls	$ 7,193.14	$ 7,000
45	Cable Meggar Testing	1	ls	$ 13,325.71	$ 13,000
46	Modifications to ALCMS	1	ls	$ 142,125.71	$ 142,000
47	LED L-810 Obstruction Light	2	ea	$ 5,211.43	$ 10,000
48	Pavement Markings and Striping (2 Coats)	4500	sf	$ 1.19	$ 5,000
49	In-Pavement Runway Centerline Light w/ Base Can, Isolation Transformer in New PCC Pavement	20	ea	$ 3,808.61	$ 76,000
50	Elevated Runway Edge Light w/ Base Can, Isolation Transformer in New PCC Pavement	12	ea	$ 2,094.74	$ 25,000
51	In-Pavement TWY Centerline Light w/ Base Can, Isolation Transformer in New PCC Pavement	195	ea	$ 2,285.17	$ 446,000
52	Elevated TWY Edge Light w/ Base Can, Isolation Transformer in New PCC Pavement	65	ea	$ 1,190.19	$ 77,000

RSA 6R-24L Refinement 1

Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
53	In-Pavement Runway Touch Down Zone Light w/ Base Can, Isolation Transformer in New PCC Pavement	30	ea	$ 4,379.90	$ 131,000
54	In-Pavement Runway Guard Zone Light w/ Base Can, Isolation Transformer in New PCC Pavement	40	ea	$ 3,427.75	$ 137,000
55	Existing Elevated Runway Guard Light on New Base Can, at New Location	4	ea	$ 1,904.31	$ 8,000
56	Relocate Existing Airfield Signs	2	ea	$ 1,618.75	$ 3,000
57	Removal of Electrical items	1	ls	$ 160,000.00	$ 160,000
58	Install Runway 6L Localizer Antenna Foundation	1	ls	$ 65,450.49	$ 65,000
59	Procure abd Install 6L Localizer Antenna	1	ls	$ 249,940.06	$ 250,000
60	Install 6L Localizer Cables	1	ls	$ 57,129.16	$ 57,000
61	Construction Barricades, Signs, and Construction Fencing to Accommodate Phasing	1	ls	$ 160,000.00	$ 160,000
62	Relocate Existing Security Guard House	1	ea	$ 35,000.00	$ 35,000
					$ 8,574,000
			15.61%		**$ 1,338,000**
					$ 9,912,000
			30.00%		**$ 2,974,000**
					$ 12,886,000

RSA 6R-24L Refinement 2

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
All Areas	Clearing & Grubbing	1	Clearing & Grubbing	11	Acres	$ 3,000.00	$ 33,000.00
AOA Fence	Mon-Fri Normal Working Hours	2	Relocated AOA Fence	660	lf	$ 21.64	$ 14,000.00
Removal of Ex Service Rd & Shoulder	Mon-Fri Normal Working Hours	3	Asphalt Pavement Removal, 2-inch to 8-inch	5500	sy	$ 4.01	$ 22,000.00
Remove Ex TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	4	Remove and Crush PCC Pavement 18-inch thickness	1725	sy	$ 22.51	$ 39,000.00
Rough Grading at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	5	Unclassified Excavation/Embankment	4100	cy	$ 26.26	$ 108,000.00
Rough Grading at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	6	Earthwork-Fill w/ On-Site Material	2500	cy	$ 10.00	$ 25,000.00
Rough Grading at TWY	Mon-Fri Normal Working Hours	7	Unclassified Excavation/Embankment	2300	cy	$ 16.41	$ 38,000.00
Rough Grading at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	8	Earthwork-Fill w/ On-Site Material	7800	cy	$ 10.00	$ 78,000.00
Rough Grading & Sloping at New Service Road	Mon-Fri Normal Working Hours	9	Unclassified Excavation/Embankment	1100	cy	$ 16.41	$ 18,000.00
Unsuitable Excavation at Service Road	Mon-Fri Normal Working Hours	10	Unsuitable Excavation	2300	cy	$ 23.71	$ 55,000.00
6" Subgrade Preparation at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	11	Subgrade Preparation	3200	sy	$ 3.44	$ 11,000.00
6" Subgrade Preparation at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	12	Subgrade Preparation	2500	sy	$ 3.44	$ 9,000.00
Subgrade Preparation Service Rd	Mon-Fri Normal Working Hours	13	Subgrade Preparation	1600	sy	$ 2.15	$ 3,000.00
New TWY Connection	Mon-Fri Normal Working Hours	14	Mill AC Pavement	100	sy	$ 6.86	$ 1,000.00
New TWY Connection	Mon-Fri Normal Working Hours	15	Grind PCC Pavement	100	sy	$ 14.14	$ 1,000.00
8" TH CAB at Runway Shoulder	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	16	Crushed Agrregate Base Course (FAA Item P209)	1100	cy	$ 114.97	$ 126,000.00
12" TH CAB at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	17	Crushed Agrregate Base Course (FAA Item P209)	1300	cy	$ 114.97	$ 149,000.00
6" TH CB at Service Road	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	18	Crushed Agrregate Base Course (FAA Item P209)	1000	cy	$ 114.97	$ 115,000.00
12" TH CAB at Service Road	Mon-Fri Normal Working Hours	19	Crushed Agrregate Base Course (FAA Item P209)	1600	cy	$ 71.86	$ 115,000.00
19" PMB at Runway Shoulder	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	20	Process Miscellaneous Base Course	2500	cy	$ 42.97	$ 107,000.00
12" Econocrete at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	21	12-inch Econocrete Base Course	14500	sy	$ 45.26	$ 656,000.00
4" AC at Runway Shoulder 25' Wide/Each Side	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	22	Asphalt Concrete Pavment, Class B (Greenbook)	1100	ton	$ 148.34	$ 163,000.00

RSA 6R-24L Refinement 2

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
3" AC at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	23	Asphalt Concrete Pavment, Class B (Greenbook)	1000	ton	$ 92.71	$ 93,000.00
5" AC at Service Road	Mon-Fri Normal Working Hours	24	Asphalt Concrete Pavment, Class B (Greenbook)	1300	ton	$ 92.71	$ 121,000.00
19" PCC at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	25	19-inch PCC Pavement (650 psi-28-day)	14500	sy	$ 136.05	$ 1,973,000.00
17" PCC at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	26	17-inch PCC Pavement (650 psi-28-day)	9000	sy	$ 136.05	$ 1,224,000.00
Ditch Area	Mon-Fri Normal Working Hours	27	Furnish & Install Precast Concrete Culvert		cy	$ 940.00	$ -
Runway, TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	28	Airfield Painting w/ Refelctive Beads	35000	sf	$ 1.57	$ 55,000.00
TWY Shoulder Green Paint	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	29	Airfield Painting w/o Refelctive Beads	50000	sf	$ 0.67	$ 34,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	30	One 2-inch Conduit	8240	lf	$ 29.83	$ 246,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	31	Two 4-inch Conduit	6240	lf	$ 80.00	$ 499,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	32	Manhole	4	ea	$ 32,045.71	$ 128,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	33	Handhole	10	ea	$ 15,131.43	$ 151,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	34	Pullbox	20	ea	$ 2,137.14	$ 43,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	35	Airfield Lighting Cable #8 XLP for 6.6 amp circuit	17000	lf	$ 3.04	$ 52,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	36	Airfield Lighting Cable #6 XLP for 20 amp circuit	33500	lf	$ 3.35	$ 112,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	37	4 Module Sign	3	ea	$ 17,600.00	$ 53,000.00

RSA 6R-24L Refinement 2

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	38	New 10kw Regulator	1	ea	$ 54,331.43	$ 54,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	39	Diamond Leave Out	20	ea	$ 1,955.89	$ 39,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	40	Sonotube Leave Out	10	ea	$ 1,206.17	$ 12,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	41	Photometric Testing	1	ls	$ 21,531.43	$ 22,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	42	Regulator Ttesting	1	ls	$ 7,193.14	$ 7,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	43	Cable Meggar Testing	1	ls	$ 13,325.71	$ 13,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	44	Modifications to ALCMS	1	ls	$ 142,125.71	$ 142,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	45	LED L-810 Obstruction Light	2	ea	$ 5,211.43	$ 10,000.00
Service Road	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	46	Pavement Markings and Striping (2 Coats)	4500	sf	$ 1.19	$ 5,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	47	In-Pavement Runway Centerline Light w/ Base Can, Isolation Transformer in New PCC Pavement	20	ea	$ 3,808.61	$ 76,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	48	Elevated Runway Edge Light w/ Base Can, Isolation Transformer in New PCC Pavement	12	ea	$ 2,094.74	$ 25,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	49	In-Pavement TWY Centerline Light w/ Base Can, Isolation Transformer in New PCC Pavement	195	ea	$ 2,285.17	$ 446,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	50	Elevated TWY Edge Light w/ Base Can, Isolation Transformer in New PCC Pavement	65	ea	$ 1,190.19	$ 77,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	51	In-Pavement Runway Touch Down Zone Light w/ Base Can, Isolation Transformer in New PCC Pavement	30	ea	$ 4,379.90	$ 131,000.00

RSA 6R-24L Refinement 2

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	52	In-Pavement Runway Guard Zone Light w/ Base Can, Isolation Transformer in New PCC Pavement	40	ea	$ 3,427.75	$ 137,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	53	Existing Elevated Runway Guard Light on New Base Can, at New Location	4	ea	$ 1,904.31	$ 8,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	54	Relocate Existing Airfield Signs	2	ea	$ 1,618.75	$ 3,000.00
TWY Edge Lights	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	55	Removal of Electrical items	1	ls	$ 160,000.00	$ 160,000.00
	Mon-Fri Normal Working Hours	56	Install Runway 6L Localizer Antenna Foundation	1	ls	$ 65,450.49	$ 65,000.00
	Mon-Fri Normal Working Hours	57	Procure abd Install 6L Localizer Antenna	1	ls	$ 249,940.06	$ 250,000.00
	Mon-Fri Normal Working Hours	58	Install 6L Localizer Cables	1	ls	$ 57,129.16	$ 57,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	59	Construction Barricades, Signs, and Construction Fencing to Accommodate Phasing	1	ls	$ 160,000.00	$ 160,000.00
Service Road	Mon-Fri Normal Working Hours	60	Relocate Existing Security Guard House	1	ea	$ 35,000.00	$ 35,000.00
Runway 6R-Remove Painted Pavement Markings, Runway Threshold	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	61	Remove Painted Pavement Markings	16500	sf	$ 4.60	$ 76,000.00
Runway 6R	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	62	Elevated Runway Threshold Light w/ Base Can, Isolation Transformer in New PCC Pavement	16	ea	$ 1,600.00	$ 26,000.00
	Subtotal 6R-24L - Refinement 2						$ 8,706,000.00
	General Conditions				15.61%		$ 1,359,000.00
	Subtotal w/ General Conditions						$ 10,065,000.00
	Estimating Allownace				30.00%		$ 3,020,000.00
	TOTAL 6R-24L - Refinement 2						**$ 13,085,000.00**

RSA 6R-24L Refinement 3

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
All Areas	Clearing & Grubbing	1	Clearing & Grubbing	10	Acres	$ 3,000.00	$ 30,000.00
AOA Fence	Mon-Fri Normal Working Hours	2	Relocated AOA Fence	600	lf	$ 21.64	$ 13,000.00
AOA Fence	Mon-Fri Normal Working Hours	3	Furnish & Install AOA Fence		lf	$ 50.60	$ -
RSA at 24L	Mon-Fri Normal Working Hours	4	Structural Concrete - Retaining Wall	143	cy	$ 508.43	$ 73,000.00
RSA at 24L	Mon-Fri Normal Working Hours	5	Reinforcement - Uncoated	18000	lb	$ 1.06	$ 19,000.00
Removal of Ex Service Rd & Shoulder	Mon-Fri Normal Working Hours	6	Asphalt Pavement Removal, 2-inch to 8-inch	30000	sy	$ 4.01	$ 120,000.00
Remove Ex TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	7	Remove and Crush PCC Pavement 18-inch thickness	10000	sy	$ 22.51	$ 225,000.00
Remove Runway 6L	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	8	Remove and Crush PCC Pavement 19-inch thickness	7700	sy	$ 22.51	$ 173,000.00
Rough Grading at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	9	Unclassified Excavation/Embankment	5600	cy	$ 26.26	$ 147,000.00
Rough Grading at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	10	Earthwork-Fill w/ On-Site Material	29000	cy	$ 10.00	$ 290,000.00
Rough Grading at TWY	Mon-Fri Normal Working Hours	11	Unclassified Excavation/Embankment	1500	cy	$ 16.41	$ 25,000.00
Rough Grading at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	12	Earthwork-Fill w/ On-Site Material	4500	cy	$ 10.00	$ 45,000.00
Unsuitable Excavation at Service Road	Mon-Fri Normal Working Hours	13	Unsuitable Excavation	1500	cy	$ 23.71	$ 36,000.00
6" Subgrade Preparation at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	14	Subgrade Preparation	11000	sy	$ 3.44	$ 38,000.00
6" Subgrade Preparation at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	15	Subgrade Preparation	21000	sy	$ 3.44	$ 72,000.00
Subgrade Preparation Service Rd	Mon-Fri Normal Working Hours	16	Subgrade Preparation	3200	sy	$ 2.15	$ 7,000.00
New TWY Connection	Mon-Fri Normal Working Hours	17	Mill AC Pavement	200	sy	$ 6.86	$ 1,000.00
New TWY Connection	Mon-Fri Normal Working Hours	18	Grind PCC Pavement	400	sy	$ 14.14	$ 6,000.00
8" TH CAB at Runway Shoulder	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	19	Crushed Agrregate Base Course (FAA Item P209)	2800	cy	$ 114.97	$ 322,000.00
12" TH CAB at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	20	Crushed Agrregate Base Course (FAA Item P209)	4500	cy	$ 114.97	$ 517,000.00
6" TH CB at Service Road	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	21	Crushed Agrregate Base Course (FAA Item P209)	1500	cy	$ 114.97	$ 172,000.00
12" TH CAB at Service Road	Mon-Fri Normal Working Hours	22	Crushed Agrregate Base Course (FAA Item P209)	1100	cy	$ 71.86	$ 79,000.00
19" PMB at Runway Shoulder	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	23	Process Miscellaneous Base Course	1500	cy	$ 42.97	$ 64,000.00
12" Econocrete at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	24	12-inch Econocrete Base Course	8500	sy	$ 45.26	$ 385,000.00

RSA 6R-24L Refinement 3

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
4" AC at Runway Shoulder 25' Wide/Each Side	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	25	Asphalt Concrete Pavment, Class B (Greenbook)	650	ton	$ 148.34	$ 96,000.00
3" AC at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	26	Asphalt Concrete Pavment, Class B (Greenbook)	1800	ton	$ 92.71	$ 167,000.00
5" AC at Service Road	Mon-Fri Normal Working Hours	27	Asphalt Concrete Pavment, Class B (Greenbook)	950	ton	$ 92.71	$ 88,000.00
19" PCC at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	28	19-inch PCC Pavement (650 psi-28-day)	8500	sy	$ 136.05	$ 1,156,000.00
17" PCC at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	29	17-inch PCC Pavement (650 psi-28-day)	13000	sy	$ 136.05	$ 1,769,000.00
Ditch Area	Mon-Fri Normal Working Hours	30	Furnish & Install Precast Concrete Culvert		cy	$ 940.00	$ -
Runway, TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	31	Airfield Painting w/ Refelctive Beads	42500	sf	$ 1.57	$ 67,000.00
TWY Shoulder Green Paint	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	32	Airfield Painting w/o Refelctive Beads	130000	sf	$ 0.67	$ 87,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	33	One 2-inch Conduit	10000	lf	$ 29.83	$ 298,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	34	Two 4-inch Conduit	3500	lf	$ 80.00	$ 280,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	35	Manhole	5	ea	$ 32,045.71	$ 160,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	36	Handhole	10	ea	$ 15,131.43	$ 151,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	37	Pullbox	20	ea	$ 2,137.14	$ 43,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	38	Airfield Lighting Cable #8 XLP for 6.6 amp circuit	14000	lf	$ 3.04	$ 43,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	39	Airfield Lighting Cable #6 XLP for 20 amp circuit	25000	lf	$ 3.35	$ 84,000.00

RSA 6R-24L Refinement 3

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	40	4 Module Sign	6	ea	$ 17,600.00	$ 106,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	41	New 10kw Regulator	1	ea	$ 54,331.43	$ 54,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	42	Diamond Leave Out	10	ea	$ 1,955.89	$ 20,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	43	Sonotube Leave Out	5	ea	$ 1,206.17	$ 6,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	44	Photometric Testing	1	ls	$ 21,531.43	$ 22,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	45	Regulator Ttesting	1	ls	$ 7,193.14	$ 7,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	46	Cable Meggar Testing	1	ls	$ 13,325.71	$ 13,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	47	Modifications to ALCMS	1	ls	$ 142,125.71	$ 142,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	48	LED L-810 Obstruction Light	6	ea	$ 5,211.43	$ 31,000.00
Service Road	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	49	Pavement Markings and Striping (2 Coats)	6000	sf	$ 1.19	$ 7,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	50	In-Pavement Runway Centerline Light w/ Base Can, Isolation Transformer in New PCC Pavement	12	ea	$ 3,808.61	$ 46,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	51	Elevated Runway Edge Light w/ Base Can, Isolation Transformer in New PCC Pavement	6	ea	$ 2,094.74	$ 13,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	52	In-Pavement TWY Centerline Light w/ Base Can, Isolation Transformer in New PCC Pavement	90	ea	$ 2,285.17	$ 206,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	53	Elevated TWY Edge Light w/ Base Can, Isolation Transformer in New PCC Pavement	82	ea	$ 1,190.19	$ 98,000.00

RSA 6R-24L Refinement 3

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	54	In-Pavement Runway Touch Down Zone Light w/ Base Can, Isolation Transformer in New PCC Pavement	15	ea	$ 4,379.90	$ 66,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	55	In-Pavement Runway Guard Zone Light w/ Base Can, Isolation Transformer in New PCC Pavement	41	ea	$ 3,427.75	$ 141,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	56	Existing In-Pavement Runway Guard Light on New Base Can, at New Location		ea	$ 2,094.74	$ -
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	57	Existing Elevated Runway Guard Light on New Base Can, at New Location	6	ea	$ 1,904.31	$ 11,000.00
TWY Edge Lights	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	58	Removal of Electrical items	1	ls	$ 160,000.00	$ 160,000.00
	Mon-Fri Normal Working Hours	59	Install Runway 6L Localizer Antenna Foundation	1	ls	$ 65,450.49	$ 65,000.00
	Mon-Fri Normal Working Hours	60	Procure abd Install 6L Localizer Antenna	1	ls	$ 249,940.06	$ 250,000.00
	Mon-Fri Normal Working Hours	61	Install 6L Localizer Cables	1	ls	$ 57,129.16	$ 57,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	62	Construction Barricades, Signs, and Construction Fencing to Accommodate Phasing	1	ls	$ 160,000.00	$ 160,000.00
Runway 6R-Remove Painted Pavement Markings, Runway Threshold	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	63	Remove Painted Pavement Markings	3500	sf	$ 4.60	$ 16,000.00
Runway 6R	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	64	Elevated Runway Threshold Light w/ Base Can, Isolation Transformer in New PCC Pavement	30	ea	$ 1,600.00	$ 48,000.00
All Areas	Mon-Fri Normal Working Hours	65	Hydroseeding	3.5	Acre	$ 3,332.53	$ 12,000.00
Runway 6R- 24L	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	66	F & I EMAS	240000	sf	$ 100.00	$ 24,000,000.00
	Subtotal 6R-24L - Refinement 3						$ 33,105,000.00
	General Conditions				15.61%		$ 5,168,000.00
	Subtotal w/ General Conditions						$ 38,273,000.00
	Estimating Allownace				30.00%		$ 11,482,000.00

RSA 6R-24L Refinement 3

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
	TOTAL 6R-24L - Refinement 3						**$ 49,755,000.00**

RSA 6R-24L Refinement 4 w EMAS

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
All Areas	Clearing & Grubbing	1	Clearing & Grubbing	10	Acres	$ 3,000.00	$ 30,000.00
AOA Fence	Mon-Fri Normal Working Hours	2	Relocated AOA Fence	350	lf	$ 21.64	$ 8,000.00
AOA Fence	Mon-Fri Normal Working Hours	3	Furnish & Install AOA Fence	740	lf	$ 50.60	$ 37,000.00
Removal of Ex Service Rd & Shoulder	Mon-Fri Normal Working Hours	4	Asphalt Pavement Removal, 2-inch to 8-inch	18300	sy	$ 4.01	$ 73,000.00
Remove Ex TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	5	Remove and Crush PCC Pavement 18-inch thickness	3700	sy	$ 22.51	$ 83,000.00
Rough Grading at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	6	Unclassified Excavation/Embankment	4500	cy	$ 26.26	$ 118,000.00
Rough Grading at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	7	Earthwork-Fill w/ On-Site Material	30000	cy	$ 10.00	$ 300,000.00
Rough Grading at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	8	Earthwork-Fill w/ On-Site Material	5200	cy	$ 10.00	$ 52,000.00
6" Subgrade Preparation at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	9	Subgrade Preparation	17000	sy	$ 3.44	$ 58,000.00
6" Subgrade Preparation at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	10	Subgrade Preparation	12000	sy	$ 3.44	$ 41,000.00
New TWY Connection	Mon-Fri Normal Working Hours	11	Mill AC Pavement	200	sy	$ 6.86	$ 1,000.00
New TWY Connection	Mon-Fri Normal Working Hours	12	Grind PCC Pavement	200	sy	$ 14.14	$ 3,000.00
8" TH CAB at Runway Shoulder	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	13	Crushed Agrregate Base Course (FAA Item P209)	950	cy	$ 114.97	$ 109,000.00
12" TH CAB at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	14	Crushed Agrregate Base Course (FAA Item P209)	2400	cy	$ 114.97	$ 276,000.00
6" TH CB at Service Road	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	15	Crushed Agrregate Base Course (FAA Item P209)	800	cy	$ 114.97	$ 92,000.00
19" PMB at Runway Shoulder	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	16	Process Miscellaneous Base Course	2200	cy	$ 42.97	$ 95,000.00
12" Econocrete at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	17	12-inch Econocrete Base Course	13000	sy	$ 45.26	$ 588,000.00
4" AC at Runway Shoulder 25' Wide/Each Side	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	18	Asphalt Concrete Pavment, Class B (Greenbook)	930	ton	$ 148.34	$ 138,000.00
3" AC at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	19	Asphalt Concrete Pavment, Class B (Greenbook)	800	ton	$ 92.71	$ 74,000.00
19" PCC at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	20	19-inch PCC Pavement (650 psi-28-day)	13000	sy	$ 136.05	$ 1,769,000.00

RSA 6R-24L Refinement 4 w EMAS

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
17" PCC at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	21	17-inch PCC Pavement (650 psi-28-day)	7200	sy	$ 136.05	$ 980,000.00
Ditch Area	Mon-Fri Normal Working Hours	22	Furnish & Install Precast Concrete Culvert		cy	$ 940.00	$ -
Runway, TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	23	Airfield Painting w/ Refelctive Beads	16500	sf	$ 1.57	$ 26,000.00
TWY Shoulder Green Paint	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	24	Airfield Painting w/o Refelctive Beads	43000	sf	$ 0.67	$ 29,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	25	One 2-inch Conduit	7700	lf	$ 29.83	$ 230,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	26	Two 4-inch Conduit	3700	lf	$ 80.00	$ 296,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	27	Manhole	5	ea	$ 32,045.71	$ 160,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	28	Handhole	10	ea	$ 15,131.43	$ 151,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	29	Pullbox	20	ea	$ 2,137.14	$ 43,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	30	Airfield Lighting Cable #8 XLP for 6.6 amp circuit	14000	lf	$ 3.04	$ 43,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	31	Airfield Lighting Cable #6 XLP for 20 amp circuit	25000	lf	$ 3.35	$ 84,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	32	4 Module Sign	6	ea	$ 17,600.00	$ 106,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	33	New 10kw Regulator	1	ea	$ 54,331.43	$ 54,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	34	Diamond Leave Out	10	ea	$ 1,955.89	$ 20,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	35	Sonotube Leave Out	5	ea	$ 1,206.17	$ 6,000.00

RSA 6R-24L Refinement 4 w EMAS

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	36	Photometric Testing	1	ls	$ 21,531.43	$ 22,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	37	Regulator Ttesting	1	ls	$ 7,193.14	$ 7,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	38	Cable Meggar Testing	1	ls	$ 13,325.71	$ 13,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	39	Modifications to ALCMS	1	ls	$ 142,125.71	$ 142,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	40	LED L-810 Obstruction Light	4	ea	$ 5,211.43	$ 21,000.00
Service Road	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	41	Pavement Markings and Striping (2 Coats)		sf	$ 1.19	$ -
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	42	In-Pavement Runway Centerline Light w/ Base Can, Isolation Transformer in New PCC Pavement	17	ea	$ 3,808.61	$ 65,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	43	Elevated Runway Edge Light w/ Base Can, Isolation Transformer in New PCC Pavement	9	ea	$ 2,094.74	$ 19,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	44	In-Pavement TWY Centerline Light w/ Base Can, Isolation Transformer in New PCC Pavement	20	ea	$ 2,285.17	$ 46,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	45	Elevated TWY Edge Light w/ Base Can, Isolation Transformer in New PCC Pavement	45	ea	$ 1,190.19	$ 54,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	46	In-Pavement Runway Touch Down Zone Light w/ Base Can, Isolation Transformer in New PCC Pavement	25	ea	$ 4,379.90	$ 109,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	47	In-Pavement Runway Guard Zone Light w/ Base Can, Isolation Transformer in New PCC Pavement	16	ea	$ 3,427.75	$ 55,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	48	Existing Elevated Runway Guard Light on New Base Can, at New Location	2	ea	$ 1,904.31	$ 4,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	49	Relocate Existing Airfield Signs	2	ea	$ 1,618.75	$ 3,000.00

RSA 6R-24L Refinement 4 w EMAS

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
TWY Edge Lights	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	50	Removal of Electrical items	1	ls	$ 160,000.00	$ 160,000.00
	Mon-Fri Normal Working Hours	51	Install Runway 6L Localizer Antenna Foundation	1	ls	$ 65,450.49	$ 65,000.00
	Mon-Fri Normal Working Hours	52	Procure abd Install 6L Localizer Antenna	1	ls	$ 249,940.06	$ 250,000.00
	Mon-Fri Normal Working Hours	53	Install 6L Localizer Cables	1	ls	$ 57,129.16	$ 57,000.00
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	54	Construction Barricades, Signs, and Construction Fencing to Accommodate Phasing	1	ls	$ 160,000.00	$ 160,000.00
Service Road	Mon-Fri Normal Working Hours	55	Relocate Existing Security Guard House	1	ea	$ 35,000.00	$ 35,000.00
All Areas	Mon-Fri Normal Working Hours	56	Hydroseeding	10	Acre	$ 3,332.53	$ 33,000.00
Runway 6R- 24L	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	57	F & I EMAS	120000	sf	$ 100.00	$ 12,000,000.00
	Subtotal 6R-24L - Refinement 4						$ 19,493,000.00
	General Conditions				15.61%		$ 3,043,000.00
	Subtotal w/ General Conditions						$ 22,536,000.00
	Estimating Allownace				30.00%		$ 6,761,000.00
	TOTAL 6R-24L - Refinement 4						**$ 29,297,000.00**

RSA 6R-24L Refinement 5 w EMAS

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
All Areas	Clearing & Grubbing	1	Clearing & Grubbing	10	Acres	$ 3,000.00	$ 30,000
AOA Fence	Mon-Fri Normal Working Hours	2	Relocated AOA Fence	350	lf	$ 22.00	$ 7,700
AOA Fence	Mon-Fri Normal Working Hours	3	Furnish & Install AOA Fence	740	lf	$ 51.00	$ 37,740
Removal of Ex Service Rd & Shoulder	Mon-Fri Normal Working Hours	4	Asphalt Pavement Removal, 2-inch to 8-inch	18,300	sy	$ 4.00	$ 73,200
Remove Ex TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	5	Remove and Crush PCC Pavement 18-inch thickness	3,700	sy	$ 23.00	$ 85,100
Rough Grading at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	6	Unclassified Excavation/Embankment	4,500	cy	$ 26.00	$ 117,000
Rough Grading at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	7	Earthwork-Fill w/ On-Site Material	30,000	cy	$ 10.00	$ 300,000
Rough Grading at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	8	Earthwork-Fill w/ On-Site Material	5,200	cy	$ 10.00	$ 52,000
6" Subgrade Preparation at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	9	Subgrade Preparation	17,000	sy	$ 3.50	$ 59,500
6" Subgrade Preparation at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	10	Subgrade Preparation	12,000	sy	$ 3.50	$ 42,000
New TWY Connection	Mon-Fri Normal Working Hours	11	Mill AC Pavement	200	sy	$ 7.00	$ 1,400
New TWY Connection	Mon-Fri Normal Working Hours	12	Grind PCC Pavement	200	sy	$ 14.00	$ 2,800
8" TH CAB at Runway Shoulder	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	13	Crushed Agrregate Base Course (FAA Item P209)	950	cy	$ 115.00	$ 109,250
12" TH CAB at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	14	Crushed Agrregate Base Course (FAA Item P209)	2,400	cy	$ 115.00	$ 276,000
6" TH CAB - TWY Shoulder	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	15	Crushed Agrregate Base Course (FAA Item P209)	800	cy	$ 115.00	$ 92,000
19" PMB at Runway Shoulder	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	16	Process Miscellaneous Base Course	2,200	cy	$ 43.00	$ 94,600
12" Econocrete at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	17	12-inch Econocrete Base Course	13,000	sy	$ 45.00	$ 585,000
4" AC at Runway Shoulder 25' Wide/Each Side	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	18	Asphalt Concrete Pavment, Class B (Greenbook)	930	ton	$ 148.00	$ 137,640
3" AC at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	19	Asphalt Concrete Pavment, Class B (Greenbook)	800	ton	$ 93.00	$ 74,400
19" PCC at Runway	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	20	19-inch PCC Pavement (650 psi-28-day)	13,000	sy	$ 136.00	$ 1,768,000

RSA 6R-24L Refinement 5 w EMAS

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
17" PCC at TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	21	17-inch PCC Pavement (650 psi-28-day)	7,200	sy	$ 136.00	$ 979,200
Runway, TWY	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	22	Airfield Painting w/ Refelctive Beads	34,500	sf	$ 1.60	$ 55,200
TWY Shoulder Green Paint	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	23	Airfield Painting w/o Refelctive Beads	43,000	sf	$ 0.75	$ 32,250
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	24	One 2-inch Conduit	7,700	lf	$ 30.00	$ 231,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	25	Two 4-inch Conduit	3,700	lf	$ 80.00	$ 296,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	26	Manhole	5	ea	$ 32,000.00	$ 160,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	27	Handhole	10	ea	$ 15,100.00	$ 151,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	28	Pullbox	20	ea	$ 2,100.00	$ 42,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	29	Airfield Lighting Cable #8 XLP for 6.6 amp circuit	14,000	lf	$ 3.00	$ 42,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	30	Airfield Lighting Cable #6 XLP for 20 amp circuit	25,000	lf	$ 3.50	$ 87,500
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	31	4 Module Sign	6	ea	$ 17,600.00	$ 105,600
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	32	New 10kw Regulator	1	ea	$ 54,300.00	$ 54,300
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	33	Diamond Leave Out	10	ea	$ 2,000.00	$ 20,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	34	Sonotube Leave Out	5	ea	$ 1,200.00	$ 6,000

RSA 6R-24L Refinement 5 w EMAS

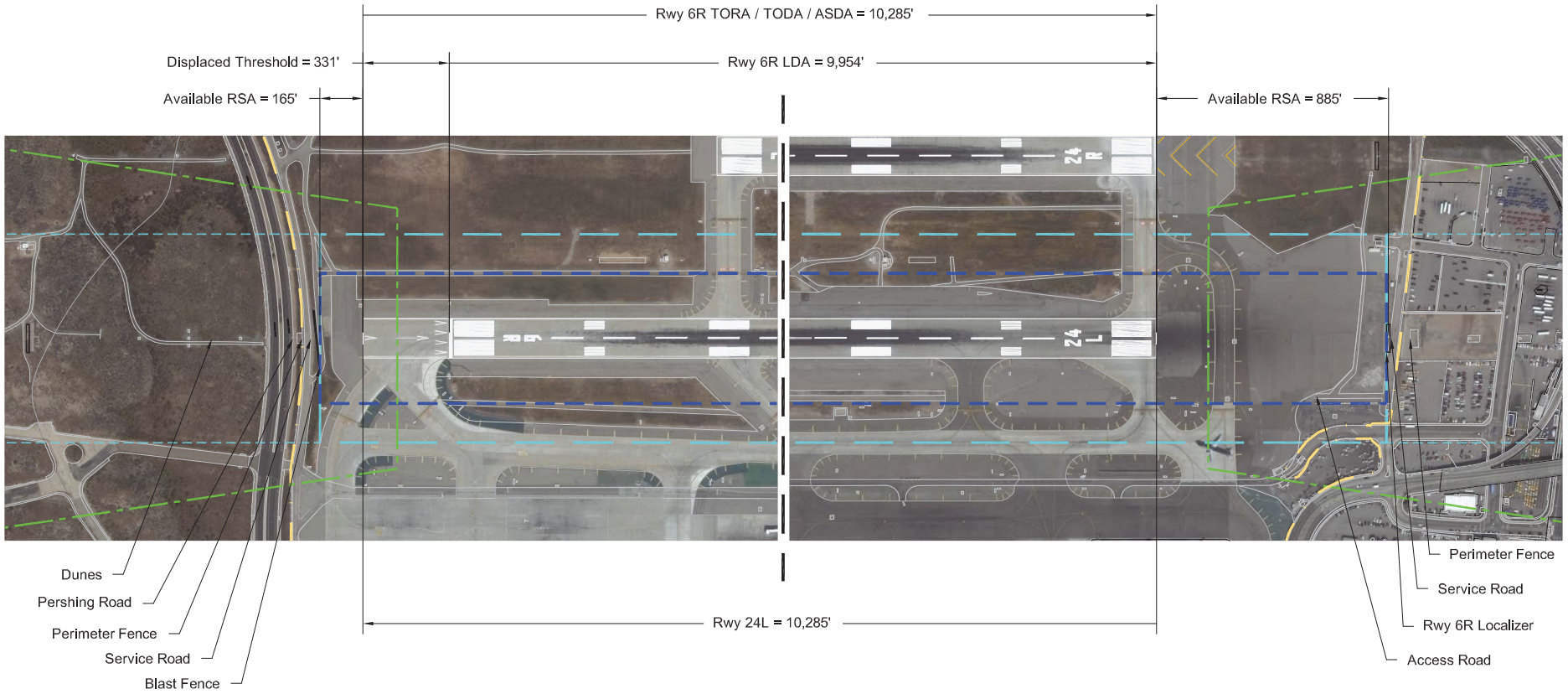
SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	35	Photometric Testing	1	ls	$ 21,500.00	$ 21,500
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	36	Regulator Ttesting	1	ls	$ 7,200.00	$ 7,200
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	37	Cable Meggar Testing	1	ls	$ 13,300.00	$ 13,300
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	38	Modifications to ALCMS	1	ls	$ 142,000.00	$ 142,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	39	LED L-810 Obstruction Light	4	ea	$ 5,200.00	$ 20,800
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	40	In-Pavement Runway Centerline Light w/ Base Can, Isolation Transformer in New PCC Pavement	17	ea	$ 3,800.00	$ 64,600
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	41	Elevated Runway Edge Light w/ Base Can, Isolation Transformer in New PCC Pavement	9	ea	$ 2,100.00	$ 18,900
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	42	In-Pavement TWY Centerline Light w/ Base Can, Isolation Transformer in New PCC Pavement	20	ea	$ 2,300.00	$ 46,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	43	Elevated TWY Edge Light w/ Base Can, Isolation Transformer in New PCC Pavement	45	ea	$ 1,200.00	$ 54,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	44	In-Pavement Runway Touch Down Zone Light w/ Base Can, Isolation Transformer in New PCC Pavement	25	ea	$ 4,400.00	$ 110,000
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	45	In-Pavement Runway Guard Zone Light w/ Base Can, Isolation Transformer in New PCC Pavement	16	ea	$ 3,400.00	$ 54,400
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	46	Existing Elevated Runway Guard Light on New Base Can, at New Location	2	ea	$ 1,900.00	$ 3,800
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	47	Relocate Existing Airfield Signs	2	ea	$ 1,600.00	$ 3,200
TWY Edge Lights	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	48	Removal of Electrical items	1	ls	$ 160,000.00	$ 160,000
	Mon-Fri Normal Working Hours	49	Install Runway 6L Localizer Antenna Foundation	1	ls	$ 65,500.00	$ 65,500

Los Angeles World Airports
AIRPORTS DEVELOPMENT GROUP

Revised: December 2, 2009 by Joe Miller
Dated: June 12, 2009
Estimator: David Tsao

RSA 6R-24L Refinement 5 w EMAS

SOW / Location	Work Schedule	Item No.	Item Description	Estimated Quantity	Unit	AVG UP	Total Using Average UP
	Mon-Fri Normal Working Hours	50	Procure abd Install 6L Localizer Antenna	1	ls	$ 250,000.00	$ 250,000
	Mon-Fri Normal Working Hours	51	Install 6L Localizer Cables	1	ls	$ 57,100.00	$ 57,100
	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	52	Construction Barricades, Signs, and Construction Fencing to Accommodate Phasing	1	ls	$ 160,000.00	$ 160,000
Service Road	Mon-Fri Normal Working Hours	53	Relocate Existing Security Guard House	1	ea	$ 35,000.00	$ 35,000
Runway 6R-Remove Painted Pavement Markings, Runway Threshold	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	54	Remove Painted Pavement Markings	18000	sf	$ 4.60	$ 83,000.00
All Areas	Mon-Fri Normal Working Hours	54	Hydroseeding	10	Acre	$ 3,300.00	$ 33,000
Runway 6R- 24L	11:30PM to 5:30 AM, 5 hours production for 8 hours shift gives 8/5=1.6 factor ro UP	55	F & I EMAS	120,000	sf	$ 100.00	$ 12,000,000
	Subtotal 6R-24L - Refinement 5						**$ 19,611,000**
	General Conditions				15.61%		**$ 3,061,000**
	Subtotal w/ General Conditions						**$ 22,672,000**
	Estimating Allowance				30.00%		**$ 6,802,000**
	TOTAL 6R-24L Refinement 5						**$ 29,474,000**



Source: *FAA Advisory Circular 150/5300-13*; Los Angeles International Airport Layout Plan, Landrum & Brown, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

0 400 ft.

north

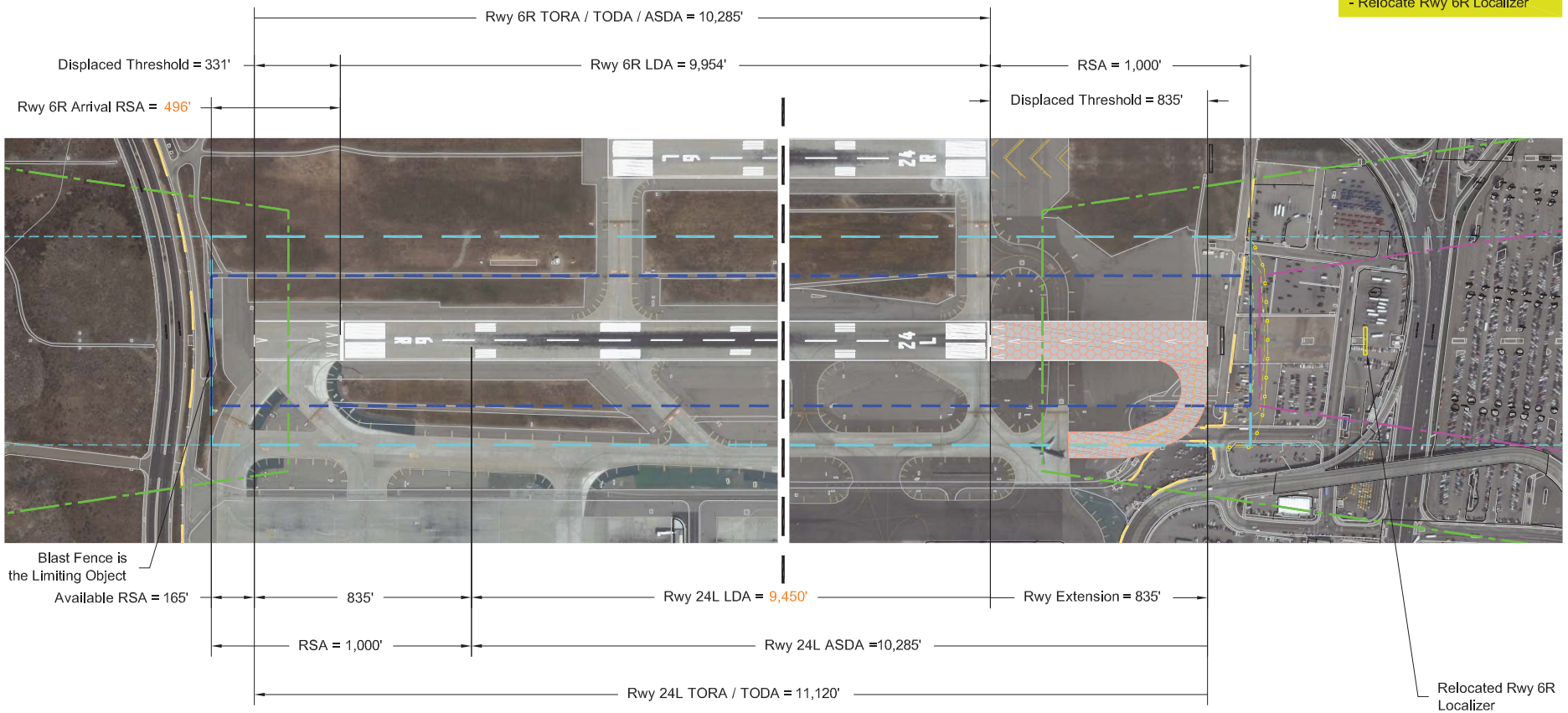
Acronyms:
TORA Take-Off Run Available
TODA Take-Off Distance Available
ASDA Accelerate-Stop Distance Available
LDA Landing Distance Available

Legend:
Runway Safety Area
Runway Object Free Area
Runway Protection Zone
Central Portion of the RPZ
Existing Airport Property Line

Runway 6R-24L Existing Condition

Drawing: Z:\LAWA\LAX RSA Study\CAD\Rwy 6R-24L\1-Basic Concepts_Runway 6R-24L.dwg, Layout: Existing 11x17_May 05, 2009, 9:05am

Steps:
- Extend Rwy 24L End
- Implement Declared Distances
- Relocate Rwy 6R Localizer



Note: Rwy 6R Arrival RSA does not meet the 600' FAA requirement.

Source: *FAA Advisory Circular 150/5300-13*; Los Angeles International Airport Layout Plan, Landrum & Brown, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

0 400 ft.

north

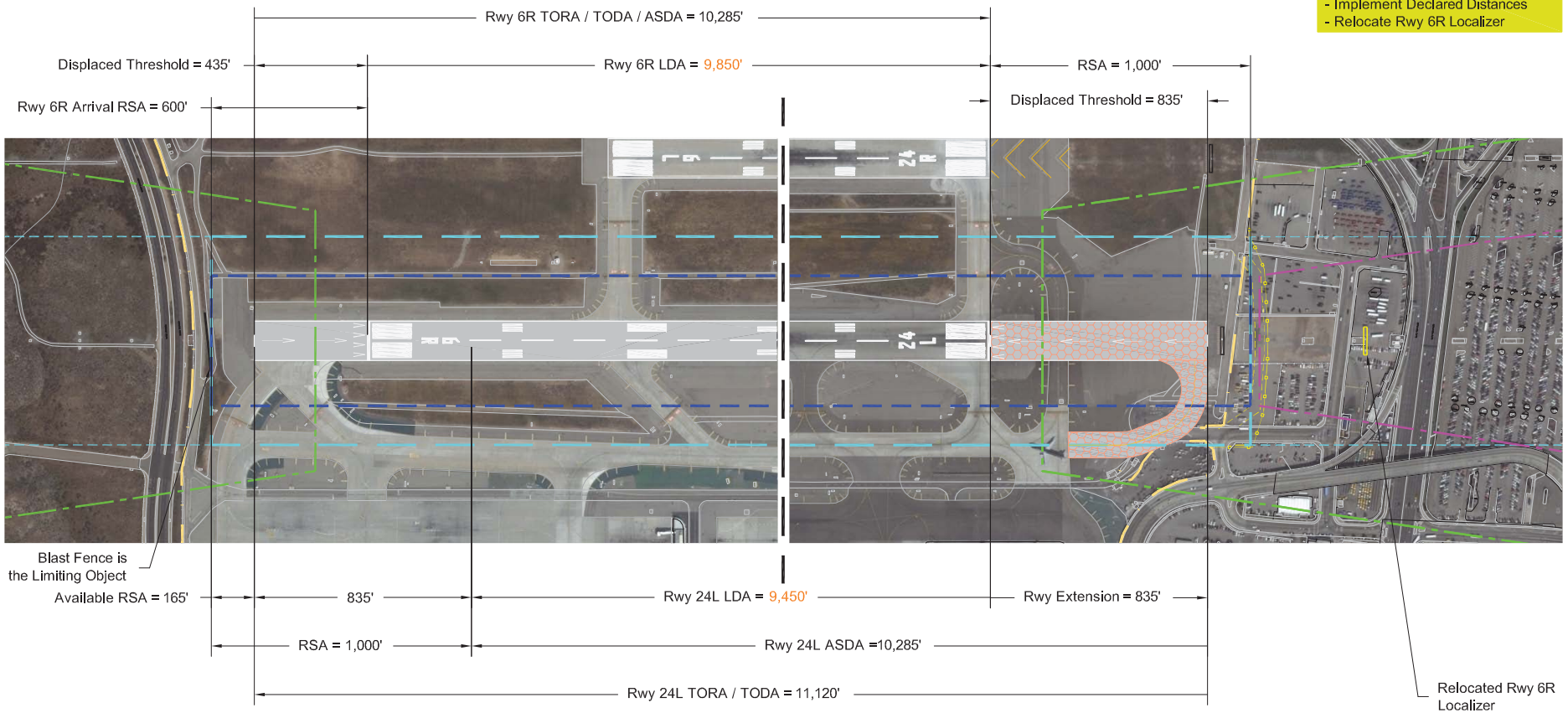
Legend:

- Runway Safety Area
- Runway Object Free Area
- Central Portion of the RPZ
- Airport Property Line
- Runway/Taxiway Pavement to be Built
- Relocated AOA Fence
- Approach Runway Protection Zone
- Departure Runway Protection Zone
- Relocated Service Road

Drawing: Z:\LAWA\LAX RSA Study\CAD\Rwy 6R-24L\2-Runway 6R-24L-Refinement 1.dwg, Layout: R1_May 05, 2009, 9:11am

Runway 6R-24L Refinement 1

Steps:
- Extend Rwy 24L End
- Shift Rwy 6R Displaced Threshold
- Implement Declared Distances
- Relocate Rwy 6R Localizer



Source: *FAA Advisory Circular 150/5300-13*; Los Angeles International Airport Layout Plan, Landrum & Brown, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

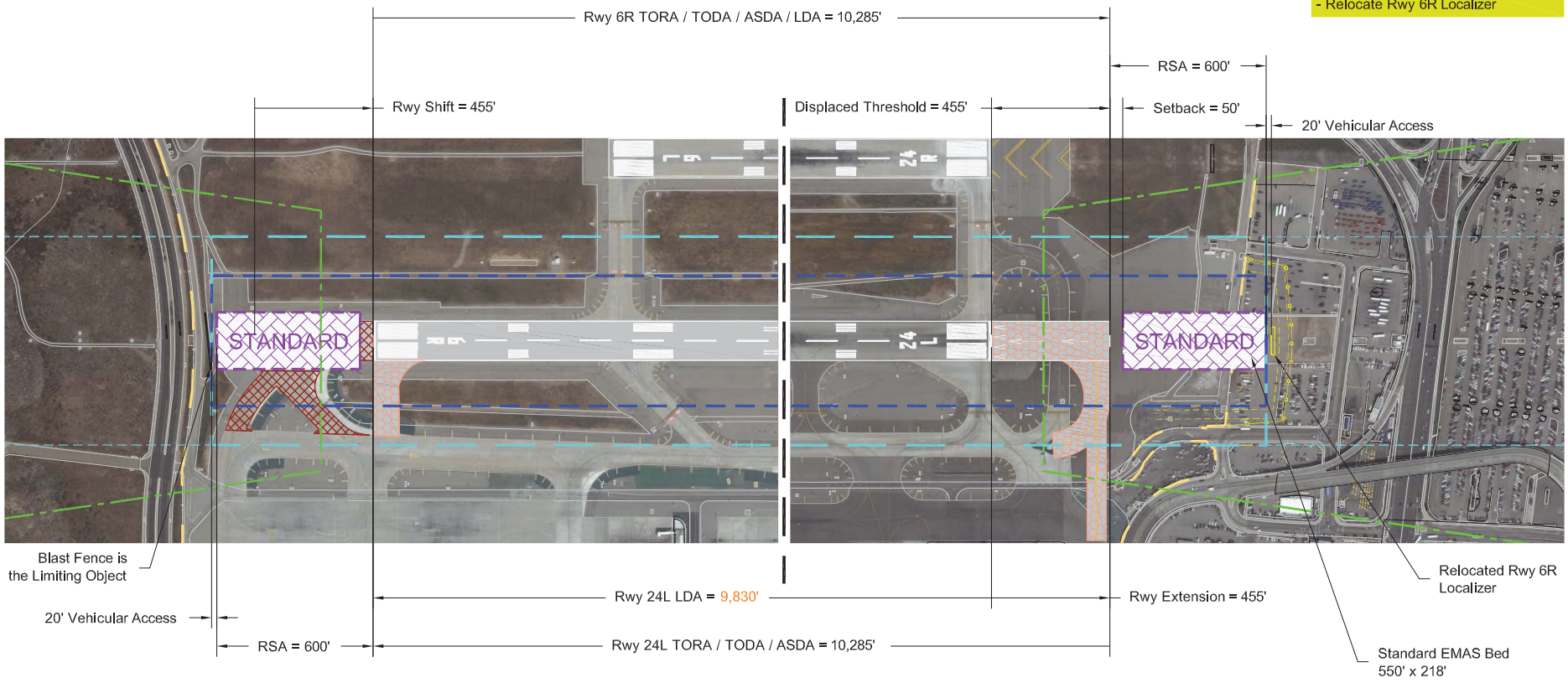
0 400 ft. north

Legend:
- Runway Safety Area
- Runway Object Free Area
- Central Portion of the RPZ
- Airport Property Line
- Runway/Taxiway Pavement to be Built
- Relocated AOA Fence
- Approach Runway Protection Zone
- Departure Runway Protection Zone
- Relocated Service Road

Drawing: Z:\LAWA\LAX RSA Study\CAD\Rwy 6R-24L\2-Runway 6R-24L-Refinement 2.dwg, Layout: R2_May 11, 2009, 1:14pm

Runway 6R-24L Refinement 2

Steps:
- Shift Rwy 455' to the east
- Install Standard EMAS on both ends
- Relocate Rwy 6R Localizer



Source: *FAA Advisory Circular 150/5300-13*; Los Angeles International Airport Layout Plan, Landrum & Brown, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: RIcondo & Associates, Inc.

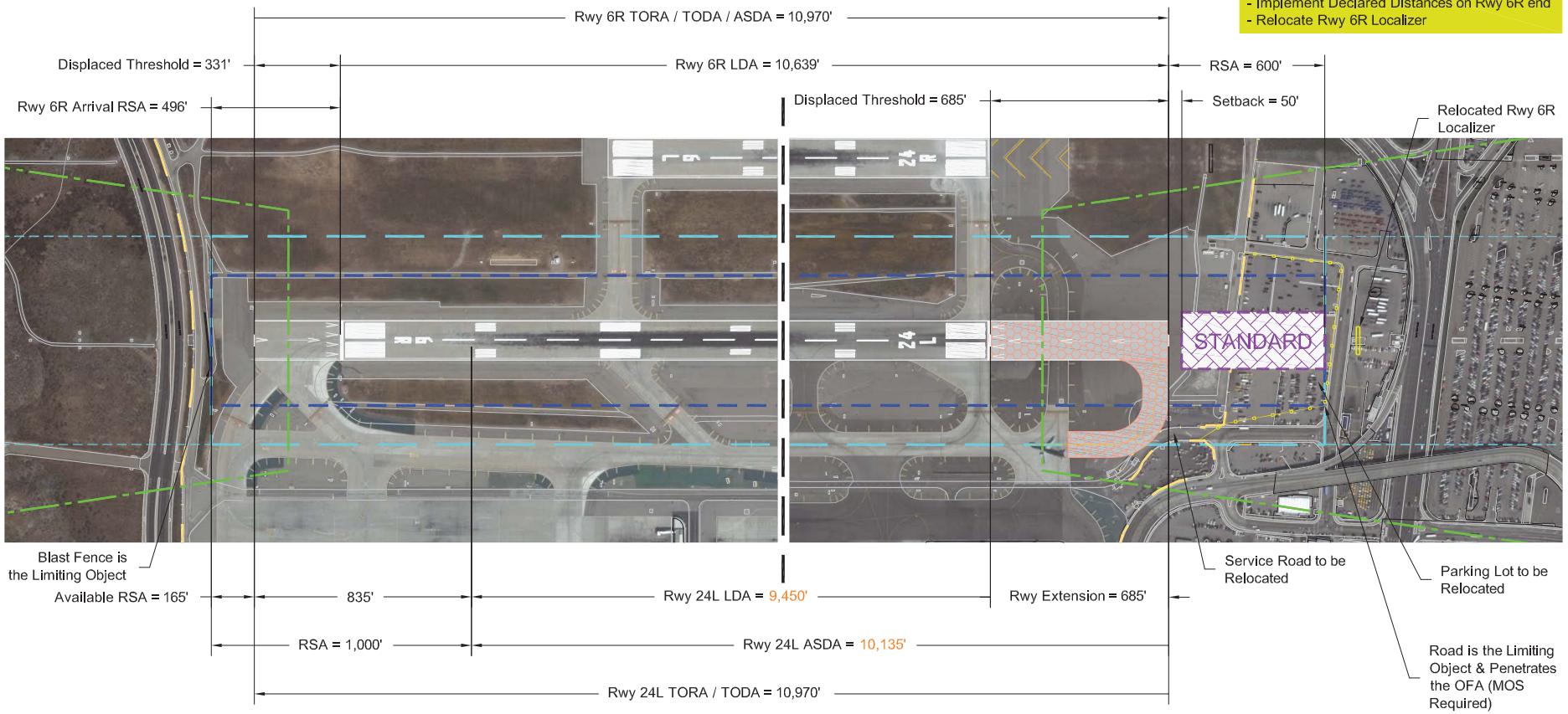
0 400 ft. north

Legend:
- Runway Safety Area
- Runway Object Free Area
- Central Portion of the RPZ
- Airport Property Line
- Runway/Taxiway Pavement to be Built
- Relocated AOA Fence
- Approach Runway Protection Zone
- Departure Runway Protection Zone
- Relocated Service Road

Drawing: Z:\LAWA\LAX RSA Study\CAD\Rwy 6R-24L\2-Runway 6R-24L-Refinement 3.dwg, Layout: R3, May 11, 2009, 12:40pm

Runway 6R-24L Refinement 3

Steps:
- Extend Rwy 24L end as far east as possible with Standard EMAS Installation
- Implement Declared Distances on Rwy 6R end
- Relocate Rwy 6R Localizer



Note: Rwy 6R Arrival RSA does not meet the 600' FAA requirement.

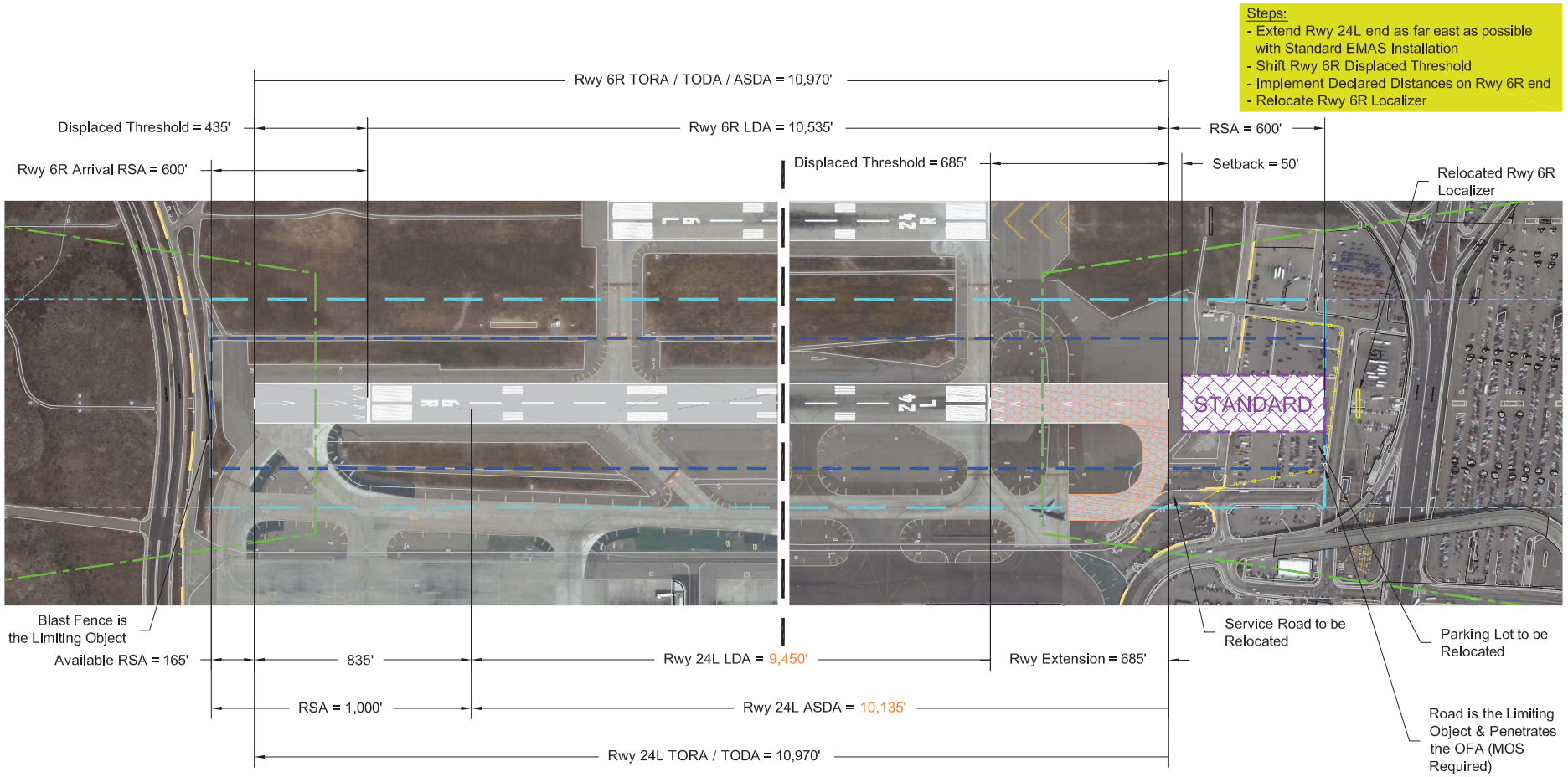
Source: *FAA Advisory Circular 150/5300-13*; Los Angeles International Airport Layout Plan, Landrum & Brown, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

0 400 ft. north

Legend:
- Runway Safety Area
- Runway Object Free Area
- Central Portion of the RPZ
- Airport Property Line
- Runway/Taxiway Pavement to be Built
- Relocated AOA Fence
- Approach Runway Protection Zone
- Departure Runway Protection Zone
- Relocated Service Road

Drawing: Z:\LAWA\LAX RSA Study\CAD\Rwy 6R-24L\2-Runway 6R-24L-Refinement 4.dwg, Layout: R4_May 11, 2009, 12:53pm

Runway 6R-24L Refinement 4



Note: Rwy 6R Arrival RSA does not meet the 600' FAA requirement.

Source: *FAA Advisory Circular 150/5300-13*; Los Angeles International Airport Layout Plan, Landrum & Brown, 2005; Aerial Photography, Digital Globe, March 14, 2008.
Prepared by: Ricondo & Associates, Inc.

0 400 ft. north

Legend:
- Runway Safety Area
- Runway Object Free Area
- Central Portion of the RPZ
- Airport Property Line
- Runway/Taxiway Pavement to be Built
- Relocated AOA Fence
- Approach Runway Protection Zone
- Departure Runway Protection Zone
- Relocated Service Road

Drawing: Z:\LAWA\LAX RSA Study\CAD\Rwy 6R-24L\2-Runway 6R-24L-Refinement 5.dwg, Layout: R5, May 11, 2009, 1:11pm

Runway 6R-24L Refinement 5

Appendix C

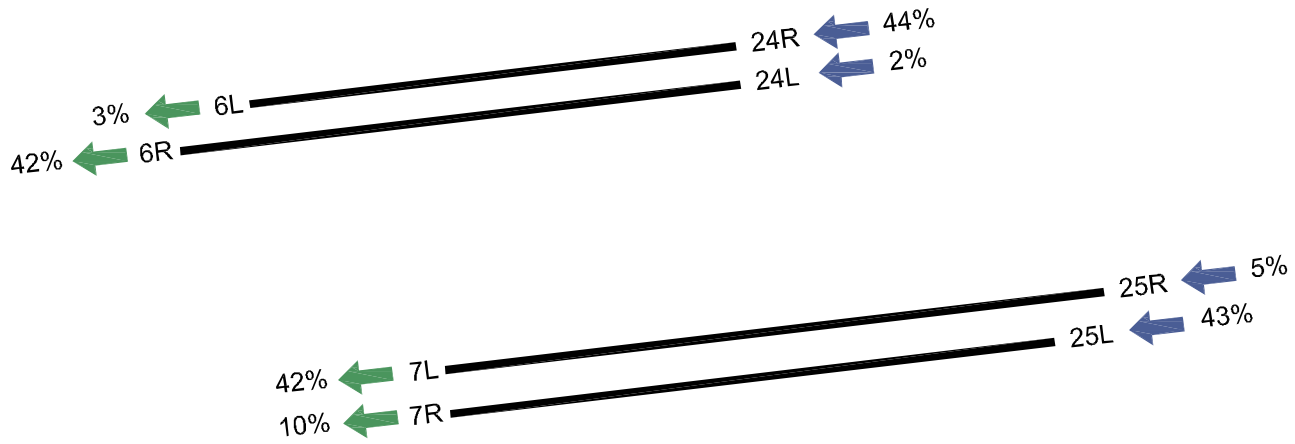
Operational Impact Assessment for Runways 6L-24R & 6R-24L

Representative Fleet Performance Data

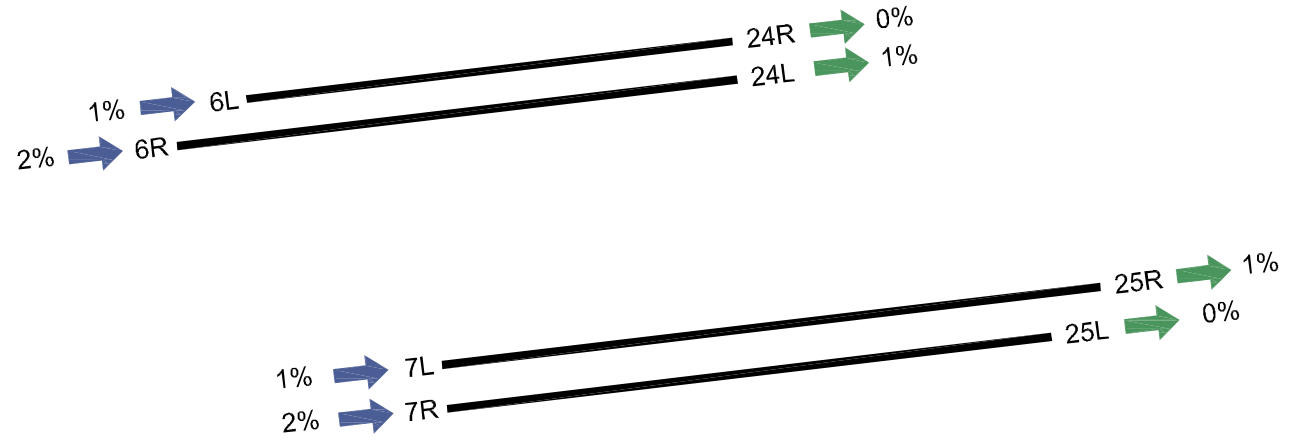
	Landing						Take-Off					
	Conditions						Conditions					
Aircraft Type	Distance (ft)	Temperature	Runway	Flaps	Powerplant	MGLW (lbs)	Distance (ft)	Temperature	Runway	Powerplant	MGTOW (lbs)	
Airbus Industrie A300-600/R/CF/RCF	5,100	All			PW/GE	308,650	8,700	ISA + 15 C		GE	375,890	
Airbus Industrie A300B/C/F-100/200												Not Available
Airbus Industrie A310-200CF												Not Available
Airbus Industrie A318	4,200	All			PW/CFM	126,765	6,000	ISA		PW/CFM	149,914	
Airbus Industrie A319	4,700	ISA			CFM	137,788	6,400	ISA + 15 C		CFM	162,039	
Airbus Industrie A320-100/200	4,800	All			CFM	142,197	7,300	ISA + 15 C		CFM/V2500	171,960	
Airbus Industrie A321	5,600	ISA			CFM/V2500	171,519	9,000	ISA + 15 C		CFM/V2500	206,131	
Airbus Industrie A330-200	5,700	ISA			RB/PW/GE	401,240	11,000	ISA + 15 C		RB/PW/GE	513,676	
Airbus Industrie A340-200	6,200	ISA			CFM	407,854	11,700	ISA + 15 C		CFM	606,270	
Airbus Industrie A340-300	6,600	ISA			CFM	423,287	12,300	ISA + 15 C		CFM	609,577	
Airbus Industrie A340-500	6,700	All			RB	542,336	13,600	ISA + 15 C		RB	837,755	
Airbus Industrie A340-600	7,000	All			RB	584,224	13,500	ISA + 15 C		RB	837,755	
Airbus Industrie A380	6,200	All			All	850,984	9,700	ISA + 15 C		GP7270	1,234,588	
Boeing 717-200	5,738	ISA	Wet		BR715	110,000	8,275	ISA + 15 C	Dry	BR715	121,000	
Boeing 727-100	5,600	All	Wet			142,500	8,675	ISA + 13.9 C		JT8D-7	169,000	
Boeing 727-200/231A	5,900	All	Wet			161,000	12,750	ISA + 13.9 C		JT8D-9	209,500	
Boeing 737-100/200	6,300	All	Wet	15		107,000	9,700	ISA + 15 C		JT8D-15/15A	128,100	
Boeing 737-300	6,200	All	Wet	15		115,800	10,700	ISA + 15 C		CFM56-3B1	139,500	
Boeing 737-400	7,000	All	Wet	15		124,000	10,200	ISA + 15 C		CFM56-3B-2	150,000	
Boeing 737-500	5,800	All	Wet	15		110,000	8,700	ISA + 15 C		CFM56-3B-1	150,000	
Boeing 737-600	5,500	All	Wet	15		121,500	8,800	ISA + 15 C		CFM56-7B18	144,500	
Boeing 737-700/700LR	5,800	All	Wet	15		129,200	9,200	ISA + 15 C		CFM56-7B20	154,500	
Boeing 737-800	7,100	All	Wet	15		146,300	9,700	ISA + 15 C		CFM56-7B24	174,200	
Boeing 737-900	7,500	All	Wet	15		146,300	9,700	ISA + 15 C		CFM56-7B24	174,200	
Boeing 747-100	7,800	All	Wet	25		585,000	11,700	ISA + 11.7 C		JT9D-3AW	750,000	
Boeing 747-200/300	6,900	All	Wet	25		605,000	11,700	ISA + 15 C		CF6-50E2	833,000	
Boeing 747-400	8,530	All	Wet	25		630,000	11,300	ISA + 17.2 C		CF6-80C2B1	875,000	
Boeing 747-400C	8,530	All	Wet	25		630,000	Not Avail.				875,000	
Boeing 747-400F	9,186	All	Wet	25		666,000	11,500	ISA + 17.2 C			875,000	
Boeing 757-200	5,900	All	Wet	30	PW2037 / 2040	210,000	10,100	ISA + 14 C		PW2037	255,000	
Boeing 757-300	6,550	All	Wet	30	PW2040 / 2043	224,000	10,400	ISA + 16 C		PW2040	270,000	
Boeing 767-200/ER/EM	6,000	All	Wet	25		300,000	11,700	ISA + 17 C		CF6-80C2B2 / PW4052	395,000	
Boeing 767-300/300ER	6,500	All	Wet	25		320,000	11,000	ISA + 17 C		CF6-80C2B4 / PW4052 / RB	412,000	
Boeing 767-400ER	7,300	All	Wet	25		350,000	11,400	ISA + 15 C	Wet	PW4062	450,000	
Boeing 777-200/200LR/233LR	6,400	All	Wet	25	GE90-110B1L	492,000	10,700	ISA + 15 C		GE90-110B1L	766,000	
Boeing 777-300/300ER/333ER	7,200	All	Wet	25	GE90-115BL	554,000	10,500	ISA + 15 C		GE90-115BL	775,000	
Canadair RJ200ER/RJ-440	4,850	ISA			CF34-3B1	47,000	5,800	ISA		CF34-3B1	51,000	
Canadair RJ700	4,900	All		45 deg	CF34-81C	67,000	5,400	ISA + 15 C		CF34-81C	72,750	
Canadair RJ900	5,235	ISA			CF34-8C5	73,500	5,833	ISA		CF34-8C5	80,500	
Dehavilland Dash-8-400	4,221	ISA			PW150A	61,750	4,600	ISA		PW150A	64,500	
Embraer 120 Brasilia	4,400	All	Dry	45 deg	PW 118	25,794	6,000	ISA + 15 C	Dry	PW 118	26,433	
Embraer 135	4,450	ISA	Dry	45 deg	All	40,785	5,500				44,092	
Embraer 140	4,550	All	Dry	45 deg	AE3007 A1/3	41,226	6,400	ISA + 15 C	Dry	AE3007 A1/3	46,517	
Embraer 145	4,750	ISA	Dry	45 deg	AE3007 A1P	44,092	7,800	ISA + 15 C	Dry	AE3007 A1	53,131	
Embraer 170	4,200	All		45 deg	AE3007 A1/3	41,226	5,400	ISA + 15 C		AE3007 A1/3	46,517	
Embraer 190	4,341				GE CF34-10E	97,003	6,745	ISA		GE CF34-10E	114,199	
Lockheed L-1011-500 Tristar	8,500	ISA	Wet	10/33 deg		368,000	9,900	ISA + 19.6 C		RB211-524B	496,000	
McDonnell Douglas DC-10-10	5,800	All	Dry	50 deg	CF6-6D/-6D1	363,500	12,500	ISA + 20 C		CF6-6D1	430,000	
McDonnell Douglas DC-10-30	8,700	All	Wet	50 deg	CF6-50C/-50C1	403,000	12,500	ISA + 20 C		CF6-50C	555,000	
McDonnell Douglas DC-10-30CF	9,300	All	Wet	50 deg	CF6-50C/-50C1	411,000	12,500	ISA + 20 C		CF6-50C	555,000	
McDonnell Douglas DC-8-63	7,100	ISA	Wet	Full	JT3D-3B	258,000	12,300	ISA + 15 C		JT3D-3B	355,000	
McDonnell Douglas DC-8-63F	7,600	ISA	Wet	Full	JT3D-3B	275,000	11,100	ISA + 15 C		JT3D-7	355,000	
McDonnell Douglas DC-8-71	7,500	ISA	Wet	Full	CFM56-2-C1	240,000	9,400	ISA + 15 C		CFM56-2-C1	325,000	
McDonnell Douglas DC-8-73	7,900	ISA	Wet	Full	CFM56-2-C1	275,000	10,500	ISA + 15 C		CFM56-2-C1	355,000	
McDonnell Douglas DC-8-73F	7,900	ISA	Wet	Full	CFM56-2-C1	275,000	10,500	ISA + 15 C		CFM56-2-C1	355,000	
McDonnell Douglas DC-9-15F	5,800	ISA	Wet	Full	JT8D-1	81,700	7,300	ISA + 15 C		JT8D-1	90,700	
McDonnell Douglas DC-9-30	6,200	ISA	Wet	40 deg	JT8D-7	99,000	8,100	ISA + 15 C		JT8D-7	108,000	
McDonnell Douglas DC-9-40	6,000	ISA	Wet	40 deg	JT8D-15	102,000	6,800	ISA + 15 C		JT8D-15	114,000	
McDonnell Douglas MD-11	9,250	ISA	Wet	35 deg	All	471,500	10,100	ISA + 15 C		CF6-80C2D1F	602,500	
McDonnell Douglas MD-90	6,500	ISA	Wet	28 deg	V2500-D5	142,000	7,400	ISA + 15 C		V2500-D5	156,000	
McDonnell Douglas Super 80/MD81/2/3/7/8	6,100	ISA	Wet	28 deg	JT8D-219	139,500	8,250	ISA + 15 C		JT8D-219	160,000	
Saab-Fairchild 340/B	3,800	All		20 deg	CT7-9B	28,000	4,600	ISA + 20 C		CT7-9B	28,500	

Notes: Fleet mix obtained from OAG (January through November 2008)
Consult with airlines for specific operating procedures prior to facility design.

West Flow



East Flow



Arrivals

Departures

Notes: 1. Operations data for the calendar year 2008.
2. Total percentages may not add up to 100% due to rounding.

Source: Los Angeles International Airport Noise Management.
Prepared by: Ricondo & Associates, Inc.

Figure C-1

north

Runway Use Configurations

Table C-2 *Los Angeles International Airport*

Runway 6L Aircraft Operations Breakdown for 2008

6L Arrivals

Number of total 6L arrival operations	3,933
Percentage of total airport arrival operations	1.4%

	Existing Runway	Declared Distances Alternative
LDA	8,925'	8,566'
Potential 6L aircraft arrival restrictions	415[1/]	415[1/]
Percentage of total 6L arrival operations	10.6%	10.6%

Aircraft with Potential Landing Weight Restrictions (Existing Rwy)[2/]	Additional Aircraft with Potential Landing Weight Restrictions with Reduction in Runway Length[2/]
DC-10-31F	DC10-30
MD-11	
B747-400F	

6L Departures

Number of total Rwy 6L departure operations	263
Percentage of total airport departure operations	0.1%

	Existing Runway	Declared Distances Alternative
ASDA	8,925'	8,566'
Potential 6L aircraft departure restrictions	92	94
Percentage of total 6L departure operations	35.0%	35.7%

Aircraft with Potential Payload Restrictions (Existing Rwy)[3/]		Additional Aircraft with Potential Payload Restrictions with Reduction in Runway Length[3/]
A321	B747-400F	A300-600/R/CF/RCF
A330-200	B757-200	B727-100
A340-200	B757-300	B737-500
A340-300	B767-200/ER/EM	B737-600
A340-500	B767-300/300ER	
A340-600	B767-400ER	
A380	B777-200/200LR/233LR	
B727-200/231A	B777-300/300ER/333ER	
B737-100/200	L-1011-500 Tristar	
B737-300	DC-10-10	
B737-400	DC-10-30	
B737-700/700LR	DC-10-30CF	
B737-800	DC-8-63	
B737-900	DC-8-63F	
B747-100	DC-8-71	
B747-200/300	DC-8-73	
B747-400	DC-8-73F	
B747-400C	MD-11	

Notes: [1/] Includes all B747-400 and all MD-DC-10 types
[2/] Assumes maximum gross landing weight (MGLW) and wet runway
[3/] Assumes maximum gross takeoff weight (MGTOW)

Source: Los Angeles International Airport Noise Management; Official Airline Guide (OAG); Aircraft Manufacturers' Manuals October 2009
Prepared by: Ricondo & Associates, Inc. DRAFT

Table C-3 *Los Angeles International Airport*

Runway 24R Aircraft Operations Breakdown for 2008

24R Arrivals

Number of total Rwy 24R arrival operations	120,591
Percentage of total airport arrival operations	44.1%

	Existing Runway	Declared Distances Alternative
LDA	8,925'	8,925'
Potential 24R aircraft arrival restrictions	7,156[1/]	7,156[1/]
Percentage of total 24R arrival operations	5.9%	5.9%

Aircraft with Potential Landing Weight Restrictions (Existing Rwy)[2/]	Additional Aircraft with Potential Landing Weight Restrictions with Reduction in Runway Length[2/]
B747-400F	None
DC-10-30CF	
MD-11	

24R Departures

Number of total Rwy 24R departure operations	7,251
Percentage of total airport departure operations	2.6%

	Existing Runway	Declared Distances Alternative
ASDA	8,925'	8,925'
Potential 24R aircraft departure restrictions	3,505[1/]	3,505[1/]
Percentage of total 24R departure operations	48.3%	48.3%

Aircraft with Potential Payload Restrictions (Existing Rwy)[3/]		Additional Aircraft with Potential Payload Restrictions with Reduction in Runway Length[3/]
A321	B757-200	None
A330-200	B757-300	
A340-200	B767-200/ER/EM	
A340-300	B767-300/300ER	
A340-500	B767-400ER	
A340-600	B777-200/200LR/233LR	
A380	B777-300/300ER/333ER	
B727-200/231A	L-1011-500 Tristar	
B737-100/200	DC-10-10	
B737-300	DC-10-30	
B737-400	DC-10-30CF	
B737-700/700LR	DC-8-63	
B737-800	DC-8-63F	
B737-900	DC-8-71	
B747-100	DC-8-73	
B747-200/300	DC-8-73F	
B747-400	MD-11	
B747-400F		

Notes: [1/] Includes all B747-400 and all DC-10 types
[2/] Assumes maximum gross landing weight (MGLW) and wet runway
[3/] Assumes maximum gross takeoff weight (MGTOW)

Source: Los Angeles International Airport Noise Management; Official Airline Guide (OAG); Aircraft Manufacturers' Manuals October 2009
Prepared by: Ricondo & Associates, Inc. DRAFT

Table C-4 *Los Angeles International Airport*

Runway 6R Aircraft Operations Breakdown for 2008

6R Arrivals

Number of total 6R arrival operations	5,120
Percentage of total airport arrival operations	1.9%

	Existing Runway	Declared Distances Alternative
LDA	9,954'	9,839'
Potential 6R aircraft arrival restrictions	0	0
Percentage of total 6R arrival operations	0.0%	0.0%

No operational impacts with existing or reduced landing length. See Table 1.

6R Departures

Number of total Rwy 6R departure operations	2,738
Percentage of total airport departure operations	1.0%

	Existing Runway	Declared Distances Alternative
ASDA	10,285'	10,170'
Potential 6R aircraft departure restrictions	559	616
Percentage of total 6R departure operations	20.4%	22.5%

Aircraft with Potential Payload Restrictions (Existing Rwy)[1/]		Additional Aircraft with Potential Payload Restrictions with Reduction in Runway Length[1/]
A330-200	B767-200/ER/EM	B737-400
A340-200	B767-300/300ER	
A340-300	B767-400ER	
A340-500	B777-200/200LR/233LR	
A340-600	B777-300/300ER/333ER	
B727-200/231A	DC-10-10	
B737-300	DC-10-30	
B747-100	DC-10-30CF	
B747-200/300	DC-8-63	
B747-400	DC-8-63F	
B747-400C	DC-8-73	
B747-400F	DC-8-73F	
B757-300		

Note: [1/] Assumes maximum gross takeoff weight (MGTOW)

Source: Los Angeles International Airport Noise Management; Official Airline Guide (OAG); Aircraft Manufacturers' Manuals October 2009

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Runway 24L Aircraft Operations Breakdown for 2008

24L Arrivals

Number of total Rwy 24L arrival operations	6,155
Percentage of total airport arrival operations	2.3%

	Existing Runway	Declared Distances Alternative
LDA	10,285'	9,450'
Potential 24L aircraft arrival restrictions	0	0
Percentage of total 24L arrival operations	0.0%	0.0%

No operational impacts with existing or reduced landing length. See Table 1.

24L Departures

Number of total Rwy 24L departure operations	117,402
Percentage of total airport departure operations	42.1%

	Existing Runway	Declared Distances Alternative
ASDA	10,285'	9,450'
Potential 24L aircraft departure restrictions	24,155[1/]	38,947[1/]
Percentage of total 24L departure operations	20.6%	33.2%

Aircraft with Potential Payload Restrictions (Existing Rwy)[2/]		Additional Aircraft with Potential Payload Restrictions with Reduction in Runway Length[2/]
A330-200	B767-200/ER/EM	A380
A340-200	B767-300/300ER	B737-100/200
A340-300	B767-400ER	B737-400
A340-500	B777-200/200LR/233LR	B737-800
A340-600	B777-300/300ER/333ER	B737-900
B727-200/231A	DC-10-10	B757-200
B737-300	DC-10-30	L-1011-500 Tristar
B747-100	DC-10-30CF	MD-11
B747-200/300	DC-8-63	
B747-400	DC-8-63F	
B747-400F	DC-8-73	
B757-300	DC-8-73F	

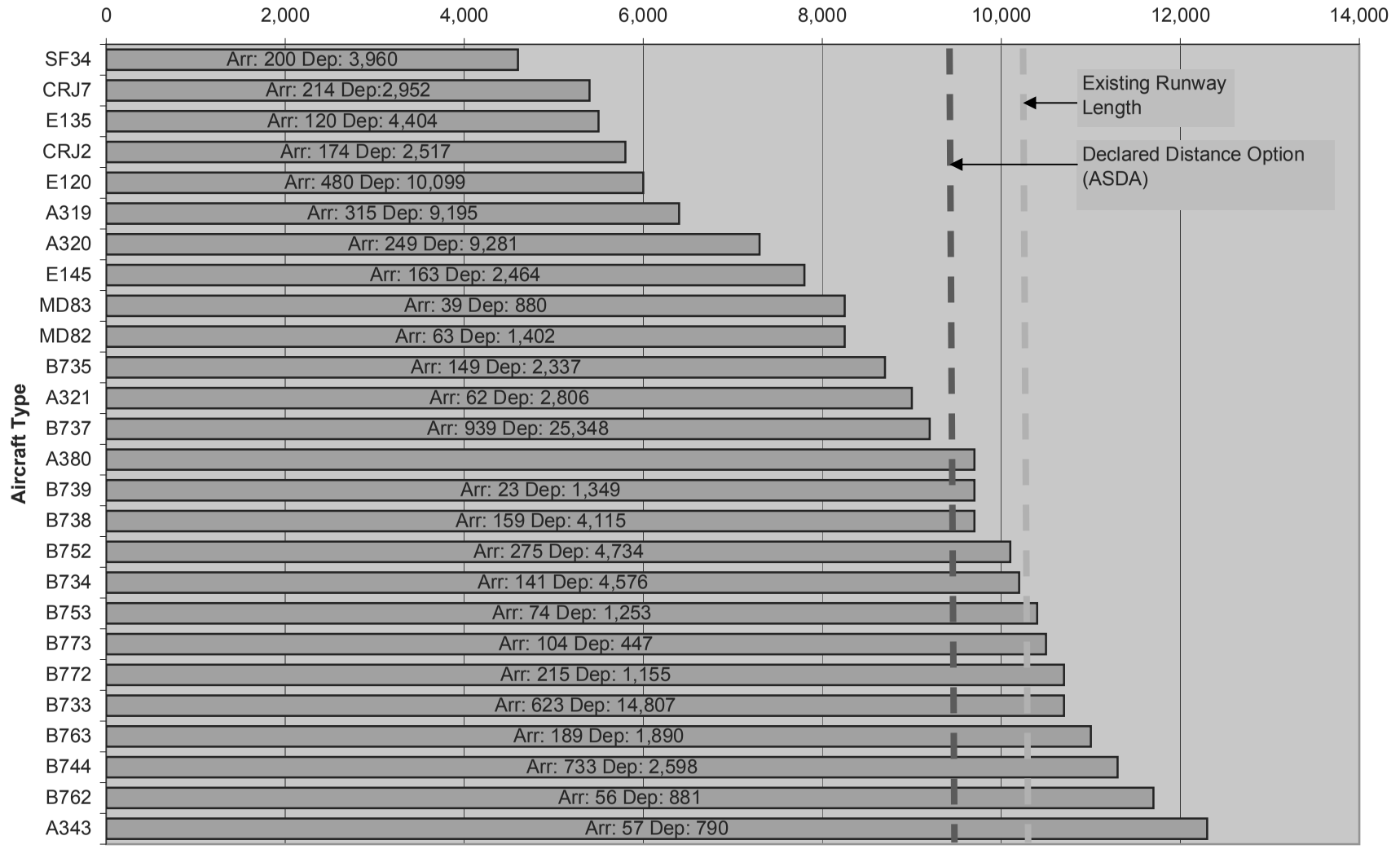
Note: [1/] Includes all B747-400 types

[2/] Assumes maximum gross takeoff weight (MGTOW)

Figure C-2

Runway 24L Required Takeoff Runway Length at MGTOW (feet)

Los Angeles International Airport



Source: Los Angeles International Airport Noise Management, 2008; Aircraft Manufacturers' Airport Planning Manuals (APMs). October 2009

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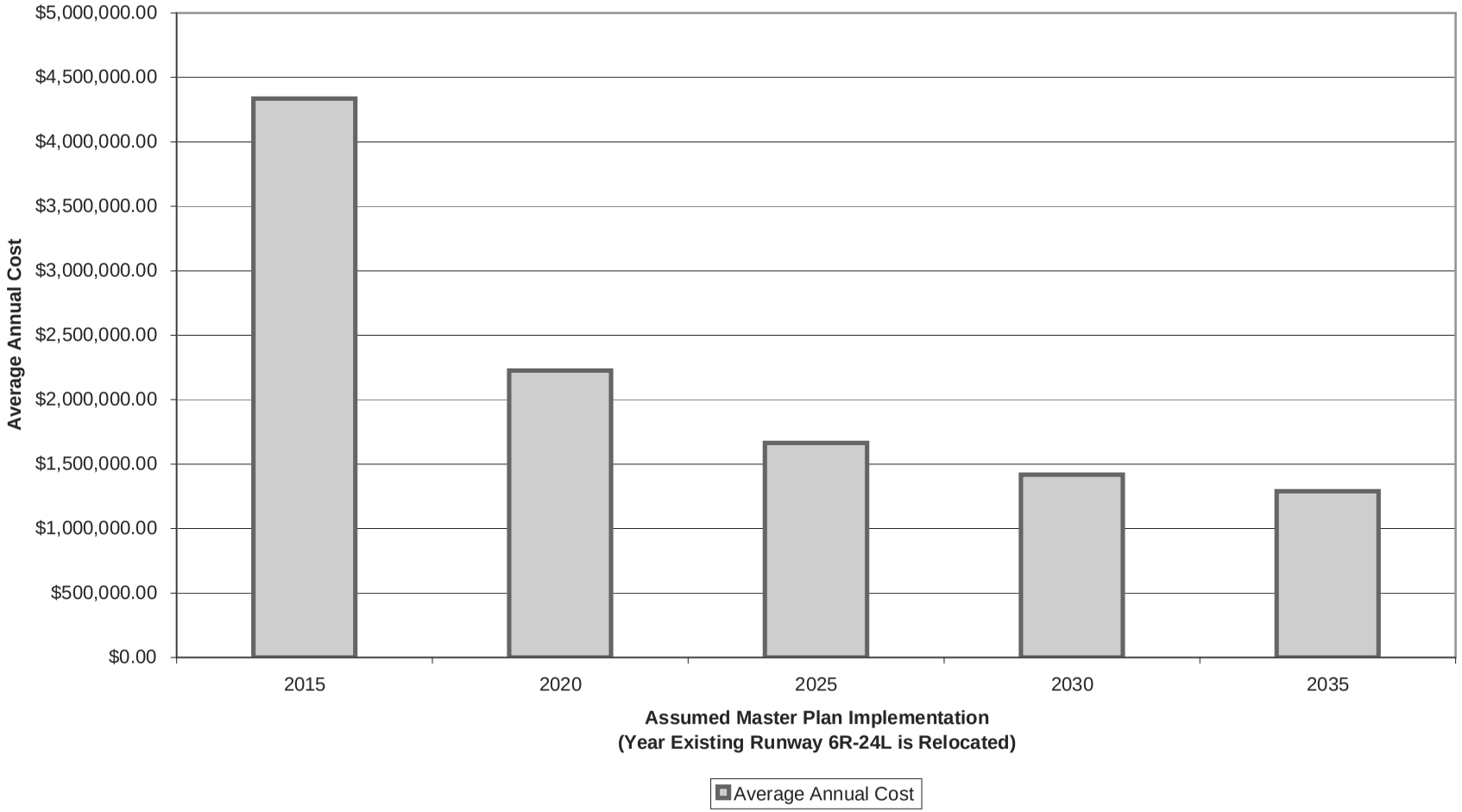
Appendix D

Payback Analysis (Runway 6R-24L Extension)

Figure D-1

Runway 6R-24L RSA Improvement Alternative - Refinement 1 (Assumes in-service 2012) *Los Angeles International Airport*

Projected Average Annual Cost of RSA Improvement



Note: Cost estimates provided by U.S. Cost, Inc. for Refinement 1 do not include the relocation of the Runway 6R MALSR.

Source: U.S. Cost, Inc.; Ricondo & Associates, Inc. October 2009

Prepared by: Ricondo & Associates, Inc. DRAFT

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