APPENDIX D-1
RUNWAY LENGTH ANALYSIS

This appendix includes the runway length analysis for Gnoss Field Airport that was prepared for the Updated Purpose and Need Working Paper to verify an appropriate length for Gnoss Field Airport Runway 13/31.
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APPENDIX D-1

RUNWAY LENGTH ANALYSIS

GNOSS FIELD AIRPORT

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RUNWAY LENGTH ANALYSIS

1.0 INTRODUCTION

Marin County has prepared several evaluations of the Gnoss Field Airport’s (DVO or Airport) operations and facilities, including the 1989 Airport Master Plan\(^1\), the 1997 Update of the Airport Master Plan, the 2002 Preliminary Design Report for the proposed runway extension\(^2\), and the evaluations leading up to the preparation of the Draft and Final EIS.\(^3\) These studies identified the limitations regarding the Airport’s ability to accommodate existing aircraft and aviation users for which the Airport was designed. Specifically, prior evaluations found the Airport’s 3,300-foot long runway could not fully accommodate existing aviation activity of the critical aircraft. This evaluation updates those prior evaluations based on the current critical aircraft identified in Appendix A the family of B-II Turboprop aircraft, which is the most demanding aircraft grouping with regular use.

FAA Advisory Circular (AC) 150/5325-4B, Runway Length Requirements for Airport Design\(^4\), is the FAA’s guidance document for identifying the appropriate runway length for airport runways. AC 150/5325-4B, Paragraph 101 Background, describes runway length factors and evaluations as follows:

“Airplanes today operate on a wide range of available runway lengths. Various factors, in turn, govern the suitability of those available runway lengths, most notably airport elevation above mean sea level, temperature, wind velocity, airplane operating weights, takeoff and landing flap settings, runway surface condition (dry or wet), effective runway gradient, presence of obstructions in the vicinity of the airport, and, if any, locally imposed noise abatement restrictions or other prohibitions. Of these factors, certain ones have an operational impact on available runway lengths. That is, for a given runway the usable length made available by the airport may not be entirely suitable for all types of airplane operations.”

AC 150/5300-13A, Airport Design, Paragraph 105b Design Aircraft, states describing aircraft using an airport that:

“The first consideration of the airport planner should be the safe operation of aircraft likely to use the airport... However, it is not the usual practice to base the airport design on an aircraft that uses the airport infrequently...”

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\(^1\) Airport Master Plan Marin County Airport Gnoss Field, 1989.
As stated in AC 150/5300-13A Airport Design, Paragraph 105a, Applicability of Airport Design Standards:

“Airport designs that are based on large aircraft never likely to be served by the airport are not economical.”

The general approach to the selection of airport dimensional design standards is described in FAA Order 5090.3C Field Formulation of the National Plan of Integrated Airport Systems (NPIAS), Paragraph 3-4 Airport Dimensional Standards which states:

“Airport dimensional standards (such as runway length and width, separation standards, surface gradients, etc.) should be selected which are appropriate for the critical aircraft that will make substantial use of the airport in the planning period.” and “The critical aircraft may be a single aircraft or a composite of the most demanding characteristics of several aircraft. The critical aircraft is used to identify the appropriate Airport Reference Code for airport design criteria.”

In regard to the critical aircraft AC 150/5000-17, Critical Aircraft and Regular Use Determination states:

“The critical aircraft is the most demanding aircraft type, or grouping of aircraft with similar characteristics, that make regular use of the airport. Regular use is 500 annual operations, including both itinerant and local operations but excluding touch-and-go operations. An operation is either a takeoff or landing.”

As described in detail in Appendix A, the critical aircraft (also called the design aircraft, or critical design aircraft) for DVO is the family of B-II Turboprop aircraft, which is the most demanding aircraft grouping with regular use. The design concept followed in AC 150/5325-4B for determining the necessary runway length for the critical aircraft is to consider several physical characteristics of the critical aircraft including whether the Maximum Certificated Takeoff Weight is 12,500 pounds or less, the Approach Speed of the aircraft, and whether the aircraft carries less than 10 passengers, or 10 or more passengers. The appropriate chapter of AC 150/5325-4B is then followed to determine the appropriate runway length.

AC 150/5325-4B Runway Length Requirements for Airport Design provides guidelines for airport designers and planners to determine recommended runway lengths for new runways or extensions to existing runways. AC 150/5325-4B, Paragraph 101 states regarding runway length determinations that:

“In summary, the goal is to construct an available runway length for new runways or extensions to existing runways that is suitable for the forecasted critical design aircraft.”

AC 150/5325-4B, Paragraph 103 further states:

“The design objective for the main primary runway is to provide a runway length for all airplanes that will regularly use it without causing operational weight restrictions.”
For airport projects receiving Federal funding, the use of the methods described in AC 150/5325-4B to determine runway length is mandatory. This Runway Length Analysis used the procedures in AC 150/5325-4B to verify the necessary runway length to meet the purpose and need of this project, which, consistent with AC 150/5325-4B, is: allow existing aircraft, as represented by the family grouping of critical aircraft at DVO, to operate without operational weight restrictions (i.e. at Maximum Gross Take Off Weight) under hot weather conditions (i.e., mean daily maximum temperature of the hottest month).^5

AC 150/5325-4B Paragraph 201, Design Guidelines, identifies five specific variable factors that affect runway length that must be considered in determining the recommended runway length for an airport using the family grouping methodology. These are:

- Airplane Type
- Approach Speed
- Number of Passengers
- Airport Elevation
- Mean Daily Maximum Temperature of the Hottest Month

For aircraft with a Maximum Certificated Takeoff Weight (MTOW) of 12,500 pounds or less, such as the B-II family of turboprop aircraft at DVO, AC 150/5325-4B, Paragraph 202, Design Approach, provides a small airplane design concept for considering the five factors described above in order to determine a recommended runway length. Airport planners can use the appropriate “runway length curves” in AC 150/5325-4B for the weight and characteristics of a critical aircraft or a family grouping of critical aircraft under consideration to establish the necessary runway length. The current runway length determination for this project is based on the appropriate runway length curve for a family grouping of critical aircraft.

AC 150/5325-4B also allows the airport planner to consider the runway length requirements of a specific critical aircraft using that aircraft’s airplane flight manual if the aircraft’s requirements are not met using the runway length curves. Although that method was used to calculate the necessary runway length at Gnoss Field Airport based on the Cessna 525 aircraft airplane flight manual in the June 2014 Final EIS, that method is no longer applicable because the Cessna 525 business jet it was based on is not currently forecasted to have the minimum 500 annual operations at the airport necessary to be designated the critical aircraft for DVO (See Appendix A).

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^5 Hotter air is less dense than cooler air so that an aircraft wing creates less lift in hotter air. Therefore, other factors being equal, aircraft require a longer runway to attain sufficient speed to take off on a hot day, as compared to a cooler day.
2.0 RUNWAY LENGTH ANALYSIS

AC 150/5325-4B Chapter 2, Runway Lengths for Small Airplanes with Maximum Certificated Takeoff Weight of 12,500 Pounds (5,670 Kg) or Less, describes procedures for calculating necessary runway lengths using a small airplane design concept. Paragraph 205 applies to Small Airplanes with Approach Speeds of 50 Knots or More with Maximum Certificated Takeoff Weight of 12,500 Pounds (5,670 Kg) or Less, which is the appropriate category for DVO. Paragraph 205 references two distinct runway length curves based on seating capacity and the mean daily maximum temperature of the hottest month of the year at the Airport. Using the most demanding aircraft category at DVO, it was determined the Small Airplane with Fewer than 10 Passenger Seats chart (i.e., Figure 2-1 of AC 150/5325-4B) also portrayed the most demanding runway length requirement. The following inputs were used to determine the recommended runway length requirement for DVO to meet the project purpose and need. The project purpose and need is to allow existing aircraft, as represented by the family grouping of critical aircraft at DVO, to operate without operational weight restrictions under hot weather conditions.

Input Data:

Airport elevation: Sea Level

Mean daily maximum temperature of the hottest month: 82°F

Using Figure 2-1 from FAA AC 150/5325-4B, Small Airplanes with Fewer than 10 Passenger Seats, the inputs listed above analyzed along the curve (see Exhibit B-1).

(1) Step 1 – Find the mean daily maximum temperature of the hottest month, 82°F Fahrenheit (°F).

(2) Step 2 – Proceed vertically to the airport elevation, which for DVO is sea level (two feet).

(3) Step 3 – Proceed horizontally to the runway length axis.

(4) Step 4 – Read runway length. The runway length requirement derived from Figure 2-1, FAA AC 150/5325-4B, is 3,550 feet and rounded up to 3,600 feet per FAA guidance.

AC 150/5325-4B Paragraph 205 states:

"Figure 2-1 categorizes small airplanes with less than 10 passenger seats (excludes pilot and co-pilot) into two family groupings according to “percent of fleet,” namely, 95 and 100 percent of the fleet.”

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Paragraph 205a goes on to state:

“The differences between the two percentage categories are based on the airport’s location and the amount of existing or planned aviation activities. The airport designer should make the selection based on the following criteria.”

Paragraph 205a (1) states:

“95 Percent of Fleet. This category applies to airports that are primarily intended to serve medium size population communities with a diversity of usage and a greater potential for increased aviation activities. Also included in this category are those airports that are primarily intended to serve low-activity locations, small population communities, and remote recreational areas. Their inclusion recognizes that these airports in many cases develop into airports with higher levels of aviation activities.”

Paragraph 205a (2) states:

“100 Percent of Fleet. This type of airport is primarily intended to serve communities located on the fringe of a metropolitan area or a relatively large population remote from a metropolitan area.”

DVO is located northeast of the City of Novato in Marin County. As Marin County is at the northern end of the San Francisco-Oakland-Hayward Metropolitan Statistical Area, the airport serves communities on the fringe of the metropolitan area. Therefore, the 100 Percent of Fleet category curve is appropriate to use in the analysis.

The runway length requirement derived from the 100 Percent of Fleet runway length curve in Figure 2-1 of AC 150/5325-4B and shown in Exhibit B-1 is 3,550 feet. FAA AC 150/5325-4B Appendix 3, Paragraph 1-3, Calculations, includes a provision for rounding calculated lengths of 30 feet and over up to the next 100-foot interval when using specific Aircraft Performance Manuals. Because the analysis using Figure 2-1 relies upon some visual interpretation, the same approach to round up to the next highest 100-foot runway length interval is applied to account for potential inaccuracies in the visual interpretation process. Thus, the runway length of 3,550 feet is rounded up to 3,600 feet to establish the runway length requirement.

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EXHIBIT B-1
RUNWAY LENGTH DETERMINATION USING RUNWAY LENGTH CURVES PROCESS
Gnoss Field Airport

Sources: Runway length for 100 percent of Fleet at Gnoss Field Airport based on FAA AC 150/5325-4B Runway Length Requirements for Airport Design, Figure 2-1; Landrum & Brown analysis.