Runway Safety Area Practicability Study

Dillingham Airport Master Plan Update

Project No. CFAPT00353/ AIP 3-02-0078-017-2018

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List of Acronyms

A&H	Aviation and Hazard
AAC	Aircraft Approach Category
AC	Advisory Circular
ADEC	Alaska Department of Environmental Conservation
ADG	Airplane Design Group
AIP	Airport Improvement Program
AMP	Airport Master Plan
APDES	Alaska Pollutant Discharge Elimination System
ARFF	Airport Rescue and Firefighting
ASDA	Accelerate-Stop Distance Available
AWOS	Automated Weather Observing System
BIA	Bureau of Indian Affairs
CASC	Crushed Aggregate Surface Course
CFR	Code of Federal Regulations
DLG	Dillingham Airport
DME	Distance Measuring Equipment
DOT&PF	Department of Transportation and Public Facilities
EA	Environmental Assessment
EMAS	Engineered Materials Arresting Systems
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
FO	Fiber Optic
FONSI	Finding of no Significant Impact
FSS	Flight Service Station
GA	General Aviation
GPS	Global Positioning System
LDA	Landing Distance Available
LIDAR	Light/Laser Detection and Ranging
LOC	Localizer
LOS	Line-of-Sight
MALSR	Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights
MOS	Modification of Standards
M&O	Maintenance & Operation
NAVAIDs	Navigational Aids
NDB	Non-Directional Beacon
NEPA	National Environmental Policy Act
NPI	Non-Precision Instrument
NPIAS	National Plan of Integrated Airport Systems
ODALS	Omni-Direction Approach Lights
OFA	Object Free Area
PAPI	Precision Approach Path Indicator
PFAS	Perfluoroalkyl and Polyfluoroalkyl Substances
PSS/SS	Scrub-Shrub Wetlands

PEM/EM	Emergent Wetlands
RD	Road
RDC	Runway Design Code
RNAV	Area Navigation
ROFA	Runway Object Free Area
ROW	Right of Way
RPZ	Runway Protection Zone
RSA	Runway Safety Area
RW	Runway
SAWS	Stand Alone Weather Station
SHPO	State Historic Preservation Office
TDG	Taxiway Design Group
TODA	Takeoff Distance Available
TOFA	Taxiway Object Free Area
TORA	Takeoff Run Available
TW	Taxiway
USACE	United States Army Corps of Engineers
USC	United States Code
USGS	United States Geological Survey
VASI	Visual Approach Path Indicator
VOR	Very High Frequency Omni-Directional Range

1.0 Introduction

This study evaluates alternatives to improve the Runway (RW) 1/19 Runway Safety Area (RSA) to meet dimensions established by the Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5300-13 *Airport Design*, for the Dillingham Airport (DLG).

This study will discuss RSA improvement alternatives and present a preferred alternative. The study will inform the Alaska Department of Transportation and Public Facilities' (DOT&PF) and FAA's determination of an appropriate RSA configuration.

According to FAA Order 5200.8 *Runway Safety Area Program*, the airport sponsor must document alternatives considered and explain why the preferred alternative was selected over others.

2.0 Background

The FAA classifies DLG within the National Plan of Integrated Airport System (NPIAS) as a non-hub, primary commercial service airport. DLG is regulated under Title 14 Code of Federal Regulations Part 139 (14 CFR 139).

DLG is a vital air transportation hub for cargo and passengers between Anchorage and communities in the western Bristol Bay region. DLG was built in the 1950s. Initial construction consisted of a 3,750-foot-long, gravel-surfaced runway and access road. Through the 1960s and 1970s, additional land was acquired; the runway was lengthened; and aprons, facilities, roads, and utilities were added. The runway was lengthened to the northeast by 1,000 feet in 1965. The northeast end of the runway was again extended to its current configuration in 1973. The runway was paved in 1980. A project in the early 2000s (AIP 3-02-0078-1003) included the widening of the safety area by 50 ft on both sides.[1]

This RSA Practicability Study supports the Dillingham Airport Master Plan (AMP) Update. The previous master plan was published in 2005 and included an RSA Practicability Study. An RSA Practicability Study and reevaluation was again performed in 2011. The 2012 Dillingham Airport Improvements project [DOT&PF Project No. 59304/Airport Improvement Program (AIP) No. 3-02-0078-013-2012] incrementally improved the RSA by lengthening and widening it (to 250 feet from centerline on the west side). A runway shift project with further RSA expansion is planned but requires vetting by the findings of this study.

3.0 Purpose and Need

Under FAA Order 5200.8 *Runway Safety Area Program*, all RSAs at airports certificated under 14 CFR 139 shall conform to the standards in FAA AC 150/5300-13 *Airport Design* to the extent practicable. DLG does not currently meet the RSA standards for Aircraft Approach Category (AAC)-Airplane Design Group (ADG) C-III and requires additional embankment to meet RSA dimensional standards.

[1] Dillingham Airport Improvements (59304) Geotechnical Report, DOT&PF Central Region Materials, February 2012

4.0 Existing Conditions

4.1 Runway Layout and Facilities

DLG is composed of a single, asphalt-surfaced runway, two aprons, and three taxiways. The runway, designated as RW 1/19, is 150 feet wide and 6,400 feet long. The 790,000-square-foot Terminal Apron connects to RW 1/19 near the midpoint via two 500-foot-long taxiways (TWs), designated TW A and TW B. The General Aviation (GA) Apron is situated to the west of the Terminal Apron and connected by TW C. The GA Apron is surfaced with recycled asphalt pavement. Leaseholder facilities are located along the west edge of the Terminal Apron and around the perimeter of the GA Apron. DLG is a Part 139 Certificated airport, Class I, Airport Rescue and Firefighting (ARFF) Index B. Under CFR certification requirements, it has perimeter airport security fencing and firefighting equipment.

4.2 Critical Aircraft and Runway Length

The DLG Aviation Activity Forecast and Critical Aircraft Determination was approved by the FAA on March 24, 2021. The existing critical aircraft category is C-III. Combined operations by group C-III aircraft exceed the 500-operation threshold required for a critical aircraft determination under AC 150/5000-17 *Critical Aircraft and Regular Use Determination*. No single C-III aircraft currently achieves 500 annual operations individually. Their operations must be grouped for the critical aircraft and runway length determination.

By 2040, the ultimate critical aircraft is forecasted to be the Lockheed L-100, which is an AAC/ADG C-IV aircraft. Alaska Airlines also anticipates replacing their Boeing 737-700 operations with 737-800s in 2022-2023 and possibly 737-900s (all C-III aircraft) at an undetermined point in the future. Based on the ultimate critical aircraft need, FAA may approve the planned infrastructure needs based on C-IV standards; however, justification for future projects must be based on actual activity levels at the time the project is requested for development. Changes to the aircraft fleet mix are not anticipated to alter the Runway Design Code (RDC) or runway length determination in the near term. For these reasons, C-III standards and existing aircraft operations were used in this study and runway length determination. An updated aircraft operations summary, critical aircraft and runway length determination should be performed at the time of a future project to verify planned airport dimensions and FAA funding eligibility. Table 1 summarizes C-III group aircraft operations at DLG in 2019 from the FAA-approved DLG AMP Aviation Forecast, originally reported by the Bureau of Transportation Statistics T-100 database.

Table 1: C-III Fleet Mix Operations (2019)[2]

AAC - ADG	Aircraft	Annual Operations
C-III	Boeing 737-100/200	15
	Boeing 737-300	175
	Boeing 737-400	88
	Boeing 737-700/700LR/Max 7	264
	McDonnell Douglas DC-9-30	78
	McDonnell Douglas DC9 Super 80/MD81/82/83/88	199
C-III Total		**819**

[2]Dillingham Airport Master Plan Update Aviation Forecast; Bureau of Transportation Statistics: T-100 Domestic Segment, January-December 2019.

The existing runway length is 6,400 feet, which is longer than required for the critical aircraft. Runway length requirements for group C-III aircraft were determined under AC 150/5325-4B *Runway Length Requirements for Airport Design*. Airport elevation, temperature, aircraft characteristics, aircraft operational weights, and runway gradient were used to extrapolate or adjust runway lengths from aircraft planning manual FAR charts. The FAR runway takeoff length required by the critical aircraft group achieving 500 cumulative annual operations is 6,000 feet.

Table 2 provides a summary of the runway length determination process. The length required by each aircraft in the critical aircraft grouping was determined from manufacturer planning FAR charts utilizing the adjustment factors mentioned above. The runway length must be required by 500 operations by the critical aircraft grouping for FAA funding eligibility. The table is sorted in descending order by runway length required by each aircraft. The runway length was selected from the first column where 500 cumulative operations are achieved. Additional backup documentation on the runway length determination is available in Appendix C.

A reduction in runway length is not popular with airport users. A common request from air carriers during the master plan interviews was to not reduce the runway length. However, FAA will not participate in a runway reconstruction beyond the length determined under AC 150/5325-4B *Runway Length Requirements for Airport Design* and AC 150/5000-17 *Critical Aircraft and Regular Use Determination.* A runway length reduction has the additional benefit of increasing existing embankment length available for the RSA.

Table 2: Runway Length Determination[3]

Aircraft	737-200	MD-82	737-400	737-700	DC-9-41 (30)	737-300
Annual Operations	15	199	88	264	78	175
Cumulative Operations	15	214	302	566	644	819
AAC-ADG	C-III	C-III	C-III	C-III	C-III	C-III
MTOW (lbs.)	115,500	149,500	150,000	154,500	114,000	139,500
Operational TOW (lbs.)	112,500	137,000	129,000	132,500	107,500	117,500
Takeoff Length Requirement (ft.)	9,000	6,400	6,200	6,000	6,000	5,700

[3] FAA AC 150/5325-4B; Airplane Characteristics for Airport Planning, various manufactures; See Appendix C

4.3 Runway Safety Area

RSA dimension standards are established by the FAA and published in Table 3-5 of AC 150/5300-13A *Airport Design*. The runway safety area is graded and sized to enhance the safety of aircraft that overshoot, underrun, or veer off the runway. It prevents structural damage to the aircraft or injury to occupants and provides accessibility to rescue and firefighting equipment in the case of an accident. The size of the RSA embankment is dependent upon the AAC/ADG of the critical aircraft using the runway. The RSA dimensional standards for a C-III runway are 500 feet wide (centered on the runway centerline), extending 1,000 feet beyond the runway departure end and 600 feet prior to the threshold.

The existing RSA is undersized and non-standard. It is too narrow, is not centered around the runway, and does not extend far enough beyond the south runway end. The current RSA dimensions are 350 feet by 8,000 feet. Its width extends 250 feet west of the runway centerline and only 100 feet to the east. The south RSA length beyond the RW 19 end is 600 feet. The current north RSA length beyond the RW 1 end meets standards at 1,000 feet. See Table 3 and Figure 1 for current RSA dimensions. Because there are no published reduced declared distances at DLG, the runway departure ends are coincident with the runway thresholds.

Table 3: Existing and C-III Standard RSA[4]

	Existing	Standard	Meets Standard
RSA Width	350 ft (250 West, 100 ft East of CL)	500 ft	No
RSA Length			
Beyond End of RW 1 (North)	1,000 ft	1,000 ft Beyond Departure End / 600 ft Prior to Threshold	Yes
Beyond End of RW 19 (South)	600 ft	1,000 ft Beyond Departure End / 600 ft Prior to Threshold	No

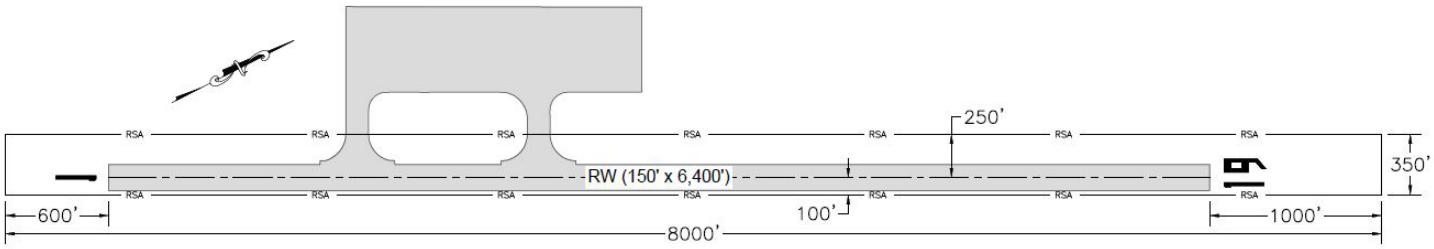


Figure 1: Existing RSA Dimensions

[4] Standard C-III RSA dimensions from FAA AC 150/5300-13A, Table 3-5

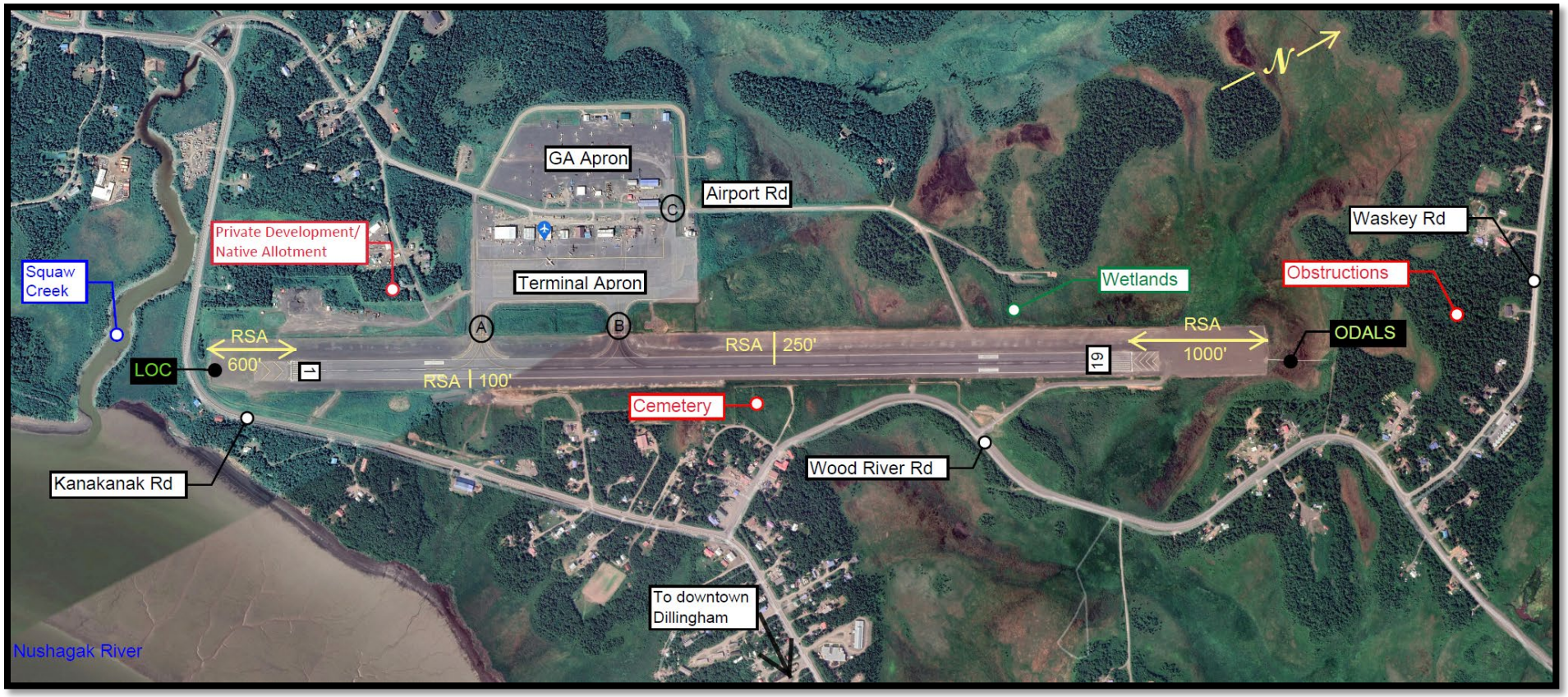


Figure 2: Airport Layout

4.4 Site Constraints and RSA Impact Considerations

There are several site constraints around the airport that limit the expansion of the existing RSA. The existing airport layout and surrounding site constraints are depicted on Figure 2 and discussed in the following sections.

4.4.1 Community Roads

Dillingham is not on the statewide road system. Kanakanak Road is the main road connection to downtown Dillingham. Kanakanak Road loops around the south end of the runway and continues along the southeast side of the runway, through airport property and within the Runway Object Free Area (OFA). See Figure 3. There is a significant elevation difference of 18 feet between the south RSA and the road elevation and steep embankment slopes off the RSA end (2 horizontal: 1 vertical).

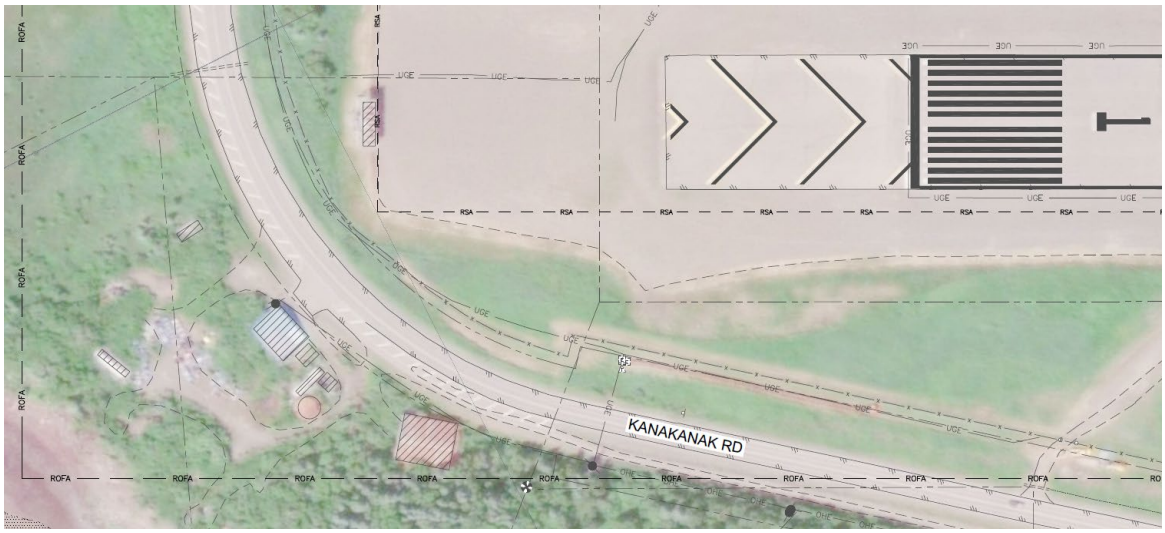


Figure 3: Kanakanak Road within OFA

A portion of Wood River Road curves towards the east edge of the runway, entering airport property and the OFA (Figure 4). These road constraints limit RSA expansion to the south and east.

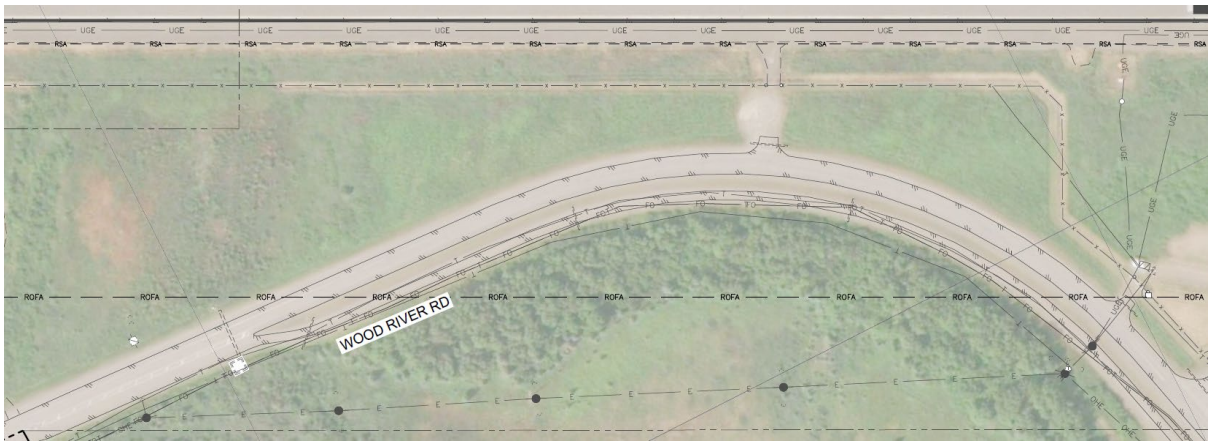


Figure 4: Wood River Road within OFA

4.4.2 Cemetery

The Evergreen Cemetery is located on a knoll east of the runway and within the OFA (Figures 5 & 6). The cemetery boundary begins directly east of a road just outside the airport fence. The cemetery is within the airport property interest as fee property and an easement. Airport fee property (Tract I) extends 50 feet east of the fence line into the cemetery. DOT&PF holds an Avigation and Hazard (A&H) and right-of-way (ROW) easement (Tract IV) for the remainder of cemetery land from Choggiung Limited.

The cemetery would be within the RSA if it were expanded to standards around the existing runway. This would require embankment to be built over the current cemetery and necessitate its relocation. There would likely be strong public opposition to relocating the cemetery.

This study recommends that the Evergreen Cemetery be closed to new burials, regardless of which RSA alternative is selected. There are alternate sites for new burials. Four other active cemeteries currently exist in Dillingham, and the city has recently purchased land to begin a new cemetery. DOT&PF does not have the outright authority over the portion of the cemetery outside airport fee property and within the easement; closure would require cooperation with the community and landowner.

Figure 5: Evergreen Cemetery Photo

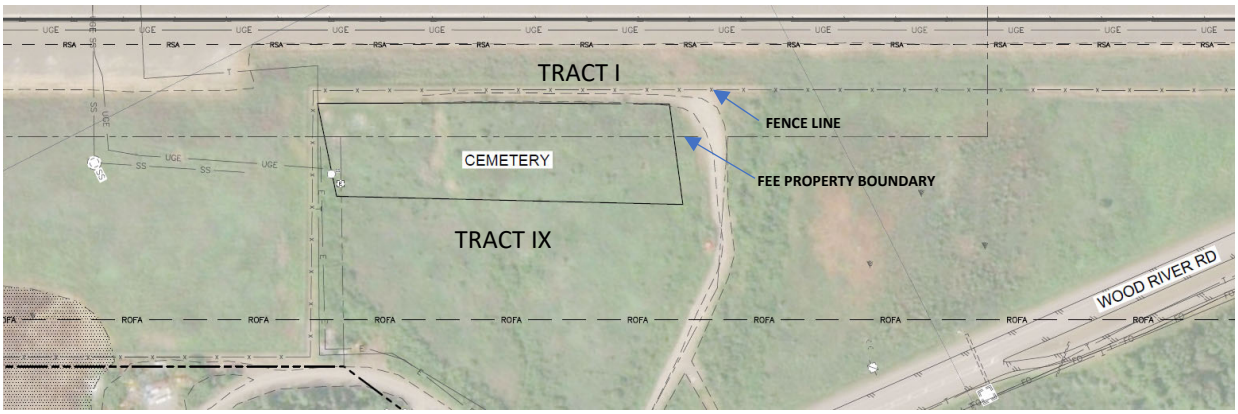


Figure 6: Evergreen Cemetery Aerial

4.4.3 Utilities

There are existing utilities at and around the airport that may be affected by RSA expansion. Nushagak Electric and Telephone Incorporated owns the electrical power and telecommunications lines that run along roadways in the vicinity and provide service to airport facilities. Power and telecommunication are provided via a combination of underground and overhead lines. Electrical circuits are on 3-phase power. Telecommunication lines are a combination of copper, coaxial, and fiber optic cables.

Sewer service to the airport is owned by the City of Dillingham. Electric, telecom and sanitary sewer services to the airport cross the runway immediately north of the apron. There are culverts under the runway and taxiway.

Relocation of three spans of overhead electric lines on poles along Kanakanak Road (south of the Runway 1 end) to underground lines was performed with the Dillingham Airport Improvements project (Project No. 59304) in conjunction with RSA expansion and LOC/DME relocation. Utility relocation has already occurred along the curve on Wood River Road in anticipation of a future road realignment. More information is provided in the Utilities Inventory prepared for the Master Plan. A utility conflict report, utility agreements, and relocation design will be required for a future project that corrects the RSA.

4.4.4 Airport Fence

Fencing surrounding several areas of the airport is difficult to access for repairs. Much of the land is wet, densely vegetated, and not suitable for breach identification and repair access by vehicle. A portion of the airport fence is situated at the bottom of the south RSA embankment slope, limiting access for maintenance, and causing the accumulation of snow from plowing operations. Snow drifts at multiple locations accumulate to the point where they overtop the fence. There is a project in the design phase for fence improvements and construction of a service road to bring the fence into compliance with 49 CFR § 1542.203.

4.4.5 Land Use and ROW Considerations

DLG property is surrounded by residential development on all sides except the northeast. Much of the surrounding parcels are held as Alaska Native Allotments. Most residential development is centered around the major road corridors of Kanakanak Road and Wood River Road. There are also homes and parcels along Waskey Road, which intersects the RW 19 approach. Two residences are adjacent to the airport property boundary to the northwest and are only accessible by Airport Road. There is a cluster of residences along the southeast edge of the runway. The Dillingham Airport Land Occupancy drawing identifies an encroachment east of the runway.

The Bureau of Indian Affairs (BIA) effectively controls the platting process for sub-dividing allotment properties for partial parcel acquisition. BIA control over this process can lower the likelihood of project success, increase project costs, and cause significant delays for partial property acquisition. For these reasons, full-parcel acquisition is recommended for required airport property acquisition of Native Allotments. For the purposes of this study, full acquisition of allotment properties is assumed to fully contain and protect the Runway Protection Zones (RPZs) and OFAs within airport property.

The ultimate decision to acquire full or partial parcels will be made closer to an RSA expansion project. The final determination should consider the necessity of the acquisition to protect the RPZs/OFAs/RW approaches, parcel ownership/allotment restricted status, likelihood of success, timeline, costs, existing site development, and BIA control over the subdividing/platting process. The acquisition of A&H easements should also be considered, especially where airspace obstructions are the only deficiency.

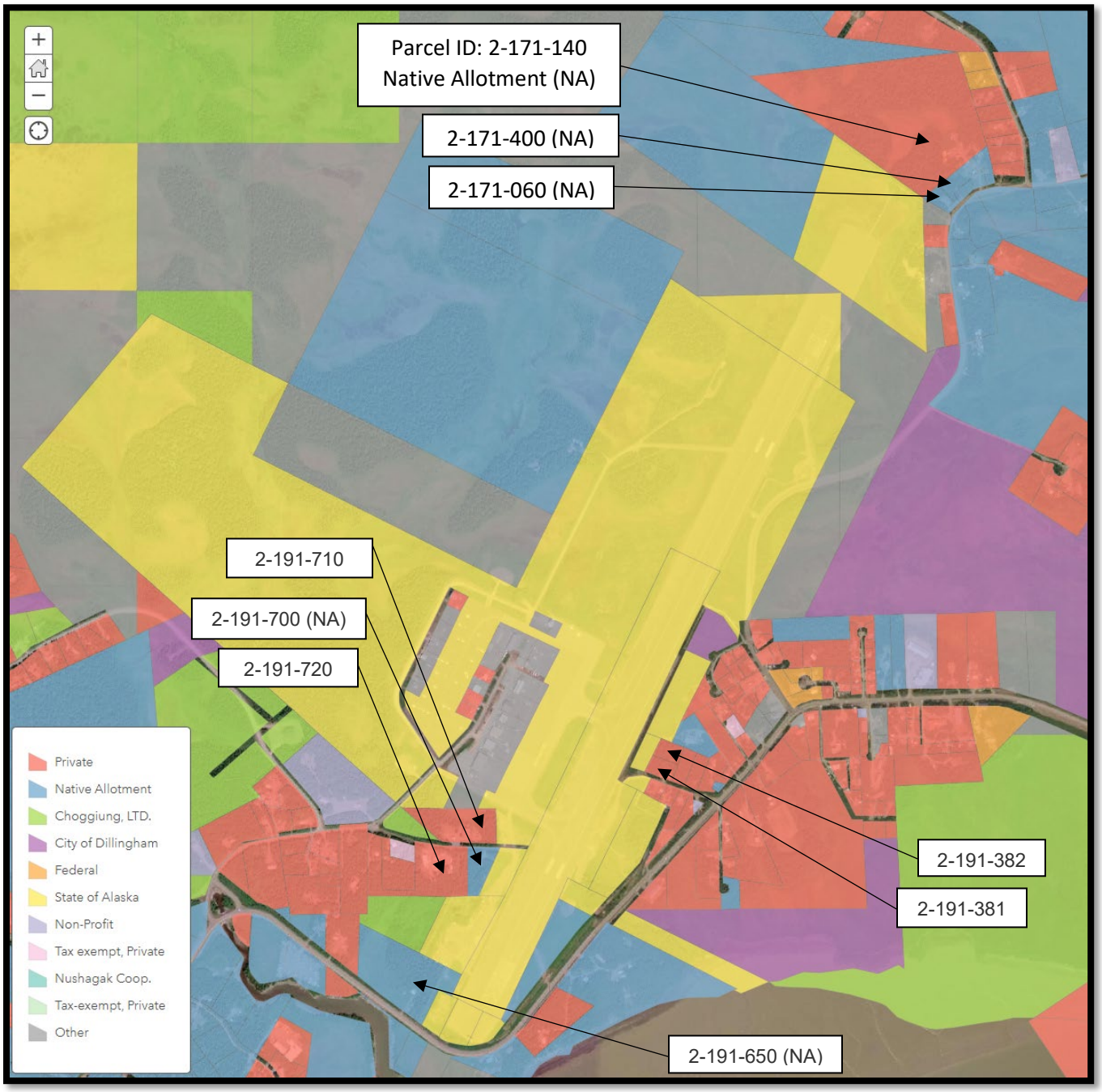


Figure 7: Land Ownership Map[5]

[5] City of Dillingham/Arc GIS, Parcels Online, https://city-of-dillingham-dillingham.hub.arcgis.com/datasets/parcelsonline/

4.4.6 Airspace Obstructions

There are existing obstructions to the RW 19 approach. It is not practicable to clear all the identified existing and ultimate obstructions. Some obstructions are located on privately held land, including residential development and Alaska Native Allotments. A&H easements may be acquired for the topping or clearing of obstructing trees.

From AC 150/5300-13A *Airport Design*:

> *"Land acquisition to protect all possible airspace intrusions is generally not feasible, and is usually supplemented by local zoning, easements, or other means to mitigate potential incompatible land uses and potential obstacle conflicts… At a minimum for new runways, land acquisition should include Object Free Areas (OFAs) and Runway Protection Zones (RPZs). To the extent practicable, land acquisition should include adequate areas surrounding the runway(s) to protect the runway approach and departure surfaces identified in paragraph 303, and for existing and planned runway OFAs and RPZs."*

For the figures and cost estimates under this study, property would be acquired for RPZs and OFAs; obstructions would be cleared only within airport property.

4.4.7 Wetlands and Environmental Background Information

There are United States Army Corps of Engineers mapped wetlands on and around airport property, most prevalently around the north end of the airport (Figure 8). Squaw Creek drains into the Nushagak River south of the airport.

An Environmental Assessment (EA) was prepared for the Dillingham Airport Improvements project, which widened and extended the RSA to its current configuration. This was "the maximum extent practicable" at the time of project. The EA resulted in a Finding of no Significant Impact (FONSI). The project was found to be in accordance with National Environmental Policy Act (NEPA) and approved by FAA in 2012. The State Historic Preservation Office (SHPO) concurred with a determination of no historic properties affected. Required permits pursuant to the Clean Water Act included: APDES Construction General Permit, Alaska Wastewater General Permit for any construction dewatering in the vicinity of contaminated sites, and a USACE wetlands permit.[6]

The 2012 Dillingham Airport Improvements project included 12.7 acres of unavoidable wetland impacts. Wetland avoidance and minimization measures for the project included: minimizing the wetland fill footprint by steepening side slopes to 2:1 in areas and stabilizing side slopes with native vegetation to prevent stormwater pollution. The proposed RSA widening alternatives would have similar environmental documentation and permit requirements. The magnitude of wetland impacts is similar between the previous RSA expansion and the proposed RSA widening.

The Alaska Department of Environmental Conservation (ADEC) Contaminated Sites Database shows three active contaminated sites on the DLG aprons, including one PFAS site.[7] The report of PFAS may complicate projects involving excavation and will require coordination with ADEC.

[6] Dillingham Airport Improvements (59304) Final Environmental Assessment, DOT&PF, May 2012
[7] Alaska DEC Contaminated Sites, Alaska Department of Environmental Contamination, https://dec.alaska.gov/spar/csp/.

Figure 8: Wetlands Map[8]

[8] US Fish and Wildlife Service National Wetland Inventory, https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/

4.4.8 Geology and Soil Conditions

The ground surrounding the runway to the northwest is comprised of compressible peat, underlain by silt. Geotechnical investigations were performed for RSA embankment expansion under the Dillingham Airport Improvements project. The following is summarized from the Geotechnical Report for the project: In upland areas in the airport vicinity, there is a thick layer of silt overlying sand or gravel deposits. The minimum depth to coarse-grained soils is 20 feet. The native soils in lowland terrain are generally poorly drained muskeg terrain underlain by peat deposits. Peat thickness north and west of RW 19 is as thick as 21.5 feet. The peat deposits are typically wet (saturated to ground surface), low density, and highly compressible. The underlying silt subgrade materials are highly frost susceptible, but no permafrost was encountered during drilling. Embankment materials are sand and gravel from local sources.[9]

Northwest RSA expansion under that project was composed of geotextile stabilization over undisturbed ground, borrow contained within a geogrid envelope, and crushed aggregate surface course (CASC). Surcharge and muck excavation were considered in the geotechnical recommendations. Muck excavation was cost prohibitive due to significant peat depths. A surcharge height was deemed to constitute an airspace obstruction to the runway. Consolidation was anticipated, with staged construction recommended. Primary consolidation was expected to occur during the first construction, while secondary, lesser consolidation was expected to continue though the life of the embankment.[10]

To date, the northwest RSA embankment is experiencing concerning levels of differential settlement and instability. A berm has emerged in the muskeg outside the embankment edge with surface irregularities and cracks exceeding a four-foot depth in certain areas.

4.5 Runway Line of Sight and Parallel Taxiway

4.5.1 LOS Deficiency

In addition to the substandard RSA and OFA penetrations, the runway also has a significant line-of-sight (LOS) deficiency. The LOS deficiency is caused by long-term embankment settlement at the northeast end after the runway was lengthened back in the 1970s.[11] The elevations of both thresholds are below the elevation at the runway mid-point. The crest curve in the middle of the runway forms a hump that blocks the ability to view the other runway end when a plane is positioned at the opposite threshold.

For airports without a full-length parallel taxiway, AC 150/5300-13 *Airport Design* requires that “any point 5 feet (1.5 m) above the runway centerline must be mutually visible with any other point 5 feet (1.5 m) above the runway centerline.” In the existing runway profile configuration, the crest curve near the midpoint of the runway profile violates the five-foot LOS line by 7.2 feet. To fully correct the runway LOS, the RW 19 threshold would need to be raised by 15.7 feet. Elevating the RW 1 threshold is restricted due to maximized embankment slopes and the proximity to Kanakanak Road. The elevation of the crest curve is limited from significant cut by the need to tie into TWs A and B and the apron at acceptable grades.

[9] Dillingham Airport Improvements (59304) Geotechnical Report, DOT&PF Central Region Materials, February 2012
[10] Dillingham Airport Improvements (59304) Geotechnical Recommendations, DOT&PF Central Region Materials, April 2012
[11] Dillingham Airport Improvements (9304) Runway Safety Area Practicability Study Memorandum, DOWL HKM, January 2011

4.5.2 Parallel Taxiway

With the addition of a full-length parallel taxiway, the AC 150/5300-13A line-of-sight requirement is lessened to visibility between any two points on the runway separated by half the runway length. Adding a parallel taxiway would reduce RW 19's elevation raise requirement to 4.3 feet.

A full parallel taxiway would run the full length of the runway, intersecting the apron and connecting at both thresholds. Construction of a full-length parallel taxiway would require acquisition of private and Native Allotment land south of the apron for the taxiway, TOFA, and perimeter fencing south of the apron. Property acquisition may take 3 – 5 years or more. The costs for full parcel acquisition may range from $300,000 - $500,000, depending on the relative ease or contentiousness of acquisition for the individual parcels. Approximately three parcels would be impacted, including two private parcels (Parcel IDs 2-191-710 & 2-191-720) and one Native Allotment (2-191-700).

Regarding environmental impacts, constructing a parallel taxiway would place fill into 9 acres of wetlands.

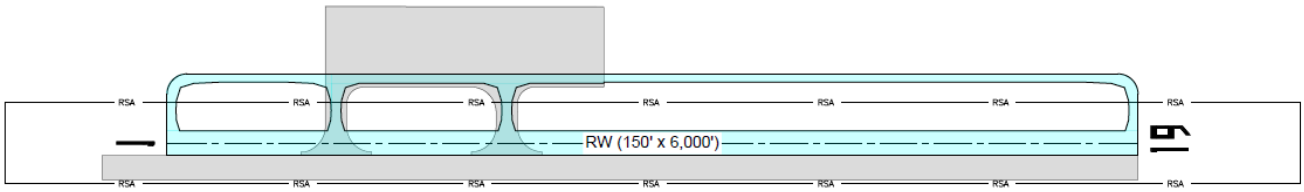


Figure 9: Full-Length Parallel Taxiway

A partial-length parallel taxiway would also provide safety mitigation and increased operational capacity by allowing aircraft to move off the runway more quickly. Property acquisition would not be required for a partial parallel taxiway that extends north from the apron to the RW 19 threshold; however, a partial parallel taxiway would not relax the LOS requirements.

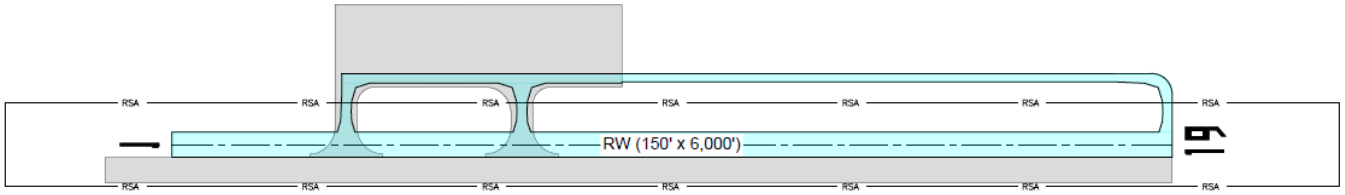


Figure 10: Partial-Length Parallel Taxiway

The parallel taxiway would be built to a 50-foot width in accordance with design standards for the Taxiway Design Group (TDG) 3 critical aircraft. DOT&PF Maintenance and Operation (M&O) personnel have expressed concerns about snow berms limiting usable taxiway width in the winter; however, FAA will only participate in funding new taxiways sized to the standard dimensions stated for the critical aircraft group. An additional benefit of the full parallel taxiway is that it could be used as a temporary runway during future runway projects, including projects to correct LOS; however, the narrow taxiway width will limit which aircraft are able to utilize it as a temporary runway.

4.5.3 LOS Correction

The LOS deficiency may be resolved in one of two ways: by raising the RW 19 threshold with nearly 16 feet of fill or by placing approximately 4 feet of fill at the RW 19 threshold and constructing a full-length parallel taxiway. Full

LOS correction without a full-length taxiway is not possible over one construction season. It would have to be completed incrementally over several seasons or several projects. In contrast, once a full-length parallel taxiway is constructed, the RW 19 threshold elevation will only need to be raised by 4.3 feet which would still be challenging to construct all-at-once next to an open runway.

The existing runway profile and LOS correction scenarios are depicted in Figure 11. Cross sections are shown in Figure 12. The extent to which the proposed runway can be raised is limited by safety and airspace surfaces around the existing runway used in a temporary half-width configuration to maintain operations during construction. This limitation could be eliminated by constructing the full parallel taxiway for use as a temporary runway during runway LOS correction construction.

The estimated costs of full and partial taxiway construction and LOS correction are provided in Table 4. The threshold elevation could also be raised incrementally beginning with the runway shift, followed by adding materials during each successive pavement and rehabilitation project. It would take over ten years for the LOS to be resolved using the incremental method. The costs would be higher over time due to mobilization and administrative costs for each project.

Construction of a partial-length parallel taxiway for safety mitigation should evaluated while property acquisition is being pursued for the construction of a full-length parallel taxiway.

Table 4: LOS and Parallel TW Cost Estimates

Option	LOS Resolved	RW Fill Material	ROW Needed	Added Cost
LOS Correction w/o TW	Yes	1,382,430 Tons	No	$13.3 Million+
Partial Parallel TW	No	-	No	$6.7 Million+
Full Parallel TW	LOS Correction w/ TW	-	Yes	$9.1 Million+
LOS Correction w/ TW	w/ Full Parallel TW	293,420 Tons	No	$2.1 Million+

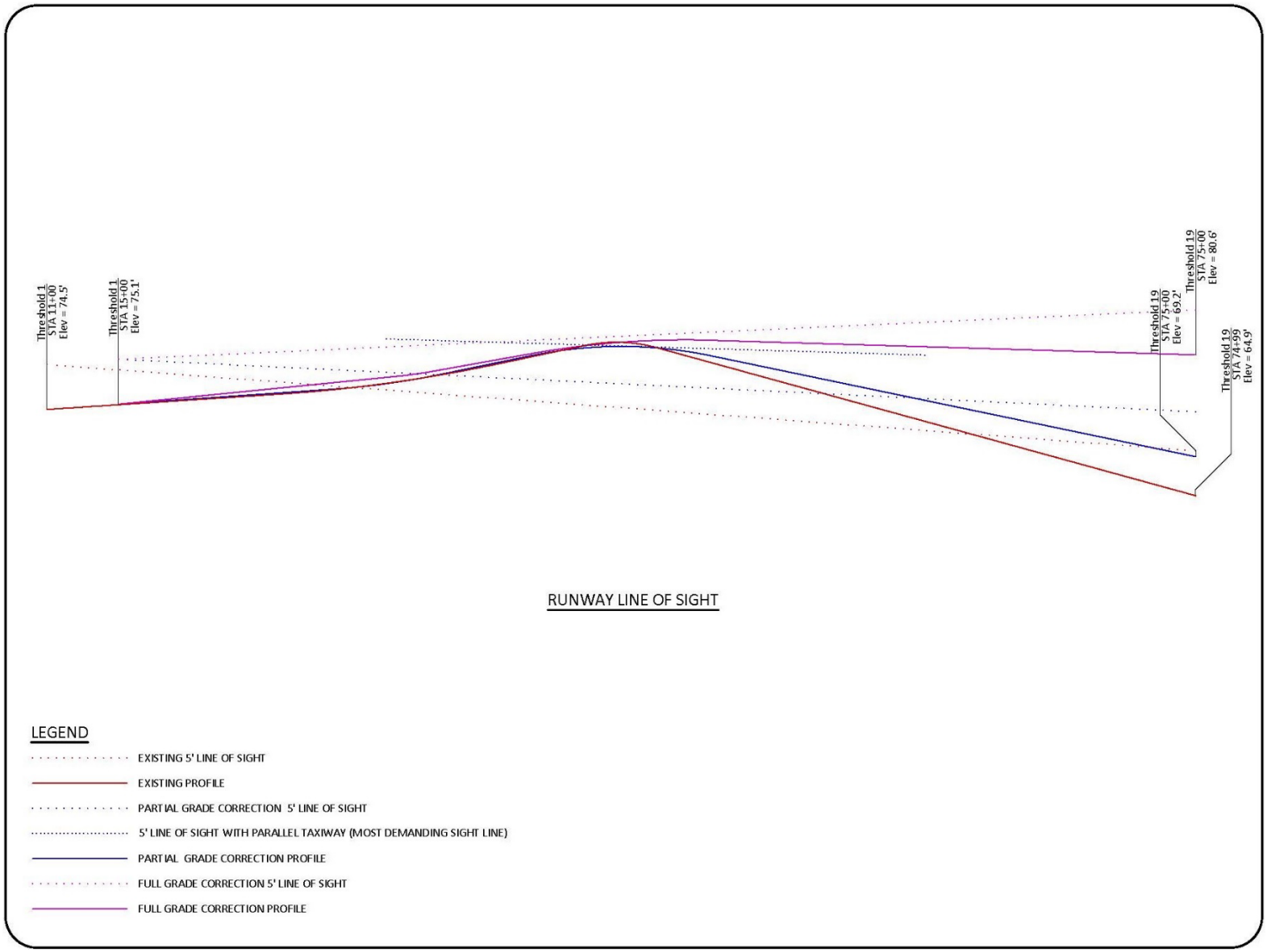


Figure 11: LOS Profiles

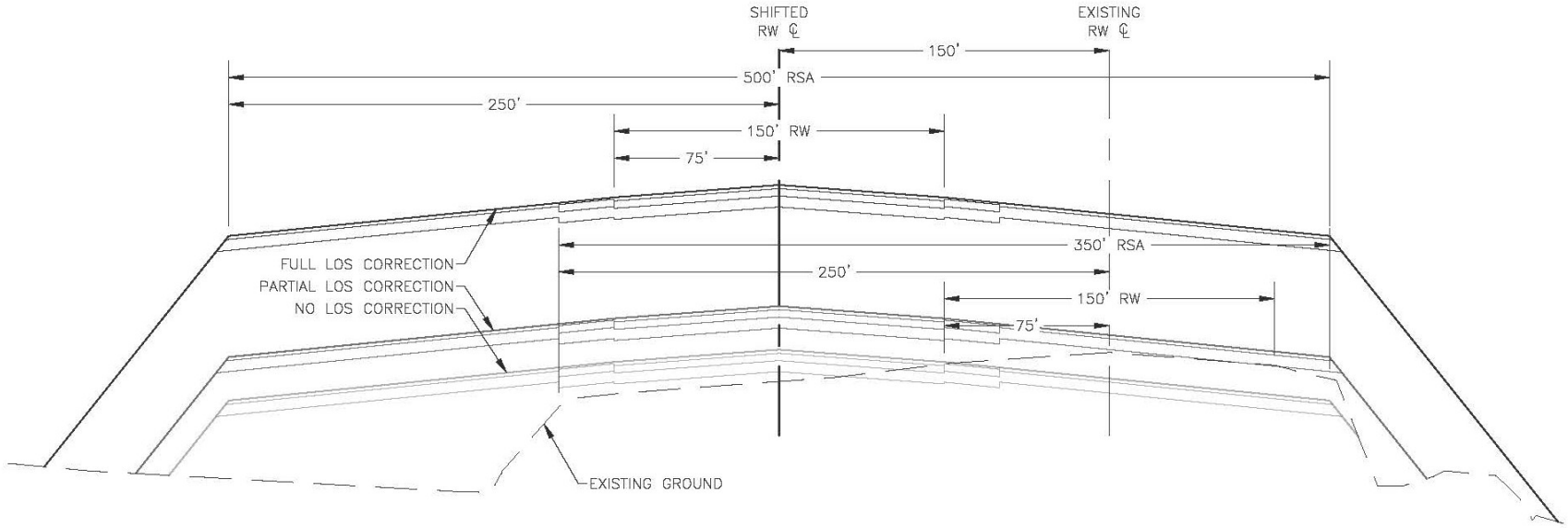


Figure 12: LOS Correction Sections

4.6 Visual and Navigation Aids, Approach Procedures, and Airport Lighting

4.6.1 Visual and Navigation Aids

There are visual and navigational aids (NAVAIDs) in place for DLG. NAVAIDs and equipment at the airport consist of: omni-directional approach lights (ODALs), rotating airport beacon, localizer, precision approach path indicator (PAPI), visual approach path indicator (VASI), wind cones/segmented circle, Stand Alone Weather Station (SAWS), and an automated weather observing system (AWOS). The AWOS is located immediately south of the Terminal Apron, outside the existing OFA. There is an FAA flight service station (FSS) located near TW C and north of the Terminal Apron.

The localizer is positioned at the end of the south RSA on a steel platform. Very high frequency omni-directional range (VOR), distance measuring equipment (DME), and non-directional beacon (NDB) facilities are located off site, approximately 3 miles south of the airport. The location of the other airport NAVAIDs is shown on the airport diagram below.

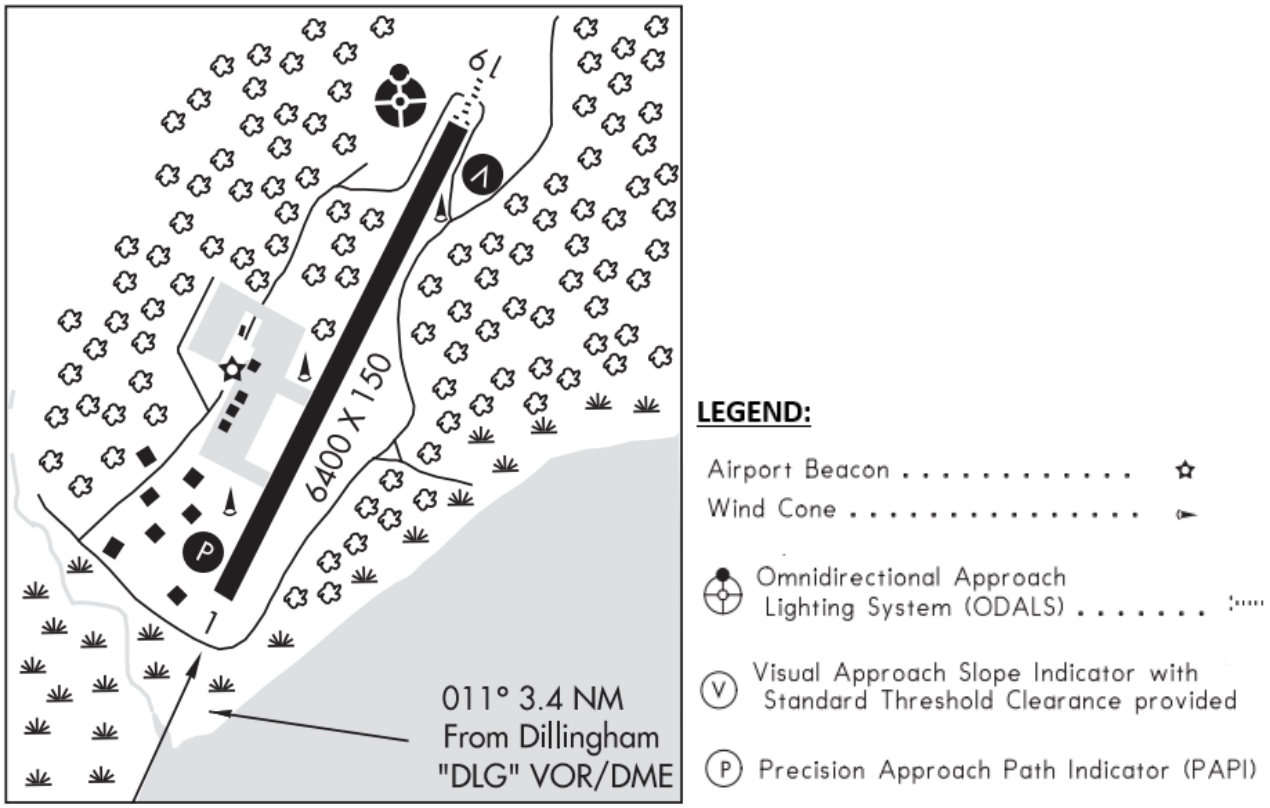


Figure 13: Airport Diagram with NAVAIDs[12]

4.6.2 Approach Procedures

The localizer allows for a non-precision instrument (NPI) approach to RW 19. The VOR enables a NPI approach to RW 1. There are also RNAV (GPS) approaches to both runway ends published in the Alaska volume of the FAA U.S. Terminal Procedures Publication. RW 1 is the primary runway direction used for airport approach and departure.

[12] FAA Chart Supplement Alaska, DLG, Effective 1/27/22 to 3/24/2022

4.6.3 Airport Lighting

The Dillingham Airport lighting system is comprised of high-intensity runway lighting and medium-intensity taxiway lighting. The airport lighting system is failing and should be replaced. All the lighting components have degraded including the regulator, connections, insulation, wiring, and transformers. The lighting system is approximately 16 years old. This is beyond the 10-year minimum useful life defined in Table 3-8 of FAA Order 5100.38D *Airport Improvement Program Handbook*, meaning it is eligible for replacement. Ohm resistance testing performed on the runway and taxiway lighting systems revealed values well below standards in Specification L-108, indicating degradation of the conductor insulation.

5.0 RSA Improvement Alternatives

This study has determined that it is practicable to shift the runway 150 feet west towards the apron and expand the RSA. FAA Order 5200.8 *Runway Safety Area Program* provides guidance in determining considered alternatives for the RSA to conform to AC 150/5300-13A standards:

> *The first alternative to be considered in every case is constructing the traditional graded area surrounding the runway. Where it is not practicable to obtain the entire safety area in this manner, as much as possible should be obtained. Then, the following alternatives shall be addressed in the supporting documentation. The applicability of these alternatives will vary, depending on the location.*
>
> *a. Relocation, shifting, or realignment of the runway*
> *b. Reduction in runway length where the existing runway length exceeds that which is required for the existing or projected design aircraft*
> *c. A combination of runway relocation, shifting, grading, realignment, or reduction*
> *d. Declared distances*
> *e. Engineered Materials Arresting Systems (EMAS)*

The following RSA alternatives would use a combination of methods and improvements as determined during the design of a future project to correct the RSA and other airport deficiencies. Each alternative sets the adjusted runway profile similar to existing elevations and assumes additional fill would be placed on the RW 19 end in a future project to address the LOS deficiency. Each alternative also assumes that Modifications of Standards (MOS) would be obtained as needed for LOS and OFA deficiencies not corrected by the RSA project. Line-of-sight resolution methodology should be considered based on the evaluation and cost estimates provided in section 4.5.

The following four alternatives were considered for their practicability:

- Alternative 1: Offset RW 150’ west
- Alternative 2: Offset RW 150’ west, shift RW 1 threshold 400’ north
- Alternative 3: Expand existing RSA
- Alternative 4: No build, publish declared distances

5.1 Alternative 1: Offset RW 150' West

5.1.1 Description

This alternative consists of offsetting the runway 150 feet west of the current location. The new west runway edge will be at the current west edge of the RSA so the RSA will need to be widened 150 feet to the west to meet standards. The runway length would remain 6,400 feet, exceeding the required runway length for the critical aircraft. The safety area to the south would meet standards by the implementation of declared distances. The RW 19 Landing Distance Available (LDA) and Accelerate-Stop Distance Available (ASDA) would be decreased to 6,000 feet.

The alternative figure below shows the proposed runway relocation and RSA in relation to the existing airport. See Appendix A: Alternative Figures for more detail, including runway profiles and surrounding impacts.

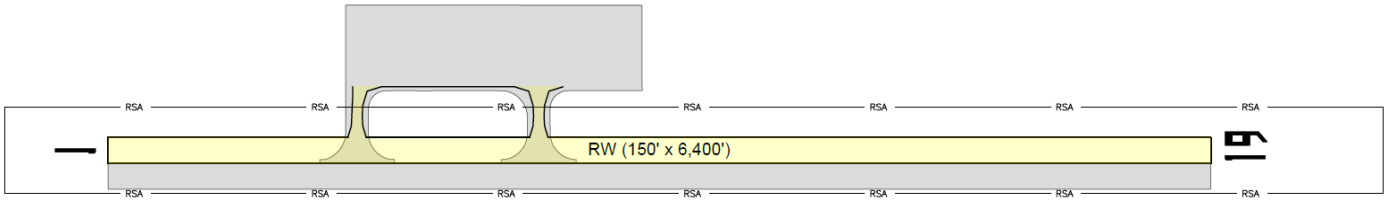


Figure 14: Alternative 1

5.1.2 Airport Impacts

Moving the runway would be a full reconstruction with complete runway demolition, a new structural section composed of subbase, stabilized base course, and asphalt pavement. Additional fill would be added during reconstruction to reduce the line-of-sight deficiency. The runway offset would shorten TW A and TW B to 400 feet. The taxiways would be reconstructed back to the apron to accommodate the runway shift. The taxiways would be updated to current FAA fillet geometry standards and their width would be reduced to 50 feet in accordance with TDG 3 standards.

Offsetting the runway would allow the existing RSA to be widened to the 500-foot standard by constructing an additional 150 feet of embankment to the west. RSA embankment expansion would not be required to the east. This would minimize disruption of existing infrastructure east of the runway.

This alternative proposes a 6,400-foot-long runway to match existing length. FAA will only participate in reconstructing a 6,000' runway due to the change in critical aircraft. As the airport sponsor, DOT&PF would be responsible for the costs of constructing a runway length exceeding an FAA approved runway length determination.

Implementing declared distances would provide the required 1,000-foot safety area beyond the RW 19 departure end with the existing 600-foot RSA embankment and 400 feet of remaining runway pavement beyond the RW 19 LDA and ASDA. This would allow the RSA to meet length standards without needing to relocate Kanakanak Road.

The runway does not currently have paved shoulders, but they are recommended for ADG III aircraft and would be added at a width of 25 feet.[13] No displaced thresholds, clearways, or stop ways are proposed. 200 x 200-foot blast pads would be reconstructed beyond the runway thresholds within the RSA length. Shoulders and blast pads would be constructed at a reduced pavement section, as they are not intended to be structural pavement. Runway pavement markings would be applied to the shifted runway, similar to existing dimensions.

Runway edge and threshold lighting, as well as connecting taxiway lighting would be replaced. The ODALs, PAPI/VASI, and localizer would be replaced in-line with the offset runway. FAA may elect to replace the ODALS with MALSR and not replace the PAPI/VASI, in accordance with current NAVAID standard installations. FAA electrical equipment enclosures, the primary wind cone and segmented circle, SAWS antenna, supplemental wind cone, and AWOS would be relocated, because they are within the shifted runway OFA. The two culverts crossing under the runway and RSA would be extended. The TW A and B cross culverts would be removed and relocated to near the toe of the proposed runway embankment.

5.1.3 Roadway and Utility Impacts

Wood River Road would be realigned to outside the OFA. The overhead electric line along this portion of the road has already been relocated in advance of the road realignment. Buried telephone and fiber optic (FO) lines remain along the existing Wood River Road curve and would be relocated. The utilities are owned by Nushagak Electric and Telephone Cooperative. The FO line runs from their downtown Dillingham office to a hut on Waskey Road. FO will not allow for additional splices to be added. The FO relocation would need to tie into existing nodes outside airport property. There is fish processor at the end of Wood River Road operating during the summer months with substantial loads and will require coordination if utility services are interrupted.

Several underground utilities cross underneath the runway embankment near the midpoint, including telephone, FO, electric, and sanitary sewer lines. Airport base maps indicate there is an electrical vault and sanitary sewer manhole within the existing west RSA, but their existence has not been field verified. These surface structures would need to be relocated, because they conflict with the proposed runway location.

5.1.4 Cemetery Impacts

The Evergreen Cemetery is located within airport fee property and an easement. The cemetery is an OFA penetration. Based on USGS LIDAR data, the cemetery and fence would remain an OFA penetration with the 150-foot west runway shift, but to a lesser extent than in the existing configuration.

The study recommends the cemetery be closed to new burials. Previous mitigation measures surrounding the cemetery included fencing and tree clearing. Continued tree clearing is recommended to reduce OFA penetrations. MOS would need to be applied for the cemetery remaining an OFA penetration as required under FAA Order 5300.1G.

5.1.5 ROW, Obstruction, and LOS Impacts

Right-of-way acquisition for this alternative would impact four Native Allotment parcels. Acquisition is required to fully contain the RPZs and OFA within airport property. Full acquisition of allotment parcels is assumed.

Airport property does not encompass the entirety of the existing north RPZ. The RPZ footprint would shift with the runway. Property acquisition is required to fully contain the north RPZ. Approximately 7.25 acres of the RPZ would

[13] FAA AC 150.5300-13A Airport Design, Section 304c & Table 3-5

be outside airport property and within Parcel IDs 2-171-140 and 2-171-060. A review of the record's office records revealed both parcels are likely in restricted allotment status. The total acreage of these two Parcels is 35 acres.

With the runway shift, the OFA extends 35 feet outside airport property on the west side, south of the apron. Two allotment parcels (Parcel IDs 2-191-700 and 2-191-650) would be acquired. For full parcel take, approximately 12 acres would be acquired to contain the shifted OFA. The airport perimeter fence should be relocated to encompass the OFA and newly acquired property. Property acquisition would allow for a full parallel taxiway to mitigate the LOS deficiency.

Trees penetrate the existing RW 19 Part 77 approach surface by 23 feet. With the runway shift under this alternative, these penetrations would remain at 23 feet. There are existing terrain penetrations along most of the existing runway OFA. This alternative would level the proposed OFA based on the shifted runway location and elevation.

OFA and airspace obstructions would be reduced by raising the RW 19 threshold elevation associated with the LOS improvements. The LOS correction with parallel taxiway option introduced in Section 4.5 would reduce RW 19 Part 77 approach surface tree penetrations to 19 feet. The RW 19 raise associated with the LOS correction without a parallel taxiway added would further reduce these penetrations to 7 feet.

Following the RPZ parcel acquisition, runway airspace obstructions could be cleared. Tree cleaning (and minor terrain leveling) would occur to clear obstructions to RW 19 Part 77 approach and transitional surfaces and the departure surface within the expanded airport property. Based on available data, additional obstructions would remain outside the acquired parcel limits. It is not considered feasible to acquire property and clear all obstructions within the runway approach and departure surfaces.

Identified obstructions are shown on the alternative figures in Appendix A, identified by obstruction type (trees vs terrain) and which surface they penetrate.

5.1.6 Environmental Impacts and Geology

The primary environmental impact for RSA expansion is placement of fill into wetlands. There are existing wetlands west of the runway (Figure 4). Fill for expanding the RSA into this area would impact wetlands. Approximately 14 acres of wetland impacts are estimated for the safety area embankment expansion.

RSA expansion into the northwest wetland areas would require stabilization techniques to combat settlement, such as over-excavation, allowing for embankment consolidation, and the placement of geotextiles, among other methods.

5.1.7 Costs

The cost for this alternative broken out by element is shown in the table below. Estimate justification is contained within Appendix B.

Table 5: Alternative 1 Cost Estimate

Phase	Phase Estimate
Design	$4,800,571
ROW	$5,804,000
Obstruction Removal & Clearing	$950,000
Utilities	$1,525,000
RW & RSA Construction	$36,523,077
Airport Lighting	$1,421,940
Approach Lights & Navaids	$1,278,690
Road Realignment	$503,000
Total Estimate:	**$52,806,278**

5.2 Alternative 2: Offset RW 150' West, Shift RW 1 Threshold 400' North

5.2.1 Description

Like Alternative 1, this alternative achieves RSA width through offsetting the runway and expanding the RSA embankment width 150 to the west. In addition, the RW 1 threshold would be shifted 400 feet north along this new runway centerline, resulting in a runway length of 6,000 feet.

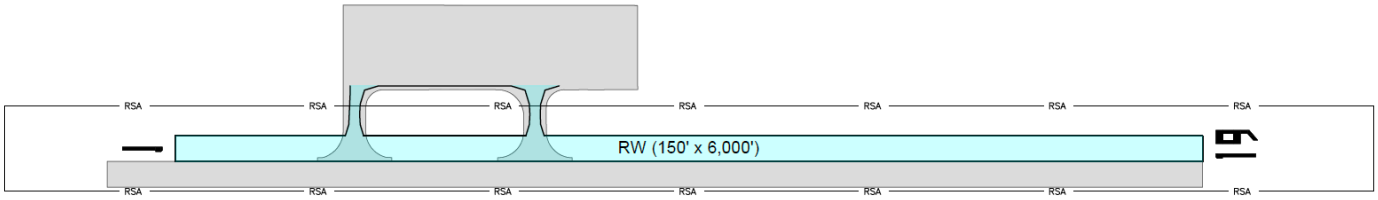


Figure 15: Alternative 2

5.2.2 Airport Impacts

This alternative has similar impacts to Alternative 1 but achieves the required RSA length by a shortening the runway through a northern RW 1 threshold shift and without implementing declared distances. Offsetting the runway and shifting the RW 1 threshold would provide the 500-foot RSA width and 1,000-foot RSA length beyond the threshold.

Complete runway and taxiway demolition and reconstruction would be required with new airport lighting, markings, approach lighting, visual aid and NAVAID (ODALs, PAPI/VASI, wind cones and segmented circle, SAWS antenna, AWOS) relocation. TW A and B length would be decreased to 400 feet long and 50 feet wide with fillet geometry. Paved runway shoulders and blast pads at both ends would be provided. Extension of the runway cross culverts would be required.

5.2.3 Roadway and Utility Impacts

Impacts to Kanakanak Road are avoided through the northern RW 1 threshold shift. Wood River Road would be relocated to outside the ROFA. Telephone and FO lines along Wood River Road would also be relocated. Utility surface structures for lines crossing under the airport that conflict with the proposed runway location would be relocated.

5.2.4 Cemetery Impacts

No RSA embankment construction is proposed towards the Evergreen Cemetery. The proposed runway offset moves the OFA away from the cemetery, but it would remain an OFA penetration. Like Alternative 1, the cemetery is recommended to be closed to new burials and an MOS obtained for the remaining OFA violation.

5.2.5 ROW, Obstruction, and LOS Impacts

This alternative would require the same ROW acquisition as Alternative 1. Airport property would need to be obtained for the RW 19 RPZ and west runway OFA. The acquisition of four Native Allotment parcels is required. Total ROW acquisition is estimated at 47 acres. Property acquisition would allow for a full parallel taxiway to mitigate the LOS deficiency.

RW 19 airspace obstructions are the same under this alternative as Alternative 1. Tree obstructions within the proposed RPZ would be cleared once property is acquired. Terrain leveling would be required within the OFA to eliminate penetrations.

5.2.6 Environmental Impacts and Geology

This alternative would also fill 14 acres into the northwest wetland areas for RSA expansion. RSA expansion into the peat area would require stabilization techniques to combat settlement.

5.2.7 Cost

The cost for this alternative broken out by element is shown in the table below. Estimate justification is contained within Appendix B.

Table 6: Alternative 2 Cost Estimate

Phase	Phase Estimate
Design	$4,743,813
ROW	$5,804,000
Obstruction Removal & Clearing	$1,116,000
Utilities	$1,525,000
RW & RSA Construction	$35,789,501
Airport Lighting	$1,421,940
Approach Lights & Navaids	$1,278,690
Road Realignment	$503,000
Total Estimate:	**$52,181,944**

5.3 Alternative 3: Expand Existing RSA

5.3.1 Description

This alternative consists of expanding the RSA embankment around the existing runway.

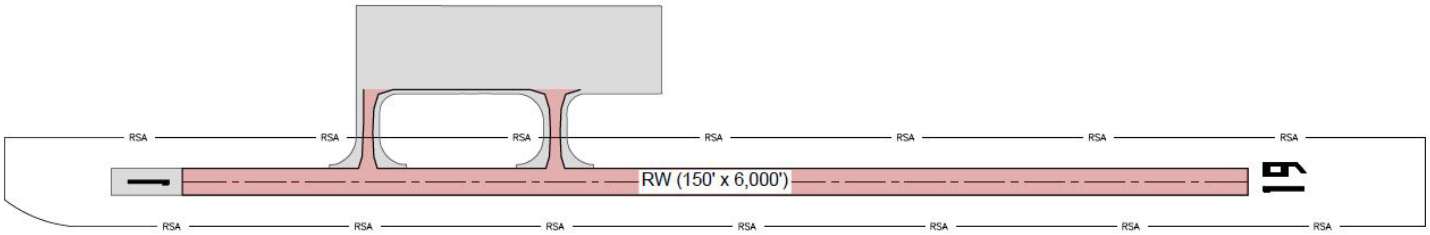


Figure 16: Alternative 3

5.3.2 Airport Impacts

The RW 1 threshold would be shifted 400 feet to reduce the runway length to 6,000 feet and achieve 1,000-foot RSA length to the south. The east RSA width would be expanded to obtain a total RSA width of 500 feet, centered around the current runway.

The runway would be shortened by removing and re-marking pavement. Existing pavement may remain south of the relocated RW 1 threshold for use as the blast pad. There is not an immediate need to reconstruct the runway if it is not relocated. The taxiways may also remain unaltered. Without a runway reconstruction, there is no opportunity to adjust the runway profile elevations to improve LOS. The airport lighting system is failing and should be replaced. Most visual aids and NAVAIDs can remain in place. The SAWS antenna, wind cones and segmented circle would be relocated to outside the runway OFA. The RW 1 PAPI would be relocated with the shifted threshold. Runway cross culverts would be extended under the new RSA embankment to the east.

5.3.3 Roadway and Utility Impacts

The proposed RSA would be chamfered at the south end to avoid impacts to Kanakanak Road. The RW 19 threshold shift and the chamfered RSA widening would make incremental improvements to RSA but would require an MOS for the RSA slightly below standards. Unlike Alternatives 1 and 2, the runway would not be offset from Wood River Road. The road would penetrate the runway OFA, to a greater extent than the other alternatives. Wood River Road and associated utilities would be relocated to outside the OFA.

5.3.4 Cemetery Impacts

Expansion of the RSA embankment fill to the east would cover a portion of the cemetery. A portion of the burial sites would have to be exhumed and relocated under this alternative. This is likely not feasible.

5.3.5 ROW, Obstruction, and LOS Impacts

Right-of-way acquisition for this alternative will impact approximately five parcels, including two private parcels and three Native Allotments. The entirety of the RW 19 RPZ is not within airport property at the current runway alignment. Acquisition for the RW 19 RPZ would impact one additional allotment (Parcel ID 2-171-400) beyond Alternatives 1 and 2. Acquisition of two private parcels (Parcel IDs 2-191-381 & 2-191-382), situated to the east of the runway, would be required to fully contain the OFA around the existing runway. The OFA property acquisition west of the runway under Alternatives 1 and 2 is not needed under this alternative. 36 acres of property acquisition

would be required. Property acquisition under alternative would not allow for a full parallel taxiway. LOS mitigation options would be extremely limited.

The current runway location has airspace (RW 19 Part 77 and departure surface tree penetrations up to 30 feet) and OFA penetrations. These would be cleared within the property to be acquired.

5.3.6 Environmental Impacts and Geology

This alternative would expand the RSA to east rather than the west. There are wetlands to the east of the current runway embankment as shown in Figure 4. This alternative would place fill into five acres into wetlands.

The existing ground conditions are generally more stable and less susceptible to settlement east of the current runway. The runway would not be relocated so as to make the best use of recently constructed RSA embankment like it would under the previous alternatives.

5.3.7 Cost

The cost for this alternative broken out by element is shown in the table below. Estimate justification is contained within Appendix B.

Table 7: Alternative 3 Cost Estimate

Phase	Phase Estimate
Design	$2,610,677
ROW	$4,560,000
Obstruction Removal & Clearing	$938,000
Utilities	$1,366,000
RW & RSA Construction	$17,030,250
Airport Lighting	$1,395,300
Approach Lights & Navaids	$314,220
Road Realignment	$503,000
Total Estimate:	**$28,717,447**

5.4 Alternative 4: No Build, Publish Declared Distances

5.4.1 Description

This alternative would provide no constructed improvements to the existing conditions of the airport. The RSA embankment width would remain below FAA AC 150/5300-13A *Airport Design* standards at 350 feet and not centered around the runway. Declared distances may be published to improve the south RSA length beyond the RW 19 departure end to meet standards.

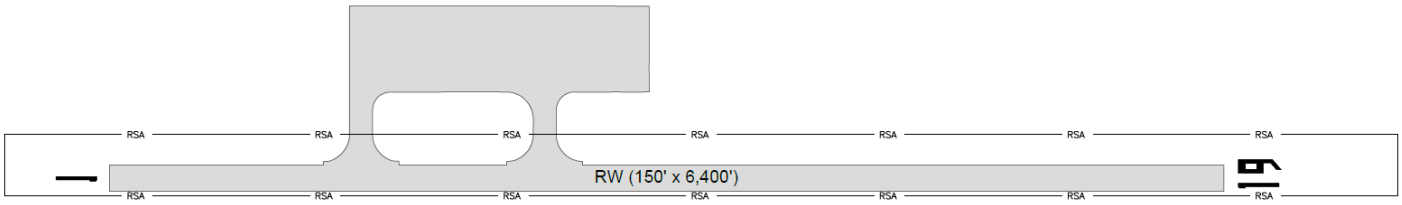


Figure 17: Alternative 4

5.4.2 Impacts

The RW 19 LDA and ASDA may be reduced by 400 feet to provide 1,000 feet of safety area to the south; however, this would reduce the usable portion of RW 19. All other declared distances remain at 6,400 feet. Because the RSA is not being physically improved and the runway is not being reconstructed, the runway is not required to be shortened.

Substandard RSA width and all other existing deficiencies would remain. Evergreen Cemetery and Wood River Road would remain as OFA penetrations. Departure and Part 77 approach surface tree penetrations would remain. Airport property would not fully encompass the north RPZ or east OFA. No property would be acquired. This alternative would not allow for a full parallel taxiway. LOS mitigation options would be extremely limited.

This alternative would make incremental improvements to the RSA by implementing declared distances but would not improve the RSA width or address other deficiencies.

6.0 Alternatives Considered and Deemed Not Feasible

Other alternatives considered under this study but determined not feasible include:

6.1 EMAS

An Engineered Materials Arresting System (EMAS) can be installed to stop errant aircraft when there is insufficient safety area beyond the runway end available. Runway Safe is the sole manufacturer of EMAS products that meet the FAA requirements of AC 150-5220-22B *Engineered Materials Arresting Systems for Aircraft Overruns*.

These systems have ongoing maintenance and replacement costs and require specialized equipment to clear snow. The crushable panels must be repaired or replaced when damaged by aircraft, vehicles, or wildlife. The premanufactured EMAS panels must be shipped to Dillingham, adding costs over local materials for the other alternatives. The Dillingham barge landing facility is a tidal harbor and only for seasonal use, complicating any panel replacement needed over the winter months. The EMAS installation has strict foundation stability requirements and will require deep site preparation to mitigate the differential settlement experienced at DLG.

According to FAA Order 5200.8 *Runway Safety Area Program,* EMAS is the last alternative consideration for addressing RSA deficiencies. It should only be considered and implemented when there are no feasible alternatives. Due to availability of the other presented alternatives to address the south deficient safety area length (such as reduced runway length and declared distances), an EMAS was deemed not feasible.

6.2 Runway Rotation

While a northwestern runway rotation would shift the runway partially away from Evergreen Cemetery and other RSA and OFA constraints to the east of the runway, it would shift the RW 19 approach further into the hillside and increase obstructions. This option would violate Federal Regulation Title 14 Part 77 *Safe, Efficient Use, and Preservation of Navigable Airspace*. It would also increase the need for the acquisition of allotment properties and decrease wind coverage of the runway.

6.3 Airport Relocation

A complete airport relocation would be more cost prohibitive than any of the presented alternatives and cause the most environmental impacts. The other alternatives maintain the current apron, taxiways, embankment, access road, and facilities, which would have to be reconstructed if the airport is relocated. Dillingham is not on the road system, and there is limited buildable land available for an airport relocation. Full private parcels, including Native Allotments, would need to be acquired to construct a new airport and access road. Construction would also take many years due to soil conditions and embankment consolidation needs.

7.0 Preferred Alternative

A matrix comparing the alternatives and impacts is presented in Table 8. Alternatives 1 and 2 have a similar disposition, impacts, and costs. They differ in the proposed runway length. Based on the runway length determined from the current fleet mix, only a 6,000-foot runway is required and fundable under the FAA Airport Improvement Program. Alternative 1 only achieves the south RSA length through declared distances, which is inferior to the RW 1 threshold shift and runway shortening under Alternative 2.

Alternative 3 maintains the runway in the current location and expands the RSA to the east to meet width standards. The eastward RSA embankment expansion increases impacts and proximity to surrounding community infrastructure. The increased proximity to site constraints limits any future airport expansion. Leaving the runway in place does not provide an opportunity to correct the LOS deficiency. This alternative requires relocation of the cemetery, which would be highly contentious and is not considered feasible.

Alternative 4, the no-build alterative, does not make significant improvements to the deficient RSA. RSA length could be achieved by implementing declared distances, but the RSA width would remain significantly undersized and not symmetric around the runway.

Alternative 2 is the preferred alternative because it obtains standard RSA dimensions, is in conformance with the runway length determination, and limits impacts to surrounding infrastructure.

Table 8: Alternatives Matrix

Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Basic Description	Offset RW 150' West	Offset RW 150' West, Shift RW 1 Threshold 400' North	Expand Existing RSA	No Build
RW Length	6,400'	6,000'	6,000'	6,400'
RW & RSA Construction	RW offset 150' west, RSA widened westward to meet 500' standard width. TW A & B shortened to 400'. Declared distances shorten LDA and ASDA to 6,000'	RW offset 150' west, RSA widened westward to meet 500' standard width. TW A & B shortened to 400'. RW 1 threshold shifted 400' north to create 1,000' RSA length to the south	Build RSA around existing RW; RW 1 threshold shifted 400' north to create 1,000' RSA length to the south; Extend RSA east to meet 500' standard width	None. Declared distances shorten LDA and ASDA to 6,000'
RSA Meets Standards?	Yes	Yes	RSA chamfered to avoid impacts to Kanakanak Rd	No
Re-Align Wood River Road	Yes, due to minor OFA penetration after RW offset	Yes, due to minor OFA penetration after RW offset	Yes, relocated. Greater OFA penetration without RW offset	No, remains OFA penetration
Re-Align Kanakanak Road	No	No	RSA chamfered to avoid impacts	No
Utility Impacts	Relocate telecom & FO lines along Wood River Rd. Relocate electrical vault and SS manholes for lines crossing under the RW.	Relocate telecom & FO lines along Wood River Rd. Relocate electrical vault and SS manholes for lines crossing under the RW.	Relocate telecom & FO lines along Wood River Rd. No impacts to utilities crossing under the RW midpoint.	None
Airport Lighting	Runway edge, threshold, and connecting TW lighting replaced	Runway edge, threshold, and connecting TW lighting replaced	Existing lighting system replaced in kind due to failure, age	Lighting system should be replaced under separate project
Navaids	ODALs, PAPI/VASI, localizer, and wind cone & segmented circle replaced	ODALs, PAPI/VASI, localizer, and wind cone & segmented circle replaced	Wind cone and segmented circle relocated outside RW OFA (existing deficiency).	No impacts
Evergreen Cemetery Disposition	Remains an OFA penetration; close to new burials, clear trees	Remains an OFA penetration; close to new burials, clear trees	Within the expanded RSA, relocate	No change, remains OFA penetration
Obstruction Clearing	Part 77 and departure surface tree obstructions to the north. OFA terrain leveling.	Part 77 and departure surface tree obstructions to the north. OFA terrain leveling.	Part 77 and departure surface tree obstructions to the north. OFA terrain leveling (existing deficiencies).	Existing obstructions remain
Property Acquisition	For OFA to the southwest; north RPZ	For OFA to the southwest; north RPZ	For OFA to the east; north RPZ	None

8.0 Constructability and Schedule

The preferred RSA alternative should also consider the compatibility of correcting other deficiencies at the airport. Other than the RSA size, the other primary deficiency at DLG is the runway LOS as discussed in Section 4.5. The LOS correction scenario with the construction of a parallel taxiway is the most cost-effective and useful solution to bring the runway into LOS compliance. Combined with Alternative 2, the total cost of RSA and LOS correction would be $63.5 million.

Table 9: RSA & LOS Combined Costs

Element	Estimate
Alternative 2 (Preferred Alternative):	$52,181,944
Full Parallel TW:	$9,178,290
LOS Correction w/ TW:	$2,168,210
Total Estimate:	**$63,528,444**

It is not feasible to close the airport during construction because of essential medevac service and economic impacts from the fishing industry. Corrections to the runway LOS for the shifted runway are limited by the need to maintain safe, temporary operations on the current runway during construction. The embankment raise required to correct the runway LOS would constitute an airspace (Part 77 primary and transitional surfaces) and safety surface (OFA, Obstacle Free Zone) obstruction to the current runway. These surfaces do not allow elevations or positive slopes extending above the elevation of the in-use runway. The dimensions of these surfaces would have to be reduced temporarily during construction to the extent safe for the operating aircraft. The amount the runway can be raised concurrently with an RSA expansion and runway shift project should be vetted through the development of the project's Construction Safety and Phasing Plan. The figure below shows half-width phasing for a runway elevation raise scenario.

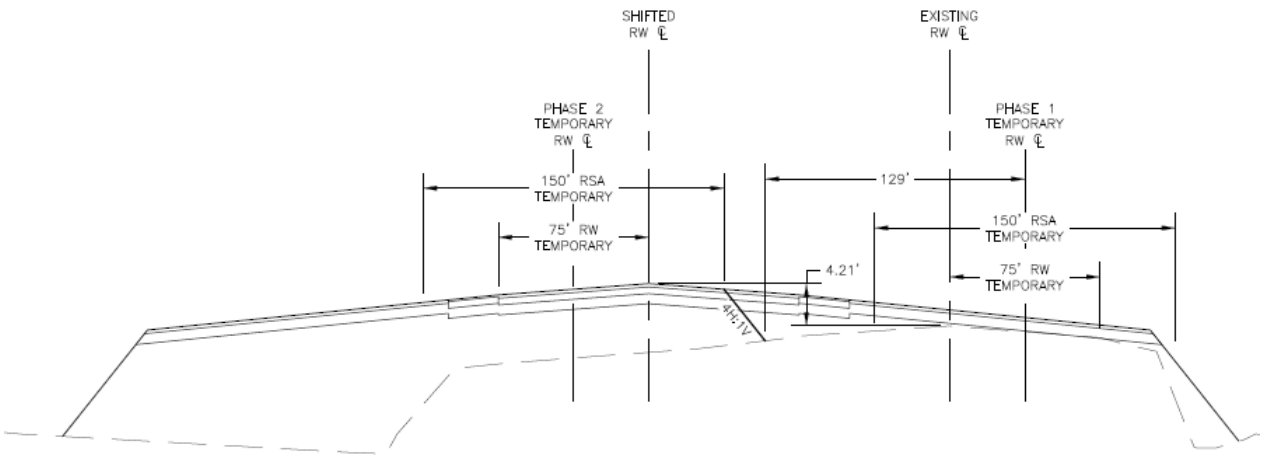


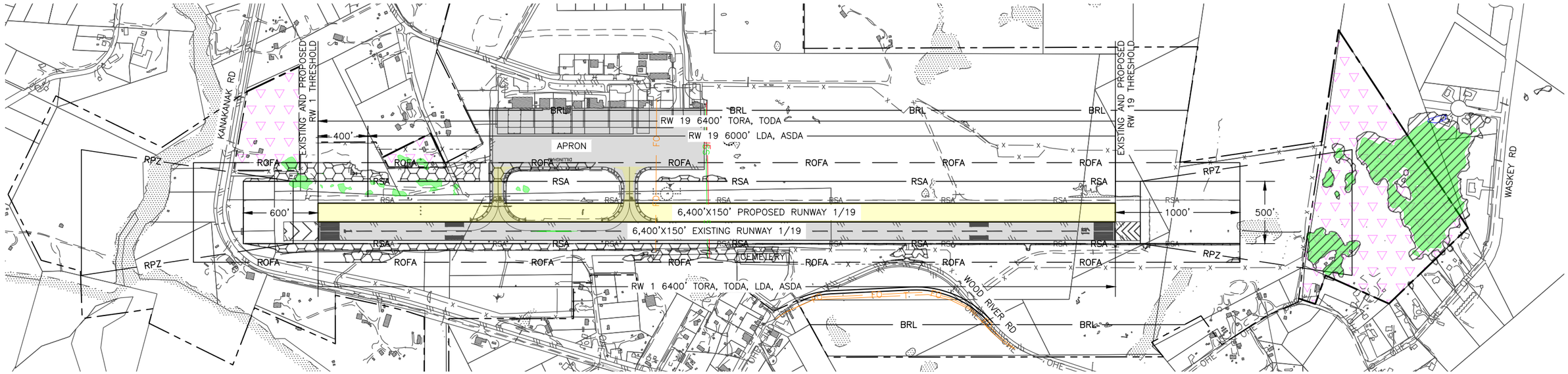
Figure 18: Half-Width Phasing for RW Raise

It is not anticipated that the LOS can be safely corrected under the same project that will improve the RSA and shift the runway. Instead, it is recommended to first construct the RSA improvements, followed by a parallel taxiway for use as a temporary runway during construction of the LOS improvements. Property acquisitions are required for the full parallel taxiway and estimated to take up to 5 years or more. The partial parallel taxiway should be constructed while property acquisitions are pursed for the south leg of the full parallel taxiway.

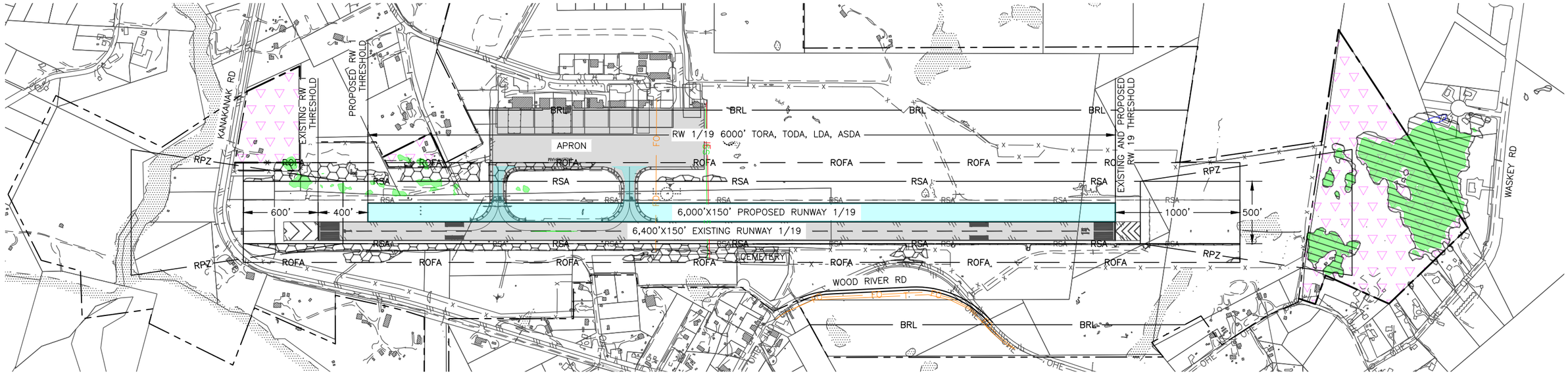
It is also recommended that the RSA improvements be constructed as a two-phase project. The RSA embankment fill should be expanded to required dimensions. Due to continued settlement concerns, further geotechnical investigations and recommendations should be performed. The newly expanded, full RSA should be allowed to consolidate prior to construction of the runway shift. The RSA improvement and runway shift also requires acquisition of allotment properties to fully contain the RPZ and shifted OFA. MOS's would be required for the project for remaining LOS and property deficiencies, with the understanding they would be corrected under the subsequent projects.

APPENDIX A

Alternative Figures



ALTERNATIVE 1 – OFFSET RW 150' WEST
NTS



ALTERNATIVE 2 – OFFSET RW 150' WEST, SHIFT RW 1 THRESHOLD 400' NORTH
NTS

LEGEND:

- PART 77 OBSTRUCTIONS
- DEPARTURE SURFACE TERRAIN OBSTRUCTION
- DEPARTURE SURFACE TREE OBSTRUCTIONS
- OFA PENETRATIONS
- PROPERTY ACQUISITION
- EXISTING AIRPORT PROPERTY
- ULTIMATE AIRPORT PROPERTY (FEE/A&H EASEMENT)

400' 200' 0 400' 800'

Designed By: MIM
Drawn By: AVA/RLC
Checked By: CJB

Date Revised: 3/15/2022, 10:31 AM
Layout Name: ALT_OVW
File Path and Name: Z:\project\2820.01 DOT_C DLG AMP Update\Civil\CAD\Alternatives\Alt. Overview\00353-DLG_Design_Alt_Overview_edit.dwg

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R&M CONSULTANTS, INC.
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CERT. OF AUTH. NO. AECC111

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STATE OF ALASKA
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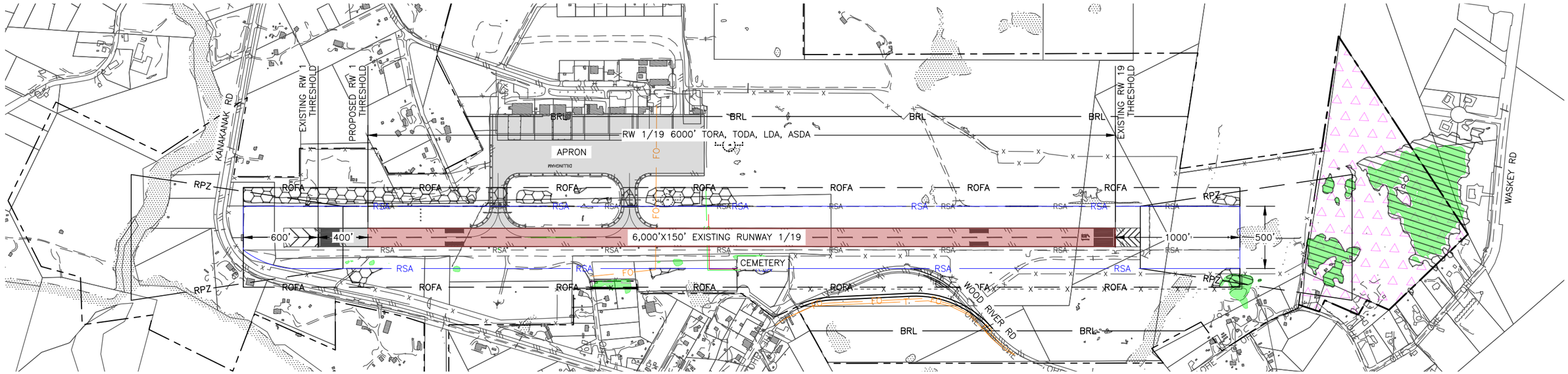
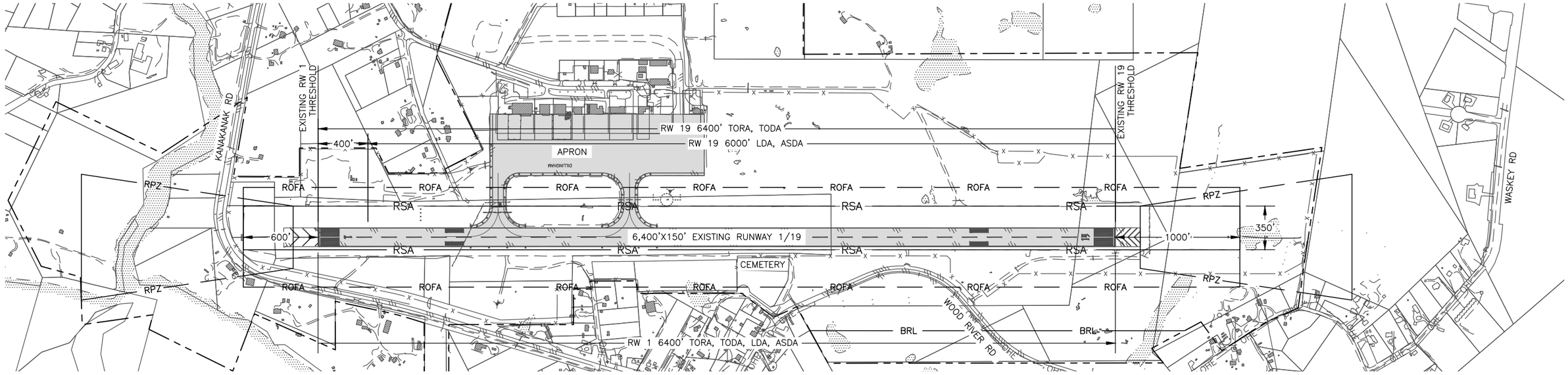
CENTRAL REGION
4111 AVIATION AVE., ANCHORAGE ALASKA 99502
PHONE (907) 269-0590

DILLINGHAM AIRPORT
DILLINGHAM, ALASKA
AIRPORT MASTER PLAN
PROJECT No. CFAPT00353
AIP No. 3-02-0078-017-2018
ALTERNATIVE OVERVIEW

DATE: 3/15/2022
SHEET: 1 OF 2



ALTERNATIVE 3 – EXPAND EXISTING RW RSA, SHIFT RW 1 THRESHOLD 400' NORTH
NTS



ALTERNATIVE 4 – NO BUILD, PUBLISH DECLARED DISTANCES
NTS

LEGEND:

- PART 77 OBSTRUCTIONS
- DEPARTURE SURFACE TREE OBSTRUCTIONS
- OFA PENETRATIONS
- PROPERTY ACQUISITION
- EXISTING AIRPORT PROPERTY
- ULTIMATE AIRPORT PROPERTY (FEE/A&H EASEMENT)

400' 200' 0 400' 800'

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R&M CONSULTANTS, INC. 9101 VANGUARD DR. ANCHORAGE, AK 99507 (907) 522-1707 CERT. OF AUTH. NO. AECC111			

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AIP No. 3-02-0078-017-2018
ALTERNATIVE OVERVIEW

DATE: 3/15/2022
SHEET: 2 OF 2

Designed By: MIM
Drawn By: AVA/RLC
Checked By: CJB
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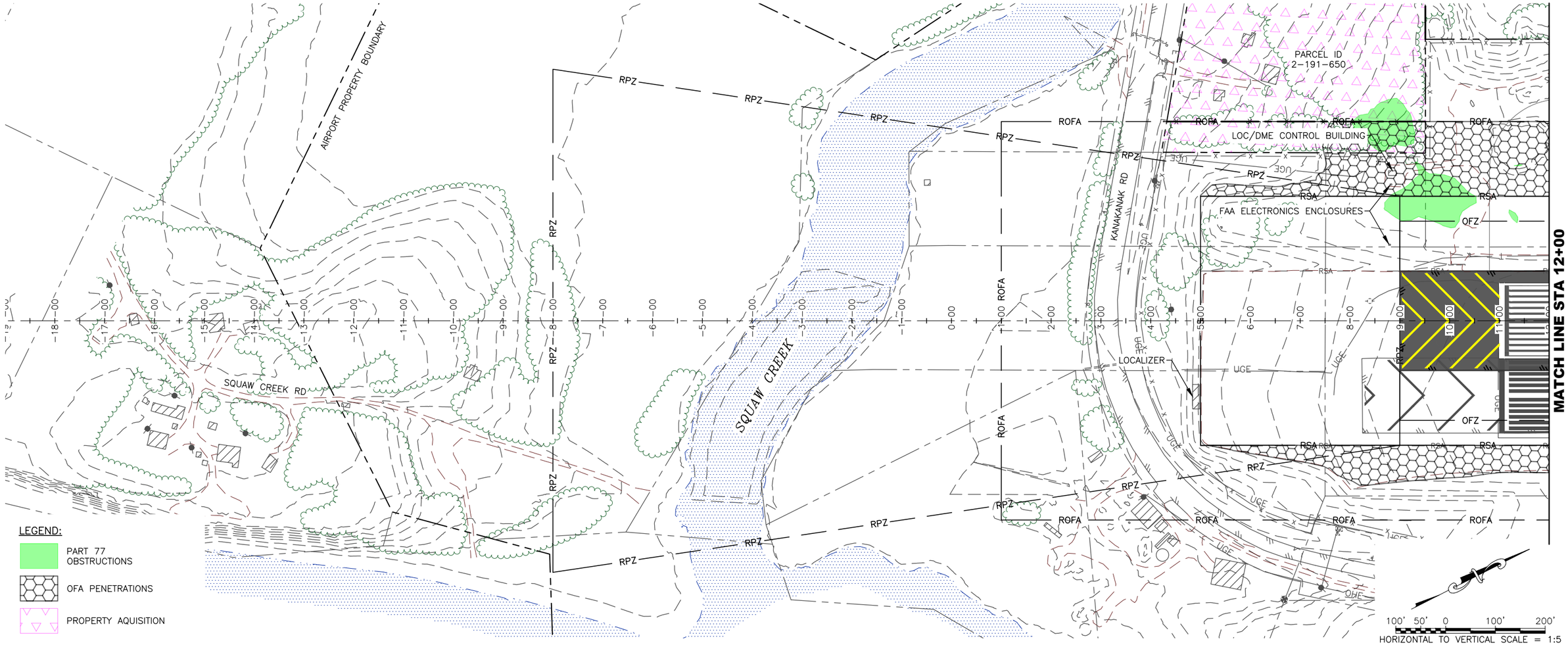
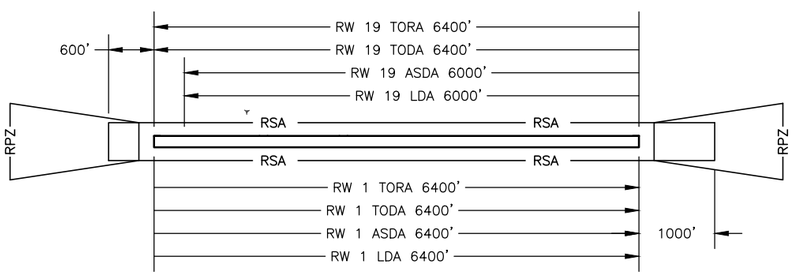


LEGEND:

- PART 77 OBSTRUCTIONS
- OFA PENETRATIONS
- PROPERTY AQUISITION



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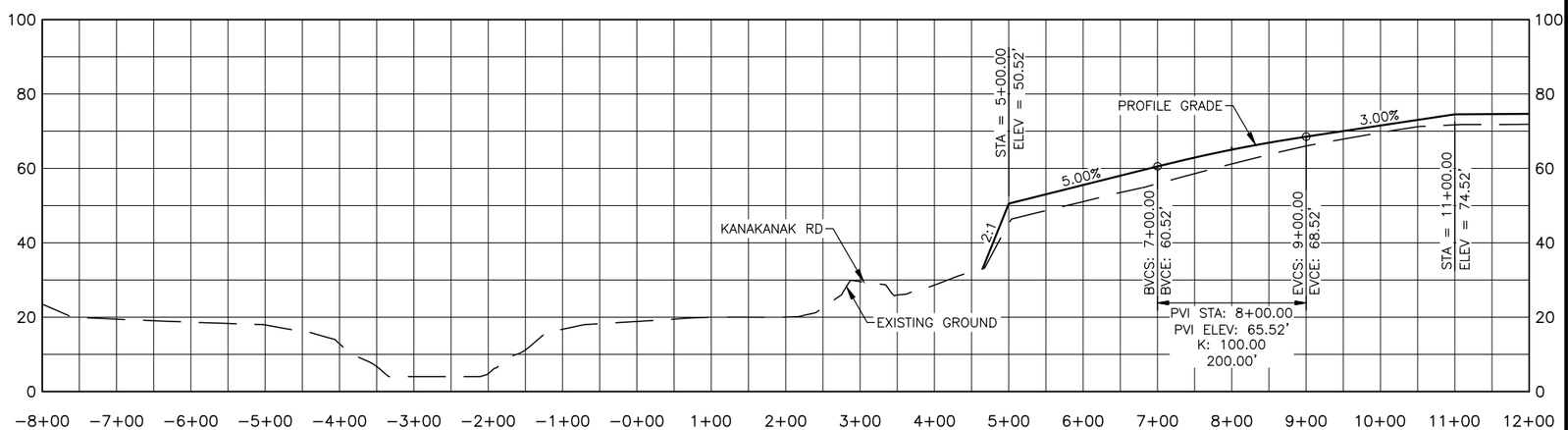

IMPACTS:

1. RUNWAY OFFSET 150' WEST OF EXISTING POSITION.
2. CONSTRUCT EMBANKMENT FOR RSA ON WEST SIDE.
3. ADJUST LOC POSITION TO ALIGN WITH OFFSET RUNWAY.
4. LOC/DME CONTROL BUILDING TO BE RELOCATED OUTSIDE OF ROFA.
5. FAA ELECTRONICS ENCLOSURES TO BE RELOCATED OUTSIDE OF ROFA.
6. PROPERTY ACQUISITION TO CONTROL ROFA.
7. ADJUST AIRPORT PERIMETER FENCING.
8. TERRAIN REMOVAL.
9. OBSTRUCTION REMOVAL.
10. REPLACE AIRPORT LIGHTING SYSTEM.

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PROJECT No. CFAPT00353
AIP No. 3-02-0078-017-2018
ALTERNATIVE No. 1
NO GRADE CORRECTION

DATE: 3/22/2022

SHEET: 1 OF 4

Designed By: MIM
Drawn By: AVA/RLC
Checked By: CJB

Date Revised: 3/22/2022, 11:05 AM
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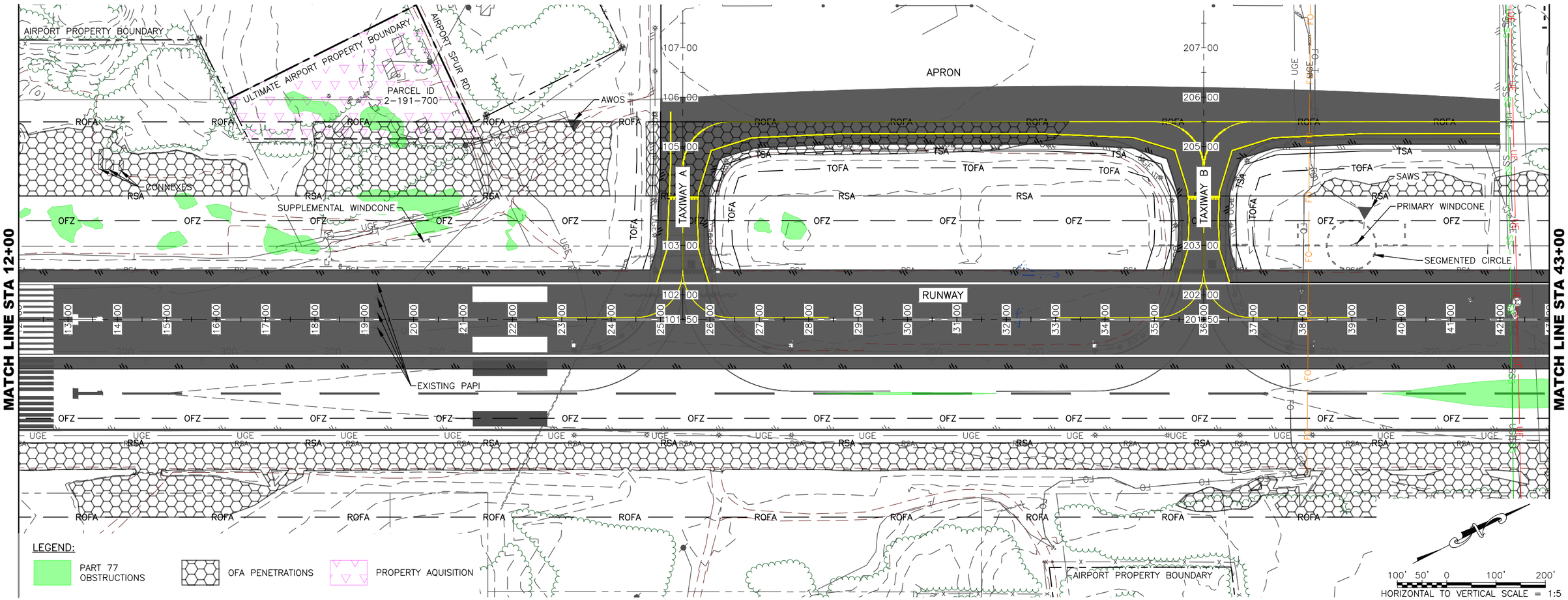

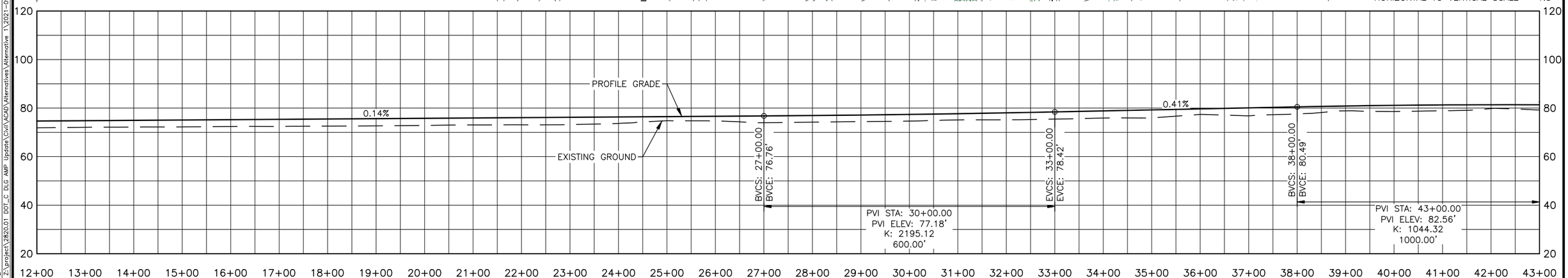

IMPACTS:

1. RUNWAY OFFSET 150' WEST OF EXISTING POSITION.
2. CONSTRUCT EMBANKMENT FOR RSA ON WEST SIDE.
3. RELOCATE AWOS, SAWS ANTENNA, PRIMARY WINDCONE, SEGMENTED CIRCLE, AND SUPPLEMENTAL WINDCONE.
4. RELOCATE AIRPORT SPUR ROAD AND BUILDINGS OUTSIDE OF ROFA.
5. PAPI RELOCATION.
6. SANITARY SEWER SYSTEM, UNDERGROUND ELECTRIC, AND FIBER OPTIC ADJUSTMENTS.
7. PROPERTY ACQUISITION TO CONTROL ROFA.
8. ADJUST AIRPORT PERIMETER FENCING.
9. TERRAIN REMOVAL.
10. OBSTRUCTION REMOVAL.
11. REPLACE AIRPORT LIGHTING SYSTEM.
12. EXTEND 42" DIA. RUNWAY CROSS CULVERT 150'.
13. REPLACE TAXIWAY A AND TAXIWAY B 42" DIA. CROSS CULVERTS.

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Designed By: MIM
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Checked By: CJB

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MATCH LINE STA 43+00

MATCH LINE STA 74+00

ROFA — RSA — OFZ — UGE

RUNWAY 19 / 01

AIRPORT RD

CEMETERY

WOOD RIVER RD

VASI

VASI

SUPPLEMENTAL WINDCONE

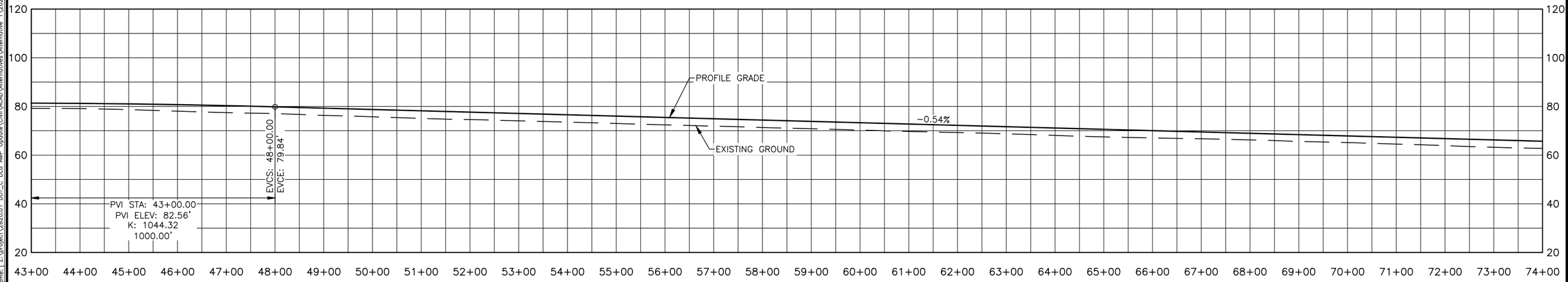
LEGEND:

PART 77 OBSTRUCTIONS

OFA PENETRATIONS

100' 50' 0 100' 200'

HORIZONTAL TO VERTICAL SCALE = 1:5



IMPACTS:

1. RUNWAY OFFSET 150' WEST OF EXISTING POSITION.
2. CONSTRUCT EMBANKMENT FOR RSA ON WEST SIDE.
3. REPLACE VASI SYSTEM WITH PAPI SYSTEM.
4. REALIGN WOOD RIVER RD AND ADJACENT FIBER OPTIC AND TELEPHONE UTILITY OUTSIDE OF ROFA.
5. ADJUST AIRPORT PERIMETER FENCING.
6. TERRAIN REMOVAL.
7. REPLACE AIRPORT LIGHTING SYSTEM.

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DATE: 3/22/2022

SHEET: 3 OF 4

Designed By: MIM
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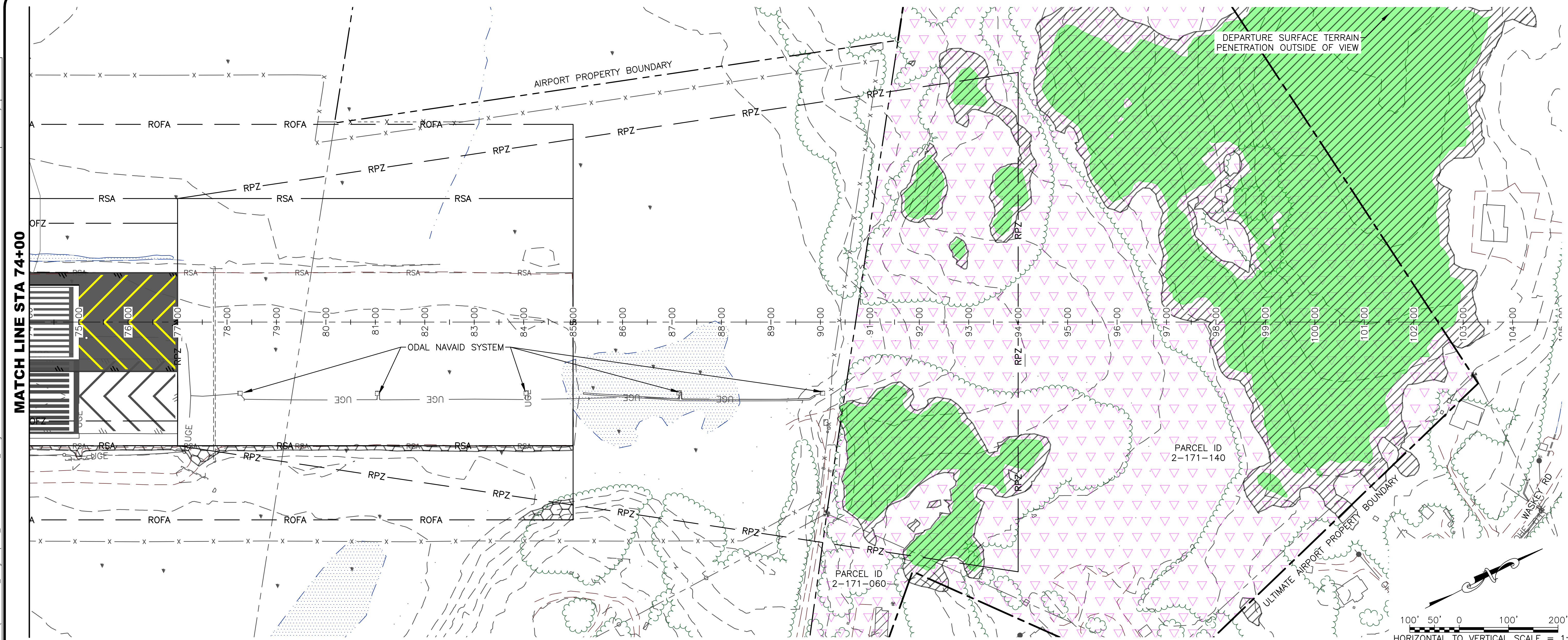

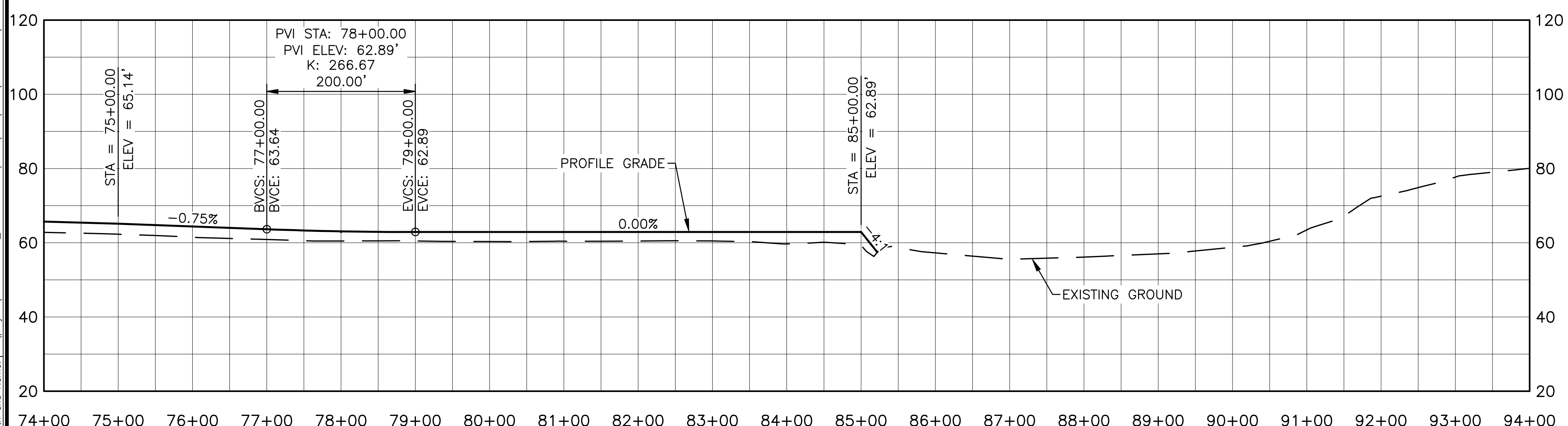

LEGEND:

- PART 77 TREE OBSTRUCTIONS
- DEPARTURE SURFACE TREE OBSTRUCTIONS
- OFA PENETRATIONS
- PROPERTY AQUISITION

IMPACTS:

1. RUNWAY OFFSET 150' WEST OF EXISTING POSITION.
2. CONSTRUCT EMBANKMENT FOR RSA ON WEST SIDE.
3. RELOCATE ODAL NAVAID SYSTEM.
4. OBSTRUCTION REMOVAL.
5. TERRAIN REMOVAL.
6. PROPERTY ACQUISITION FOR CONTROL OF RPZ.
7. ADJUST AIRPORT PERIMETER FENCING.
8. REPLACE AIRPORT LIGHTING SYSTEM.
9. EXTEND 42" DIA. RUNWAY CROSS CULVERT 150'.

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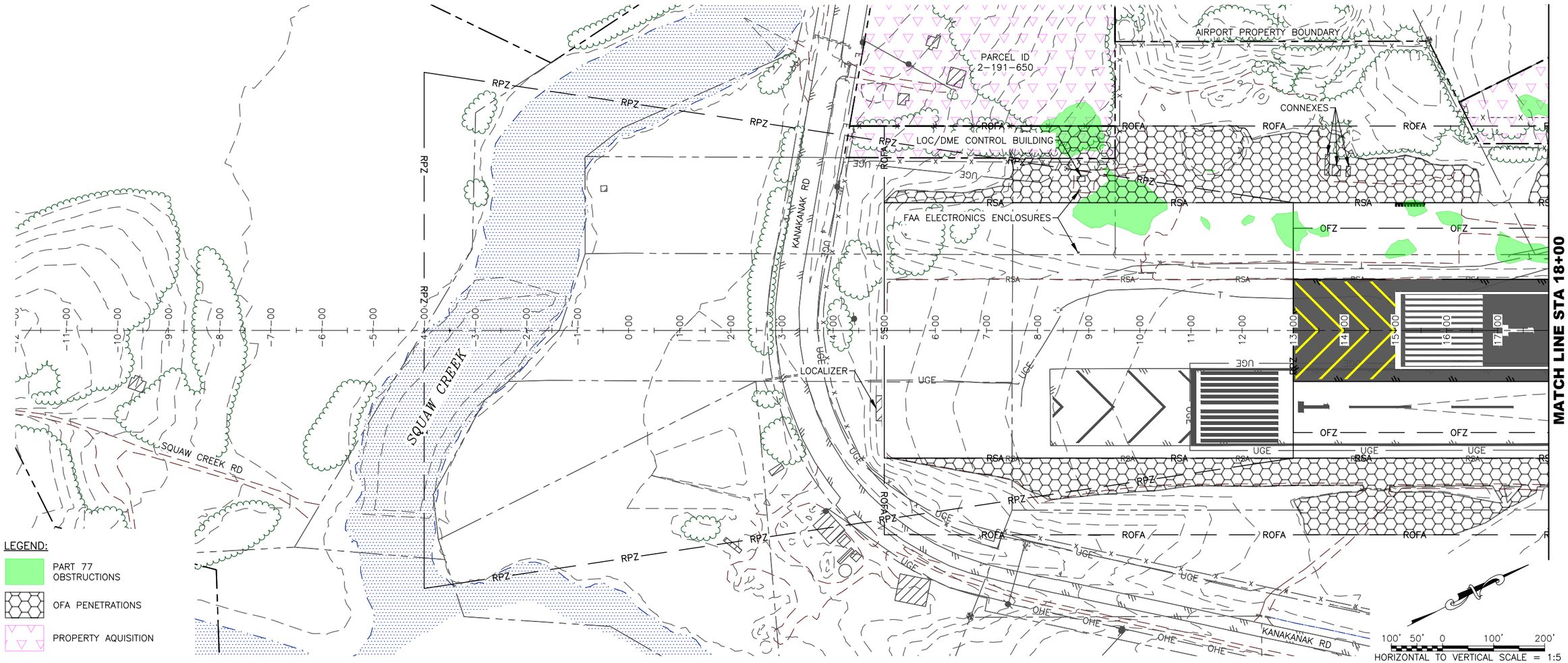
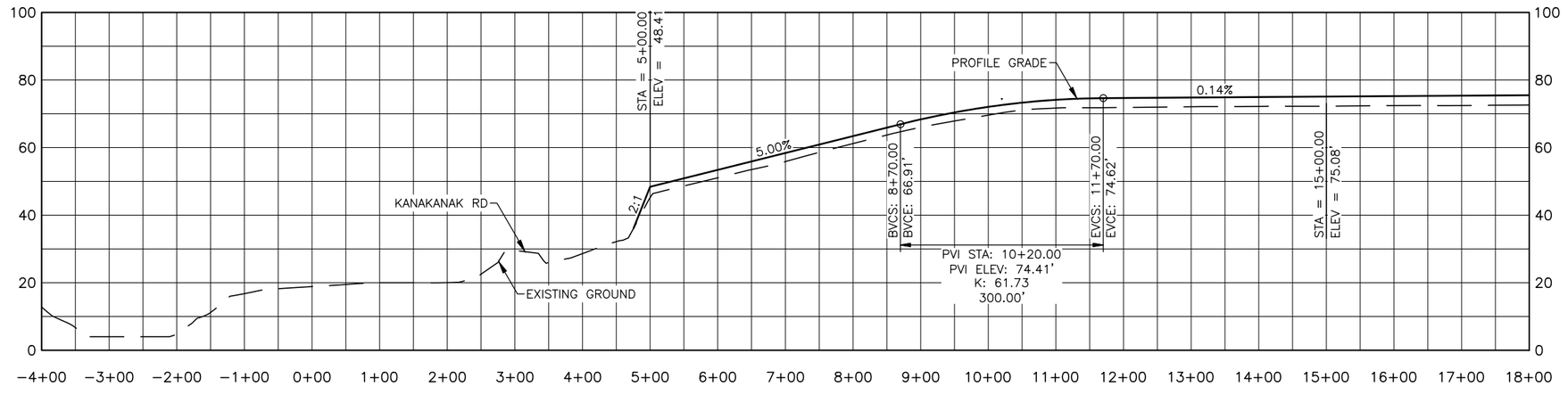


LEGEND:

- PART 77 OBSTRUCTIONS
- OFA PENETRATIONS
- PROPERTY AQUISITION

IMPACTS:

1. RUNWAY OFFSET 150' WEST OF EXISTING POSITION AND RW 1 THRESHOLD SHIFTED 400' TO THE NORTH.
2. CONSTRUCT EMBANKMENT FOR RSA ON WEST SIDE.
3. ADJUST LOC POSITION TO ALIGN WITH OFFSET RUNWAY.
4. LOC/DME CONTROL BUILDING TO BE RELOCATED OUTSIDE OF ROFA.
5. FAA ELECTRONICS ENCLOSURES TO BE RELOCATED OUTSIDE OF ROFA.
6. PROPERTY ACQUISITION TO CONTROL ROFA.
7. ADJUST AIRPORT PERIMETER FENCING.
8. TERRAIN REMOVAL.
9. OBSTRUCTION REMOVAL.
10. REPLACE AIRPORT LIGHTING SYSTEM.



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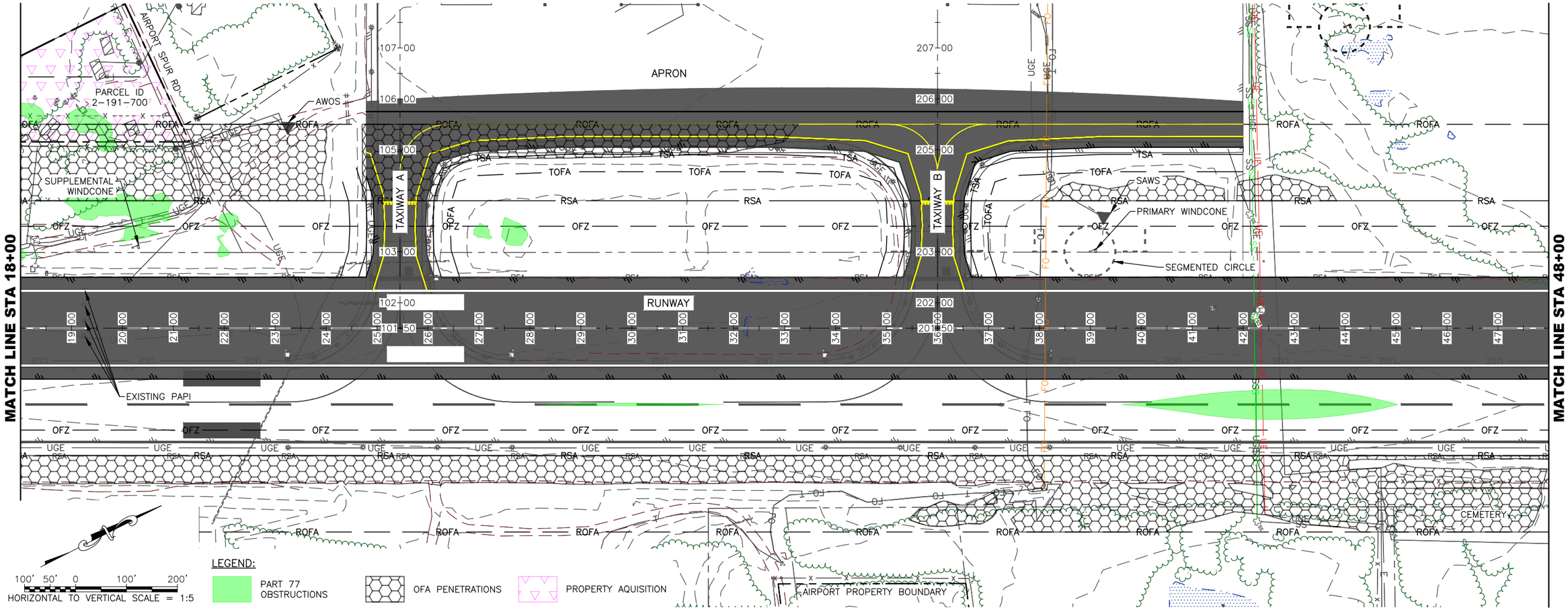
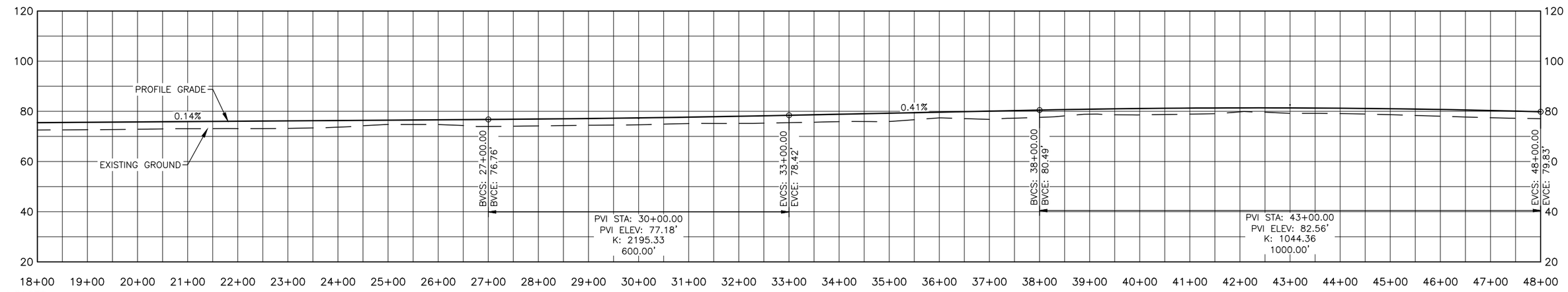
AIRPORT MASTER PLAN
PROJECT No. CFAPT00353
AIP No. 3-02-0078-017-2018
ALTERNATIVE No. 2
NO GRADE CORRECTION

DATE: 3/22/2022

SHEET: 1 OF 4





IMPACTS:

1. RUNWAY OFFSET 150' WEST OF EXISTING POSITION.
2. CONSTRUCT EMBANKMENT FOR RSA ON WEST SIDE.
3. RELOCATE AWOS, SAWS ANTENNA, PRIMARY WINDCONE, SEGMENTED CIRCLE, AND SUPPLEMENTAL WINDCONE.
4. RELOCATE AIRPORT SPUR ROAD AND BUILDINGS OUTSIDE OF ROFA.
5. PAPI RELOCATION.
6. SANITARY SEWER SYSTEM, UNDERGROUND ELECTRIC, AND FIBER OPTIC ADJUSTMENTS.
7. PROPERTY ACQUISITION TO CONTROL ROFA.
8. ADJUST AIRPORT PERIMETER FENCING.
9. TERRAIN REMOVAL.
10. OBSTRUCTION REMOVAL.
11. REPLACE AIRPORT LIGHTING SYSTEM.
12. EXTEND 42" DIA. RUNWAY CROSS CULVERT 150'.
13. REPLACE TAXIWAY A AND TAXIWAY B 42" DIA. CROSS CULVERTS.

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DATE: 3/22/2022

SHEET: 2 OF 4

Designed By: MIM
Drawn By: AVA/REC
Checked By: CAB

Date Revised: 3/22/2022, 10:56 AM
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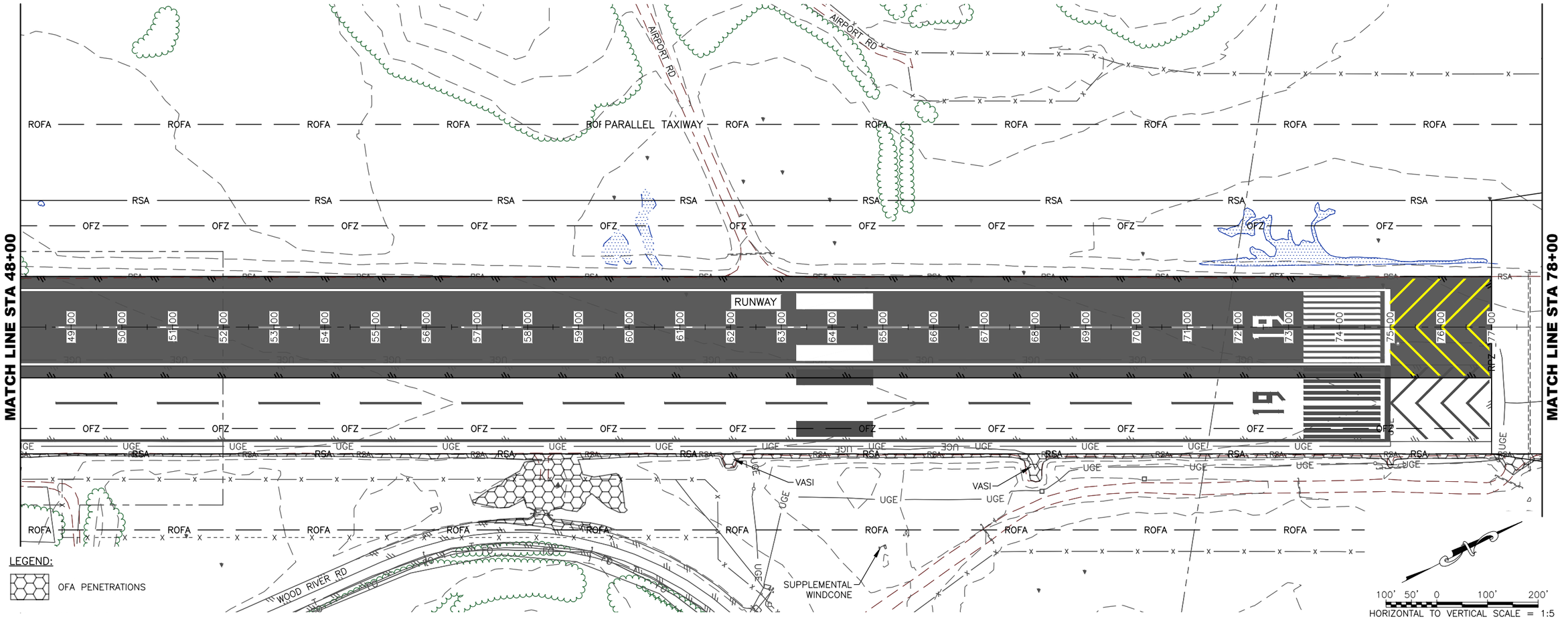

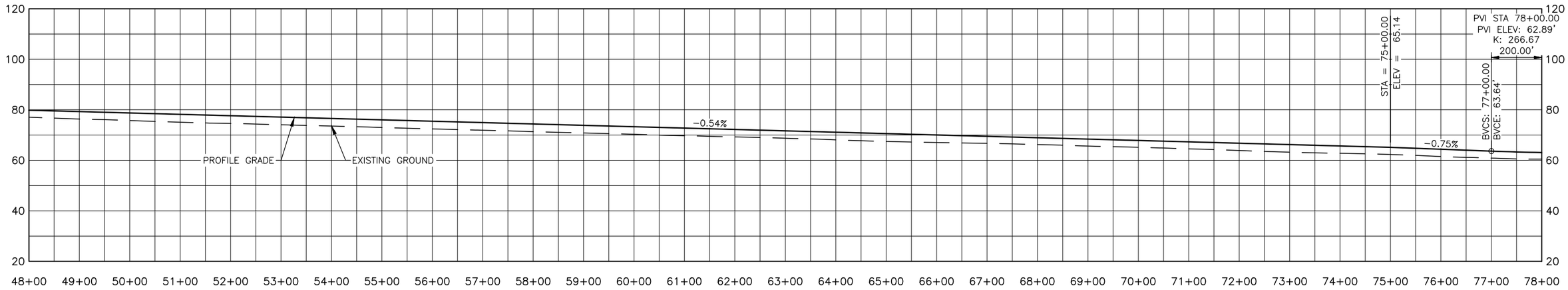

IMPACTS:

1. RUNWAY OFFSET 150' WEST OF EXISTING POSITION.
2. CONSTRUCT EMBANKMENT FOR RSA ON WEST SIDE.
3. RELOCATE VASI SYSTEM.
4. REALIGN WOOD RIVER RD AND ADJACENT FIBER OPTIC AND TELEPHONE UTILITY OUTSIDE OF ROFA.
5. ADJUST AIRPORT PERIMETER FENCING.
6. TERRAIN REMOVAL.
7. REPLACE AIRPORT LIGHTING SYSTEM.
8. EXTEND 42" DIA. RUNWAY CROSS CULVERT 150'.

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DATE: 3/22/2022

SHEET: 3 OF 4

Designed By: MIM
Drawn By: AVA/RLC
Checked By: CJB

Date Revised:
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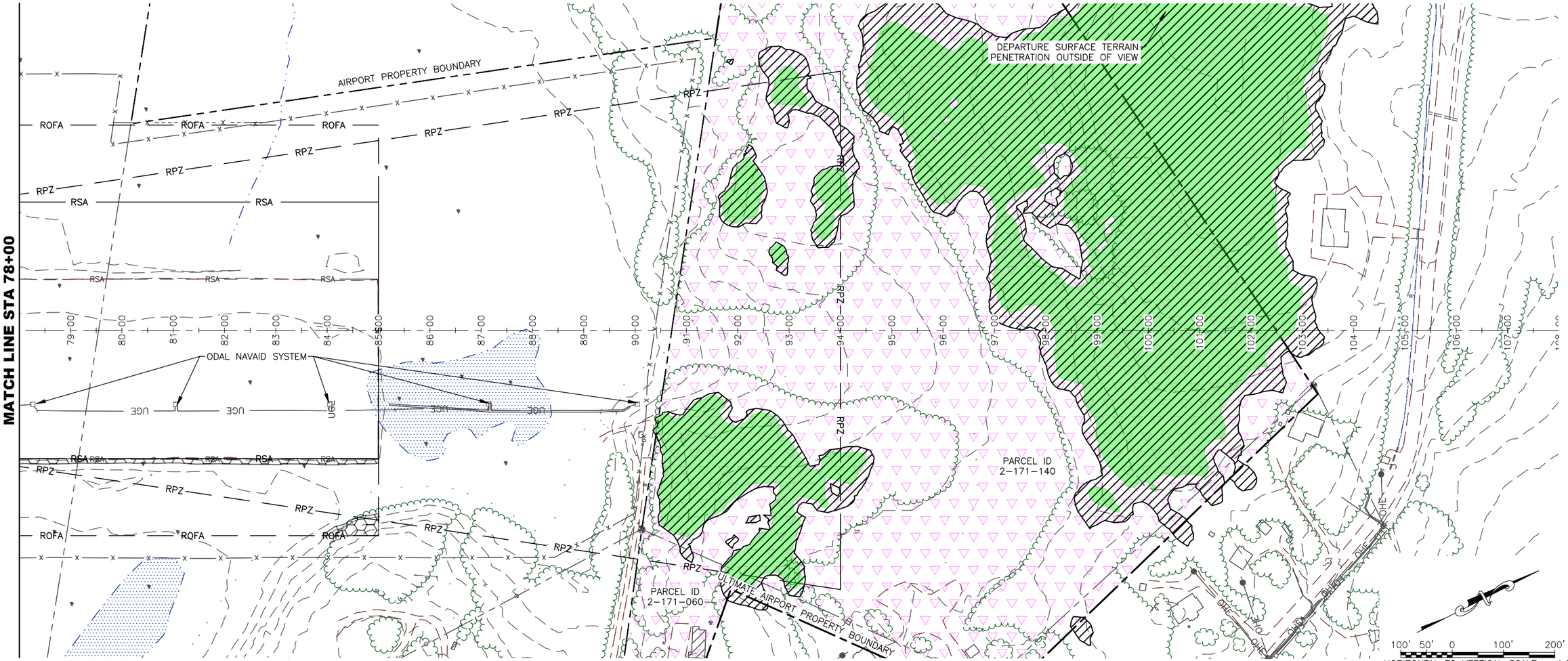

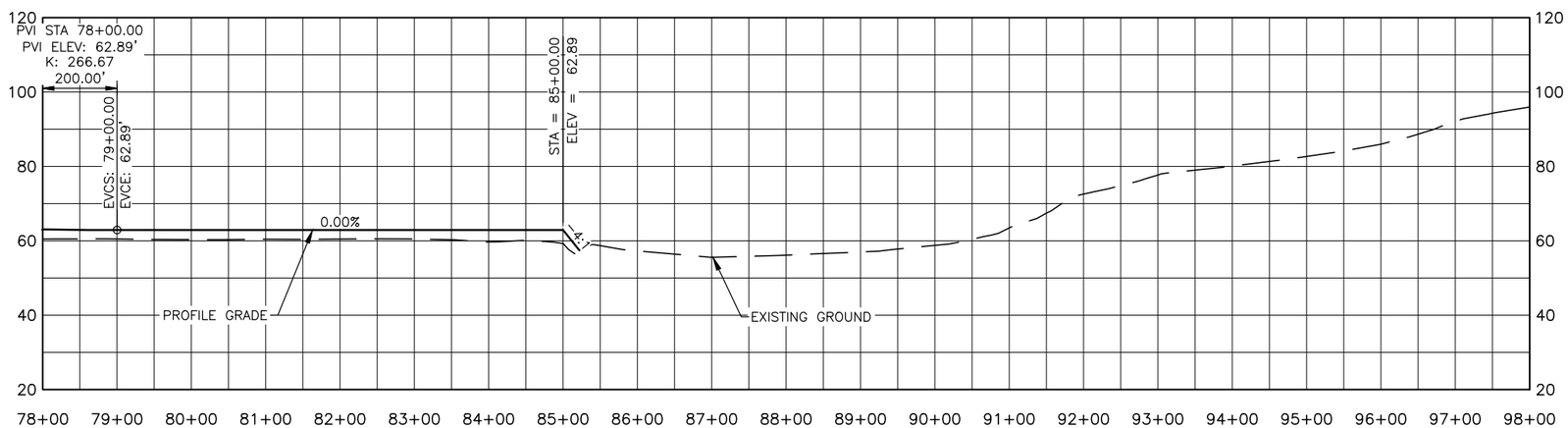

LEGEND:

- PART 77 TREE OBSTRUCTIONS
- DEPARTURE SURFACE TREE OBSTRUCTIONS
- OFA PENETRATIONS
- PROPERTY AQUISITION

IMPACTS:

1. RUNWAY OFFSET 150' WEST OF EXISTING POSITION.
2. CONSTRUCT EMBANKMENT FOR RSA ON WEST SIDE.
3. RELOCATE ODAL NAVAID SYSTEM.
4. OBSTRUCTION REMOVAL.
5. TERRAIN REMOVAL.
6. PROPERTY ACQUISITION FOR CONTROL OF RPZ.
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Drawn By: AVA/REC
Checked By: CJB

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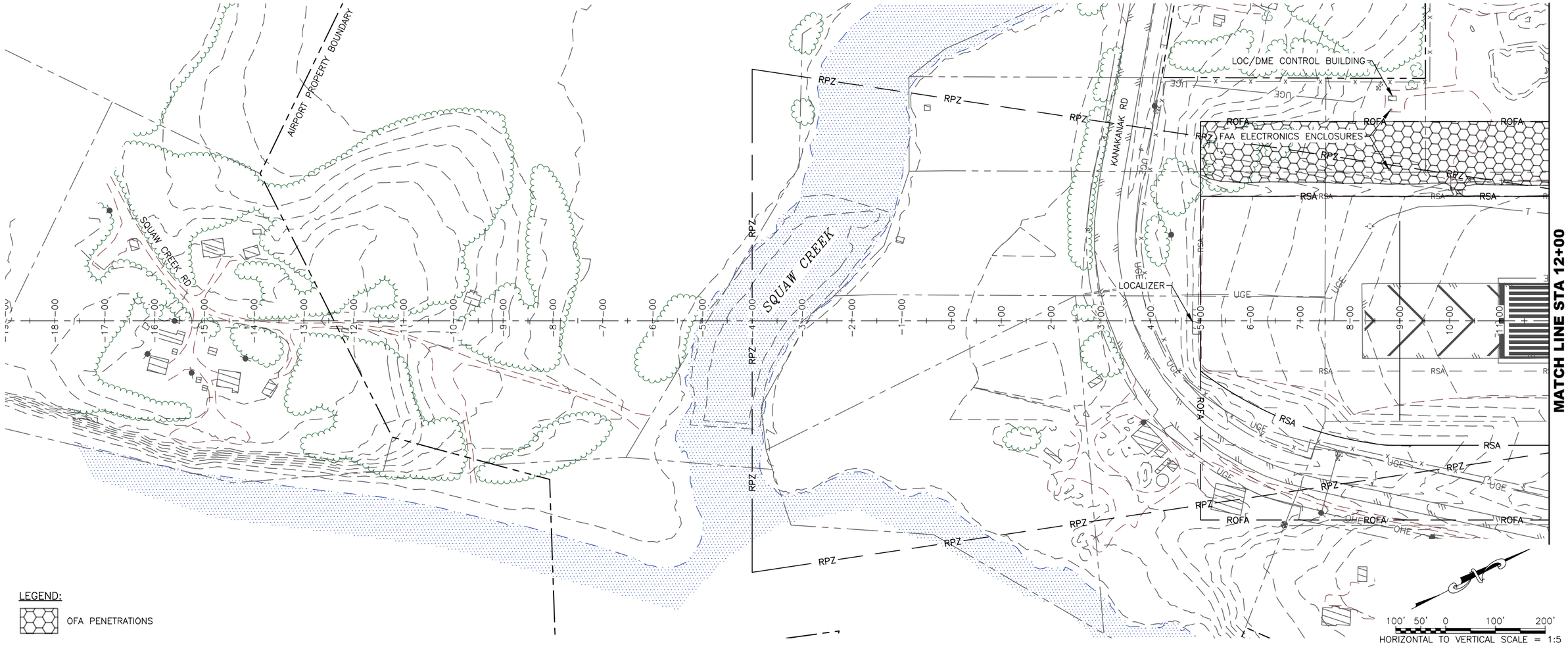
DATE: 3/22/2022

SHEET: 4 OF 4

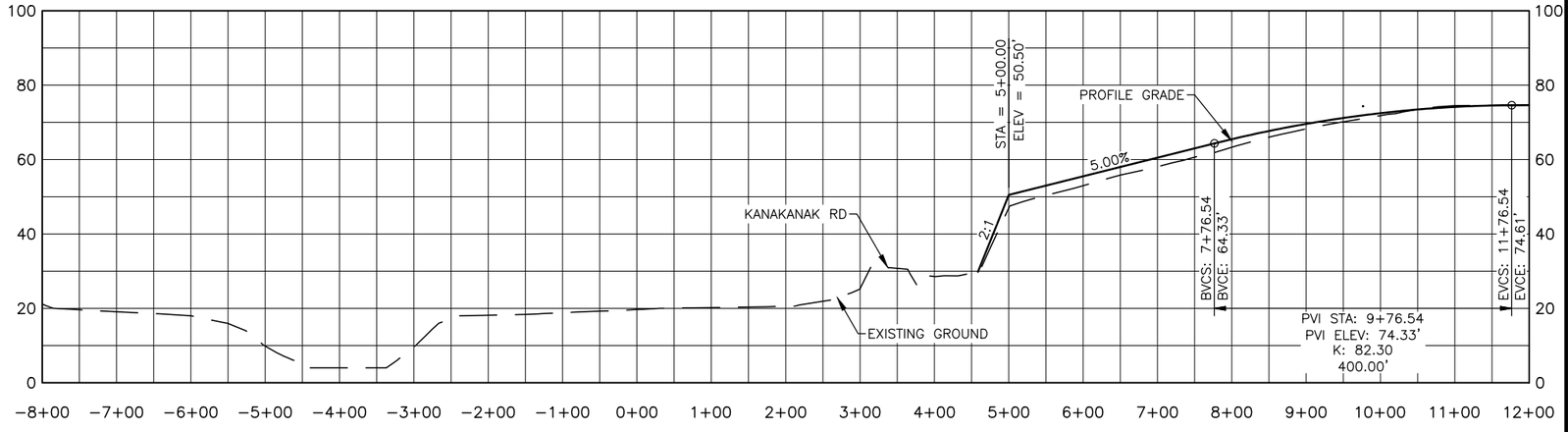


LEGEND:

OFA PENETRATIONS

IMPACTS:

1. CONSTRUCT EMBANKMENT FOR RSA ON EAST SIDE.
2. FAA ELECTRONICS ENCLOSURES TO BE RELOCATED OUTSIDE OF ROFA.
3. SHIFT RW 1 THRESHOLD 400' NORTH.
4. REPLACE AIRPORT LIGHTING SYSTEM.



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Drawn By:	AVA/RLC
Checked By:	CdB

Date Revised:	3/22/2022, 11:14 AM
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PLANS DEVELOPED BY:
R&M CONSULTANTS, INC.
9101 VANGUARD DR.
ANCHORAGE, AK 99507
(907) 522-1707
CERT. OF AUTH. NO. AECC111

BY	DATE	REVISION

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
CENTRAL REGION
4111 AVIATION AVE., ANCHORAGE ALASKA 99502
PHONE (907) 269-0590

DILLINGHAM AIRPORT
DILLINGHAM, ALASKA
AIRPORT MASTER PLAN
PROJECT No. CFAPT00353
AIP No. 3-02-0078-017-2018
ALTERNATIVE No. 3
NO GRADE CORRECTION

DATE: 3/22/2022

SHEET: 1 OF 4

MATCH LINE STA 12+00

MATCH LINE STA 43+00

APRON

RUNWAY

TAXIWAY A

TAXIWAY B

AWOS

AIRPORT SPUR RD

CONNEXES

SUPPLEMENTAL WINDCONE

EXISTING PAPI

SAWS

PRIMARY WINDCONE

SEGMENTED CIRCLE

KANAKANAK RD

PARCEL ID 2-191-381

PARCEL ID 2-191-382

AIRPORT PROPERTY BOUNDARY

ROFA

OFZ

RSA

TSA

TOFA

UGE

FO

SS

LEGEND:

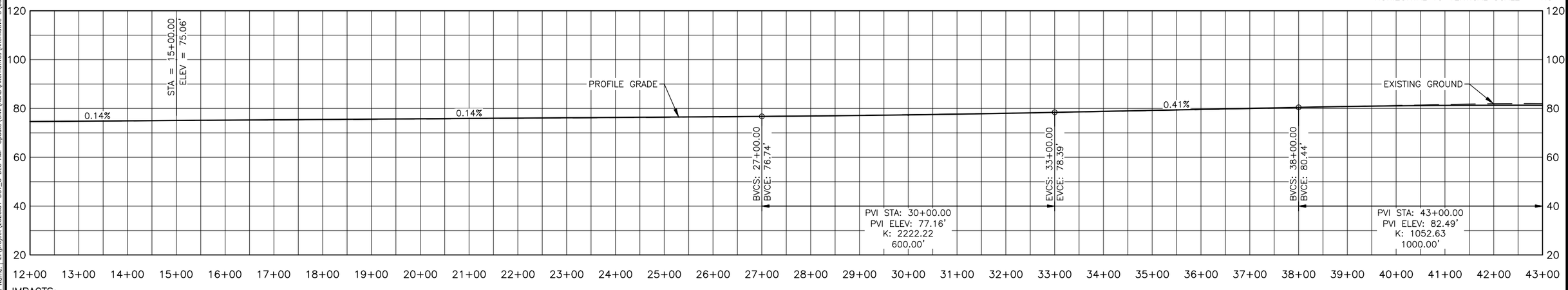
PART 77 OBSTRUCTIONS

OFA PENETRATIONS

PROPERTY AQUISITION

100' 50' 0 100' 200'

HORIZONTAL TO VERTICAL SCALE = 1:5



IMPACTS:

1. CONSTRUCT EMBANKMENT FOR RSA ON EAST SIDE.
2. FIBER OPTIC ADJUSTMENTS.
3. RELOCATE PAPIs TO ACCOMMODATE RW 1 THRESHOLD SHIFT.
4. RELOCATE SAWS ANTENNA, PRIMARY WIND CONE, SEGMENTED CIRCLE, AND SUPPLEMENTAL WIND CONE OUTSIDE OF ROFA.
5. ADJUST AIRPORT PERIMETER FENCING.
6. ACQUIRE PROPERTY FOR ROFA CONTROL.
7. PART 77 OBSTRUCTION REMOVAL.
8. REPLACE AIRPORT LIGHTING SYSTEM.
9. EXTEND 42" DIA. RUNWAY CROSS CULVERT 150'.

PLANS DEVELOPED BY:
R&M CONSULTANTS, INC.
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DILLINGHAM AIRPORT
DILLINGHAM, ALASKA
AIRPORT MASTER PLAN
PROJECT No. CFAPT00353
AIP No. 3-02-0078-017-2018
ALTERNATIVE No. 3
NO GRADE CORRECTION

DATE: 3/22/2022

SHEET: 2 OF 4

Designed By: MIM
Drawn By: AVA/RLC
Checked By: CJB

Date Revised: 3/22/2022, 11:14 AM
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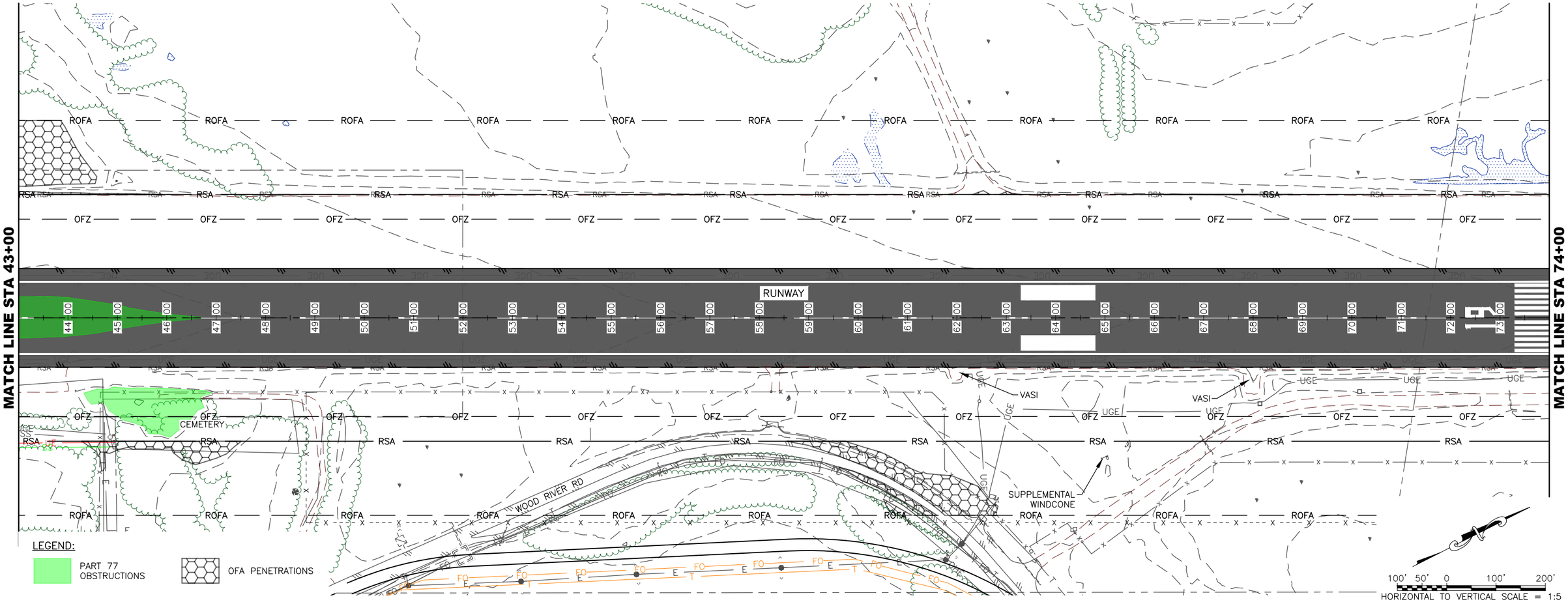

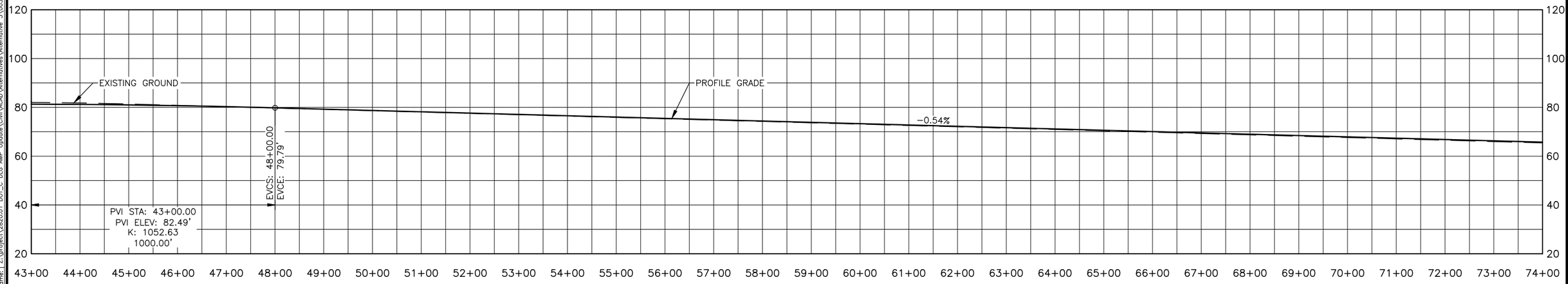

IMPACTS:

1. CONSTRUCT EMBANKMENT FOR RSA ON EAST SIDE.
2. RELOCATE SUPPLEMENTAL WIND CONE.
3. PART 77 OBSTRUCTION REMOVAL.
4. REALIGN WOOD RIVER RD AND ADJACENT FIBER OPTICE AND TELEPHONE OUTSIDE OF ROFA.
5. ADJUST AIRPORT PERIMETER FENCING.
6. ADJUST AIRPORT MAINTENANCE ROADS.
7. REPLACE AIRPORT LIGHTING SYSTEM.

PLANS DEVELOPED BY:
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BY	DATE	REVISION

STATE OF ALASKA
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CENTRAL REGION
4111 AVIATION AVE., ANCHORAGE ALASKA 99502
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DILLINGHAM AIRPORT
DILLINGHAM, ALASKA
AIRPORT MASTER PLAN
PROJECT No. CFAPT00353
AIP No. 3-02-0078-017-2018
ALTERNATIVE No. 3
NO GRADE CORRECTION

DATE: 3/22/2022

SHEET: 3 OF 4

Designed By: MIM
Drawn By: AVA/RLC
Checked By: CJB

Date Revised:
Layout Name: 3
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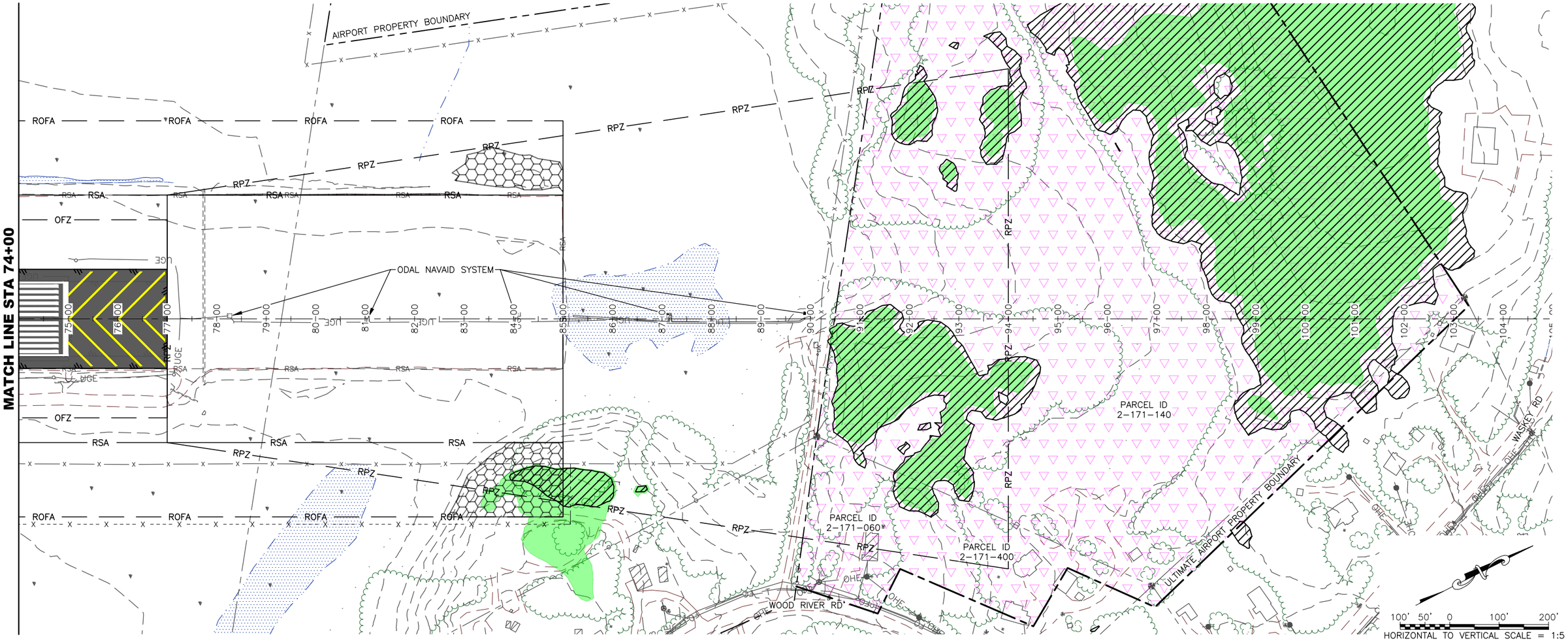

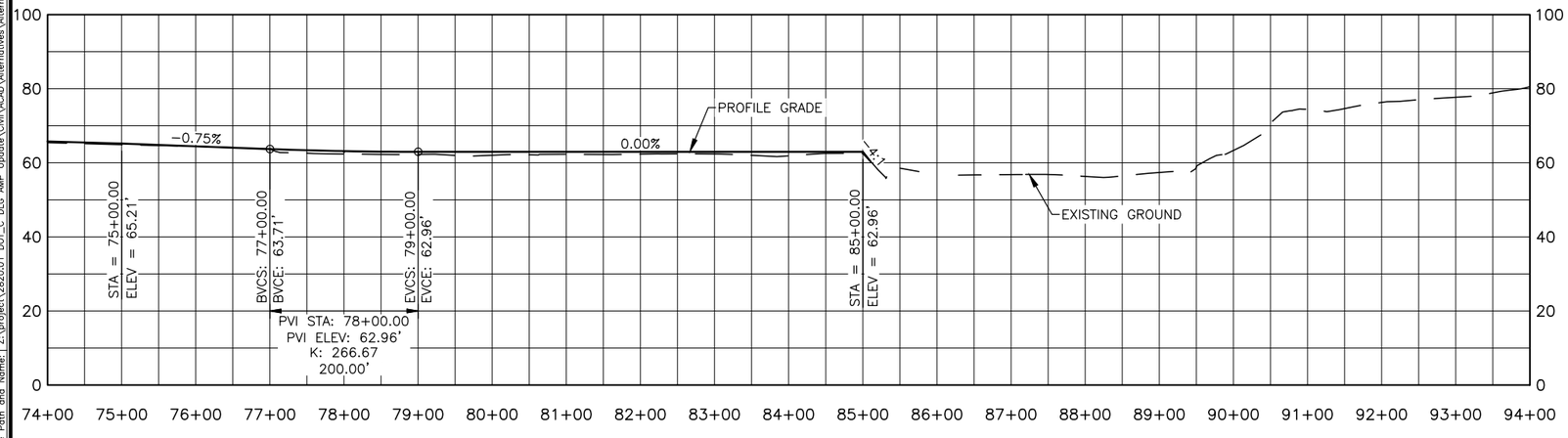

LEGEND:

- PART 77 TREE OBSTRUCTIONS
- DEPARTURE SURFACE TREE OBSTRUCTIONS
- OFA PENETRATIONS
- PROPERTY AQUISITION

IMPACTS:

1. CONSTRUCT EMBANKMENT FOR RSA ON EAST SIDE.
2. OBSTRUCTION REMOVAL.
3. PROPERTY ACQUISITION FOR CONTROL OF RPZ.
4. ADJUST AIRPORT PERIMETER FENCING.
5. ADJUST AIRPORT MAINTENANCE ROADS.
6. REPLACE AIRPORT LIGHTING SYSTEM.
7. EXTEND 42" DIA. RUNWAY CROSS CULVERT 150'.

Designed By: MIM
Drawn By: AVA/RLC
Checked By: CJB

Date Revised: 3/22/2022, 11:14 AM
Layout Name: 4
File Path and Name: Z:\project\2820.01 D07_C DLG AMP Update\Civil\ACAD\Alternatives\Alternative 3\00353-DLG-Alternative_3.dwg

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ALTERNATIVE No. 3
NO GRADE CORRECTION

DATE: 3/22/2022
SHEET: 4 OF 4

APPENDIX B

Cost Estimates

Engineer's Estimate Summary

State of Alaska - Department of Transportation and Public Facilities

Central Region

Dillingham Airport Master Plan

Project No. CFAPT00353 / Federal No. AIP 3-02-0078-017-2018

Alternative No. 1 - Base Estimate

Item No.	*Pay Item*	*Pay Unit*	*Quantity*	*Unit Price*	*Amount*
D701.010.0042	CS PIPE, 42-INCH	LINEAR FOOT	400	$ 450.00	$ 180,000.00
F162.010.0008	8-FEET CHAIN-LINK FENCE	LINEAR FOOT	3,689	$ 100.00	$ 368,880.00
F170.010.0000	STEEL BOLLARDS	EACH	12	$ 1,300.00	$ 15,600.00
F171.020.0000	RELOCATE POWER GATE OPERATOR SYSTEM	LUMP SUM	All Req'd	$ 100,000.00	$ 100,000.00
G100.010.0000	MOBILIZATION AND DEMOBILIZATION	LUMP SUM	All Req'd	$ 4,000,000.00	$ 4,000,000.00
G115.010.0000	WORKERS MEALS AND LODGING, OR PER DIEM	LUMP SUM	All Req'd	$ 1,000,000.00	$ 1,000,000.00
G130.010.0000	FIELD OFFICE	LUMP SUM	All Req'd	$ 70,000.00	$ 70,000.00
G130.020.0000	FIELD LABORATORY	LUMP SUM	All Req'd	$ 40,000.00	$ 40,000.00
G130.060.0000	NUCLEAR TESTING EQUIPMENT STORAGE SHED	EACH	1	$ 8,500.00	$ 8,500.00
G130.110.0000	FIELD COMMUNICATIONS	CONTINGENT SUM	All Req'd	$ 20,000.00	$ 20,000.00
G131.010.0000	ENGINEERING TRANSPORTATION (TRUCK)	EACH	3	$ 45,000.00	$ 135,000.00
G135.010.0000	CONSTRUCTION SURVEYING BY THE CONTRACTOR	LUMP SUM	All Req'd	$ 250,000.00	$ 250,000.00
G300.010.0000	CPM SCHEDULING	LUMP SUM	All Req'd	$ 10,000.00	$ 10,000.00
G700.010.0000	AIRPORT FLAGGER	CONTINGENT SUM	All Req'd	$ 75,000.00	$ 75,000.00
G700.040.0000	TRAFFIC CONTROL FOR AIRPORTS	CONTINGENT SUM	All Req'd	$ 50,000.00	$ 50,000.00
L100.0X0.0000	AIRPORT LIGHTING	LUMP SUM	All Req'd	$ 1,421,940.00	$ 1,421,940.00
L100.0Y0.0000	APPROACH LIGHTING & NAVIGATIONAL AIDS	LUMP SUM	All Req'd	$ 1,278,690.00	$ 1,278,690.00
O100.0X0.0000	OBSTRUCTION REMOVAL & CLEARING	LUMP SUM	All Req'd	$ 950,000.00	$ 950,000.00
P152.010.0000	UNCLASSIFIED EXCAVATION	CUBIC YARD	326,920	$ 10.00	$ 3,269,200.00
P154.020.0000	SUBBASE COURSE	TON	357,960	$ 20.00	$ 7,159,200.00
P160.010.0000	EXCAVATION OF PAVEMENT	SQUARE YARD	130,420	$ 5.00	$ 652,100.00
P209.020.0000	CRUSHED AGGREGATE BASE COURSE	TON	20,300	$ 40.00	$ 812,000.00
P299.020.0000	CRUSHED AGGREGATE SURFACE COURSE	TON	76,550	$ 55.00	$ 4,210,250.00
P318.020.0000	FOAMED ASPHALT STABILIZED BASE COURSE	SQUARE YARD	135,550	$ 10.00	$ 1,355,500.00
P318.040.0000	ASPHALT BINDER	TON	1,424	$ 1,400.00	$ 1,993,600.00
P318.050.0000	PORTLAND CEMENT	TON	854	$ 700.00	$ 597,800.00
P401.010.0030	HOT MIX ASPHALT TYPE II, CLASS A	TON	37,070	$ 140.00	$ 5,189,800.00

Engineer's Estimate Summary

State of Alaska - Department of Transportation and Public Facilities

Central Region

Dillingham Airport Master Plan

Project No. CFAPT00353 / Federal No. AIP 3-02-0078-017-2018

Alternative No. 1 - Base Estimate

Item No.	*Pay Item*	*Pay Unit*	*Quantity*	*Unit Price*	*Amount*
P401.030.5240	ASPHALT BINDER, PG 52-40V	TON	2,039	$ 1,400.00	$ 2,854,600.00
P401.080.0000	HOT MIX ASPHALT PRICE ADJUSTMENT	CONTINGENT SUM	All Req'd	$ 210,000.00	$ 210,000.00
P401.090.0000	ASPHALT MATERIAL PRICE ADJUSTMENT	CONTINGENT SUM	All Req'd	$ -	$ -
P603.010.0010	TACK COAT, STE-1	TON	91	$ 1,550.00	$ 141,050.00
P620.010.0000	RUNWAY & TAXIWAY PAINTING	SQUARE FOOT	95,240	$ 2.25	$ 214,290.00
P620.075.0000	TEMPORARY RUNWAY & TAXIWAY PAINTING	SQUARE FOOT	117,050	$ 2.00	$ 234,100.00
P621.010.0000	SAW-CUT GROOVES	SQUARE YARD	106,667	$ 1.75	$ 186,667.25
P640.020.0000	SEGMENTED CIRCLE (PANEL-TYPE)	LUMP SUM	All Req'd	$ 100,000.00	$ 100,000.00
P641.010.0000	EROSION, SEDIMENT, AND POLLUTION CONTROL ADMINISTRATION	LUMP SUM	All Req'd	$ 20,000.00	$ 20,000.00
P641.050.0000	TEMPORARY EROSION, SEDIMENT, AND POLLUTION CONTROL BY DIRECTIVE	CONTINGENT SUM	All Req'd	$ 350,000.00	$ 350,000.00
P641.060.0000	WITHOLDING	CONTINGENT SUM	All Req'd	$ -	$ -
P641.070.0000	SWPPP MANAGER	LUMP SUM	All Req'd	$ 125,000.00	$ 125,000.00
P670.010.0000	HAZARD MARKER BARRIER, PLASTIC	EACH	84	$ 460.00	$ 38,640.00
P671.010.0000	RUNWAY CLOSURE MARKER, VINYL MESH	EACH	7	$ 1,900.00	$ 13,300.00
P671.020.0000	RUNWAY CLOSURE MARKER, ILLUMINATED	EACH	2	$ 35,000.00	$ 70,000.00
P671.040.0000	TAXIWAY CLOSURE MARKER, VINYL	EACH	4	$ 1,900.00	$ 7,600.00
R100.0X0.0000	RIGHT-OF-WAY ACQUISITION	LUMP SUM	All Req'd	$ 5,804,000.00	$ 5,804,000.00
T901.010.0000	SEEDING	ACRE	15.0	$ 7,000.00	$ 105,000.00
T905.010.0020	TOPSOILING, CLASS B	SQUARE YARD	58,080	$ 3.50	$ 203,280.00
T908.010.0000	MULCHING	SQUARE YARD	58,080	$ 1.50	$ 87,120.00
U100.0X0.0000	UTILITY RELOCATION	LUMP SUM	All Req'd	$ 1,525,000.00	$ 1,525,000.00
Z100.0X0.0000	ROAD RE-ALIGNMENT	LUMP SUM	All Req'd	$ 503,000.00	$ 503,000.00
			Total Basic Bid:		$ 48,005,707.25
			Construction Engineering @ 20%:		$ 9,601,141.45
			ICAP @ 5.88%:		$ 3,387,282.70
			Project Total:		$ 60,994,131.40

Engineer's Estimate Summary

State of Alaska - Department of Transportation and Public Facilities

Central Region

Dillingham Airport Master Plan

Project No. CFAPT00353 / Federal No. AIP 3-02-0078-017-2018

Alternative No. 2 - Base Estimate

Item No.	*Pay Item*	*Pay Unit*	*Quantity*	*Unit Price*	*Amount*
D701.010.0042	CS PIPE, 42-INCH	LINEAR FOOT	400	$ 450.00	$ 180,000.00
F162.010.0008	8-FEET CHAIN-LINK FENCE	LINEAR FOOT	3,689	$ 100.00	$ 368,880.00
F170.010.0000	STEEL BOLLARDS	EACH	12	$ 1,300.00	$ 15,600.00
F171.020.0000	RELOCATE POWER GATE OPERATOR SYSTEM	LUMP SUM	All Req'd	$ 100,000.00	$ 100,000.00
G100.010.0000	MOBILIZATION AND DEMOBILIZATION	LUMP SUM	All Req'd	$ 4,000,000.00	$ 4,000,000.00
G115.010.0000	WORKERS MEALS AND LODGING, OR PER DIEM	LUMP SUM	All Req'd	$ 1,000,000.00	$ 1,000,000.00
G130.010.0000	FIELD OFFICE	LUMP SUM	All Req'd	$ 70,000.00	$ 70,000.00
G130.020.0000	FIELD LABORATORY	LUMP SUM	All Req'd	$ 40,000.00	$ 40,000.00
G130.060.0000	NUCLEAR TESTING EQUIPMENT STORAGE SHED	EACH	1	$ 8,500.00	$ 8,500.00
G130.110.0000	FIELD COMMUNICATIONS	CONTINGENT SUM	All Req'd	$ 20,000.00	$ 20,000.00
G131.010.0000	ENGINEERING TRANSPORTATION (TRUCK)	EACH	3	$ 45,000.00	$ 135,000.00
G135.010.0000	CONSTRUCTION SURVEYING BY THE CONTRACTOR	LUMP SUM	All Req'd	$ 250,000.00	$ 250,000.00
G300.010.0000	CPM SCHEDULING	LUMP SUM	All Req'd	$ 10,000.00	$ 10,000.00
G700.010.0000	AIRPORT FLAGGER	CONTINGENT SUM	All Req'd	$ 75,000.00	$ 75,000.00
G700.040.0000	TRAFFIC CONTROL FOR AIRPORTS	CONTINGENT SUM	All Req'd	$ 50,000.00	$ 50,000.00
L100.0X0.0000	AIRPORT LIGHTING	LUMP SUM	All Req'd	$ 1,421,940.00	$ 1,421,940.00
L100.0Y0.0000	APPROACH LIGHTING & NAVIGATIONAL AIDS	LUMP SUM	All Req'd	$ 1,278,690.00	$ 1,278,690.00
O100.0X0.0000	OBSTRUCTION REMOVAL & CLEARING	LUMP SUM	All Req'd	$ 1,116,000.00	$ 1,116,000.00
P152.010.0000	UNCLASSIFIED EXCAVATION	CUBIC YARD	337,180	$ 10.00	$ 3,371,800.00
P152.200.0000	BORROW	TON	0	$ 10.00	$ -
P154.020.0000	SUBBASE COURSE	TON	355,780	$ 20.00	$ 7,115,600.00
P160.010.0000	EXCAVATION OF PAVEMENT	SQUARE YARD	124,670	$ 5.00	$ 623,350.00
P209.020.0000	CRUSHED AGGREGATE BASE COURSE	TON	19,116	$ 40.00	$ 764,637.60
P299.020.0000	CRUSHED AGGREGATE SURFACE COURSE	TON	78,940	$ 55.00	$ 4,341,706.38
P318.020.0000	FOAMED ASPHALT STABILIZED BASE COURSE	SQUARE YARD	128,000	$ 10.00	$ 1,280,000.00
P318.040.0000	ASPHALT BINDER	TON	1,365	$ 1,400.00	$ 1,911,000.00
P318.050.0000	PORTLAND CEMENT	TON	819	$ 700.00	$ 573,300.00
P401.010.0030	HOT MIX ASPHALT TYPE II, CLASS A	TON	34,130	$ 140.00	$ 4,778,200.00
P401.030.5240	ASPHALT BINDER, PG 52-40V	TON	1,878	$ 1,400.00	$ 2,629,200.00
P401.080.0000	HOT MIX ASPHALT PRICE ADJUSTMENT	CONTINGENT SUM	All Req'd	$ 210,000.00	$ 210,000.00
P401.090.0000	ASPHALT MATERIAL PRICE ADJUSTMENT	CONTINGENT SUM	All Req'd	$ -	$ -

Engineer's Estimate Summary

State of Alaska - Department of Transportation and Public Facilities

Central Region

Dillingham Airport Master Plan

Project No. CFAPT00353 / Federal No. AIP 3-02-0078-017-2018

Alternative No. 2 - Base Estimate

Item No.	*Pay Item*	*Pay Unit*	*Quantity*	*Unit Price*	*Amount*
P603.010.0010	TACK COAT, STE-1	TON	92	$ 1,550.00	$ 142,600.00
P620.010.0000	RUNWAY & TAXIWAY PAINTING	SQUARE FOOT	87,150	$ 2.25	$ 196,087.50
P620.075.0000	TEMPORARY RUNWAY & TAXIWAY PAINTING	SQUARE FOOT	117,050	$ 2.00	$ 234,100.00
P621.010.0000	SAW-CUT GROOVES	SQUARE YARD	100,000	$ 1.75	$ 175,000.00
P640.020.0000	SEGMENTED CIRCLE (PANEL-TYPE)	LUMP SUM	All Req'd	$ 100,000.00	$ 100,000.00
P641.010.0000	EROSION, SEDIMENT, AND POLLUTION CONTROL ADMINISTRATION	LUMP SUM	All Req'd	$ 20,000.00	$ 20,000.00
P641.050.0000	TEMPORARY EROSION, SEDIMENT, AND POLLUTION CONTROL BY DIRECTIVE	CONTINGENT SUM	All Req'd	$ 350,000.00	$ 350,000.00
P641.060.0000	WITHHOLDING	CONTINGENT SUM	All Req'd	$ -	$ -
P641.070.0000	SWPPP MANAGER	LUMP SUM	All Req'd	$ 125,000.00	$ 125,000.00
P670.010.0000	HAZARD MARKER BARRIER, PLASTIC	EACH	84	$ 460.00	$ 38,640.00
P671.010.0000	RUNWAY CLOSURE MARKER, VINYL MESH	EACH	7	$ 1,900.00	$ 13,300.00
P671.020.0000	RUNWAY CLOSURE MARKER, ILLUMINATED	EACH	2	$ 35,000.00	$ 70,000.00
P671.040.0000	TAXIWAY CLOSURE MARKER, VINYL	EACH	4	$ 1,900.00	$ 7,600.00
R100.0X0.0000	RIGHT-OF-WAY ACQUISITION	LUMP SUM	All Req'd	$ 5,804,000.00	$ 5,804,000.00
T901.010.0000	SEEDING	ACRE	15	$ 7,000.00	$ 105,000.00
T905.010.0020	TOPSOILING, CLASS B	SQUARE YARD	58,080	$ 3.50	$ 203,280.00
T908.010.0000	MULCHING	SQUARE YARD	58,080	$ 1.50	$ 87,120.00
U100.0X0.0000	UTILITY ADJUSTMENTS OR RELOCATION	LUMP SUM	All Req'd	$ 1,525,000.00	$ 1,525,000.00
Z100.0X0.0000	ROAD REALIGNMENT	LUMP SUM	All Req'd	$ 503,000.00	$ 503,000.00
				Total Basic Bid:	$ 47,438,131.48
				Construction Engineering @ 20%:	$ 9,487,626.30
				ICAP @ 5.88%:	$ 3,347,234.56
				Project Total:	$ 60,272,992.33

Engineer's Estimate Summary

State of Alaska - Department of Transportation and Public Facilities

Central Region

Dillingham Airport Master Plan

Project No. CFAPT00353 / Federal No. AIP 3-02-0078-017-2018

Alternative No. 3 - Base Estimate

Item No.	*Pay Item*	*Pay Unit*	*Quantity*	*Unit Price*	*Amount*
F162.010.0008	8-FEET CHAIN-LINK FENCE	LINEAR FOOT	5,266	$ 100.00	$ 526,560.00
F170.010.0000	STEEL BOLLARDS	EACH	12	$ 1,300.00	$ 15,600.00
F171.020.0000	RELOCATE POWER GATE OPERATOR SYSTEM	LUMP SUM	All Req'd	$ 100,000.00	$ 100,000.00
G100.010.0000	MOBILIZATION AND DEMOBILIZATION	LUMP SUM	All Req'd	$ 4,000,000.00	$ 4,000,000.00
G115.010.0000	WORKERS MEALS AND LODGING, OR PER DIEM	LUMP SUM	All Req'd	$ 1,000,000.00	$ 1,000,000.00
G130.010.0000	FIELD OFFICE	LUMP SUM	All Req'd	$ 70,000.00	$ 70,000.00
G130.020.0000	FIELD LABORATORY	LUMP SUM	All Req'd	$ 40,000.00	$ 40,000.00
G130.060.0000	NUCLEAR TESTING EQUIPMENT STORAGE SHED	EACH	1	$ 8,500.00	$ 8,500.00
G130.110.0000	FIELD COMMUNICATIONS	CONTINGENT SUM	All Req'd	$ 20,000.00	$ 20,000.00
G131.010.0000	ENGINEERING TRANSPORTATION (TRUCK)	EACH	3	$ 45,000.00	$ 135,000.00
G135.010.0000	CONSTRUCTION SURVEYING BY THE CONTRACTOR	LUMP SUM	All Req'd	$ 250,000.00	$ 250,000.00
G300.010.0000	CPM SCHEDULING	LUMP SUM	All Req'd	$ 10,000.00	$ 10,000.00
G700.010.0000	AIRPORT FLAGGER	CONTINGENT SUM	All Req'd	$ 75,000.00	$ 75,000.00
G700.040.0000	TRAFFIC CONTROL FOR AIRPORTS	CONTINGENT SUM	All Req'd	$ 50,000.00	$ 50,000.00
L100.0X0.0000	AIRPORT LIGHTING	LUMP SUM	All Req'd	$ 1,395,300.00	$ 1,395,300.00
L100.0Y0.0000	APPROACH LIGHTING & NAVIGATIONAL AIDS	LUMP SUM	All Req'd	$ 314,220.00	$ 314,220.00
O100.0X0.0000	OBSTRUCTION REMOVAL & CLEARING	LUMP SUM	All Req'd	$ 938,000.00	$ 938,000.00
P152.010.0000	UNCLASSIFIED EXCAVATION	CUBIC YARD	38,090	$ 10.00	$ 380,900.00
P152.200.0000	BORROW	TON	425,150	$ 17.00	$ 7,227,550.00
P160.010.0000	EXCAVATION OF PAVEMENT	SQUARE YARD	7,340	$ 5.00	$ 36,700.00
P299.020.0000	CRUSHED AGGREGATE SURFACE COURSE	TON	34,550	$ 55.00	$ 1,900,250.00
P620.010.0000	RUNWAY & TAXIWAY PAINTING	SQUARE FOOT	93,240	$ 2.25	$ 209,790.00
P640.020.0000	SEGMENTED CIRCLE (PANEL-TYPE)	LUMP SUM	All Req'd	$ 100,000.00	$ 100,000.00
P641.010.0000	EROSION, SEDIMENT, AND POLLUTION CONTROL ADMINISTRATION	LUMP SUM	All Req'd	$ 20,000.00	$ 20,000.00
P641.050.0000	TEMPORARY EROSION, SEDIMENT, AND POLLUTION CONTROL BY DIRECTIVE	CONTINGENT SUM	All Req'd	$ 250,000.00	$ 250,000.00
P641.060.0000	WITHOLDING	CONTINGENT SUM	All Req'd	$ -	$ -
P641.070.0000	SWPPP MANAGER	LUMP SUM	All Req'd	$ 125,000.00	$ 125,000.00
P671.020.0000	RUNWAY CLOSURE MARKER, ILLUMINATED	EACH	2	$ 35,000.00	$ 70,000.00
R100.0X0.0000	RIGHT-OF-WAY ACQUISITION	LUMP SUM	All Req'd	$ 4,560,000.00	$ 4,560,000.00
T901.010.0000	SEEDING	ACRE	17.0	$ 7,000.00	$ 119,000.00
T905.010.0020	TOPSOILING, CLASS B	SQUARE YARD	58,080	$ 3.50	$ 203,280.00

Engineer's Estimate Summary

State of Alaska - Department of Transportation and Public Facilities

Central Region

Dillingham Airport Master Plan

Project No. CFAPT00353 / Federal No. AIP 3-02-0078-017-2018

Alternative No. 3 - Base Estimate

Item No.	*Pay Item*	*Pay Unit*	*Quantity*	*Unit Price*	*Amount*
T908.010.0000	MULCHING	SQUARE YARD	58,080	$ 1.50	$ 87,120.00
U100.0X0.0000	UTILITY RELOCATION	LUMP SUM	All Req'd	$ 1,366,000.00	$ 1,366,000.00
Z100.0X0.0000	ROAD RE-ALIGNMENT	LUMP SUM	All Req'd	$ 503,000.00	$ 503,000.00

Total Basic Bid:	$ 26,106,770.00
Construction Engineering @ 20%:	$ 5,221,354.00
ICAP @ 5.88%:	$ 1,842,093.69
Project Total:	$ 33,170,217.69

APPENDIX C

Runway Length Determination

Dillingham Airport
Airport Elevation (NAVD88) = 82'[5]
Mean Max Temperature, Hottest Month = 62.5°F, July[5]
Existing Runway Length = 6,400'
Standard Day Temp = 59.0°F
ANC-DLG is approx. 330 miles. Use this value for Payload/Range charts. It's assumed most large aircraft are based out of ANC.
High Point = 81.99', Low Point = 64.89'; Runway gradient correction equals 10 x (81.99-64.89) = 171'[6]

MTOW - Maximum takeoff weight
MLW - Maximum landing weight
TOW - Takeoff weight

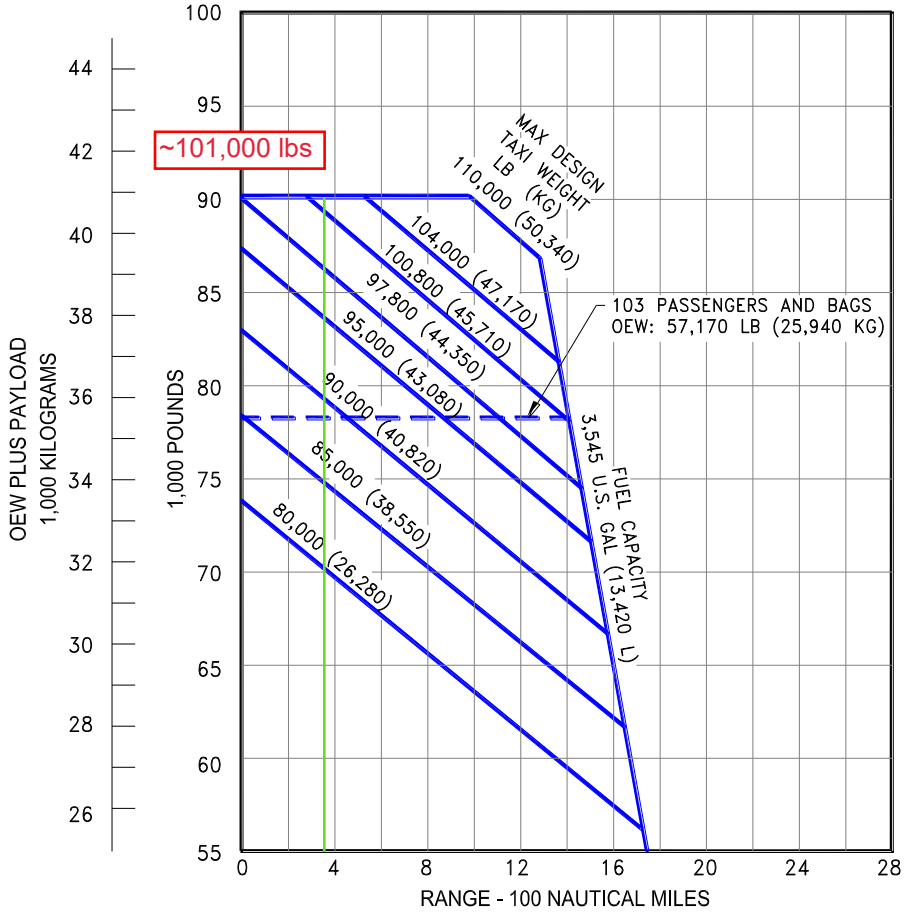
Runway Length Determination per FAA AC 150/5325-4B *Runway Length Requirements for Airport Design*													
Aircraft[1]	**Operations[1]**	**Cumulative Operations**	**AAC-ADG**	**TDG**	**MTOW (lbs)[2,3]**	**Operational TOW (lbs)[4,7]**	**MLW (lbs)[3,4,10]**	**FAR Takeoff Length Requirement (ft)[4,7,8]**	**- with Gradient Correction, Rounded (ft)**	**FAR Landing Length Requirement (ft)[4,7,8,9]**	**Jane's Operational TOW (lbs)[10]**	**Janes's Takeoff Length (ft)[10]**	**Jane's Landing Length (ft)[10]**
Beoing 737-200	15	15	C-III	3	115,500	112,500	103,000	8,750	9,000	5,400	109,000	6,650	4,500
McDonnell Douglas DC9 MD82	199	214	C-III	4	149,500	137,000	130,000	6,200	6,400	5,500	-	7,450	4,920
Boeing 737-400	88	302	C-III	3	150,000	129,000	124,000	6,000	6,200	6,000	150,000	8,740	5,050
Beoing 737-700/700LR/Max 7	264	566	C-III	3	154,500	132,500	134,000	5,800	6,000	5,600	-	-	-
McDonnell Douglas DC-9-41 (30)	78	644	C-III	2	114,000	107,500	100,000	5,800	6,000	5,500	121,000	6,850	4,720
Boeing 737-300	175	819	C-III	3	139,500	117,500	114,000	5,500	5,700	5,350	138,500	7,500	4,700
Lockheed L-382E	168	987	C-IV	2	164,000	-	130,000	-	-	3,100	155,000	3,580	2,750
								Average:	6,550		Average:	7,438	
								Rounded up to nearest 100':	6,600		Rounded up to nearest 100':	7,500	
								Average weighted by operations:	6,110		Average weighted by operations:	7,564	
								Rounded up to nearest 100':	6,200		Rounded up to nearest 100':	7,600	
Runway Length Determiniation per FAA AC 150/5325-4B *Runway Length Requirements for Airport Design* for Potential Future Aircraft													
Beoing 737-800	0	0	C-III	3	174,200	151,000	146,300	5,900	6,100	6,700	-	-	-
Beoing 737-900	0	0	C-III	3	174,200	151,000	146,300	6,900	7,100	6,700	-	-	-
Beoing 737-900ER	0	0	C-III	3	187,700	162,500	157,300	6,900	7,100	6,400	-	-	-

[1]R&M Consultants, Inc. DLG Master Plan Update - Aviation Forecast, 2021 from BTS T-100 Dataset, 2019 Operations
[2]FAA Aircraft Characteristics Database v2, 2018
[3]Everts Air - About - Our Fleet, 2021
[4]Boeing 737 Airplane Characteristics for Airport Planning Rev A, 2020
[5]DLG Airport Layout Plan, 2016
[6]CFAPT00104 DLG Runway Rehabilitation Construction Plans
[7]DC-9 Airplane Charachteristics for Airport Planning, 1984
[8]MD-80 Series Airplane Characteristics for Airport Planning, 1990
[9]LM-100J Brochure, 2018
[10]Jane's All the World's Aircraft In Service, 2020

3.2 PAYLOAD/RANGE FOR LONG RANGE CRUISE

3.2.1 Payload/Range for Long Range Cruise: Model 737-100 (JT8D-7 Engines)

NOTES:
* DOMESTIC RESERVES
* JT9D–7 ENGINES
* STANDARD DAY, ZERO WIND
* LRC AT 30,000 FEET (9,150 METERS)
* CONSULT WITH USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN



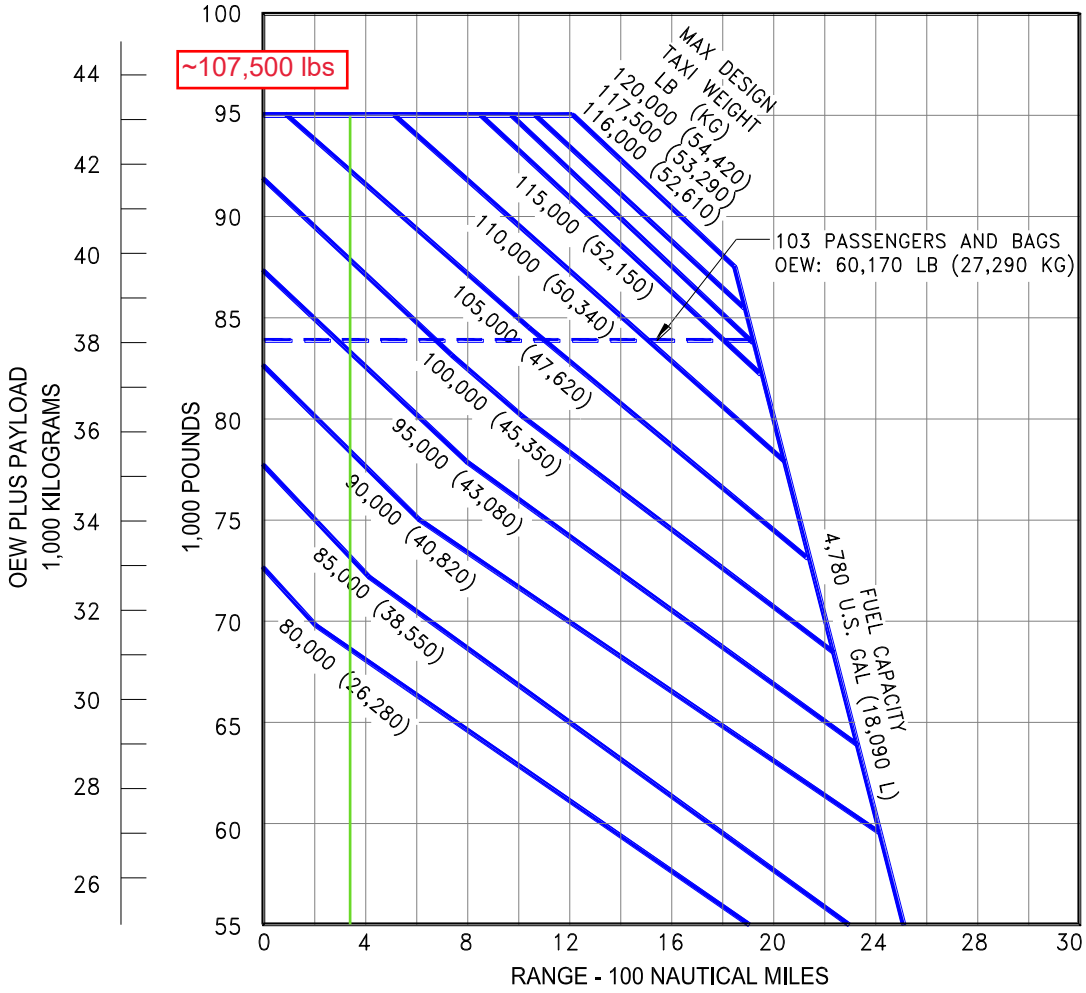
* FOR TAKEOFF WEIGHT, SUBTRACT 500 LB (227 KG) FROM TAXI WEIGHT

Assume range at 350 miles for ANC - DLG

3.2.2 Payload/Range for Long Range Cruise: Model 737-200 (JT8D-9/9A Engines)

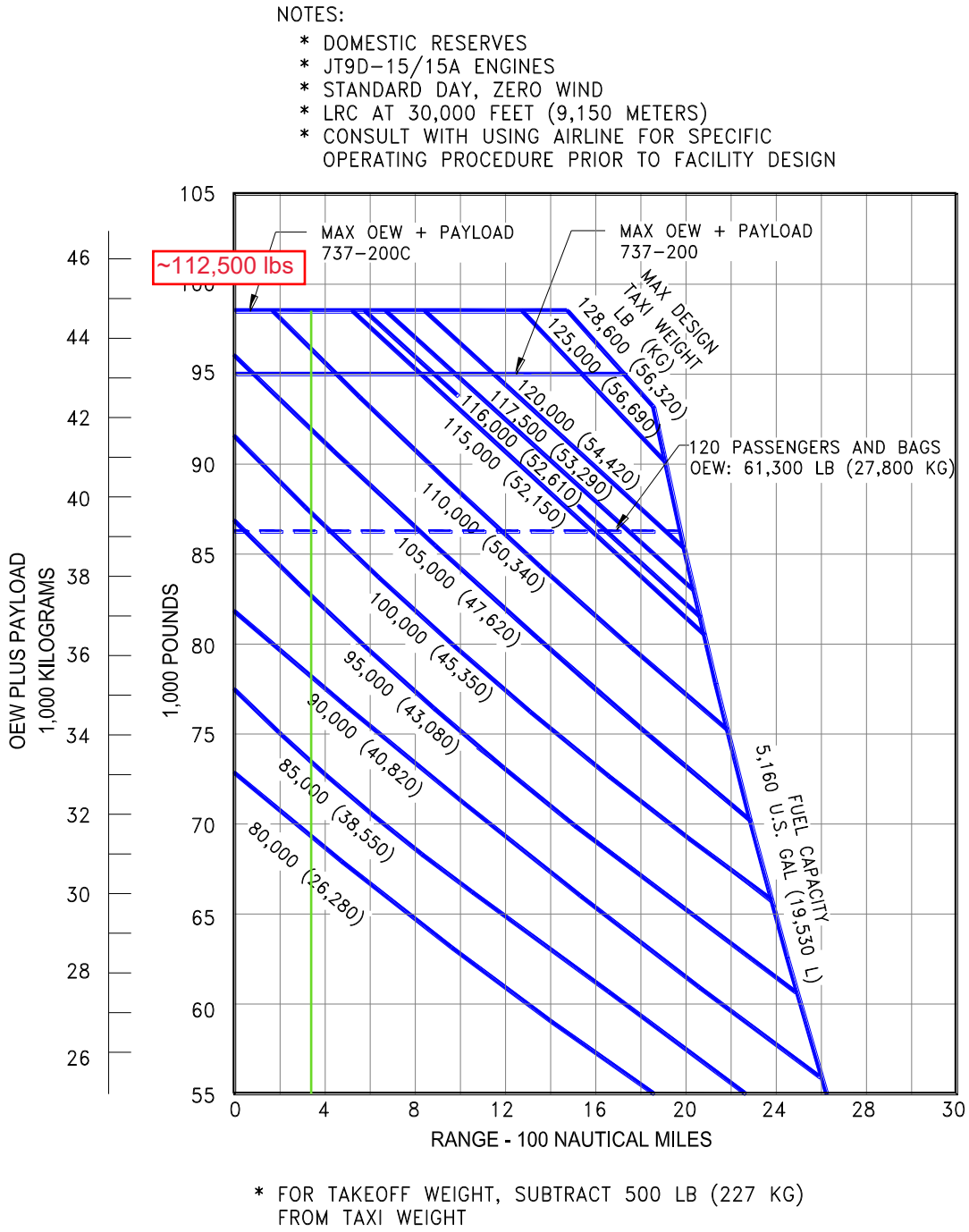
NOTES:

* DOMESTIC RESERVES
* JT9D-9/9A ENGINES
* STANDARD DAY, ZERO WIND
* LRC AT 30,000 FEET (9,150 METERS)
* CONSULT WITH USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN



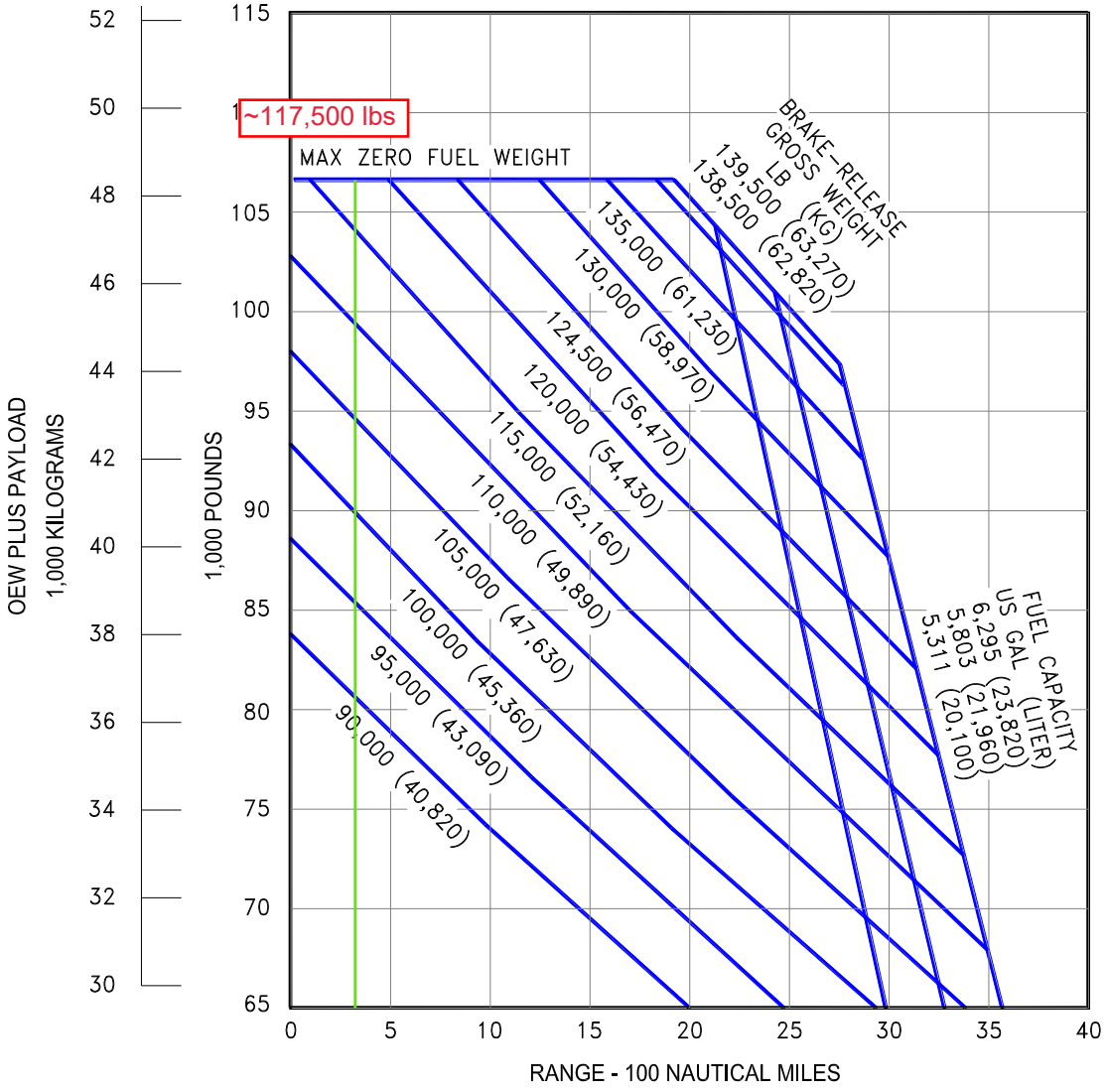
* FOR TAKEOFF WEIGHT, SUBTRACT 500 LB (227 KG) FROM TAXI WEIGHT

3.2.3 Payload/Range for Long Range Cruise: Model 737-200 (JT8D-15/15A Engines)

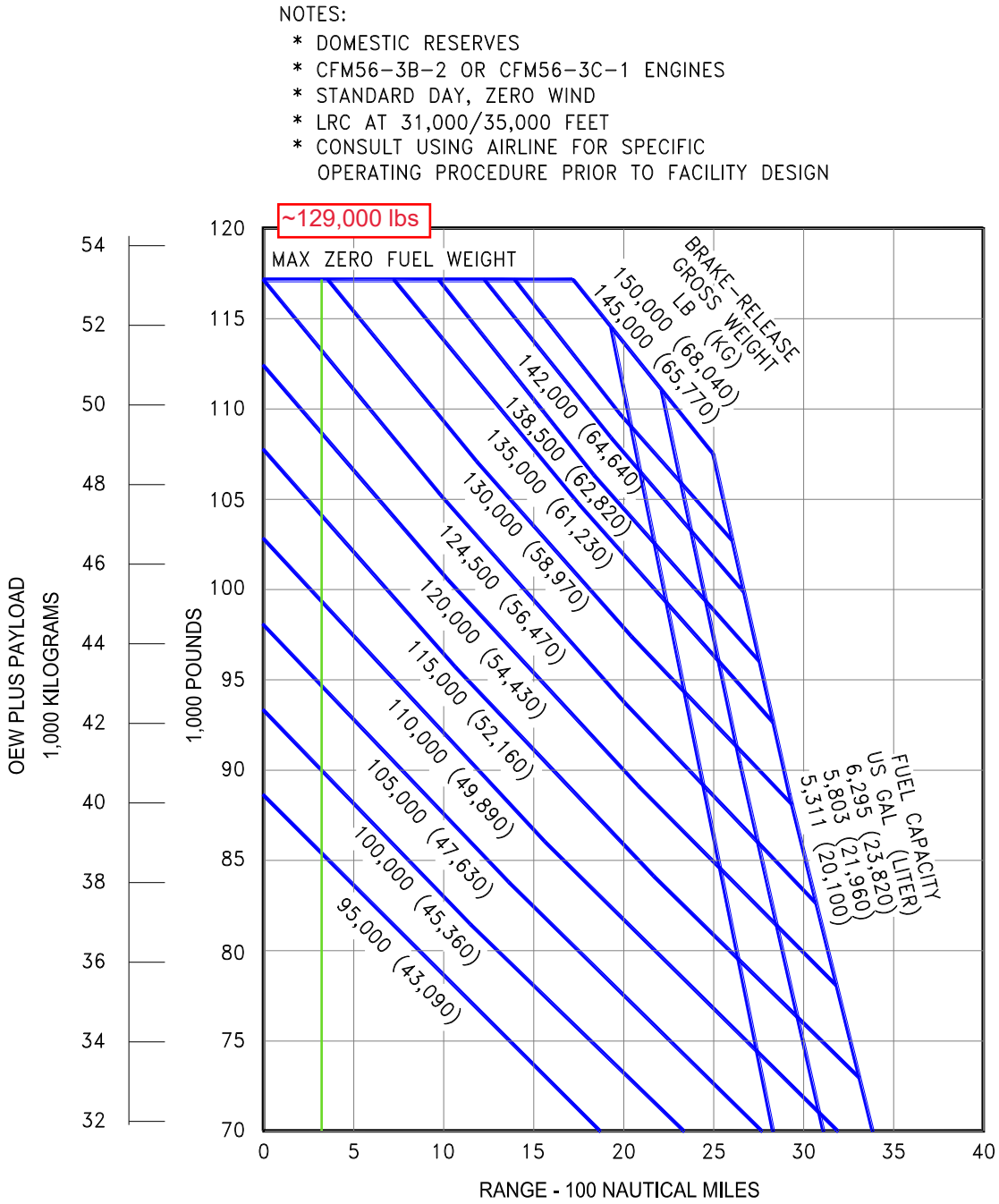


3.2.6 Payload/Range for Long Range Cruise: Model 737-300

NOTES:
* DOMESTIC RESERVES
* CFM56-3B-1 OR CFM56-3B-2 ENGINES
* STANDARD DAY, ZERO WIND
* LRC AT 31,000/35,000 FEET
* CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN



3.2.7 Payload/Range for Long Range Cruise: Model 737-400



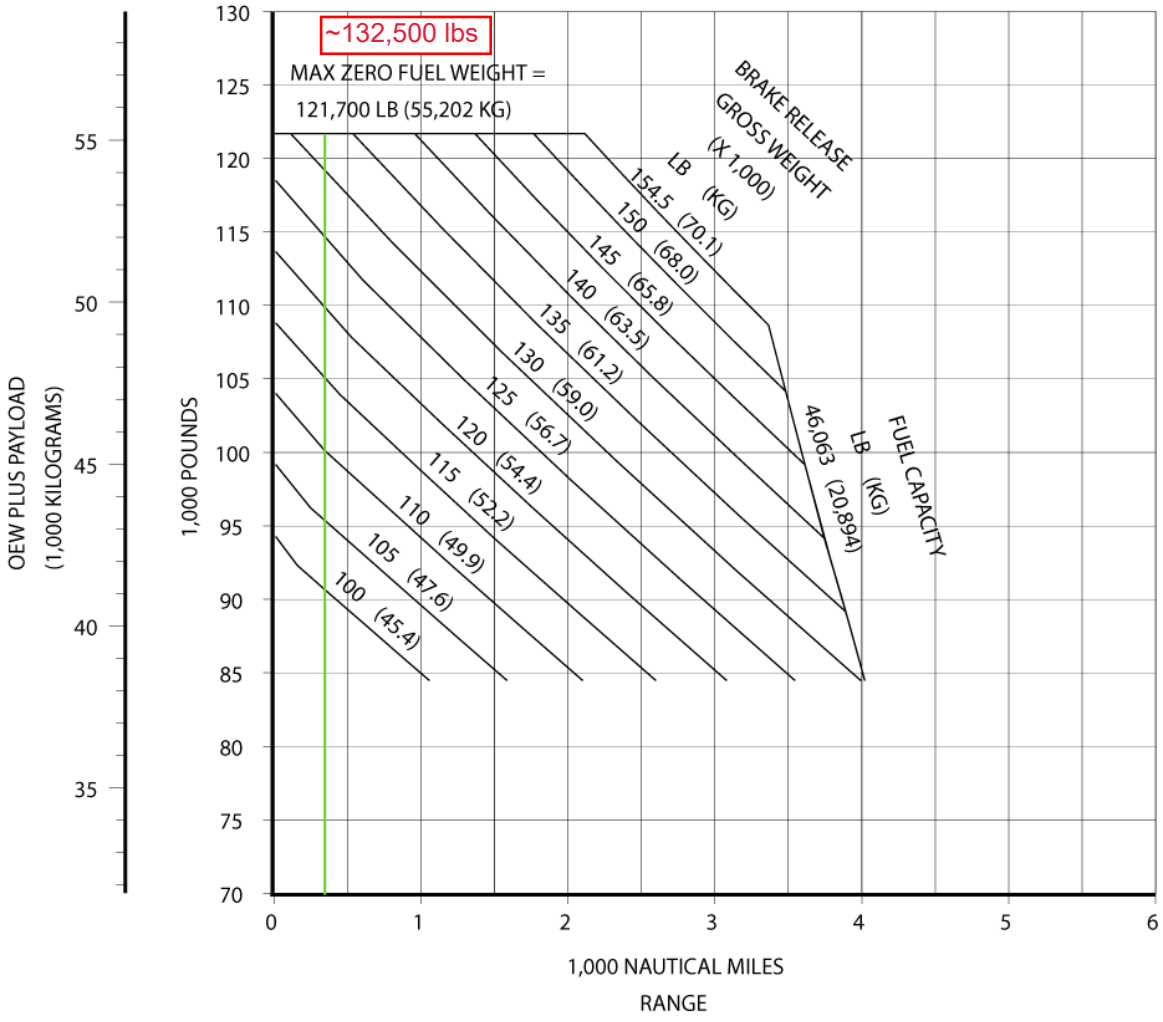
3.2.10 Payload/Range for Long Range Cruise: Model 737-700

DO NOT USE FOR DISPATCH

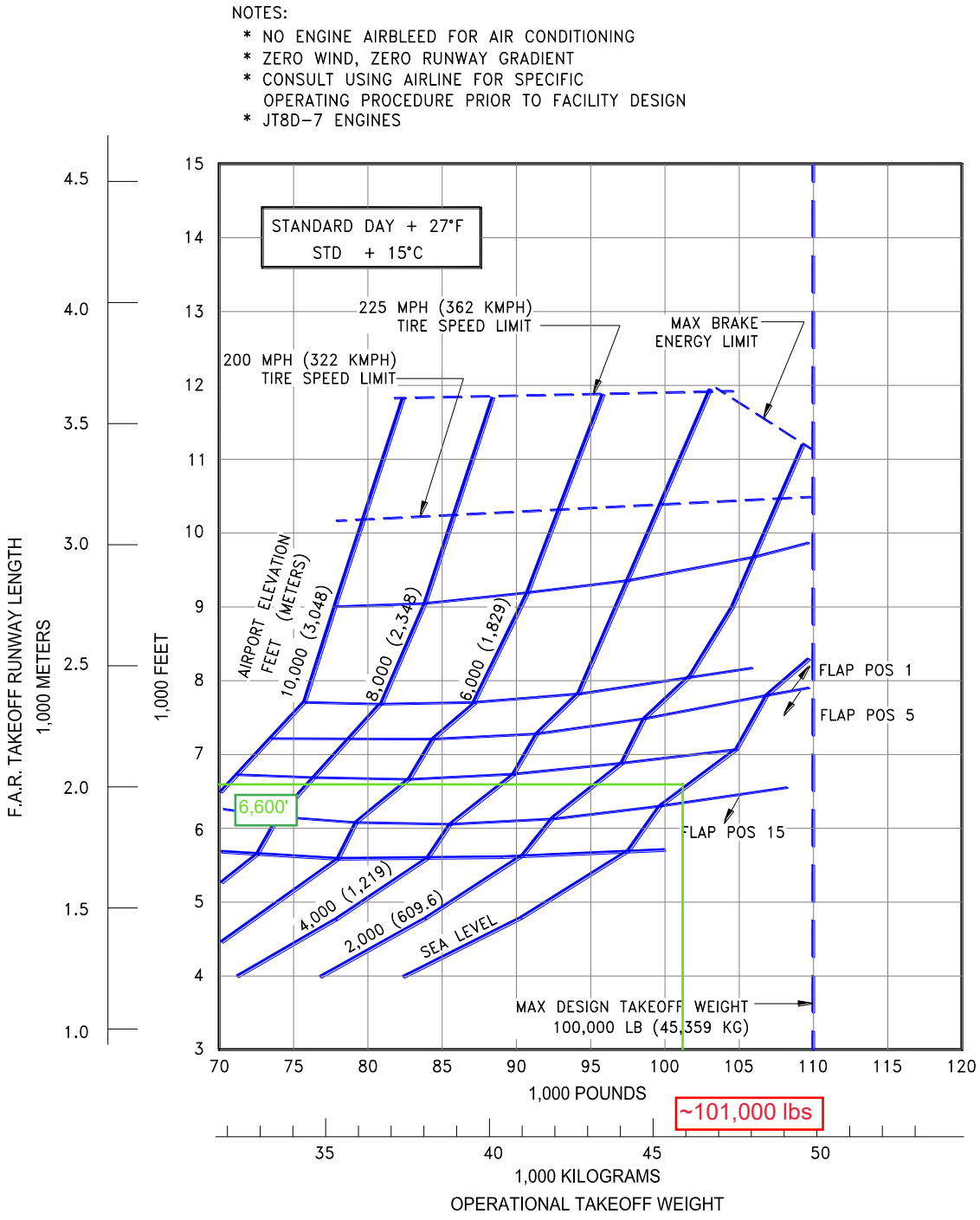
Payload/Range

737-700/-700W (CFM56-7B Series)

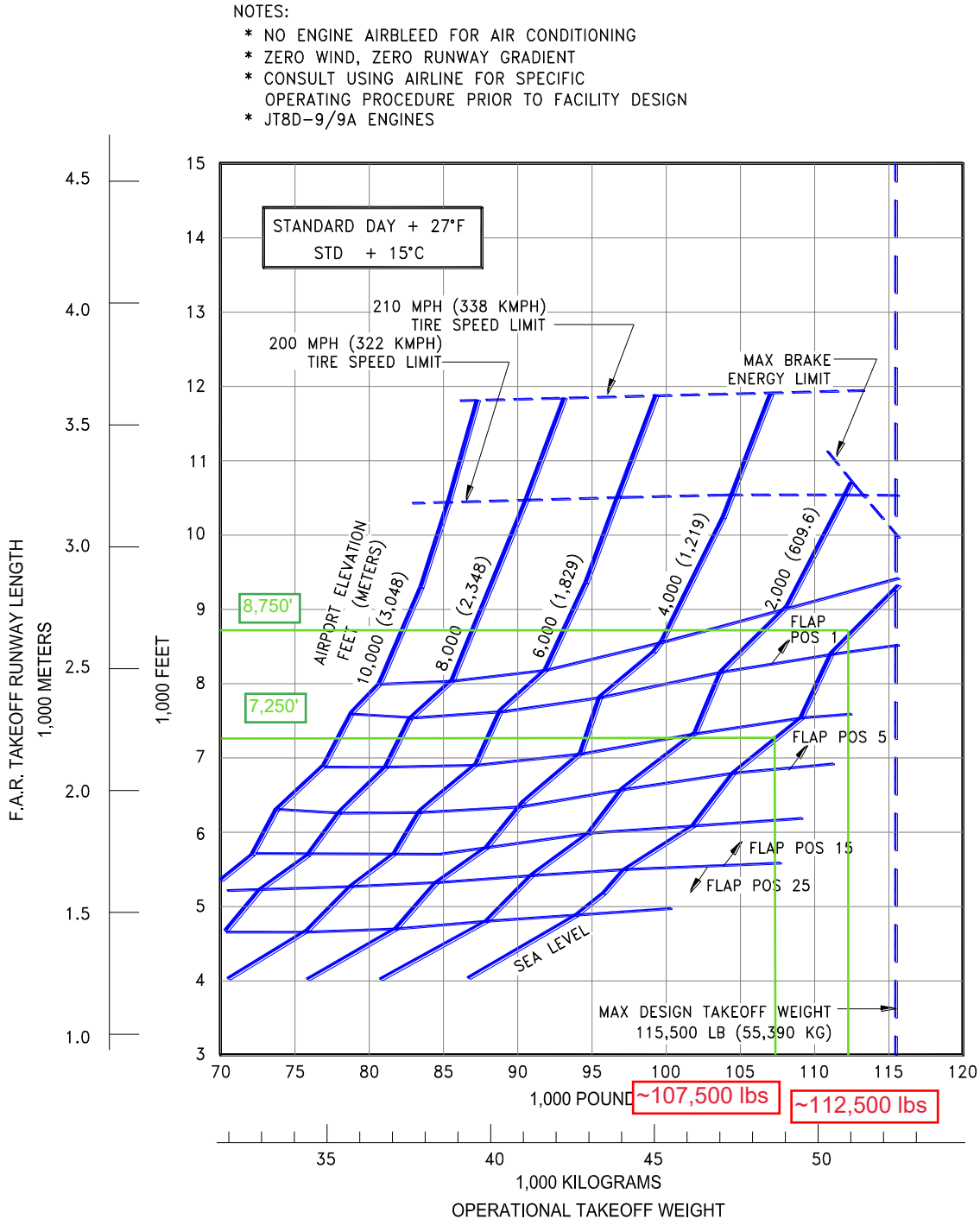
- STANDARD DAY, ZERO WIND
- CRUISE MACH = LRC
- NORMAL POWER EXTRACTION AND AIR CONDITIONING BLEEDS
- TYPICAL MISSION RULES
- NON-WINGLET PERFORMANCE SHOWN. WINGLET AIRCRAFT WILL HAVE SLIGHTLY GREATER RANGE.
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE AND OEW PRIOR TO FACILITY DESIGN.



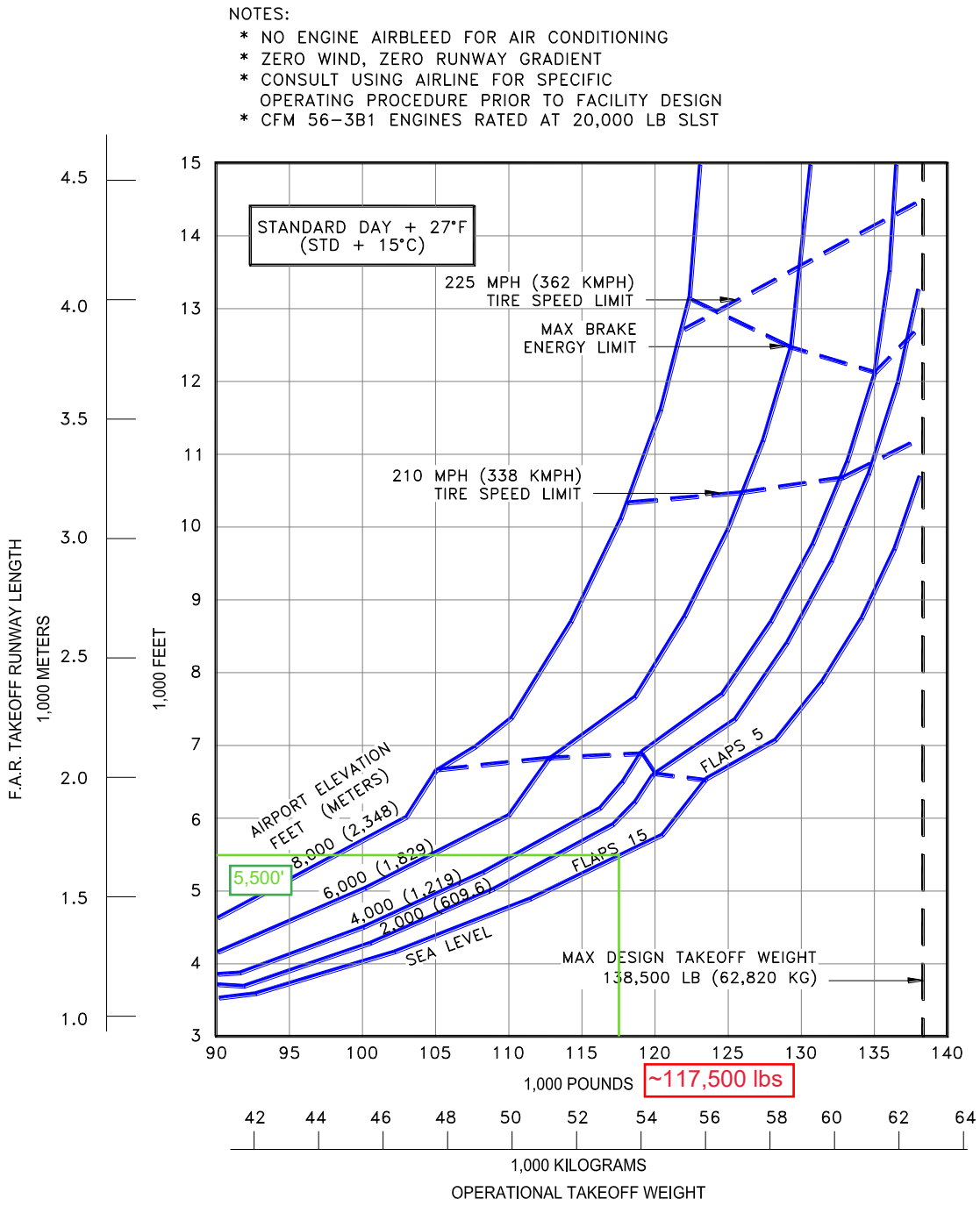
3.3.2 F.A.R. Takeoff Runway Length Requirements - Standard Day + 27°F (STD + 15°C): Model 737-100 (JT8D-7 Engines)



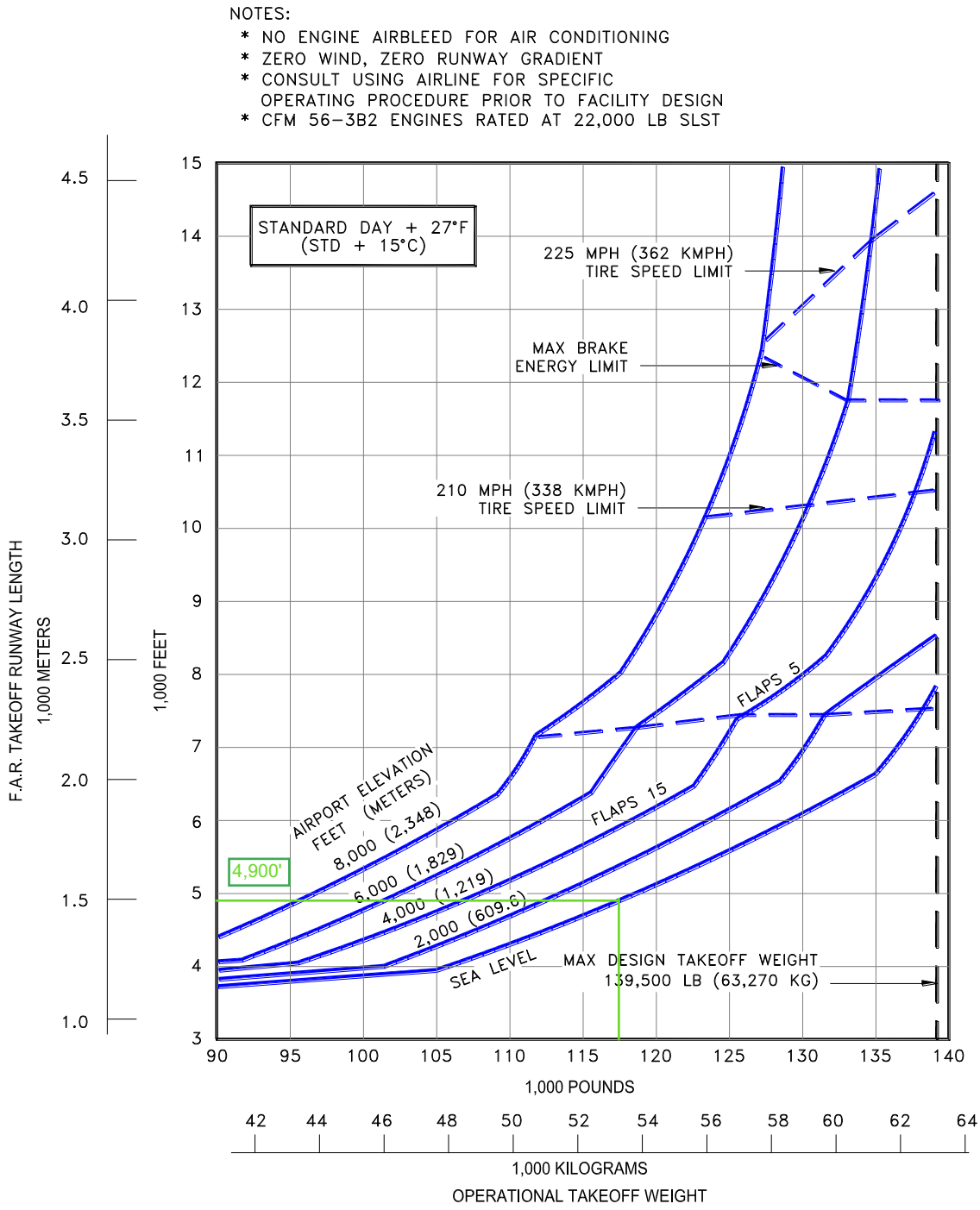
3.3.4 F.A.R. Takeoff Runway Length Requirements - Standard Day + 27°F (STD + 15°C): Model 737-200 (JT8D-9/9A Engines)



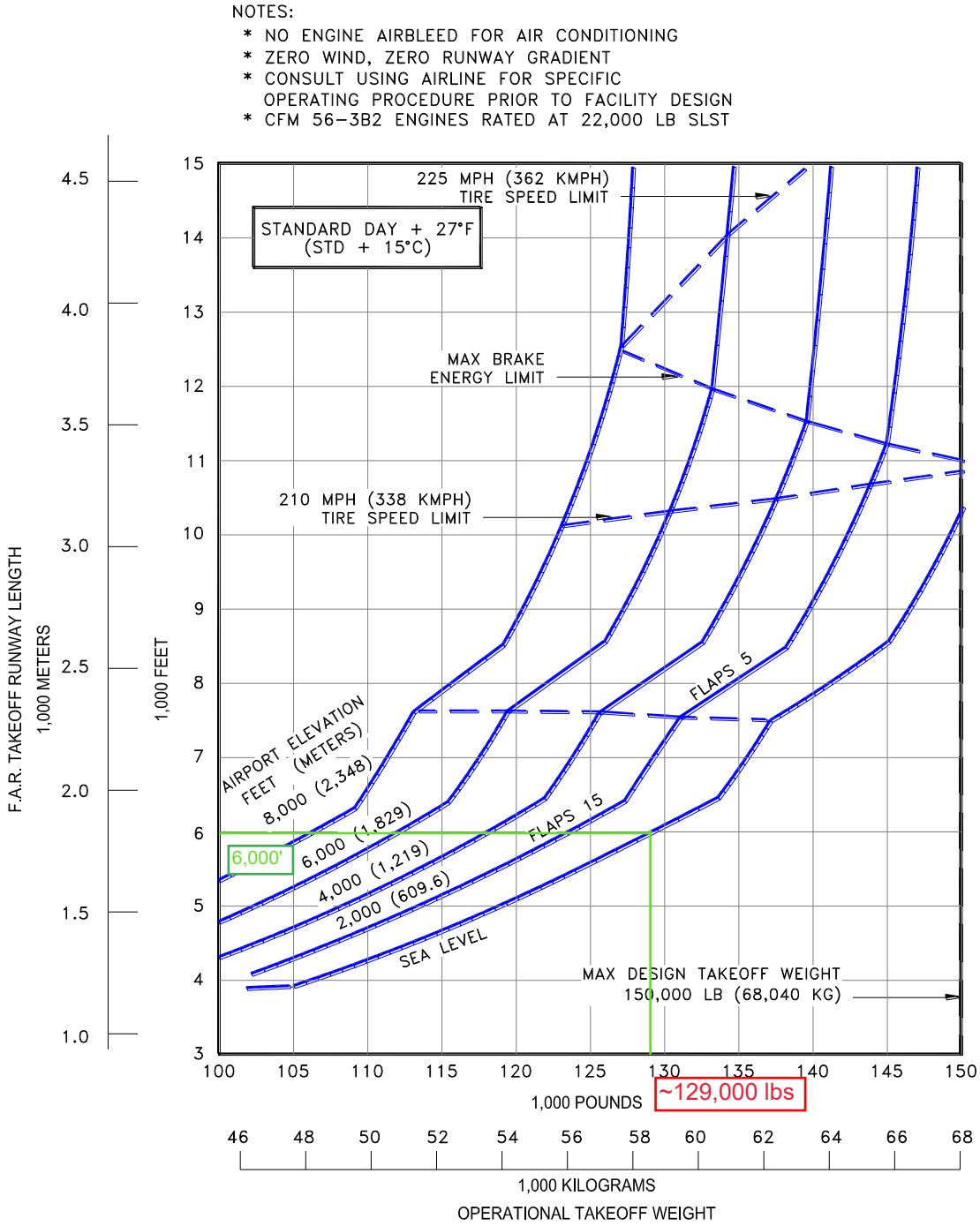
3.3.12 F.A.R. Takeoff Runway Length Requirements - Standard Day + 27°F (STD + 15°C): Model 737-300 (CFM56-3B1 Engines at 20,000 LB SLST)



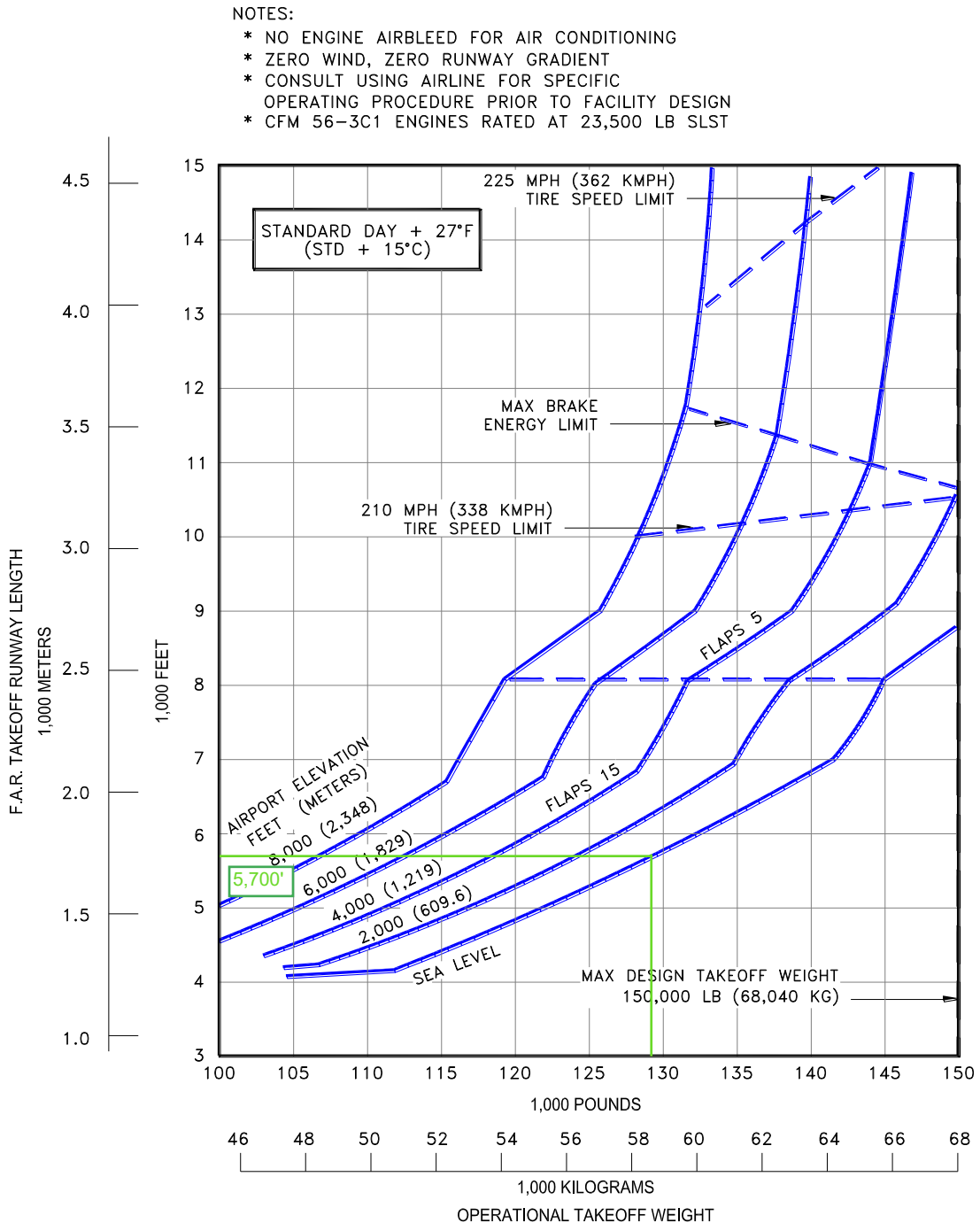
3.3.14 F.A.R. Takeoff Runway Length Requirements - Standard Day + 27°F (STD + 15°C): Model 737-300 (CFM56-3B-2 Engines at 22,000 LB SLST)



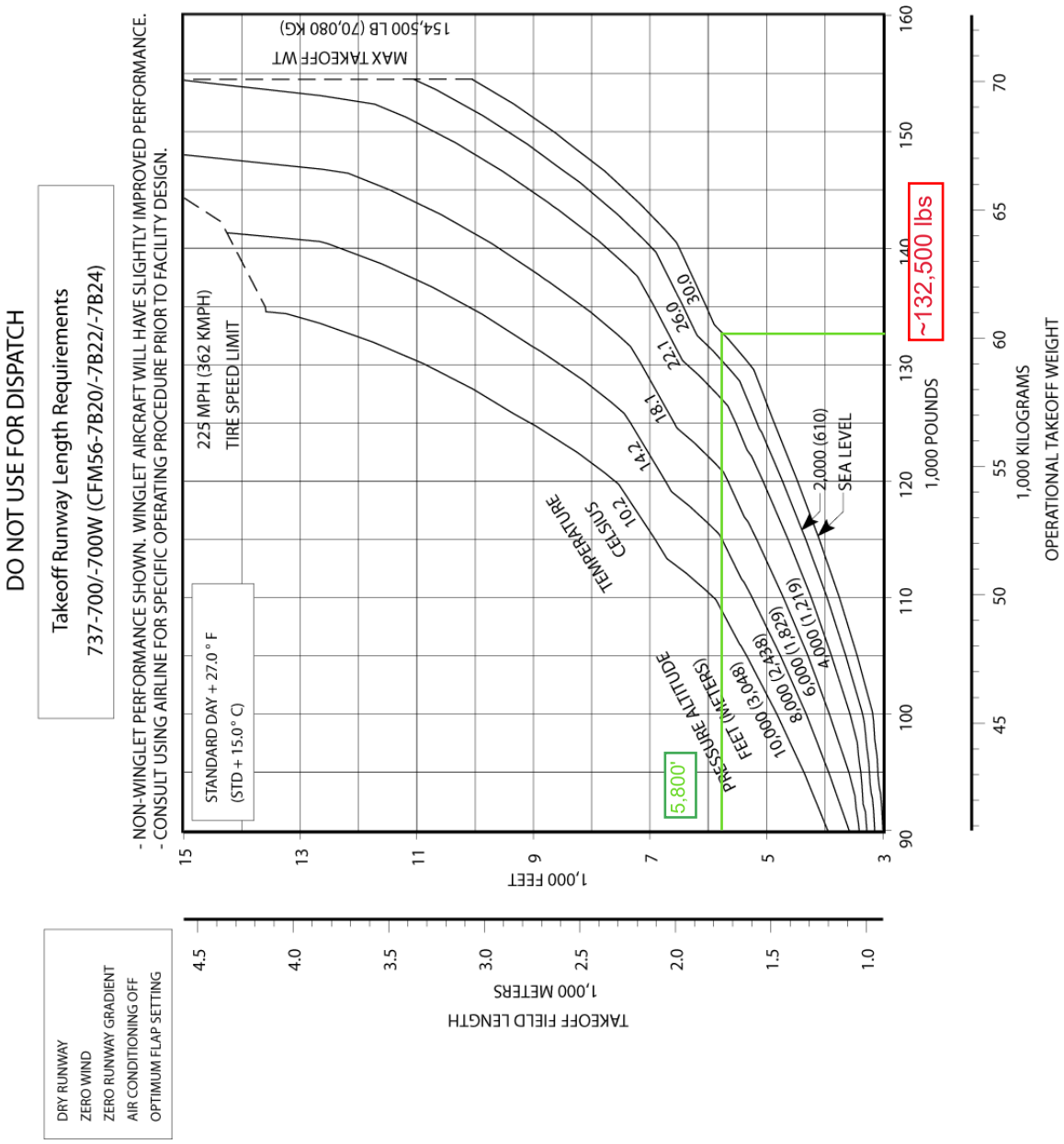
3.3.16 F.A.R. Takeoff Runway Length Requirements - Standard Day + 27°F (STD + 15°C): Model 737-400 (CFM56-3B-2 Engines at 22,000 LB SLST)



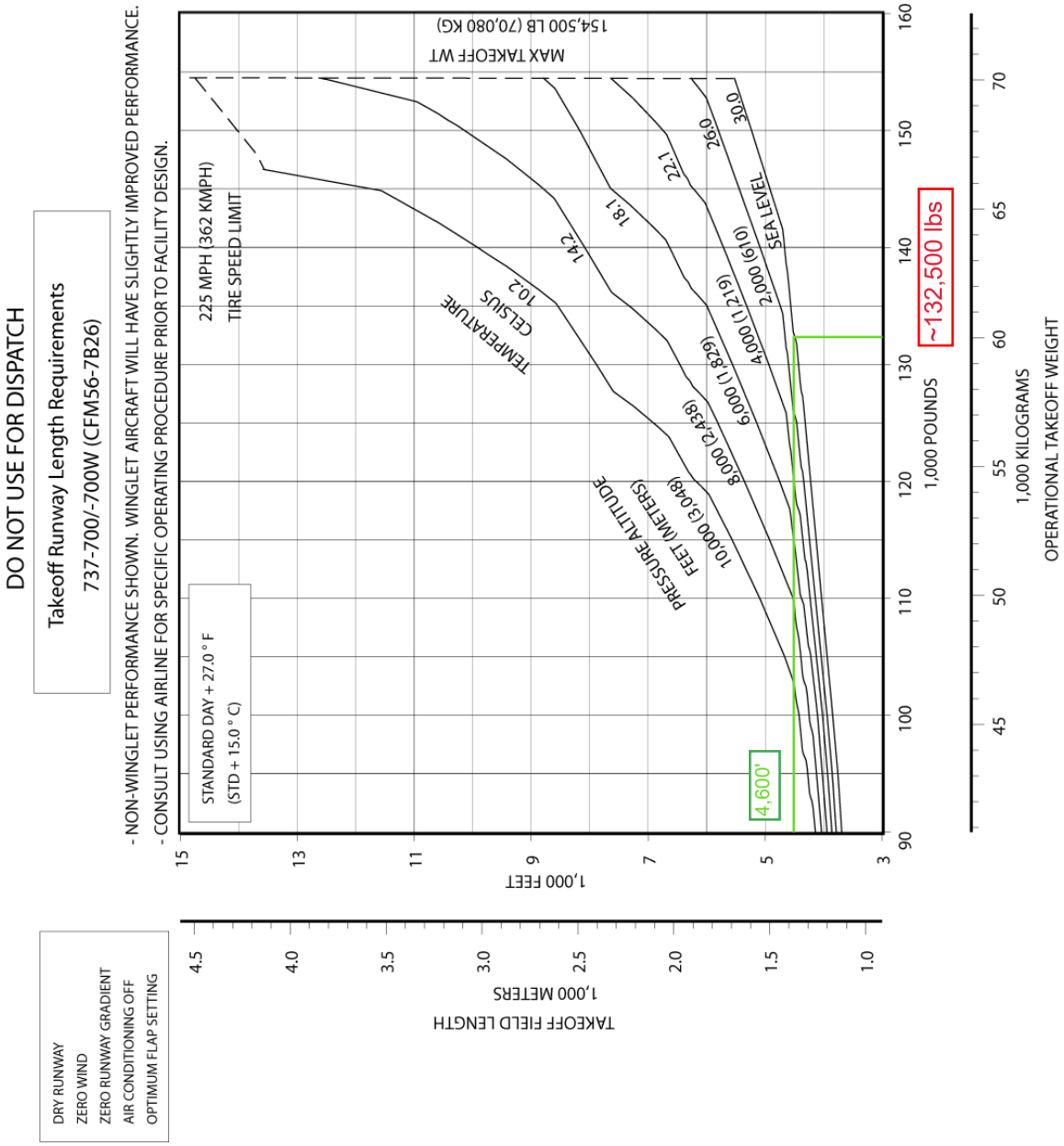
3.3.18 F.A.R. Takeoff Runway Length Requirements - Standard Day + 27°F (STD + 15°C): Model 737-400 (CFM56-3C1 Engines at 23,500 LB SLST)



3.3.32 F.A.R. Takeoff Runway Length Requirements - Standard Day + 27°F (STD + 15°C), Dry Runway: Model 737-700 (CFM56-7B20/-7B22/-7B24 Engines at 20,000 LB SLST)

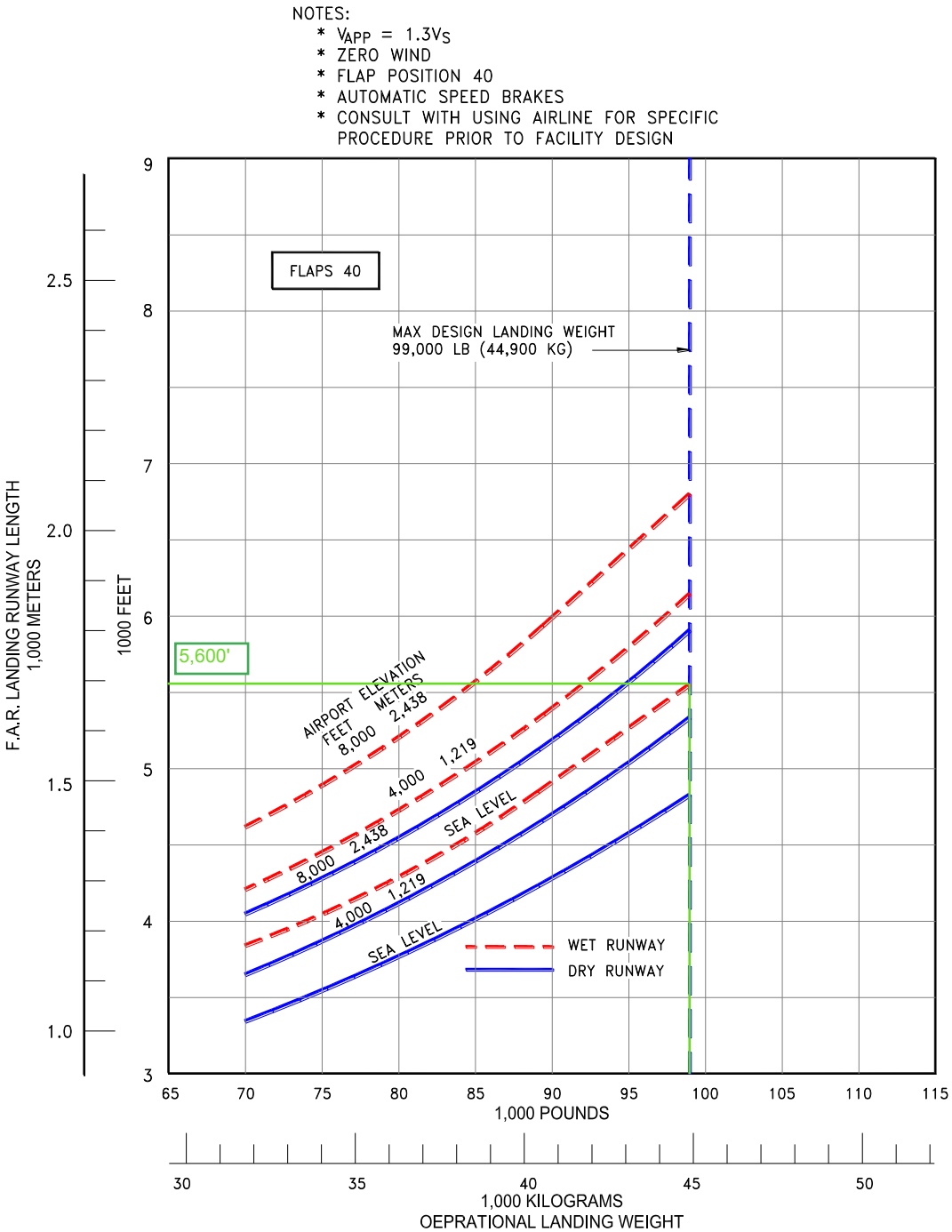


3.3.36 F.A.R. Takeoff Runway Length Requirements - Standard Day, +27°F (STD + 15°C), Dry Runway: Model 737-700/-700W (CFM56-7B26 Engines at 26,000 LB SLST

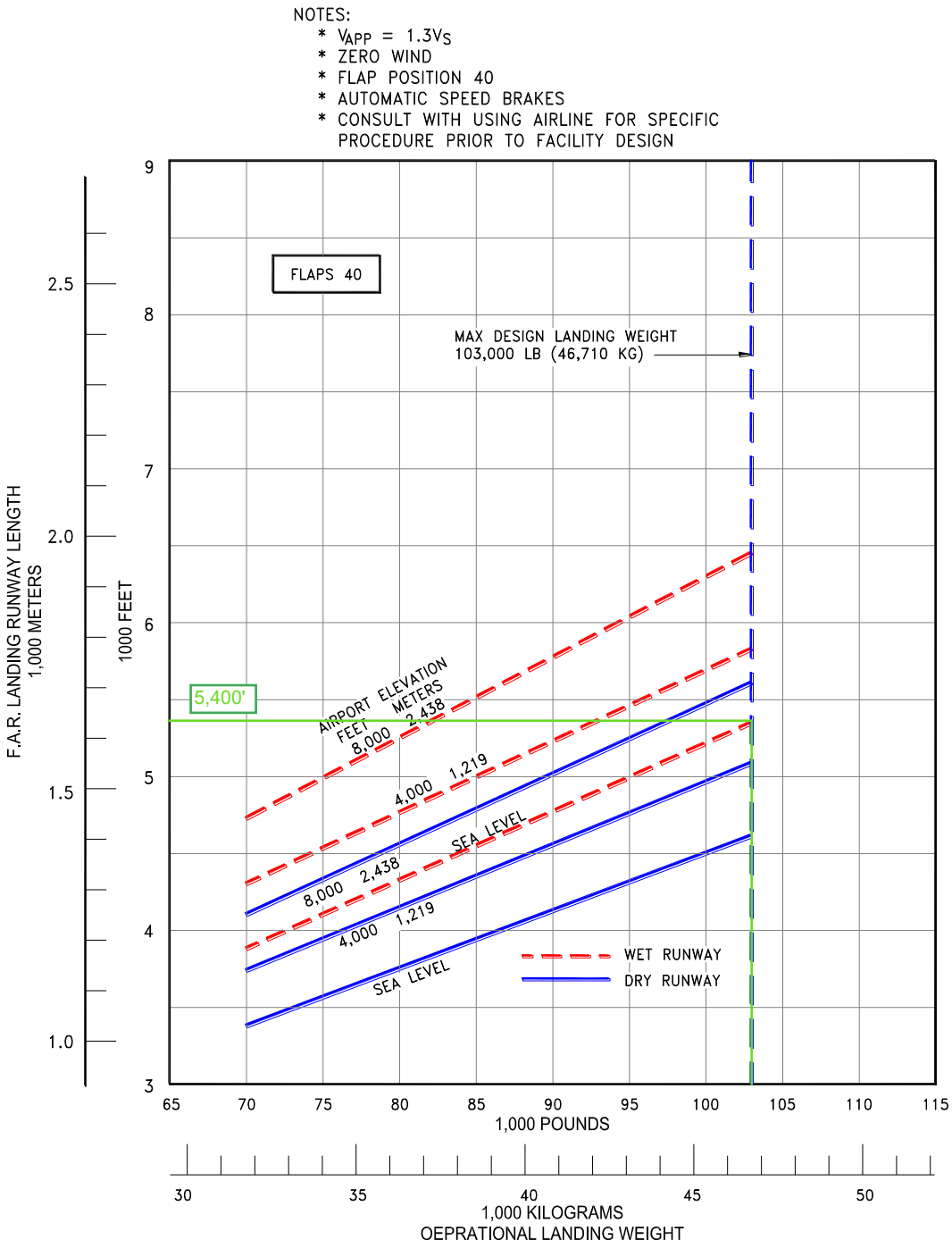


3.4 F.A.R. AND J.A.R. LANDING RUNWAY LENGTH REQUIREMENTS

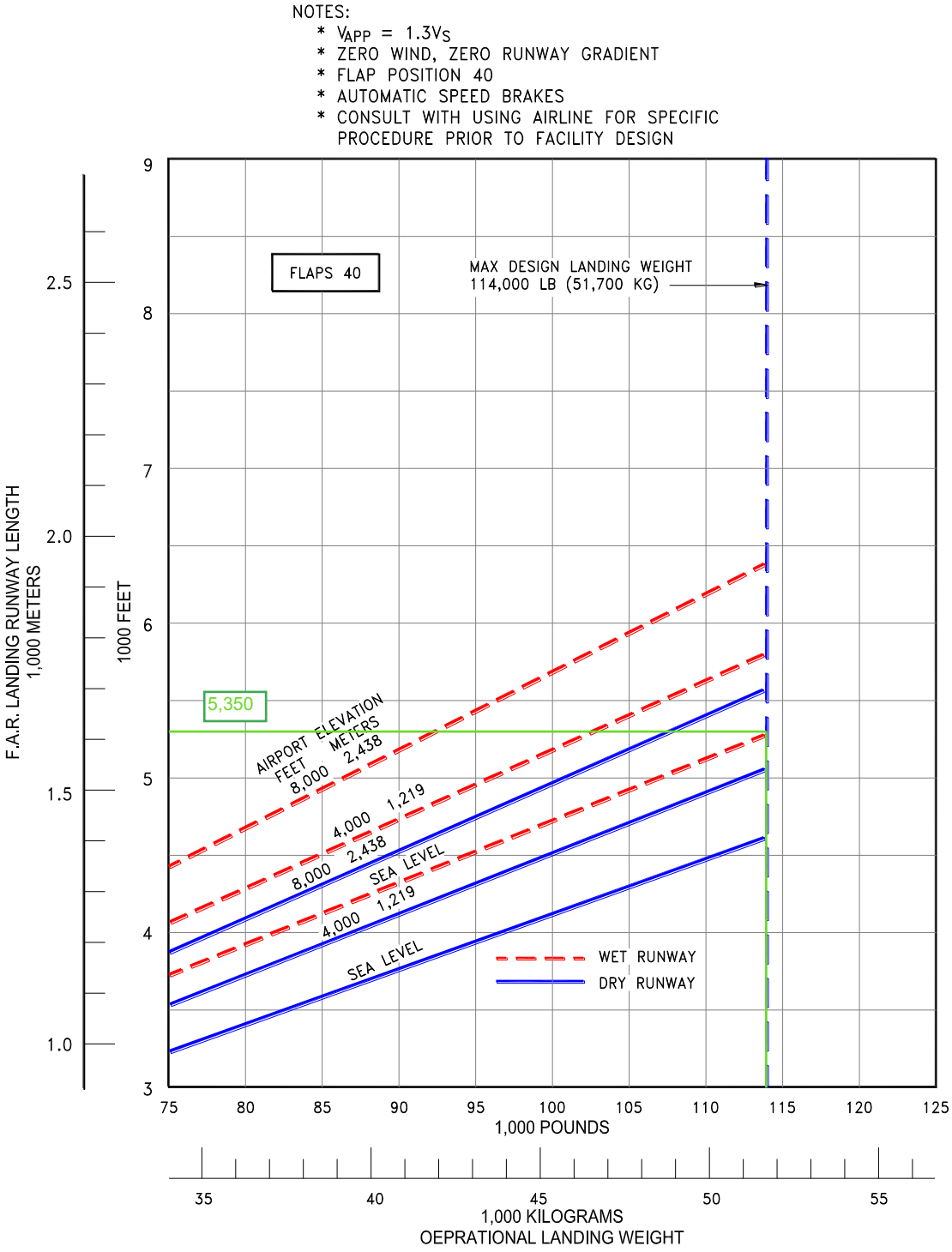
3.4.1 F.A.R. Landing Runway Length Requirements - Flaps 40: Model 737-100



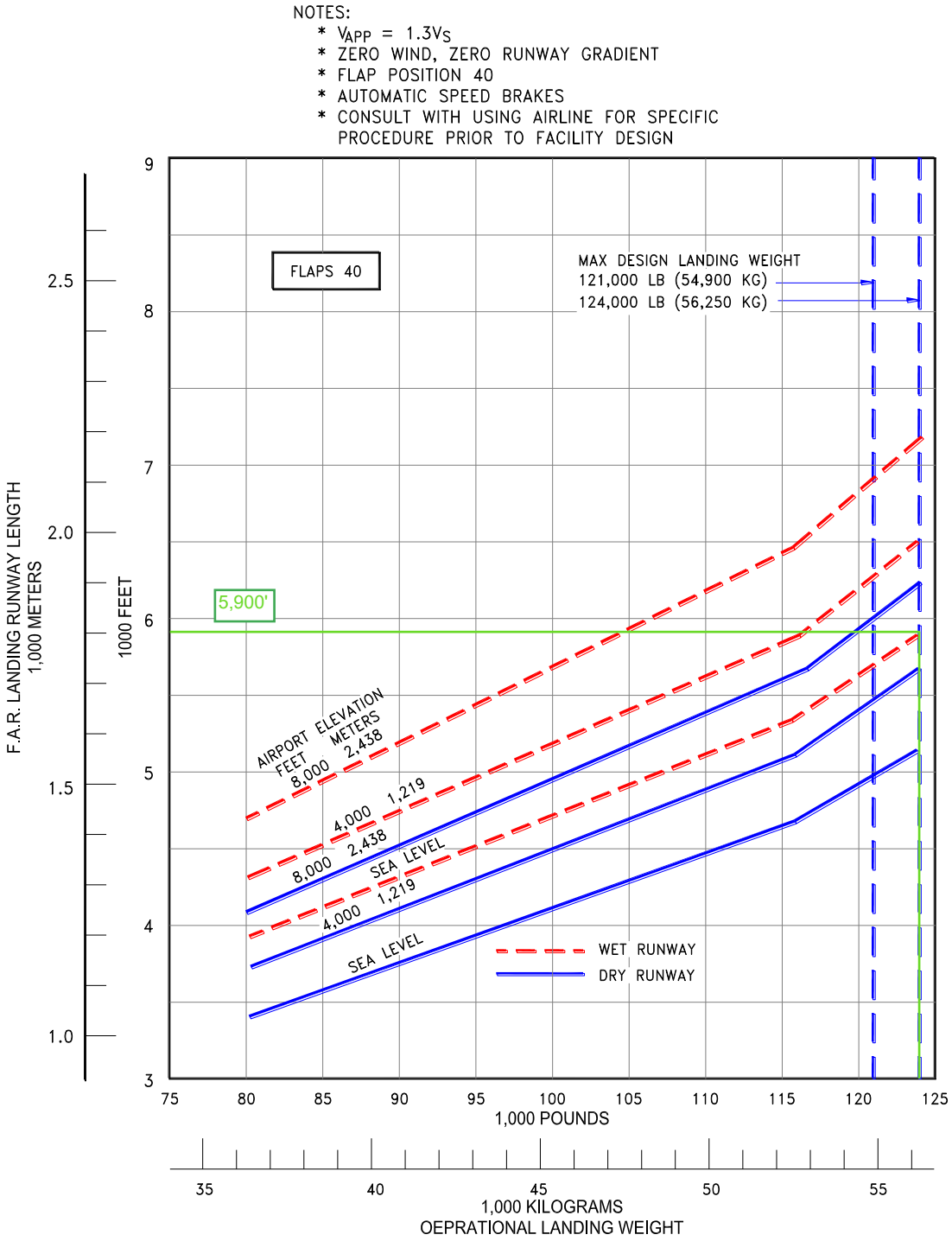
3.4.4 F.A.R. Landing Runway Length Requirements - Flaps 40: Model 737-200, -200C



3.4.10 F.A.R. Landing Runway Length Requirements - Flaps 40: Model 737-300



3.4.13 F.A.R. Landing Runway Length Requirements - Flaps 40: Model 737-400



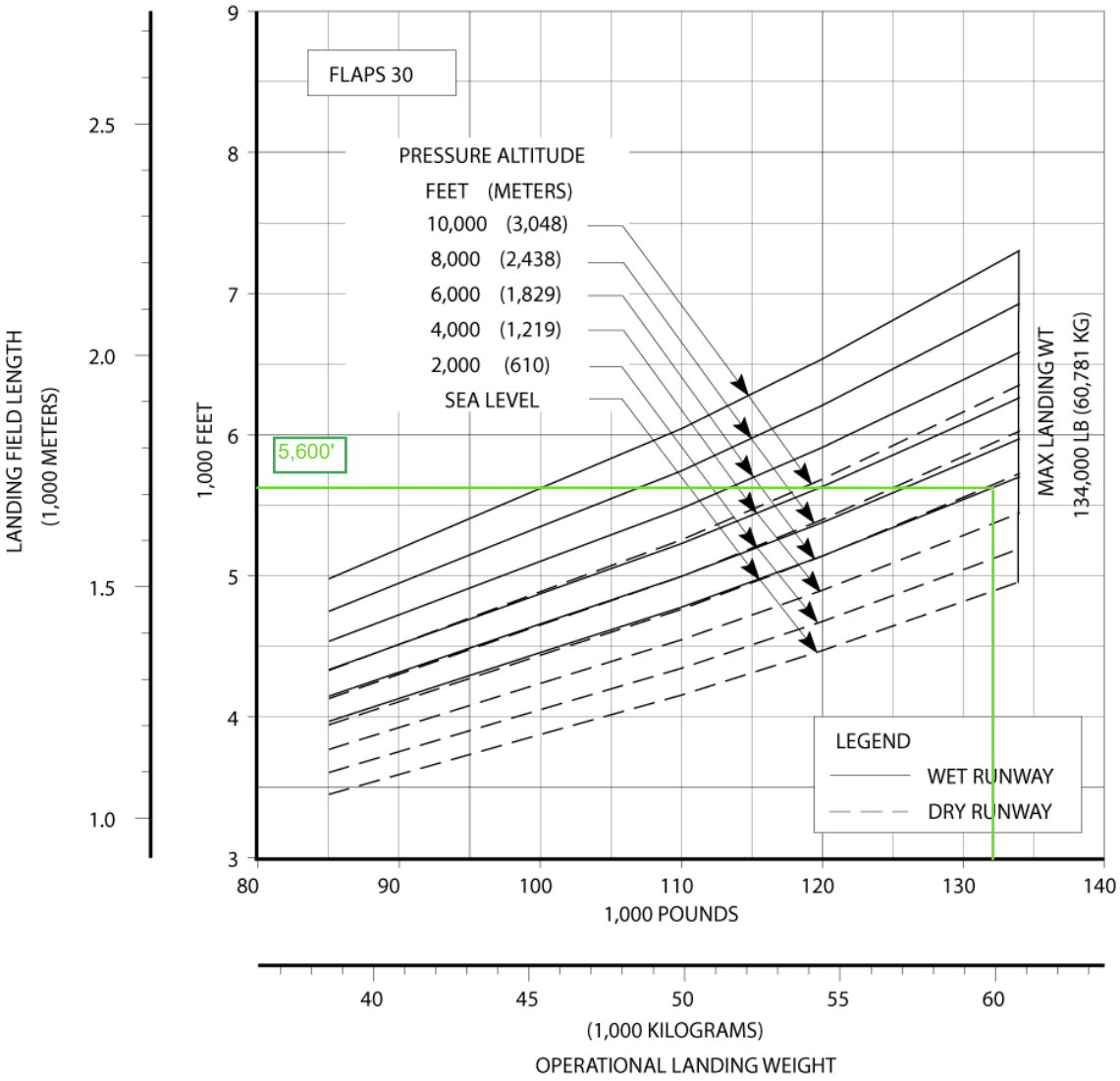
3.4.20 F.A.R. Landing Runway Length Requirements - Flaps 30: Model 737-700ER

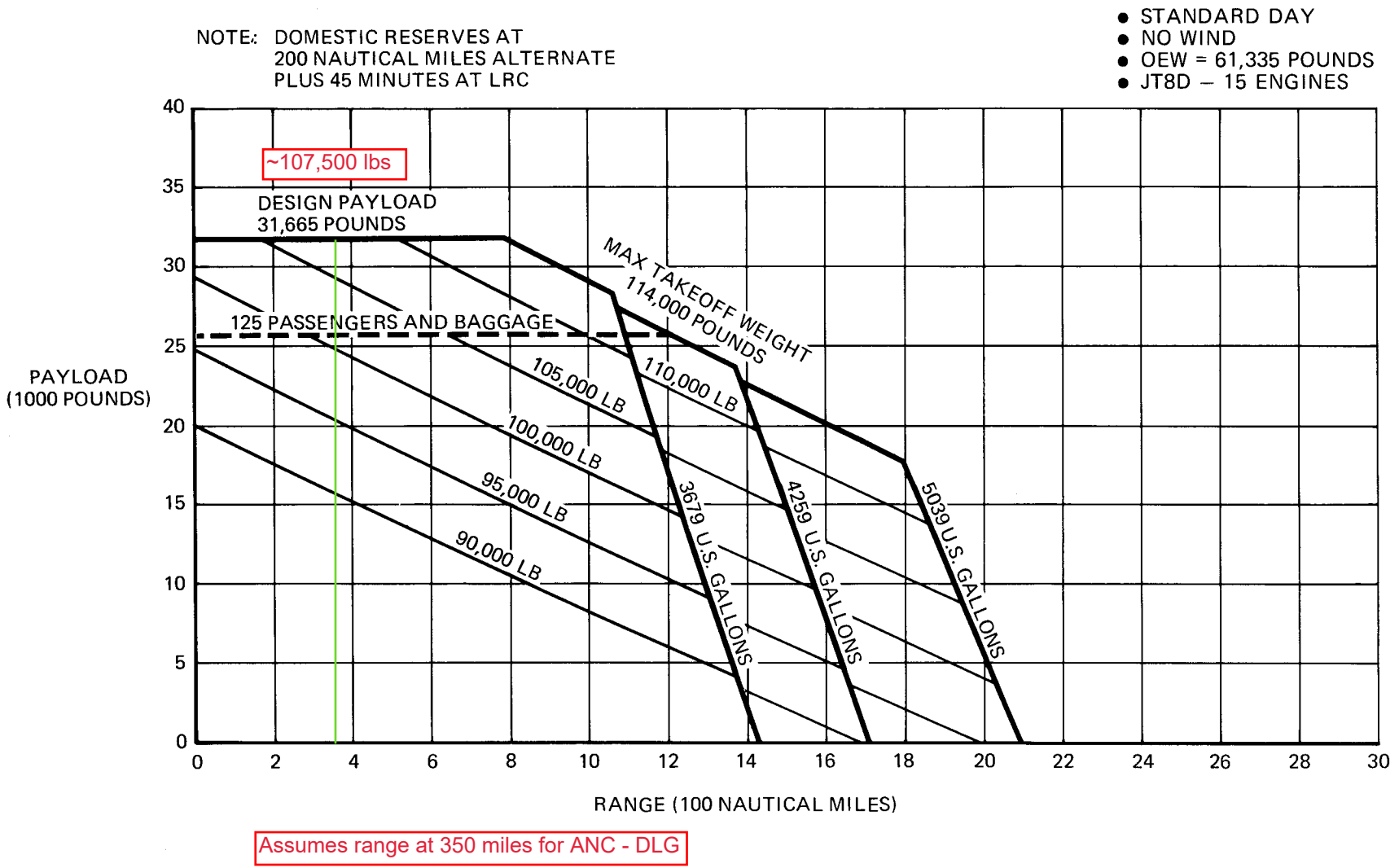
DO NOT USE FOR DISPATCH

Landing Field Length

737-700/-700W/-700ER/-700ERW/-700C/-700CW/BBJ1 (CFM56-7B Series)

- STANDARD DAY, ZERO WIND
- AUTO SPOILERS OPERATIVE
- ANTI-SKID OPERATIVE
- ZERO RUNWAY GRADIENT
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN



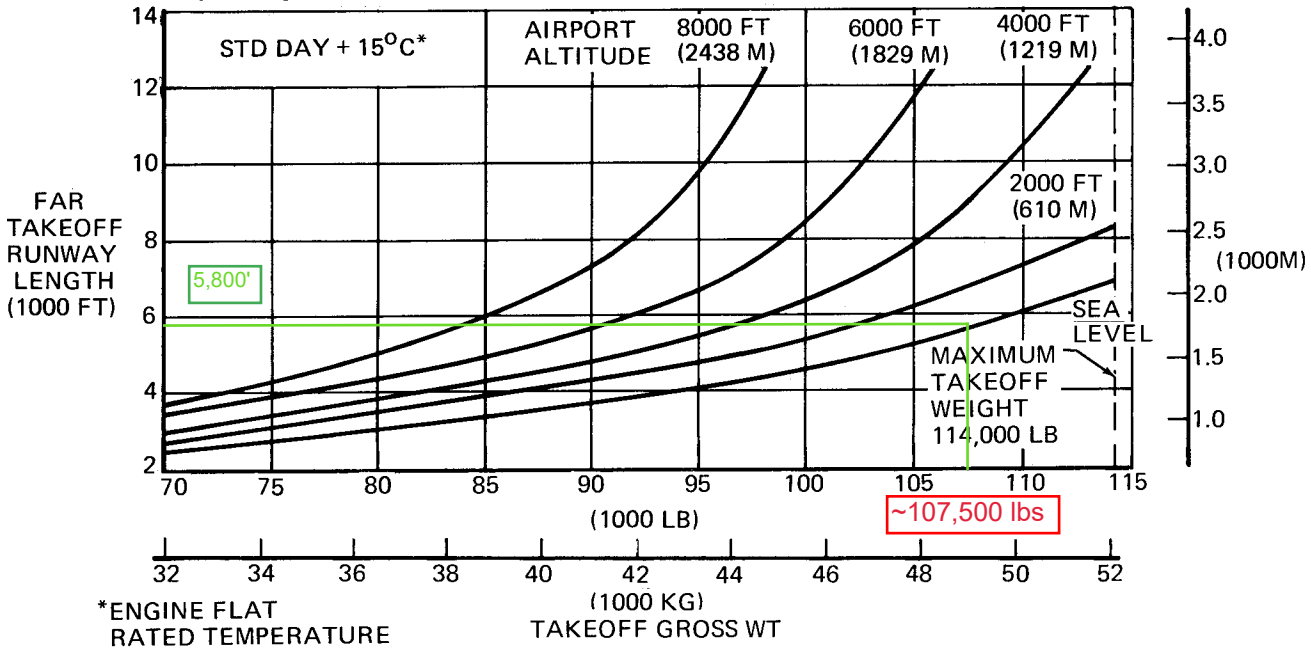


Assumes range at 350 miles for ANC - DLG

3.2 PAYLOAD-RANGE
PAYLOAD-RANGE FOR TYPICAL LONG-RANGE CRUISE AT 30,000 FT
MODEL DC-9-41

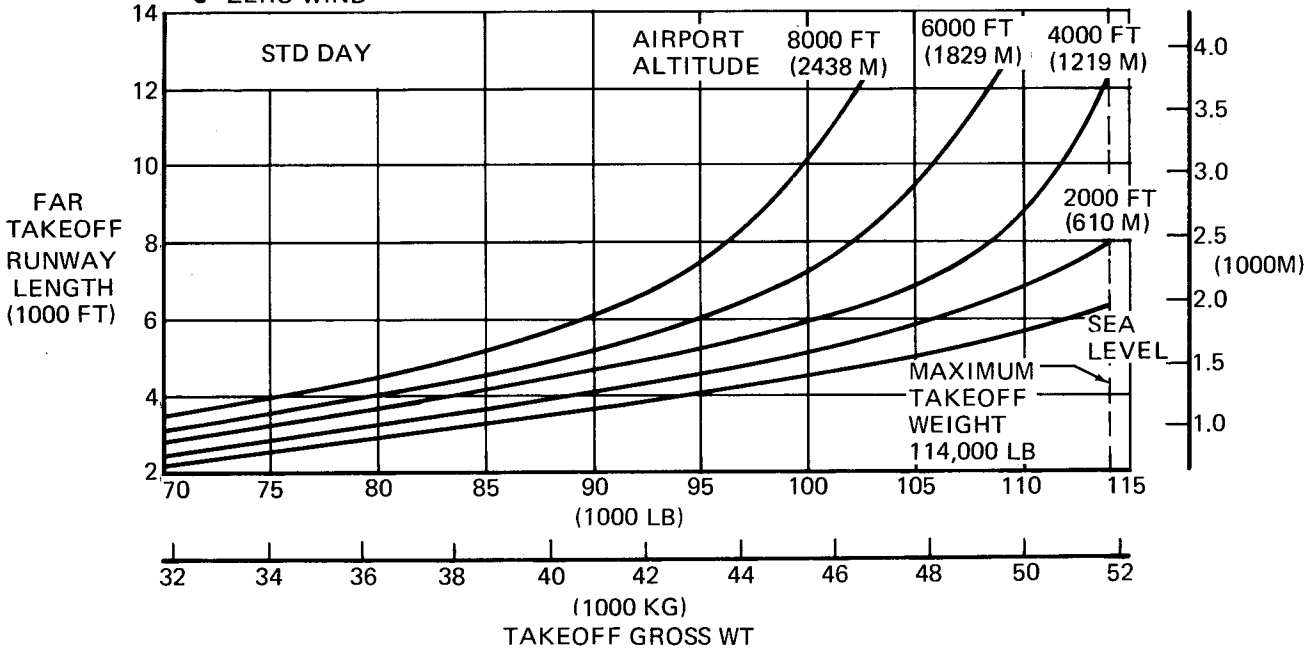
NOTES:

- JT8D-15 ENGINES
- MAX TAKEOFF POWER
- ZERO RUNWAY GRADIENT
- ZERO WIND
- COORDINATE WITH USING AIRLINE FOR SPECIFIC REQUIREMENTS PRIOR TO FACILITY DESIGN



NOTES:

- JT8D-15 ENGINES
- MAX TAKEOFF POWER
- ZERO RUNWAY GRADIENT
- ZERO WIND
- COORDINATE WITH USING AIRLINE FOR SPECIFIC REQUIREMENTS PRIOR TO FACILITY DESIGN



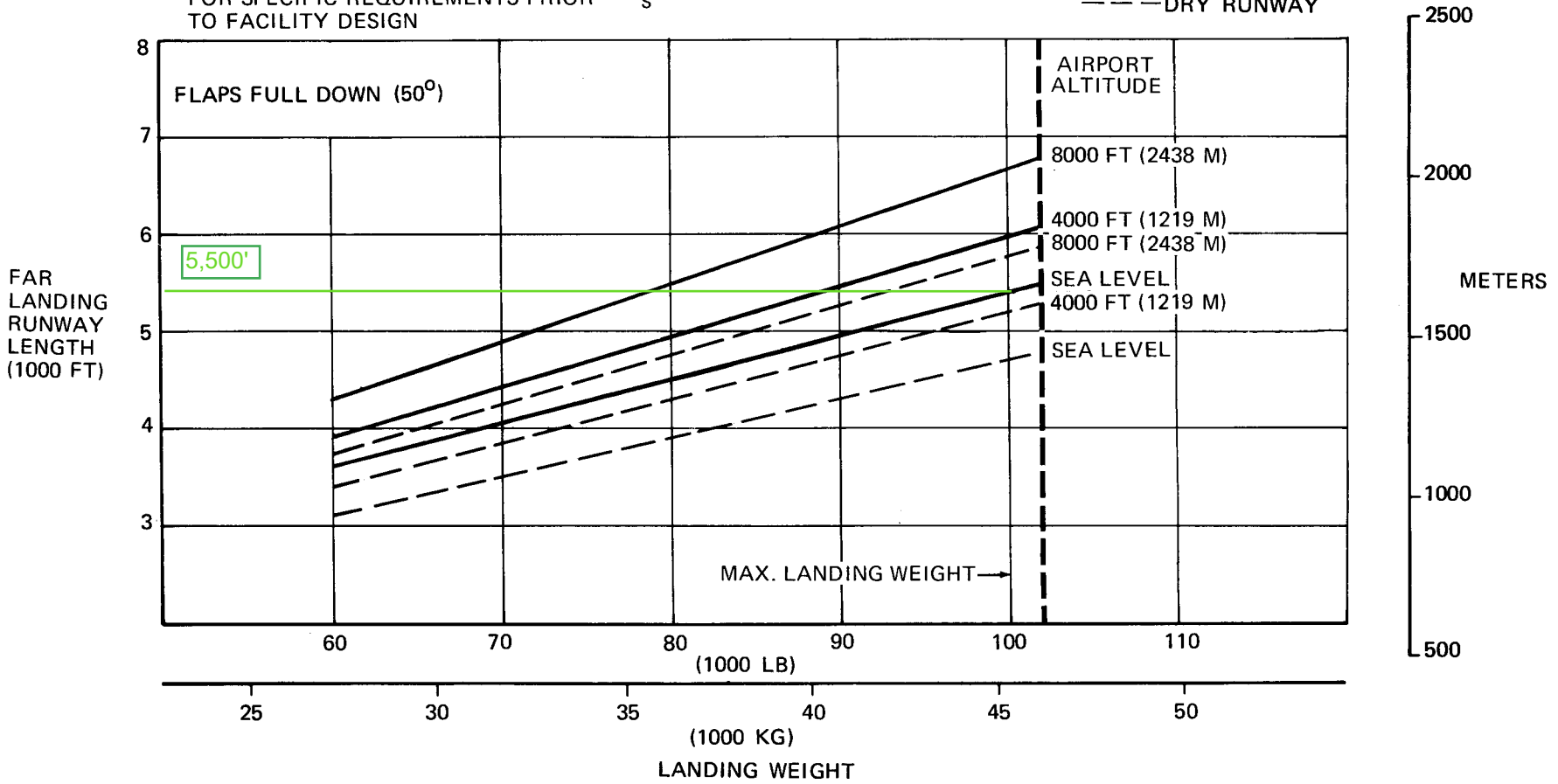
3.3 FAR TAKEOFF RUNWAY LENGTH REQUIREMENTS MODEL DC-9-41

NOTES:

- STANDARD DAY
- 3-DEG GLIDESLOPE
- ZERO WIND AT 50-FOOT HEIGHT
- ZERO RUNWAY GRADIENT
- COORDINATE WITH USING AIRLINES FOR SPECIFIC REQUIREMENTS PRIOR TO FACILITY DESIGN

- $V_{APP} = 1.3\ V_S$ FAR (DRY AND WET RUNWAY)

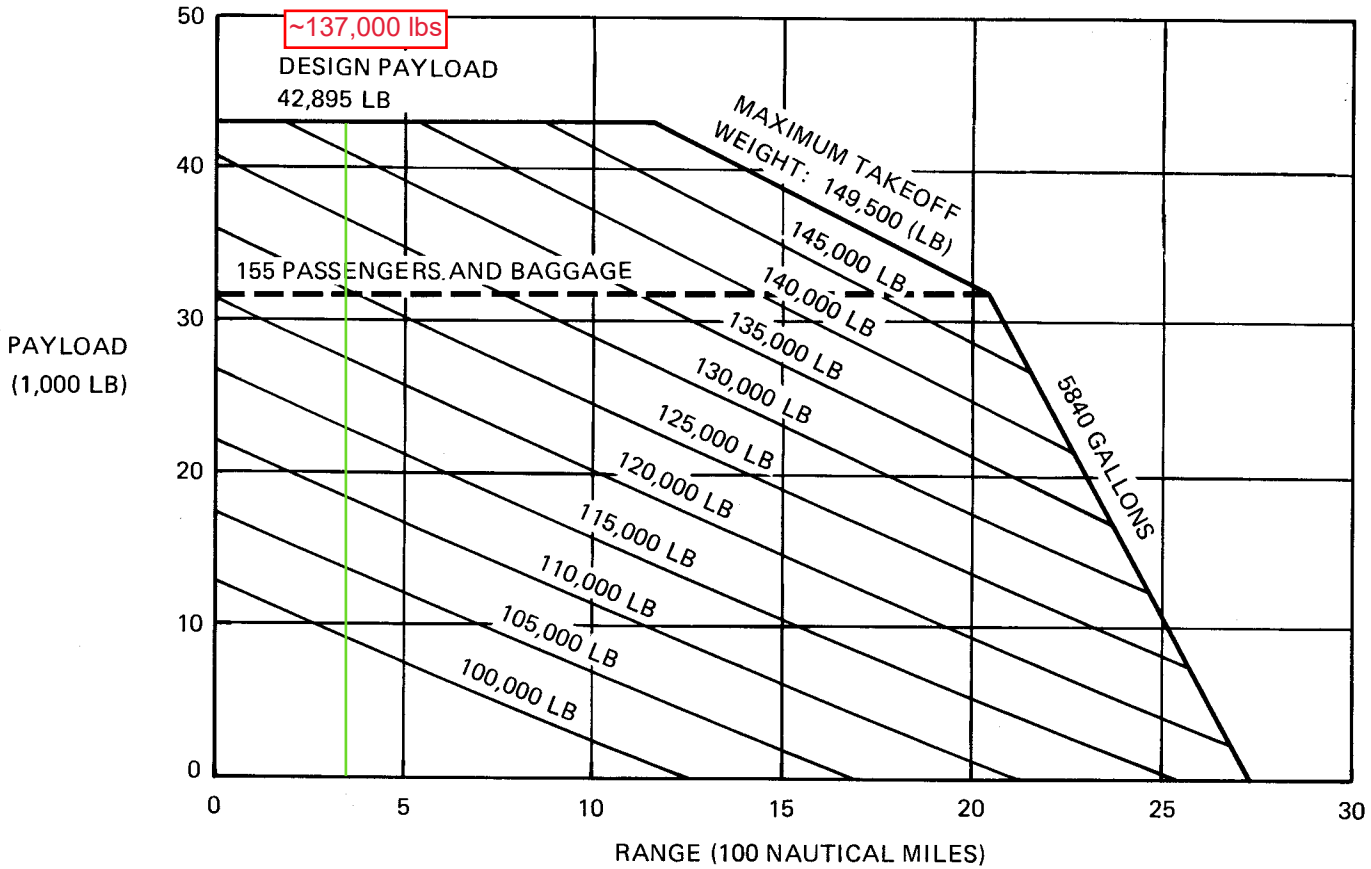
V_{APP} IS APPROACH VELOCITY
V_S IS STALL VELOCITY



3.4 FAR LANDING RUNWAY LENGTH REQUIREMENTS
MODEL DC-9-41

NOTE: RESERVES BASED ON
FAR 121.639
200 N MI DISTANCE
TO ALTERNATE

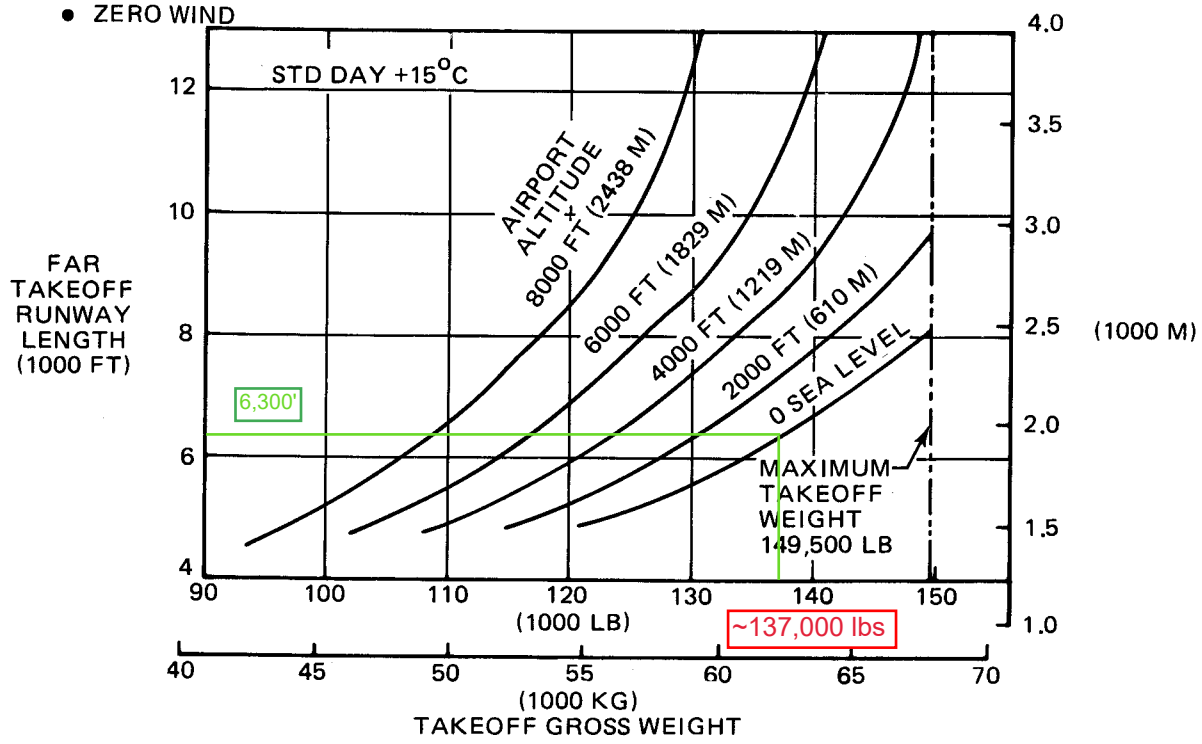
- STANDARD DAY
- NO WIND
- OEW = 78,549 LB
- JT8D-217/217A ENGINES



3.2 PAYLOAD-RANGE
PAYLOAD-RANGE FOR TYPICAL LONG-RANGE CRUISE AT 31,000 FT/35,000 FT STEP
MODEL MD-82 AND -88

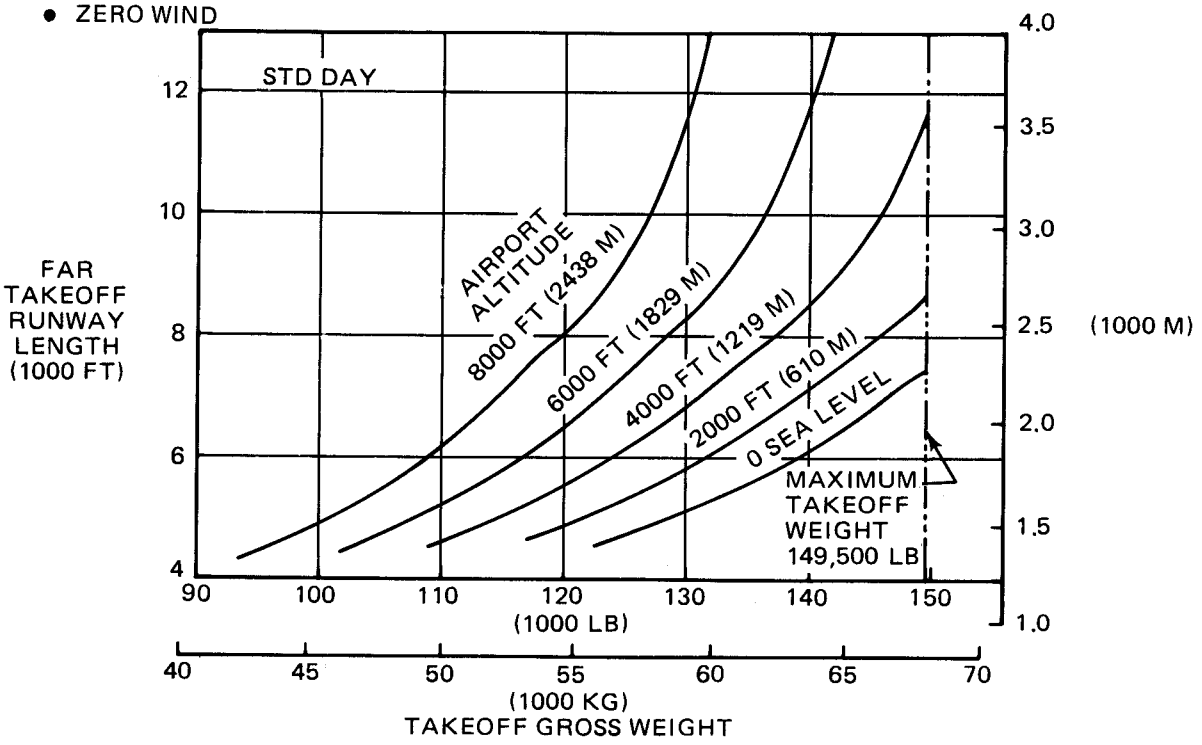
NOTES:

- JT8D-217 ENGINES
- NORMAL TAKEOFF THRUST AND ART
- ZERO RUNWAY GRADIENT
- ZERO WIND
- COORDINATE WITH USING AIRLINE FOR SPECIFIC REQUIREMENTS PRIOR TO FACILITY DESIGN



NOTES:

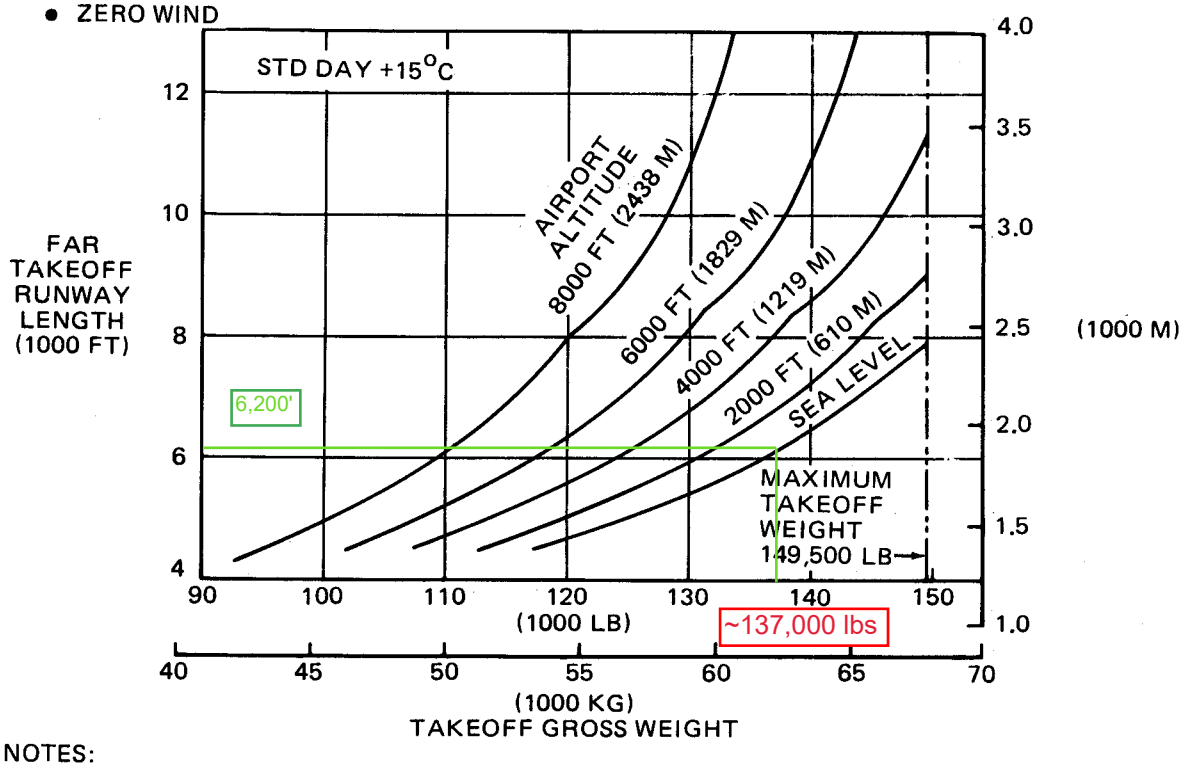
- JT8D-217 ENGINES
- NORMAL TAKEOFF THRUST AND ART
- ZERO RUNWAY GRADIENT
- ZERO WIND
- COORDINATE WITH USING AIRLINE FOR SPECIFIC REQUIREMENTS PRIOR TO FACILITY DESIGN



3.3 FAR TAKEOFF RUNWAY LENGTH REQUIREMENTS MODEL MD-82

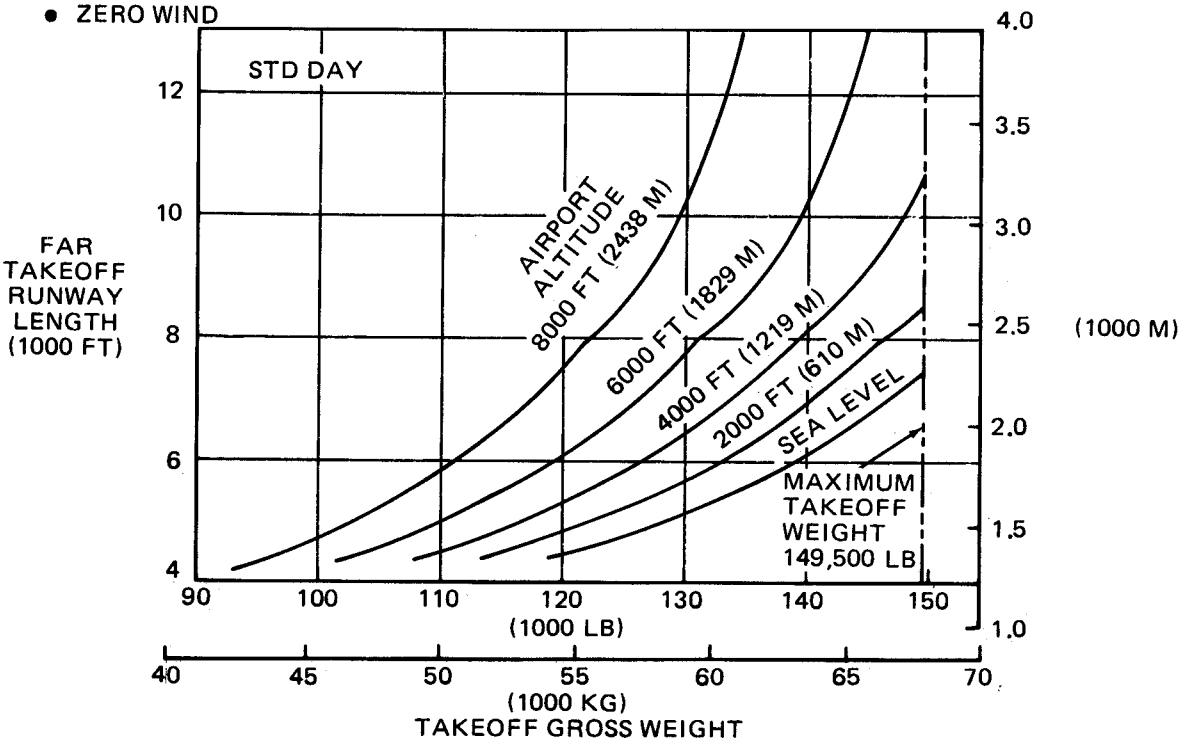
NOTES:

- JT8D-217A ENGINES
- NORMAL TAKEOFF THRUST AND ART
- ZERO RUNWAY GRADIENT
- ZERO WIND
- COORDINATE WITH USING AIRLINE FOR SPECIFIC REQUIREMENTS PRIOR TO FACILITY DESIGN



NOTES:

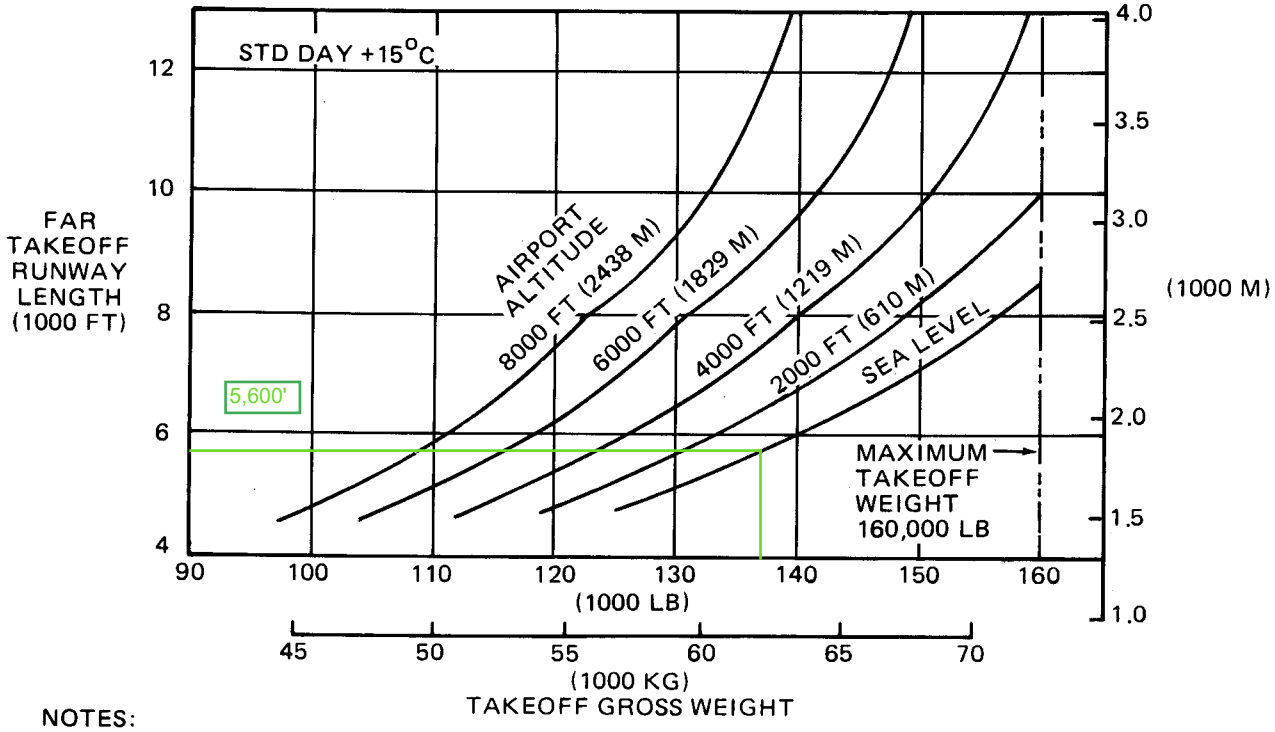
- JT8D-217A ENGINES
- NORMAL TAKEOFF THRUST AND ART
- ZERO RUNWAY GRADIENT
- ZERO WIND
- COORDINATE WITH USING AIRLINE FOR SPECIFIC REQUIREMENTS PRIOR TO FACILITY DESIGN



3.3 FAR TAKEOFF RUNWAY LENGTH REQUIREMENTS MODEL MD-82 AND -88

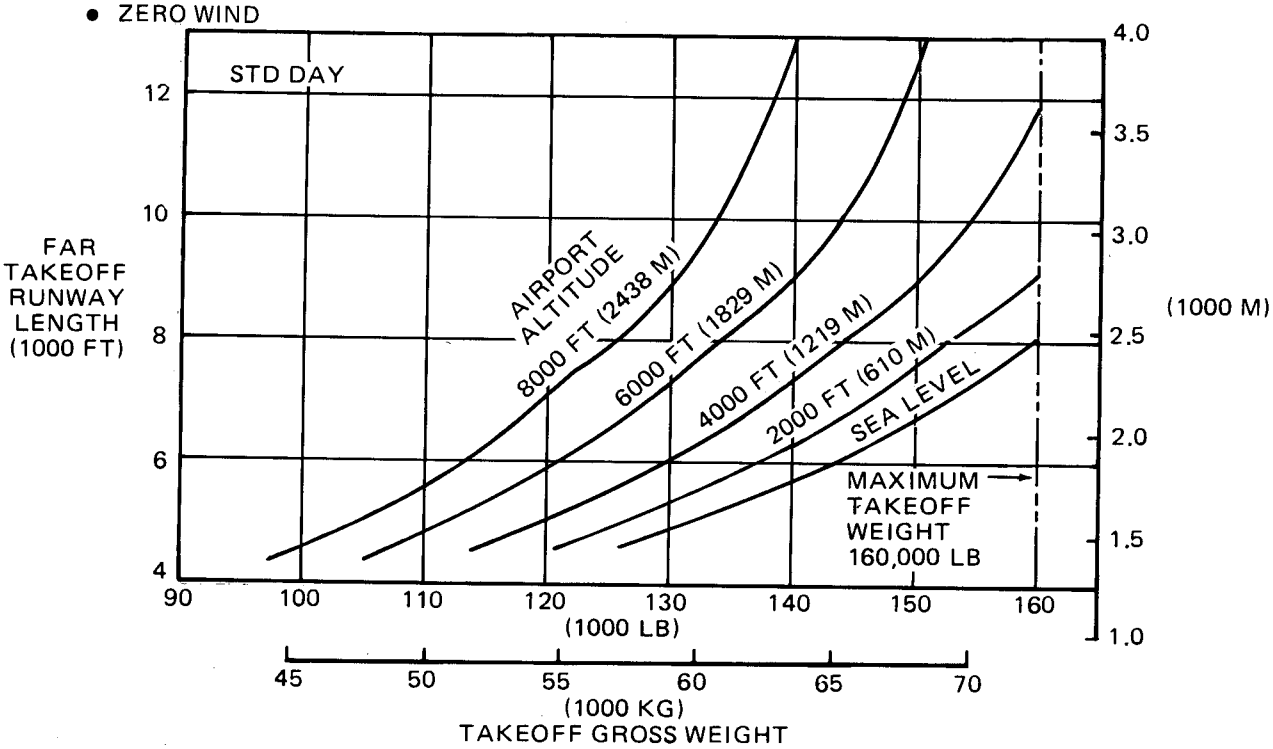
NOTES:

- JT8D-219 ENGINES
- NORMAL TAKEOFF THRUST AND ART
- ZERO RUNWAY GRADIENT
- ZERO WIND
- COORDINATE WITH USING AIRLINE FOR SPECIFIC REQUIREMENTS PRIOR TO FACILITY DESIGN



NOTES:

- JT8D-219 ENGINES
- NORMAL TAKEOFF THRUST AND ART
- ZERO RUNWAY GRADIENT
- ZERO WIND
- COORDINATE WITH USING AIRLINE FOR SPECIFIC REQUIREMENTS PRIOR TO FACILITY DESIGN



3.3 FAR TAKEOFF RUNWAY LENGTH REQUIREMENTS MODEL MD-83

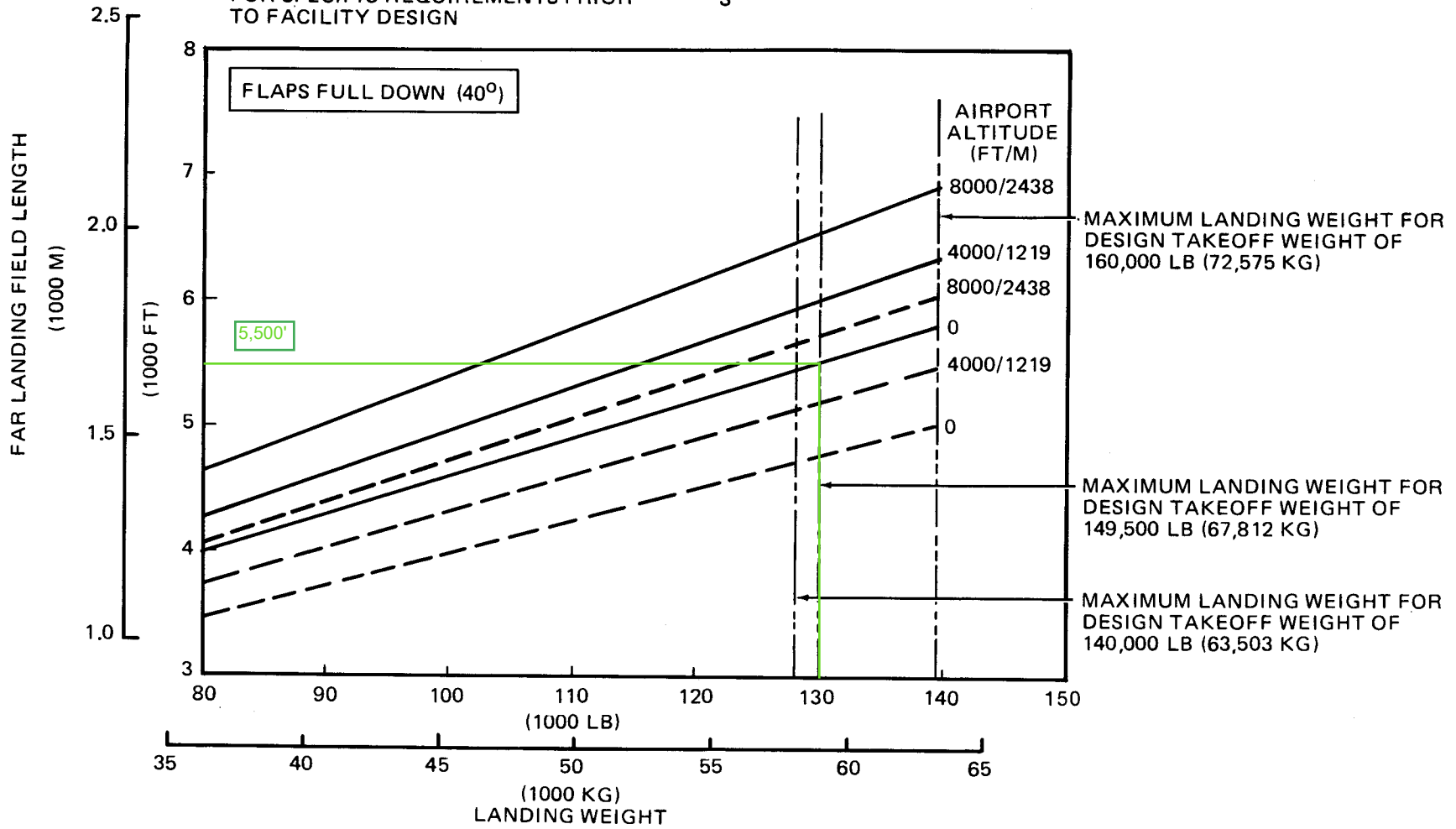
NOTES:

- STANDARD DAY
- 3-DEG GLIDESLOPE
- SLATS EXTENDED
- ZERO WIND AT 50-FOOT HEIGHT
- ZERO RUNWAY GRADIENT
- COORDINATE WITH USING AIRLINES FOR SPECIFIC REQUIREMENTS PRIOR TO FACILITY DESIGN

- V_{APP} = 1.3 V_S FAR
  = (DRY AND WET RUNWAY)

V_{APP} IS APPROACH VELOCITY

V_S IS STALL VELOCITY



3.4 FAR LANDING RUNWAY LENGTH REQUIREMENTS MODEL MD-81, -82, -83, AND -88

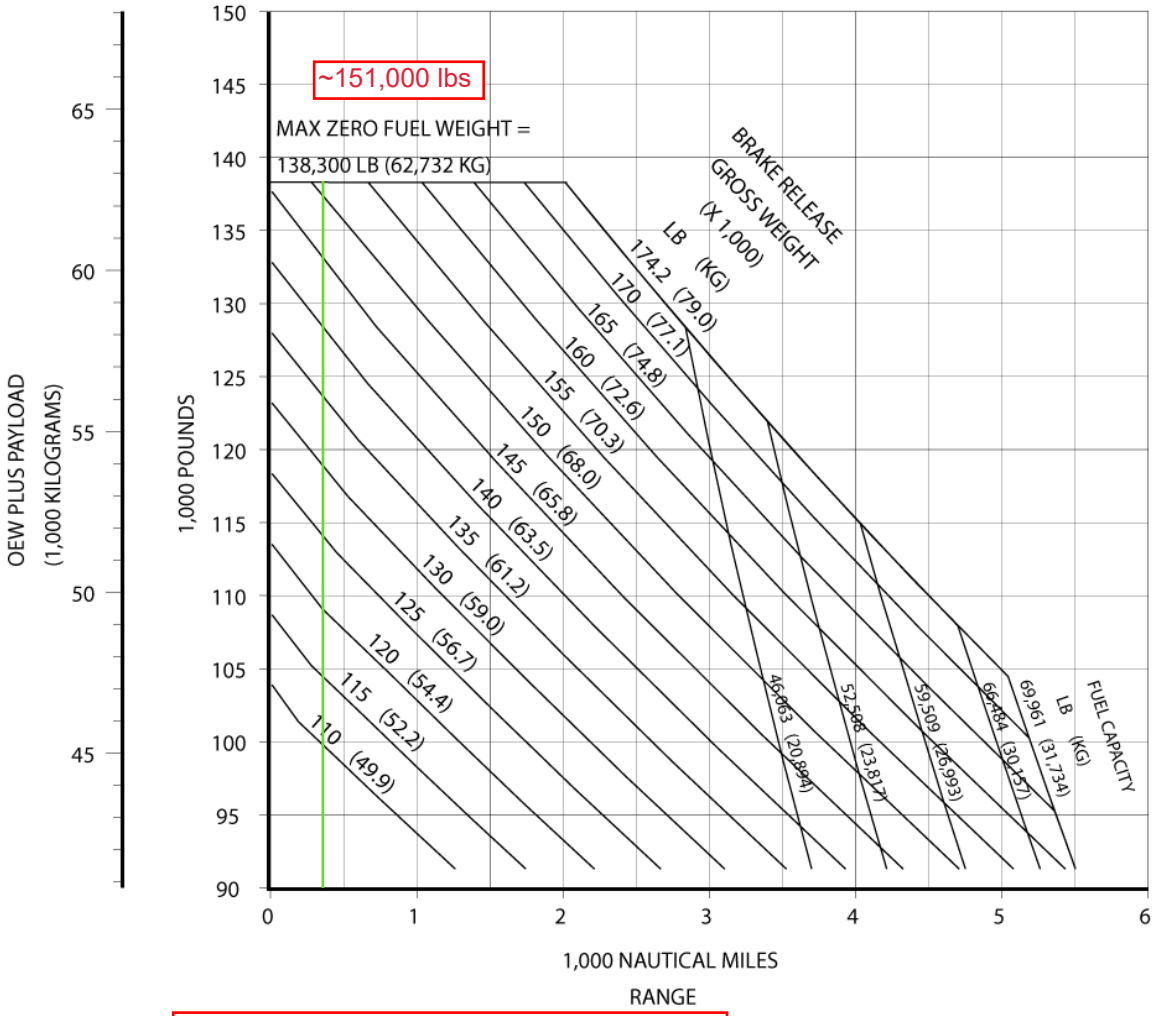
3.2.12 Payload/Range for Long Range Cruise: Model 737-800

DO NOT USE FOR DISPATCH

Payload/Range

737-800/800W/BBJ2 (CFM56-7B Series)

- STANDARD DAY, ZERO WIND
- CRUISE MACH = LRC
- NORMAL POWER EXTRACTION AND AIR CONDITIONING BLEEDS
- TYPICAL MISSION RULES
- NON-WINGLET PERFORMANCE SHOWN. WINGLET AIRCRAFT WILL HAVE SLIGHTLY GREATER RANGE.
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE AND OEW PRIOR TO FACILITY DESIGN.



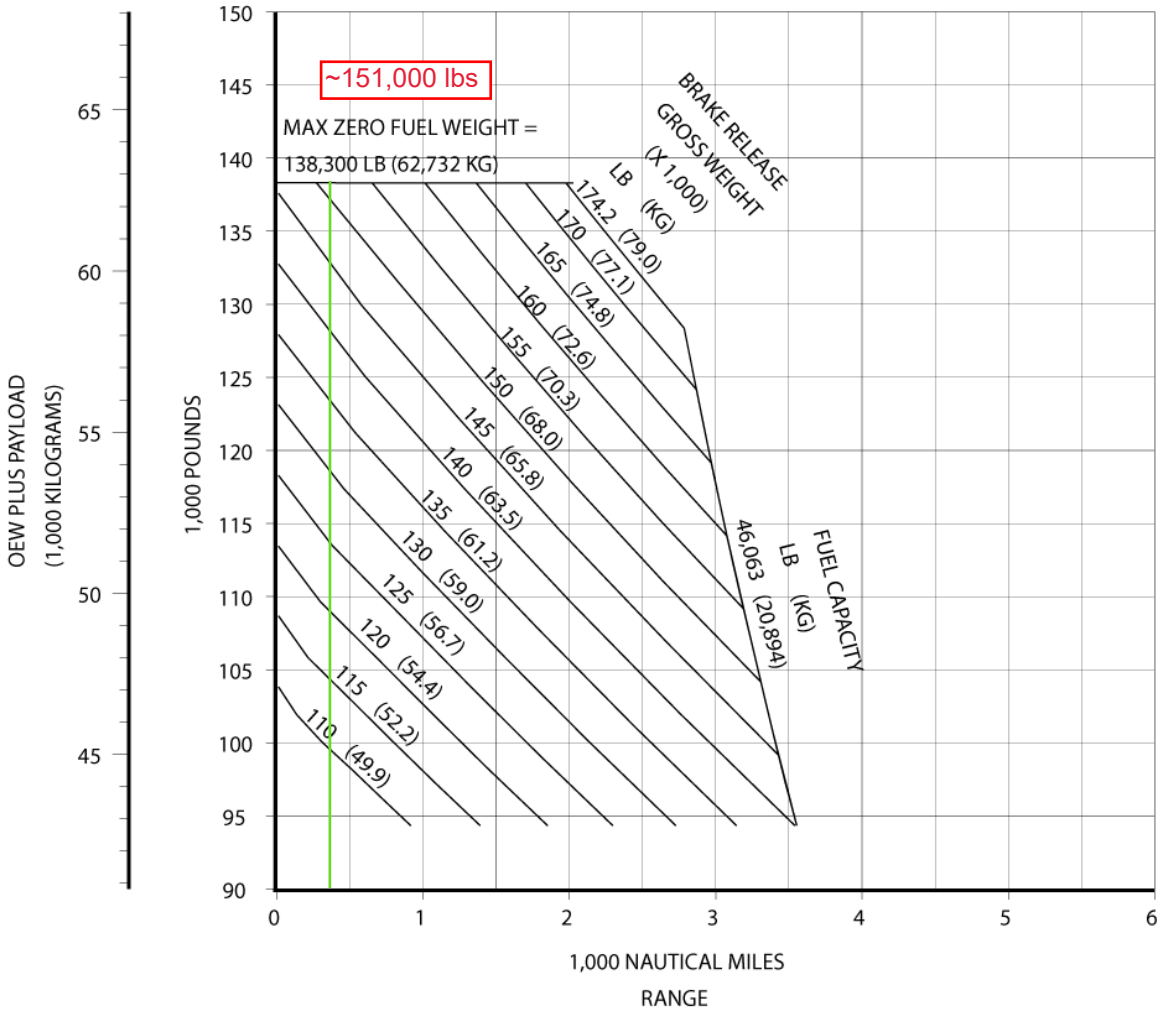
3.2.13 Payload/Range for Long Range Cruise: Model 737-900

DO NOT USE FOR DISPATCH

Payload/Range

737-900/-900W (CFM56-7B Series)

- STANDARD DAY, ZERO WIND
- CRUISE MACH = LRC
- NORMAL POWER EXTRACTION AND AIR CONDITIONING BLEEDS
- TYPICAL MISSION RULES
- NON-WINGLET PERFORMANCE SHOWN. WINGLET AIRCRAFT WILL HAVE SLIGHTLY GREATER RANGE.
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE AND OEW PRIOR TO FACILITY DESIGN.



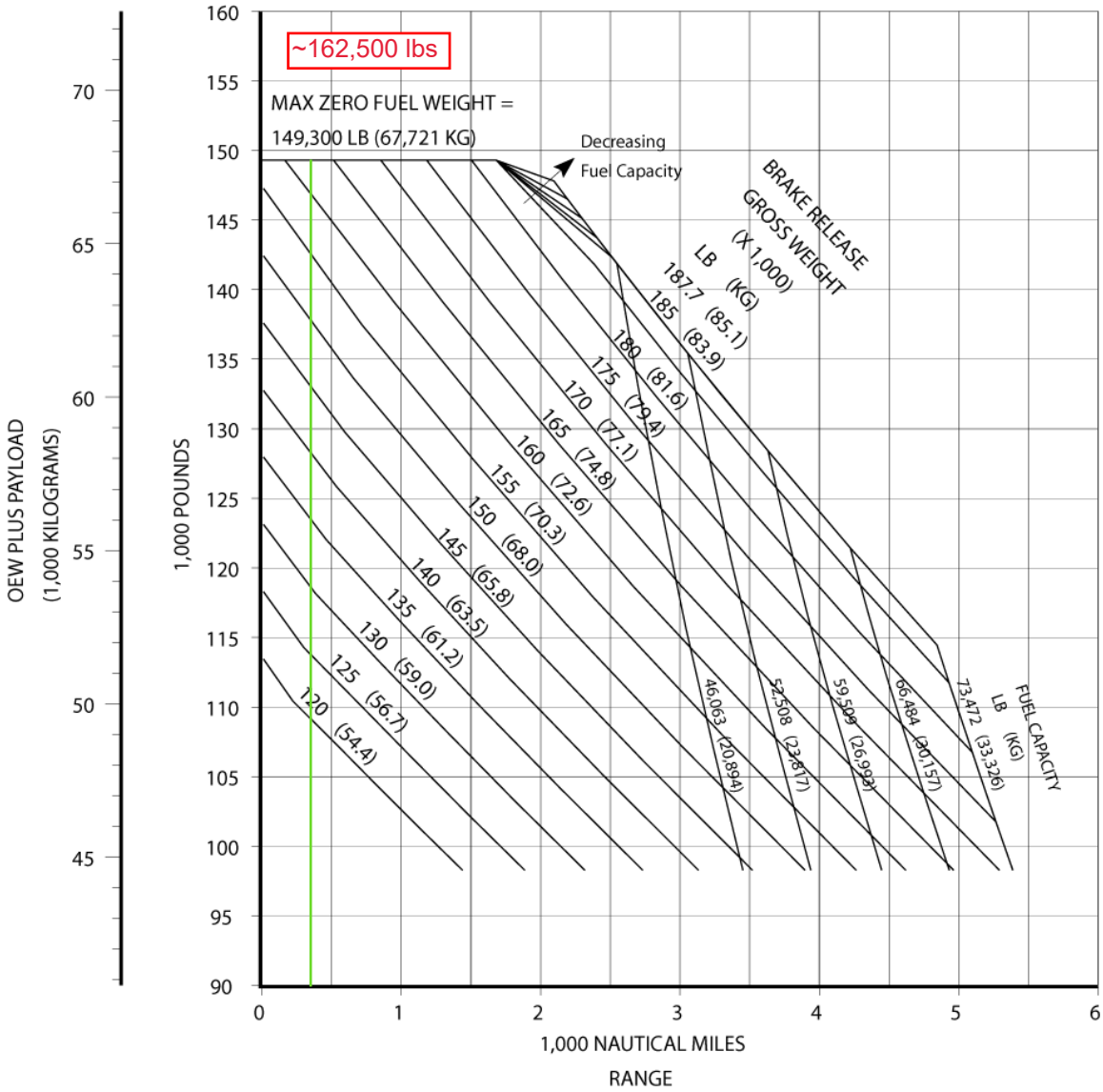
3.2.14 Payload/Range for Long Range Cruise: Model 737-900ER

DO NOT USE FOR DISPATCH

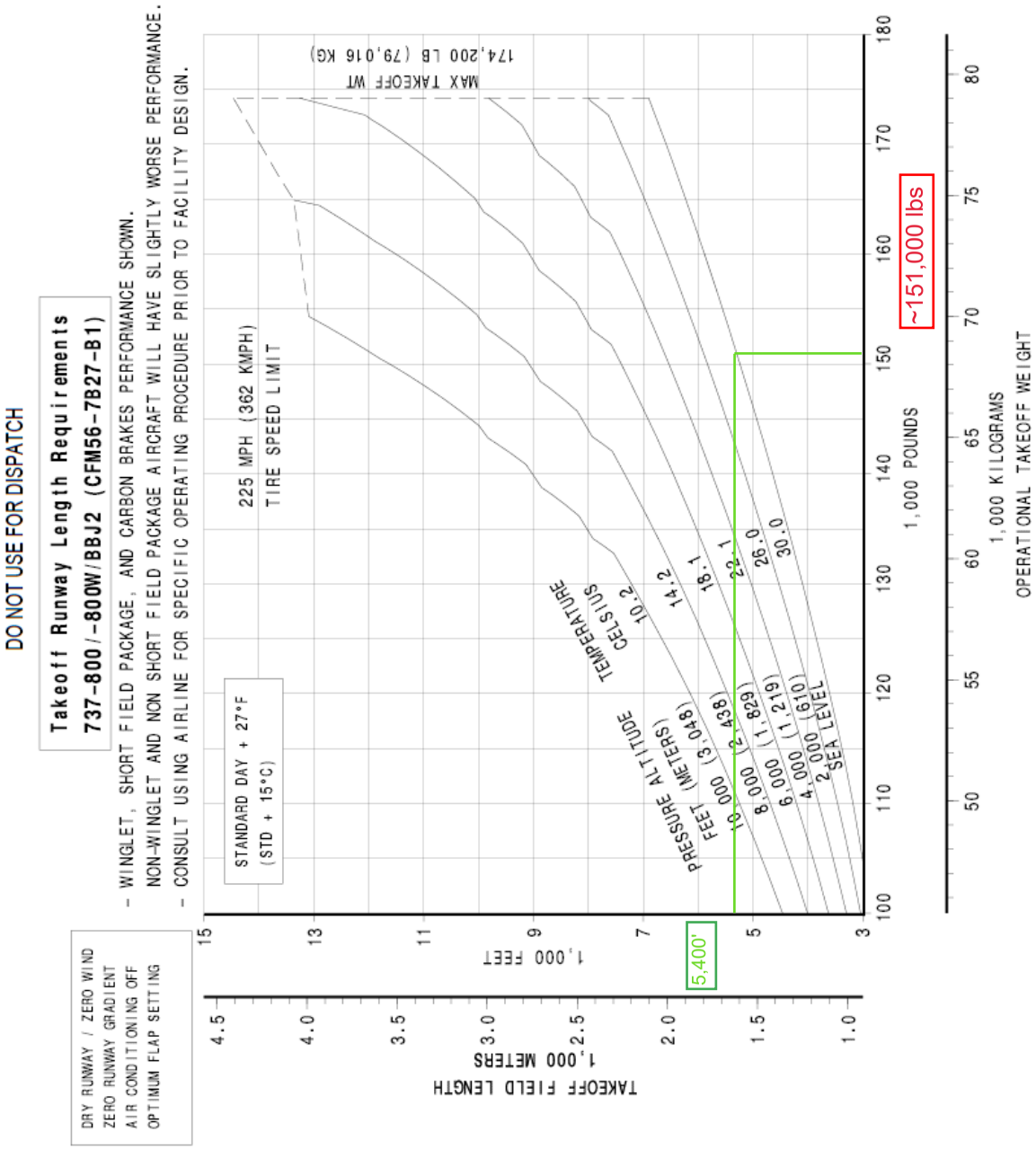
Payload/Range

737-900ER/900ERW/BBJ3 (CFM56-7B Series)

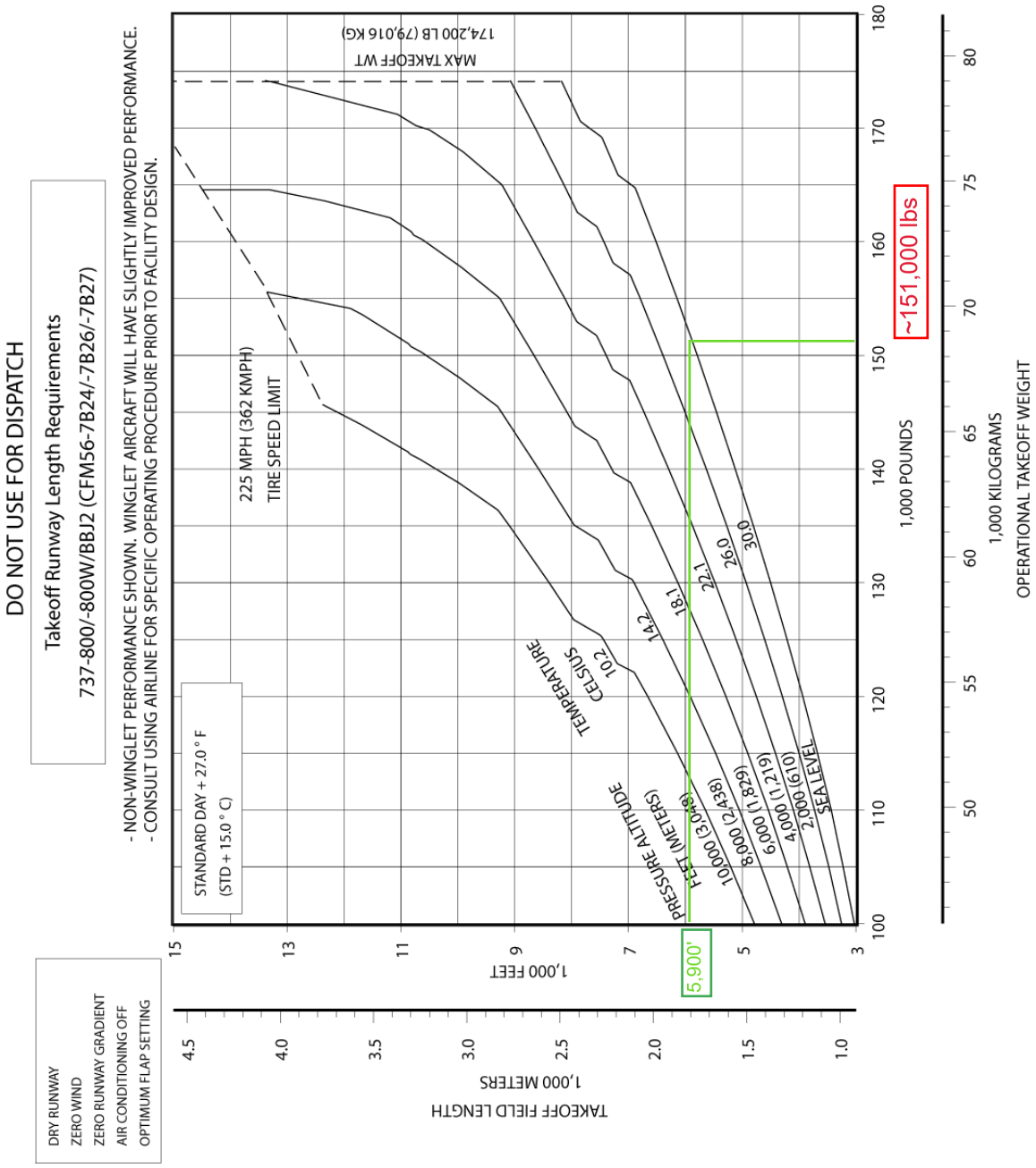
- STANDARD DAY, ZERO WIND
- CRUISE MACH = LRC
- NORMAL POWER EXTRACTION AND AIR CONDITIONING BLEEDS
- TYPICAL MISSION RULES
- NON-WINGLET PERFORMANCE SHOWN. WINGLET AIRCRAFT WILL HAVE SLIGHTLY GREATER RANGE.
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE AND OEW PRIOR TO FACILITY DESIGN.



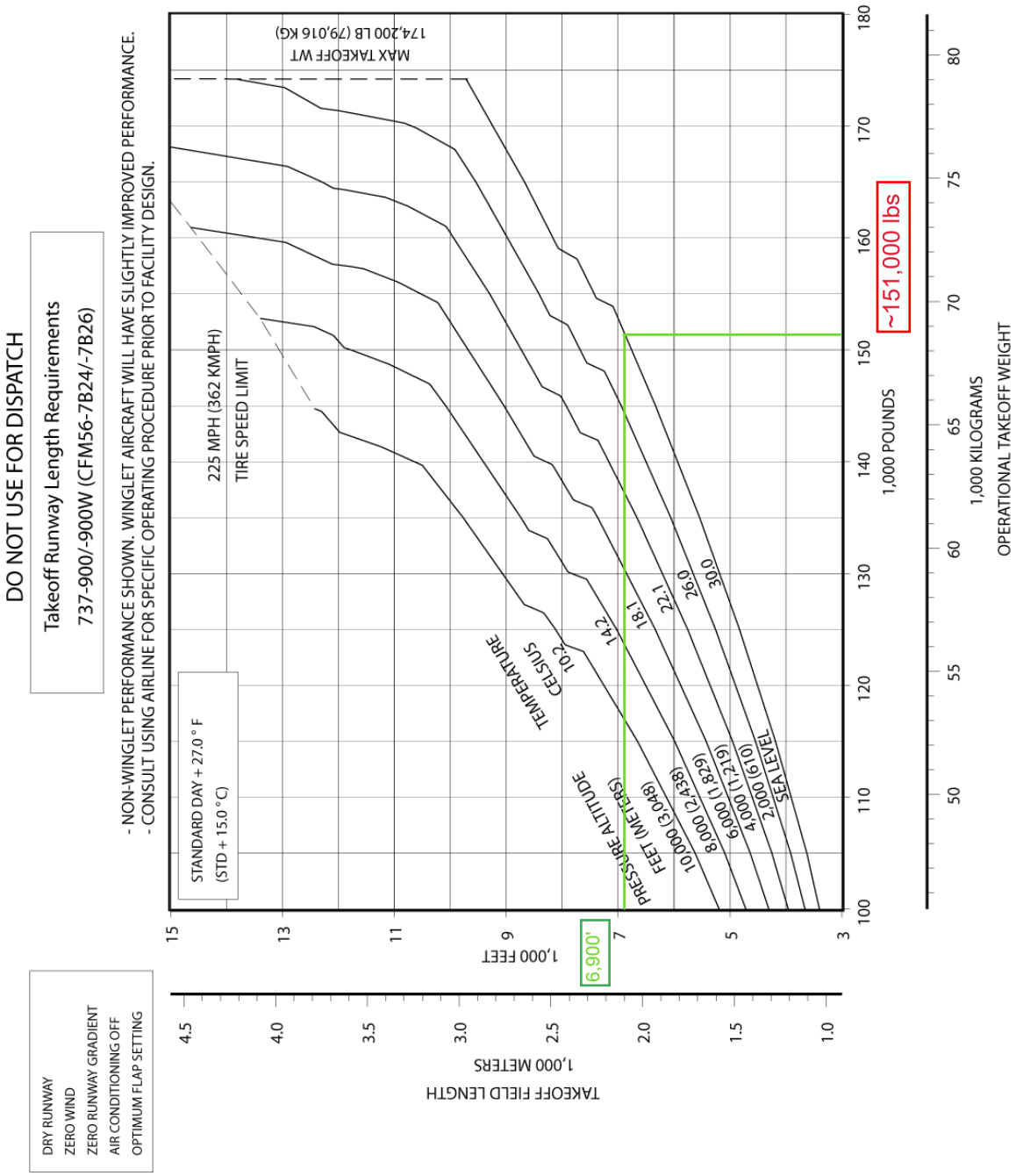
3.3.48 F.A.R. Takeoff Runway Length Requirements - Standard Day + 27°F (STD + 15°C), Dry Runway: Model 737-800/-800W/BBJ2 (CFM56-7B27-B1 Engine at 26,000 LB SLST)



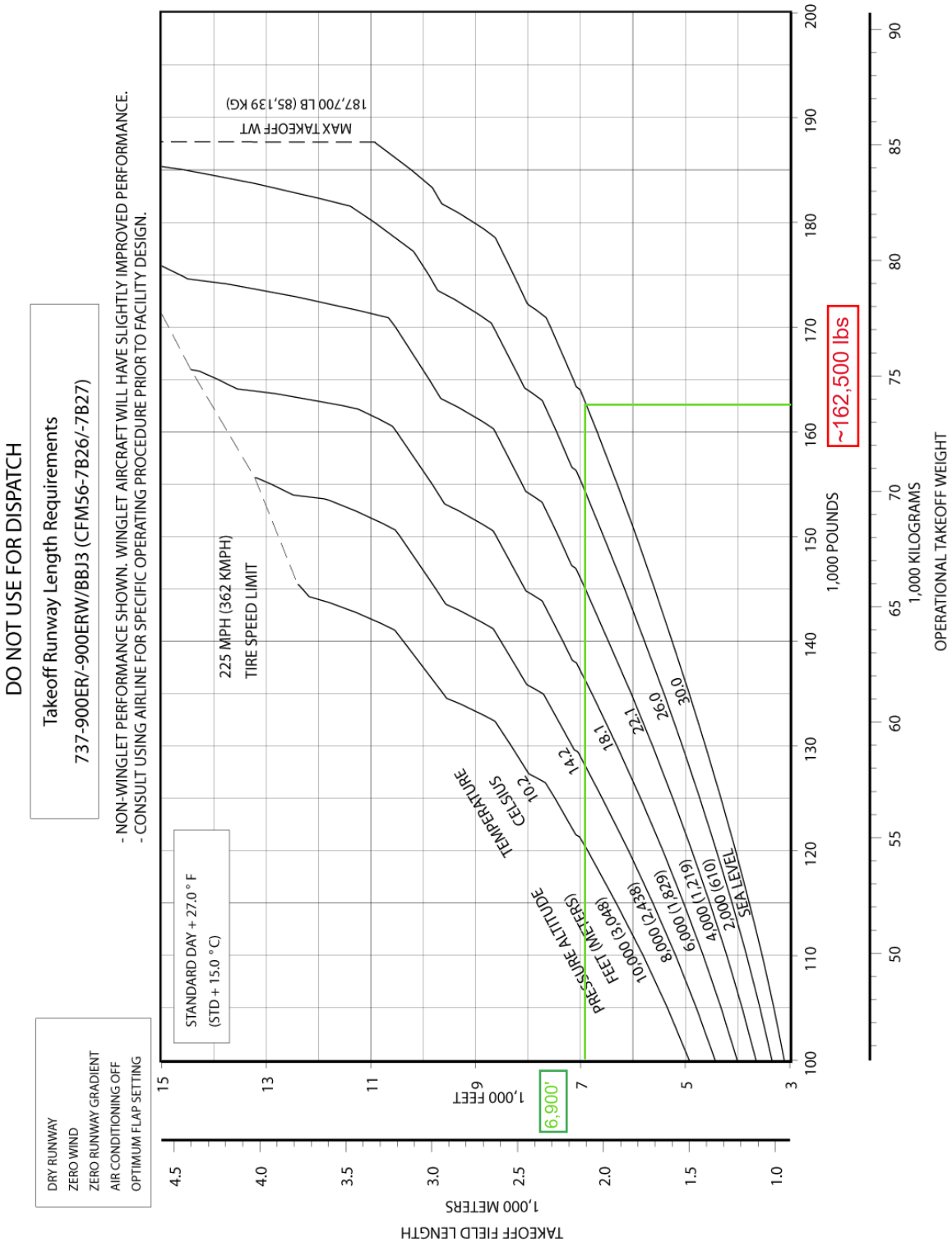
3.3.52 F.A.R. Takeoff Runway Length Requirements - Standard Day + 27°F (STD + 15°C), Dry Runway: Model 737-800 / -800W / BBJ2 (CFM56-7B24/-7B26/-7B27 Engines at 26,000 LB SLST)



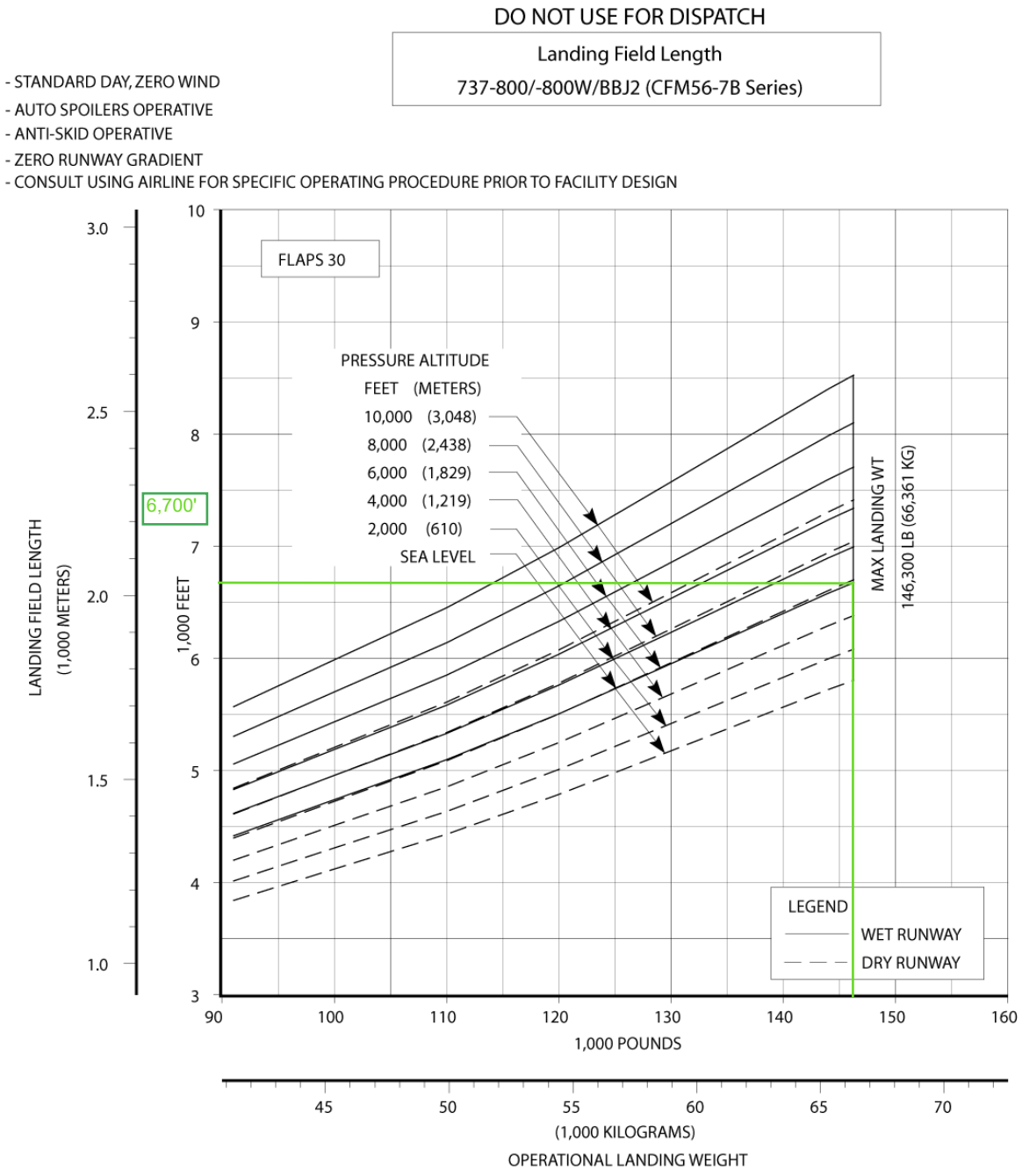
3.3.56 F.A.R. Takeoff Runway Length Requirements - Standard Day + 27°F (STD + 15°C), Dry Runway: Model 737-900/-900W (CFM56-7B24/-7B26 Engines at 24,000 LB SLST)



3.3.60 F.A.R. Takeoff Runway Length Requirements - Standard Day + 27°F (STD + 15°C), Dry Runway: Model 737-900ER/-900ERW/BBJ3 (CFM56-7B26/-7B27 Engines at 26,000 LB SLST)



3.4.21 F.A.R. Landing Runway Length Requirements - Flaps 30: Model 737-800



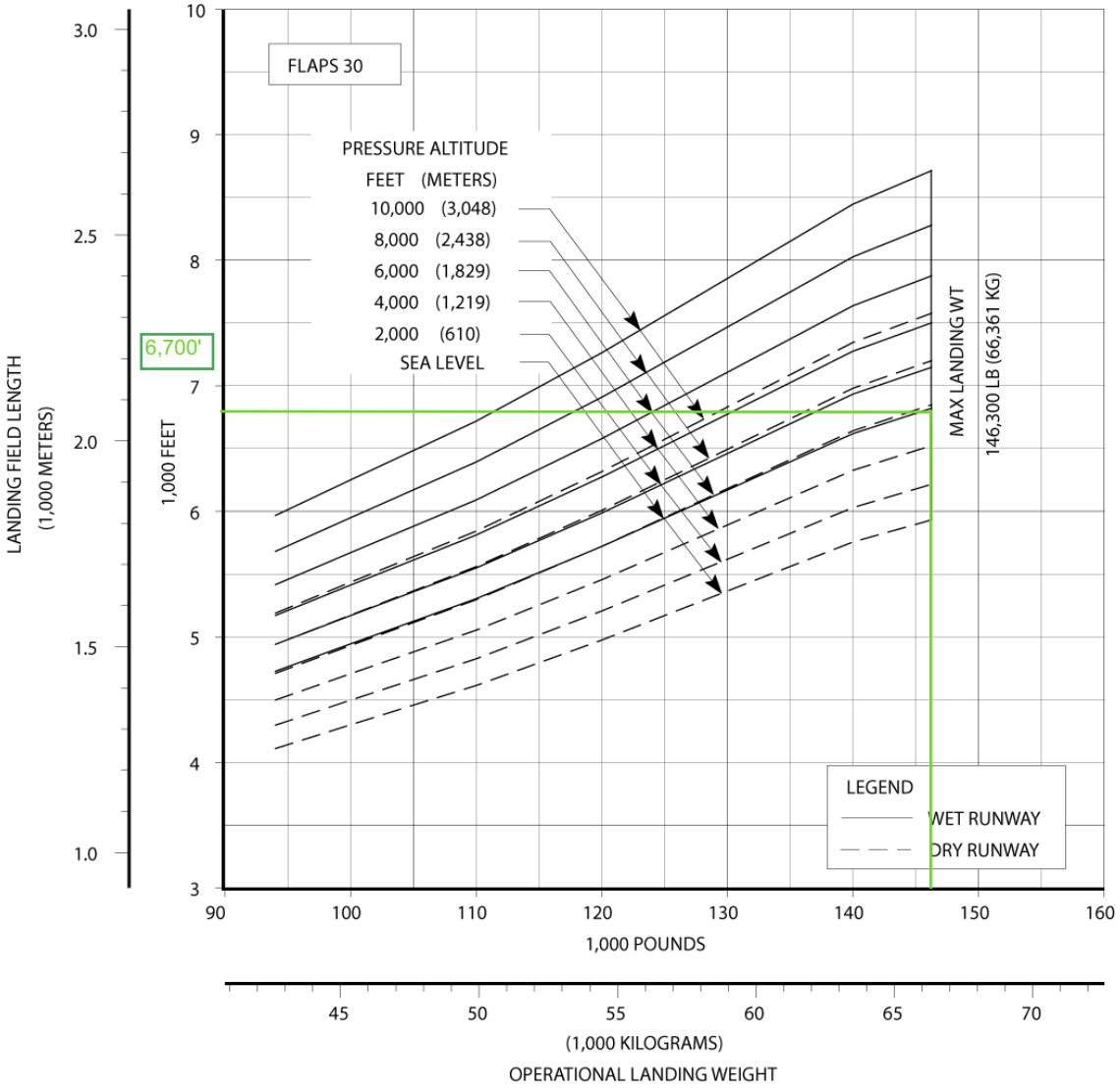
3.4.22 F.A.R. Landing Runway Length Requirements - Flaps 30: Model 737-900

DO NOT USE FOR DISPATCH

Landing Field Length

737-900/-900W (CFM56-7B Series)

- STANDARD DAY, ZERO WIND
- AUTO SPOILERS OPERATIVE
- ANTI-SKID OPERATIVE
- ZERO RUNWAY GRADIENT
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN



3.4.23 F.A.R. Landing Runway Length Requirements - Flaps 30: Model 737-900ER

DO NOT USE FOR DISPATCH

Landing Field Length

737-900ER/-900ERW/BBJ3 (CFM56-7B Series)

- STANDARD DAY, ZERO WIND
- AUTO SPOILERS OPERATIVE
- ANTI-SKID OPERATIVE
- ZERO RUNWAY GRADIENT
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN