Runway Safety Area Practicability Study

Kwigillingok Airport Improvements

Introduction

The purpose of this paper is to evaluate the Runway Safety Area (RSA) alternatives available for the Kwigillingok Airport (GGV) and recommend the best practicable alternative to improve the RSA for the airport.

This study will discuss RSA improvement alternatives and select a preferred alternative. The study will inform the Alaska Department of Transportation and Public Facilities' (the Department) and FAA's determination of an improved RSA configuration that is protected from further erosion caused by a nearby tidal slough.

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.

Background

GGV is a federally obligated airport and is classified within the National Plan of Integrated Airport System (NPIAS) as a Basic General Aviation service airport.

GGV is a vital air transportation hub for cargo and passengers between Anchorage and the village of Kwigillingok. The Kwigillingok Airport Improvements project has been delayed for several years waiting acquisition of the required right-of-way (ROW). The current project started in 2010, but the project need is much older, dating back to around 1992. Since the current project was started, two interim surface maintenance projects have brought in crushed material in 2012 and 2018 to help keep the runway operational. Community members from the village have been reaching out to the Department since the spring of 2021 with concerns about the runway condition. If the acquisitions proceed on the current course, final acquisitions of a key parcel needed to move the slough away from the runway may still be four to six years away.

Purpose and Need

Under FAA Order 5200.8 *Runway Safety Area Program*, all RSAs at federally obligated airports shall conform to the standards in the current FAA AC 150/5300-13 *Airport Design* to the extent practicable. GGV does not currently meet the RSA standards for Aircraft Approach Category (AAC)-Airplane Design Group (ADG) A-II(s) and requires additional embankment to meet RSA dimensional standards.

Existing Conditions

Critical Aircraft

The currently approved 2014 Airport Layout Plans (ALP) shows the Kwigillingok Airport as an A-I with an ultimate of B-I. However, according to T-100 data through 2021, dating back to at least 2007, operations by the Cessna 208, an A-II(s) aircraft, have exceeded 500 per year. See Figure 1 for the Kwigillingok Preliminary Critical Aircraft determination. A more thorough critical aircraft determination will be done with the ALP to be accomplished in conjunction with the project.

T-100 ID: KWK

Preliminary Critical Aircraft Analysis* - Summary

Date: 4/21/2023 Checker: AMF

Facility: GGV Kwigillingok, AK

Years

	Code	AAC	ADG	Aircraft Description	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021		Max Total	Max Year
Aircraft	10	A	I	Beech Bonanza 35A/C/D/E/G/H/J/K/S/V/ 36A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	
	26	0	0	Gipps Aero Ga8 Airvan	0	0	0	0	0	0	0	50	450	758	976	1036	808	938	386		1036	2018
	35	A**	I	Cessna C206/207/209/210 Stationair	4588	4412	4554	4980	4848	4338	3940	3806	3488	3032	1260	1292	1422	876	700		4980	2010
	79	A	I	Piper PA-32 (Cherokee 6)	0	0	0	0	0	0	0	0	0	0	0	2	30	12	8		30	
	117	B	I	Beech Baron (55 Series)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	
	194	B	I	Piper PA-31 (Navajo)/T-1020	2	2	18	6	0	0	0	0	0	0	0	0	0	0	0		18	
	412	A	II	Casa/Nurtanio C212 Aviocar	142	114	50	34	62	38	70	100	66	68	58	88	72	70	96		142	
	416	A	II	Cessna 208 Caravan	758	764	802	666	602	726	1438	1472	1154	1264	1274	1088	1344	496	1002	***	1472	2014
	479	A	II	Pilatus PC-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	
	486	A	II	Shorts Harland SC-7 Skyvan	56	6	110	64	126	106	40	0	0	0	0	0	0	0	0		126	
	487	B	II	Shorts 330	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	
Total Operations:					5646	5300	5534	5770	5638	5208	5490	5428	5168	5178	3584	3522	3682	2414	2214			

* preliminary analysis based on T-100 data

** C206 AAC = A; C209 AAC = B

*** most demanding aircraft with over 500 operations

Figure 1 – Preliminary Critical Aircraft Determination

Runway Layout and Facilities

GGV is composed of a single, unlighted, gravel-surfaced runway, one taxiway, and one apron. The runway, designated as Runway (RW) 15/33, is 40 feet wide and 1,835 feet long with only a 40-foot wide by 2,315-foot-long RSA. The apron is irregularly shaped with a single bay snow removal equipment building and is offset 175 feet from the runway centerline. The last recorded project was a surface maintenance project in 2018 that placed crushed aggregate on the existing runway and taxiway.

Water bodies surround the runway on all sides. Ponds have formed along the eastern toe of the RSA embankment, and a tidal slough has formed along the west side. The slough is actively eroding the southwest end as can easily be seen in Google Earth. A small tidal stream from the north has now started draining the pond north of the apron, despite residents efforts to maintain a make-shift dam for years to prevent it.

Runway Safety Area

RSA dimension standards are established by the FAA and published in Table G-3 of AC 150/5300-13B *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. 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 A-II(s) runway are 150 feet wide (centered on the runway centerline) and 300 feet beyond each runway end.

The RSA was 100’ x 2950’ in 1985 and has significantly narrowed after many years of settlement and erosion in the silty, wet, discontinuous permafrost environment. A 2018 preconstruction survey shows an embankment top between 40’ to 45’ wide and approximately 585’ of embankment on the north end has overgrown and been abandoned. **The existing runway and RSA are extremely narrow by current standards, at only 40’ wide each, and short compared to most Alaskan rural airports with a runway only 1,835’ long with a 2,315’ RSA.**

Site Constraints and RSA Impact Considerations

Geology and Soil Conditions

This region is underlain primarily by poorly drained interbedded marine and terrestrial deltaic and eolian deposits. The typical soils in the project area are surface organics over layered organics, organic silts, and silts.

The topography is generally flat with numerous thaw lakes and branching slough channels that are affected by tidal action from the Kuskokwim Bay. The area is discontinuously perennially frozen ground with thawed ground beneath lakes, sloughs, and river channels. Generally, the higher ground is frozen and lower is thawed to the depths tested.

According to the Permafrost Map of Alaska (Oscar J. Ferrians, Jr., 1965), see Figure 2, Kwigillingok is generally underlain by moderately thick to thin permafrost. Any significant excavation in the project area can cause warming, and settlement.

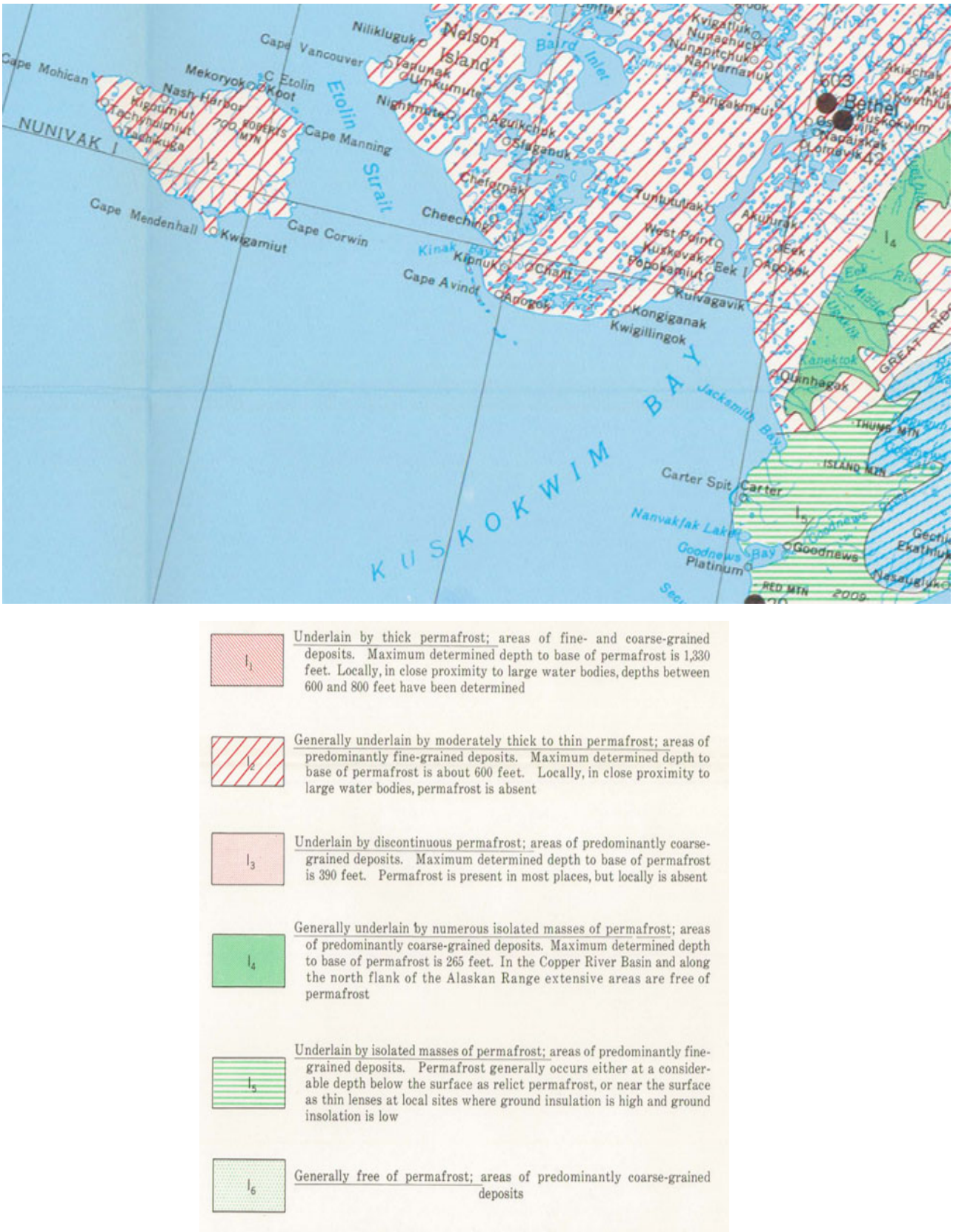

Figure 2 – Permafrost Map of Alaska

Wetlands

Wetlands, including open water, are abundant in the Kwigillingok vicinity and region (See Figure 3). The most common wetland type found at Kwigillingok consists of palustrine emergent, primarily associated with low lying flat areas surrounding rivers. Most of these wetlands are seasonally flooded after spring snowmelt and with summer rains. Some wetlands are also flooded by the twice-daily tides impacting the area. They are typically saturated on the surface with areas of open water.

The entire proposed project area is in Palustrine Emergent Wetlands and open water except for existing human disturbance delineated as Uplands. Uplands are mainly associated with the existing airport (runway, taxiway, apron, and access road). The trail between the existing barge landing at the mouth of the Kwigillingok River to the community also accounts for a portion of the uplands.

Hydrology

There is a slough that flows adjacent to the west side of the existing runway that flows out of a drained lake southwest of the runway. The embankment forces the slough to make a sharp 90° left turn near the southwest portion of the runway and flow north roughly parallel to the runway embankment. This appears to be causing erosion of the approximately 10’ high embankment.

At the north end of the runway, the slough turns right to flow southeast. This area of the abandoned runway appears to be experiencing similar erosion. The abandoned runway embankment in this area is approximately 5’ high.

This slough is tidally influenced. On the rising (flood) tide, flow comes up the Kwigillingok River and flows up the slough adjacent to the runway and into the drained lake. Following high tide, the ebb tide flows out the slough and back to the Kwigillingok River and Kuskokwim Bay.

The amount of erosion caused by the slough is limiting the length of the runway that can be widened without realigning the channel. Because the land is low lying, and the village is near the coast, the runway also must be raised above the 100-year storm surge with 1-foot of freeboard, resulting in a design elevation of 19.3 feet.

Project scope

The alternatives presented in this paper were considered with the following scope in mind:

- Construct a new or rehabilitate the existing RW embankment and RSA to accommodates an A-II(s) design aircraft
- Install a RW and TW lighting system
- Construct a new or rehabilitate the existing TW and apron to meet the new RW grades
- Install erosion protection as needed

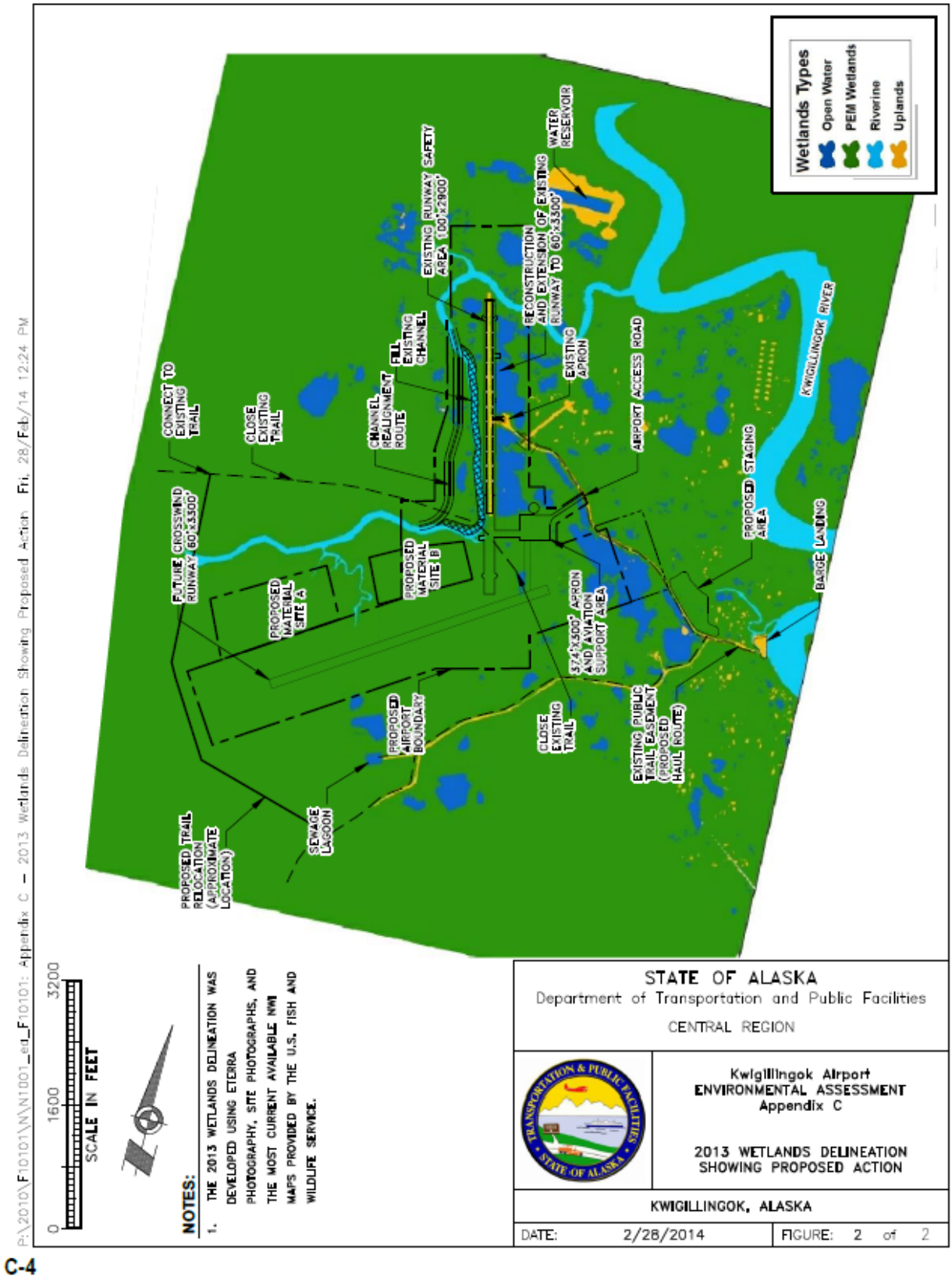

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Figure 3 – Wetlands Delineation

RSA Improvement Alternatives

Alternative 1: Incremental RSA Improvement

Alternative 1 proposes to construct a 75' x 1,835' runway with a 120' x 2,435' RSA and increasing the width of the RSA to the standard 150' where practicable by reclaiming the abandoned north end of the runway. This alternative would construct erosion protection along the northeast and southwest edges of the RSA to prevent further erosion in these areas. The runway dimensions are based on preliminary modeling within the constraints of the slough. The critical aircraft, the Cessna 208 Caravan, is barely an A-II(s) aircraft, with wings that are only 3 feet wider than the maximum for an A-I aircraft. Also, the current fleet of aircraft is currently operating on the existing runway/RSA combination embankment. Alternative 1 will improve safety, widen the runway, provide standard end RSAs, and provide incremental improvement to RSA width. At an approximate cost of $50M, this alternative is practicable and is the preferred alternative. See attached exhibit at the end of this report.

The following six alternatives were considered, but deemed not practicable or feasible:

- Alternative 2: Fill embankment into the slough
- Alternative 3: Relocation or Shift/Realignment of the runway
- Alternative 4: Reduction in runway length where the existing runway length exceeds that which is required for the existing or projected design aircraft
- Alternative 5: A combination of runway relocation, shifting, grading, realignment, or reduction
- Alternative 6: Declared distances
- Alternative 7: Engineered Materials Arresting Systems (EMAS)

Alternative 2: Fill Embankment into the Slough

Alternative 2 proposes to construct a 75' x 1,835' runway with a 150' x 2,435' RSA by constructing embankment with erosion protection in the slough along the west side of the RW. Filling and armoring the slough would reduce its capacity to carry high tide. The opposite bank would need to be excavated by a volume equal to the volume of fill in the slough, which would negatively impact the property on the opposite side of the slough. The property on the opposite side of the slough is a Native Allotment and one of the parcels the Department has been working to acquire for several years. Therefore, this alternative is deemed not feasible.

Alternative 3: Relocation or Shift/Realignment of the RW

A. Runway Relocation:

Alternative 3.A proposes to construct a 75' x 3,300' runway with a 150' x 3,900' RSA by relocating the airport to a new site. The Native Village of Kwigillingok is experiencing settlement and melting permafrost, which is exposing the village to more flooding and storm surge impacts. In response, the village is considering relocation and is evaluating three sites for community relocation (See Figure 4). These three sites are further discussed below.

Figure 4: Relocation Sites

Site 1

Site 1 is located approximately 23 miles from the current location. Relocation to Site 1 was deemed not practicable or feasible at this time because it would remove airport access from the village while they are likely still 20 to 30 years away from moving.

Site 2 and 3

Sites 2 and 3 are approximately 3.5 and 1 mile away from the current location, respectively. Both options would have significant wetland impacts and require a new Environmental Assessment and ALP. This would greatly increase the time required for project development and there are safety concerns about the current runway deteriorating to an unusable level before construction can begin.

The cost of building access to either of these sites has been deemed not practicable at this time due to timeframes for ROW acquisition, environmental review, planning studies, and ALP updates, which would further delay construction of improvements.

The cost of construction in western Alaska is very high because the locations are remote, have high transportation costs, and lack the availability of local material sources. Currently high inflation rates are making this situation worse. At a cost of approximately $81M, relocation to improve the lateral RSA was deemed not practicable at this time.

B. Runway Shift/Realignment:

Alternative 3.B proposes to construct a 75’ x 3,300’ runway with a 150’ x 3,900’ RSA by shifting the RW to the east or realigning the RW by constructing embankment in the ponds to the east of the RW. Constructing this embankment would greatly increase the wetland impacts for the project, which may trigger an Environmental Assessment and delay the project further. The excessive settlement

experienced by the current embankment has shown that the area is prone to large amounts of settling due to the soft foundation soils and permafrost thawing. Any new embankment would experience similar settlement which would introduce more instability along a new runway centerline. Keeping the runway centerline on top of the existing runway centerline will provide the best foundation for the improvements. Additionally, the current apron and SREB lie within the current A-II(s) Runway Object Free Area (ROFA). Shifting the runway east would create a greater obstruction with no feasible location to move the SREB outside of the ROFA. Therefore, this alternative is deemed not practicable or feasible.

Alternative 4: Reduction in Runway Length

Alternative 4 proposes to reduce the runway length from 1,835' to 1,715' to obtain standard end RSA lengths of 300'. This would allow the end RSAs to meet the standard of 300' for an A-II(s) facility, however, this further shortens an already short runway. Shortening the runway length also does not improve the substandard lateral RSAs. Therefore, this alternative is deemed not practicable.

Alternative 5: Combination

Alternative 5 is a combination of Alternative 2 and Alternative 3, which proposes to construct75' x 3,300' runway with a 150' x 3,900' RSA by shifting partially to the east by constructing embankment in the ponds to the east of the RW and constructing embankment with erosion protection into the slough along the west side of the RW. This alternative is not feasible due to the same reasons described under Alternative 2 and 3 above.

Alternative 6: Declared Distances

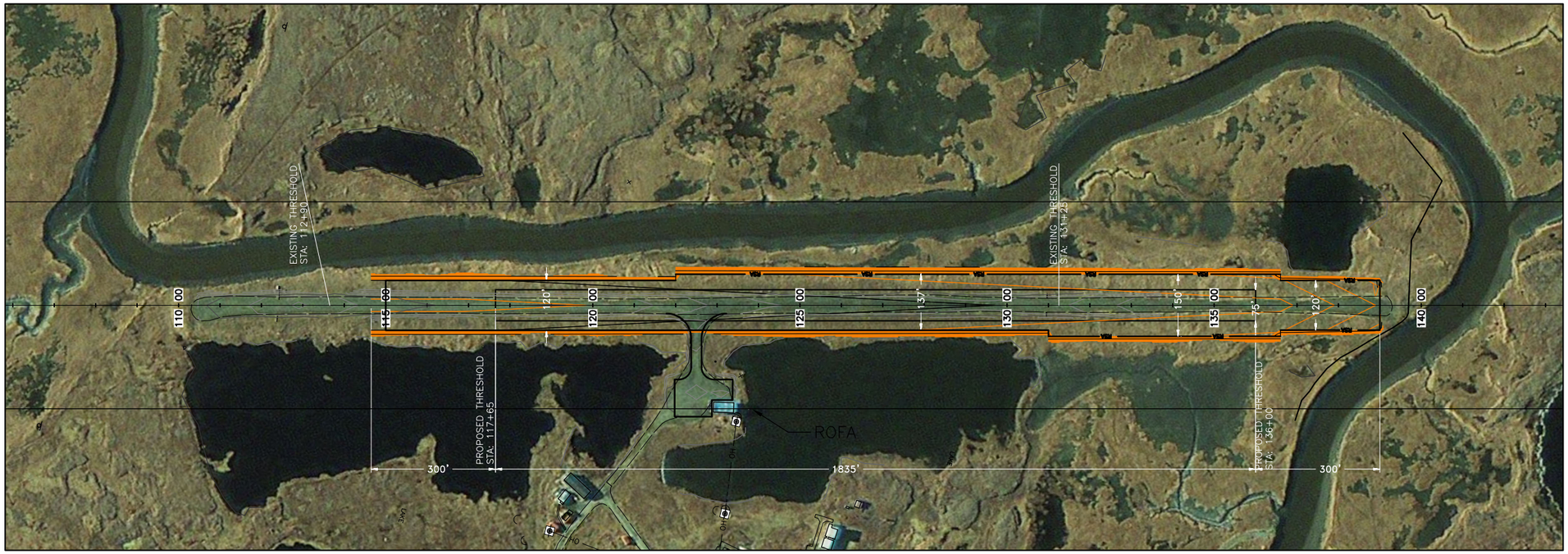
Alternative 6 proposes to implement declared distances to obtain standard end RSA lengths of 300'. This would allow the end RSAs to meet the standard of 300', however implementing declared distances does not improve the substandard lateral RSAs. Therefore, this alternative is deemed not practicable.

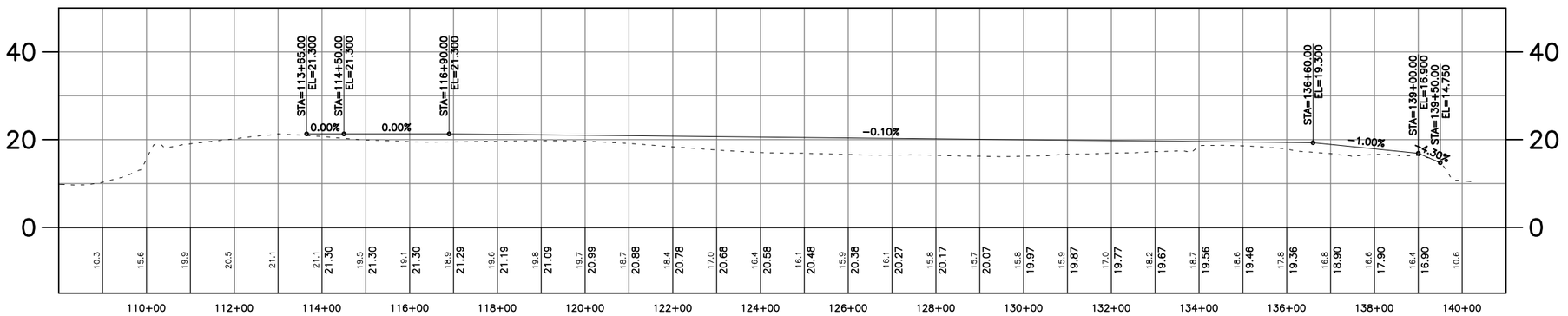
Alternative 7: Engineered Materials Arresting Systems (EMAS)

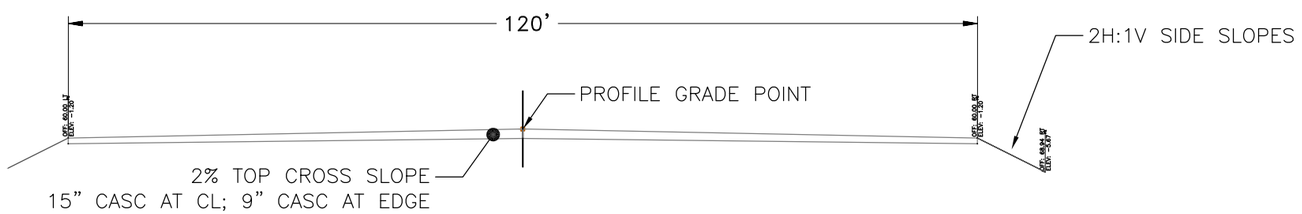
Alternative 7 proposed to construct an Engineered Materials Arresting System (EMAS). An EMAS is intended to stop errant aircraft when there is insufficient safety area beyond the runway end available. The design aircraft for this airport is too light for EMAS to be effective. Therefore, this alternative is deemed not feasible.

Conclusion

Seven alternatives were evaluated to determine the best practicable alternative to improve the runway safety area at the airport. The selected Alternative 1 is recommended because it provides incremental improvement to the current sub-standard runway and RSA in a more expedient and cost-effective manner than the other alternatives evaluated. This alternative will widen the runway, provide standard end RSAs, and incrementally improve the lateral RSA. This alternative would provide a **75' x 1,835' runway and a 120' x 2,435' RSA and increase the width of the RSA to the standard 150' where practicable (at the north end).**







PRELIMINARY DESIGN

BY	DATE	REVISION

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

KWIGILLINGOK AIRPORT
KWIGILLINGOK, ALASKA
RSA PRACTICABILITY STUDY
ALTERNATIVE 1 EXHIBIT

DATE: 10/06/2023
SHEET: 1 OF 1

Designed By: XXX
Drawn By: XXX
Checked By: XXX

Date Revised: 10/06/2023, 12:47 PM
Layout Name: P&P
File Path and Name: \\dot.soa.alaska.gov\shared\AVI\AVD\Projects\Kwigillingok\Kwig APT Improvements 52571\Civil Design\New Design\CMODL-CORR-KWIG_Phase1_AMD.dwg