

TECHNICAL MEMO

To
Ben McPhee, P.Tech. (Eng)
Director of Infrastructure, Town of Vermilion

From
Valentino Tjia, P.Eng, P.E.
Senior Project Manager, Transportation
Infrastructure

Re
Vermilion Municipal Airport (YVG) – Object
Limitation Surface Analysis of Runway 10-28

Date
October 10, 2023

McElhanney Ltd. (McElhanney) has been retained by the Town of Vermilion (ToV) to identify any obstruction to the Vermilion Municipal Airport (YVG) master plan, particularly related to the construction of a proposed fertilizer blender system for Cargill. A map of the study area is shown in **Figure 1** below.



Figure 1: Study Area

1. BACKGROUND

YVG is a registered aerodrome located in the northeast portion of ToV, within the larger County of Vermilion River in Alberta. YVG is operational 24 hours per day, seven days per week, and is capable of supporting visual flight rules (VFR) and night operations¹. YVG has one asphalt Runway 10-28 (RWY 10-28), and it has not been classified under the new *TP 312E 5th Edition Aerodrome Standards and Recommended Practices (amended January 15, 2020)*, Aircraft Group Number (AGN) system. AGN is a new classification system that interrelates the technical specifications of the aerodrome and the characteristics of the critical size of aircraft that are able to use the runway, taxiway, and apron¹.

The wind direction for RWY 10-28 is predominantly west to east, making Runway 10 ideal for take-offs and Runway 28 for landings:

- Runway 10 has a full length of 3,378 ft (1,030 m) and 75 ft (22.9 m) wide for take-offs, as aircraft can reach the end of Runway 28.
- Runway 28, predominantly used for landings, has a displaced threshold with a runway measuring 2,292 ft (699 m) long and 75 ft (22.9 m) wide. The threshold is the beginning of that portion of the runway that is declared usable for landing and provides a visual indication for pilots to descend at the appropriate distance. The threshold at Runway 28 was displaced as a result of the construction of the existing Cargill grain facility; this displacement is noted in the Canadian Flight Supplement as shown in **Figure 2** below.

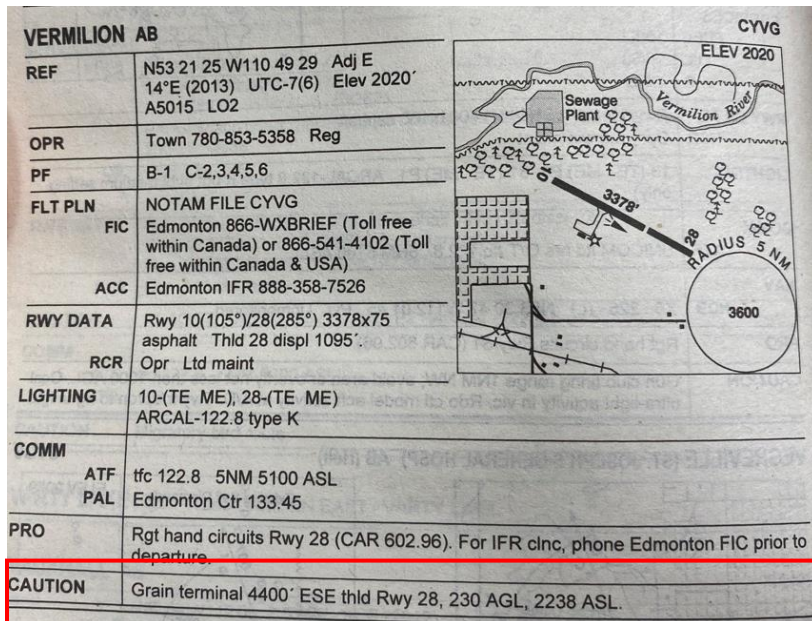


Figure 2 Canadian Flight Supplement for Vermilion Municipal Airport

¹ OEI Vermilion Municipal Airport Master Plan, 29 April 2019.



In April 2019, YVG developed the Vermilion Municipal Airport Master Plan and intends to extend RWY 10-28 to 4,000 ft (1,219 m) to support medevac operations using King Air 350 fixed-wing aircraft, among other improvements. Understanding that the existing Cargill grain facility may impact the overall operation with the future runway improvements, YVG plans to realign RW 10-28 by 4 to 6 degrees, rotated about the existing end of Runway 10 to allow for the runway extension.

With the proposed Cargill fertilizer system slated to be constructed southwest of the existing Cargill grain facility, an analysis of the runway's Object Limitation Surface (OLS) is required to confirm whether this proposed structure would intrude into the approach surface of incoming aircraft with the realignment of RWY 10-28. The total height of the fertilizer system facility is 110.6 feet (33.7m), located approximately 1.2km southeast of the proposed Runway 28. An elevation view of the structure is based on the drawing prepared by Credence, Sheet 006, dated April 10, 2023. The drawing, with measurements of its height, is included in **Appendix B** and explained further in Section 2 below.

2. MAPPING AND SURVEY

McElhanney completed a ground topographic survey of YVG on September 8, 2023 to capture the asphalt road surface of the runway, taxiway, and apron. The topographic survey was supplemented with aerial orthophoto and LiDAR. The LiDAR was ordered through Altalis in 7.5m XYZ DEM Grid projected as NAD83 CSRS UTM Zone 12. The survey and LiDAR were transformed from the UTM to 3TM coordinate system to be consistent with ToV's standardized system.

Existing Cargill Grain Facility

McElhanney completed a field survey on September 13, 2023 to confirm the elevation and height of the existing Cargill grain facility. The survey result indicates that the existing top of light (the highest point of the structure) is at Elevation 681.46. As part of the facility, there were two elevator bases that were surveyed; the approximate survey elevations are Elevation 612.511 and 612.453, with an average elevation of 612.47. Therefore, the total height from base to top of light measures 226.4 ft (69.0 m). The field survey measurement information is included in **Appendix C**.

Proposed Cargill Fertilizer Facility

The proposed Cargill's fertilizer facility is assumed to be situated at the same base Elevation 612.47, as there is no elevation information on the drawing by Credence. The total height of the structure is 110.6 ft (33.71 m), and the estimated top elevation of the new structure is Elevation 646.18.

ToV also provided survey information that was received from a third-party. McElhanney compared the elevations provided with the surveyed and calculated elevations noted above. We observed that the elevations differ by 0.79m to 0.80m between the two data sets and note this minimal difference would not significantly impact the analysis of the OLS. **Table 1** shows the elevation comparison:



Table 1. Elevation Comparison (Datum Elevation based on NAD83 CSRS, UTM Zone 12)

Point	Third-Party Source				MCL	
	Northing	Easting	Elevation	Description	Elevation	Difference
5000	5910951	513257	645.39	PROPOSED FERTILIZER PLANT TOWER	646.18	0.79 m
5001	5910948	513258.3	645.39	PROPOSED FERTILIZER PLANT TOWER		
5002	5910947	513255.6	645.39	PROPOSED FERTILIZER PLANT TOWER		
5003	5910949	513254.2	645.39	PROPOSED FERTILIZER PLANT TOWER		
5004	5911096	513325.5	680.66	EXISTING ELEVATOR	681.46	0.80 m
5005	5911090	513328.3	680.66	EXISTING ELEVATOR		
5006	5911085	513317.4	680.66	EXISTING ELEVATOR		
5007	5911090	513314.7	680.66	EXISTING ELEVATOR		
5008	5911444	513468.5	621.617	ASCM 156588		

3. OBJECT LIMITATION SURFACE ANALYSIS RESULTS

McElhanney completed an analysis of RWY 10-28’s OLS to determine the approach and transitional surfaces of the runway and confirm whether the Cargill facilities will encroach into the proposed runway airspace. Two scenarios were analyzed based on ToV’s direction to realign the RWY 10-28 centreline: a 4-degree clockwise rotation about the west Runway 10 limit and a 6-degree clockwise rotation about the west Runway 10 limit, as illustrated in **Figure 3** below.



Figure 3: Runway Realignment Options

The analysis assumed a 4000 ft (1,219 m) runway with thresholds at both ends of RWY 10-28. The OLS is a surface that establishes the limit to which objects may project into the airspace associated with an aerodrome so the aircraft operations may be conducted safely. The parameters used for this analysis are in accordance with the TP312 5th Edition, explained below and summarized in **Table 2**:

1. AGN II runway that accommodates aircraft wingspan between 14.94 m and up to but not including 24.10m. The King Air 350 has a wingspan of 17.65m, which fits under this classification.
2. Non-precision runway categorized based on current airfield lighting having Threshold End (TE) with Medium Intensity (ME) with runway edge lighting and ARCAL. The categorization of RWY 10-28 as non-precision will be applicable even with the future implementation of the Global Positioning Approach (GPS) approach.
3. Runway strip² width is 70m from each side of runway centreline for AGN II non-precision.
4. Runway strip² length is 60m beyond end of runway for AGN II non-precision.

Table 2 TP312 Parameters for the Proposed RWY 10-28

Parameter	Value
AGN	AGN II Non-Precision
Approach (metres)	
Length of Inner Edge Each Side of Centreline (Runway strip width)	70
Distance from Threshold (Runway strip length)	60
First Section	2,500 @ 3.33%
Second Section	-
Transitional³	
Slope First Segment	25%
Slope Second Segment	14.3%
Divergence	10%
Inner Transitional (m)⁴	
Distance from Centreline	40
Slope	Vertical

3.1. 4-DEGREE ALIGNMENT

The existing runway slopes at normal crown with varying crossfall, and it is assumed for analysis purposes that the realigned runway would follow the same grading due to the relatively flat topography of the area. In this scenario, the runway strip elevation was determined to be at Elevation 617.459, the

² Runway strip is a defined area, which includes the runway and stopway where provided, intended to protect aircraft lying over it during take-off or landing operations (Source: TP312 5th Edition, amended January 15, 2020)

³ Transitional surface is a complex surface along the side of the runway strip and all or part of the side of the approach surface, that slopes upwards and outwards to a specific height (Source: TP312 5th Edition, amended January 15, 2020)

⁴ Inner Transitional surface is a complex surface extending lengthwise on the runway strip that extends upwards and outwards to the outer obstacle identification surface ((Source: TP312 5th Edition, amended January 15, 2020)



highest elevation of the nearest point on the runway centreline. The resulting approach surface for Runway 28 is illustrated below in **Figure 4** in red:

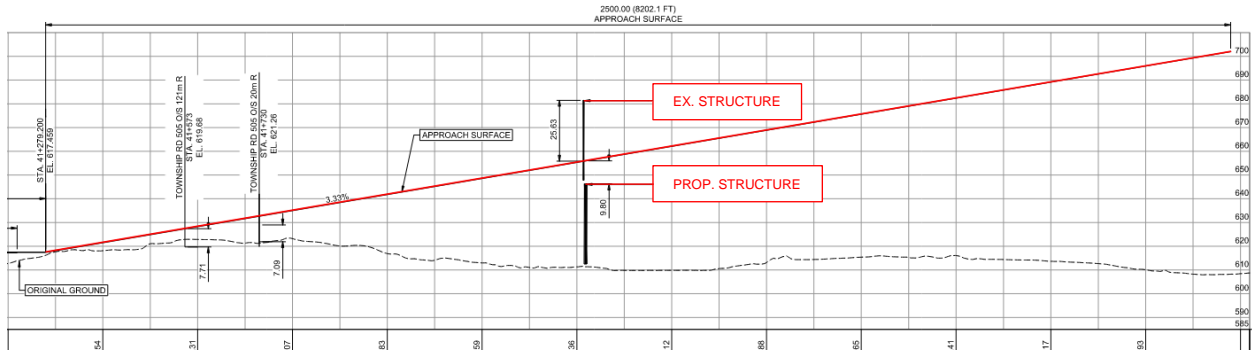


Figure 4: Approach Surface of 4-Deg Alignment

The approximate top elevation of the proposed Cargill fertilizer structure is at Elevation 646.18 based on the calculated elevation explained on **Section 2**. The proposed structure is estimated to clear the approach surface by 9.8m; thus, it is not anticipated to be an issue with the realignment of RWY 10-28.

The existing Cargill grain facility with a top elevation of 681.46m will encroach into the approach surface by 25.6m. The OLS plan and profile exhibit for this 4-degree alignment is included in **Appendix D**.

3.2. 6-DEGREE ALIGNMENT

With the 6-degree alignment, the runway strip elevation was determined to be at Elevation 617.167. The resulting approach surface for Runway 28 is illustrated below in **Figure 5** in red:

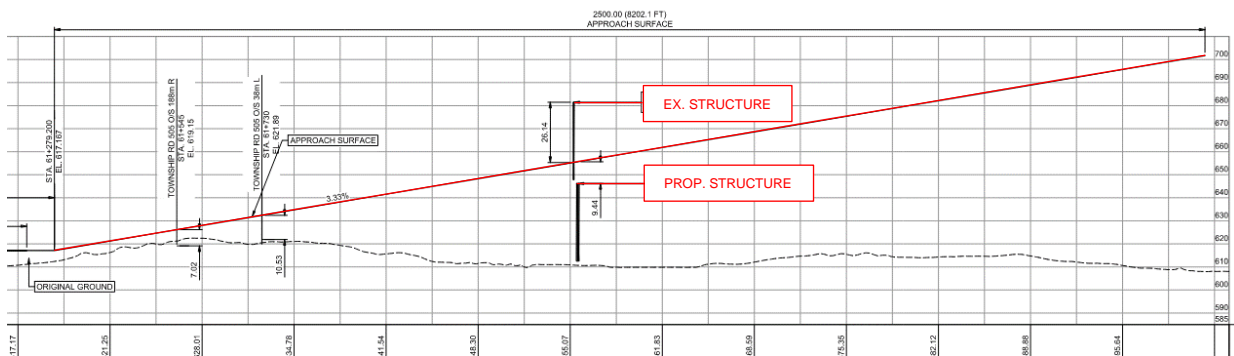


Figure 5: Approach Surface of 6-Deg Alignment

Similar to the 4-degree alignment, the proposed Cargill fertilizer structure is not anticipated to be an issue as the structure is estimated to clear the approach surface by 9.4m. The existing Cargill grain structure will encroach into the approach surface by 26.1m. The OLS plan and profile exhibit for the 6-degree alignment is included in **Appendix D**.



MCL also looked at the surrounding topography and potential major road networks that are close to YVG. Based on our review, we determined that the 4-degree and 6-degree alignments would not obstruct any existing infrastructure, assuming that there is no planned development in the future or lowering of the highest runway elevations noted in this analysis.

4. CONCLUSION

Based on the OLS analysis completed in realigning RWY 10-28 by 4 degrees and 6 degrees clockwise, the proposed Cargill fertilizer blender system does not impact the overall operation for future runway improvements. However, the existing Cargill grain facility will encroach into the approach surface. The analysis assumes the runway would be lengthened to 4000 ft, with thresholds placed at both ends of the runway.

YVG has expressed interest to equip the runway with GPS approach. The GPS Approach is defined by a series of waypoints and altitude restrictions that the pilot will follow to the runway threshold, free of conventional guidance such as a localizer/glideslope etc⁵. However, the categorization of RWY 10-28 as non-precision with the approach surface noted in this technical memo will still be applicable even with this implementation of GPS approach. That means that extending the Runway 10-28 is not viable with the GPS approach.

Based on the obstacle of the existing Cargill structure, ToV and YVG should consider realigning Runway 10-28 counterclockwise until it is close to a true east-west orientation. However, this option may present its own challenges, such as negatively impacting the adjacent residential area west of the airport. Detailed for the exact location is not currently part of this analysis.

CLOSING

We trust the above meets the requirements of the Project at this time. Please contact the undersigned should you have any questions or require any clarification.

Sincerely,
Prepared by:



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Reviewed by:

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Transportation Engineer
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⁵ Source: Infinite Flight at: [https://infiniteflight.com/guide/flying-guide/descent-to-landing/global-positioning-system-\(gps\)-approach](https://infiniteflight.com/guide/flying-guide/descent-to-landing/global-positioning-system-(gps)-approach)



APPENDIX A

Statement of Limitations

Statement of Limitations

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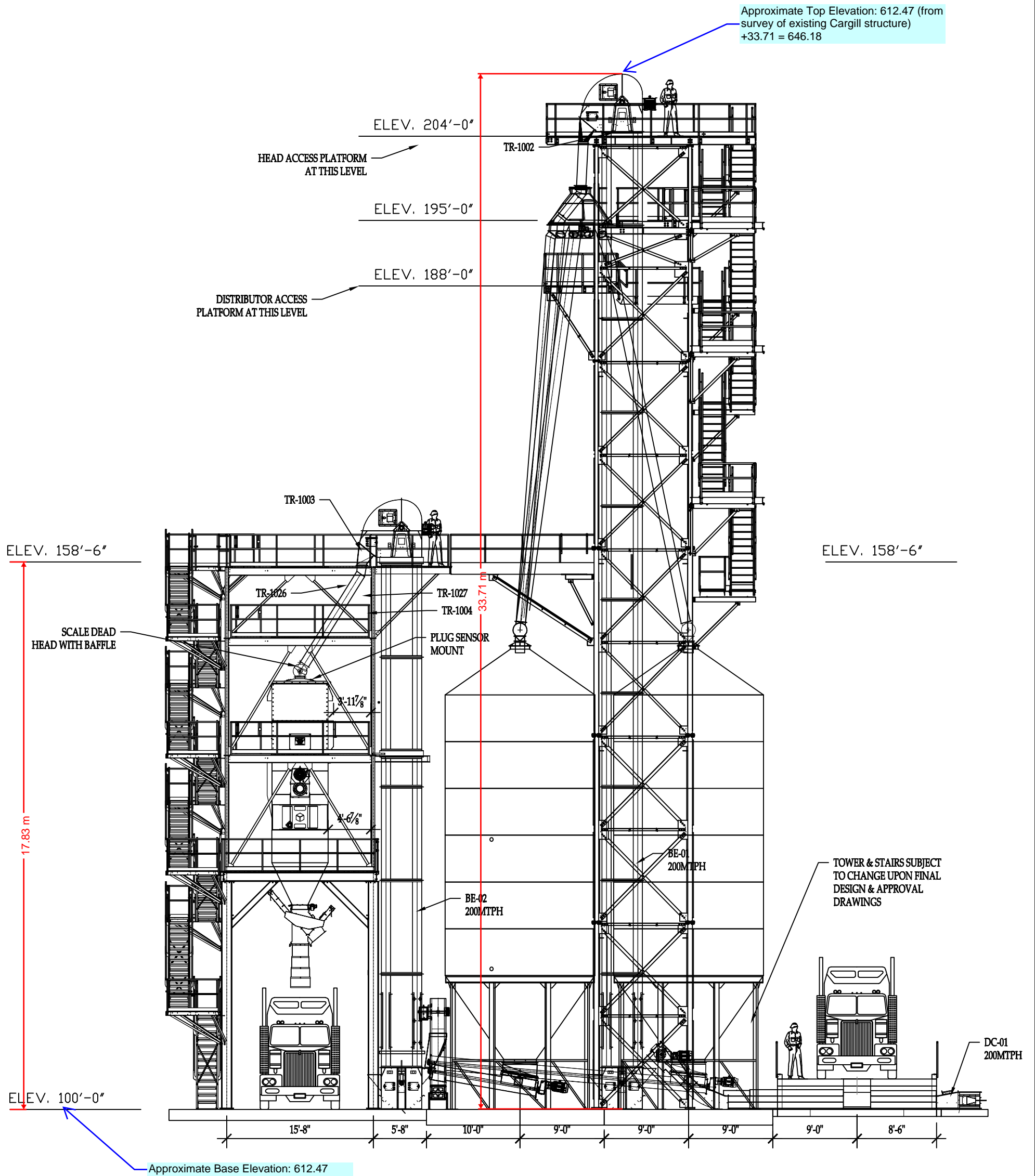


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APPENDIX B

Proposed Cargill Fertilizer System



006
 SHEET NUMBER
 DATE
 April 10, 2023



PROJECT NAME 10 Bin Blend System	CLIENT Cargill
SHEET DESCRIPTION Elevation View	DRAWN BY KB
PROJECT LOCATION Vermilion, Ab	SCALE AS NOTED
JOB NUMBER 23-2468	

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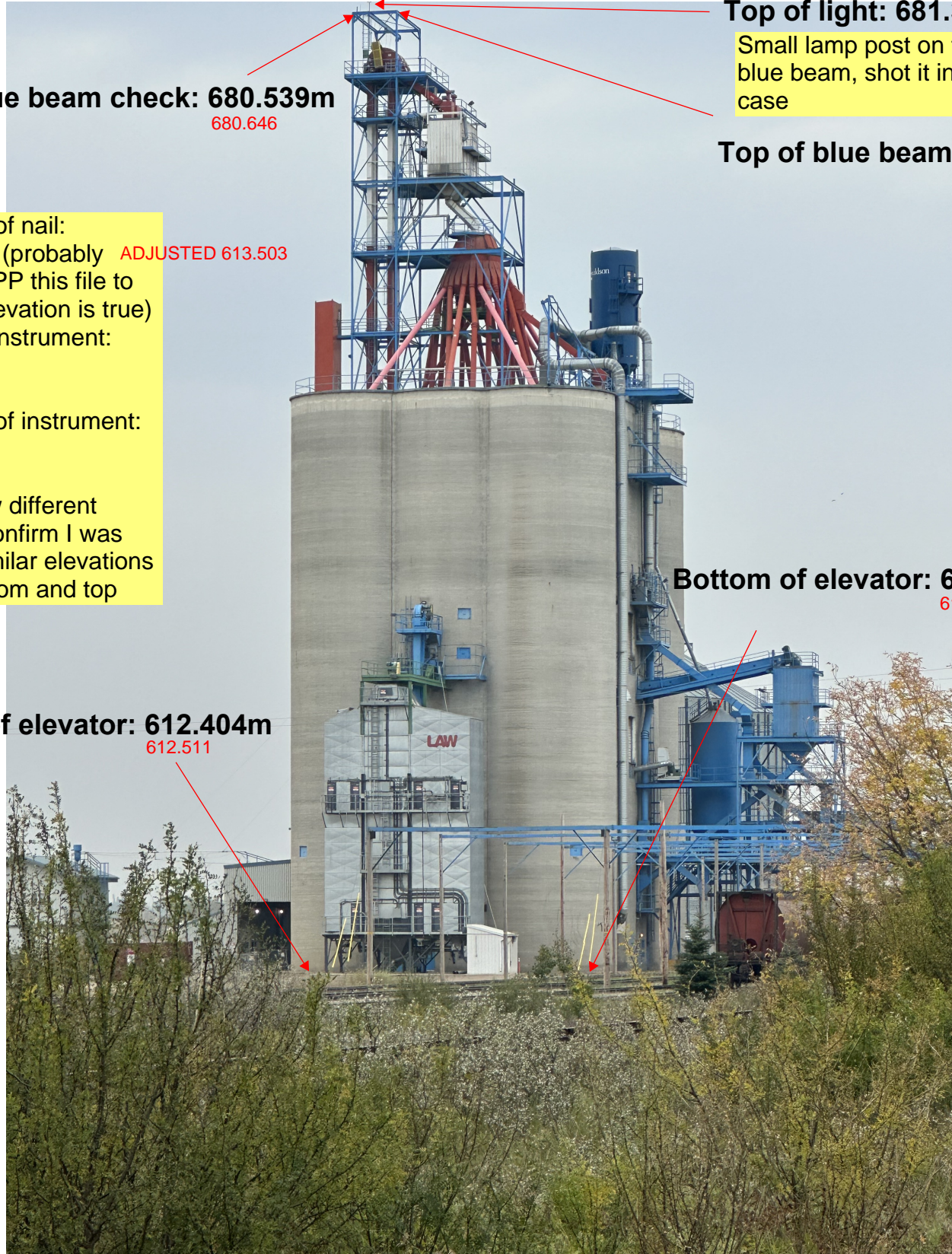
APPENDIX C

Existing Cargill Grain Facility

Client: TOV	Job # : 3411-14284-09	
Location: Vermilion	Page: 5	of 8
File Name: 14284CS	Crew: C. Sweeney	Equipment: Trimble RTK
Survey Type: Elevations	Date: 13-Sep-2023	Notes/Comments:



McElhanney



681.460

Top of light: 681.353m

Small lamp post on top of blue beam, shot it in just in case

Top of blue beam check: 680.539m

680.646

Top of blue beam: 680.533m

680.640

Elevation of nail:
613.396m (probably **ADJUSTED 613.503**
need to PPP this file to confirm elevation is true)
Height of instrument:
1.744

Elevation of instrument:
615.14

Shot a few different spots to confirm I was getting similar elevations at the bottom and top

Bottom of elevator: 612.346m

612.453

Bottom of elevator: 612.404m

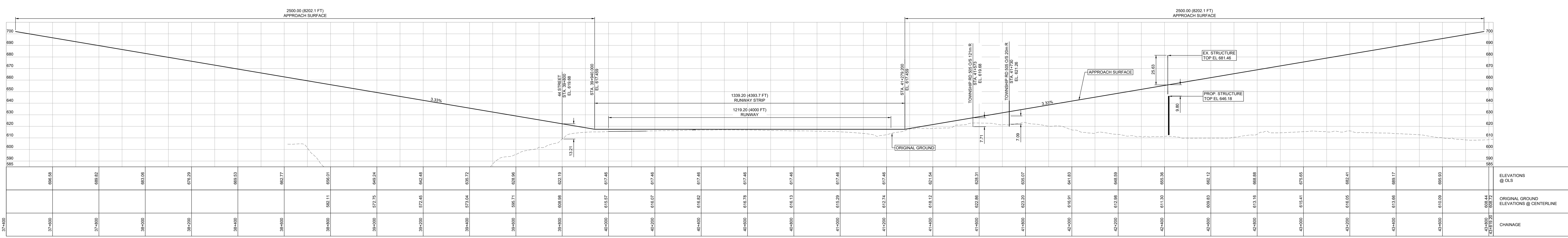
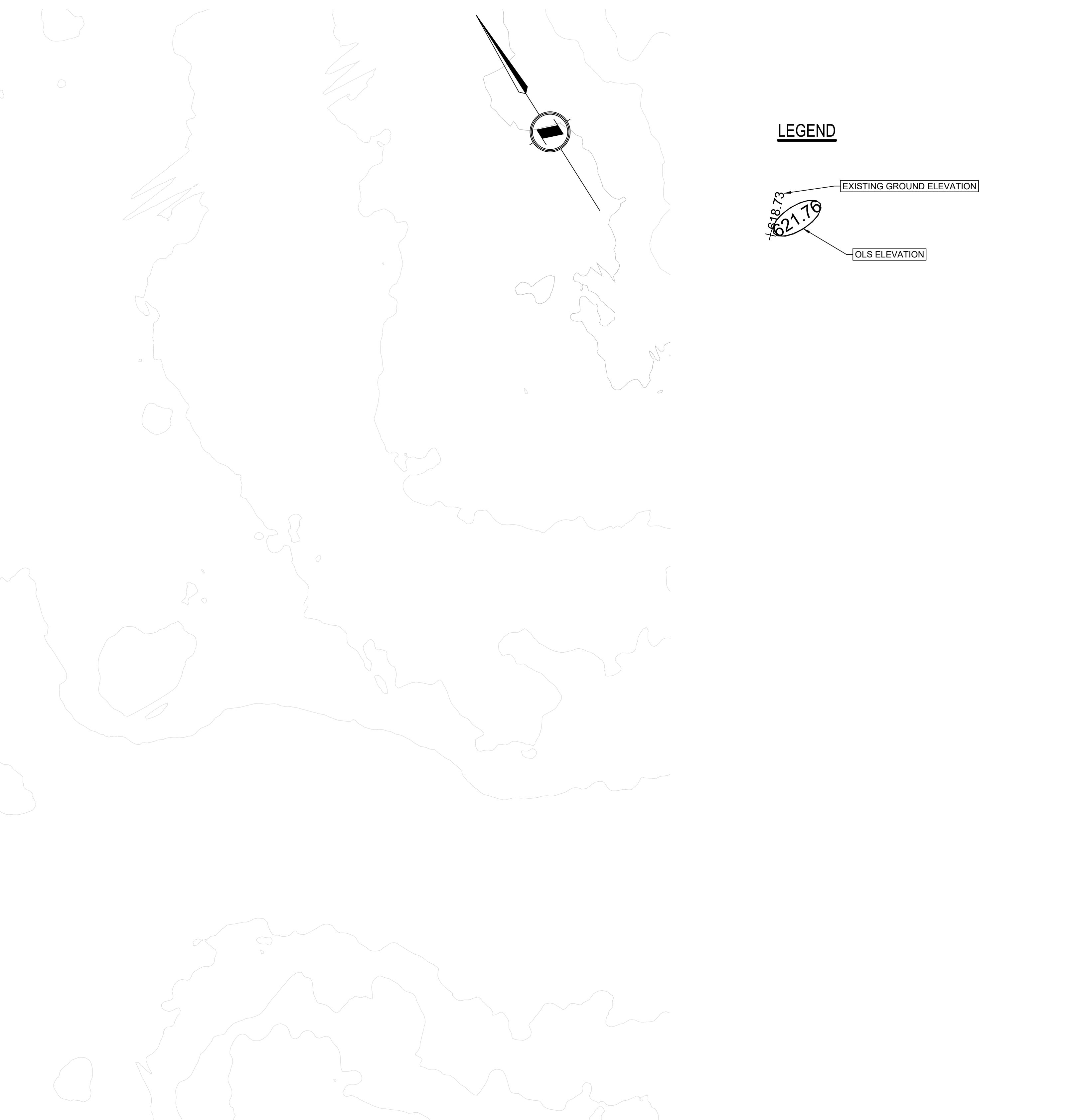
612.511

APPENDIX D

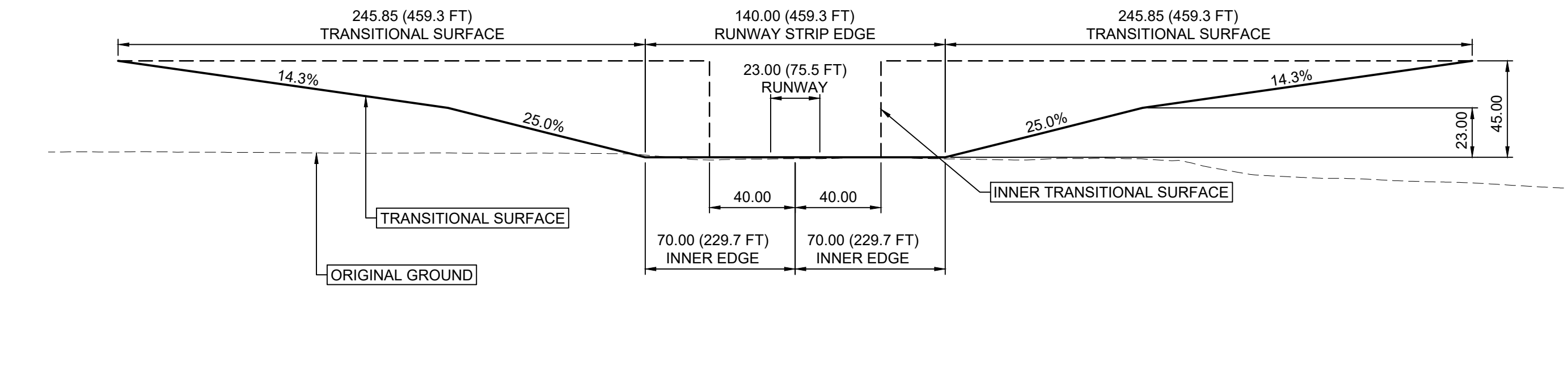
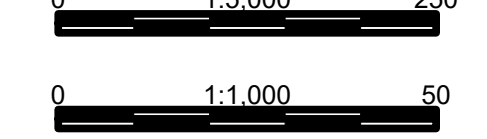
OLS Plan and Profile



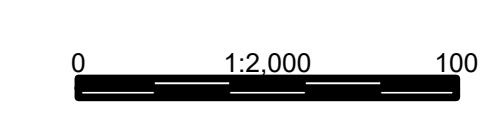
PLAN
SCALE 1:5000



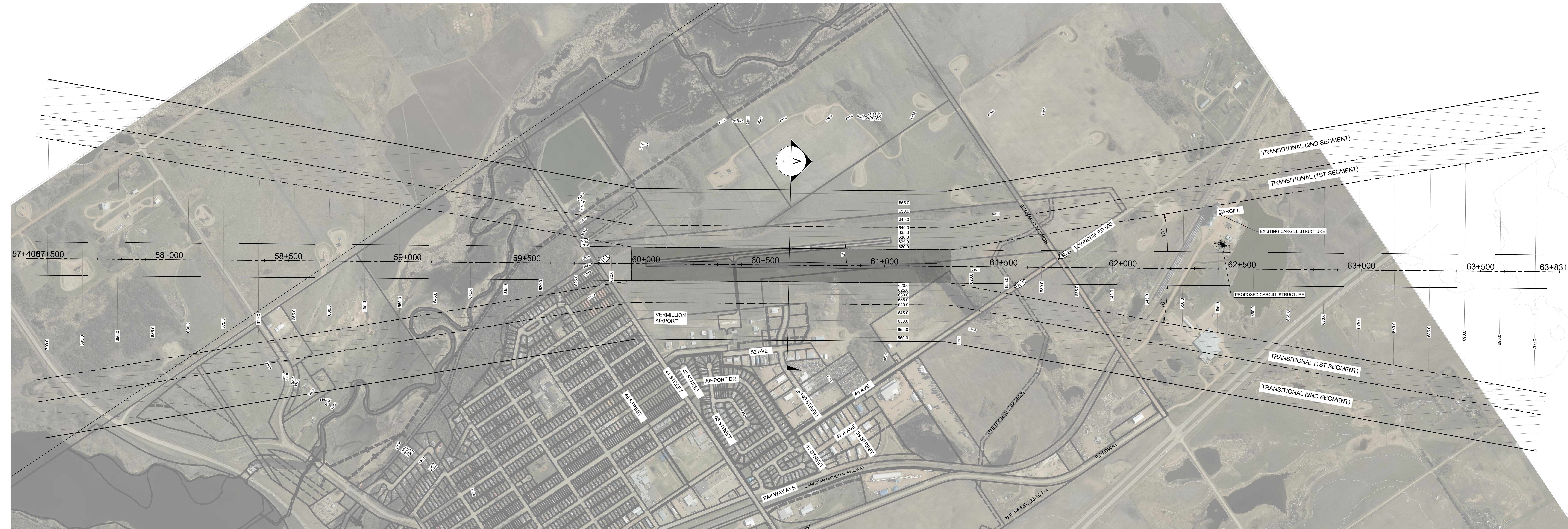
PROFILE
SCALE 1:5000 H, 1:1000 V



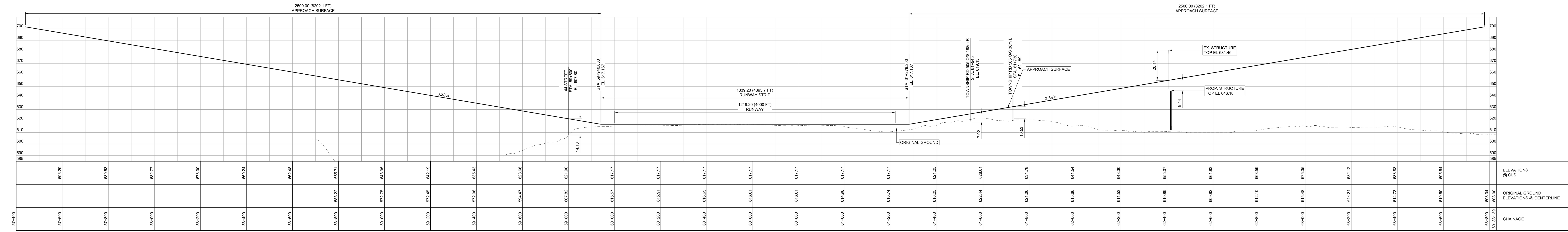
SECTION A
SCALE 1:2000



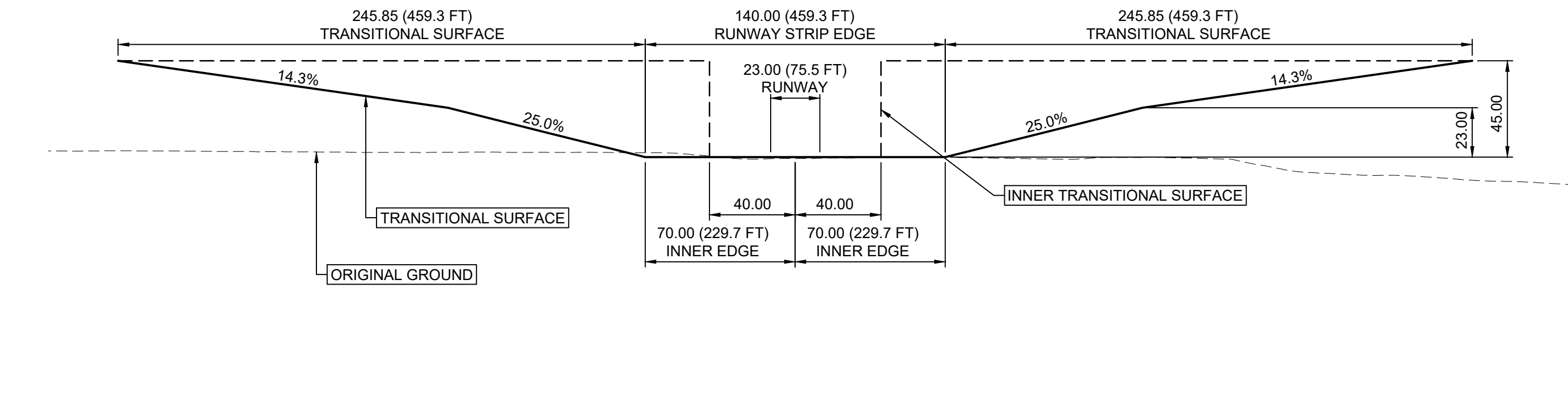
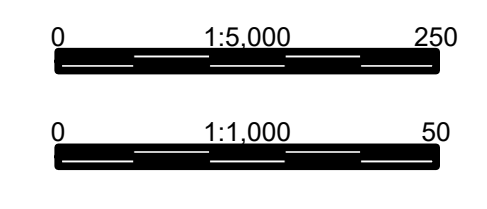
DRAFT
FOR DISCUSSION
09/26/2023



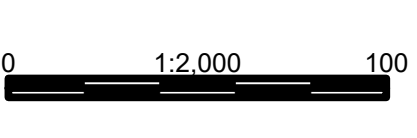
PLAN
SCALE 1:5000



PROFILE
SCALE 1:5000 H, 1:1000 V



SECTION A
SCALE 1:2000



DRAFT
FOR DISCUSSION
09/26/2023