



## APPENDIX E

# RUNWAY SAFETY AREA DETERMINATION

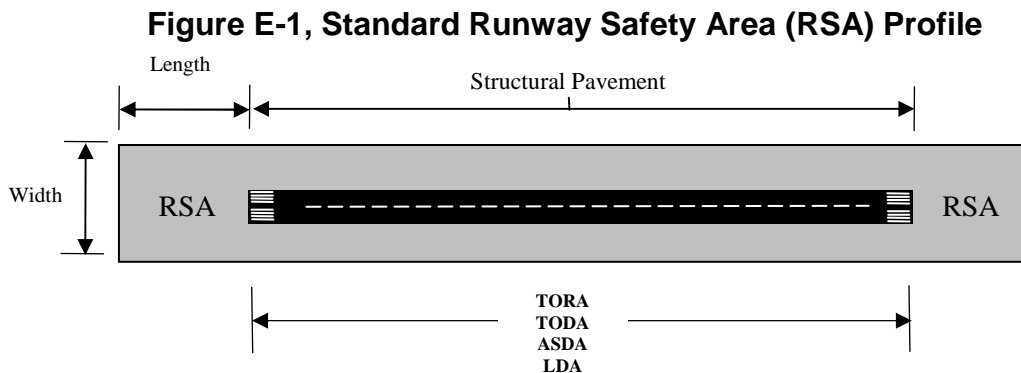
The purpose of this analysis is to evaluate existing deficiencies for Runway Safety Area (RSA) at Merritt Island Airport (COI) and to propose alternatives that comply with prescribed Federal Aviation Administration (FAA) standards. Recognizing that conformity with RSA criteria may be challenging, an initial meeting between the Titusville-Cocoa Airport Authority (TICO), LPA and FAA Airport Districts Office (ADO) was held to discuss historic modifications to standards, non-standard design and RSA issues at COI. As a result of that meeting, this study was developed to evaluate the critical Airplane Design Group (ADG) and RSA requirements in order to maximize the utilization of the runway without compromising safety standards as set forth in FAA Order 5200.8, Runway Safety Area Program. In order to complete this analysis of RSA, a combination of the following corrective measures must be considered: declared distances, Engineered Materials Arresting System (EMAS), cut and fill, runway relocation, shifting, or realignment, or a combination of thereof. Additional consideration was also be given to object free areas, Part 77 surfaces, and building restriction lines that are used to establish proposed development areas adjacent to Runway 11-29. Further, since the airport is surrounded on three sides by the Intracoastal Waterway (Newfound Harbor), all proposed RSA improvements will include reconstruction of the seawall.

### RSA-RUNWAY ENVIRONMENT RELATIONSHIP

The RSA is an integral part of the runway environment. RSA dimensions are established in **FAA AC 150/5300-13, *Airport Design***, and are based upon the Airport Reference Code (ARC). The RSA is intended to provide a measure of safety in the event of an aircraft's excursion from the runway by significantly reducing the extent of personal injury and the hazard of structural damage during aircraft overruns, undershoots and lateral veering. Many circumstances contribute to the potential for aircraft excursions including insufficient runway length, pilot error, weather conditions with low visibility, site constraints including precipitous terrain drop-offs, bodies of water, wetlands, residential or commercial development, availability of visual and electronic aids for landing, as well as runway contamination caused by rain, snow, and ice. In addition, mechanical failure may inhibit an aircraft's propensity to decelerate in time during landing or during an aborted takeoff.

The function of the RSA is to create a buffer between the runway pavement and non-movement areas. Takeoffs and landings are generally regarded as the most critical phases of flight where more than 60 percent of aircraft accidents occur. During these segments, aircraft are subject to a variety of controls and operational factors including a runway's usable operating dimensions. A growing list of RSA related accidents has contributed to

the mounting concern that airports do not provide adequate safety areas to reduce injury to persons and property. As a result, state and federal legislation was enacted in an effort to standardize safety area requirements. The FAA coordinated a study in 1990 which identified airports currently not in compliance with RSA design requirements. Recognizing the significant safety enhancement afforded by RSA improvements, the FAA issued **Order 5200.8, Runway Safety Area Program**, in an effort to guide the improvement process by identifying potential alternatives to the traditional cleared and graded safety areas as illustrated in **Figure E-1**.



*Source: The LPA Group Incorporated, 2008.*

As shown, the RSA profile runs beyond the structural pavement of the runway along the extended runway centerline. As previously mentioned, the width and length of the RSA is dependent upon the most critical aircraft using the runway. **Figure E-1** represents the traditional cleared and graded safety areas in which sufficient land can be accommodated beyond both runway ends, without the need to displace any thresholds. In this situation, the full length of the runway may be used for aircraft movement. However, as explored later in this document, alternative RSA accommodations may be achieved by employing other means if conditions permit.

## EXISTING CONDITIONS

### Airfield Overview

COI's single runway system, Runway 11-29, has a published length of 3,601 feet and width of 75 feet. The runway is supplemented by two parallel taxiways – Taxiway A is a full-length parallel taxiway on the southern side and Taxiway B is a 2,300 foot long partial-parallel taxiway on the northwestern side of the runway. Various connector taxiways provide access between the runway, parallel taxiways, and landside areas. As illustrated in **Figure E-2**, the airport property lies on a peninsular landmass, with the southeastern end of the runway (Runway 29 end) surrounded on three sides by the Intracoastal Waterway (Newfound Harbor).



**FAA Advisory Circular (AC) 150/5300-13, *Airport Design***, characterizes an Airport Reference Code (ARC) as a coding system used to relate airport design criteria to the operational and physical characteristics of aircraft operating or anticipated to operate at an airport. Each dimensional criterion is specified based on aircraft approach category, represented by a letter A-E corresponding to aircraft approach speed in knots, and airplane design group, represented by a Roman numeral I-VI corresponding to aircraft wingspan in feet. The alphanumeric coding system is most often used to describe the airport's capacity to handle aircraft that correspond to approach speed and wing span. It is also used to determine runway-specific handling capacity. **Table E-1** summarizes the elements of these categorizations.

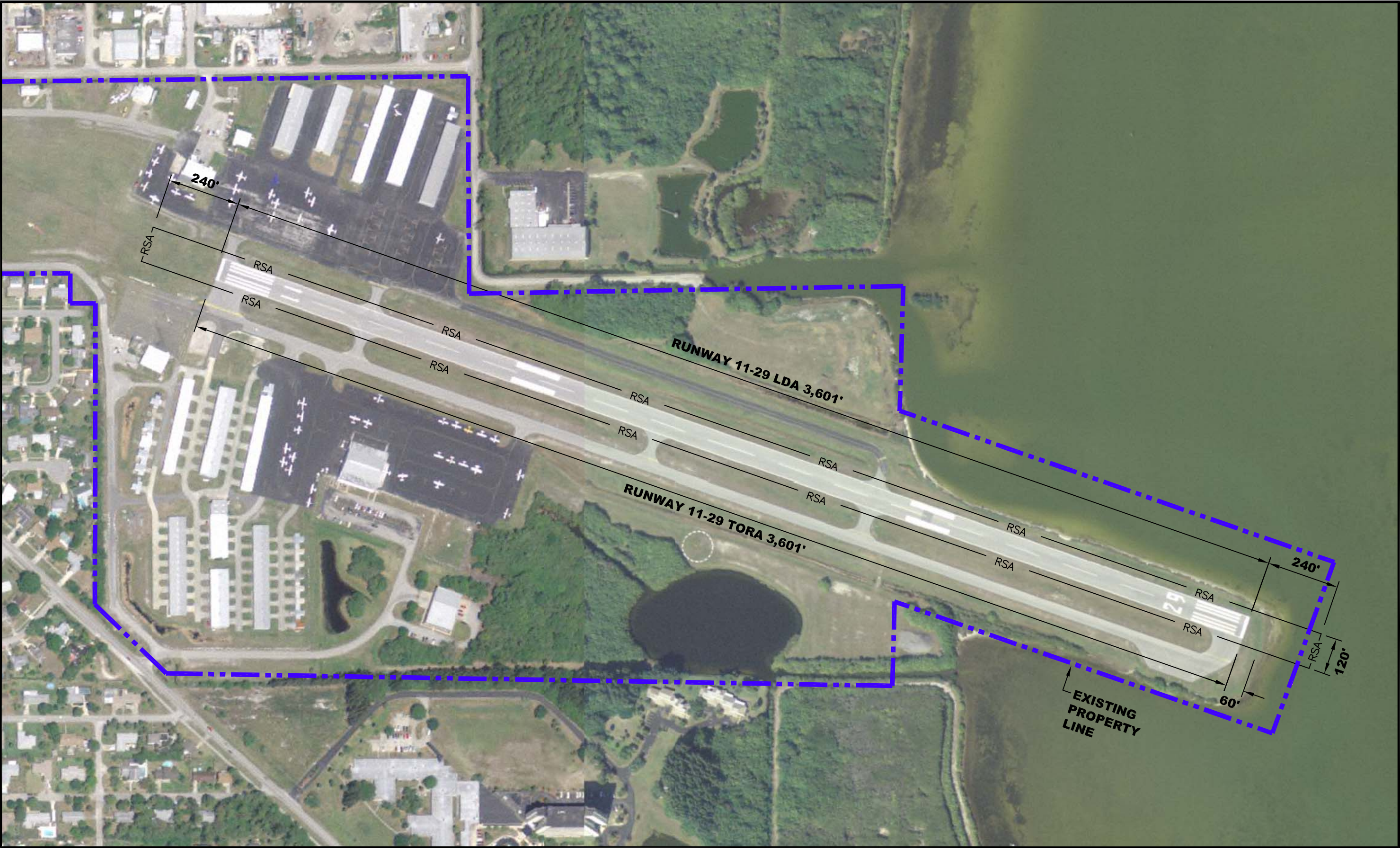
**TABLE E-1  
FAA REFERENCE CODE CLASSIFICATIONS**

Aircraft Approach Category	Aircraft Approach Speed (AS) in Knots	Airplane Design Group	Aircraft Wingspan (WS)
<b>A</b>	AS < 91	<b>I</b>	WS < 49 ft
<b>B</b>	91 ≤ AS < 121	<b>II</b>	49 ft ≤ WS < 79 ft
<b>C</b>	121 ≤ AS < 141	<b>III</b>	79 ft ≤ WS < 118 ft
<b>D</b>	141 ≤ AS < 166	<b>IV</b>	118 ft ≤ WS < 171 ft
<b>E</b>	166 ≤ AS	<b>V</b>	171 ft ≤ WS < 214 ft
		<b>VI</b>	214 ft ≤ WS < 262 ft

Source: The LPA Group Incorporated, 2008.

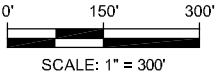
In **Chapter 4, *Demand Capacity/Facility Requirements***, the airport's existing and future ARC was identified as B-I light. The light designation is applied to airports that predominately serve small aircraft with maximum takeoff weights of 12,500 pounds or less, and coincides with the most demanding aircraft that operates and performs at least 500 operations per year at the airport. While larger category aircraft currently utilize COI on an occasional basis, such as the Beechcraft King Air 200 with an ARC of B-II, the primary operator of those aircraft, Baer Air, intends to shift operations from COI to Melbourne International and Flagler County Airports (MLB and XFL). As a result, the number of B-II aircraft operations is expected to decrease at COI. Since the airport's facilities were constructed based upon the B-I light design requirements, it was recommended by the ADO that larger aircraft, B-II or greater, provide notice to the TICO Airport Authority prior to operating at the COI. This will provide another level of safety since the airport is not currently equipped with an Air Traffic Control Tower (ATCT).

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RSA DETERMINATION STUDY  
EXISTING CONDITIONS



DATE  
12/15/2008  
**E-2**  
DRAWING NO.



### Existing Runway Design Specifications

The FAA sets forth particular dimensional criteria for runway design and runway separation standards. These standards reflect the variation in aircraft design dimensions and provide safety clearance between taxiway and runway environments. These dimensions are fundamental components that establish an index from which RSA dimensional criteria are determined. This section will investigate the existing runway design elements at COI and will facilitate the discussion for recommending alternative modifications to RSA elements that are presented later in this appendix.

#### *Runway 11-29*

Runway 11-29 has a weight bearing capacity of 22,000 pounds for aircraft with a single-gear configuration. Criteria outlined by the FAA state that for the ARC B-I light designation a runway width of 60 feet is required. Currently, Runway 11-29 has a published width of 75 feet which exceeds FAA standards. However, no width reduction is recommended as part of the Master Plan Update, so the airport may continue to safely accommodate B-II single and dual-wheel aircraft. The current runway centerline to parallel taxiway centerline offset between Runway 11-29 and the parallel taxiways is 150 feet, which also meets FAA criteria for ARC B-I light. **Table E-2** identifies various FAA design standard criteria in comparison to the existing characteristics of the airfield at COI.

Runway 11-29 is also served by two non-precision instrument approaches to Runway 11. These consist of straight-in approaches to the runway end via horizontal guidance to pilots only – vertical guidance is only provided with a precision instrument approach. The existing approaches to Runway 11 include: Global Positioning System (GPS) based approach that provides visibility minimums as low as one-mile; and Non-Directional Beacon (NDB) based approach that also provides visibility minimums as low as one-mile. No published approaches exist or are recommended for Runway 29 primarily due to controlled and restricted airspace south and east of the airport (e.g., Patrick Air Force Base and NASA restricted airspace).



**TABLE E-2**  
**EXISTING B-I DIMENSIONAL STANDARDS**

Design Standard	Runway 11-29 Existing		FAA Standard B-I Dimension
	11	29	
Runway 11-29 to Taxiway A	150 ft		150 ft
Runway 11-29 to Taxiway B	150 ft		150 ft
Runway Width	75 ft		60 ft
RSA Length beyond Runway End	240 ft	60 ft	240 ft
RSA Width	120 ft	120 ft	120 ft
ROFA Width	250 ft	250 ft	250 ft
ROFA Length beyond Runway End	240 ft	240 ft	240 ft

Sources: AC 150/5300-13 and The LPA Group Incorporated, 2008.

## DEVELOPMENT CONSIDERATIONS

### Background

This section presents initial development considerations assessed given the airport's operational characteristics, number of historical incidents and/or accidents, and forecast future fleet mix. Since Runway 11-29 is the only available runway at COI, maintaining the current runway length for both takeoff and landing is considered of primary importance for continued operational safety and for the continued sustainability of existing based airport businesses. Because Runway 11-29 is only 3,601 feet, partially surrounded by water, and regularly used by larger B-II aircraft, maintaining the current runway length is vital for maintaining the overall safety of the airfield. Further, potentially shifting operations toward the Runway 11 threshold would increase noise exposure to residential properties located approximately 400 feet north and west of the Runway 11 threshold.

The FAA and National Transportation Safety Board (NTSB) maintain databases of aircraft incidents and accidents that occurred at the airport and the causes of those events. The FAA Aircraft/Incident Data System (AIDS) database contains incident records for all categories of civil aviation incidents that have been recorded at COI since November 4, 2008 as shown in **Table E-3**. According to the FAA, incidents are defined as events that do not meet the aircraft damage or personal injury thresholds contained in the NTSB definition of an accident. For example, the database contains reports of collisions between aircraft and birds while on approach to or departure from an airport. While such a collision may not have resulted in sufficient aircraft damage to reach the damage threshold of an NTSB accident, the fact that the collision occurred is valuable safety information that may be used in the establishment of aircraft design standards or in programs to deter birds from nesting in areas adjacent to airports. The FAA incident records in **Table E-3** show several aircraft roll-outs from the runway during takeoff and



landing, thus illustrating the historical need for standard RSA at the airport. Additionally, the NTSB accident data in **Table E-4** identifies known accidents that have occurred within the RSA beyond either end of Runway 11-29, including at least one that consisted of an aircraft landing short of Runway 29 and subsequently crashing in the Intracoastal Waterway (Newfound Harbor). Incidents and accidents at COI have historically ranged from minor incidents with little damage to major accidents. Most accidents were exacerbated by the lack of standardized safety area beyond the Runway 29 threshold. Further, since Runway 11 is the primary takeoff runway at COI, providing standard RSA beyond Runway 29 is critical in the event of an aborted takeoff.

In evaluating potential RSA options, it is necessary to identify the future fleet mix at an airport. COI as part of the TICO Aviation System will remain a general aviation (GA) airport. However, the airport is poised to attract a sizeable number of new-era micro or very light jet (VLJ) aircraft, which were introduced in part with the Small Aircraft Transportation System (SATS). For example, in **Chapter 3, Aviation Activity Forecasts**, the number of VLJ operations at COI is forecast to increase from zero in 2007 to 4,860 by 2027, thus presenting a whole new class of aircraft into the regular activity mix at COI. These turbine-powered aircraft are expected to serve smaller communities because of their propensity to operate on shorter runways than typical turbine powered aircraft. As a result, micro jets are anticipated to increase and bring new business activity to small GA airports around the country. These micro jets are classified by their weight and existing prototypes are less than 12,500 pounds. Accordingly, this singular operational characteristic does not require additional runway lengthening at COI to accommodate VLJ aircraft, although RSA improvements are still necessary.

In **FAA Order 5200.8, Runway Safety Area Program**, five specific alternatives are to be considered for those safety areas that are unable to meet the traditional graded area surrounding the runway. The alternatives evaluation process was resolved through a two-step process that first subjected all design options to a preliminary screening review. In order to achieve the best option for RSA improvements at COI, several alternatives were subsequently analyzed, scrutinized, and then ranked reflecting several factors including cost, environmental impact, safety, and operational efficiency. These alternatives were then refined to include design considerations identified as the most practicable for COI, which are detailed more thoroughly in the later sections of this appendix.

# Merritt Island Airport

## Master Plan Update



**TABLE E-3  
FAA INCIDENT DATA**

Event Date	Airport Name	Event Type	Aircraft Damage	Phase of Flight	Aircraft Make Name	Aircraft Model Name
30-Apr-08	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	ROLL-OUT (FIXED WING)	PIPER	PA-28
6-Nov-07	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	LEVEL OFF TOUCHDOWN	BEECH	BE-35
1-Oct-06	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	TAKEOFF GROUND ROLL		
17-Aug-05	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	NORMAL CRUISE	CESSNA	CE-421
22-Aug-04	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	ROLL-OUT (FIXED WING)		
8-Feb-04	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	ROLL-OUT (FIXED WING)	NAMER	SNJ-4
10-Mar-03	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	ROLL-OUT (FIXED WING)		
21-Feb-03	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	FORCED LANDING	BEECH	BE-45
25-Jan-03	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	ROLL-OUT (FIXED WING)	BEECH	BE-35
30-May-02	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	GROUND TAXI, OTHER AIRPLANE		
14-Apr-02	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	TAKEOFF GROUND ROLL		
15-Aug-01	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	ROLL-OUT (FIXED WING)	PIPER	PA-46
5-Aug-01	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	LEVEL OFF TOUCHDOWN	BLANCA	BL-7
4-Dec-99	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	LEVEL OFF TOUCHDOWN	MOONEY	M-20
21-Aug-99	MERRITT ISLAND	INCIDENT - AIR CARRIER	MINOR	GROUND TAXI, OTHER AIRPLANE	PIPER	PA-31
13-May-99	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	LEVEL OFF TOUCHDOWN		
1-Jan-99	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	TAKEOFF GROUND ROLL	PIPER	PA-34
27-Oct-97	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	LEVEL OFF TOUCHDOWN	BEECH	BE-45
15-Mar-97	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	ROLL-OUT (FIXED WING)	CESSNA	CE-172
30-Jun-93	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	ROLL-OUT (FIXED WING)	PIPER	PA-28
12-Jul-92	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	LEVEL OFF TOUCHDOWN	GULSTM	GA-AA
3-Apr-92	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	LEVEL OFF TOUCHDOWN	MOONEY	M-20
10-Apr-91	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	LEVEL OFF TOUCHDOWN	CESSNA	CE-150
29-Apr-90	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	ROLL-OUT (FIXED WING)	BLANCA	BL-8
4-Nov-88	MERRITT ISLAND	INCIDENT - GENERAL AVIATION	MINOR	FORCED/PRECAUTIONARY LANDING		

Sources: FAA Accident/Incident Data System, The LPA Group Incorporated, 2008.

**TABLE E-4  
NTSB ACCIDENT DATA**

Event Date	Phase of Flight	Crash Site	Fatalities	Injuries	Aircraft Type
21-Feb-03	Landing - RW 29	Beyond RW 11	0	0	Beech A45
8-Aug-02	Landing - RW 11	Beyond RW 29	0	0	Aviat Aircraft Inc. A1
17-Aug-86	Landing - RW 29	In Water Beyond RW 29	0	1	Champion / 7KCAB

Sources: NTSB Accident Database, The LPA Group Incorporated, 2008.



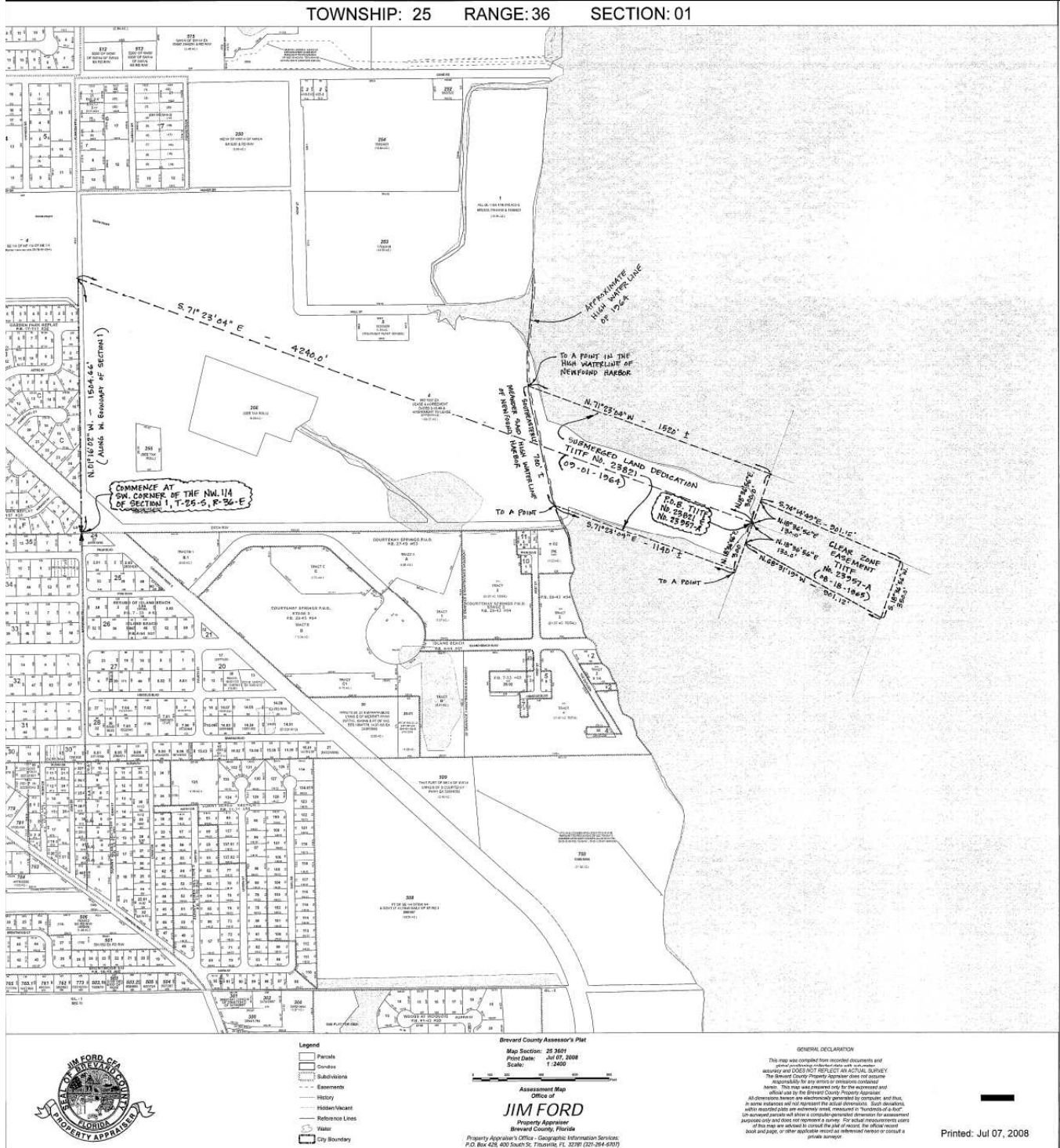
### Runway Relocation, Shifting, or Realignment

Existing RSA deficiencies at COI are a direct result of the constrained land mass on which the airport is situated. The topography and environmental habitats surrounding COI limits runway lengthening and the sensitivity of such require that RSA deficiencies be resolved by other means. The proximity of Runway 11-29 to the Intracoastal Waterway (Newfound Harbor) requires RSA modifications to extend into the water, which involves dredging and filling portions of the Intracoastal to regain safety area beyond Runway 29 which has eroded over the years. As illustrated in **Figure E-2** (on page E-4), the airport property line extends approximately 200 feet beyond the end of Runway 29 into the Intracoastal. As a result, an additional 40+ feet is required to accommodate the standardized safety area and associated seawall. However, according to property information, a Corrective Dedication of Clear Zone Easement No. 23957-A provided by the grantor, Trustees for the Internal Improvement Fund State of Florida, issued in 1965 (**Figure E-3**) shows a dedicated clear zone area beyond the existing airport property boundary. This clear zone area has the following dimensions: 260 feet x 901.12 feet x 350 feet. Therefore, since an easement already exists, it may be possible to obtain the additional property required to accommodate safety area and seawall requirements. Still, since this will require the cut and fill of portions of the Intracoastal Waterway, careful consideration of potential environmental impacts must be undertaken.

Subsequently, due to land constraints and nearby residential properties located approximately 400 feet beyond Runway 11, no feasible alternatives were identified for relocating, shifting, or realigning Runway 11-29 at COI. Specifically, no feasible development options could be identified for these alternatives which would not require significant impacts to existing airport infrastructure, large-scale dredging and filling, and/or required acquisition of residential properties. Options for such development were initially considered and dismissed, based on discussions with the TICO and FAA. Therefore, other alternatives as prescribed in **FAA Order 5200.8, Runway Safety Area Program**, were investigated for COI.



**Figure E-3**  
**Corrective Dedication of Clear Zone Easement No. 23957-A**



Sources: Brevard County Property Appraisers Office, 1965 and the LPA Group Incorporated, 2008



### Runway Length Reduction

The consideration for runway length reduction is plausible only when existing runway length exceeds that which is required to accommodate the existing and/or projected critical design aircraft. In this regard, several factors and operational characteristics at COI make any reduction in the runway length ineffective including:

- In **Chapter 4, Demand Capacity/Facility Requirements**, the runway length requirement for COI was determined to be 3,700 feet, which is 99 feet greater than currently provided by Runway 11-29. As such, many existing small aircraft users of the airport would not be able to operate with the same capability as currently provided if the runway length were further reduced.
- Runway length is critical to many of the businesses based at the airport, particularly those which conduct training operations. Consequently if the runway length were reduced, those businesses may not be able to offer the same types of operations, potentially resulting in relocation to another airport, financial loss, etc.
- Residential development is currently located approximately 400 feet beyond the end of Runway 11. Reduction in the runway length could increase the potential for an accident to occur within this residential area. Additionally, reduction in the runway length could increase aircraft noise exposure within this residential area.

Therefore, if at all possible, options that included a reduction in the runway length were not recommended so that impacts to current airport users, businesses, and surrounding property owners could be avoided. Regardless, to further emphasize these potential impacts, one of the RSA alternatives, **Alternative C**, illustrates a runway length reduction through the relocation of the Runway 29 threshold.

### Combination of Runway Relocation, Shifting, or Reduction

As mentioned in the sections above, alternatives that relocate, shift, realign, or reduce the length of Runway 11-29 are not considered effective for COI because of land constraints and the need to maintain the current runway length to prevent serious safety threats to the residential properties currently located approximately 400 feet beyond the end of Runway 11.

### Declared Distances

In cases where standardizing RSA is impracticable, an alternative to achieving RSA is determined through the use of declared distances. The FAA revised its standards for runway safety area and linked its design characteristics with declared distance information in **AC 150/5300-13, Airport Design**. In previous versions of the advisory circular, FAA set forth precise and uniform design characteristics for RSA, which established identical dimensions beyond both runway ends. Cognizant that some airports are unable to adhere and comply with these specifications, the FAA incorporated an alternative clause that asserts RSAs may be defined within the confines of the runway

structural pavement by using declared distances. Consequently, takeoff run available (TORA) would be reduced by the same factor as the standard RSA beyond the runway threshold. The refined RSA area, therefore, would be located or overlap the runway structural pavement. As a result, the pavement area under which the relocated RSA is defined may not be used for specific operational calculations.

As illustrated in **Figure E-4**, the declared distance alternative allows the airport to determine what portions of an operational runway can be considered to satisfy an aircraft's accelerate-stop, takeoff, and landing distance requirements while still complying with standard RSA requirements. This option allows the implementation of declared distances for those airports that cannot provide sufficient distance beyond the runway ends. A brief description of each declared distance is denoted in the following.

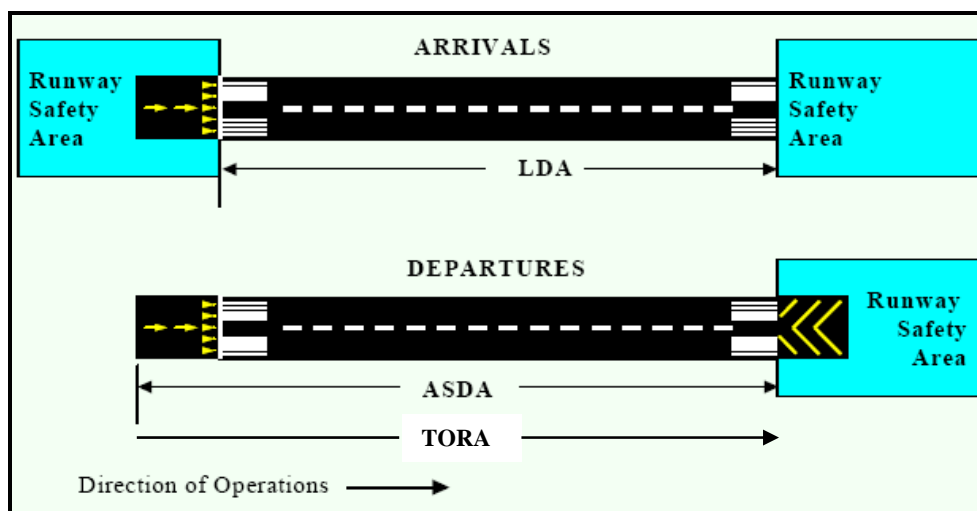
**Takeoff Run Available (TORA)** — the distance to accelerate from brake release to lift-off plus safety factors.

**Takeoff Distance Available (TODA)** — the distance to accelerate from brake release past lift-off to start of takeoff climb plus safety factors.

**Accelerate-Stop Distance Available (ASDA)** — the distance to accelerate from brake release to  $V_1$  and then decelerate to a stop, plus safety factors.

**Landing Distance Available (LDA)** — the distance from the threshold to complete the approach, touchdown, and decelerate to a stop, plus safety factors.

**Figure E-4, Declared Distances Sample Schematic**



*Source: FAA Presentation (Airports Annual Conference), The LPA Group Incorporated, 2008.*

Declared distances are not currently in effect for Runway 11-29. Given the property constraints of the airport and the need to maintain the full length to accommodate existing



airport users, declared distances would not be effective to implement since it would result in a permanent reduction in runway length (for either takeoff or landing, depending upon implementation). Unless the runway and associated RSA were extended in either direction through other methods such as dredge and fill and/or property acquisition, there would be no other possible way to maintain the existing runway length for both takeoff and landing. Consequently since a runway extension in either direction is infeasible at COI, declared distances are also considered infeasible. Regardless, to further emphasize these potential impacts, one of the RSA alternatives (**Alternative A**) illustrates the use of declared distances to correct the non-standard RSA beyond Runway 29.

### Engineered Materials Arresting System (EMAS)

On occasion, aircraft can and do overrun the ends of runways. An overrun occurs when an aircraft surpasses the pavement confines of a runway environment and proceeds into an unpaved area of the airfield not designated for aircraft use. Aircraft overruns usually occur during landing and aborted takeoffs, during which aircraft are unable to sufficiently decelerate in time to remain on existing runway pavement. According to **FAA AC 150/5220-22, Engineered Materials Arresting Systems for Aircraft Overruns**, the majority of these aircraft come to rest within 1,000 feet of the runway end and between the extended edges of the runway. Data collected by the FAA over a 12-year period between 1975 and 1987 indicate that nearly 90 percent of aircraft overruns occur at exit speeds of 70 knots or less.

Based upon the potential hazards these incidents may cause, the FAA incorporated a model of RSAs into airport design standards. In compliance with these standards, the RSA must be capable, under normal (dry) conditions, of supporting aircraft that overrun the runway without causing structural damage to aircraft or injury to its occupants. However, many airports face the issue of natural obstacles, encroaching development, or environmental restrictions that prohibit the feasible development of these RSAs.

Due to the difficulty associated with attaining a standard RSA at many airports, the FAA spearheaded research to explore the use of various materials for arresting systems. Commonly referred to as Engineered Materials Arresting System (EMAS), this initiative has gained widespread support. An EMAS is designed to stop an aircraft during an overrun by exerting predictable deceleration forces on its landing gear. The EMAS is considered fixed by its function and frangible by its design and is intended to fail at a specific impact load. EMAS structures are sloped and built above the existing grade to absorb the aircraft's velocity and forward movement. Centered on the extended runway centerline, the EMAS structure is located beyond the end of the runway at a distance determined by available land area and EMAS materials.

### COI EMAS Evaluation

A core objective of any airport improvement project is balancing effectiveness and cost. The EMAS alternative would be a reasonable means of achieving RSA if the expected



level of operational activity and fleet diversity were expected to increase over the planning horizon. However, COI's role within the aviation system will remain as an important general aviation facility predominately serving the needs of aircraft with maximum certificated takeoff weights of 12,500 pounds or less.

As described in the previous section, design characteristics that dictate the construction of the EMAS bed is based upon historical data formerly obtained by the FAA. The structural integrity of the EMAS is contingent upon several variables that affect the way in which the structure fails upon impact, including the impact load in terms of weight and velocity of the aircraft prior to contact with the arrestor bed. Thus, the design aircraft at COI, both existing and expected in the near term, are not compatible with the design attributes of the EMAS, which is intended to arrest heavier aircraft with greater exit speeds. Therefore, for the purposes of this analysis, further consideration was not given to the EMAS alternative as its function is infeasible for the type of operational activity at COI.

## ALTERNATIVES EVALUATION

Compliance with FAA mandated RSA requirements may be attained via several alternatives, each having distinctive benefits and associated disadvantages. As previously emphasized, achieving these standards may be afforded by implementing non-standard substitutes to RSA dimensions published in **FAA AC 150/5300-13, *Airport Design***, as practicable. Additionally, the unique property of COI demands additional consideration to be given to potential environmental impacts, which are discussed later in this appendix. Therefore, based upon the four potential alternatives outlined by the FAA, three potentially viable alternatives were developed specific to COI including:

- Alternative A – RSA Fulfillment Using Declared Distances Only
- Alternative B – RSA Fulfillment Using Dredge and Fill
- Alternative C – RSA Fulfillment Using Relocated Thresholds

As mentioned earlier, seawall reconstruction is required no matter which preferred RSA alternative is recommended. Therefore, the preliminary environmental assessment and cost estimates include seawall improvements.



## Alternative A—RSA Fulfillment Using Declared Distances Only

As mentioned earlier, the assimilation of declared distances resolves RSA deficiencies by diminishing runway landing and takeoff lengths independently. Airports that implement this methodology publish their declared distances in airport facility directories and other pilot resources. These resources are consulted to determine landing and departure accommodations relative to a specific runway. As shown in **Figure E-5**, Alternative A assumes no structural modifications to the RSA. Rather, it incorporates adjustments to the takeoff run available (TORA) and to the landing distance available (LDA) in order to meet B-II RSA criteria. Additionally, seawall improvements along the airport's coastal boundary, for a length of approximately 2,700 feet, are included in this alternative to prevent further erosion of the coast and to stabilize the RSA area beyond Runway 29.

The existing available RSA length beyond the Runway 29 end is approximately 60 feet, as previously noted in **Table E-2**. To achieve a standard 240 foot RSA beyond this runway end for B-I light aircraft, 180 feet of usable pavement area must be sacrificed, thereby reducing the TORA to 3,421 feet for operations on Runway 11, and the LDA to 3,421 for operations on both runway ends. **Table E-5** outlines the declared distances associated with Alternative A.

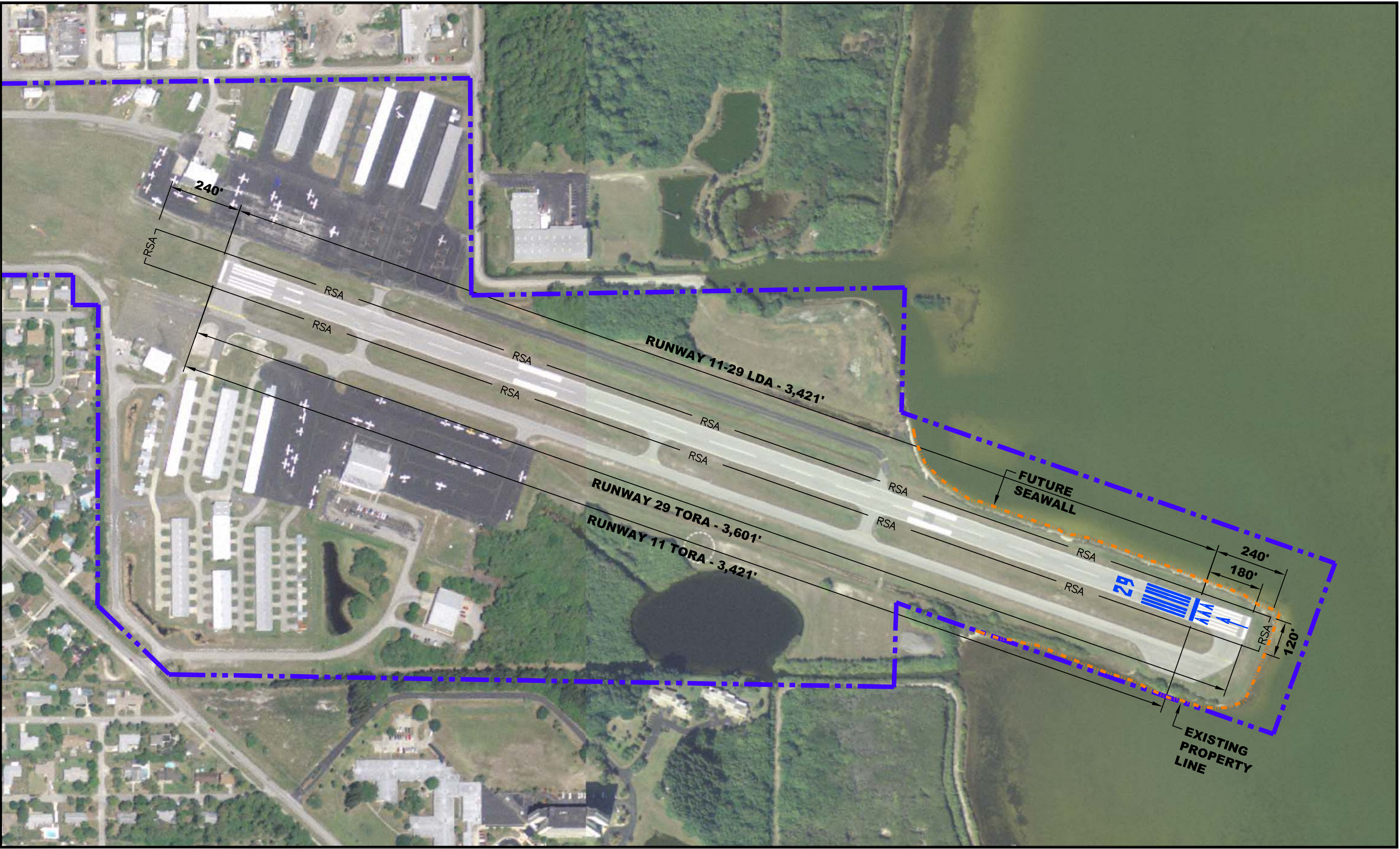
**TABLE E-5**  
**RUNWAY 11-29 DECLARED DISTANCES**

Declared Distance	Runway 11	Runway 29
Displaced Threshold	0 ft	180 ft
TORA	3,421 ft	3,601 ft
TODA	3,421 ft	3,601 ft
ASDA	3,421 ft	3,601 ft
LDA	3,421 ft	3,421 ft

Sources: The LPA Group Incorporated, 2008.

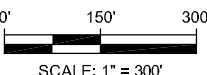
Although this alternative is considered cost effective since it requires no construction to correct the RSA shortfall, it will limit aircraft use on Runway 11-29. Further, the costs for seawall improvements would be substantial under any of the alternatives which are needed to stabilize the airport's coastal boundary and RSA area. Regarding Alternative A, a sizeable portion of pavement is sacrificed so that ARC B-I light RSA criterion can be achieved. While maintaining satisfactory dimensions for RSA is crucial, the reduction of runway pavement, especially at a single runway airport, as a means of doing so reduces the airport's operating capacity to serve particular aircraft and may lead to a reduction in the airport's future role within the aviation system. Specifically, the length available for aircraft landing (i.e., LDA) is permanently reduced through the use of declared distances.

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RSA DETERMINATION STUDY  
ALTERNATIVE A



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DRAWING NO.



Since aircraft landing on Runway 29 would be provided with less available landing length, the operational safety of the airport would be reduced for existing airport users potentially posing a serious safety threat to nearby residential properties. In addition considerations mentioned the relocated landing threshold would further require the relocation of the Precision Approach Path Indicator (PAPI) and Runway End Identifier Lights (REILs) associated with the Runway 29 approach.

Anticipated order of magnitude costs associated with Alternative A are provided in **Table E-6**.

**TABLE E-6**  
**ALTERNATIVE A ORDER OF MAGNITUDE COSTS**

Project	Estimated Costs
Remark Runway Markings	\$20,000
Relocate PAPI and REILs on Runway 29	\$30,000
Seawall design and construction	\$4,800,000
Environmental Assessment & Permitting	\$500,000
<b>Total</b>	<b>\$5,350,000</b>

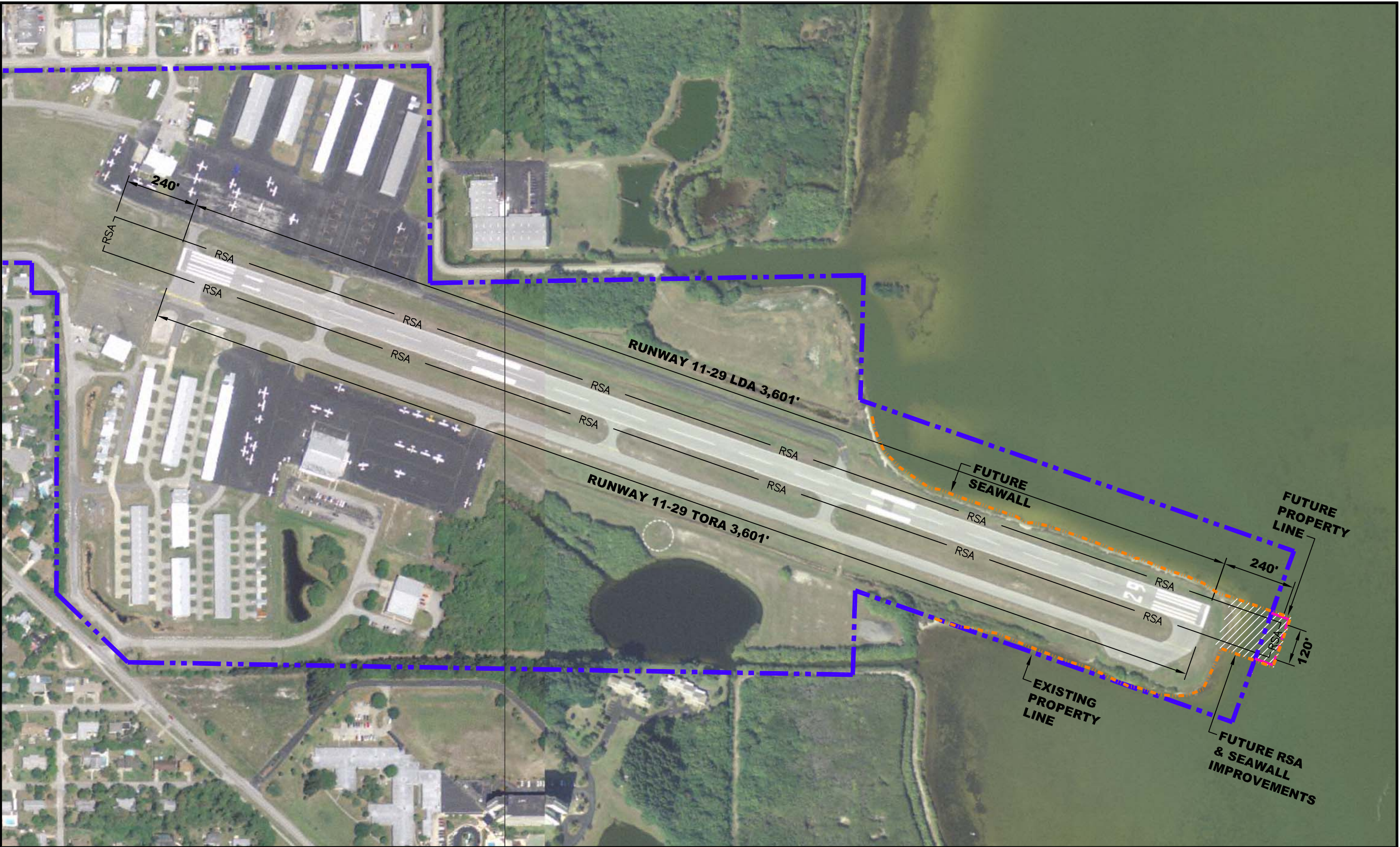
Source: The LPA Group Incorporated, 2008.

### Alternative B—RSA Fulfillment Using Dredge and Fill

In an effort to preserve the entire operating length of Runway 11-29, dredge and fill could be used to regain the runway safety area lost through erosion. Because of continued disintegration of both the seawall and safety area, only 60 feet of graded property is usable beyond the Runway 29 threshold. To obtain the safety area required, approximately 0.33 acres of land would need to be acquired, as illustrated in **Figure E-6**. In conjunction with the RSA, seawall improvements were also considered. Based upon structural requirements, 5,630 cubic yards (CY) of dredge and 16,889 CY of fill is required to accommodate both improvements. Further, unlike the Alternatives A and C, Alternative B does not require the remarking of the runway pavement and relocation of either the PAPI-4 or REILs.

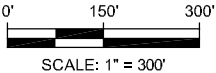
This method of attaining runway safety area requirements is costly but may qualify for FAA funding assistance. Additionally, an environmental assessment of this area is required to determine the significance and extent of environmental impacts, specifically presence of benthic invertebrate communities as required by **FAA Order 1050.1E**, *Environmental Impacts: Policies and Procedures*.

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Brevard County - Merritt Island Airport  
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RSA DETERMINATION STUDY  
ALTERNATIVE B



DATE  
12/15/2008

E-6

DRAWING NO.



Anticipated order of magnitude costs associated with Alternative B are shown in **Table E-7**.

**TABLE E-7**  
**ALTERNATIVE B ORDER OF MAGNITUDE COSTS**

Project	Estimated Costs
Engineering Design	\$300,000
Environmental Assessment & Permitting	\$275,000
Environmental Mitigation	\$600,000
Administration & Testing	\$180,000
Construction (Seawall and RSA)	\$5,400,000
<b>Total</b>	<b>\$6,755,000</b>

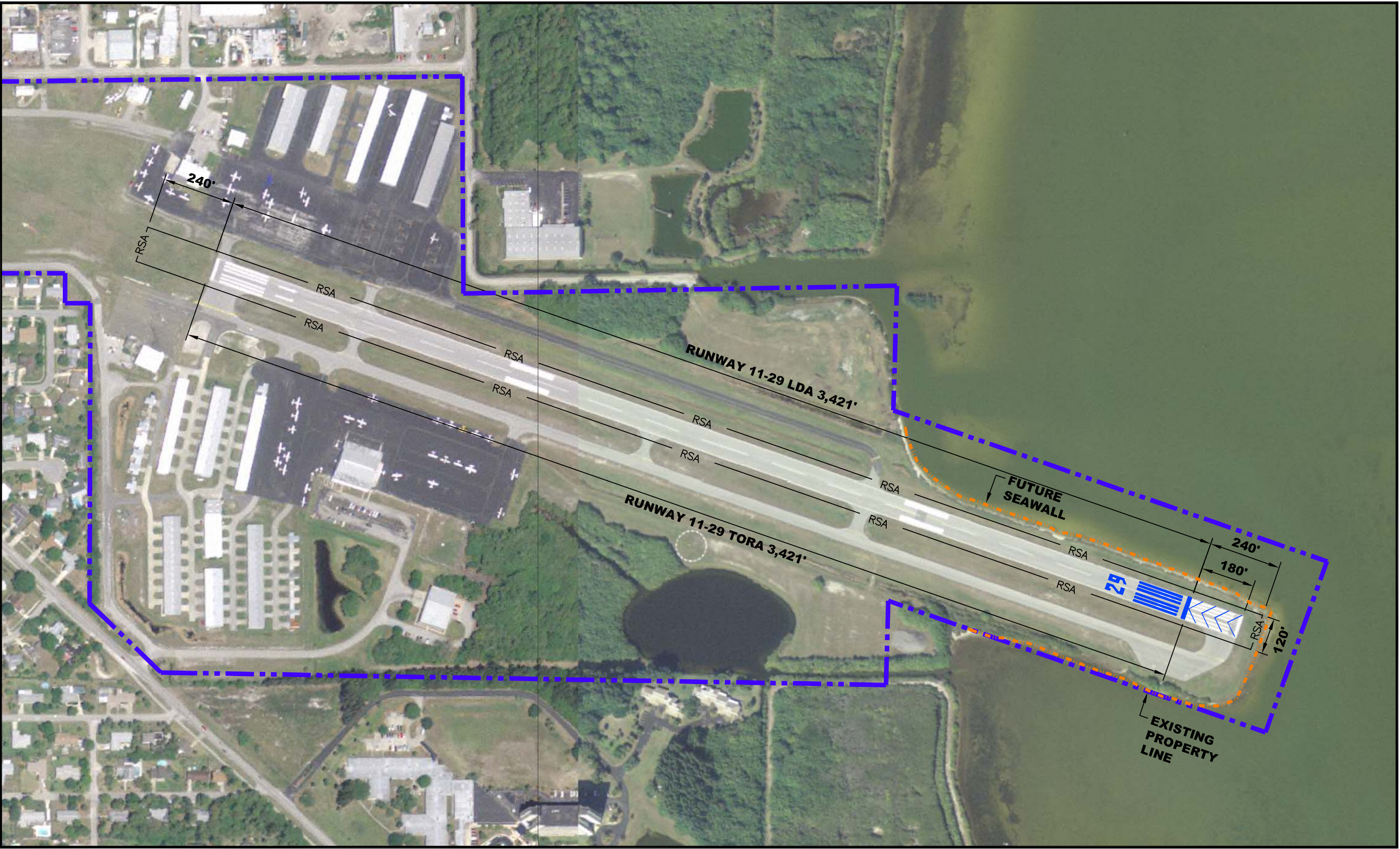
Source: The LPA Group Incorporated, 2008.

### Alternative C—RSA Fulfillment Using Relocated Thresholds

A third alternative for providing RSA criteria is permanently relocating the Runway 29 threshold approximately 180 feet to the northwest. In relocating the threshold, unlike the use of declared distances, the pavement beyond the threshold cannot be used for aircraft operations. The relocated threshold is marked by a demarcation bar, which is a 10-foot-wide white-painted stripe that extends across the width of the runway. The distance between the beginning of the runway pavement and the relocated threshold will be remarked with yellow-painted chevrons, indicating that the pavement is unusable for takeoff or landing. As with the other two alternatives, Alternative C includes seawall improvements for the entire coastal boundary of the airport property, for a length of approximately 2,700 feet as illustrated in **Figure E-7**.

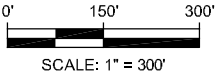
Alternative C is a cost-effective means of achieving the required RSA dimensions comparable in cost to Alternative A, Declared Distances. However, unlike either Alternative A or B, Alternative C will restrict both the takeoff and landing distance to 3,421 feet for aircraft operating on either Runway 29 or 11. Since COI only has a single runway configuration, the TICO Authority stressed the need to maintain both the instrument approach to Runway 11 as well as the existing runway length of 3,601 feet. Alternative C accommodates the RSA requirements, but by limiting the runway length, negatively impacts existing and future aircraft operations and aviation business. Further, shortening the runway could increase noise impacts to residential areas surrounding the airport as well as increase potential incidents since the airport is heavily used for flight training.

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RSA DETERMINATION STUDY  
ALTERNATIVE C



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**E-7**  
DRAWING NO.



Anticipated order of magnitude costs associated with Alternative C as shown in **Table E-8** are similar to Alternative A with the exception that Alternative C will require additional pavement markings (i.e. relocation of Runway 29 threshold, identification markings, and the addition of non-movement pavement markings (yellow chevrons)).

**TABLE E-8**  
**ALTERNATIVE C ORDER OF MAGNITUDE COSTS**

Project	Estimated Costs
Remark Runway Markings	\$40,000
Relocate PAPI and REILs on Runway 29	\$30,000
Seawall Improvements	\$4,800,000
Environmental Assessment & Permitting	\$500,000
<b>Total</b>	<b>\$5,390,000</b>

*Source: The LPA Group Incorporated, 2008.*

## **ENVIRONMENTAL AND OPERATIONAL CONSIDERATIONS**

Due to the proposed seawall improvements, any of the RSA alternatives described in this appendix require the preparation of an Environmental Assessment (EA) study to investigate potential impacts that would result from the implementation of the project. Through a review of available literature, geographic information systems (GIS) data, and aerial photography, a preliminary review of the potential environmental impacts and permitting requirements for the proposed alternatives was conducted, as described in the sections below.

### **Alternative A**

The corrective RSA action associated with Alternative A, RSA fulfillment using declared distances, would not result in environmental impacts by itself, since the major project components would include remarking the runway and primarily moving NAVAIDs and lighting. However, the proposed seawall improvements will likely involve some environmental impacts to the following natural resource categories which would be further investigated as part of an EA study:

- Federal and state jurisdictional wetlands;
- Other Waters of the U.S./Surface waters of the state;
- Seagrasses;
- Protected species (manatee);
- Mangroves;
- Essential fish habitat; and,
- Aquatic preserve impacts (Banana River).

Types of environmental permitting and/or coordination that may be required would include the following:



- Environmental Resource Permit (ERP) for federal and state jurisdictional wetlands and/or surface waters impacts, seagrass impacts, mangrove trimming and/or removal, and sovereign submerged lands lease/acquisition;
- Coordination with the U.S. Fish and Wildlife Service; National Oceanic and Atmospheric Administration, Marine Fisheries Service (NOAA Fisheries); and Florida Fish and Wildlife Conservation Commission (FFWCC) for potential protected species impacts;
- Coordination with NOAA Fisheries for Essential Fish Habitat impacts.

### Alternative B

Alternative B proposes to correct the non-standard RSA beyond Runway 29 by dredging and filling a portion of the Intracoastal Waterway (Newfound Harbor). All of the potential environmental impact categories mentioned above are also applicable to this alternative, although the impacts may be greater due to the additional dredging and filling activities required to obtain the extended RSA. However, at least 120 x 140 feet of this area was previously disturbed since it consisted of the former Airport RSA property, which has been eroded over time.

### Alternative C

Relocation of the runway threshold would result in the same potential environmental impacts as Alternative A.

### Regulatory Requirements

Development projects that involve filling of wetlands in Brevard County may require regulatory permits and/or coordination from local, state, and federal agencies including:

- Florida Department of Environmental Protection
- Department of Community Affairs Coastal Zone Management Division
- Army Corps of Engineering
- United States Coast Guard
- National Marine Fisheries Services
- United States Fish and Wildlife Services

As mentioned earlier, the EA phase of the project would determine the extent and significance of environmental impacts, which will dictate the regulatory permits required for the construction of the project.

### SELECTION OF PREFERRED ALTERNATIVE

An evaluation matrix, which addresses the aforementioned criteria for each alternative, is presented in **Table E-9**. This matrix summarizes the consultant's analyses of the development concepts. The recommended RSA concept for COI was based upon



qualitative and quantitative assessment of each airfield alternative option and was carefully scrutinized to complement the recommendations of this Master Plan Update report. The evaluation scores afford a measurable assessment of the three RSA alternative concepts with respect to the criteria described in this document.

Although Alternatives A, use of displaced thresholds only, and C, permanent threshold relocation, were the least expensive of the three alternatives to implement, both alternatives recoup most of the RSA required by sacrificing runway length as denoted by their low scores under Runway Length Preservation. Alternative B was the most expensive option. This alternative maintains the entire length of Runway 11-29, and thus best serves the needs of existing airport users. Further stabilization of the coast in the near-term is considered critical for reducing future costs and environmental impacts associated with the substantial erosion issue that has and continues to occur at COI. Thus based upon preliminary discussions with both the Titusville-Cocoa Airport Authority and FAA Airport Districts Office, this appeared to be the most reasonable alternative especially since reconstruction of the seawall is required. For the reasons described in this appendix, other options that reduced the available runway length for aircraft operations were deemed infeasible due to operational safety and business concerns associated with airport users and tenants, as well as surrounding land owners. **Table E-9** illustrates a comparison and relative scoring of each alternative based upon existing and future operations. The scoring is based on a 1 to 3 scale, where 1 represents the best scenario and 3 represents the worst scenario.

**TABLE E-9**  
**RSA ALTERNATIVES EVALUATION**

Evaluation Factor	Alternative A	Alternative B	Alternative C
<b>Implementation Cost</b>			
Direct Costs – Construction	2	3	2
Indirect Costs – Lost Revenue Potential	2	1	3
<b>Runway Length Preservation</b>	2	1	3
<b>Environmental Factors</b>	2	3	2
<b>Safety Factors</b>	2	1	3
<b>Total Evaluation Score</b>	<b>10</b>	<b>9</b>	<b>13</b>
<b>Average Evaluation Score</b>	<b>2</b>	<b>1.8</b>	<b>2.6</b>

Source: The LPA Group Incorporated, 2008.

## Preferred Alternative Cost Estimate

Cost estimates are required in order to determine the magnitude of expense associated with the proposed RSA improvements. It is important to note that the final cost estimates considered the cut and fill associated with both the RSA improvements as well as the reconstruction of the seawall. Any additional fill needed to accommodate recommended development as outlined in this Master Plan Update were not included within this report.

# Merritt Island Airport

## Master Plan Update



Based upon the recommended RSA improvements, a detailed cost estimate is provided in **Table E-10**. In order to develop the detailed cost estimates associated with Alternative B, The LPA Group prepared calculations based upon average unit costs for major materials, including labor plus engineering services. Engineering services include design, construction administration, inspection, testing and survey work. Environmental cost estimates were obtained based upon LPA's environmental team's knowledge of the area and airport, and include costs project assessment, permitting and mitigation. It is important to note that seawall improvements include the entire coastal boundary of the airport property.

**TABLE E-10**  
**PRELIMINARY ORDER OF MAGNITUDE**  
**CONSOLIDATED COST ESTIMATES**  
**RSA and Seawall Reconstruction**

Project		Estimated Cost
<b>Environmental</b>		
	Environmental Assessment & Permitting	\$300,000
	Sea Grass Mitigation	\$600,000
	<b>Subtotal</b>	<b>\$900,000</b>
<b>Construction Costs and Engineering Fees</b>		
	Design Construction Cost	\$300,000
	Administration and Testing	\$180,000
	Clearing and Grubbing (2.07 Acres)	\$104,000
	Demolition Items	\$75,000
	Sheet Pile (54,000 SF)	\$2,700,000
	Rubble RipRap (4,844 Tons)	\$450,000
	Fill (16,889 CY)	\$150,000
	Sod (4,288 SY)	\$6,500
	Drainage Modifications	\$100,000
	Dredging (5,630 CY)	\$125,000
	<b>Subtotal Construction</b>	<b>\$4,190,500</b>
	Mobilization (5%)	\$210,000
	Night Work (10%)	\$420,000
	Over Water Construction (3%)	\$125,000
	Safety and Security (3%)	\$125,000
	Contingency (25%)	\$1,050,000
	<b>Total Construction</b>	<b>\$6,120,500</b>
	<b>TOTAL</b>	<b>\$7,020,500</b>

Source: The LPA Group Incorporated, 2008