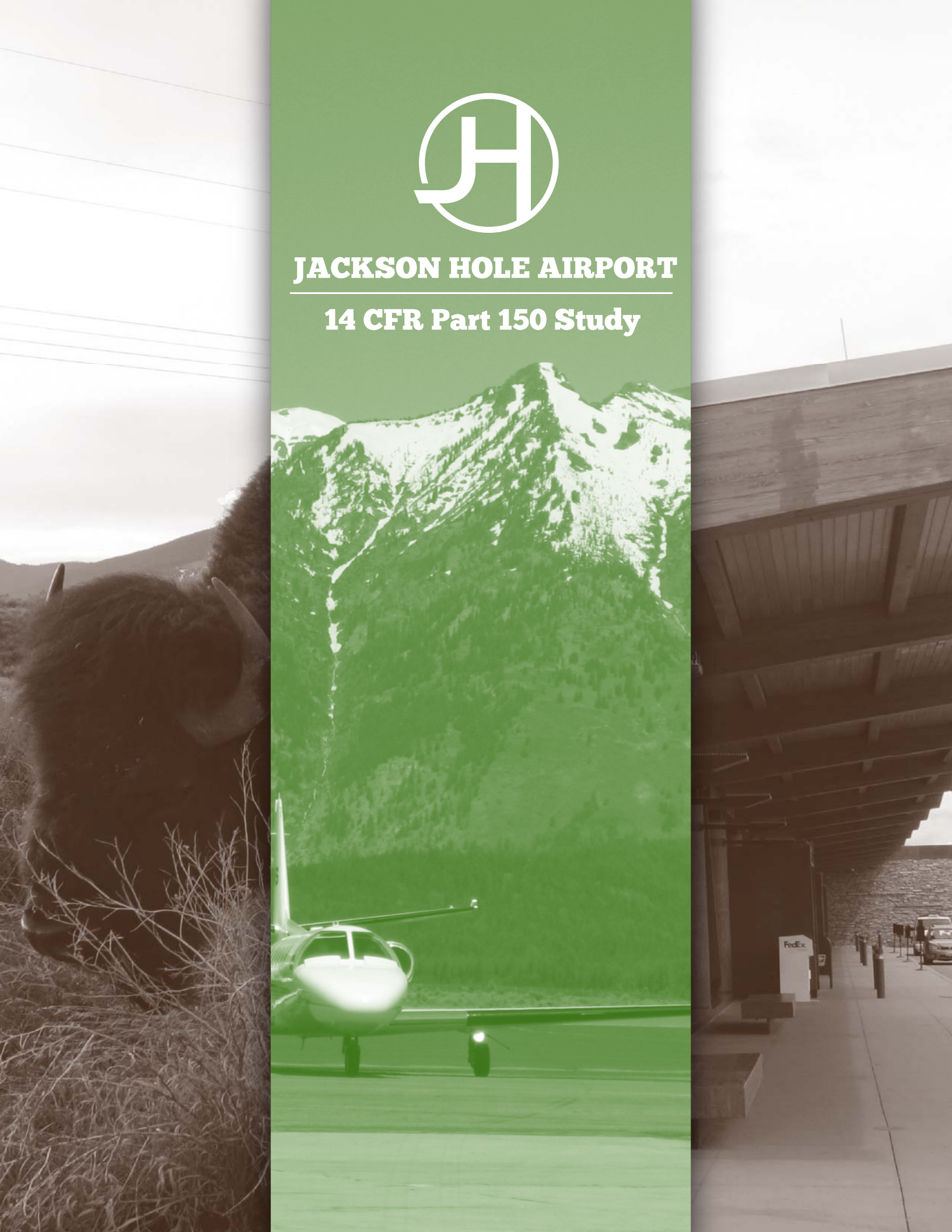
JACKSON HOLE AIRPORT

14 CFR Part 150 Study



JACKSON HOLE AIRPORT
14 CFR Part 150 Study

March 2018

The preparation of this document was financed in part through a planning grant from the Federal Aviation Administration (FAA) as provided under Section 505 of the Airport and Airway Improvement Act of 1982 as amended by the Airway Safety and Capacity Expansion Act of 1987. The contents do not necessarily reflect the views or policy of the FAA.

Acceptance of this report does not in any way constitute a commitment on the part of the United States to participate in the development depicted herein, nor does it indicate that the proposed development is environmentally acceptable in accordance with appropriate public law. This document is intended to be a planning document by Jackson Hole Airport. Final decisions concerning implementation of the recommendations shall be made by Jackson Hole Airport.

The Noise Exposure Map and accompanying documentation for the Noise Exposure Maps and Noise Compatibility Program for Jackson Hole Airport, submitted in accordance with 14 CFR Part 150 with the best available information, are hereby certified as true and complete to the best of my knowledge and belief.

In addition, it is hereby certified that the airport sponsor has afforded persons adequate opportunity to submit their views, data, and comments concerning the correctness and adequacy of this draft noise compatibility study and draft noise exposure maps.

Signed: _____

Dated: _____

Mead&Hunt
BridgeNet *International*
Synergy Consultants

JACKSON HOLE AIRPORT

March 14, 2018

Dear Ms. Krull:

Enclosed are copies of the Jackson Hole Airport (JAC) Title 14 Code of Federal Regulations (CFR) Part 150 Noise Exposure Maps (NEMs) and Noise Compatibility Program (NCP), along with supporting documentation as submitted by the Jackson Hole Airport Board (Airport Operator). This is an update to the previous Part 150 Studies completed in 2004 and 1985. We are submitting these documents pursuant to Title 49 USC Chapter 471 and Title 14 CFR Part 150 and the applicable Federal Aviation Administration (FAA) guidelines for approval and acceptance. The maps contained in the documents are the official NEMs for the Airport. The Part 150 Land Use Guidelines were used to determine compatibility.

Both the existing and future NEM contours were generated using the Integrated Noise Model (INM) 7.0d, the latest version at the time of project initiation.[1] The five-year NEM is based on the Future Base Case noise contour without the recommendations provided in the NCP. The "existing condition " map, which is based on the data for the year the NEMs were developed (2014), accurately represents the year of submission (2018). In addition, the "future condition" map (2020) is representative of 2023 data. Please refer to Appendix I - Forecast Validation Memo for the support for these statements.

This letter also certifies that the Airport has afforded interested persons adequate opportunity to submit their views, data, and comments concerning the correctness and adequacy of the draft noise exposure maps and descriptions of forecast aircraft operations. Several meetings were conducted over the course of the study, including 5 study input committee meetings, two public workshops and a Public Hearing (held November 20, 2017) and the public was afforded interested person adequate opportunity to submit both written and verbal comments. More information on the public involvement process is contained in Appendix G and H of the Study. Each map and the description of consultation and opportunity for public comment are true and complete. The JAC Airport Board approves of the Recommendations (see attached resolution) and this serves as the official submittal to the FAA of the NEMs and NCP.

Sincerely,

James P. Elwood, A.A.E
Executive Director – Jackson Hole Airport

[1] FAA's Aviation Environmental Design Tool (AEDT), which has replaced the legacy INM tool (effective May 29, 2015), was not used in this Study because it had not yet been released when the Study began.

JACKSON HOLE AIRPORT BOARD
P.O. Box 159 • Jackson, WY 83001 • (307) 733-7695 • Fax (307) 733-9270
Jim Elwood, A.A.E., Airport Director

RESOLUTION NO. 2018-02
OF THE
JACKSON HOLE AIRPORT BOARD
ADOPTING & ACCEPTING FAR PART 150 NOISE COMPATABLITY STUDY UPDATE

February 21, 2018

The Jackson Hole Airport Board (the "Board"), a body corporate, organized under the laws of Wyoming, finds that:

WHEREAS, the Board is the owner, operator and sponsor of the Jackson Hole Airport;

WHEREAS, the Board through its consultants, Mead & Hunt, has conducted a 14 CFR Part 150 Study Update (the "Study"), evaluating several noise abatement and mitigation measures to reduce aircraft noise exposure over both Grand Teton National Park and the community;

WHEREAS, such mitigation measures have been considered in public meetings, the Board has conducted a final public hearing to present the Findings and Recommendations of the Study to the public, and has received public comments on the same; and

WHEREAS, the draft FAR 150 Study document has been submitted to the Federal Aviation Administration ("FAA"), and its comments have been received and been incorporated into the Final Study.

NOW, THEREFORE, it is resolved by the Jackson Hole Airport Board, in open and public meeting as follows:

1. The Board hereby adopts and accepts the Final Study document in the form submitted by Mead & Hunt, and direct that it be submitted to the FAA for acceptance and approval.

2. The Board requests that FAA accept the Noise Exposure Maps and approve the Recommendations set forth in the Final FAR 150 Study document.

Adopted by the Board in open and public meeting this 21th day of February 2018.

JACKSON HOLE AIRPORT BOARD

By:_____
Jerry Blann, President

ATTEST

By:_____
John Eastman, Secretary

Noise Compatibility Program and Noise Exposure Map Checklists

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Noise Compatibility Program Checklist

I. IDENTIFICATION AND SUBMISSION OF PROGRAM: ***Page Number***

A. Submission is properly identified:
   1. 14 C.F.R Part 150 NCP? Yes, Cover, Fly Sheet, Cover Letter
   2. NEM and NCP together? Yes, Cover Letter
   3. Program revision? Yes, NCP/NEM Part 150 Study Update, Cover Letter

B. Airport and Airport Operator's name identified? Yes, Cover, Fly Sheet

C. NCP transmitted by airport operator cover letter? Yes, Cover letter

II. CONSULTATION:

A. Documentation includes narrative of public participation and consultation process? Yes, 10.1-10.2, Appendix G, H

B. Identification of consulted parties:
   1. All parties in 150.23(c) consulted? Yes, 10.1-10.2, Appendix G, H
   2. Public and planning agencies identified? Yes, 10.1-10.2, Appendix G, H
   3. Agencies in 2., above, correspond to those affected by the NEM noise contours? Yes, 10.1-10.2, Appendix G, H

C. Satisfies 150.23(d) requirements:
   1. Documentation shows active and direct participation of parties in B, above? Yes, 10.1-10.2, Appendix G, H
   2. Active and direct participation of general Public and opportunity to submit their views, data and comments on the formulation and adequacy of the NCP? Yes, 10.1-10.2, Appendix G, H
   3. Participation was prior to and during development of NCP and prior to submittal to FAA? Yes, 10.1-10.2, Appendix G, H
   4. Indicates adequate opportunity afforded to all consulted parties to submit views, data, etc.? Yes, 10.1-10.2, Appendix G, H

D. Evidence is included there was notice and opportunity for a public hearing on the final NCP? Yes, Appendix H

E. Documentation of comments:
   1. Includes summary of public hearing comments, if hearing was held? Yes, 10.1-10.2, Appendix H
   2. Includes copy of all written material submitted to operator? Yes, Appendix G, H
   3. Includes operator's responses/disposition of written and verbal comments? Yes, Appendix G, H

F. Is there written evidence from the appropriate office within the FAA that the sponsor received informal agreement to carry out proposed flight procedures N/A

III. NOISE EXPOSURE MAPS: [150.23, B150.3, B150.35 (f)]

(This section of the checklist is not a substitute for the Noise Exposure Map checklist. It deals with maps in the context of the Noise Compatibility Program submission.)

A. Inclusion of NEMs and supporting documentation:
   1. Map documentation either included or incorporated by reference? Yes, 4.15-4.16, 9.1-9.3
   2. Maps previously found in compliance by FAA? Yes, ROA 2004
   3. Compliance determination still valid? Yes, ROA 2004
      (a) Existing condition NEM represents conditions at the airport at the time of submittal of the NCP for FAA approval?
      (b) Forecast condition NEM represents conditions at the airport at least 5 years into the future from the date of submittal of the NCP to the FAA for approval?
      (c) Sponsor letter confirming elements (a) and (b), above, if date of submission is either different than the year of submittal of the previously approved NEMs or over 12 months from the date shown on the face of the NEM?
      (d) If (a) through (c) cannot be validated, the NEMs must be redone and resubmitted as per 150.21.
   4. Does 180-day period have to wait for map compliance finding? Yes

B. Revised NEMs submitted with program:
   (Review using NEM checklist if map revisions included in NCP

submittal. Report applicable findings in the spaces below after a full review using the NEM checklist and narrative)

1. Revised NEMs included with program? Yes, 4.16, 9.2,
2. Has airport operator requested in writing that FAA to make a determination on the NEM(s), showing NCP measures in place when NCP approval is made? No

C. If program analysis used noise modeling:
   1. INM or HNM, or FAA-approved equivalent? Yes, 3.27-3.33
   2. Monitoring in accordance with A150.5? Yes, 3.27-3.33

D. Existing condition and 5-year maps clearly identified as the official NEMs?
   Yes, 4.16, 9.2 and Large-Scale Maps Submitted Separately

IV. CONSIDERATION OF ALTERNATIVES: [B150.7, 150.23 (e)]

A. At a minimum, are the alternatives below considered or if they were rejected was the reason for rejection reasonable and based on accurate technical information and local circumstances?
   1. Land acquisition and interest therein, including air rights, easements, and development rights? Yes, 6.9
   2. Barriers, acoustical shielding, public building sound proofing Yes, 6.9
   3. Preferential runway system Yes, 6.9
   4. Voluntary Flight procedures Yes, 7.1-7.55
   5. Restrictions described in B150.7 (taking into account Part 161 requirements). Yes, 6.8
   6. Other actions with beneficial impact not listed in the regulation Yes, 8.1-8.14
   7. Other FAA recommendations (see D, below) N/A

B. Responsible implementing authority identified for each considered alternative? Yes, 9.1-9.38

C. Analysis of alternative measures:
   1. Measure clearly described? Yes, 7.1-7.55, 8.1-8.14
   2. Measures adequately analyzed? Yes, 7.1-7.55, 8.1-8.14
   3. Adequate reasoning for rejecting alternatives? Yes, 6.8-6.9, 7.1-7.55, 8.1-8.14

D. Other actions recommended by the FAA:
   Should other actions be added? N/A

(List separately, or on back, actions and discussions with airport operator to have them included prior to the start of the 180-day cycle. New measures adopted by the airport sponsor must be subject to consultation before they can be submitted to the FAA for action. (See E., below)

V. ALTERNATIVES RECOMMENDED FOR IMPLEMENTATION:

[150.23 (e),B150.7, B150.35 (b), B150.5]

A. Document clearly indicates:
   1. Alternatives recommended for implementation? Yes, 9.1-9.38
   2. Final recommendations are airport operator's, not those of consultant or third party? Yes, Cover Letter

B. Do all program recommendations:
   1. Relate directly or indirectly to reduction of noise and non-compatible land uses? Yes, 9.1-9.38
      (Note: All program recommendations, regardless of Whether previously approved by the FAA in an earlier Part 150 study, must demonstrate a noise benefit if the airport sponsor wants FAA to consider the measure for approval in a program update. See E., below)
   2. Contain description of contribution to overall effectiveness of program? Yes, 9.1-9.38
   3. Noise/land use benefits quantified to extent possible? Yes, 9.1-9.38
   4. Does each alternative include actual/anticipated effect on reducing noise exposure within noncompatible area shown on NEM? Yes, 7.1-7.55
   5. Effects based on relevant and reasonable expressed assumptions? Yes, 9.1-9.38
   6. Does the document have adequate supporting data that the measure contributes to noise/land use compatibility? Yes, 9.1-9.38

C. Analysis appears to support program standards set forth in 150.35 (b) and B150.5? Yes, 9.1-9.38

D. When use restrictions are recommended for approval by the FAA:
   1. Does (or could) the restriction affect Stage 2 or Stage 3 aircraft operations (regardless of whether they presently operate at the airport)? (If restriction affects Stage 2 helicopters, Part 161 also applies.) N/A
   2. If the answer to D1. is yes, has the airport sponsor completed the Part 161 process and received FAA Part 161 approval for a

restriction affecting Stage 3 aircraft? For restrictions affecting only Stage 2 aircraft, has the airport sponsor successfully completed the Stage 2 analysis and consultation process required by Part 161 and meet the regulatory requirements and is there evidence by letter from FAA stating this fact? N/A

3. Are non-restrictive alternatives with potentially significant noise/compatible land use benefits thoroughly analyzed so that appropriate comparisons and conclusions among all alternatives can be made? N/A

4. Did the FAA regional or ADO reviewer coordinate the use restriction with APP-600 prior to making determination on start of 180-days? N/A

E. Do the following also meet Part 150 analytical standards:
   1. Recommendations which continue existing practices that are submitted for reapproval? Yes, 9.1-9.38
   2. New recommendations or changes proposed at end of Part 150 process? Yes, 9.1-9.38

F. Documentation indicates how recommendations may change previously adopted noise compatibility plans, programs or measures? Yes, 9.1-9.38

G. Documentation also:
   1. Identifies agencies that are responsible for implementing each recommendation Yes, 9.1-9.38
   2. Indicates whether those agencies have agreed to implement? N/A
   3. Indicates essential government actions necessary to implement recommendations? Yes, 9.1-9.38

H. Time Frame:
   1. Includes agreed-upon schedule to implement alternatives? Yes, 9.1-9.38
   2. Indicates period covered by the program? Yes, Cover Letter

I. Funding/Costs:
   1. Includes costs to implement alternatives? Yes, 9.1-9.38
   2. Includes anticipated funding sources? Yes, if applicable, 9.1-9.38

VI. PROGRAM REVISION: [150.23 (e) (9)]

Supporting documentation includes provision for revision?	Yes, 9.35

Noise Exposure Map Checklist

I. IDENTIFICATION AND SUBMISSION OF MAP DOCUMENT: ***Page Number***

A. Is this submittal appropriately identified as one of the following, submitted under 14 CFR Part 150: Cover, Cover Letter
   1. A NEM only N/A
   2. A NEM and NCP Yes, Cover Letter
   3. A revision to NEMs which have previously been determined by FAA to be in compliance with Part 150? Yes, Cover Letter

B. Is the airport name and the qualified airport operator identified? Yes, Cover, Cover Letter

C. Is there a dated cover letter from the airport operator which indicates the documents are submitted under Part 150 for appropriate FAA determination? Yes, Cover Letter

II. CONSULTATION: [150.21 (b), A150.(a)]

A. Is there a narrative description of the consultation accomplished, including opportunities for public review and comment during map development? Yes, 10.1-10.2, Appendix G, H

B. Identification:
   1. Are the consulted parties identified? Yes, 10.1-10.2, Appendix G, H
   2. Do they include all those required by 150.21 (b) and A150.105 (a)? Yes, 10.1-10.2, Appendix G, H
   3. Agencies in 2., above, correspond to those indicated on the NEM? Yes, 10.1-10.2, Appendix G, H

C. Does the documentation include the airport operator's certification, and evidence to support it, that interested persons have been afforded adequate opportunity to submit their view, data, and comments during map development and in accordance with 150.21 (b)? Yes, Cover Letter, Large-scale Maps, Fly Sheet, Appendix G, H

D. Does the document indicate whether written comments were received during consultation and, if there were comments, that they are on file with the FAA region? Yes, 10.1-10.2, Appendix G, H

III. GENERAL REQUIREMENTS: [150.21]

A. Are there two maps, each clearly labeled on the face with year (existing condition year and 5-year)?
Yes, 4.16, 9.2, Large-scale maps submitted separately

B. Map currency:
1. Does the existing condition map year match the year on the airport operator's submittal letter? No[1], 4.16, Cover Letter, Appendix I
2. Is the 5-year map based on reasonable forecasts and other planning assumptions and is it for the fifth calendar year after the year of submission? No
3. If the answer to 1 and 2 above is no, has the airport operator verified in writing that data in the documentation are representative of existing condition and 5-year forecast conditions as of the date of submission? Yes, Cover Letter, Appendix I

C. If the NEM and NCP are submitted together:
1. Has the airport operator indicated whether the 5-year map is based on 5-year contours without the program vs. contours if the program is implemented? Yes, 9.1
2. If the 5-year map is based on program implementation:
   a. are the specific program measures which are reflected on the map identified? N/A
   b. does the documentation specifically describe how these measures affect land use compatibilities depicted on the map? N/A
3. If the forecast year NEM does not model program implementation, the airport operator must either submit a revised forecast NEM showing program implementation conditions [B150.3(b), 150.35(f)] or the sponsor must demonstrate the adopted forecast year NEM with approved NCP measures would not change by plus/minus 1.5 DNL? (150.21(d)) Yes, 9.5

[1] *Note: The base case year (2014) was used because it was the last full year of operations when the project started. Therefore, it was considered to be the best year for the base case NEM.*

IV. MAP SCALE, GRAPHICS, AND DATA REQUIREMENTS:

[A150.101, A150.105, 150.21 (a)]

A. Are the maps of sufficient scale to be clear and readable (they must not be less than 1" to 2,000') and is the scale indicated on the maps?
Yes, 4.16, 9.2, Large-scale maps submitted separately

B. Is the quality of the graphics such that required information is clear and readable?
Yes, 4.16, 9.2, Large-scale maps submitted separately

C. Depiction of the airport and its environs.
1. Is the following graphically depicted to scale on both the existing condition and 5-year maps:
   a. Airport boundaries
   Yes, 4.16, 9.2, Large-scale maps submitted separately
   b. Runway configurations with runway end numbers
   Yes,4.16, 9.2, Large-scale maps submitted separately
2. Does the depiction of the off-airport data include:
   a. A land use base map depicting streets and other identifiable geographic features Yes, 4.16, 9.2
   b. The area within the 65 Ldn (or beyond, at local discretion) Yes, 4.16, 9.2
   c. Clear delineation of geographic boundaries and the names of all jurisdictions with the 65 Ldn (or beyond, at local discretion) Yes 4.16, 9.2

D. 1. Continuous contours for at least the Ldn 65, 70, and 75? Yes, 4.16, 9.2, Large-scale maps submitted separately
2. Has the local land use jurisdiction(s) adopted a lower local standard and if so, has the sponsor depicted this on the NEMs? Local standard discussed in Appendix D
3. Based on current airport and operational data for the existing condition year NEM, and forecast data representative of the selected year for the forecast NEM? Yes, Cover Letter, Chapter 2, Appendix I

E. Flight tracks for the existing condition and forecast year forecast time frames (these may be on supplemental graphics which must use the same land use base map as the existing condition and forecast NEM), which are numbered to correspond to accompanying narrative?
Yes, 4.13-4.14, same existing and future

F. Locations of any noise monitoring sites (these may be on supplemental graphics which must use the same land use base map and scale as the official NEMs) Yes, 3.31, Large scale maps

G. Noncompatible land use identification:
1. Are noncompatible land uses within at least the 65 Ldn depicted on the maps?
No non-compatible land uses in 65 Ldn, 4.14, 9.2, Large-scale maps submitted separately
2. Are noise sensitive public buildings identified? N/A
3. Are the noncompatible uses and noise sensitive public buildings readily identifiable and explained on the map legend?
N/A
4. Are compatible land uses, which would normally be considered noncompatible, explained in the accompanying narrative?
N/A

V. NARRATIVE SUPPORT OF MAP DATA:

[150.21 (a), A150.1, A150.103]

A. 1. Are the technical data, including data sources, on which the NEMs are based adequately described in the narrative? Yes, 2.1-2.16, 4.1-4.21
2. Are the underlying technical data and planning assumptions reasonable? Yes, 2.1-2.16, 4.1-4.21

B. Calculation of Noise Contours:
1. Is the methodology indicated? Yes, Cover Letter, 4.1-4.21
a. Is it FAA approved? Yes, 4.1-4.21
b. Was the same model used for both maps? Yes, 4.1-4.21
c. Has AEE approval been obtained for use of a model other than those which have previous blanket FAA approval? N/A

2. Correct use of noise models:
   a. Does the documentation indicate the airport operator has adjusted or calibrated FAA-approved noise models or substituted one aircraft type for another? No
   b. If so, does this have written approval from AEE? N/A
3. If noise monitoring was used, does the narrative indicate that Part 150 guidelines were followed? Yes, 3.27-3.34
4. For noise contours below 65 Ldn, does the supporting documentation include explanation of local reasons? (Narrative explanation is highly desirable but not required by the Rule.) Yes, Appendix D, Use Agreement

C. Noncompatible Land Use Information:
1. Does the narrative give estimates of the number of people residing in each of the contours (Ldn 65, 70 and 75, at a minimum) for both the existing condition and 5-year maps? Yes, 5.1-5.3, 9.3
2. Does the documentation indicate whether Table 1 of Part 150 was used by the airport operator? Yes, 3.23
   a. If a local variation to Table 1 was used:
      (1) does the narrative clearly indicate which adjustments were made and the local reasons for doing so? N/A
      (2) does the narrative include the airport operator's complete substitution for Table 1? N/A
3. Does the narrative include information of self-generated or ambient noise where compatible/ noncompatible land use identifications consider non-airport/aircraft sources? N/A
4. Where normally noncompatible land uses are not depicted as such on the NEMs, does the narrative satisfactorily explain why, with reference to the specific geographic areas? N/A
5. Does the narrative describe how forecast aircraft operations, forecast airport layout changes, and forecast land use changes will affect land use compatibility in the future? Yes, 1.29 (future land use), 6.8 (layout changes, none) 5.1-5.3, 9.3

VI. MAP CERTIFICATIONS: [150.21 (b), 150.21 (e)]

A. Has the operator certified in writing that interested persons have been afforded adequate opportunity to submit views, data, and comments concerning the correctness and adequacy of the draft maps and forecasts? Yes, Cover Letter, 10.1-10.2, Appendix G and H

B. Has the operator certified in writing that each map and description of consultation and opportunity for public comment are true and complete? Yes, Cover Letter

Part 150 Noise Compatibility Study
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List of Commonly Used Acronyms

AMSL	Above Mean Sea Level
ARFF	Aircraft Rescue and Fire Fighting
ARP	Airport Reference Point
ARTCC	Air Route Traffic Control Center
ASLF	Approach lighting System with Centerline Sequenced Flashing Lights
ATCT	Airport Traffic Control Tower
CFR	Code of Federal Regulations
DOI	United States Department of the Interior
DME	Distance Measuring Equipment
DNL	Day-Night Noise Level
EDF	Airport Reference Code for Elmendorf Air Force Base
FBO	Fixed Base Operator
FAA	Federal Aviation Administration
FCC	Federal Communication Commission
GA	General Aviation
GTNP	Grant Teton National Park
HIRL	High Intensity Runway Edge Lights
IFR	Instrument Flight Rules
ILS	Instrument Landing System
JAC	Airport Reference Code for Jackson Hole Airport
LOA	Letter of Agreement
MSL	Mean Sea Level
NAS	National Airspace System
NAVAIDS	Navigational Aids
NCP	Noise Compatibility Program
NEM	Noise Exposure Map
NM	Nautical Mile
NPS	National Park Service
RSIP	Residential Sound Insulation Program
STAR	Standard Terminal Arrival Route
TRACON	Terminal Radar Approach Control
VFR	Visual Flight Rules
VOR	Very High Frequency Omni-Directional Radio- Range

JACKSON HOLE AIRPORT
CFR Part 150 Study

1
Inventory

Chapter 1 – Inventory

INTRODUCTION. An airport undertakes a Title 14 Code of Federal Regulations (CFR) Part 150 Study (Study) to evaluate ways to make adjacent land uses compatible with airport related noise. Additionally, due to Jackson Hole Airport's (JAC) unique location within the Grand Teton National Park (GTNP), there are requirements to examine noise impacts based on agreements between the Jackson Hole Airport Board (Airport Board) and the National Park Service (NPS) that are outside of the normal Part 150 study process. This Study is an update to JAC's previous Part 150 Study and examines ways to further reduce noise impacts.

JAC is the primary air transportation facility serving the resort community of Jackson, Wyoming, as well as serving as a gateway to GTNP, Yellowstone National Park, and other nearby natural areas such as the National Elk Refuge. JAC is part of the Federal Aviation Administration's (FAA) National Plan of Integrated Airport Systems. It is located approximately nine miles north of Jackson, Wyoming. It is the busiest airport in Wyoming in terms of passenger enplanements.[1] JAC operates under a Use Agreement (**Appendix A**) with the Department of the Interior (DOI), and it is operated by the Airport Board.

This Study is an update of the 2003 Study that was adopted by the Airport Board. The Noise Exposure Maps (NEMs) were accepted and the Noise Compatibility Program (NCP) was approved by the FAA in 2003 and 2004, respectively.

Since completion of the previous study there have been changes to aircraft fleet mix and in aircraft activity levels at JAC as well as updates to the FAA noise model. The forecast has been updated to reflect these changes, as described in **Chapter 2**, and approved by the FAA (**Appendix B**). Many of these changes may have resulted in changes in noise exposure and therefore necessitated an update to the previous NEMs and NCP. In addition, an airport is required to keep its NEMs up to date if they choose to actively participate in the Part 150 program pursuant to the Part 150 regulations.

[1] Federal Aviation Administration, Terminal Area Forecast – State of Wyoming, data queried October 27, 2016.

The purpose of the Inventory chapter is to establish a baseline of information about existing airport facilities and operations, flight procedures, noise abatement procedures, local land use, and DOI and NPS policies for the GTNP. The inventory data were used for assumptions in the modeling of new aircraft noise exposure contours. The FAA is the federal agency responsible for 14 CFR Part 150 Studies. However, this Study is unique in that a second federal agency, the NPS, also has a stake in the process in accordance with the Use Agreement. Ultimately, it will be FAA's responsibility to accept the NEMs and approve measures eligible under the Part 150 regulations.

Because of the unique location of JAC within the GTNP, this Study considers supplemental non-Part 150 related noise factors based upon the requirements of the Use Agreement between the DOI and the Airport Board. The additional supplemental noise measurements and modeling are included in the Appendices to this Study (**Appendix C – Noise Monitoring and Appendix D – Supplemental Noise Metrics**).

1.1 Jackson Hole Airport

JAC is classified by the FAA as a non-hub primary commercial service airport. A non-hub primary commercial service airport is an airport that has more than 10,000 annual passenger boardings, but less than 0.05% of the total passenger boardings within the U.S.[2] It resides on approximately 533 acres. Although JAC is located entirely within the GTNP, the Airport Sponsor is a different public body, the Airport Board. JAC is operated by the Airport Board, whose members are appointed by the Town of Jackson and Teton County officials. The Executive Director and other airport staff are responsible for the day-to-day operations. JAC operates in GTNP under a Use Agreement between the Airport Board and the DOI dated April 23, 1983, as amended (**Appendix A**). Including options which may be exercised by the Airport Board, the Agreement has a potential term through April 23, 2053. JAC was created by the Town of Jackson in its present location in the 1930s. Scheduled passenger service began in 1941. In 1943, a large portion of the Jackson Hole valley, including JAC, was designated as the Jackson Hole National Monument by presidential proclamation. The Jackson Hole National Monument, including JAC, was incorporated into the GTNP in 1950.

Access to JAC is via East Airport Road, which connects to U.S. Highway 191/26/89 on JAC's eastern side. JAC has an Airport Reference Point (ARP) of Latitude 43° 36' 26.400" N, Longitude 110° 44' 15.900" W and an elevation of approximately 6451 feet Above Mean Sea Level (AMSL). The generalized airport location is illustrated on **Figure 1-1** and **Figure 1-2**.

JAC is served seasonally by four major domestic airlines: American Airlines, Delta Air Lines, SkyWest Airlines, and United Airlines, which provide direct service to Denver, Salt Lake City, Dallas/Ft. Worth, Minneapolis, Chicago, Newark, JFK, Atlanta, San Francisco, Houston, and Los Angeles.[3] In addition, JAC accommodates a number of general aviation operations as well as military operations. The NPS also utilizes JAC for various aviation needs related to management of the GTNP, such as search and rescue, fire suppression, emergency services and other resource related management. Operations are further discussed in **Chapter 2**.

[2] http://www.faa.gov/airports/planning_capacity/passenger_allcargo_stats/categories/

[3] July and August tend to be the busiest months for commercial service relative to summer visitors to GTNP, followed by the winter season related to ski tourism and GTNP.

Figure 1-1 - Airport Vicinity Map

Figure 1-2 - Airport Location Map

1.1.1 Airside Inventory

Runways. JAC has one runway, Runway 1-19, that is generally oriented from north to south on a true bearing of N 20° 44' 08" E. It is 6,300 feet long and 150 feet wide, and is an asphalt runway overlaid with a Porous Friction Course (PFC), which is listed as being in good condition based on criteria in Advisory Circular (AC) 150-5320-6E, Airport Pavement Design and Evaluation. The current load-bearing capacities for Runway 1-19 are 75,000 pounds for single-wheel landing gear, 200,000 pounds for dual-wheel landing gear, and 380,000 pounds for dual tandem wheel landing gear. The runway has effective and maximum gradients of 0.6%, sloping upward to the north. Both ends of Runway 1-19 have precision instrument markings.

Taxiways. Runway 1-19 has one full length parallel taxiway, Taxiway A. Taxiway A centerline is separated from Runway 1-19 centerline by 400 feet. Taxiway A is 75 feet wide and has four right-angled connector taxiways used to access or exit Runway 1-19. Taxiways A1 and A4 are located at Runway Ends 1 and 19, respectively, and Taxiways A2 and A3 are located 1,845 feet and 3,945 feet, respectively, from the Runway End 1 threshold measured along runway centerline. JAC has two additional right-angled taxiway connectors that connect the general aviation apron and the commercial service apron to Taxiway A.

Electronic Navigational Aids. Electronic navigational equipment located on the airfield includes a Localizer (LOC) antenna array at the departure end of Runway 19 and a Glide Slope (GS) antenna at the approach end of Runway 19. Combined, the LOC and GS constitute an Instrument Landing System (ILS) for Runway 19 which is protected by FAA-mandated critical areas that must be cleared to prevent signal interference. This navigational equipment is owned and operated by the FAA.

Differential Global Position Satellite (DGPS) antenna and a Very-high-frequency Omni directional Range Radio Beacon (VOR) are also located on the airfield. The DGPS antenna is not currently functional, but JAC is pursuing integration with a Ground Based Augmentation System (GBAS) for more precise GPS approaches. The VOR is a type of short-range radio navigation system, enabling aircraft with a receiving unit to determine their position and stay on course by receiving radio signals transmitted by a network of fixed ground radio beacons.

Lighting Systems. JAC has a number of different lighting systems to assist pilots and airport staff during nighttime and low visibility. Each runway end is currently equipped with Medium Intensity Approach Lighting Systems (MALS), Runway Centerline Lighting System (RCLS) and four-light Precision Approach Path Indicator (PAPI) units. A High-Intensity Runway Lighting (HIRL) system is in place for the runway edge. The taxiways are equipped with Medium Intensity Taxiway Edge Lights (MITL). Additional lighting includes an airport beacon, a lighted wind cone, a lighted wind tee and segmented circle. Runway lighting is designed in accordance to Part 139.311(c) and FAA AC 150/5340-30G, Design and Installation Details for Airport Visual Aids. The MALS, HIRL, and MITL systems are controlled by the Airport Traffic Control Tower (ATCT), but are pilot and Airport controlled after ATCT hours.

1.1.2 Landside Inventory

Terminal. JAC completed a major terminal expansion project in 2010 which included renovations to the ticketing hall, gate and boarding areas, restaurant, security checkpoint, and outbound baggage area. This 2010 terminal expansion included the addition of 52,000 square feet of new terminal area, and the renovation of 48,000 square feet of terminal area. In late 2014, JAC completed a 15,000-square foot inbound baggage claim project. The terminal currently has nine commercial service gates. JAC has 11 spaces on the commercial service apron.

Other Landside Facilities. A passenger drop-off area in front of the terminal is adjacent to an automobile parking area. Other landside facilities include a rental car service and storage facility for cleaning, fueling, and maintenance of the rental car fleet, aircraft hangars for airport tenants, and a Fixed Base Operator (FBO). FBO services include aircraft fueling, maintenance, and tie down spaces; aircraft rental; flight training; and catering. Existing airside and landside facilities are shown on **Figure 1-3**.

Figure 1-3 - Existing Airport Layout

1.2 Airspace and Air Traffic Control

Airport Traffic Control Tower (ATCT). JAC has a controlled airfield with an on-site ATCT. The ATCT is operational daily from 7 AM to 9 PM. Air traffic controllers located in the tower provide instructions to aircraft operating in the air and on the ground. The primary purpose of the ATCT is to ensure that aircraft separation is maintained when operating within the vicinity of JAC and aircraft operating in the Aircraft Operating Area (AOA) on the ground. The ATCT also provides local weather and limited aviation weather observation.

Controllers in the ATCT provide instruction and separation to approaching and departing aircraft within JAC's Class D airspace. Air traffic immediately outside the JAC's Class D airspace is controlled and separated by the Salt Lake City Air Route Traffic Control Center (ARTCC). See the Area Airspace section below for more information on airspace.

The ATCT is located approximately 1,000 feet west of Runway 1-19. The tower height is 68 feet above ground level, and the tower cab floor elevation is 40 feet above ground level. The ATCT location and height provides controllers with sufficient visibility of controlled movement areas, including the runway, taxiways, terminal area, and airspace in the airport vicinity.

Area Airspace. The airspace over the JAC area and all of the US is under the jurisdiction of the FAA. This authority was granted by Congress via the Federal Aviation Act of 1958. The FAA established the National Airspace System (NAS) to protect persons and property on the ground and to establish a safe and efficient airspace environment for civil, commercial, and military aviation. The NAS is defined as the common network of US airspace, including air navigation facilities; airports and landing areas; aeronautical charts; associated rules, regulations, and procedures; technical information; personnel; and material. System components shared jointly with the military are also included.

14 CFR Parts 71, 73 and 91 define categories of airspace, each with distinct operating requirements, which conform in both name and description with airspace designations used internationally. The categories are classified as Class A, B, C, D, E, and G, and each has decreasingly restrictive requirements regarding air traffic control (ATC) communications, aircraft entry, aircraft separation, and Visual Flight Rules (VFR) operations. The general shape and requirements of each airspace class are shown in Error! Reference source not found.. The airspace in the vicinity of JAC is shown in Error! Reference source not found..

Figure 1-4 - Airspace Classifications

Figure 1-5 - Jackson Hole Airspace

JAC is in the center of Class D controlled airspace with a radius of about 4.5 nautical miles. JAC's Class D airspace extends from the earth's surface up to 2,500 feet Above Ground Level (AGL). All aircraft must be in two-way communication with ATC to enter and operate within Class D airspace.

The approach and departure corridors for JAC are Class E airspace which extends approximately 20 nautical miles north and south of JAC, extending from 700 feet AGL up to, but not including, 18,000 feet above MSL. All aircraft conducting Instrument Flight Rules (IFR) operations must be in two-way communication with ATC to enter and operate within Class E airspace. Class E airspace is used by aircraft transiting to and from an airport below Class A airspace (18,000 feet above MSL). Its requirements ensure the safety of instrument approach and departure areas.

During ATCT hours, both Class D and Class E requirements are in effect. When the ATCT is closed the Class D airspace reverts to Class E airspace and is subject to those requirements.

The en route environment related to JAC consists of several low altitude Victor Airways, all of which originate from the Jackson VOR. A Victor airway is a type of low altitude Class E airspace that can be described as "a highway in the sky," connecting distant VOR beacons that radiate signals in all directions.

Approach and Departure Procedures. JAC has several published instrument approach and departure procedures. An instrument approach procedure is a series of predetermined maneuvers for the orderly transfer of an aircraft under IFR conditions from the beginning of the initial approach to a landing or to a point from which a landing may be made visually. Approach procedures at JAC include ILS, Global Positioning System (GPS), and VOR based procedures. All published instrument approach procedures are listed in **Table 1-1**, including their associated Threshold Crossing Height (TCH), Glide Slope Angle (GSA), visibility minimums, and Decision Heights (DHs).[4]

[4] Threshold Crossing Height (TCH): the theoretical height of the glide slope above the runway threshold.
Glide Slope Angle (GSA): The angle of decent plane which provides vertical guidance for a pilot on approach.
Visibility minimums: flight visibility (average forward visibility for a pilot)
Decision Heights (DHs): the lowest altitude on approach at which, if required visual reference to the approach (runway markings etc.) are not visible to the pilot, the pilot must initiate a missed approach.

Table 1-1 - Instrument Approach Procedures

Runway	Approach Name	TCH	GSA	Visibility Minimum	Decision Height
RWY 19	ILS or LOC Z	50 feet AGL	3.00°	3/4 mile (4000 ft RVR)	200 feet
RWY 19	RNAV (RNP) Z	53 feet AGL	3.00°	1 & 1/4 miles (6000 feet RVR)	500 feet
RWY 19	ILS or LOC Y	50 feet AGL	3.00°	2 miles	700 feet
RWY 19	RNAV (GPS) Y	55 feet AGL	3.45°	3 miles	1200 feet
RWY 19	VOR/DME	38 feet AGL	3.19°	3 miles	1400 feet
RWY 1	RNAV (RNP) Z	50 feet AGL	3.00°	1 mile (5000 feet RVR)	400 feet
RWY 1	RNAV (GPS) X	50 feet AGL	3.00°	2 miles	1000 feet
RWY 1	VOR/DME	50 feet AGL	3.33°	2 & 3/4 miles	1000 feet
RWY 1	RNAV (RNP) Y	50 feet AGL	3.00°	4 miles	1000 feet

Source: FAA U.S. Terminal Procedures, 2011 JAN 13 to 2011 FEB 10
Notes: All minimums shown are for Category C aircraft. Alternate minimums may apply under Instrument Meteorological Conditions (IMC).

An ILS is a precision instrument system consisting of a localizer, glide slope, and outer, middle, and inner marker beacons. There are three Categories (CAT) of ILS approaches – CAT I, II, III – each of which have defined minimum DHs and Runway Visual Ranges (RVRs), as shown in **Table 1-2**.

Table 1-2 - ILS Category Definitions

Category	DH Minimum	RVR Minimum
CAT I	Not less than 200 feet	Not less than 2,400 feet *
CAT II	Not less than 100 feet	Not less than 1,200 feet
CAT IIIa	No DH, or DH below 100 feet	Not less than 700 feet
CAT IIIb	No DH, or DH below 50 feet	Not less than 150 feet
CAT IIIc	None	None

* For runways with touchdown zone and centerline lighting, RVR is not less than 1,800 feet

JAC currently has a CAT I ILS approach procedure, coupled with a MALS that allows for lower visibility minimums. Special equipment and aircraft/aircrew authorization are required for CAT II and III operations.

JAC currently has five GPS-based Area Navigation (RNAV) approach procedures with various operational and visibility requirements. Three of the GPS-based approach procedures are Required Navigation Performance (RNP) procedures, which optimize flight paths, cut fuel burn, reduce carbon dioxide emissions, and shift noise away from residential areas where possible. Similar to CAT II and CAT III ILS approaches, special aircraft/aircrew certification requirements apply. Published GPS approaches are typically used by general aviation aircraft and RNP procedures are used by commercial carriers. The RNP standard procedures at JAC can be flown by all of the airlines.

JAC currently has two non-precision VOR approach procedures facilitated by an on-site VOR beacon. The VOR emits a set of very high frequency (VHF) navigational signals, which, when identified by navigation instruments in an aircraft, determine the direction of the VOR from the aircraft with respect to magnetic north.

The VOR at JAC is also equipped with Distance Measuring Equipment (DME), which provides the distance of the VOR from the aircraft as well. A VOR is dynamic in the sense that it provides pilots with the ability to make approaches both to and from the navigational facility.

There are also two published obstacle departure procedures for JAC, TETON THREE DEPARTURE for Runway End 1 and the GEYSER FOUR DEPARTURE for Runway End 19. Departure procedures are preplanned routes that provide transitions from the departure airport to the en route structure. The climb gradient, visibility, and cloud ceiling minimums for obstacle departure procedures at JAC are listed in **Table 1-3**.

Table 1-3 - Obstacle Departure Procedures

Departure Name	Climb Gradient Minimum	Visibility Minimum[1]	Cloud Ceiling Minimum[1]
TETON THREE DEPARTURE - RWY 1	335 ft. per NM to 14,000 ft. MSL	3 miles	4,400 ft.
GEYSER FOUR DEPARTURE - RWY 19	450 ft. per NM to 14,000 ft. MSL	3 miles	4,400 ft.

Source: FAA U.S. Terminal Procedures, 2009 SEP 24 to 2009 OCT 22

[1] Visibility and cloud ceiling minimums only apply in visual conditions

NM = nautical mile

These departure procedures provide obstacle clearance for departing aircraft, and allow for efficient air traffic routing and pilot/controller workload reductions.

1.3 Current Noise Management Program

Due to the immediate proximity of sensitive areas of natural quiet, JAC's continued existence within GTNP was made contingent upon a Use Agreement between the DOI and the Airport Board (**Appendix A**). The NPS has historically worked closely with JAC and the FAA to assess noise effects to GTNP; to determine special noise level criteria for the GTNP based on the sensitivity of wildlife, ecosystems, and the uses of GTNP; and to implement measures that reduce noise effects.

Therefore, JAC has in place a number of unique considerations and requirements to protect the GTNP from noise impacts and mitigate/abate noise effects to levels deemed compatible with the different types of natural areas in GTNP. There are four plans that define noise abatement measures/regulations at JAC: FAA's Vision 100 Act, the Use Agreement's noise control plan, the currently approved NCP, and the current published noise abatement procedures.

1.3.1 Vision 100

The Vision 100 Century of Aviation Reauthorization Act, approved by Congress in December 2003, allows commercial service airports that lease land from a federal agency to impose Stage 2 restrictions. This allowed JAC to ban Stage 2 aircraft under 75,000 pounds. JAC enacted the ban on June 28, 2004. Since that time, Stage 2 aircraft have been banned nationwide with Stage 2 aircraft under 75,000 pounds being phased out as of December 31, 2015.

1.3.2 Use Agreement – Noise Control Plan

The Use Agreement, adopted in 1983, is an agreement between JAC and the DOI for the operation of JAC and contains a noise control plan (**Appendix A**). The primary objectives of the noise control plan as stated in the Use Agreement are "*to ensure that future airport operations are controlled in such a manner that aircraft noise exposure will remain compatible with the purposes of Grand Teton National Park and will result in no significant increase in cumulative or single event noise impacts on noise sensitive areas of the Park.*" The noise sensitive areas of the park are defined by the critical area boundary (45 DNL). The noise control plan *"... utilizes the latest in noise mitigation technology and procedures. The revised plan will be developed in a comprehensive study to consider all of the relevant environmental, economic, and operational considerations.*" The consideration of new approach/departure procedures based on the latest technology will be included in this Study to meet the requirements of the Use Agreement.

The Use Agreement also contains the following noise abatement measures:

- Moose noise measurement location cannot exceed 55 DNL annually;
- A defined Critical Area Boundary where noise cannot exceed 45 DNL within GTNP (**Figure 1-6**); and
- Aircraft single event noise limit on approach is 92 dBA (as defined by the approach dBA level from Advisory Circular 36-3H).

Figure 1-6 - Grand Teton National Park 45 DNL Restriction Line

In order to meet the requirements of the Use Agreement, the Airport Board developed an Airline Access Plan. The Airline Access Plan was grandfathered by the Airport Noise and Capacity Act of 1990 (ANCA). This Access Plan placed a limit on the number of operations of commercial jet aircraft that was then adopted by all the airlines at JAC. The limit on operations was determined to be 6.5 Average Daily Departures of the 737-200/D17. Increases in operations could only be accomplished by substituting these aircraft with the quieter, new generation aircraft which at that time were just entering service. The Airport Board has also adopted a voluntary Noise Abatement Procedures Policy, which advises pilots of operational procedures to mitigate noise over both GTNP and the residential area south of JAC.

An additional condition of the Use Agreement states that no commercial scenic, charter, or training flights over noise sensitive areas of GTNP can originate from JAC. A noise sensitive area, as defined in Paragraph 11-5.b(8) of FAA Order 1050.1F, is "[a]n rea where noise interferes with normal activities associated with its use. Normally, noise sensitive areas include residential, educational, health, and religious structures and sites, and parks, recreational areas, areas with wilderness characteristics, wildlife refuges, and cultural and historical sites…"

1.3.3 Noise Compatibility Program

JAC has completed two Part 150 Studies over the past 30 years (1985 and 2004), leading up to this most current Study in 2018). Most recently, JAC developed an NCP, approved in 2004, as part of the last Part 150 Update. This NCP was designed to reduce noise effects on GTNP and the surrounding community. In addition, JAC communicates with local planners about appropriate land use to encourage compatible development surrounding JAC, and works cooperatively with the DOI and NPS, ATCT, the airlines, and the local community to minimize impacts whenever required or possible.

The 2004 NCP proposed seven recommendations for airport access, land use, and administrative measures. **Table 1-4** provides a summary of the NCP recommendations and indicates the FAA approval, disapproval, or other determination made in the NCP Record of Approval (ROA) for the 2004 Part 150 Study. **Table 1-5** provides a summary of the NCP recommendations for the 1985 Part 150 Study. A copy of both ROAs are included in **Appendix F**. The tables identify which recommendations were approved or not approved by FAA, and which recommendations have been implemented. Note that several elements within the 2004 NCP were found to not require an FAA determination, because the restrictions requested were already in place under separate regulations, such as Vision 100.

Table 1-4: 2004 Noise Compatibility Study Recommendations

Recommendation	Summary	Approved/Disapproved/Status
Noise Abatement		
Restriction of Aircraft Generating Highest Noise Levels, Stage 3 Exempt [1]	Limit aircraft dBA on approach from 92 dBA to 88 dBA for non-Stage 3 aircraft.	No FAA determination necessary for restrictions or prohibitions on Stage 2 restrictions due to Vision 100 act.
Restriction of Aircraft Generating Highest Noise Levels [1]	Limit aircraft dBA on approach to 88 dBA.	No FAA determination necessary for restrictions or prohibitions on Stage 2 aircraft; Disapproved for restriction of Stage 3 aircraft.
Restriction of Aircraft Generating Highest Noise Levels, a Stage 3 Requirement [1]	Add a Stage 3 requirement that would ban Stage 2 aircraft.	No FAA determination necessary for restrictions or prohibitions on Stage 2 aircraft.
Restriction of Aircraft Generating Highest Noise Levels or a Stage 2 Ban, Part 161 Analysis Funding	Request federal funds to conduct Part 161 analysis.	Disapproved regarding Stage 2; Disapproved regarding Stage 3 pending additional information.
Land Use		
Reduction of Noise Intrusion to Sensitive Land Uses in the Airport Environs [2]	Teton County has adopted the Jackson Hole Airport Resolution.	Disapproved; FAA does not intend to interfere with local land use decisions.
Administrative		
Noise Complaint Response and Investigation	Maintain noise complaint system.	Approved/Implemented
Update and Renew the Part 150 Study	Update Part 150 Study.	Approved/Implemented as needed

Source: Jackson Hole Airport Part 150 Record of Approval, approved on May 17, 2004.

1. In its findings which addressed the first three alternative noise abatement recommendations in a single determination, the FAA specified that the noise abatement recommendations were disapproved regarding restrictions or prohibitions on operations by Stage 3 aircraft for purposes of the Part 150 Study, pending a submission of additional information and compliance with Part 161, because Vision 100 did not authorize JAC to restrict Stage 3 aircraft operations, only Stage 2 operations.

2. Note: the Jackson Hole Airport Resolution had already been adopted by Teton County at the time of the previous Study, and is still currently in force. The Resolution created the Jackson Hole Airport Height Regulations and the Jackson Hole Airport Noise Regulations – discussed in the *Airport Environs* section of this chapter.

Table 1-5 1985 Noise Compatibility Study Recommendations

Recommendation	Summary	Approved/Disapproved/Status
Noise Abatement		
Access Plan Elements	Elements of the Access Plan were included in a Noise Abatement Rule adopted by JAC for commercial service aircraft operating at JAC; includes a limit of average daily departures based on fleet mix.	Approved; Implemented
Continue Existing Curfew	Continue existing curfew imposed on scheduling flights between 9:30 pm and 7:00 am; does not apply to emergency flights.	Approved; Implemented
Impose Curfew on Any New Airlines	Impose a new curfew on new airlines.	Disapproved; all curfew restrictions will be based on the existing curfew in previous measure.
Single Event Limit	Town of Jackson established a 92 dBA approach noise limit.	Approved; Implemented
Departure Routes	Institute a new VFR departure route for airlines using southern departures to Idaho Falls to avoid overflights of GTNP.	Approved; Implemented
Preferential Runway	Maximize the use of southern departures to avoid unnecessary departures over GTNP.	Approved; Implemented
Land Use		
Transfer of Development Rights (TDR)	Have the County research and designate the area south of the airport as a "sending" unit in the development of the TDR concept for the county.	Approved/ Not Implemented due to inadequate enabling legislation
Zoning Changes	Involves the un-platted areas south of the Airport within the 65 DNL contour of the future NEM to be down-zoned by the county to a density of one unit per six acres.	Approved; Not implemented due to size of 65 DNL contour
Subdivision Regulations	JAC recommends that the County amend existing subdivision regulations to require the dedication of noise easements for all new development within the 65 DNL contour as shown on the future NEM	Approved; Not implemented; 65 and 75 DNL contours now only exist on airport property.
Building Code	Amend the County building code to require noise level reduction of 25 and 30 dB within the 65 DNL and 75 DNL contours, for new construction.	Approved; noise reduction recommended in the Jackson Hole Airport Noise Regulation but not in building code; 65 and 75 DNL contours now only exist on airport property.
Acoustical Survey/Noise Attenuation	A joint Airport Board/Teton County acoustical survey is recommended to be performed on existing houses within the 65 DNL contour based on the Future NEM to determine the level of sound attenuation needed to achieve the desired noise reduction. At the conclusion, if feasible, attenuate these homes.	Approved; Not Implemented

Table 1-5, Continued 1985 Noise Compatibility Study Recommendations

Recommendation	Summary	Approved/Disapproved/Status
Land Use		
Purchase of Noise Easement or Fee Title	As a last resort effort, depending on circumstances relating to the above land use recommendations, the Airport Board many determine to purchase noise easements, or even purchase homes or properties.	Approved; Not Implemented
Comprehensive Planning	Amend the Teton County Comprehensive Plan to reflect the recommended density changes outlined above and to develop land use compatibility guidelines based on the land use matrix included in the Part 150 Study.	Approved; Not Implemented
Administrative		
Automatic Weather Observation System	Continuously broadcast weather information and disseminate information to pilots regarding approach and departure routes, altitudes and procedures required by the noise abatement plan.	Approved; Implemented at the time (Technology for this has changed over the years)
Pilot Educational Services	Program which includes airport signing, handouts to itinerant pilots and mailings to local pilots, plus the UNICOM advisory of the Noise Abatement Program.	Approved/Implemented (Methods have changed over the years).
Voluntary Noise Abatement Procedures (information)	JAC board is responsible for disseminating noise abatement information to pilots whenever possible. Reminds pilots of the 92 dBA single event noise level; preferred departure on Runway 18 with a 45 degree left turn as soon as possible; avoid overflights of GTNP if possible; not to overfly GTNP below 3,000 feet above ground level; plan arrival and departure routing to and from the south of the airport.	Approved/Implemented (Preferred Departure was discontinued due to ATCT concerns)
Lease Requirements	Prohibit origination of commercial scenic or charter flights, as well as aircraft training operations, over noise sensitive areas of GTNP by airport tenants having contracts with JAC by continuing to insert clauses in all subcontracts prohibiting such operations.	Approved/Implemented
Noise Complaint System	Continue the extensive noise complaint system and initiate a new procedure that includes an annual published report in the local newspaper on the type and number of complaints.	Approved/Partially Implemented
Noise Monitoring Program	Annually complete noise measurements.	Approved/Implemented
Update and Renew the Part 150 Study	Update Part 150 Study.	Approved/Implemented as needed

Source: Jackson Hole Airport Part 150 Record of Approval, 1985.

Note: The Runway at JAC used to be designated Runway 18 when the 1985 NCP was approved. It is now designated Runway 19.

1.3.4 Voluntary Noise Abatement Procedures

In addition to the grandfathered special mandatory procedures and abatement measures previously described in **Section 1.3**, JAC currently has several voluntary noise abatement measures established. These procedures are voluntary and must consider safety (similar to all noise abatement measures). The FAA has a primary function to determine under what conditions flight operations may be conducted without causing degradation of safety. Under ideal conditions, aircraft takeoffs and landings should be conducted into the wind. Considerations such as delay and capacity problems, runway length, approach aids, noise abatement, and other factors may require aircraft operations to be conducted in a specific manner.

Aircraft arriving and departing on Runway 19 avoid overflights of GTNP as much as possible based on conditions. Arrivals from the north should stay east of Highway 89 until reaching Moose reporting point on a 4-mile final approach. The preferred arrival runway is Runway 1. Aircraft should plan on a right downwind for Runway 1 when approaching from the northwest through the northeast and stay east of Hwy 89. Approaches from the south should plan on a straight in arrival to Runway 1.

According to ATCT staff, Runway 19 is used for arrivals and departures at least 85% of the time. During IFR conditions, use of Runway 19 increases to at least 94%. If prevailing winds are less than five knots (5.8 mph), aircraft depart Runway 19 and aircraft land Runway 1. Approximately 5% of air carrier operations use circle-to-land procedures. ATCT staff does not approve operations with tailwinds above seven knots (8.1 mph), which are only conducted by pilot preference.

Preferred Routes

This section presents the preferred routes published for use by the pilot community; therefore, the language used is specific and technical in nature.

Arrivals:

- ***Runway 19*** – Avoid overflight of GTNP as much as possible. When approaching from the north, stay east of Highway 89 until reaching Moose on 4-mile final. Plan to enter on left downwind for Runway 19 when approaching from all other directions.
- ***Runway 01*** – Runway 01 is the preferred arrival runway. Plan on a right downwind for Runway 01 when approaching from the northwest through northeast and stay east of

Highway 89. Approaches from the south, plan on a straight in arrival to Runway 01. Maintain 8,000 feet AMSL until 4 miles on final.

- ***IFR Arrivals*** – IFR arrivals are urged to request visual approaches and follow these noise abatement procedures whenever weather conditions permit.

Departures:

- ***Runway 19*** – Runway 19 is the preferred departure runway. Make a 45° left turn as soon as practical after takeoff to avoid overflight of residential area. Proceed on course after reaching 8,500 feet AMSL. Avoid northwest climbs over GTNP.
- ***Runway 01*** – Turn right to stay east of Highway 89 as soon as practical after takeoff. Avoid climbs to the northwest over GTNP.
- ***IFR Departures*** – IFR departures during VFR conditions are urged to utilize these noise abatement procedures during climbout. Aircraft should ask tower or Salt Lake City (SLC) Center for VFR noise abatement climb to intercept IFR route whenever weather conditions permit.

Voluntary Noise Abatement Procedures:

- ***Voluntary Curfew*** – Do not land between 11:30 PM and 6:00 AM or takeoff between 10:00 PM and 6:00 AM, unless an emergency exists.
- Use noise abatement procedures for your particular aircraft.
- Noise abatement does not apply to missed approach.
- No flights below 3,000 feet AGL over GTNP and stay east of the Snake River.

Airport staff receive a report from Flight View, showing N-numbers and times of aircraft operations at JAC. The airport staff looks up the addresses and companies that operate during the voluntary curfew (with the exception of life-flights). For any aircraft that do not conform to the voluntary curfew, JAC sends them a notification letter. Although the curfew is voluntary, JAC finds that the letter notifications can help reduce the number of nighttime operations during the curfew. Due to this process and the other noise mitigation processes in place, JAC receives few noise complaints.

1.4 Flight Track and Noise Monitoring System

In 2003, JAC installed a noise monitoring system consisting of six permanent noise monitoring sites as shown in **Figure 1-7** and **Table 1-6**. Prior to installation of the permanent system, JAC completed seasonal monitoring from 1984 to 2003. The noise measurements conducted for this Study are included as **Appendix C** to this report and were used to track single event noise.

Figure 1-7 - Existing Noise Monitors

Table 1-6 - Noise Monitoring Sites

Site #	Name	Description
1	Moulton Loop	Zenith Drive and Spring Gulch Rd.
2	Golf Course	Jackson Hole Golf & Tennis Club
3	Barkers Ranch	Circle H Ranch (Barker's Residence)
4	Moose	Moose Entrance
5	4 Lazy F Ranch	4 Lazy F Ranch
6	Timber Island	East of Timber Island

Source: BridgeNet International, 2014.

JAC's permanent noise monitoring system utilizes 01dB noise monitoring hardware at all of the measurement sites. The permanent monitoring system is state-of-the-art and complies with all specific International Standards (IEC) and measurement standards established by the American National Standards Institute (ANSI) for Type 1 instrumentation. In addition to the permanent noise monitors, temporary noise monitors were established to supplement the permanent noise monitoring system. An additional 10 locations were established both south of JAC and in GTNP as seen in **Figure 1-7**. The permanent noise monitoring equipment outside the park are *Opera@* meters manufactured by 01dB. The units in the Park were upgraded to the new version called Duo, also manufactured by 01dB. The temporary sites use a combination of meters that included Duo and Solo sound level meters manufactured by 01dB. For temporary sites that were measured by NPS, these meters were Larson Davis 831 sound level meters.

The data collected by the permanent monitors include the continuous measurement of 1-second average or equivalent (LEQ) noise levels. This type of measurement system allows for the measurement and identification of Single Event Noise Exposure Level (SEL) noise events at a lower threshold. This allows for a more accurate measurement of lower aircraft noise levels that are typical of the sites in GTNP. Analysis of these data resulted in the SEL noise levels from each individual flyover, the hourly LEQ noise levels, and the daily DNL noise levels for the measurement period. The data collected by the noise monitors were not used to construct the NEMs.

In fall of 2008, the FAA installed a BI-6 radar system at JAC. The BI-6 radar system is a state-of-the-art monopulse secondary surveillance radar that can interrogate transponder equipped aircraft to determine aircraft range, azimuth, assigned code, altitude, Mode-S identification, and emergency status. With the installation of radar, the noise monitoring system was also upgraded.

The upgrade consisted of numerous components: access to the BI-6 radar data, weather data, and the addition of new features to the remote noise monitoring stations. The BI-6 radar data connection allows for the noise monitoring system to correlate an aircraft noise event to the aircraft causing the event. At the same time the noise monitoring sites were also upgraded to collect data that allow for the calculation of audibility. Audibility measurements follow the protocol that Volpe Center established for measuring aircraft audibility noise in a park setting.

The audibility metric is measured by a human listening to noise (either recorded or live) and making a determination as to the source of the noise they are listening to. The audible contribution of aircraft and other noise sources to GTNP's natural quiet can be determined from audio recordings from the noise monitoring system. The upgrade allows the noise monitoring system to more accurately measure and evaluate the aircraft noise levels using multiple noise metrics at the noise measurement points including collecting data to quantify the aircraft audibility levels at these locations.

JAC maintains a live feed of all of the IFR aircraft activity in the United States directly from the FAA center data as a secondary information source compiled by Harris. These data are fused from multiple sensors, including en-route data, ADS-B transponders, and the BI-6 radar located at JAC. VFR operations are determined from the FAA's Terminal Area Forecast and OpsNet databases. When possible, VFR data are correlated with the noise event data using custom software. Each flight is assigned a unique identification track number so all of the data for any particular flight can be compiled. The flight information includes data such as the ARTS aircraft type, ARTS airline code, departing and arriving airport codes, and flight number. The position information includes the X and Y coordinates as well as the altitude of the aircraft at each point. The location information given provides the information necessary to determine the direction of flow for runway usage.

1.5 Airport Environs

As mentioned previously, JAC has unique considerations and requirements in place to protect the park environs from noise impacts and mitigate/abate noise effects to levels deemed compatible with the different types of natural areas in GTNP. JAC also works closely with Teton County and the Town of Jackson on noise issues in nearby communities. For purposes of this Study, the Town of Jackson zoning and land use will not be discussed here in detail because Jackson is approximately 9 miles south of JAC and is therefore outside the range of any potential JAC noise impacts.

1.5.1 Zoning

Zoning is a useful tool for controlling land use development and promoting compatibility while supporting private land ownership. Existing land use within Teton County is controlled primarily through the implementation of the Article II: Zoning District Regulations of the Teton County Land Development Regulations. Zoning districts in the vicinity of JAC include Neighborhood Conservation-Single Family (SF), Planned Unit Development (PUD), Rural (RU), Public/Semi-Public (SP), Planned Resort (PD), and Park (PA). **Figure 1-8** depicts the existing generalized zoning for Teton County near JAC.

Jackson Hole Airport Resolution

In 1987, Teton County adopted the Jackson Hole Airport Resolution in order to "protect and promote the public health, safety, and welfare by avoiding obstructions to aircraft at the Jackson Hole Airport." The Resolution created two types of regulations, described in detail below: the Jackson Hole Airport Height Regulations and the Jackson Hole Airport Noise Regulations.

HEIGHT REGULATIONS. The territorial jurisdiction of the Height Regulations includes "all of the land lying beneath the approach surfaces, transitional surfaces, horizontal surfaces, and conical surfaces as they apply to Jackson Hole Airport." The Resolution created five airport zones, with specific height limitation regulations for each zone: Precision Instrument Runway Approach Zone; Runway Larger Than Utility with A Visibility Minimum Greater Than ¾ Mile Non-Precision Instrument Approach Zone; Transition Zone; Horizontal Zone; and Conical Zone. In addition, no uses are allowed in these zones that would create electrical interference with airport/aircraft signals and communications, making it difficult for pilots to distinguish the airport lighting, impair visibility, create glare, or otherwise endanger aircraft operations.

NOISE REGULATIONS. The territorial jurisdiction of the Noise Regulations includes "all lands within 65 and 70 ldn contours as depicted on the Noise Exposure Map of the Jackson Hole Airport" submitted in accordance with 14 CFR Part 150. The Noise Regulations state that if any part of a subdivision is to be located within two miles of the runway centerline, the subdivision plats shall be annotated to indicate the immediate proximity to JAC. Noise reduction measures for the structure construction are also recommended for achieving a 25-dB noise reduction.

1.5.2 Existing Land Use

Existing Teton County land uses west and south of JAC are generally reflective of existing zoning and are characterized primarily by low-density residential development, park/open space lands (including the Jackson Hole Golf and Tennis Club), resort uses, and some commercial uses. The Town of Jackson is approximately 9 miles south of JAC and has a wide variety of land uses.

The Snake River runs to the west of JAC along the boundary of Bridger-Teton National Forest. Farther west across the Snake River is Teton Village at the base of the Jackson Hole Mountain Resort, with commercial and residential uses and a ski area.

To the east beyond the GTNP boundary and continuing south to Jackson is the National Elk Refuge. Bridger-Teton National Forest also lies east of GTNP. North of JAC within the GTNP is the Park Headquarters at Moose, which has several commercial and residential uses, as well as NPS housing and administration buildings.

An estimate of population, residential units, and noise sensitive facilities exposed to aircraft noise levels of 65 DNL and higher are presented in Chapter 5, Land Use Analysis Chapter. Land use acreages for the 45, 50, 55, and 60 DNL and higher contours are included in **Appendix D** to this report and are included for disclosure purposes only to meet the requirements of the Use Agreement.

1.5.3 Future Land Use

The Town of Jackson and Teton County adopted the Jackson/Teton County Comprehensive Plan in April 2012 to serve as a guide for future development within Jackson and Teton County.

The Comprehensive Plan recognizes the importance of JAC as a key destination in the area along with the National Parks.

The Plan also recognizes that the areas west and south of JAC serve as gateways to these major destinations and should be carefully planned accordingly. The Comprehensive Plan includes a Future Land Use Plan to envision what the community will look like upon full implementation of the themes and goals of the Comprehensive Plan.

Regarding directions for future development, the Comprehensive Plan classifies the subareas west of JAC as primarily Preservation and Conservation-oriented subareas. These subarea types are focused on preserving existing infrastructure with no change to undeveloped open space, scenic resources, or wildlife habitat, and are focused on improving conservation through increasing the amount of such resources.

The exception to this trend is Teton Village, which is classified as a more development-oriented subarea. Based upon these classifications, and due to the prevalence of protected natural lands in the region, future land use changes can be expected to have little impact on land use development and change within the airport vicinity.

Figure 1-8 - Generalized Existing Zoning

JACKSON HOLE AIRPORT
CFR Part 150 Study

2
Forecasts

Chapter 2 - Forecasts

INTRODUCTION. This chapter summarizes the methodology and results for the aircraft forecasts developed for use in this Study. These forecasts include projections for enplanements as well as operations and fleet mix for both commercial service and general aviation aircraft. Specifically, the forecasts provide data for input into the Integrated Noise Model (INM), the model required by the FAA for Part 150 Studies.[1] The INM uses physical and operational characteristics of an airport, aircraft operational data, as well as data on aircraft type, flight track locations, and other information to model aircraft noise. Both existing and future projected noise levels are modeled. The noise modeling methodology and results are discussed in subsequent chapters. The forecasts were approved by the FAA in 2016 (**Appendix B**).

2.1 Background

Both the Town of Jackson and Teton County experienced rapid population growth during the 1990s and, although that growth has slowed, the population continues to increase. As a popular area offering year-round outdoor activities, Jackson Hole tends to cater to a wealthier demographic. As a result, the adjusted median household income of residents of Teton County has risen steadily in recent decades. GTNP has also seen an overall upward trend in growth in number of annual visitors since 2004. The local economy has continued to grow and thrive during recent decades, based on relatively steady growth in national park and ski resort visitation, and resulting in growth in local businesses and development. There is no reason to assume any major change in these trends in the future. Thus, these forecasts assume overall continued growth in the local economy, as well as continued expansion of JAC's user base and passenger demand.

The following sections describe the analysis for the aspects of aviation activity examined for this forecast, which included enplanements, aircraft operations, and aircraft fleet mix. The primary trends that were identified and considered for future activity at JAC were:

- Continued steady growth in enplanements over the long term;

[1] FAA's Aviation Environmental Design Tool (AEDT), which has replaced the legacy INM tool (effective May 29, 2015), was not used in this Study because it had not yet been released when the Study began.

- An increase in average commercial service aircraft size, causing corresponding slower rate of growth in the number of commercial service operations, but increased aircraft capacity;
- A slowing of growth in overall general aviation activity; and
- The phasing out of commercial turboprop aircraft including the Bombardier Q-400 and Embraer EMB 120 in favor of regional jet aircraft and mainline narrow body aircraft. Locally, this trend has been evident for several years and as of Summer 2014, airlines serving JAC are now exclusively operating regional jet and narrow-body aircraft.

2.2 Forecast Methodology

The first step in the forecasting process involved summarizing activity forecasts from the 2011 *Operational Enhancement Study,* as well as forecasts published by the Aeronautics Division of the Wyoming Department of Transportation (WYDOT), the FAA *Aerospace Forecast: Fiscal Years 2014-2034*, and the FAA's January 2015 Terminal Area Forecast (TAF) for comparative purposes. Next, a series of forecasting scenarios was generated based on the growth trends identified in these publications with consideration given to local socioeconomic indicators and expected future trends. Finally, a preferred forecast was selected for each type of activity. The preferred forecasts represent those forecasts that demonstrated the most consistency with observable historic and anticipated new and continuing trends for enplanements, operations levels, and fleet mix at JAC.

Forecasts were prepared for the future 5-year (2020) and 10-year (2025) timeframes from the date of expected submission of the noise contours. It is also important to note that the base year for the purposes of the activity forecasts is calendar year 2014 and the base year for the existing contour map to be used in this Study is also calendar year 2014. 2014 was used as the base year because it was the last full year of operations when this Study was initiated, and operations are still representative of current conditions. The future 5-year contour (2020) is also still representative of future conditions. The typical planning period for forecasting is a 20-year period, and these forecasts continue through the 20-year timeframe (2034). However, the forecasts for years after 2020 are provided for informational purposes only. The preferred forecasts for the existing, 5-year and 10-year timeframes have been highlighted in yellow in several of the tables below. Forecasting of any type of future activity is as much an art as a science, particularly in the current era of airline deregulation and changing operating methodologies. Any forecast, therefore, should be revised and updated periodically to reflect new conditions and developments.

2.3 Historic Airport Activity

A tabulation of historical aviation activity information since 2004 is presented in **Table 2-1**. This table includes a combination of the best available data sources including Airport Management records and the FAA Air Traffic Activity Data System (ATADS).

Table 2-1 - Historical Aviation Activity, 2004-2014

Year	Passenger Enplanements[1]	Commercial Passenger Operations*	GA Operations*[2]	Military Operations*	Total Operations*
2004	215,587	2,824	28,777	192	31,793
2005	250,165	3,779	29,002	291	33,072
2006	277,978	5,511	26,451	272	32,234
2007	283,042	5,223	25,076	306	30,605
2008	311,761	6,925	23,037	257	30,219
2009	290,087	6,889	21,958	155	29,002
2010	294,408	6,594	18,899	114	25,607
2011	285,520	6,242	19,341	193	25,776
2012	277,632	6,049	19,680	349	26,078
2013	294,984	6,596	16,925	388	23,909
2014	313,474	7,156	18,791	170	26,117

Source: Mead & Hunt.
* Historical operations data compiled from FAA ATADS.
[1] Passenger enplanement data compiled from Airport Management records.
[2] GA Operations includes non-scheduled Air Taxi operations.
Note: Operations for 2016 and 2017 were examined in Appendix I – Forecast Validation Memo.

Total aircraft operations (an operation is defined as either a takeoff or a landing) at JAC have fluctuated since 2005, when they were at their highest. Passenger enplanements have also fluctuated, but have experienced an overall increase of more than 97,000 enplanements since 2004. Commercial passenger operations have also generally increased. General aviation operations have gradually declined since 2005, while military operations have greatly fluctuated over time.

Table 2-2 summarizes the percentage of operations for each aircraft type. In recent years, commercial passenger service has been provided by United, American Airlines, Delta, and SkyWest which currently offer service to Atlanta, Chicago, Dallas/Fort Worth, Denver, Dulles, New York, Newark, Los Angeles, Minneapolis, Salt Lake City, Seattle, and San Francisco.

JAC has separate winter and summer airline schedules in order to meet the seasonal travel needs of its user base. Spring and fall are typically slower seasons for Jackson, with summer being the busiest season, followed by winter.

A key trend taking place on a national scale is the replacement of turboprop aircraft with narrow-body and regional jet aircraft. This trend is based on a number of factors including the replacement of aging aircraft, better fuel efficiency of newer aircraft, and airline strategies to reduce the number of flights resulting in fuller airplanes and higher profitability.

Locally, this trend has been evident for a number of years, with turboprops declining over time. In early 2014, there were only a small number of turboprop operations and as of Summer 2014, airlines serving JAC are now exclusively operating regional jet and narrow-body aircraft. This trend is also evident in general aviation activity as fewer smaller aircraft are flying and businesses are operating larger capacity, higher performance aircraft. The following table shows actual 2014 operations by aircraft type at JAC as reported by the Tower (FAA ATADS).

Table 2-2 - Existing Operations by Aircraft Type (2014)

Aircraft Type	Operations	Percentages
Commercial Service	**7,156**	**27.17%**
-Turboprop	82	1.15%
-Regional Jet	3,012	42.09%
-Narrow-Body	4,062	56.76%
General Aviation and	**18,961**	**72.82%**
-Single Engine	6,001	31.65%
-Multi Engine Piston/Turboprop	3,470	18.30%
-Jet	9,414	49.65%
-Other (Helicopter, Ultra-Light,	76	0.40%
Total	**26,117**	**100.00%**

Source: Mead & Hunt.
* GA Operations includes Air Taxi operations.
2014 Commercial Service operations from operations from FAA ATADS.
Note: In early 2014, there were a small number of turboprop operations prior to them being entirely phased out in the summer.

2.4 Aviation Activity Forecasts

The following sections include aviation activity forecasts for passenger enplanements, commercial service aircraft operations, general aviation and military operations, local and itinerant operations, and operations by aircraft type (fleet mix).

2.4.1 Passenger Enplanements Forecast

As mentioned above, JAC is served by multiple airlines offering service daily, weekly, and multiple times per week to a number of major U.S. airports. Passenger enplanements have grown at an average annual growth rate of approximately 4.54 percent since 2004. From 2004-2014, enplanement levels were at their highest in 2014 at 313,474. The load factor averaged 79.60 percent for calendar year 2014.

Utilizing growth rates based on both local and national trends, four (4) forecast scenarios were developed. For comparison purposes, forecasts from the FAA's January 2015 TAF, the 2011 *Jackson Hole Operational Enhancement Study*, and the 2009 *Wyoming Statewide Airport Inventory and Implementation Plan* have been included. The passenger enplanement scenarios are presented in **Table 2-3**.

- **Scenario 1:** Applies the average annual historical and projected population growth rate for Teton County, which is equal to 1.36 percent. Scenario 1 reflects a steady, progressive, and conservative increase in enplanements.
- **Scenario 2:** Applies a growth rate of 3.25 percent that is representative of historic growth in the Jackson Hole area economy, based upon annual GTNP visitation and ski resort skier days. Scenario 2 reflects what would be a very high possible maximum growth rate for enplanements.
- **Scenario 3:** Uses the High Growth forecast growth rate for passenger enplanements of 2 percent for JAC from the *Wyoming Statewide Airport Inventory and Implementation Plan*.
- **Scenario 4:** Assumes an average annual growth rate of 1.9 percent. This is equal to the forecast for national growth of domestic enplanements from the *FAA Aerospace Forecast: Fiscal Years 2014-2034*, which was developed to predict future demand using a set of assumptions and forecasts that are consistent with the emerging trends and structural changes taking place within the aviation industry. In comparison, the TAF, which is the official FAA forecast of aviation activity used for individual airport projections, assumes a 2.97 percent average annual growth rate for domestic enplanements between 2014-2034.

Table 2-3 - Passenger Enplanements Forecast Scenarios, 2014-2034

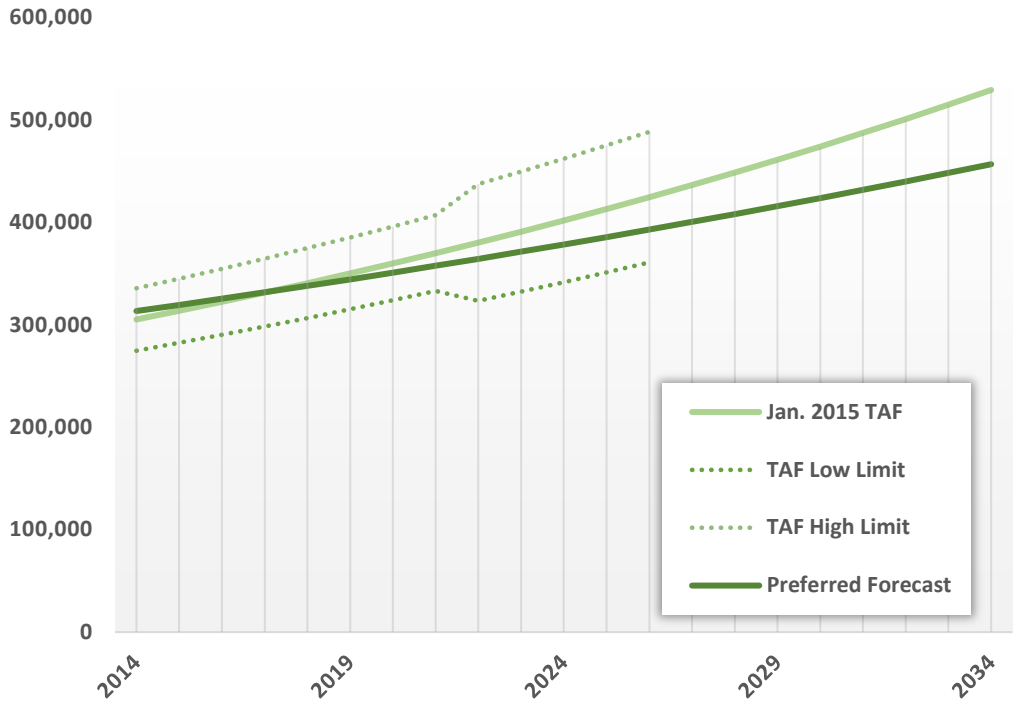
Year	Jan. 2015 TAF 2.97%	2011 Operational Enhancement Study[1]	Historical Trend Line Since 2004[2]	2009 WYDOT Plan[3]	Scenario One 1.36%	Scenario Two[4] 3.25%	Scenario Three 2.00%	Scenario Four 1.90%
2014	305,186	---	313,474[5]	306,079*	313,474[5]	313,474[5]	313,474[5]	313,474[5]
2015	313,700	---	317,073	---	317,752	323,667	319,743	319,430
2016	322,451	---	323,030	---	322,089	334,192	326,138	325,499
2017	331,448	---	328,987	337,770	326,485	345,059	332,661	331,684
2018	340,696	365,094	334,944	---	330,941	356,279	339,314	337,986
2019	350,203	---	340,901	---	335,457	367,864	346,101	344,407
2020	359,975	---	346,858	---	340,035	379,826	353,023	350,951
2021	370,019	---	352,815	---	344,676	392,177	360,083	357,619
2022	380,344	---	358,772	372,743	349,380	404,930	367,285	364,414
2023	390,958	404,657	364,729	---	354,149	418,097	374,630	371,338
2024	401,869	---	370,687	---	358,982	431,692	382,123	378,393
2025	413,084	---	376,644	---	363,881	445,729	389,766	385,583
2026	424,613	---	382,601	---	368,847	460,223	397,561	392,909
2027	436,464	---	388,558	411,336	373,881	475,188	405,512	400,374
2028	448,647	450,205	394,515	---	378,984	490,640	413,622	407,981
2029	461,170	---	400,472	---	384,156	506,594	421,895	415,733
2030	474,044	---	406,429	---	389,399	523,067	430,333	423,632
2031	487,277	---	412,386	---	394,714	540,076	438,939	431,681
2032	500,880	---	418,343	---	400,101	557,637	447,718	439,883
2033	514,862	---	424,300	---	405,561	575,770	456,672	448,240
2034	529,238		430,257	---	411,096	594,493	465,806	456,757

Source: Mead & Hunt.
Highlighted rows denote years of analysis and yellow cells indicate preferred forecasts for those years.
* Data are actually for the year 2012
--- Data not available.
1. Data obtained from the June 2011 Jackson Hole Airport Operational Enhancement Study.
2. Trend projection utilized data from Airport Management records from years 2004-2014.
3. Data obtained from the 2009 Wyoming Statewide Airport Inventory and Implementation Plan Low Growth Passenger Enplanements Forecast for Jackson Hole Airport.
4. Historical visitation statistics for Grand Teton National Park obtained from National Park Service website; historical visitation statistics for Jackson Hole Mountain Resort obtained from jacksonhole.com; annual growth rate is the average of annual growth rates for 2003-2013 for these two indicators.
5. Actual. Airport-reported data for 2014 enplanements.

Scenario 4, based on FAA projected national growth in enplanements, is the preferred enplanements forecast for this Study. Scenario 4 was chosen because it generally reflects local socioeconomic indicators and is very similar to the historical trend at JAC of strong growth in enplanements. Airport staff reviewed the various enplanements forecast scenarios and agrees that the 1.9% growth rate is reasonable. The preferred forecast numbers are highlighted yellow in the table.

According to FAA's June 2008 guidance, Review and Approval of Aviation Forecasts, "For all classes of airports, forecasts for total enplanements and total operations are considered consistent with the FAA's TAF if the forecasts are within 10 percent of the TAF figures during the first 5 years and within 15 percent during the first 10 years. If the forecast is not consistent with the TAF, differences must be resolved if the forecast is to be used in FAA decision-making. This may involve revisions to the airport sponsor's submitted forecasts, adjustments to the TAF, or both." The comparison of the preferred forecast for passenger enplanements with the TAF limits is presented in **Figure 2-1**. As indicated in the following figure, the preferred enplanement forecast is within the TAF limits.

Figure 2-1: Preferred Passenger Enplanements Forecast Compared with TAF Consistency Limits, 2014-2034



Source: Mead & Hunt.

2.4.2 Commercial Passenger Service Operations Forecast

The establishment of projected passenger enplanements, in addition to identifying a current fleet mix, is required to properly project commercial service aircraft operations. The Boarding Load Factor (BLF) of the airlines serving JAC is one method of determining the forecast of commercial service operations. The BLF is the ratio of seats available for passenger boarding on a particular aircraft compared to the number of passengers actually boarding (for example, if an aircraft has fifty seats available and twenty-five passengers board, the BLF is 50 percent). According to recent FAA estimates included in the FAA Aerospace Forecasts Fiscal Years 2014-2034, average national load factors of approximately 83.2 percent were achieved by the air carrier industry in 2014 and are expected to increase to 83.8 by 2034. According to the Bureau of Transportation Statistics, industry load factors were only 78.9 percent 10 years ago, indicating that increasing load factors have been an industry trend for a number of years. The BLF for JAC in 2014 was approximately 79.6 percent and is expected to increase and even slightly exceed the national average by the end of the planning period in accordance with this industry trend.

Table 2-4 presents the commercial service operational forecasts, as well as enplanements, average seats per departure and the projected BLFs. As can be seen in the table, the average seats per departure is anticipated to increase in the first five years due to the change in the commercial aircraft fleet. It is anticipated that the passenger demand can be accommodated with increases in the number of flights by the same airline equipment over the 20-year planning period. Most of the increases in commercial fleet will likely be by narrow body aircraft types (B-737 and A318/319) in accordance with the aircraft capacity forecasts included in the *FAA Aerospace Forecasts Fiscal Years 2014-2034*.

Table 2-4 - Commercial Passenger Service Operations Forecast, 2014-2034

Year	Enplanements Forecast	Average Number of Seats per Departure	BLF	Departures	Operations[1]
2014	313,474[2]	110.13	79.6%	3,578	7,156[3]
2020	350,951	112.48	83.0%	3,760	7,521
2025	385,583	114.34	85.1%	4,008	8,017
2034	456,757	117.57	85.8%	4,528	9,056

Source: Mead & Hunt.
Highlighted rows denote years of analysis and yellow cells indicate preferred forecasts for those years.
BLF – Boarding Load Factor
1. Operations = Departures x 2.
2. Actual. 2014 enplanement data compiled from Airport Management records.
3. Commercial operations data from FAA ATADS.

2.4.3 General Aviation Operations Forecast

As with enplanements, several other forecasts and local and national trends were reviewed in developing the general aviation forecasts. Presented in **Table 2-5** for comparison purposes are the forecasts from the FAA TAF and the *Operational Enhancement Study*. Three (3) forecast scenarios were developed for general aviation operations.

It is important to note that non-scheduled operations conducted under the category of "Air Taxi" that were not related to scheduled commercial passenger activity have been included in this general aviation operations forecast.

- **Scenario 1:** Applies the average annual historical and projected population growth rate for Teton County, which is equal to 1.36 percent. Scenario 1 reflects a steady, optimistic growth scenario.
- **Scenario 2:** Uses the Low Growth forecast growth rate for aircraft operations of 0.32 percent for JAC from the *Wyoming Statewide Airport Inventory and Implementation Plan*.
- **Scenario 3:** Assumes an average annual growth rate of 0.50 percent. This is equal to the forecast for national growth of the active general aviation fleet from the *FAA Aerospace Forecast: Fiscal Years 2014-2034*, which was developed to predict future demand using a set of assumptions and forecasts that are consistent with the emerging trends and structural changes taking place within the aviation industry. In comparison, the TAF, which is the official FAA forecast of aviation activity used for individual airport projections, assumes a 0.57 percent average annual growth rate for the active general aviation fleet between 2014-2034

Table 2-5 - General Aviation Operations Forecast Scenarios, 2014-2034

Year	Jan. 2015 TAF 0.57%	2011 Operational Enhancement Study[1]	Scenario One 1.36%	Scenario Two 0.32%	Scenario Three 0.50%
2014	17,705	---	18,791[2]	18,791[2]	18,791[2]
2015	17,799	---	19,047	18,851	18,885
2016	17,894	---	19,307	18,911	18,979
2017	17,990	---	19,571	18,972	19,074
2018	18,087	16,843	19,838	19,033	19,170
2019	18,186	---	20,109	19,094	19,265
2020	18,286	---	20,383	19,155	19,362
2021	18,387	---	20,661	19,216	19,459
2022	18,489	---	20,943	19,277	19,556
2023	18,592	18,008	21,229	19,339	19,654
2024	18,698	---	21,519	19,401	19,752
2025	18,805	---	21,813	19,463	19,851
2026	18,913	---	22,110	19,525	19,950
2027	19,023	---	22,412	19,588	20,050
2028	19,135	19,246	22,718	19,651	20,150
2029	19,248	---	23,028	19,713	20,251
2030	19,362	---	23,342	19,777	20,352
2031	19,479	---	23,661	19,840	20,454
2032	19,597	---	23,984	19,903	20,556
2033	19,718	---	24,311	19,967	20,659
2034	19,840	---	24,643	20,031	20,762

Source: Mead & Hunt.
Highlighted rows denote years of analysis and yellow cells indicate preferred forecasts for those years.
--- Data not available.
[1] Data obtained from the June 2011 Jackson Hole Airport Operational Enhancement Study.
[2] Actual. FAA ATADS data for 2014 operations.

Scenario 1, based on county population growth, is the preferred general aviation operations forecast. The average annual growth rate of 1.36 percent is considered reasonable for a number of reasons. Given the popularity of the local attractions including GTNP and the local ski resorts, it is reasonable to assume that general aviation related operations at JAC would likely eventually return to historic levels. JAC is also heavily utilized by high performance turboprop and turbojet type general aviation aircraft.

According to the *FAA Aerospace Forecasts FY2014-2034*, the turboprop and turbojet fleet is the segment of the general aviation industry that is projected to see the most growth during the next 20 years driven by higher corporate profits and the growth of worldwide Gross Domestic Product (GDP).

For comparison, the turboprop and turbojet fleet are projected by FAA to grow at an average annual rate of 2.6 percent a year with turbojet aircraft hours flown projected to increase at an average annual rate of 4.2 percent through 2034. This is a conservative approach, to allow for responsible planning. The preferred general aviation operations forecast used in this Study is slightly more optimistic than the FAA TAF and actually exceeds the FAA TAF consistency limits in some outlier years; but total operations presented at the end of the chapter show that the overall forecasts are within the TAF consistency limits (8.7% for 2025). However, the optimism is warranted since the purpose of these forecasts for use in a Part 150 Study necessitates that caution is used to ensure that noise is not *under*estimated, especially for general aviation operations, which often fly at lower altitudes and tend to use less predictable flight patterns.

2.4.4 Military Operations Forecast

As a percentage of total annual aircraft operations, the number of military operations at JAC has historically fluctuated greatly. Given that the Department of Defense does not publicly share information about projected military operations, and in effort to not underestimate noise impact, these operations have been projected to remain constant at the previous 2013 level of 388 per year throughout the planning period in order to create a reasonable estimate relative to potential future noise for military activity.

The types of military aircraft at JAC primarily support aircraft for dignitaries that fly into JAC. This includes C130 aircraft, military versions of corporate jets (i.e., LR35 and GLF4) and military versions of turbo prop aircraft (B200). Occasionally the military vision of the B757 has operated at the airport as well. Fighter aircraft landing or performing low approaches are rare.

2.4.5 Operations Forecast by Aircraft Type

Projections of aircraft operations by type will provide an important data breakdown for input into INM. A breakdown of operations by aircraft type is a key component in noise modeling because different types of aircraft not only produce different levels and types of sound, but also tend to use different takeoff and landing procedures and require different runway specifications related to safety at takeoff and landing.

The proportions of aircraft type presented in this forecast are further broken down by specific aircraft make and model in later chapters for input into the noise model.

Table 2-6 depicts the levels of use by aircraft types that currently use and are projected to use JAC. In general, this table reflects a growing percentage of business and commercial jet aircraft, and a decreasing percentage of single and multi-engine piston aircraft. As mentioned previously, there is no projected growth in military operations from the base year level (2014).

Table 2-6 - Summary of Operations Forecast by Aircraft Type, 2014-2034

Aircraft Type	2014[2]	2020	2025	2034
Commercial Service[1]	7,156	7,521	8,017	9,056
-Turboprop	82	0	0	0
-Regional Jet	3,012	3,012	3,012	3,012
-Narrow-Body	4,062	4,509	5,005	6,044
General Aviation and Military[2*]	18,961[2]	20,771	22,202	25,031
-Single Engine Piston/Turboprop	6,001	6,159	6,139	5,920
-Multi Engine Piston/Turboprop	3,470	3,801	4,063	4,581
-Jet	9,414	10,728	11,911	14,430
-Other (Helicopter, Ultra-Light,	76	83	89	100
Total	26,117	28,292	30,219	34,087

Source: Mead & Hunt.
* GA Operations includes Air Taxi operations.
[1] Commercial Service projected proportions were estimated using 2014 proportions in combination with anticipated trends in future aircraft type.
[2] 2014 operations compiled from FAA ATADS.

2.4.6 Local and Itinerant Operations Forecast

Forecasts of operations have also been categorized into local and itinerant operations. Local operations are defined as any operation performed by an aircraft operating in the local traffic pattern or within sight of the tower; aircraft known to be departing or arriving from a local practice area within a 20-miles radius of the airport; or aircraft executing practice instrument approaches at an airport. Itinerant operations are operations performed by an aircraft, either IFR, SVFR, or VFR, that lands at an airport, arriving from outside the airport area, or departs an airport and leaves the airport area.

Given the fact that there are few flight training operations conducted at JAC, local operations are estimated to account for only 3 percent of all operations. This percentage breakdown is not expected to change over the course of the planning period. Forecasts of local and itinerant operations are shown in **Table 2-7**.

Table 2-7 - Summary of Local and Itinerant Operations

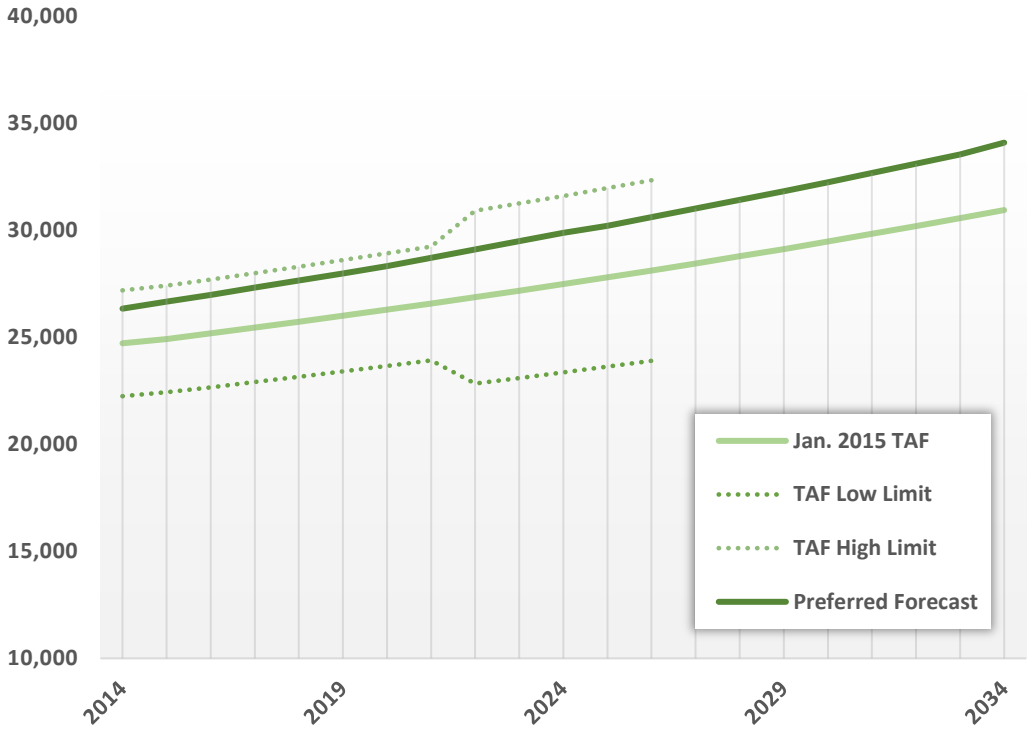
Year	Local	Itinerant	Total
2014[1]	656	25,461	26,117
2020[2]	711	27,581	28,292
2025[2]	759	29,459	30,219
2034[2]	856	33,231	34,087

Source: Mead & Hunt.
1. 2014 local and itinerant proportions compiled from FAA ATADS.
2. Projected figures are based on 2014 proportions applied to the preferred operations forecasts described in previous sections.

2.5 Summary

Figure 2-2 illustrates the forecasts for total operations, which combines the preferred forecasts for commercial service, general aviation, and military operations for JAC. As shown in the figure, the total operations forecast is within the TAF limits, and thus, consistent with the FAA's TAF. A comparison of the selected forecasts for enplanements, commercial operations, and total operations is summarized in **Table 2-8**. For purposes of comparing forecasts with the TAF, the 5- and 10-year timeframes that are used refer to the actual number of years after the base year. Thus, the years 2020 and 2025 were compared with the TAF. The forecasts described in this chapter are recommended for use in this Study to represent activity levels for the existing (2014), five-year (2020), and ten-year (2025) timeframes.

Figure 2-2: Total Operations Forecast Compared with TAF Limits, 2014-2034



Source: Mead & Hunt.

Table 2-8 - Comparison of Forecasts and TAF Forecasts, 2014-2029 (FAA Format)

Operations	Airport Forecast	TAF[1]	Airport Forecast/TAF % Difference
Passenger Enplanements			
Base Year (2014)	313,474	305,186	2.7%
2020	350,951	359,975	-2.5%
2025	385,583	413,084	-6.7%
2029	415,733	461,170	-9.9%
Commercial Operations			
Base Year (2014)	7,156	6,154	4.4%
2020	7,521	7,905	-4.9%
2025	8,017	8,902	-9.9%
2029	8,567	9,791	-12.5%
Total Operations			
Base Year (2014)	26,117	24,717	5.7%
2020	28,292	26,286	7.6%
2025	30,219	27,794	8.7%
2029	31,983	29,120	9.8%

Source: Mead & Hunt.

[1] TAF data are on a U.S. Government fiscal year basis (October through September).

JACKSON HOLE AIRPORT
CFR Part 150 Study

3
Background on Noise

Chapter 3 - Background Information on Noise and its Measurement

INTRODUCTION. Noise, by its definition, is unwanted sound. Noise is perceived by and affects people in a variety of ways. This section presents background information on the characteristics of sound and provides insight into the human perception of noise. This section also provides a means to relate the sound made by aircraft operating to and from JAC to the noise in the surrounding communities. The metrics (the way noise is measured or described) and methodologies used in this Study to describe noise from aircraft operating at JAC are also presented, including a description of the Noise Protocol developed to guide this Study due to its unique aspect of being located within a national park. These metrics enable the characterization of existing and future noise. This section is divided into the following sub-sections:

- ***Characteristics of Sound*** **-** Presents properties of sound that are important for describing noise in the airport setting.
- ***Factors Influencing Human Response to Sound*** **-** Discusses sound level conditions that produce subjective perceptions and elicit a response in humans.
- ***Health Effects of Noise*** **-** Summarizes the potential disturbances and health effects of noise to humans.
- ***Sound Rating Scales*** **-** Presents various sound rating scales and how these scales are applied to assessing noise from aircraft operations.
- ***Noise/Land Use Compatibility Guidelines*** **-** Summarizes the current guidelines and regulations used to control the use of land in areas affected by aircraft noise.
- ***Airport Noise Assessment Methodology*** **-** Describes computer modeling and on-site sound level measurements used to measure aircraft and other noise in the vicinity of airports.

3.1 Characteristics of Sound

3.1.1 Sound Level and Frequency

Sound is described in terms of sound pressure (amplitude) and frequency (similar to pitch).

Sound pressure is a direct measure of the magnitude of a sound without consideration for other factors that may influence its perception. The range of sound pressures that occur in the environment is so large that it is convenient to express them on a logarithmic scale. The standard unit of measurement for sound pressure is the Decibel (dB). Zero decibels is used to describe the reference point of 20 micro Pascals or about 0.000000003 pounds per square inch of energy. Thus, 65 decibels is that amount to the 65th power. A logarithmic scale is used because of the difficulty in expressing such large numbers.

Highlights of Sound

Noise by definition is unwanted sound. There are many ways to describe noise (metrics), however, the most commonly relied on metric is the decibel (dB), which uses a weighting system (the A-weighted decibel – dBA – most closely reflects the human ear).

A number of factors affect sound, including weather, ground effects, as well as human reaction to the noise source. Health effects associated with aircraft noise are typically impacts to sleep and communication that cause stress.

As required by Federal law, aircraft noise must be measured using the Day-Night Average Level (DNL), which is based on averaging dBA. This Study supplements this metric with other metrics such as the Sound Exposure Level (SEL), Time Above (TA), and Time Above Audible (TAA) metrics in **Appendix D**.

FAA and other federal agencies have established land use compatibility guidelines based on the DNL that identify the acceptability of various land uses within aircraft noise exposure contours.

On the logarithmic scale, a sound level of 70 dB has 10 times the energy as a level of 60 dB, while a sound level of 80 has 100 times as much acoustic energy as 60 dB. This differs from the human perception to noise, which typically judges a sound 10 dB higher than another to be twice as loud, 20 dB higher to be four times as loud, and so forth.

The frequency of a sound is expressed as Hertz (Hz) or cycles per second. The normal audible frequency range for young adults is 20 Hz to 20,000 Hz. The prominent frequency range for community noise, including aircraft and motor vehicles, is between 50 Hz and 5,000 Hz. The human ear is not equally sensitive to all frequencies, with some frequencies judged to be louder for a given signal than others. As a result, research studies have analyzed how individuals make relative judgments as to the "loudness" or "annoyance" of a sound.

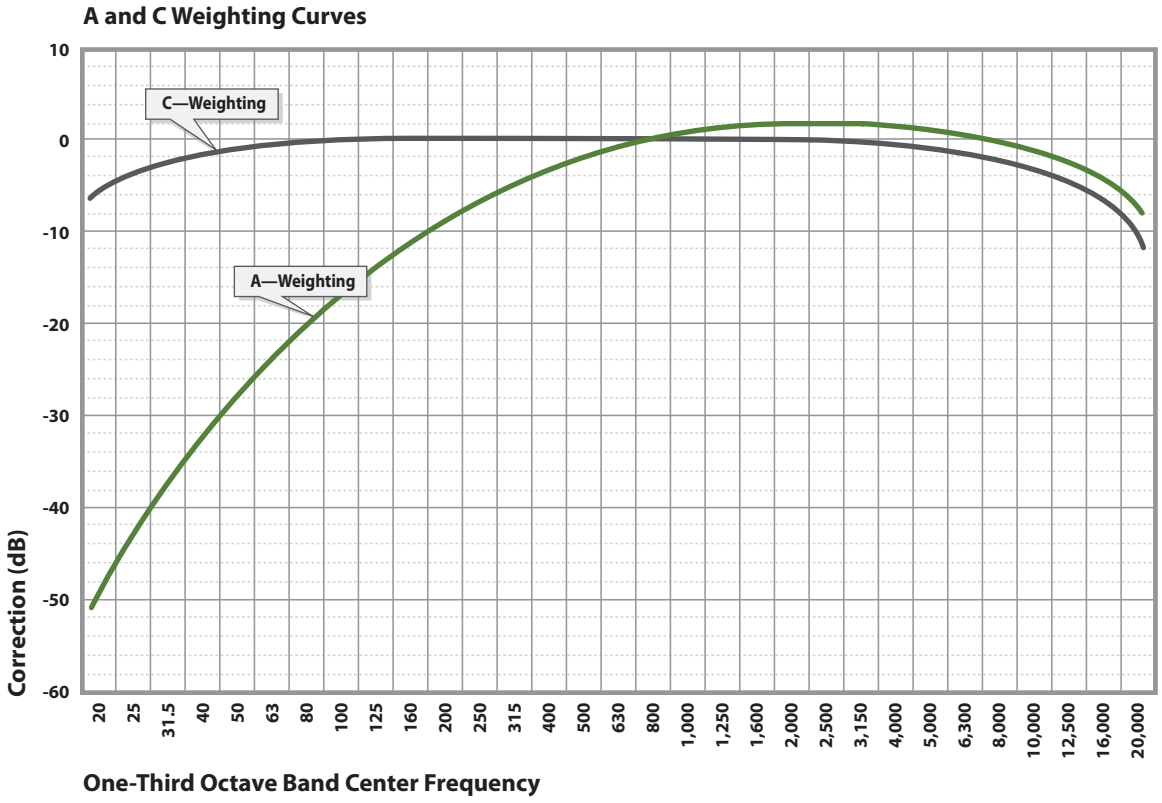
The most prominent of these scales includes Loudness Level, Frequency-Weighted Contours (such as the A-weighted scale), and Perceived Noise Level. Noise metrics used in aircraft noise assessments are based upon these frequency weighting scales that most closely reflect that experienced by a human (A-weighted scale).

Loudness Level. This scale has been devised to approximate the human subjective assessment of the "loudness" of a sound. Loudness is the subjective judgment of an individual as to how loud or quiet a particular sound is perceived.

Frequency-Weighted Contours (dBA, dBB, and dBC). To simplify the measurement and computation of sound loudness levels, frequency-weighted metrics are used. These frequency-weighted contours demonstrate different aspects of noise, and are presented in **Figure 3-1**. The most common frequency weighting is the A-weighted noise curve. The A-weighted decibel scale (dBA) focuses on frequencies approximating the sensitivity of the human ear. In the A-weighted decibel, everyday sounds normally range from 30 dBA (very quiet) to 100 dBA (very loud). Most community noise analyses are based upon the A-weighted decibel scale. Examples of various sound environments, expressed in dBA, are presented in **Figure 3-2**. **Figure 3-2** shows a reproduction of an Environmental Protection Agency guide to aircraft noise levels. While it shows a threshold of 40 dBA for noise events, in a quiet, park-like setting quieter noise events have been recorded. Noise measured in park-like settings can show events measured below 10 dBA.

Perceived Noise Level. Perceived noisiness was originally developed for the assessment of aircraft noise. Perceived noisiness is defined as "the subjective impression of the unwantedness of a not unexpected, non-pain or fear-provoking sound as part of one's environment," (Kryter, 1970) "Noisiness" curves differ from "loudness curves" in that they have been developed to rate the noisiness or annoyance of a sound as opposed to the loudness of a sound (i.e., perception of the noise).

Both loudness curves and noisiness curves have been developed from laboratory surveys of individuals. However, in noisiness surveys, individuals are asked to judge in a laboratory setting when two sounds are equally noisy or disturbing if heard regularly in their own environment. These surveys are more complex and are therefore subject to greater variability. Aircraft certification data are based upon these types of noisiness curves (see CFR Part 36 Regulations presented in the Noise and Land Use section of this chapter).



SOURCE: BridgeNet Interational

FIGURE 3-1
Frequency Weighted Contours (dBA, dBC)

EXAMPLES OF VARIOUS A-WEIGHTED DECIBEL SOUND ENVIRONMENTS

dB(A)	OVER-ALL LEVEL Sound Pressure Level Approx. 0.0002 Microbar	COMMUNITY (Outdoor)	HOME or INDUSTRY	LOUDNESS Human Judgement of Different Sound Levels
130		Military Jet Aircraft Takeoff with Afterburner from Aircraft Carrier @ 50 ft. (130)	Oxygen Torch (121)	120 dB(A) 32 Times as Loud
120 110	UNCOMFORTABLY LOUD	Rock Concert (114)	Rock and Roll Band (108-114)	110 dB(A) 16 Times as Loud
100		Boeing 747-200 Takeoff (101)		100 dB(A) 8 Times as Loud
90	VERY LOUD	Power Mower (96) DC-10-30 Takeoff (96)		90 dB(A) 4 Times as Loud
80		Car Wash @ 20 ft. (89) Boeing B-747-400 (89) Boeing B-777-300 (82.9)	Food Blender (88) Milling Machine (85) Garbage Disposal (80)	80 dB(A) 2 Times as Loud
70	MODERATELY LOUD	High Urban Ambient Sound (80) Passenger Car, 65 mph @ 25 ft. (77) Boeing 757 Takeoff (76) Airbus A319 (73.3) Boeing B-737-700 (73.4)	Living Room Music (76) TV-Audio, Vacuum Cleaner	70 dB(A)
60		Propeller Airplane Takeoff (67) Air Conditioning Unit @ 100 ft. (60)	Conversation (60)	60 dB(A) 1/2 Times as Loud
50	QUIET	Large Transformers @ 100 ft. (50)		50 dB(A) 1/4 Times as Loud
40		Bird Calls (44) Low Urban Ambient Sound (40)		40 dB(A) 1/8 Times as Loud

"Aircraft takeoff noise measured 6,500 meters from beginning of takeoff roll (Source: Advisory Circular AC-36-3H)"

SOURCE: Reproduced From Melville C. Branch And R. Dale Beland, "Outdoor Noise In The Metropolitan Environment". Published By The City Of Los Angeles. 1970.

NOTE: Modified with updated aircraft, 2016.

FIGURE 3-2
Examples of Various Sound Environments

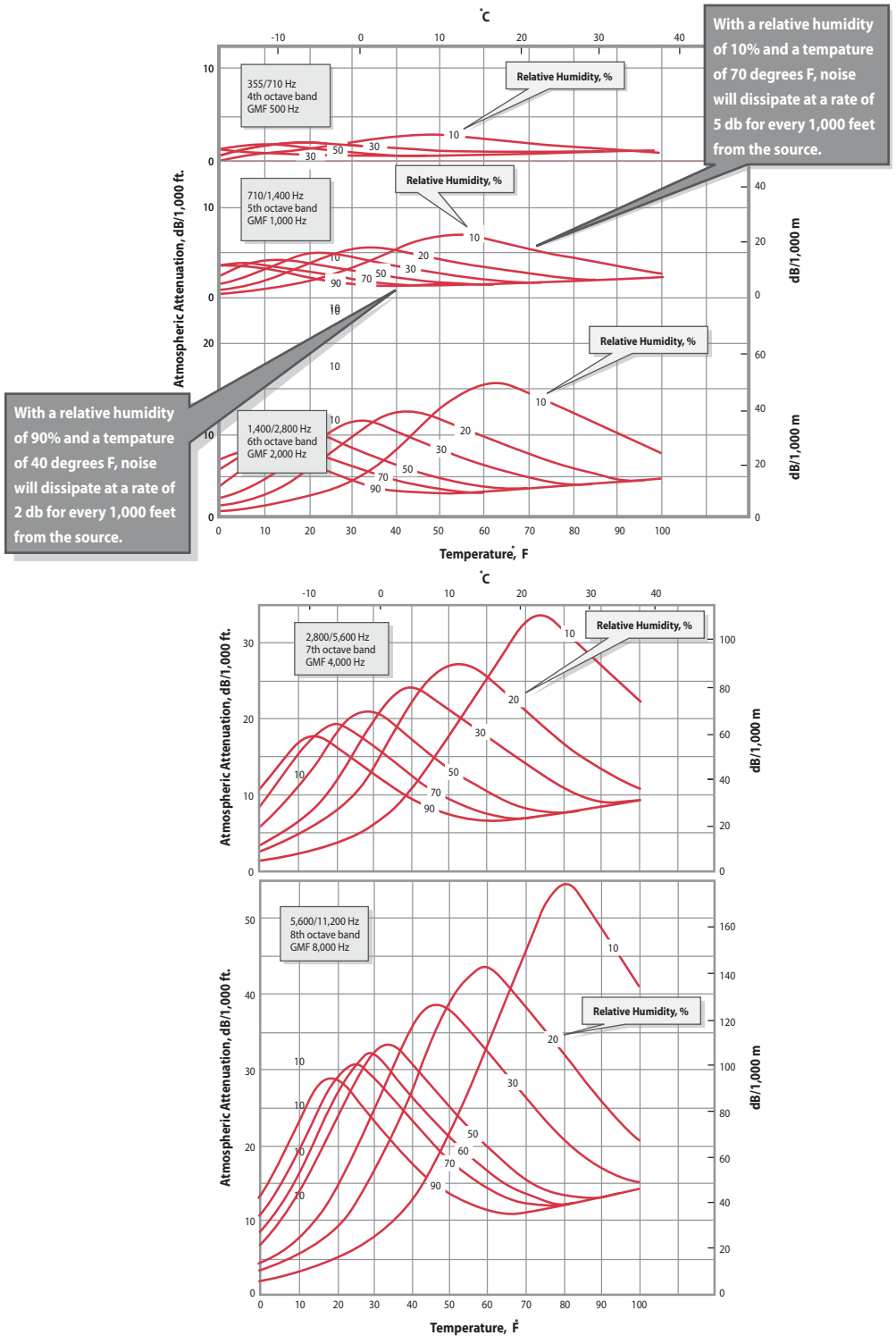
Propagation of Noise. Outdoor sound levels decrease as a result of several factors, including increasing the distance from the sound source, atmospheric absorption (characteristics in the atmosphere that actually absorb sound), and ground attenuation (characteristics on the ground that absorb sound). Sound typically travels in spherical waves, similar to waves created from dropping a stone into water. As the sound wave travels away from the source, the sound energy is spread over a greater area, dispersing the sound power of the wave.

Temperature and humidity of the atmosphere also influence the sound levels at a particular location. These influences increase with distance and become particularly important at distances greater than 1,000 feet. The degree of absorption depends on the frequency of the sound, as well as humidity and air temperature. For example, when the air is cold and humid, and therefore denser, atmospheric absorption is lowest. Higher frequencies are more readily absorbed than the lower frequencies. Over large distances, lower frequency sounds become dominant as the higher frequencies are attenuated. Examples of the effects of temperature and humidity on sound absorption are presented in **Figure 3-3**.

Noise propagation is particularly relevant in the Jackson area due to winter weather conditions. During the winter, high humidity and cold overcast conditions result in lowered noise attenuation, causing noise levels to remain higher farther from a noise source than would occur under standard summer conditions. Winter weather facilitates an atmospheric inversion (when the air nearest the earth is colder than the air above), which also results in higher aircraft noise than when inversions are not present.

Duration of Sound. Duration of a noise event is an important factor in describing sound in a community setting. The longer the noise event, the more likely that the sound will be perceived as annoying. The "effective duration" of a sound starts when a sound rises above the background sound level and ends when it drops back below the background level. Studies have confirmed a relationship between duration and annoyance and established the amount a sound must be reduced to be judged equally annoying over an increased duration time.

This relationship between duration and noise level forms the basis of how the equivalent energy principal of sound exposure is measured. Reducing the acoustic energy of a sound by one-half results in a 3 dB reduction. Conversely, doubling the duration of the sound event increases the total energy of the event by 3 dB. This equivalent energy principle is based upon the premise that the potential for a noise to impact a person is dependent on the total acoustical energy content of the noise. Noise descriptors (DNL, LEQ and SEL) are all based upon this equivalent energy principle.



SOURCE: Beranek , 1981.

FIGURE 3-3

Atmospheric Attenuation Graphs-How Noise Changes Over Distance Based on Humidity and Temperature

Change in Noise Levels. The concept of change in sound levels is related to the reaction of the human ear to sound. The human ear detects relative differences between sound levels better than absolute values of levels. Under controlled laboratory conditions, a human listening to a steady unwavering pure tone sound can barely detect a change of approximately one decibel for sound levels in the mid-frequency region. However, when ordinary noises are heard, a young healthy ear can only detect changes of two to three decibels. A five-decibel change is noticeable while a 10-decibel change is judged by the majority of people as a doubling effect of the sound.

Masking Effect. One characteristic of sound is its ability to interfere with the listener's ability to hear another sound. This is defined as the masking effect. The presence of one sound effectively raises the threshold of audibility for the hearing of a second sound. For a sound to be heard, it must exceed the threshold of hearing for that particular individual and exceed the masking threshold for the background noise.

The masking characteristic is dependent upon many factors, including the spectral (frequency) characteristics of the two sounds, the sound pressure levels, and the relative start time of sound events. The masking effect is greatest when it is closest to the frequency of the signal. Low frequency sounds can mask higher frequency sounds; however, high frequency sounds do not easily mask low frequency sounds.

Ground Effects. This term describes the effects of vegetation on noise. As sound travels away from the source, some of it is absorbed by grass, plants, and trees. The amount of such ground attenuation (rate that noise level reduces at distances farther from the noise source) depends on the structure and density of trees and foliage, as well as the height of both the source and receiver and the frequency of the sound being absorbed. If the source and the receiver of the sound are both located below the average height of the intervening foliage, the ground covering will be most effective. If either the source or the receiver rises above the height of the ground covering, the excess attenuation will become less effective. Reflected sound, however, will still be reduced.

3.2 Factors Influencing Human Response to Sound

Many factors influence how a sound is perceived and whether or not it is considered annoying to the listener. This includes not only physical characteristics of the sound, but also secondary influences such as sociological and external factors. The "Handbook of Noise Control" describes human response to sound in terms of both acoustic and non-acoustic factors. These factors are summarized in **Table 3-1**.

Sound rating scales are developed to account for how humans respond to sound and how sounds are perceived in the community. Many non-acoustic parameters affect individual response to noise. Background sound, which is an additional acoustic factor, is important in describing sound in rural settings. Research has identified a clear association of reported noise annoyance and fear of an accident. In particular, there is firm evidence that noise annoyance is associated with: (1) the fear of an aircraft crashing or of danger from nearby surface transportation; (2) the belief that aircraft noise could be prevented or reduced by pilots or authorities related to airlines; and, (3) an expressed sensitivity to noise generally. Thus, it is important to recognize that such non-acoustic factors, as well as acoustic factors, contribute to human response to noise.

Table 3-1 - Factors that Affect Individual Annoyance to Noise

Primary Acoustic Factors
Sound Level
Frequency
Duration
Secondary Acoustic Factors
Spectral (Frequency) Complexity
Fluctuations in Sound Level
Fluctuations in Frequency
Rise-time of the Noise
Localization of Noise Source
Non-acoustic Factors
Physiology
Adaptation and Past Experience
How the Listener's Activity Affects Annoyance
Predictability of When a Noise will Occur
Whether the Noise is Necessary
Individual Differences and Personality

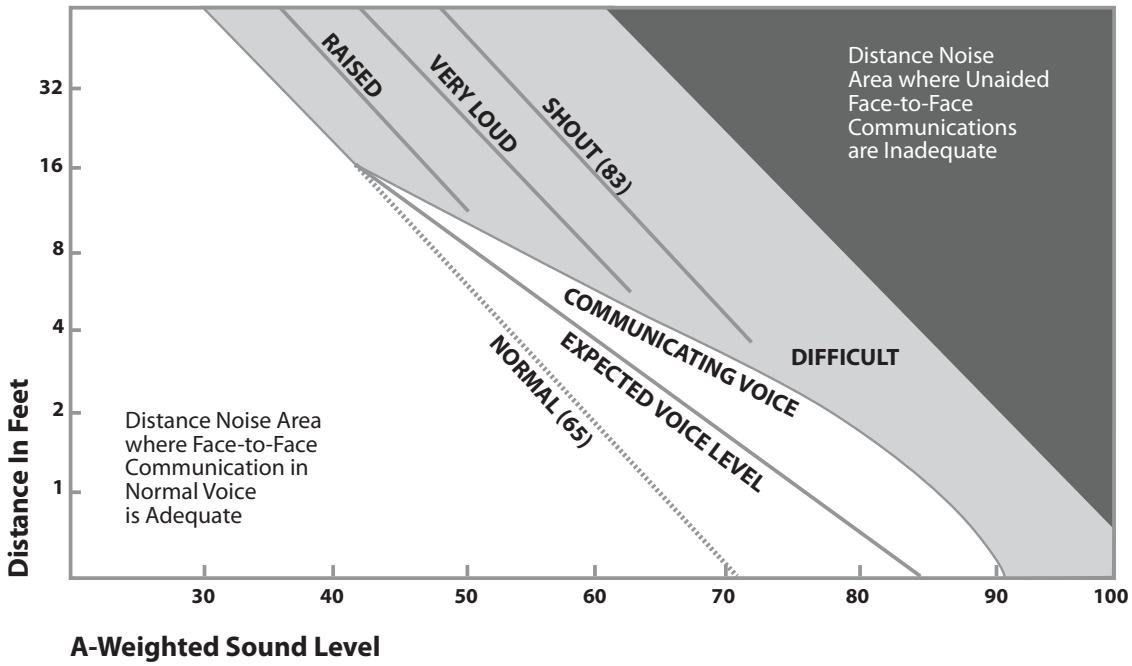
Source: C. Harris, 1979.

3.3 Potential Effects of Noise

Noise is known to have adverse effects on people and lives. From these effects, criteria have been established to help protect the public health and safety and prevent disruption of certain human activities. These criteria are based on effects of noise on people, such as hearing loss (not a factor with typical community noise), communication interference, sleep interference, physiological responses, and annoyance. Each of these potential noise impacts is briefly discussed below.

Hearing Loss is generally not a concern in community/aircraft noise situations, even when close to a major airport. The Occupational Safety and Health Administration (OSHA) identifies a noise exposure limit of 90 dBA for 8 hours per day to protect from hearing loss (higher limits are allowed for shorter duration exposures). Noise levels in neighborhoods near airports, even in very noisy neighborhoods, do not exceed the OSHA standards and are not sufficiently loud to cause hearing loss.

Communication Interference is one of the primary concerns with aircraft noise. Communication interference includes interference with hearing, speech, or other forms of communication such as watching television and talking on the telephone. Normal conversational speech produces sound levels in the range of 60 to 65 dBA, and any noise in this range or louder may interfere with the ability of another individual to hear or understand what is spoken. There are specific methods for describing speech interference as a function of the distance between speaker, listener, and voice level. **Figure 3-4** shows the relationship between the quality of speech communication and various noise levels.



SOURCE: Noise Effects Handbook , EPA.

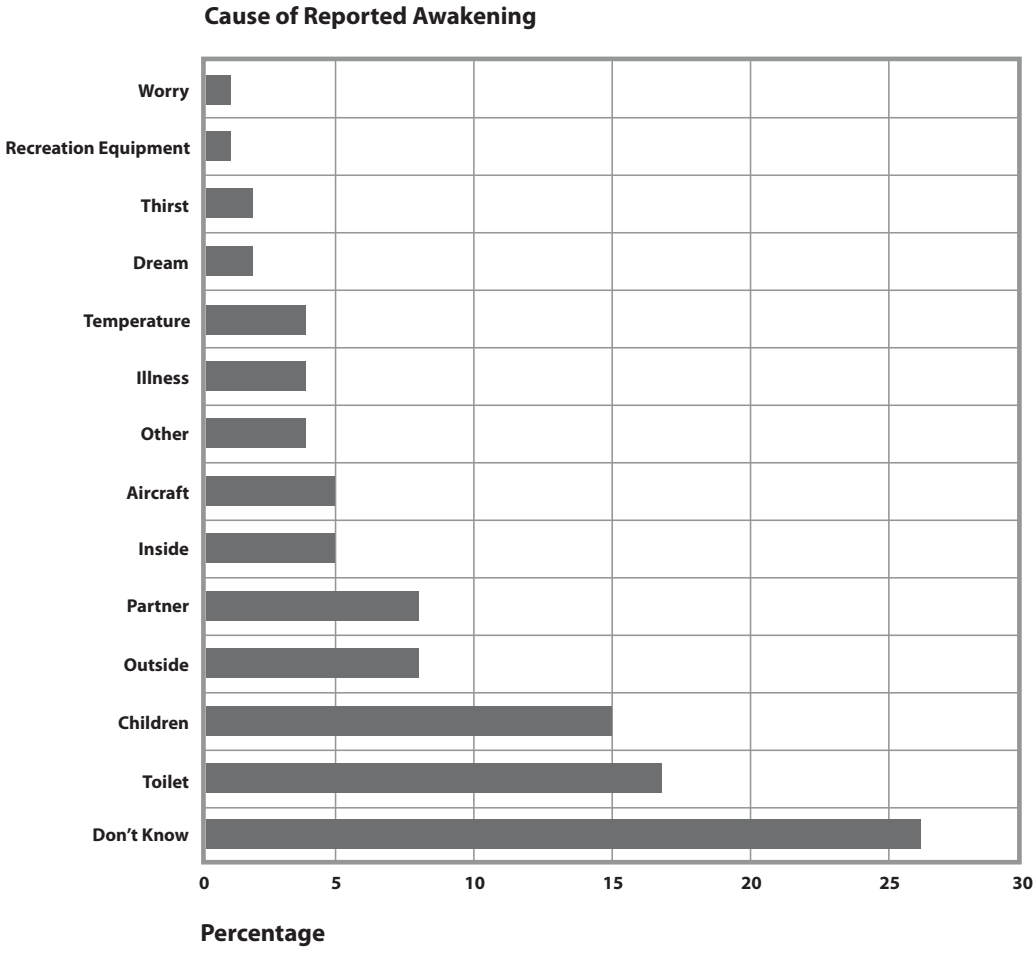
FIGURE 3-4
Quality of Speech Communication

Sleep Interference, particularly during nighttime hours, is one of the major causes of annoyance due to noise. Although sleep interference may not currently be a particular problem at JAC, the issue of sleep interference from aircraft noise has played an important role in the development of aircraft noise-related regulations and guidance. Therefore, it is described here to give its background and role in developing noise-related regulation and guidance. Typical causes of reported awakening are illustrated in **Figure 3-5**, with aircraft causing approximately 5 percent of reported awakenings.

As shown in **Figure 3-5**, aircraft noise is a minor contributor among a host of other factors that lead to awakening response.

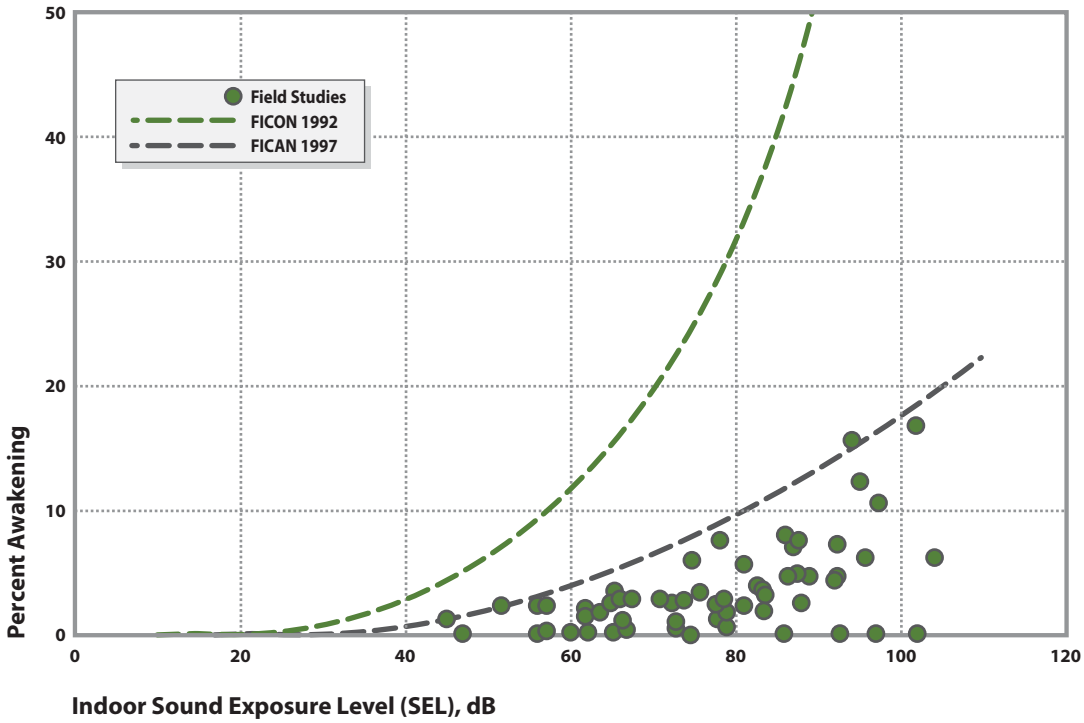
Likewise, the Federal Interagency Committee On Noise (FICON) in an earlier 1992 document, entitled Federal Interagency Review of Selected Airport Noise Analysis Issues, recommended an interim dose-response curve for sleep disturbance based on laboratory studies of sleep disturbance. This review was updated in June 1997, when the Federal Interagency Committee on Aviation Noise (FICAN) replaced the FICON recommendation with an updated curve based on the more recent in-home sleep disturbance studies. The FICAN recommended a curve based on the upper limit of the data presented, and, therefore, considers the curve to represent the "maximum percent of the exposed population expected to be behaviorally awakened," or the "maximum awakened."

The FICAN recommendation is shown on **Figure 3-6**. This is a very conservative approach. A more common statistical curve for the data points is also reflected in **Figure 3-6**. For example, the FICAN curve shows a “maximum awakened” curve showing a 10% awakening rate at a level of approximately 80 dB SEL. (The full FICAN report can be found on the internet at www.fican.org). Sleep interference continues to be a major concern to the public and an area of debate among researchers.



SOURCE: Report Of A Field Study Of Aircraft Noise And Sleep Disturbance, 1992. London Department Of Safety.

FIGURE 3-5
Causes of Reported Awakenings



SOURCE: FICAN Report, 1997.

FIGURE 3-6
Speech Interference with Different Background Noise

Physiological Responses reflect measurable changes in pulse rate, blood pressure, etc. Generally, physiological responses reflect a reaction to a loud short-term noise, such as a rifle shot or a very loud jet over flight. While such effects can be induced and observed, the extent to which these physiological responses cause harm is not known.

Annoyance is the most difficult of all noise responses to describe. Annoyance is an individual characteristic and can vary widely from person to person. What one person considers tolerable may be unbearable to another of equal hearing capability. The level of annoyance also depends on the characteristics of the noise (i.e., loudness, frequency, time, and duration), and how much activity interference (e.g., speech interference and sleep interference) results from the noise. However, the level of annoyance is also a function of the attitude of the receiver. Attitudes are affected by the relationship between the listener and the noise source (Is it your dog barking or the neighbor's dog?). Whether one believes that someone is trying to abate the noise will also affect their level of annoyance.

3.4 Sound Rating Scales

The description, analysis, and reporting of community sound levels are made difficult by the complexity of human response to sound, and the myriad of sound-rating scales and metrics that have been developed for describing acoustic effects. Various rating scales have been devised to approximate the human subjective assessment of "loudness" or "noisiness" of a sound.

Noise metrics can be categorized as cumulative metrics and single event metrics. Cumulative metrics describe the noise in terms of the total noise exposure throughout the day. Cumulative noise metrics have been developed to assess community response to noise. They are useful because the scales attempt to include the loudness and duration of the noise, the total number of noise events, and the time of day these events occur into one rating scale. Single event metrics describe the noise from individual events, such as an aircraft flyover.

3.4.1 Part 150 Required Metrics

Day Night Average Noise Level (DNL). As required by the FAA for Part 150, the primary noise criterion to describe the existing noise environment is DNL. The DNL describes noise experienced during an entire (24-hour) day. DNL calculations account for the SEL of aircraft, the number of aircraft operations, and include a penalty for nighttime operations. In the DNL scale, noise occurring between the hours of 10 p.m. to 7 a.m. is penalized by 10 dB. This penalty was selected to account for the higher sensitivity to noise in the nighttime and the expected further decrease in background noise levels that typically occur at night. In addition, it is used by other federal agencies including the EPA, the Department of Defense (DOD), and the Department of Housing and Urban Development (HUD).

Figure 3-7 illustrates how single events relate to an hourly noise level (LEQ) and how the hourly noise level over the course of a day is related to the DNL metric. This helps illustrate how the sounds a person hears when an aircraft flies overhead is different than the cumulative DNL metric that is used for analysis in a Part 150 Study.

Examples of various noise environments in terms of DNL are presented in **Figure 3-8**. The FAA has developed land use compatibility guidelines that identify the acceptability of various land uses with aircraft noise.

A-Weighted Metrics decibel (dBA). A-Weighted metrics are designed to replicate how the human ear hears noise. This metric has shown good correlation with community response and may be easily measured. The metrics used in this Study are all based upon the dBA scale.

3.4.2 Additional Metrics

To meet the requirements of the Use Agreement, this Study included additional metrics that are normally not included in a Part 150 study. Information on these additional metrics can be found in **Appendices C** and **D**.

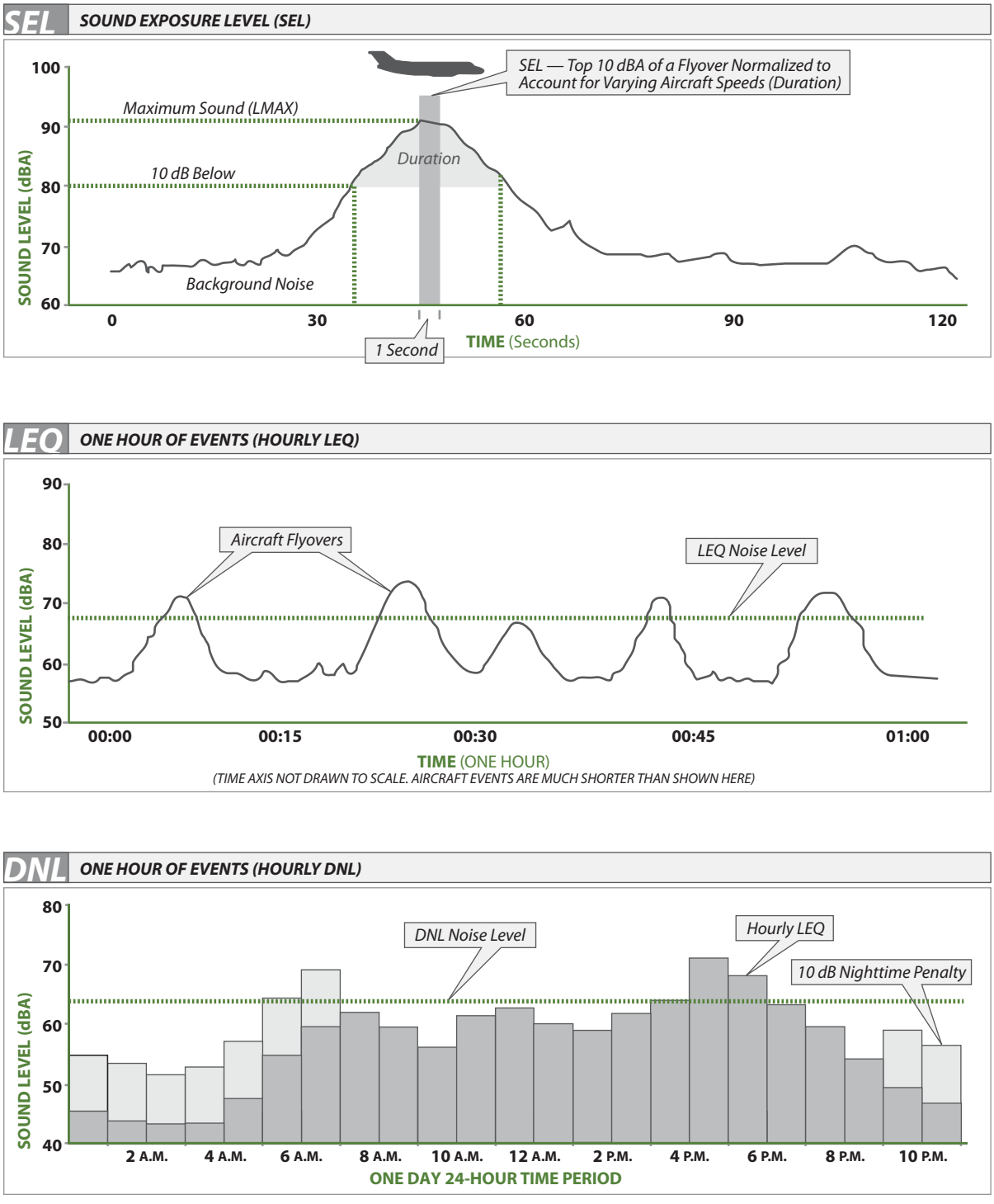
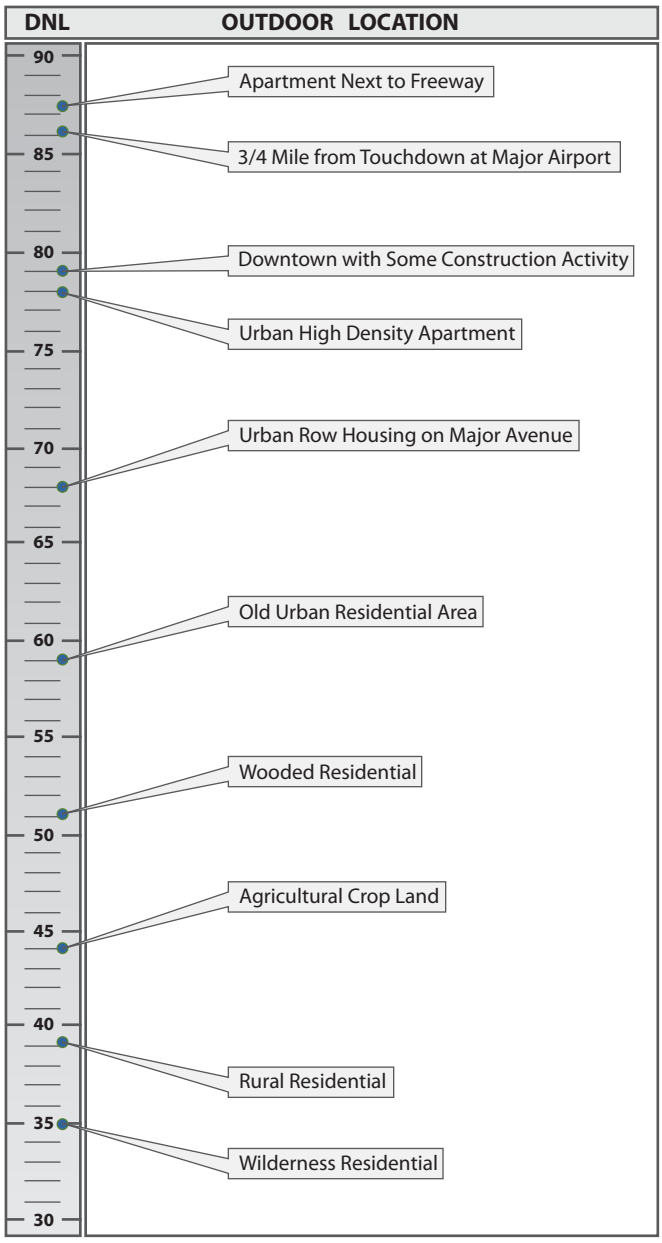


FIGURE 3-7
Examples of Lmax, SEL, LEQ, and DNL Noise Levels



SOURCE: EPA Levels Document , 1974.

FIGURE 3-8
Typical Outdoor Noise Environment in Terms of DNL

3.5 Noise/Land Use Compatibility Standards and Guidelines

Noise metrics describe noise exposure and help predict community response to various noise exposure levels. The public reaction to different noise levels has been estimated based upon extensive research on human responses to exposure of different levels of aircraft noise. **Figure 3-9** relates DNL noise levels to community response. Based on human response, land use compatibility guidelines have been developed that are defined in terms of the DNL described earlier (a 24-hour average that includes a sound level weighting for noise at night). Using these metrics and surveys, agencies have developed guidelines for assessing the compatibility of various land uses with the noise environment.

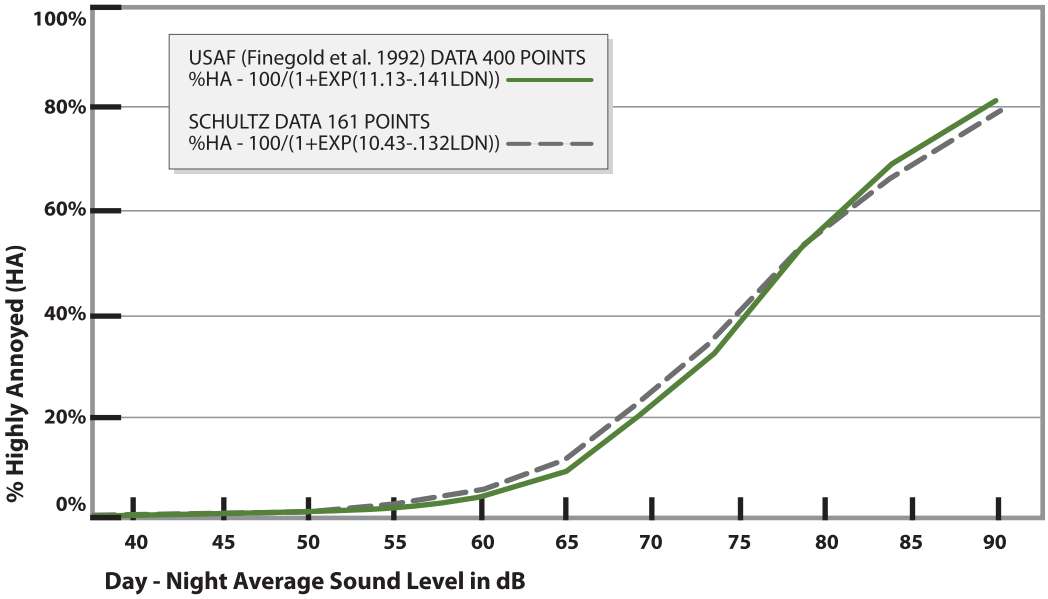
Highlights of Land Use Compatibility Guidelines

FAA and other federal agencies have established land use compatibility guidelines based on the DNL that identify the acceptability of various types of land use with aircraft noise exposure.

- Residential uses are compatible with noise up to 65 DNL;
- Schools are compatible with noise up to 65 DNL;
- Commercial development is compatible with noise up to 75 DNL

Numerous laws have been passed concerning aircraft noise.

- ASNA: FAA required to use DNL
- Phase-out of noisiest aircraft (Stage 2) >75,000 lbs in the year 2000;
- ANCA prevents adoption of airport access restrictions (i.e., curfews, and caps)
- Phase-out of Stage 2 aircraft less than 75,000 lbs (business jets) on December 31, 2015.



USAF	0.40	0.831	1.66	3.31	6.48	12.29	22.1	36.47	53.74	70.16	82.64
SCHULTZ	0.576	1.11	2.12	4.03	7.52	13.59	23.32	37.05	53.25	68.78	81.00

CALCULATED % HIGHLY ANNOYED (HA) POINTS

FIGURE 3-9
Example of Community Rection to Aircraft Noise
(Schultz Curve)

The most common noise/land use compatibility guideline or criteria used is 65 dBA DNL. The Schultz curve predicts approximately 14% of the exposed population would be highly annoyed with exposure to the 65 dBA DNL. At 60 dB DNL, it decreases to approximately 8% of the population highly annoyed. A summary of pertinent regulations and guidelines is presented below.

3.5.1 Primary Regulation

- **14 CFR Part 150, "Airport Noise Compatibility Planning" –** As a means of implementing the Aviation Safety and Noise Abatement Act (ASNA), the FAA adopted 14 CFR Part 150, Airport Noise Compatibility Planning Programs, which established a uniform program for developing balanced and cost effective programs for reducing existing and future aircraft noise at individual airports. Included in 14 CFR Part 150 was the FAA's adoption of noise and land use compatibility guidelines seen in **Figure 3-10**. An expanded version of these guidelines/chart appears in Aviation Circular 150/5020-1 (dated August 5, 1983) and is reproduced in **Figure 3-10**. These guidelines offer recommendations for determining acceptability and compatibility of land uses. The guidelines specify the maximum amount of noise exposure (in terms of the cumulative noise metric DNL) that would be considered acceptable or compatible to people in living and working areas. This is the primary guidance used for this Study. Other supplementary guidance and regulatory frameworks are described below.

LAND USE	BELOW 65	YEARLY DAY-NIGHT NOISE LEVEL (DNL) IN DECIBELS 65-70	70-75	75-80	80-85	OVER 85
RESIDENTIAL						
Residential, other than mobile homes and transient lodgings	Y	N(1)	N(1)	N	N	N
Mobile home parks	Y	N	N	N	N	N
Transient lodgings	Y	N(1)	N(1)	N(1)	N	N
PUBLIC USE						
Schools	Y	N(1)	N(1)	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums and concert halls	Y	25	30	N	N	N
Governmental services	Y	Y	25	30	N	N
Transportation	Y	Y	Y(2)	Y(3)	Y(4)	Y(4)
Parking	Y	Y	Y(2)	Y(3)	Y(4)	N
COMMERCIAL USE						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale and retail-building materials, hardware and farm equipment	Y	Y	Y(2)	Y(3)	Y(4)	N
Retail trade-general	Y	Y	25	30	N	N
Utilities	Y	Y	Y(2)	Y(3)	Y(4)	N
Communication	Y	Y	25	30	N	N
MANUFACTURING AND PRODUCTION						
Manufacturing, general	Y	Y	Y(2)	Y(3)	Y(4)	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y(6)	Y(7)	Y(8)	Y(8)	Y(8)
Livestock farming and breeding	Y	Y(6)	Y(7)	N	N	N
Mining and fishing resource production and extraction	Y	Y	Y	Y	Y	Y
RECREATIONAL						
Outdoor sports arenas and spectator sports	Y	Y(5)	Y(5)	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parks, resorts and camps	Y	Y	Y	N	N	N
Golf courses, riding stables and water recreation	Y	Y	25	30	N	N

Numbers in parentheses refer to NOTES.

The designations contained in this table do not constitute a Federal determination that any use of land covered by the program is acceptable or unacceptable under Federal, State or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local authorities. FAA determinations under Part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.

TABLE KEY

SLUCM	Standard Land Use Coding Manual.
Y(Yes)	Land Use and related structures compatible without restrictions.
N(No)	Land Use and related structures are not compatible and should be prohibited.
NLR	Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
25, 30 or 35	Land Use and related structures generally compatible; measures to achieve NLR of 25, 30 or 35 dB must be incorporated into design and construction of structure.

NOTES

(1) Where the community determines that residential or school uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB to 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide a NLR of 20 dB, thus, the reduction requirements are often stated as 5, 10 or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. However, the use of NLR criteria will not eliminate outdoor noise problems.

(2) Measures to achieve NLR of 25 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(3) Measures to achieve NLR of 30 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(4) Measures to achieve NLR of 35 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(5) Land use compatible provided that special sound reinforcement systems are installed.

(6) Residential buildings require an NLR of 25.

(7) Residential buildings require an NLR of 30.

(8) Residential buildings not permitted.

SOURCE: 14 CFR Part 150 Guidelines.

FIGURE 3-10
14 CFR Part 150 Land Use Compatibility Matrix

3.5.2 Standards and Regulations Relating to Proposed Noise Abatement Alternatives

- **Federal Aviation Administration Order 5050.4B and Order 1050.1F –** The FAA, like many other federal agencies, issues guidance for compliance with the National Environmental Policy Act (NEPA). FAA Order 1050.1F, *Considering Impacts: Policies and Procedures*, identifies the procedures for complying with NEPA for all divisions of the FAA. FAA Order 5050.4B supplements 1050.1F and identifies issues specific to the Airports Division of the FAA. These orders specify the processes for considering environmental factors when evaluating federal actions under NEPA, and include methodologies for assessing noise, as well as thresholds of significant project-related noise changes. While FAA Orders 1050.1F and 5050.4B do not apply to Part 150, implementation of noise abatement alternatives may trigger the need to complete an environmental review, subject to one of these orders, before they can be implemented. Therefore, noise abatement alternatives approved by the FAA in this Study are subject to environmental review prior to implementation.

- **FAA *Guidance on Procedures for Evaluating the Potential Noise Impacts of Airport Improvement Projects on National Parks and Other Sensitive Park Environments* (Guidance for Park-Related Supplemental Noise Studies) –** In 2007, FAA created guidance for evaluating noise impacts within national parks for use during NEPA evaluations. As with the NEPA implementing guidance, this guidance does not apply to Part 150 Studies. The *Guidance for Park-Related Supplemental Noise Studies* was used to guide the noise analysis that will be documented in this Study. A copy of the Noise Protocol is included in Appendix J to this Study. The supplemental metrics related to the Noise Protocol are included in **Appendix D**.

- **14 CFR Part 36, "Noise Standards Aircraft Type and Airworthiness Certification"** – Originally adopted in 1960, Part 36 prescribes noise standards for issuance of new aircraft type certificates; it also limits noise levels for certification of new types of propeller-driven, small airplanes as well as for transport category, large airplanes. Subsequent amendments extended the required compliance dates. Aircraft may be certificated as Stage 1, Stage 2, Stage 3, or Stage 4 (also called Chapter number outside the U.S.) aircraft based on their noise level, weight, number of engines, and, in some cases, number of passengers.

The FAA is in the process of adopting Stage 5 standards; aircraft that apply for a type certificate after December 31, 2017 would need to meet the newest Stage 5 standards for aircraft over 121,254 pounds and December 31, 2020 for aircraft weighing less than 121,254 pounds. Stage 1 aircraft over 75,000 pounds are no longer permitted to operate in the U.S. Stage 2 aircraft over 75,000 pounds were phased out of the U.S. fleet effective at the start of 2000, as discussed below by the Airport Noise and Capacity Act of 1990. Stage 2 aircraft under 75,000 pounds were phased out effective December 31, 2015. There are no dates established for the phase out of Stage 3 aircraft. CFR Part 36 has followed the regulatory requirements established by the International Civil Aviation Organization (ICAO), a world aviation industry standard setting organization.

- **Airport Noise and Capacity Act of 1990 (ANCA) –** The Airport Noise and Capacity Act of 1990 (PL 101-508, 104 Stat. 1388), also known as ANCA, or the Noise Act, established two broad directives for the FAA: (1) establish a method to review aircraft noise, and airport use or access restriction, imposed by airport proprietors, and (2) institute a program to phase-out Stage 2 aircraft over 75,000 pounds by December 31, 1999 [Stage 2 aircraft are older, noisier aircraft (B-737-200, B-727 and DC-9)]. To implement ANCA, FAA amended Part 91 to address the phase-out of large Stage 2 aircraft and the phase-in of Stage 3 aircraft. In addition, Part 91 states that all Stage 2 aircraft over 75,000 pounds were to be removed from the domestic fleet or modified to meet Stage 3 by December 31, 1999 and subsequently in December 2015, aircraft under 75,000 pounds were required to be Stage 3. There are a few exceptions, but only Stage 3 or 4 aircraft greater than 75,000 pounds are now in the domestic fleet per ANCA regulations. The airlines have phased out Stage 2 aircraft, and the mainland domestic fleet is now all Stage 3 or 4 aircraft, at a minimum. Currently, all new aircraft are to be manufactured to meet Stage 4 standards. The international community was looking to approve a more stringent standard in 2013 which the FAA calls Stage 5, which will be effective for new type certificates after December 31, 2017 and December 31, 2020, depending on the weight of the aircraft.

- **14 CFR Part 161, "Notice and Approval of Airport Noise and Access Restrictions" -** CFR Part 161 was adopted to institute a highly stringent review and approval process for implementing use or access restrictions by airport proprietors. Part 161 sets out the requirements and procedures for implementing new airport use and access restrictions by airport proprietors.

They must use the DNL metric to measure noise effects, and the Part 150 land use guideline table, including 65 DNL as the threshold contour to determine compatibility. ANCA applies to all local noise restrictions that are proposed after October 1990, and to amendments to existing restrictions proposed after October 1990. The FAA has approved only one completed Part 161 Study to date (for restricting Stage 2 corporate jets). Recent litigation has upheld the validity and reasonableness of that Part 161 restriction.

- **Vision 100 Century of Aviation Reauthorization Act –** While ANCA applies to all airports, JAC has a unique set of circumstances. The Vision 100 Century of Aviation Reauthorization Act, approved by Congress in December 2003, allows commercial service airports that lease land from a federal agency to impose Stage 2 restrictions. This allowed JAC to ban Stage 2 aircraft under 75,000 pounds in 2004. Airports that do not meet the Vision 100 airport criteria were not able to ban Stage 2 aircraft under 75,000 pounds; however, 14 CFR Part 91, which outlines general operating and flight rules, was amended to include the phase out of Stage 2 aircraft under 75,000 pounds by December 31, 2015.

- **Federal Interagency Committee on Noise (FICON) Report of 1992 –** The use of the DNL metric criteria has been criticized by various interest groups concerning its usefulness in assessing aircraft noise impacts. As a result, at the direction of the EPA and the FAA, the FICON was formed to review specific elements of the assessment on airport noise impacts and to recommend procedures for potential improvements. FICON included representatives from the Departments of Transportation and Justice, DOD, Veterans Affairs, HUD, the EPA, and the Council on Environmental Quality.

  The FICON review focused primarily on the manner in which noise impacts are determined, including whether aircraft noise impacts are fundamentally different from other transportation noise impacts; how noise impacts are described; and, whether impacts outside of DNL 65 dB should be reviewed in a NEPA document. The committee determined that there are no new descriptors or metrics of sufficient scientific standing to substitute for the present DNL cumulative noise exposure metric. FICON determined that the DNL method contains appropriate dose-response relationships (expected community reaction for a given noise level) to determine the noise impact is properly used to assess noise impacts at both civil and military airports.

The report does support agency discretion in the use of supplemental noise analysis, recommends public understanding of the DNL and supplemental methodologies, as well as aircraft noise impacts.

3.6 Noise

Assessment Methodology

Existing and future aircraft noise environments for JAC were determined through computer modeling using the FAA's INM.[1] Additionally, per the Noise Protocol, on-site sound level measurements were also used. The noise measurements followed Part 150 guidelines. The on-site measurements help establish the ambient, (non-aircraft) noise environment and identify noise levels at specific areas of interest, as indicated by the Noise Protocol. The full results of the noise measurement data and the corresponding supplemental metrics are included in **Appendices C** and **D**. This section is divided into the following sub-sections:

- **Computer Modeling –** Describes the computer noise model and modeling techniques used in this Study.
- **Noise Measurement Survey –** Describes the noise monitoring sites and the methodology used in the noise measurement survey.
- **Measurement and Analysis Procedures –** Describes the measurement and analysis procedures used to develop the various noise metrics of use in this Study.

Highlights of Noise Assessment

Two methods were used to evaluate aircraft noise at JAC:

- INM computer model
- Noise Monitoring of aircraft and ambient noise

FAA Part 150 Studies are required to model aircraft noise with the FAA INM computer model.

Noise monitoring is not required for FAA Part 150 studies. However, this Study included the use of JAC's permanent noise monitoring system and temporary portable noise measurement sites.

Actual measurements were conducted during 2014. Measurements were collected at 6 sites year-round and 10 sites for shorter periods (see **Section 3.8**).

Noise monitoring measurements collect single events at a specific monitoring site.

Aircraft radar data for all of 2014 were collected to identify the flight paths and use of the runways. These data were also correlated to the measurement results.

[1] FAA's Aviation Environmental Design Tool (AEDT), which has replaced the legacy INM tool (effective May 29, 2015), was not used in this Study because it had not yet been released when the Study began.

3.7 Computer Modeling

Computer modeling generates maps or tabular data of an airport's noise environment expressed in DNL and this modeling is used in assessing potential impacts. Computer models are most useful in developing contours that depict, like elevation contours on a topography map, areas of equal noise exposure. Accurate noise contours are largely dependent on the use of reliable, validated, and updated noise models, and collection of accurate aircraft operational data.

The FAA's INM models civilian and military aviation operations. The original INM was released in 1977. The latest version, INM Version 7.0d, was released for use in May 2013. The program includes standard aircraft noise and performance data for over 100 aircraft types that can be tailored to the characteristics of specific individual airports. Version 7.0d includes an updated database that includes some newer aircraft, the ability to include run-ups (maintenance test when the aircraft is on the ground) and topography in the computations, and a provision to vary aircraft profiles in an automated fashion. It also includes more comprehensive and flexible contour plotting routines than earlier versions of the model. This model is also used to calculate audibility.

3.8 Noise Measurement Survey

3.8.1 Purpose of Measurement Survey

Measuring noise directly using calibrated and reliable monitoring devices augments computer modeling and offers several advantages over relying solely on computer modeling. While not required by 14 CFR Part 150, measurements are often helpful in showing actual noise levels. The noise measurement survey serves to:

- Identify noise levels for individual aircraft operations specific to JAC.
- Identify the aircraft and ambient noise level at multiple locations around JAC.
- Meet the requirements outlined in the Use Agreement and the agreed upon Noise Protocol developed by the FAA and NPS for the purposes of this Study.

3.8.2 Types of Field Noise Measurements

The field noise measurement program conducted for this Study included the use of JAC's permanent noise monitoring system and ten temporary portable noise measurement sites. The noise monitors recorded the one-second average noise levels on a continuous basis and allowed for the measurement of aircraft single event data and ambient noise levels.

Noise metrics measured by the noise measurement included DNL, hourly LEQ, Time Above noise levels (TA45, TA55, and TA65), Number of Events Above (NA), single event (SEL, Lmax, and duration), Time Above Ambient, Time Audible, and ambient descriptors (L1, L10, L50, L90, L99). One-third octave spectral data and wind speed data were also collected for use in calculating the audibility. These metrics are described further in **Appendices C** and **D**.

3.8.3 Site Selection Criteria

Noise monitoring sites included locations within GTNP, additional sites located along the primary flight paths (over-flight noise), and within the communities surrounding JAC within the study area. Noise monitoring sites were selected based upon technical suitability, as well as locations of public and stakeholder interest. Information used in the selection of the noise monitoring sites includes land use pattern/proximity to neighborhoods, flight tracks, distribution of the sites representatively around JAC, and proximity to the Critical Area boundary within the GTNP.

General Criteria.

The following are general criteria for different sites to show the noise levels in different areas and environment around JAC.

- Exposure to a variety of different aircraft activity sources
- Departures and arrivals
- Commercial, commuter, and general aviation aircraft
- Ground noise and/or over-flight noise
- Proximity of the site to the Critical Area Boundary (See **Figure 1-6**)
- Representation of the potential exposure to surrounding residents
- Locations that are not in close proximity to localized non-aircraft noise sources
- Locations that are not exposed to high wind speeds
- Locations that are not severely shielded from the aircraft activity
- Locations of public interest
- Security and ease of access (winter/summer) to the noise monitoring equipment

Specific Criteria.

- Multiple locations at different distances from the departure and arrival flight paths
- Locations exposed to both jet aircraft and propeller aircraft flight paths
- Locations at different distances along the flight path to measure departure and arrival noise at different stages of the climb profiles for notable aircraft types. This should include those sites both close to and more distant from JAC.

3.8.4 Noise Measurement Locations

Noise measurements were conducted at selected locations within the airport environs. The noise monitoring sites are presented in **Figure 3-11**. **Table 3-2** reflects the addresses or approximate locations where noise equipment was placed for monitoring purposes. The noise monitoring sites (permanent and temporary) are all operating simultaneously so that noise data from the same flights can be measured and compared at different areas around the airport environment.

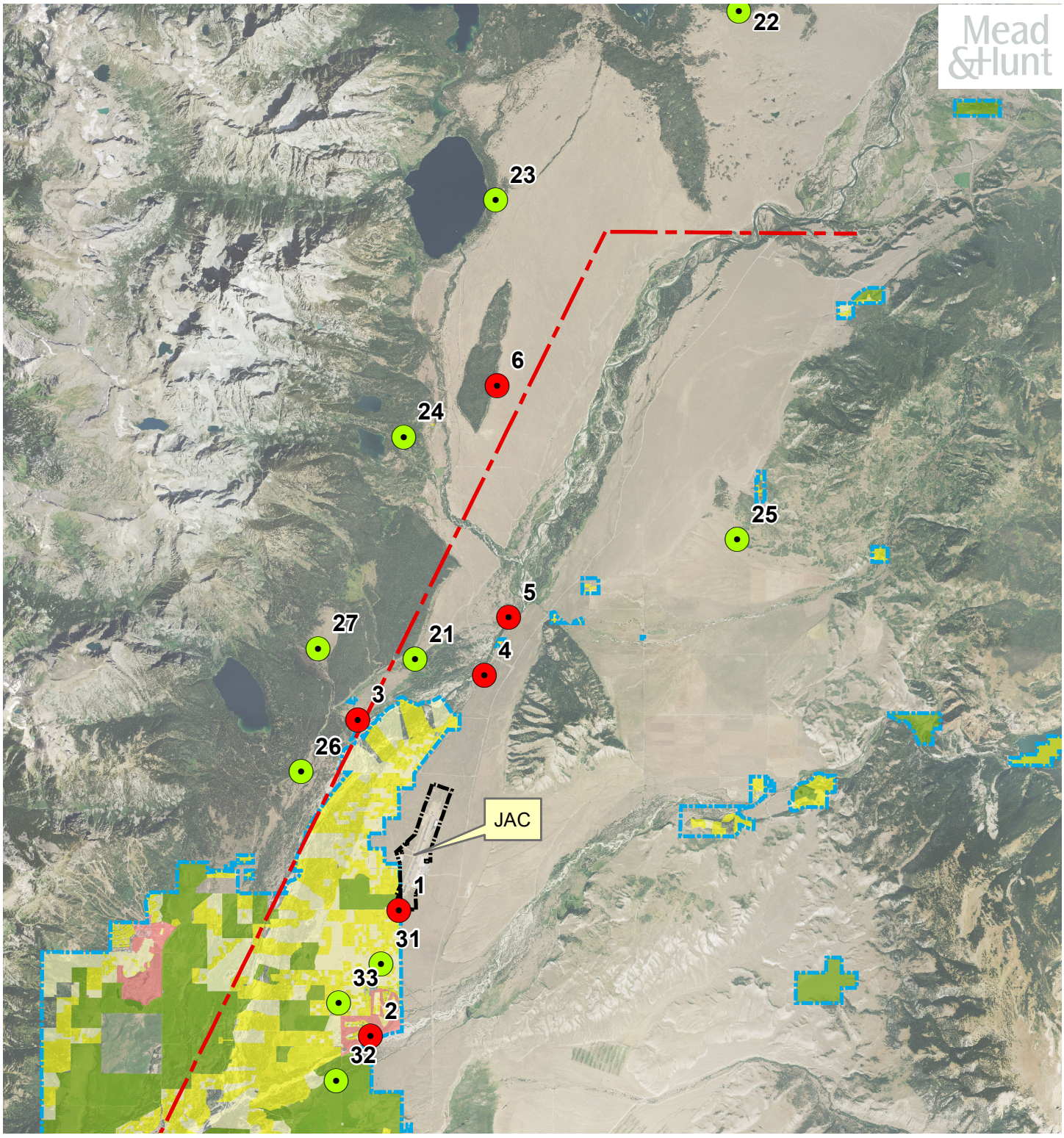


FIGURE 3-11

Combined Noise Measurement Sites

Table 3-2 - Noise Measurement Sites

Id	Description	Address	Type	Area
1	Moulton Loop	Zenith Drive and Spring Gulch Road	Permanent	Teton County
2	Golf Course	Jackson Hole Golf & Tennis Club	Permanent	Teton County
3	Barker Ranch	Circle H Ranch (Old Barker Ranch)	Permanent	GTNP
4	Moose	Moose Entrance	Permanent	GTNP
5	4 Lazy F Ranch	4 Lazy F Ranch	Permanent	GTNP
6	Timbered Island	East of Timbered Island	Permanent	GTNP
21	Moose Wilson Road	Moose Wilson Road	Temporary	GTNP
22	Potholes	Potholes	Temporary	GTNP
23	Jenny Lake	Jenny Lake	Temporary	GTNP
24	Taggart Lake	Taggart Lake	Temporary	GTNP
25	Antelope Flats	Antelope Flats	Temporary	GTNP
26	Rockefeller Center	Rockefeller Center	Temporary	GTNP
27	White Grass	North of Phelps Lake	Temporary	GTNP
31	Bar B Bar	Fox Tail Road	Temporary	Teton County
32	Bar BC Ranch South	Spring Gulch/Lower Bar BC	Temporary	Teton County
33	Sagebrush	6200 Zenith Road	Temporary	Teton County

Source: BridgeNet, February 2015.

3.8.5 Measurement Procedures

Noise measurements were conducted in the spring and summer, between March 6, 2014 – April 8, 2014 and July 26, 2014 – September 3, 2014. Measurements were collected during two different seasons to account for aircraft operational data during two weather periods. Noise monitoring was conducted during these time periods due to the timing of the Part 150 Study. Short-term noise monitoring sites were set up to simultaneously collect continuous 1-second noise levels (and noise data used for audibility) during the entire time the noise monitor is at a given location, generally two to four weeks. The equipment was checked and calibrated on a regular basis throughout the measurement survey. The time at each temporary site varied depending on the type of noise gathered, such as ambient noise, single event data, etc.

3.8.6 Acoustic Data

The noise measurement survey utilized specialized monitoring instrumentation that allowed for the measurement of aircraft single event data and ambient noise levels. The survey utilized noise monitoring hardware and software within each noise monitor that provides continuous measurement and storage of the 1-second A-weighted noise level, spectral 1/3 octave noise and audio files. From these data, along with post processing software (BridgeNet's Volans Noise Monitoring System software) and the radar data, various noise descriptors could be calculated. In addition, these data can be used to plot the time histories for noise events of interest.

3.8.7 Instrumentation

The monitoring program was consistent with state-of-the-art noise measurement procedures and equipment. The measurements consisted of monitoring A-weighted decibels in accordance with procedures and equipment that comply with specific International Standards (IEC), and measurement standards established by the American National Standards Institute (ANSI) for Type 1 instrumentation, as specified in FAA guidance concerning such measurement programs.

These sites utilized both Larson Davis and 01dB sound level meters. The analyzers automatically calculate the various single event data, which include software that provides data storage. During the survey, the noise monitoring instrumentation was calibrated at the start and then verified at the end of the measurements that the instrumentation was still in calibration tolerance.

This calibration was based on standards set by the National Institute of Standards and Technology, formerly the National Bureau of Standards. An accurate record of the meteorological conditions during measurement times was also maintained. All noise monitoring was consistent with 14 CFR Part 150 guidelines.

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CFR Part 150 Study

4
Existing & Future Noise Exposure

Chapter 4 - Existing and Future Noise Exposure

INTRODUCTION. This chapter presents the existing (2014) and future (2020) base case noise conditions. These contours are referred to as the base case or baseline noise contours, as they are the contours to which the benefits/impacts of various alternatives are compared. DNL noise contours for this Study were prepared based upon existing and forecast operational conditions at JAC presented in **Chapter 2** and show the 65 DNL, 70 DNL, and 75 DNL contours per 14 CFR Part 150 Study guidance. Note that the interactive web site for this Study (**http://volans.airportnetwork.com/js3d/jac.html**) allows the user to interactively view different flight track combinations, along with flight procedures and INM flight tracks, along with other elements, to supplement the information in this chapter. Supplemental metrics, 45 DNL and higher contours, and 2025 informational contours are included in **Appendix D**.

4.1 Existing Base Case Noise Modeling Inputs

4.1.1 Existing Aircraft Operations

The existing noise environment for JAC was analyzed based upon 2014 calendar year annual operational conditions. 2014 was used as the base year because it was the most current full year of operations when this Study was initiated in 2015, and operations are still representative of current conditions. A Part 150 Noise Compatibility Study requires that the baseline noise exposure contours reflect annual conditions using a recent continuous 12-month period. The development of the baseline conditions utilizes data from a variety of sources:

- Air Traffic Activity System (ATADS) tower counts
- FAA Traffic Flow Management System Counts (TFMSC)
- Airline Activity Reports
- Radar Operations and Flight Track Data from Noise Monitoring System

The INM noise model requires a variety of operational data to model the noise environment around an airport. These data include the following information, which are discussed in detail in the following paragraphs:

- Total Aircraft Activity Levels
- Aircraft Fleet Mix Categories
- Detailed Fleet Mix
- Time of Day
- Runway Use

- Departure and Arrival Procedures
- Flight Paths
- Flight Path Utilization

4.1.2 Total Aircraft Activity Levels

The total aircraft operational levels were derived directly from the FAA's Air Traffic Activity System (ATADS) tower counts. The ATADS data showed that for the 2014 base period, there were a total of 26,117 annual operations, or an average of 72 operations per day (an operation is one takeoff or one landing). The ATADS information also contained a breakdown as to Air Traffic Control (ATC) category of operations. The total operations and the breakdown for the base case period are presented in **Table 4-1**. Note that these ATADS activity counts are slightly higher than the JAC Tower counts in that the tower is open from 7 am to 9 pm and does not count operations outside of those hours. The ATADS includes a count of operations for the full 24-hour period.

Table 4-1 - Airport Tower Counts for Baseline Period (2014)

Category	Annual Operations	Average Daily Operations
Air Carrier	7,013	19.2
Air Taxi	7,072	19.4
General Aviation	11,862	32.5
Military	170	0.5
TOTAL	26,117	71.6

Source: FAA Air Traffic Activity System, Calendar Year 2014.

4.1.3 Aircraft Fleet Mix Categories

The breakdown by the categories used by ATC are useful for air traffic purposes, but do not provide sufficient detail necessary for the noise analysis or the details that are often of interest to the general public. As a result, the breakdowns by aircraft fleet mix categories of aircraft operations presented within this section were determined from the different sources of operational data that were described above with the primary source being the landing reports. The categories are defined relative to type of aircraft (i.e., jet or propeller), as well as size and noise characteristic.

Table 4-2 presents operations for the different categories of aircraft and matches the categories used in **Table 4-2** in **Chapter 2,** *Forecasts*.

It is not possible to definitively categorize all the operations into unique groups. For example, some general aviation propeller operations are unscheduled commuter propeller flights. Similarly, some air taxi operations are small single-engine piston aircraft that may be categorized as general aviation piston, or vice versa. However, these generally define the categories of operations that occur at JAC and are used within this Study.

Table 4-2 - Existing Operations by Aircraft Type (2014)

Aircraft Type	Operations	Percentages
Commercial Service	**7,156**	**27.17%**
Turboprop	82	1.15%
Regional Jet	3,012	42.09%
Narrow-Body	4,062	56.76%
General Aviation, Military*	**18,961**	**72.82%**
Single Engine Piston/Turboprop	6,001	31.65%
Multi Engine Piston/Turboprop	3,470	18.30%
Jet	9,414	49.65%
Other (Helicopter, Ultra-light, etc.)	76	0.40%
Total	**26,117**	**100.00%**

Source: Mead & Hunt.

* GA Operations includes Air Taxi operations.

2014 Commercial Service operations from operations from FAA ATADS.

4.1.4 Detailed Aircraft Fleet Mix

The mix of aircraft that operate at JAC is one of the most important factors in terms of the airport noise environment. Fleet mix data were determined from all of the data described previously with the primary source being the Total Monthly Enplanements report from JAC. The fleet mix assumptions are presented in **Table 4-3**. This table presents the average daily operations for each type of aircraft used in the INM noise model as well as a description of these aircraft.

The INM aircraft type assigned for each of the aircraft operating at JAC was based upon the INM type that most closely matched the type of aircraft that each airline operated at JAC. Some aircraft with smaller numbers of operations were grouped into the aircraft type that was most representative of those aircraft. Note that the same INM types are shown more than once in the table. This is to identify the separate categories of operations.

Table 4-3 - Detailed Aircraft Fleet Mix Assumptions for Existing Conditions (2014)

Aircraft Category	INM Type	Description	Daily Arrivals		Daily Departures		Daily Operations	Annual Operations	Category
			Day	Night	Day	Night			
Narrow Body Jet	A319-131	A319	2.66	0.06	2.71	0.01	5.43	1,982	
Narrow Body Jet	A320-211	A320	0.81	0.01	0.82	0.00	1.65	604	
Narrow Body Jet	737700	B737-700	0.53	0.01	0.53		1.07	390	
Narrow Body Jet	757PW	Pratt & Whitney	1.06	0.05	1.10	0.01	2.22	810	
Narrow Body Jet	757RR	Rolls Royce	0.38		0.38		0.76	276	
									4,062
Regional Jet	CRJ9-ER	CRJ-700	4.04	0.09	4.11	0.01	8.25	3,012	
									3,012
Commuter Turbo Prop	DHC830	Q400	0.11	0.00	0.11		0.22	82	
									82
Business Jet	LEAR35	Lear all series	1.84	0.03	1.84	0.03	3.73	1,361	
Business Jet	CNA55B	Small Cessna	4.35	0.11	4.37	0.09	8.92	3,257	
Business Jet	CL600	Challengers all series	1.83	0.03	1.82	0.04	3.71	1,355	
Business Jet	CIT3	Mid Size Cessna	0.85	0.01	0.84	0.02	1.72	628	
Business Jet	IA1125	Mid Size Jets	0.51	0.01	0.50	0.02	1.02	373	
Business Jet	SABR80	Older Jets	0.86	0.02	0.86	0.03	1.77	644	
Business Jet	GIIB	Hush kit	0.04		0.04		0.08	28	
Business Jet	GIV	Large Gulfstreams	1.25	0.04	1.27	0.02	2.58	943	
Business Jet	CNA750	Large Cessna	0.77	0.02	0.78	0.01	1.59	579	
Business Jet	EMB135	Large Business Jets	0.33	0.01	0.33	0.00	0.67	245	
									9,414
Twin Propeller Large	DHC6		0.39	0.01	0.39	0.01	0.78	286	
Twin Propeller Large	BEC190		2.14	0.10	2.16	0.07	4.47	1,631	
Twin Propeller	BEC9F	King Air	0.22	0.01	0.22	0.01	0.47	172	
Twin Propeller	CNA441		1.13	0.02	1.14	0.01	2.30	840	
Twin Propeller	BEC58P	Barron	0.70	0.04	0.72	0.02	1.48	542	
									3,470
Single Propeller	GASEPV	Low Performance	1.21	0.01	1.20	0.01	2.42	885	
Single Propeller	CNA20T	High Performance	1.58	0.06	1.54	0.10	3.28	1,196	
Single Propeller	CNA172	Low Performance	4.47		4.47		8.94	3,264	
Single Propeller	GASEPF	Light	0.90		0.90		1.80	656	
									6,001
Miscellaneous	DHC6		0.10		0.10		0.21	76	
									76
Total			**35.03**	**0.75**	**35.26**	**0.51**	**71.55**	**26,117**	

Source: BridgeNet International, 2016

4.1.5 Time of Day

In the DNL metric, any operations that occur after 10 p.m. and before 7 a.m. are considered more intrusive and their noise levels are penalized by adding 10 dBA, which is equivalent to a doubling in sound for those operations to account for the added sensitivity to noise during the nighttime hours. The nighttime operations assumptions were determined from JAC's flight-track monitoring system during the base period. The overall percentage of nighttime operations at JAC was determined to be 1.7 percent. For arrivals, the night time operations typically arrived after 10 p.m. For departures, it was typically departures a few minutes before 7 a.m. The time of day assumptions used in the model were specific to each aircraft operation.

4.1.6 Runway Use

An additional important consideration in developing the noise exposure contours is the percentage of time each runway is utilized. The speed and direction of the wind dictate the runway direction that is utilized by an aircraft. From a safety and stability standpoint, it is desirable, and usually necessary, to arrive and depart an aircraft into the wind. When the wind direction changes, the operations are shifted to the runway end that favors the new wind direction.

The existing conditions runway use presented in **Table 4-4** is based upon a full year of radar data. This table presents the percentage utilization of each runway for departures and arrivals separately for each category of aircraft.

Table 4-4 - Airport Percentage Runway Utilization

Category	Departures		Arrivals	
	Rwy 19	Rwy 01	Rwy 19	Rwy 01
Commercial Jets	81%	19%	80%	20%
Regional Jets	85%	15%	77%	23%
Commuter Propeller	85%	15%	77%	23%
Business Jet	85%	15%	83%	17%
GA Propeller / Other	87%	13%	75%	25%

Source: BridgeNet International, JAC Flight Track Monitoring System, 2014.

4.1.7 Departure Climb Profile

Generally, heavier aircraft climb at a slower rate, and thus the noise levels under the flight path are likely to be louder. The aircraft departure stage length is the distance the aircraft flies from an airport to its first destination and the stage length of a flight can be used as a rough surrogate for the aircraft departure weight because it is related to how much fuel an aircraft needs to carry for that distance.

The rate of climb of an aircraft is called the departure climb profile. The stage length assumption is used to determine the rate of climb of each of the different aircraft operating at the Airport (and therefore how low it is to the ground at any given point). The various stage length assumptions are associated with commercial jet operations and not for other categories of aircraft. The different stage lengths used in the INM model are listed below.

Stage Length 1:	0 to 500 nautical miles flight distance
Stage Length 2:	500 to 999 nautical miles flight distance
Stage Length 3:	1000 to 1499 nautical miles flight distance
Stage Length 4:	1500 to 2499 nautical miles flight distance
Stage Length 5:	2500 to 3499 nautical miles flight distance
Stage Length 6:	3500 to 4499 nautical miles flight distance
Stage Length 7:	+4500 nautical miles flight distance

Table 4-5 presents the location of North American airports that are points of service for commercial operations at JAC. Note that the table shows that many of the aircraft flights are to nearby hub airports for the major airlines. The destinations with the most service are SLC and DEN which are Stage Length 1. The other destinations range from Stage Length 2 up to and including Stage Length 4.

The INM noise model contains different departure climb profiles for each of the aircraft contained in the model. These climb profiles define the rate of climb, speed, and engine thrust based upon the weight of the aircraft. The flight distance stage length is used to assign the departure climb profile using the flight distance data as presented in **Table 4-5**.

Table 4-5 - Distances from Jackson Hole Airport to Commercial Airports

Airport Code	Airport	Distance (Nautical Miles)
SLC	Salt Lake City	178
DEN	Denver	353
ATL	Atlanta	1,364
DFW	Dallas/Fort Worth	904
IAD	Washington DC (Dulles)	1,512
LAX	Los Angeles	681
SFO	San Francisco	640
ORD	Chicago O'Hare	1,008
MSP	Minneapolis/St Paul	756
IAH	Houston Intercontinental	1,095
EWR	Newark	1,625
JFK	New York JFK	1,642

Source: Google, 2015.

4.1.8 Flight Paths and Flight Path Utilization

The FAA and JAC have established paths for aircraft arriving and departing from JAC. These paths are not precisely defined ground tracks, but represent a path along the ground over which aircraft generally fly. The identification of the location and use of the flight tracks is based upon the FAA's radar data, field observations, and discussions with noise-abatement personnel. A full year of actual radar data were used in the development of the INM flight paths. The flight paths used in the noise model are derived from all of the actual flight paths flown throughout the base period study year.

In the development of the existing noise contours it is important to aggregate the flight tracks into a set of generalized flight paths of aircraft operating at the Airport to allow the modeling of different alternative scenarios that may involve the shifting or redesign of the flight procedures.

In the INM noise model, a flight path consists of a backbone or center flight path, and the dispersion or spread of all flights that use that backbone. A computer program was used to develop the INM flight paths from the actual radar flight track data.

The in-house computer program, Volans, creates flight tracks that can be read in INM to create the backbone and ancillary tracks based upon the actual radar data. The software calculates the average path of all the aircraft that flew those procedures. The program also determines the dispersion of the flight tracks on that path. This is then put into the INM noise model. An example of the process used to calculate each of the flight paths was presented in the methodology section.

The modeling analysis for existing conditions included a total of 14 departure flight paths and 8 arrival flight paths at JAC. The flight paths modeled in this Study were those within the general range of the radar and the project study area. This extended to at least 30,000 feet in length with the majority of the tracks extending 100,000 feet or greater in length.

The radar flight tracks used in the modeling analysis are presented in **Figures 4-1** and **4-2**. Figure **4-1** shows on the base of the map, a random sample of south flow actual flight tracks for 500 departures and 500 arrivals from 2014 for jet aircraft. The departures are shown in turquoise and the arrivals are shown in yellow. **Figure 4-2** presents the same information in north flow.

Figures 4-3 and **4-4** presents the INM flight tracks for south flow and north flow respectively. These are presented in thicker lines of the same color. The solid line is the centerline of the flight path. The lighter lines reflect the dispersion of that flight path. The utilization of each flight path was determined based upon a full year of radar data. **Figure 4-5** and **Figure 4-6** show the same INM information, but zoomed in and on the land use base map to meet requirements set out in Part 150. Note that the interactive web site for this Study allows the user to interactively view different flight track combinations, along with flight procedures and INM flight tracks.

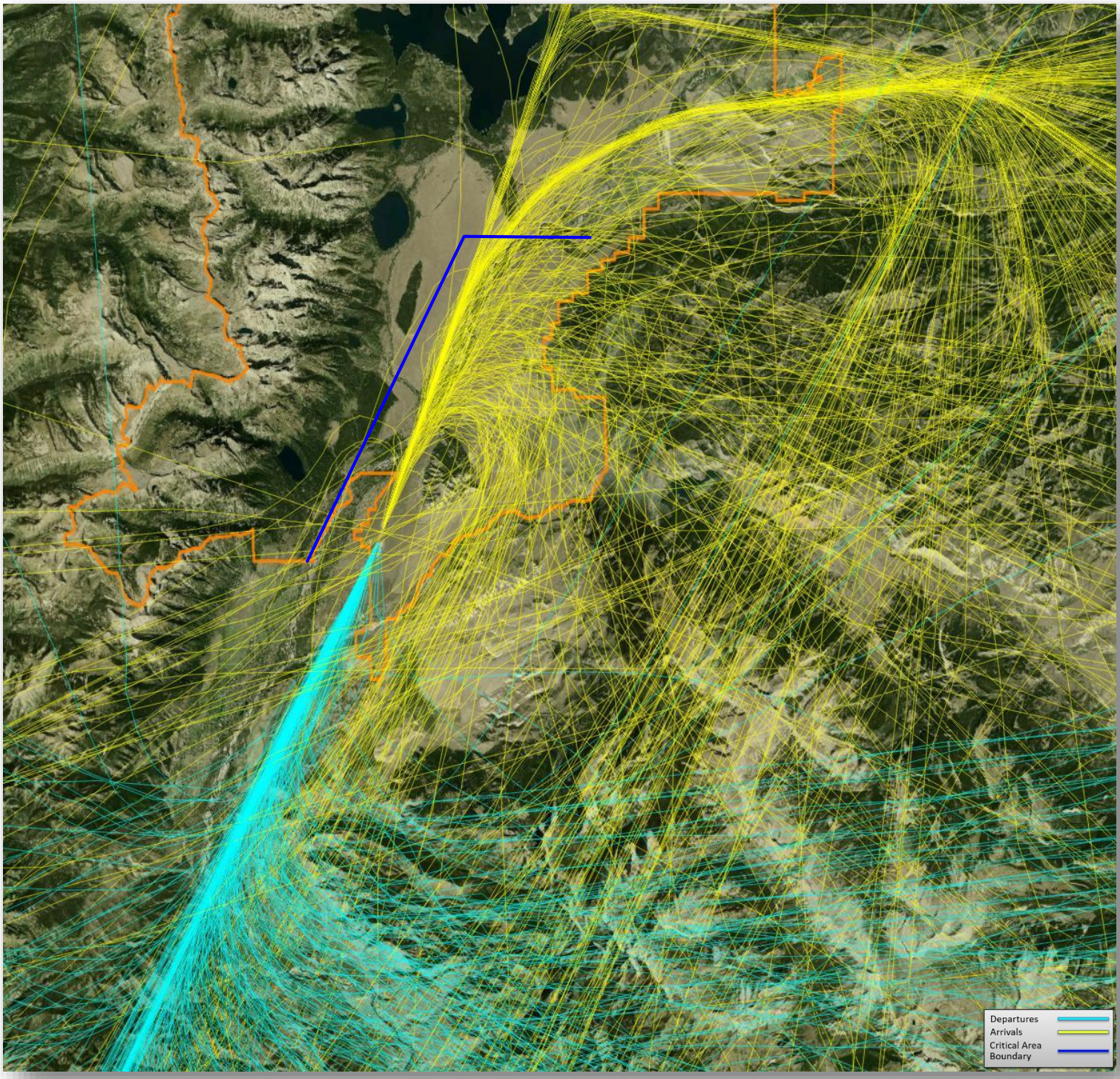


Figure 4-1
South Flow Radar Tracks

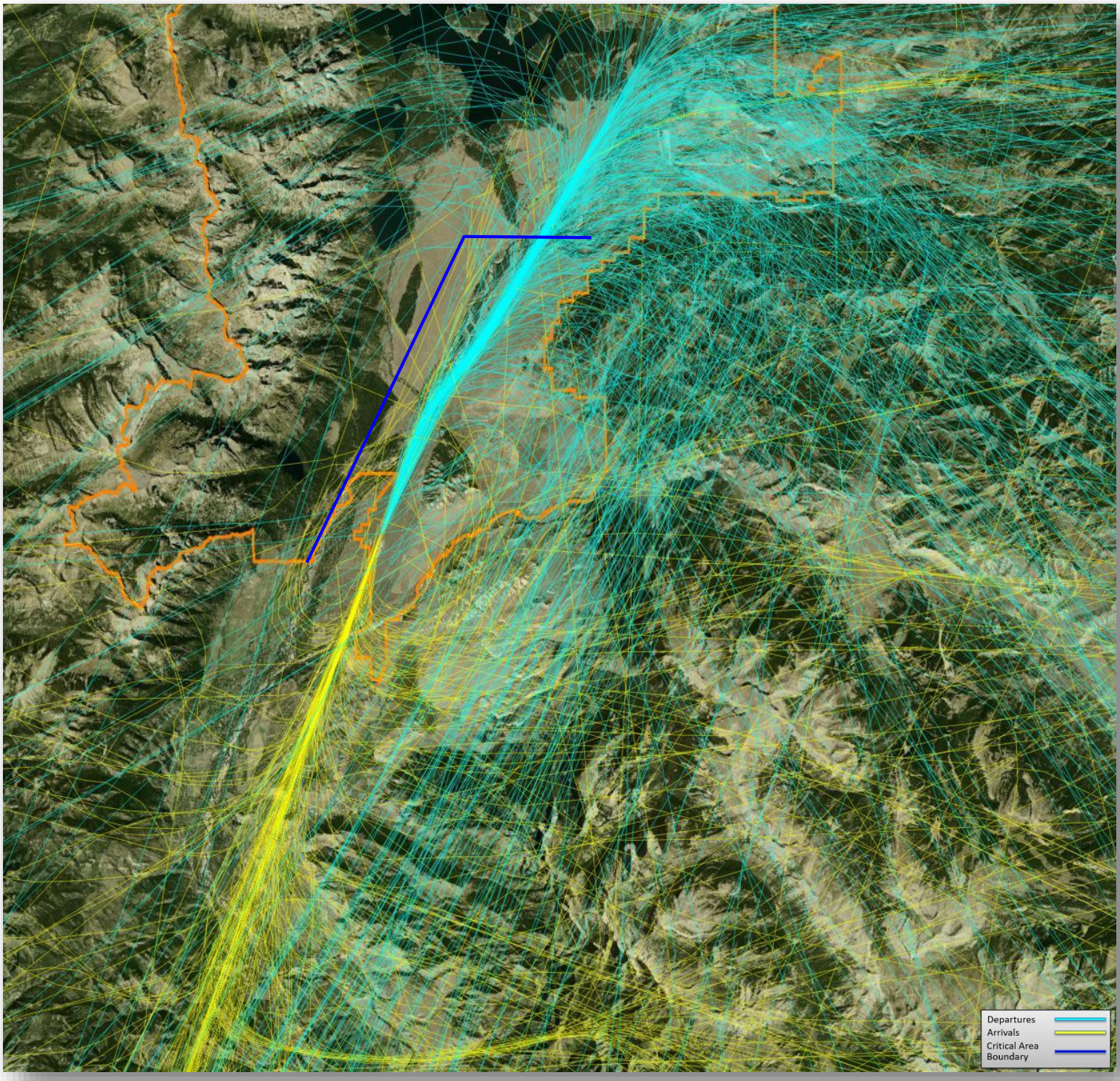


Figure 4-2
North Flow Radar Tracks

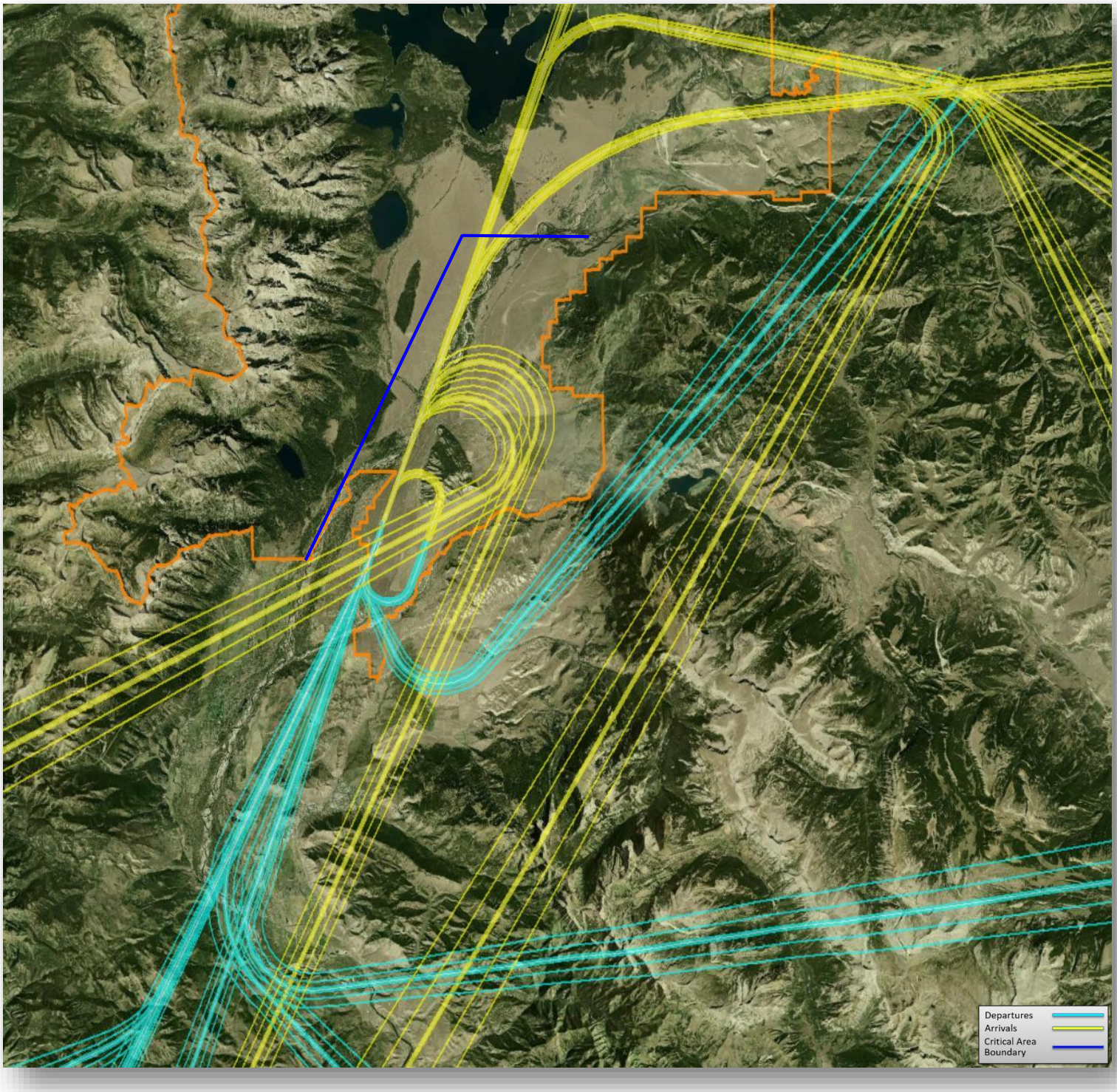


Figure 4-3
South Flow INM Tracks

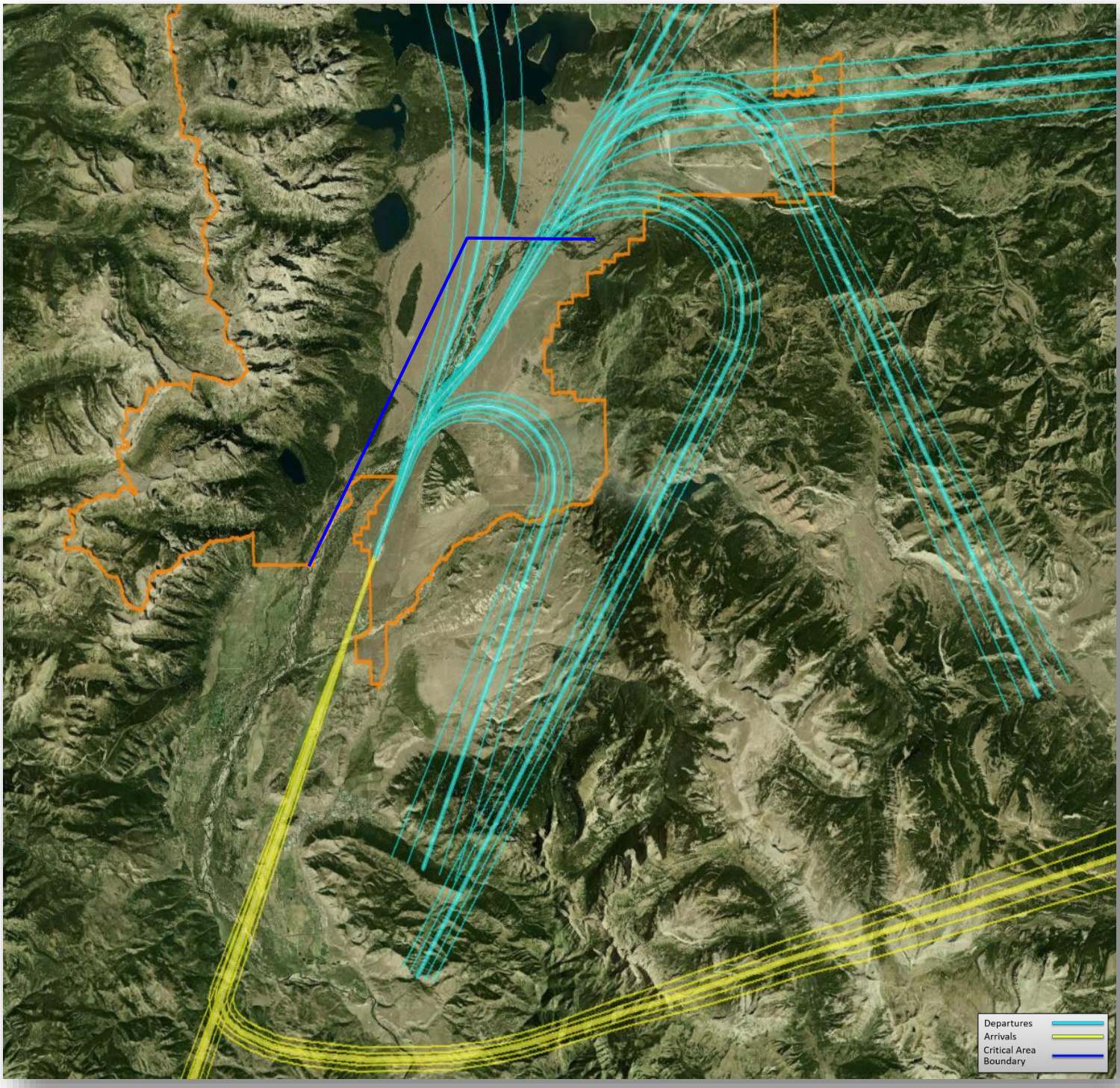
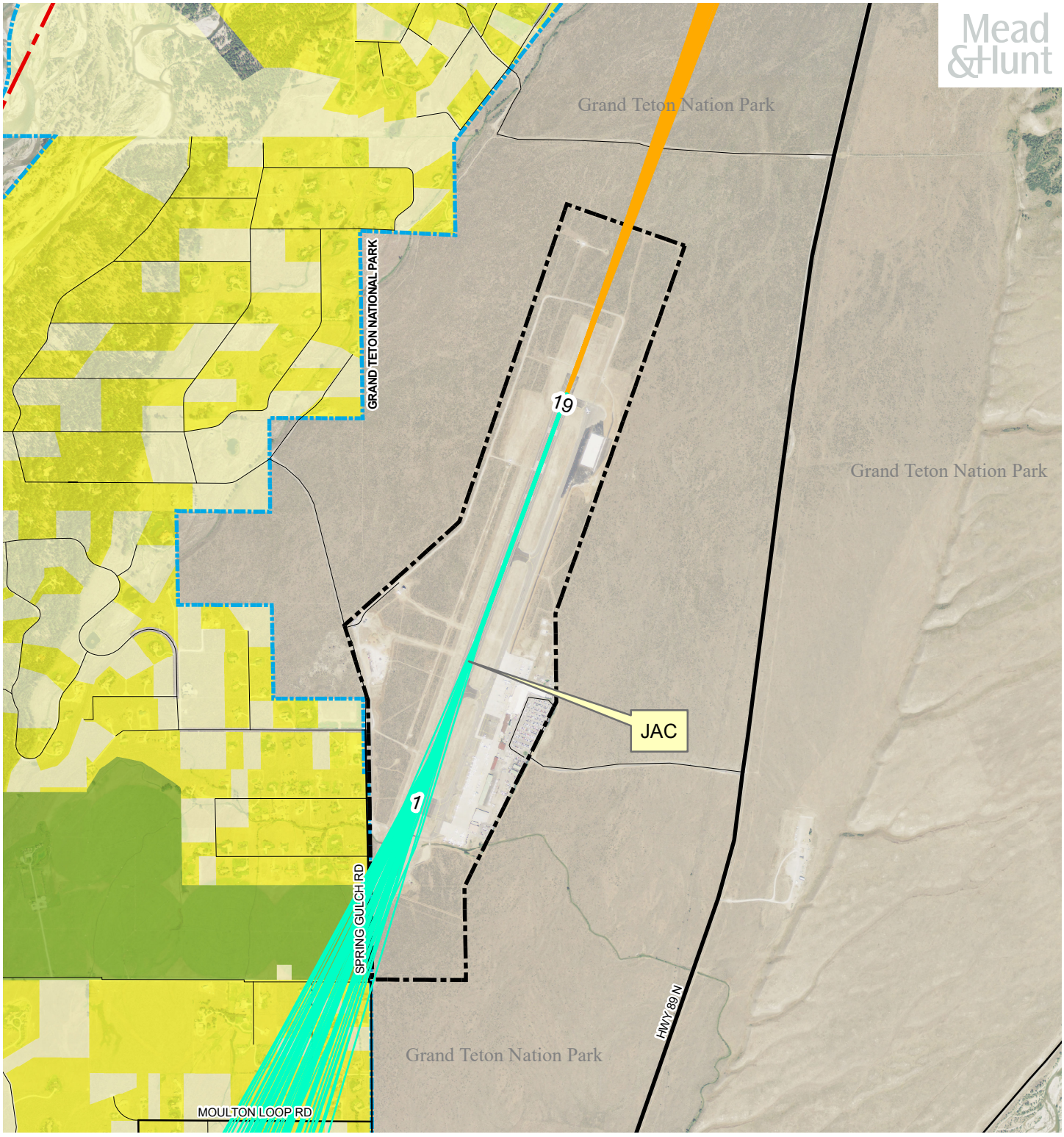


Figure 4-4
North Flow INM Tracks



Aerial Souce: 2012 NAIP WY039

N

0 1,000 2,000 4,000 Feet

Flight Tracks Legend

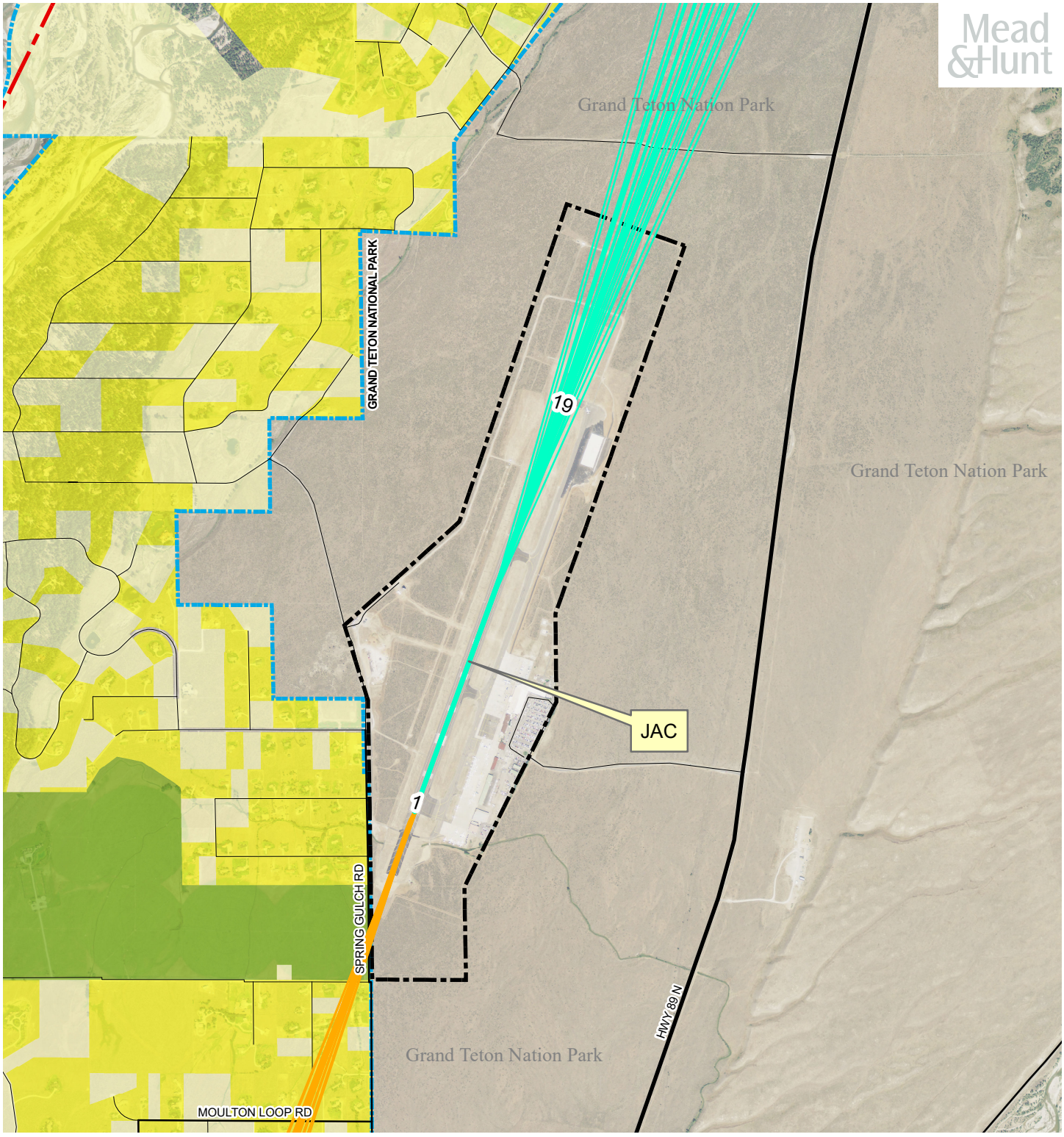
Departure **Arrival**

Generalized Land Use (Teton County GIS)

Airport Property
GTNP Boundary
Residential
Res Vacant Land
Agricultural

FIGURE 4-5

South Flow INM Tracks



Aerial Souce: 2012 NAIP WY039

N

0 1,000 2,000 4,000 Feet

Flight Tracks Legend

Departure **Arrival**

Generalized Land Use (Teton County GIS)

Airport Property
GTNP Boundary
Residential
Res Vacant Land
Agricultural

FIGURE 4-6

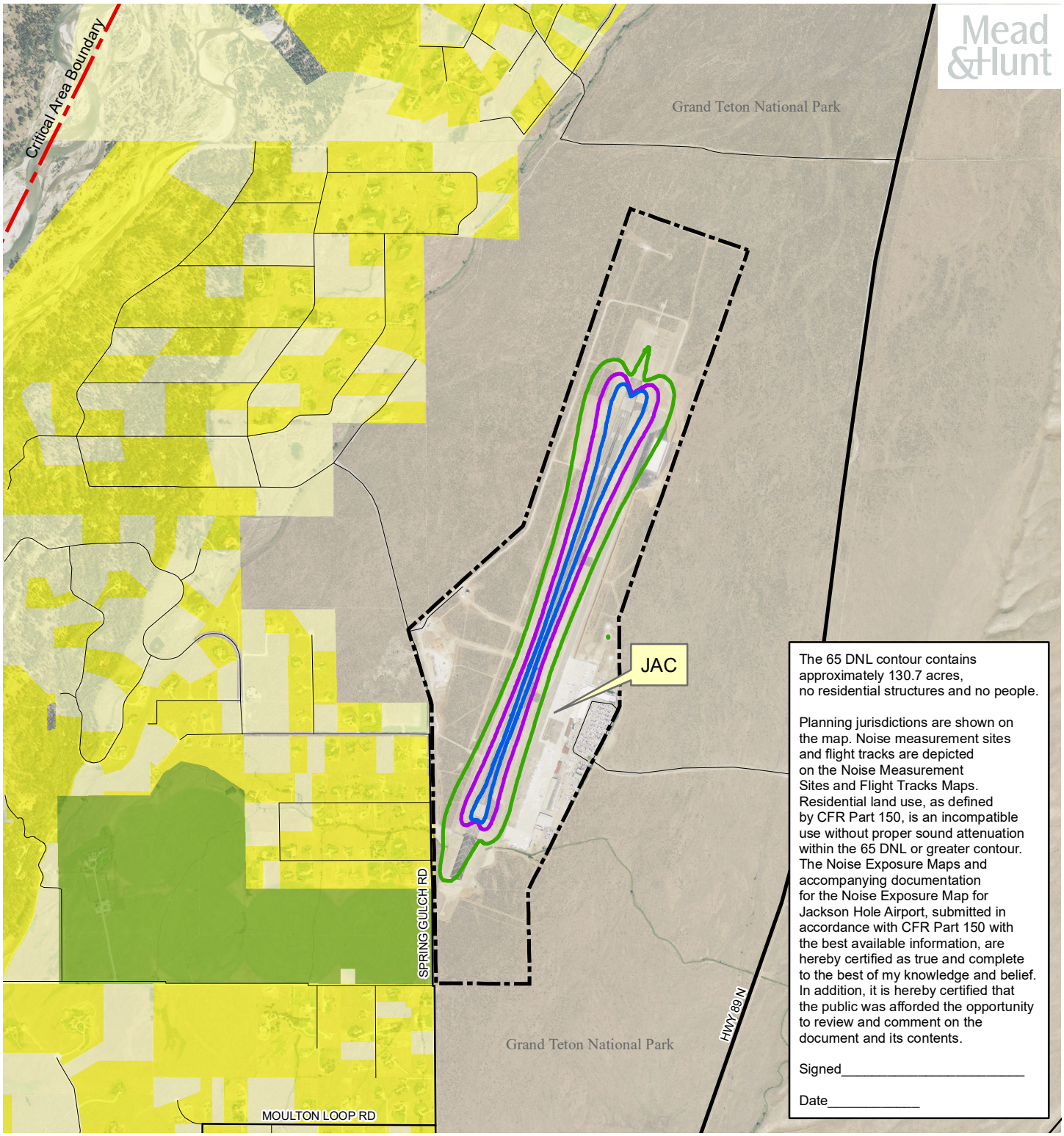
North Flow INM Tracks

4.2 Existing Base Case Noise Contours

As required by the FAA, the primary noise criterion to describe the existing noise environment is DNL. The compiled data as described in the preceding sections are used as input to the FAA's INM for the calculation of noise in the airport environs. Levels of 65 DNL and above are considered by 14 CFR Part 150 to be significant for noise-sensitive land uses such as residences, churches, and schools. However, for JAC, additional contours were generated (down to the 45 DNL noise contour) per the Use Agreement. Contours below the 65 DNL (the 45, 50, 55, and 60 DNL contours) are included in **Appendix D**.

The noise contours do not represent the noise levels present on any specific day, but, rather, represent the daily energy-average of all 365 days of operation during the year. The noise contour extends in an oval from the Airport from the runway end. This shape generally reflects the summation of the flight tracks used by all aircraft. The relative distance of the contours from the Airport along each route is a function of the frequency of use of each runway for total arrivals and departures, as well as its use at night, and the type of aircraft assigned to it.

Based upon the operational conditions presented previously and the INM noise model, noise contours were developed. The data show that for the 2014 base period, there were a total of 26,117 annual operations. The existing annual base period 2014 DNL noise exposure contours for JAC are presented in **Figure 4-7**. This represents the official existing NEM. This figure presents the 65, 70, and 75 DNL noise exposure contours, which are within JAC property. This figure is also presented on the Study web site.



Aerial Souce: 2012 NAIP WY039

N

0 1,000 2,000 4,000 Feet

Noise Contour Legend

DNL_65 DNL_70 DNL_75 Critical Boundary Area

Generalized Land Use (Teton County GIS)

Residential Res Vacant Land Agricultural Airport Property

FIGURE 4-7

Existing Noise Exposure Map (2014)

4.3 Future Base Case Noise Modeling Inputs

4.3.1 2020 Aircraft Operations

The future noise environment for JAC was analyzed based upon forecast 2020 operational conditions. The future 5-year contour (2020) is representative of future conditions. The aircraft operational levels come directly from the aviation forecast presented in the Forecasts Chapter. The forecast data show that for the Year 2020, a total of 28,292 operations are anticipated to occur at JAC. This equates to an average of 78 operations per day (an operation is either one takeoff or one landing).

Aircraft Fleet Mix Categories. The categories of aircraft are defined relative to type of user, (i.e., passenger or cargo) and type of aircraft (i.e., jet or propeller). The breakdown by these categories was determined from the aviation forecast. **Table 4-6** presents operations for the different categories of aircraft. Note General Aviation, Air Taxi, and Military are grouped within the future forecast.

Table 4-6 - Operations by Aircraft Category for Future 2020 Base Case Conditions

Aircraft Type	2020	Average daily operations
Commercial Service[1]	7,521	20.6
Turboprop	0	0
Regional Jet	3,012	8.25
Narrow-Body	4,509	12.4
General Aviation, Air Taxi and Military	20,771	56.9
Single Engine Piston/Turboprop	6,159	16.9
Multi Engine Piston/Turboprop	3,801	10.4
Jet	10,728	29.4
Other (Helicopter, Ultra-Light, etc.)	83	0.23
Total	28,292	77.6

Source: Mead & Hunt, 2015.

[1] Commercial Service projected proportions were estimated using 2014 proportions in combination with anticipated trends in future aircraft type.

Numbers may not add due to rounding.

Detailed Aircraft Fleet Mix. The mix of aircraft that operate at JAC is one of the most important factors in terms of the airport noise environment. Fleet mix data were determined from all of the data described previously. The fleet mix assumptions are presented in **Table 4-7**. This table presents the average daily operations for each type of aircraft used in the INM as well as a description of these aircraft.

The INM aircraft type assigned to each of the aircraft operating at JAC was based upon aircraft in the INM database that most closely matched the aircraft each airline operated at JAC. Some aircraft with smaller numbers of operations were grouped into the aircraft type that most closely represented those aircraft. Note that these are the same INM types shown more than once in the table. This is to identify the separate categories of operations. The percentage of operations for each of the aircraft types is also presented. The A319 aircraft are the dominant noise aircraft operating at JAC during the future year study period.

The aircraft in the future are assumed to continue to be quieter than the current mix of aircraft. There are several new generation narrow body jets, regional jets, and corporate jets with new generation engine technology that reduces the noise generated by these aircraft. The future year fleet mix included the use of more new generation quieter corporate jet aircraft and a reduction in the number of older generation louder corporate jet aircraft. The next generation of potential commercial service narrow body and regional jet aircraft are not yet in the noise models, and were not factored in the future year study.

4.3.1 Additional Operational Assumptions

Assumptions such as runway use, time of day, flight tracks and flight track usage, and departure procedures remain the same as with the existing conditions.

Table 4-7 - Detailed Aircraft Fleet Mix Assumptions for Future Year Base Case Conditions (2020)

Aircraft Category	INM Type	Description	Daily Arrivals		Daily Departures		Daily Operations	Annual Operations	Category
			Day	Night	Day	Night			
Narrow Body Jet	A319-131	A319	3.3256	0.0716	3.3904	0.0068	6.79	2,480	
Narrow Body Jet	A320-211	A320	1.2143	0.0210	1.2312	0.0041	2.47	902	
Narrow Body Jet	737700	B737-700	0.9122	0.0143	0.9265		1.85	676	
Narrow Body Jet	757PW	Pratt & Whitney	0.2938	0.0151	0.3073	0.0015	0.62	225	
Narrow Body Jet	757RR	Rolls Royce	0.3088		0.3088		0.62	225	
									4,509
Regional Jet	CRJ9-ER	CRJ-700	4.0394	0.0866	4.1126	0.0134	8.25	3,012	
									3,012
Commuter Turbo Prop	DHC830	Q400							
Business Jet	LEAR35	Lear all series	2.1154	0.0313	2.1148	0.0319	4.29	1,567	
Business Jet	CNA55B	Small Cessna	4.9623	0.1306	4.9854	0.1074	10.19	3,718	
Business Jet	CL600	Challengers all series	2.0910	0.0286	2.0760	0.0436	4.24	1,547	
Business Jet	CIT3	Mid Size Cessna	0.9656	0.0158	0.9640	0.0174	1.96	716	
Business Jet	IA1125	Mid Size Jets	0.5776	0.0060	0.5662	0.0174	1.17	426	
Business Jet	SABR80	Older Jets	0.5373	0.0216	0.5298	0.0290	1.12	408	
Business Jet	GIIB	Hush kit							
Business Jet	GIV	Large Gulfstreams	1.8730	0.0508	1.8976	0.0261	3.85	1,404	
Business Jet	CNA750	Large Cessna	0.8843	0.0216	0.8914	0.0145	1.81	661	
Business Jet	EMB135	Large Business Jets	0.3741	0.0091	0.3804	0.0029	0.77	280	
									10,728
Twin Propeller Large	DHC6		0.4232	0.0061	0.4230	0.0063	0.86	313	
Twin Propeller Large	BEC190		2.3405	0.1065	2.3673	0.0797	4.89	1,786	
Twin Propeller	BEC9F	King Air	0.2444	0.0132	0.2453	0.0123	0.52	188	
Twin Propeller	CNA441		1.2358	0.0245	1.2510	0.0093	2.52	920	
Twin Propeller	BEC58P	Barron	0.7697	0.0429	0.7881	0.0245	1.63	593	
									3,801
Single Propeller	GASEPV	Low Performance	1.2150	0.0064	1.2082	0.0132	2.44	892	
Single Propeller	CNA20T	High Performance	2.7570	0.0641	2.7226	0.0985	5.64	2,059	
Single Propeller	CNA172	Low Performance	3.4205		3.4205		6.84	2,497	
Single Propeller	GASEPF	Light	0.9740		0.9740		1.95	711	
									6,159
Miscellaneous	DHC6		0.1137		0.1137		0.23	83	
									83
Total			**37.97**	**0.79**	**38.20**	**0.56**	**77.51**	**28,292**	

Source: BridgeNet International, 2016.

4.4 Future 2020 Base Case Noise Contours

The future base period 2020 DNL noise exposure contours for JAC are presented in **Figure 4-8**. These contours assume no changes relative to alternatives discussed later in this report. The official future NEM is presented in **Chapter 9**. This figure presents the 65, 70, and 75 DNL noise exposure contours, which are all within JAC property and are also presented on the Part 150 Noise Study web site. The 45, 50, 55, and 60 DNL contours as well as additional metrics are included in **Appendix D**.

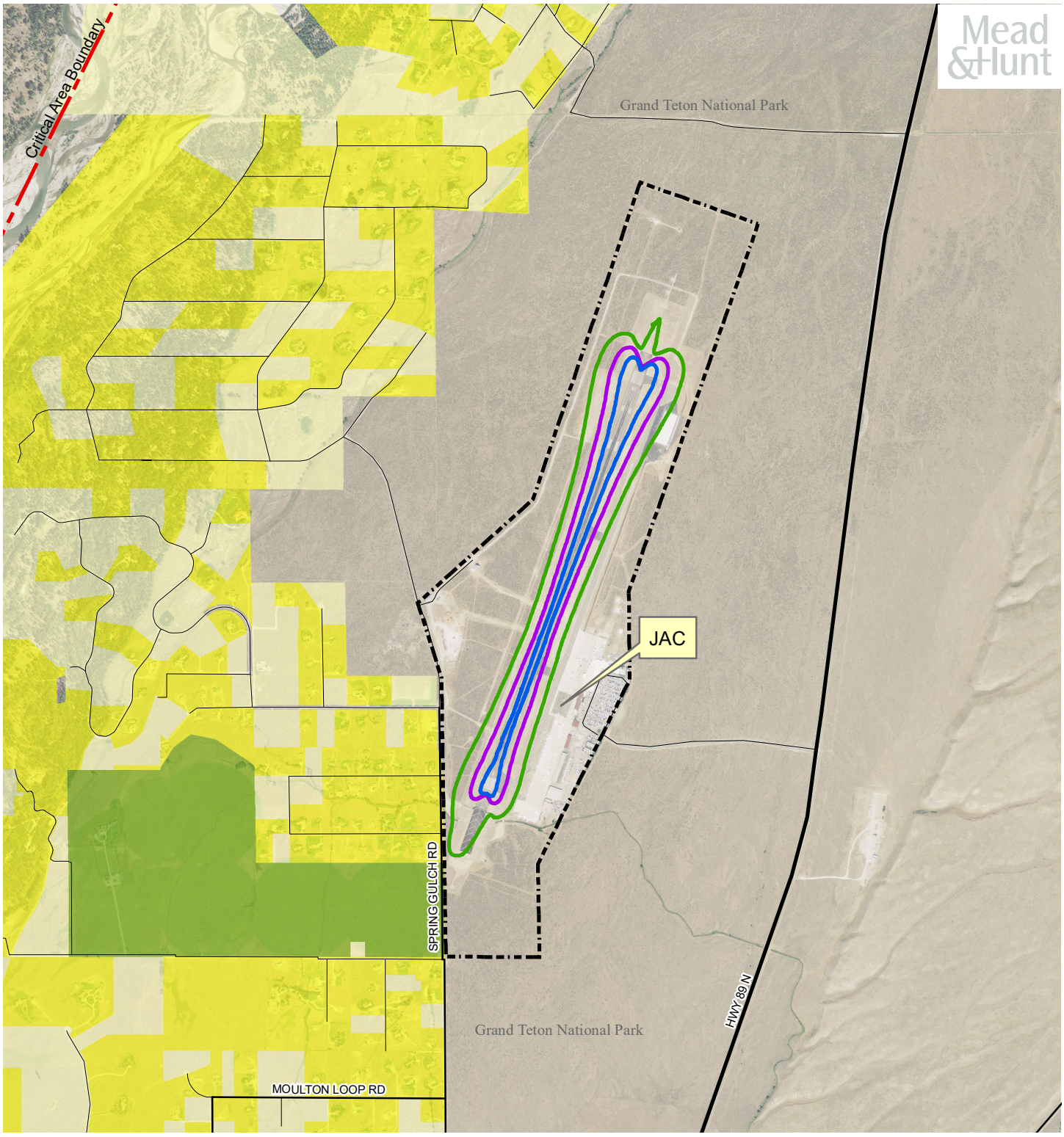


FIGURE 4-8

Future Base Case (2020) DNL Noise Contours

JACKSON HOLE AIRPORT
CFR Part 150 Study

5
Land Use Analysis

Chapter 5 - Land Use Analysis

INTRODUCTION. This chapter summarizes the compatibility of various land uses within the existing (2014) and future (2020) "base case" noise exposure contours. The 2020 contour will be the base case for evaluating alternatives for the Noise Compatibility Program. As the Part 150 Study examines alternative noise abatement or land use compatibility actions, a direct comparison will be made with the information presented in this chapter to gauge the potential success of various alternatives.

5.1 Methodology

The land use and population analysis for both the existing and future "base case" noise contours were derived from a variety of sources. The future base case is representative of future forecasted operations, with no adjustments for noise abatement or other types of noise mitigation. The positive or negative effects of each alternative are determined by comparing them to the future base case.

The existing land use maps provided in **Chapter 1** were used to determine the number of acres of different land use types. The noise contours (for 2014, 2020 and 2025) were overlaid on these maps and a Geographic Information System (GIS) computer program was used to determine the number of acres for each land use type located within each noise contour. A 2025 contour was developed for informational uses and can be used for local land use planning and zoning purposes. Population numbers were determined from the 2010 U.S. Census using the same GIS program. Housing unit counts were determined using aerial photography for each contour and were rounded up or down to the nearest five.

A Part 150 Noise Compatibility Study and the Noise Exposure Maps use the 65 DNL contour for land use compatibility analysis, based on the FAA's land use compatibility guidelines. Typically, in a Part 150 Study, only the 65, 70 and 75 DNL noise contours are displayed, as the 65 DNL and greater noise levels (i.e., all the land within the 65 DNL contour) are used for land use compatibility analysis under Part 150.

The 14 CFR Part 150 Land Use Guidelines (as presented in **Chapter 3**) state that noise sensitive land uses such as homes, schools, and religious facilities within the 65 DNL and greater contours are considered non-compatible. Noise sensitive uses can be made compatible within the 65 DNL noise contour through sound attenuation programs, such as sound insulation, noise easements, or land acquisition.

Contours were generated for existing (2014) conditions, as well as the future (2020) conditions. The Existing NEM is presented in **Chapter 4** and the Future NEM is presented in **Chapter 9**. The official NEMs show the 65+ contours. For this Study, the 45 DNL, 50 DNL, 55 DNL and 60 DNL are included in **Appendix D** for planning purposes and to address the requirements of the Use Agreement. The Use Agreement stipulates that there is a restriction line defining a Critical Area Boundary within GTNP beyond which the aircraft annual noise levels cannot exceed 45 DNL (see **Figure 1-6**). In addition, the annual level from aircraft noise at the Moose noise measurement location cannot exceed 55 DNL. Therefore, these contours are included in **Appendix D** to make sure that those cumulative noise standards outlined in the Use Agreement are met.

5.2 Existing Land Use Analysis/Existing Noise Contours, 2014 Base Case

Table 5-1 summarizes the various land uses, population, and housing units within the existing 2014 noise contours. The existing 2014 65 DNL and greater contour contains approximately 131 acres, and is entirely contained on airport property. There are no residential structures, people, schools, or religious facilities within the 65 DNL and greater contour. In addition, there are no Teton County noise sensitive historical and significant properties or other known historic sites within the 65 DNL and greater contour; therefore, there are no non-compatible land uses within the 65 DNL and greater contours.

5.3 Existing Population Analysis/Future (Base Case 2020) Noise Contours

The future base case noise contours are very similar to the existing noise contours, but show a slight size increase. This is a result of a combination of increasing operations paired with a slight reduction in noise from the corporate jet fleet mix, where louder corporate aircraft are being phased out and quieter corporate aircraft coming into service. The future 65 DNL and greater contour is expected to increase marginally from approximately 130.7 acres to 131 acres by 2020.

Table 5-1 lists the various land uses, housing units and the population that would be expected to be within the 2020 base case noise contours. There are no residential structures or people within the future base case (2020) 65 DNL and greater contour. There are also no schools or religious facilities within the 65 DNL and greater noise contour. There are no noise sensitive historic properties listed on the National Register of Historic Places or from Teton County located within the 65 DNL and greater contour. The future 2020 65 DNL and greater contour contains approximately 131 acres, and is entirely contained on airport property.

Table 5-1 - Existing Land Use Within Existing 2014 Noise Contours, Base Case and 2020 Noise Contours, Base Case

	2014 Existing Base Case			2020 Future Base Case		
Land Use	65 DNL	70 DNL	75 DNL	65 DNL	70 DNL	75 DNL
National Park	0.0	0.0	0.0	0.0	0.0	0.0
National Elk Refuge	0.0	0.0	0.0	0.0	0.0	0.0
Airport	130.7	61.6	23.8	131	62.3	24.3
Residential Acres	0.0	0.0	0.0	0.0	0.0	0.0
Persons	0	0	0	0	0	0
Housing Units	0	0	0	0	0	0
Schools	0	0	0	0	0	0
Religious Facilities	0	0	0	0	0	0
Historic Properties	0	0	0	0	0	0
Residential Vacant	0.0	0.0	0.0	0.0	0.0	0.0
Commercial	0.0	0.0	0.0	0.0	0.0	0.0
Agricultural	0.0	0.0	0.0	0.0	0.0	0.0
Exempt	0.0	0.0	0.0	0.0	0.0	0.0
Unidentified	0.0	0.0	0.0	0.0	0.0	0.0
Total Land Use Acres	130.7	61.6	23.8	131	62.3	24.3

Source: Existing Land Use, 2010 Census Data and Aerial Photography, Mead & Hunt Analysis.
Note: Acres rounded to the nearest tenth; housing and population rounded to the nearest 5.
Airport property is the area that is leased from the National Park and is located within GTNP.

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6
Potential Noise Abatement Measures

Chapter 6 - Potential Noise Abatement Measures

INTRODUCTION. This chapter provides a general overview of the potential noise abatement and noise reduction measures that are required for consideration during the Study process. Recommendations from the 2004 and 1985 Records of Approval are detailed in **Chapter 1**, Table 1-4 and Table 1-5. This chapter describes each alternative required for consideration in a Part 150 Study, whether they apply to JAC, and the reasoning for each decision. Due to the noise abatement measures already in place at JAC, many alternatives normally examined in a Part 150 Study do not apply. Alternatives that have the potential to address specific local noise issues, including issues pertaining to the GTNP, are also included. In addition, this chapter contains explanations of the roles and responsibilities of various parties in noise abatement planning and the implementation of various noise abatement measures. Alternatives that are not eliminated are brought forward into **Chapter 7** (Operational Alternatives) or **Chapter 8** (Land Use and Administration Alternatives) for further analysis.

Information on required program standards, alternatives, guidelines, and regulatory limitations may be found herein. **Chapter 6** is laid out as follows:

- 6.1 Background
- 6.2 Roles and Responsibilities
- 6.3 Regulatory Context - National Noise Reduction Efforts
- 6.4 A Discussion of Measures Available
- 6.5 Measures with Airport Proprietor Implementation Authority
  - 6.5.1 Airport and Airspace Use – Use Restrictions
  - 6.5.2 Airport Infrastructure or Airport Facilities
  - 6.5.3 Land Use Measures
  - 6.5.4 Noise Program Management
- 6.6 Measures with State or Local Government Implementation Authority
- 6.7 Measures with FAA Implementation Authority
- 6.8 Summary

6.1 Background

The Part 150 regulations list the criteria that every alternative must meet to be considered for inclusion in the NCP. The regulation states that, "the airport operator shall evaluate alternative noise control actions and develop a NCP which:

a. Reduces existing non-compatible uses and prevents or reduces the probability of the establishment of additional non-compatible uses;
b. Does not impose undue burden on interstate and foreign commerce;
c. Provides for revision in accordance with the regulation;
d. Is not unjustly discriminatory;
e. Does not derogate safety or adversely affect the safe and efficient use of airspace;
f. To the extent practicable, meets both local needs and needs of the national air transportation system, considering tradeoffs between economic benefits derived from the airport and the noise impact; and
g. Can be implemented in a manner consistent with all of the powers and duties of the Administrator of FAA."

The first portion of this regulation related to reducing existing non-compatible land uses is important at JAC because, as detailed in **Chapter 5**, there are no non-compatible land uses within the 65 DNL and greater contours. Therefore, based on the definition of non-compatible land uses in Part 150, there are no non-compatible land uses at JAC. The alternatives considered in this Study are outside the scope of a Part 150 and as a result, the FAA may not be able to approve them as part of the NCP. However, this doesn't prevent JAC from implementing these measures voluntarily with the support of the FAA outside of the Part 150 process.

In addition to the program standards that each alternative must meet, Part 150 identifies a number of specific alternatives that must be considered in developing a Part 150 NCP. These *required* alternatives are:

1. Acquisition of land and interests therein, including, but not limited to air rights, easements, and development rights, to ensure the use of property for purposes which are compatible with airport operations.
2. The construction of barriers and acoustical shielding, including the soundproofing of public buildings.
3. The implementation of a preferential runway system.

4. The use of flight procedures (including the modifications of flight tracks) to control the operation of aircraft to reduce exposure of individuals (or specific noise sensitive areas) to noise in the area around the airport.
5. The implementation of any restriction on the use of the airport by any type or class of aircraft based on the noise characteristics of those aircraft. Such restrictions may include, but are not limited to—
   a) Denial of use of the airport to aircraft types or classes which do not meet Federal noise standards;
   b) Capacity limitations based on the relative noisiness of different types of aircraft;
   c) Requirement that aircraft using the airport must use noise abatement takeoff or approach procedures previously approved as safe by the FAA;
   d) Landing fees based on FAA certificated or estimated noise emission levels or on time of arrival; and
   e) Partial or complete curfews.
6. Other actions or combinations of actions which would have a beneficial noise control or abatement impact on the public.
7. Other actions recommended for analysis by the FAA for the specific airport.

Every alternative above was reviewed to determine whether it is applicable to JAC, and whether the implementation of each alternative meets the criteria requirements for alternatives set out in Part 150. Although this Study follows the Part 150 process, it is important to note that there are other federal laws and regulations that limit how/when alternatives may be implemented.

This Study also considers the requirements of the Use Agreement between JAC and the DOI (**Appendix A**). The Use Agreement contains the following noise abatement measures: Moose noise measurement location cannot exceed 55 DNL annually (**Figure 1-7**, see Site 4), Critical Area Boundary of 45 DNL within the noise sensitive areas of GTNP (**Figure 1-6**), and Aircraft single event noise limit on approach is 92 dBA.

The requirements of the Use Agreement are examined and considered as existing conditions for purposes of this preliminary alternatives discussion.

6.2 Roles and Responsibilities

Before considering the specific aircraft noise and land use measures in more detail, it is important to understand the authority various parties have in order to make a change that results in additional noise reduction. This is referred to as roles and responsibilities.

The FAA's 1976 *Noise Abatement Policy* established the following policies regarding roles and responsibilities:

> "The **Federal Government** has the authority and responsibility to control aircraft noise by the regulation of source emissions, by flight operational procedures, and by management of the air traffic control system and navigable airspace in ways that minimize noise impact on residential areas, consistent with the highest standards of safety. The federal government also provides financial and technical assistance to airport proprietors for noise reduction planning and abatement activities and, working with the private sector, conducts continuing research into noise abatement technology.
>
> **Airport Proprietors** are primarily responsible for planning and implementing actions designed to reduce the effect of noise on residents of the surrounding area. Such actions include optimal site location, improvements in airport design, noise abatement ground procedures, land acquisition, and restrictions on airport use that do not unjustly discriminate against any user, impede the federal interest in safety and management of the air navigation system, or unreasonably interfere with interstate or foreign commerce.
>
> **State and Local Governments and Planning Agencies** provide for land use planning and development, zoning, and housing regulation that will limit the uses of land near airports to purposes compatible with airport operations.
>
> The **Air Carriers** are responsible for retirement, replacement, or retrofit of older jets that do not meet federal noise level standards, and for scheduling and flying airplanes in a way that minimizes the impact of noise on people.
>
> **Air Travelers and Shippers** generally should bear the cost of noise reduction, consistent with established federal economic and environmental policy that the adverse environmental consequences of a service or product should be reflected in its price.
>
> **Residents and Prospective Residents** in areas surrounding airports should seek to understand the noise problem and what steps can be taken to minimize its effect on people. Individual and community responses to aircraft noise differ substantially and, for some individuals, a reduced level of noise may not eliminate the annoyance or irritation. Prospective residents of areas impacted by airport noise thus should be aware of the effect of noise on their quality of life and act accordingly."

For this Study, the NPS, guided by the Use Agreement, has a fundamental role in the consideration of aircraft noise exposure.

The Airport Board has a long history of studying and then implementing practicable measures that are compatible with national efforts designed to reduce aircraft noise effects on communities and areas of natural quiet, while continuing to meet the requirements of its Use Agreement with the DOI. Thus, through the conduct of this Study, the Airport Board is committed to continuing such efforts.

6.3 Regulatory Context - National Noise Reduction Efforts

The history of noise regulations is important to understanding the regulatory context for potential alternatives that can be included in a Part 150 Study. This regulatory context is broadly discussed in **Chapter 3**.

While this Study examines use restrictions as potential alternatives, a Part 161 application, analysis and FAA approval would need to occur prior to any use restrictions being implemented and only after all non-regulatory alternatives have been examined. This is important for the alternatives discussions below.

The outcome of a Part 150 NCP is intended to define a balanced and cost-effective program for reducing land uses incompatible with existing and future noise levels. The development of reasonable measures is the focus of the Part 150 noise compatibility planning process. The objective is to explore a wide range of feasible land use measures, noise control actions, and noise exposure measures, seeking optimum accommodation of both airport users and airport neighbors within acceptable safety, economic, and environmental parameters.

These feasible measures must meet all the program standards set out in Part 150, and must not conflict with regulations (see **Chapter 3** for discussion on regulations). The measures must also meet the requirements of the Use Agreement between JAC and the DOI. See **Appendix A** for the full Use Agreement and subsequent amendments.

6.4 Discussion of Measures Available

As stated above, there are a number of measures that are required to be examined under Part 150 Studies. This section contains a generalized description of potential noise abatement and mitigation measures or actions that may be considered for JAC.

A general evaluation of each measure is made based on the regulatory criteria (outlined in **Chapter 3**) that dictate what an alternative must follow to be considered for inclusion in the NCP.

To summarize these criteria, an alternative must: 1) Have the potential of resolving the problem; 2) Be implementable within acceptable economic, environmental, and social costs; and, 3) Be implementable in compliance with federal, state, and local legislation, regulations, and ordinances. Specific to JAC, the alternative must also 4) not conflict with the requirements of the Use Agreement.

Based on Part 150 requirements, the noise alternatives must be presented according to the following categories:

a. Noise abatement alternatives for which the airport operator has adequate implementation authority;
b. Noise abatement alternatives for which the requisite implementation authority is vested in a local agency or political subdivision governing body or a state agency or political subdivision governing body; and,
c. Noise abatement options for which requisite authority is vested in the FAA or other Federal agency.

However, it is important to note that these categories refer to the generalized implementation authority (identifying who is most likely to implement), and there is some overlap within measures on who can implement a measure or who plays a part in implementation. While implementation may lie with JAC, in certain cases, there might be federal regulations that regulate how an alternative is implemented and the steps required to take to implement an action. For instance, many noise actions that lie under the implementation authority for JAC are also regulated under Part 161.

Therefore, these alternatives cannot be implemented without JAC completing the steps required in Part 161 application and having it approved by the FAA. As described above, this study does not include modeling alternatives that would require a Part 161 study, because all non-regulatory alternatives must be examined first.

Additionally, under 14 CFR Part 150, the FAA must review the NCP alternatives with respect to the program standards outlined in Section B150.5 of the Part 150 regulation and approve or disapprove each measure brought forward in a formal Record of Approval to be potentially eligible for federal funding. AIP eligibility will be determined when a project is ready to be implemented.

The measures listed in **Table 6-1** are required to be addressed in a Part 150 Study. However, due to the unique conditions and considerations at JAC, many of these alternatives do not apply. Therefore, the table below includes a list of all alternatives considered in a Part 150 Study, as well as an explanation why an alternative is or is not brought forward into analysis in this Study. Further, each measure is assigned to one of three categories identifying whether the airport operator, a state/local government, or the federal government is responsible for implementing the measure if it is included in the final NCP.[1]

Those alternatives that are brought forward are examined further in **Chapter 7**, which discusses operational alternatives and **Chapter 8**, which discusses land use, facility and administrative alternatives. The alternatives that involve operational procedures (**Chapter 7**) will undergo a FAA review considering operational, safety, and airspace considerations. Alternatives that are ultimately selected may be modeled in the future NEM and included in the final NCP.

[1] The NCP refers to the final work product of the study that documents the recommended noise abatement and land use compatibility actions.

Table 6-1 - Applicability of Measures

Measures for Consideration		Implementation Authority				
		Airport	Local Jurisdictions	FAA	**Measure Carried Forward**	**Summary**
Airport & Airspace Use Restrictions	Limit Airport Access if Aircraft Do Not Meet Certain Noise Standards	◆			No	A CFR Part 161 Study can be performed, however due to existing restrictions in place at JAC and the difficulty of conducting a Part 161 process, this will not be brought forward.
	Restrictions Based on Cumulative Impact using aircraft noise levels, aircraft type, or number of operations	◆			No	JAC has an existing cumulative restriction in place. Therefore, this will not be brought forward.
	Restrictions Based on Part 36 Certified Single-Event Noise Levels	◆			No	Restricting aircraft operations based on compliance with published noise certification data generally does not meet Part 150 program standards and would put the airport in noncompliance with their grant assurances. JAC already has an aircraft single event noise limit of 92 dBA on approach; therefore, this measure will not be brought forward.
	Landing Fees Based on Noise	◆			No	The implementation of this measure, which would be to charge a landing fee based on the noise emitted by an individual aircraft, would require a Part 161 Study. It is extremely difficult to have a Part 161 application approved by the FAA. This measure will not be brought forward.
	Implementation of a Complete or Partial Curfew	◆			No	JAC has a voluntary nighttime curfew for non-emergency operations that is followed a large majority of the time. There are no scheduled commercial operations during the voluntary curfew hours; implementing a mandatory curfew would require a Part 161 Study. This measure will not be brought forward.
Airport Infrastructure or Airport Facilities	Ban All Jet Aircraft	◆			No	This measure has been documented by case law that it is not legally possible, putting undue burden on interstate commerce and is a discriminatory regulation that violates the tenets of the U.S. Constitution. This measure will not be brought forward.
	Restrict Touch and Go Operations	◆			No	Touch and go operations are aircraft that operate landings and takeoffs in a series in the airport environment. This measure may not be legal as it can limit access or be considered a capacity restriction. This measure will not be brought forward.
	Noise Barriers	◆			No	At JAC, there are no substantial run-ups or other substantial ground related noise that would require this type of mitigation. This measure will not be brought forward.
	Construct a New Runway in a Different Orientation	◆			No	Runway orientation is based on many factors, primary among this is orientation to the prevailing winds, which is the case at JAC. Based on limited available area and the terms of the Use Agreement, a new runway is not feasible. This measure will not be brought forward.
	Runway Extension	◆			No	Based on the limited available area at JAC as well as the terms of the Use Agreement, a runway extension is not feasible without an amendment; therefore, this alternative is not considered further in this Study.
	High-Speed Taxiway Exits	◆			No	A high-speed taxiway is angled, providing the ability to exit the runway more quickly and reduce use of reverse thrust, therefore reducing noise. While this can be useful, based on the single runway configuration and limited runway length at JAC, high-speed taxiways are not feasible; therefore, this alternative is not considered further in this Study.

Land Use Measures	Acquisition of Land or Interest Therein	◆			No	Land use measures related to aircraft noise at airports can include purchasing noise-impacted properties, purchasing an easement from the property owner (effectively purchasing the right to create noise), or sound attenuating a home within the 65 DNL and higher noise contours. There are no non-compatible land uses with the 65 DNL. These acquisition and insulation alternatives are not considered further.
	Noise Monitoring Program	◆			Yes, Chapter 8	JAC has a permanent noise monitoring system in place, connected to a radar system that meets the FAA's requirements for a noise system installed using FAA funding. Potential updates to the noise monitoring system are included in **Chapter 8**.
	Land Use Controls		◆		Yes, Chapter 8	Most airport operators, including JAC, do not have land use control over the land use development around airport, as the lands are owned by other jurisdictions. However, there are many measures local jurisdictions can use to improve the compatibility of land uses around an airport including: zoning, easements, transfer of development rights, building code modifications, Capital Improvement Plan, subdivision regulations, and comprehensive planning. These alternatives are examined further in **Chapter 8**.
Operational Measures	Departure Thrust Cutback			◆	No	Aircraft that perform a departure thrust cutback use the application of thrust cutbacks at various stages of the take-off; use of this procedure is dependent on the type of land uses around the airport. The FAA defines two types of noise abatement departure profiles, one that reduces noise close in to the airport, and one that reduces noise further from the airport. There are no recommendations for reduced departure thrust because the airport has a short runway at high altitude where these types of reduced thrust departure measures are not practical.
	Designated Noise Abatement Take-Off/Approach Paths			◆	Yes, Chapter 7	This measure would result in the designation of arrival and/or departure paths that minimize overflights of noise-sensitive land uses. JAC has existing noise abatement procedures. This measure for noise abatement flight tracks are considered in the operational alternatives chapter as part of the required navigation performance (RNP) procedures.
	NextGen: Performance Based Navigation (PBN) Required Navigation Performance (RNP)			◆	Yes, Chapter 7	The FAA is upgrading the airspace and the associated tools aircraft use for navigation, including transitioning from ground-based navigation to satellite-based navigation. Procedures that use RNP technology are considered in the **Chapter 7**.
	Preferential Runway Use System			◆	No	JAC has published preferential noise abatement procedures that designate preferred arrival and departure runways. Because JAC has successfully implemented arrival and departure runways for noise abatement, this alternative is not considered further.
	Power and Flap Settings			◆	Yes, Chapter 7	Aircraft on approach generate noise from the landing gear and flaps being extended and these surfaces coming into contact with the air. As part of the RNP alternatives, reduced or delayed deployment of flaps and landing gear is integral to their design As part of all the approach procedure alternatives, the proposed approach paths will be designed to optimize minimization or delayed deployment of flaps, landing gear, and thrust. The optimized vertical flight path is a key element in the design to provide for more efficient approaches in terms of minimizing noise, emissions, and fuel consumption. This alternative is addressed as part of the other RNP procedures in **Chapter 7**.

6.5 Summary

The potential measures presented in this chapter are general in nature and provide a broad perspective of actions that could be recommended for further study and implementation and those actions that would have regulatory or other limitations. Those alternatives noted in this chapter are discussed further, along with additional alternatives, in **Chapter 7** (operational alternatives) and **Chapter 8** (land use alternatives).

JACKSON HOLE AIRPORT
CFR Part 150 Study

7
Analysis of Noise Abatement Alternatives

Chapter 7 - Analysis of Operational Noise Abatement Alternatives

INTRODUCTION. This chapter summarizes the potential operational noise abatement alternatives identified with the Study Input Committee and considered for detailed analysis in this Study. For the purposes of Part 150 Studies, alternatives involving arrival or departure procedures are included in this chapter. (Note: land use alternatives and administrative alternatives are evaluated in **Chapter 8**). The noise abatement alternatives are divided into arrivals and departures for jet aircraft with separate procedures for general aviation aircraft. According to Part 150 guidelines, there are no non-compatible land uses within the 65 DNL noise contour at JAC, meaning that no noise abatement alternatives would be eligible for federal funding as a result of this Study. However, while these noise abatement alternatives are outside of the Part 150 process, they are evaluated to identify opportunities to reduce noise outside the 65 DNL noise contour to meet the terms of the Use Agreement and identify ways to reduce noise within the GTNP.

Though the alternatives include potential navigation technologies to develop a noise abatement flight path, the goal is to develop an alternative flight path(to mitigate for noise); the goal is not specific to the technology that is included. The exact navigation technology that a procedure may be based on is dependant on the operator (general aviation vs. commercial), as well as the time period for potential implementation of the procedure. This Study evaluates desired flight paths for noise abatement, not a specific type of navigation procedure.

Since this Study has a five-year planning horizon, the analysis is not limited to the technology and criteria that is approved for use today, but it also includes what may be reasonably available within the planning horizon. The future year analysis assumes the potential use of a procedure based upon the level of equipage in the 2020 study year time frame.

The alternatives presented in this chapter provide a DNL contour analysis out to the 65 DNL, as the 65 DNL contour is the threshold contour for determining land use compatibility per the 14 CFR Part 150 land use guidelines. Because the alternatives described in this chapter do not show a substantial difference at the 65 DNL, which is contained within Airport property, **Appendix D** provides a DNL contour analysis out to the 45 DNL contour, illustrating the greater intended purpose of each alternative. Since the

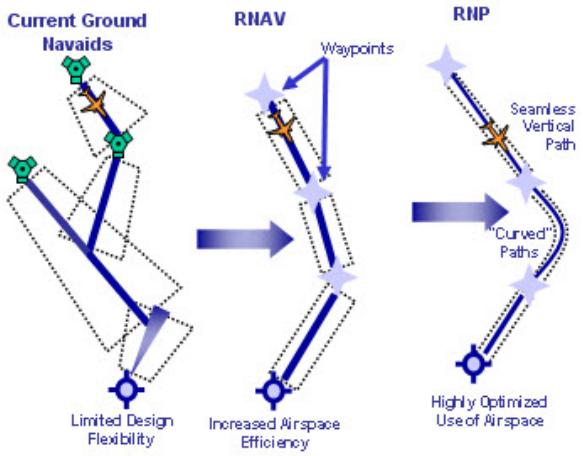
65 DNL is the contour for determining whether a measure is approvable under Part 150, this chapter addresses only alternatives within the 65 DNL. As a result, the FAA may not be able to approve them as part of the NCP. This does not prevent JAC from implementing these measures voluntarily with the support of the FAA outside of the Part 150 process.

7.1 Navigation Terminology

In aviation, acronyms are commonly used in place of long or complex names of procedures or technology. This study includes a glossary with each acronym spelled out and defined (see Table of Contents, p. viii). The following list comprises acronyms associated with NextGen navigation technologies that could potentially be applied to the noise abatement alternatives in the next section. NextGen is a set of improvements to modernize the United States air traffic system's technology, infrastructure, policies, procedures and training. NextGen will allow aircraft to navigate using satellite technology instead of relying on ground-based navigational aids.

Performance Based Navigation (PBN), Area Navigation (RNAV) & Required Navigation Performance (RNP): One of the opportunities NextGen offers is Performance Based Navigation (PBN), which allows more efficient use of airspace through point-to-point navigation, rather than restricting flight paths between ground-based radio navigation systems. PBN procedures consist of RNAV and RNP. The FAA's strategy for implementing PBN is to provide "RNAV Everywhere and RNP Where Beneficial." All RNAV and RNP approach and departure procedures rely on satellite-based navigation, breaking free of the dependency on ground-based navigation aids. PBN enables procedure designers to maximize efficient use of the airspace, altering the traditional flight paths around an airport. **Figure 7-1** shows the change between ground-based navigation aids and RNAV/RNP procedures, and highlights the difference between current point-to-point navigation and new, more flexible, PBN navigation. RNAV can be used for arrivals and departures. RNP is primarily used for arrivals.

Figure 7-1 - PBN Navigation



Source: Federal Aviation Administration

Wide Area Augmentation System (WAAS): The Wide Area Augmentation System (WAAS) provides general aviation pilots with RNAV capabilities that, in many cases, rival or exceed what is available for commercial aircraft. WAAS enables vertically guided approach procedures to any qualifying airport in most of North America with minimums as low as 200 feet decision altitude (DA), without the need to install costly Instrument Landing System (ILS) equipment. These minimums can be lower than other conventional based navigation aide (NAVAID) approaches. When rising terrain is an issue near an airport, precise vertical guidance enhances safety regardless of visibility and whether the approach is being flown during the day or at night.

Localizer Performance with Vertical Guidance LPV: Localizer Performance with Vertical Guidance (LPV) is a precision approach with WAAS for both vertical and lateral guidance. Lateral sensitivity increases as an aircraft gets closer to the runway. More than 6,000 LPV are currently in place at airports around the U.S. They have similar landing minimum capabilities to ILSs.

Localizer Performance without Vertical Guidance LP: Localizer Performance without Vertical Guidance (LP) is a non-precision approach with WAAS lateral guidance. LPs are added in locations where terrain or obstructions do not allow publication of vertically guided LPV procedures. Lateral sensitivity increases as an aircraft gets closer to the runway. Unlike an ILS, LP is not a fail-down system.

While flying an ILS, if the glideslope goes out of service, the pilot can continue the approach using just the localizer and switching from descent to a Decision Height (DH) to the higher Minimum Descent Altitude (MDA). LPV does not have the feature to fail down to the LP (localizer equivalent). LP and LPV are independent procedures.

Charted RNAV Visual: A charted RNAV visual procedure is a visual flight procedure that uses GPS waypoints for navigation. These procedures are only flown in visual flight conditions. A conventional Charted Visual procedure would be a guide to follow landmarks, such as following the river or turning south of the water tower. A Charted RNAV visual uses GPS waypoints instead, which can create very precise paths at the exact location of interest.

Ground Based Augmentation System (GBAS): A GBAS improves the accuracy of an aircraft's GPS and provides an alternative to a traditional ILS to provide approach and departure operations. JAC maintains a GBAS on site.

Optimized RNAV Standard Terminal Arrival Route (STAR): An optimized RNAV Standard Terminal Arrival Route (STAR) is an arrival procedure using RNAV navigation. This provides for a more precise point to point navigation that is independent of any ground-based navigation. Optimized refers to arrival altitudes for the waypoint that allows the aircraft to fly a more efficient optimized profile descent.

Optimized RNAV Standard Instrument Departure (SID): An optimized RNAV Standard Instrument Departure (SID) is a departure procedure using RNAV navigation. This provides for a more precise point-to-point navigation that is independent of any ground-based navigation. Optimized refers to departure altitudes for the waypoint that allows aircraft to climb out more efficiently without the need to hold the aircraft down for level flight segments. Aircraft on departure are at times "climb restricted," which means they can climb to a certain altitude and must remain at level flight at that altitude until allowed to climb higher or cleared to resume the charted navigation.

Airline/Airport Charted Specials: A Charted Special is a procedure that an airline, fractional operator, or airport publishes. Typically, an airline will create a procedure in-house for use by their pilots that is not publicly available. Large fractional corporate jet operations, such as NetJets, will also have Charted Specials. Charted Specials are typically used during visual conditions that allow use of local landmarks or terrain for guidance. This study assumes that they would be developed using GPS.

Non-Charted Waypoint Information: An airline, aircraft operator, or general aviation pilot can input waypoints to its flight management system to fly to a desired point. These waypoints are not part of a published procedure. The non-charted waypoints information provides a method to have small, general aviation aircraft fly NextGen procedures without highly sophisticated avionics.

7.2 Alternatives Considered

Table 7-1 summarizes the effects of the alternatives analyzed by comparing the affected population and housing units for each alternative to the future base case noise contours (DNL noise contours for the year 2020 based on forecast operations).

The procedural alternatives involve using a mix of ground and satellite-based technology. The satellite-based technology, commonly known as NextGen, allows aircraft to fly more precise paths and repeatable tracks over areas of compatible land use. Since the Study has a five-year planning horizon, it includes technology that has a reasonable chance of being available within the planning horizon. The future year analysis will also factor in the potential level of equipage in the general aviation and commercial fleet.

While there is no specific alternative related to modified or reduced thrust or reduced flaps, many of the alternatives require lower thrust because of the optimized nature of the procedure. Procedures such as RNP and RNAV STARS are designed so that minimum thrust is required. These procedures provide for a stabilized path that result in minimum thrust and reduced flaps.

Table 7-1 - Alternatives: Population and Housing Unit Comparison 65 DNL

Land Use	Base Case (2020)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
65 DNL Contours								
National Park	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Airport	131.0	131.0	131.0	131.4	132.3	132.4	131.0	131.0
Residential Acres	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Persons	0	0	0	0	0	0	0	0
Housing Units	0	0	0	0	0	0	0	0
Residential Vacant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agricultural	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Land Use Acres 65 DNL	131.0	131.0	131.0	131.4	132.3	132.4	131.0	131.0

Source: Existing Land Use, 2010 Census Data and Aerial Photography, Mead & Hunt Analysis.
Note: Acres rounded to the nearest tenth
U.S. Census data, 2010 2.34 individuals per household.
Airport property is the area that is leased from the National Park and is located within GTNP.

7.2.1 Alternative A1 - RNP-AR Arrival Procedure for Runway 19

NOISE ABATEMENT PROCEDURE GOAL. The goal of this alternative is to create a procedure that shifts arrival aircraft away from the Critical Area Boundary, to the east and south. This alternative further enhances noise abatement flight tracks for arriving aircraft when landing on Runway 19 by building upon the satellite-based procedures that were adopted in the past three years. This alternative would use a curved arrival path that would keep aircraft east and south of the Snake River and Highway 89, minimizing flying over the core of the park. Given that there are sensitive park areas around JAC, it is not possible to entirely avoid over-flying the park, but it is possible to minimize operations over the area west of the Snake River. These aircraft would not fly as far to the north as they do today. This alternative would reduce overflights over the central area of the Snake River.

CURRENT PROCEDURE. Aircraft, on approach to JAC, fly arrivals using published instrument approach procedure (IAP) or a visual non-published landing. There are four types of instrument approaches to Runway 19 that are used in all weather conditions and visual flight paths that are used only in good weather conditions:

- ***Historic/Conventional:*** The ILS Y procedure is a straight-in approach using the ground-based ILS. This procedure flies over the core of the park straight in from Jackson Lake and is used primarily during poor weather.
- ***Updated Conventional, 2013:*** The ILS Z procedure is an ILS approach with a close-in transition where aircraft use the ILS and then transition a GPS-based point-to-point path that flies straight in to JAC at a point eight miles from JAC. This is a point-to-point procedure resembling a curved path and is used during poor or good weather.
- ***Satellite-Based:*** The RNAV (RNP) Y procedure is an all satellite-based approach that uses advanced technology to guide aircraft on a point-to-point path that resembles a curved path and does not use ground-based navigational aids; it is used during good or poor weather and will be used by equipped commercial aircraft. It follows the same basic flight path as the ILS with a close-in transition.

- ***LPV:*** The RNAV (GPS) Z procedure is a GPS-based approach used to guide aircraft on a point-to-point path that resembles a curved path and does not use ground-based navigational aids; it is used during poor or good weather by general aviation aircraft. The RNAV RNP and RNAV GPS procedures follow the same ground track. The RNAV GPS procedure follows the same basic flight path as the ILS with a close-in transition.
- ***Visual:*** A large segment of the operations fly a path under visual conditions. There is a wide variety of paths that are generally from the south flying around Blacktail Butte or from the east, flying east of the primary instrument approach procedures.

Figure 7-2a shows existing jet flight tracks of aircraft arrivals on Runway 19 during all weather conditions.

PROPOSED ALTERNATIVE. This alternative evaluates three new arrival path transitions for aircraft landing on Runway 19 that are based upon RNP-AR navigation. RNP-AR allows aircraft to fly a more precise flight path with curved flight segments that can precisely follow desired noise abatement paths. These flight paths are designed to be flown in both visual and poor weather conditions. Generally, over the south end of the Snake River, the path is roughly the same. The central area of the Snake River will have fewer overflights and the north end of the Snake River would have even fewer overflights. The three new arrival paths are listed below and reflect different common locations from which aircraft fly. **Figure 7-2b** shows Alternative A1 with the three transitions.

1. Curved path flight with transition from the south around Blacktail Butte for arrivals from Salt Lake City,
2. Curved path flight with transition from the southeast around Blacktail Butte for arrivals from Denver, and
3. Curved path flight with transition from the northeast flying further to the east than the current instrument procedure, for arrivals from the east.

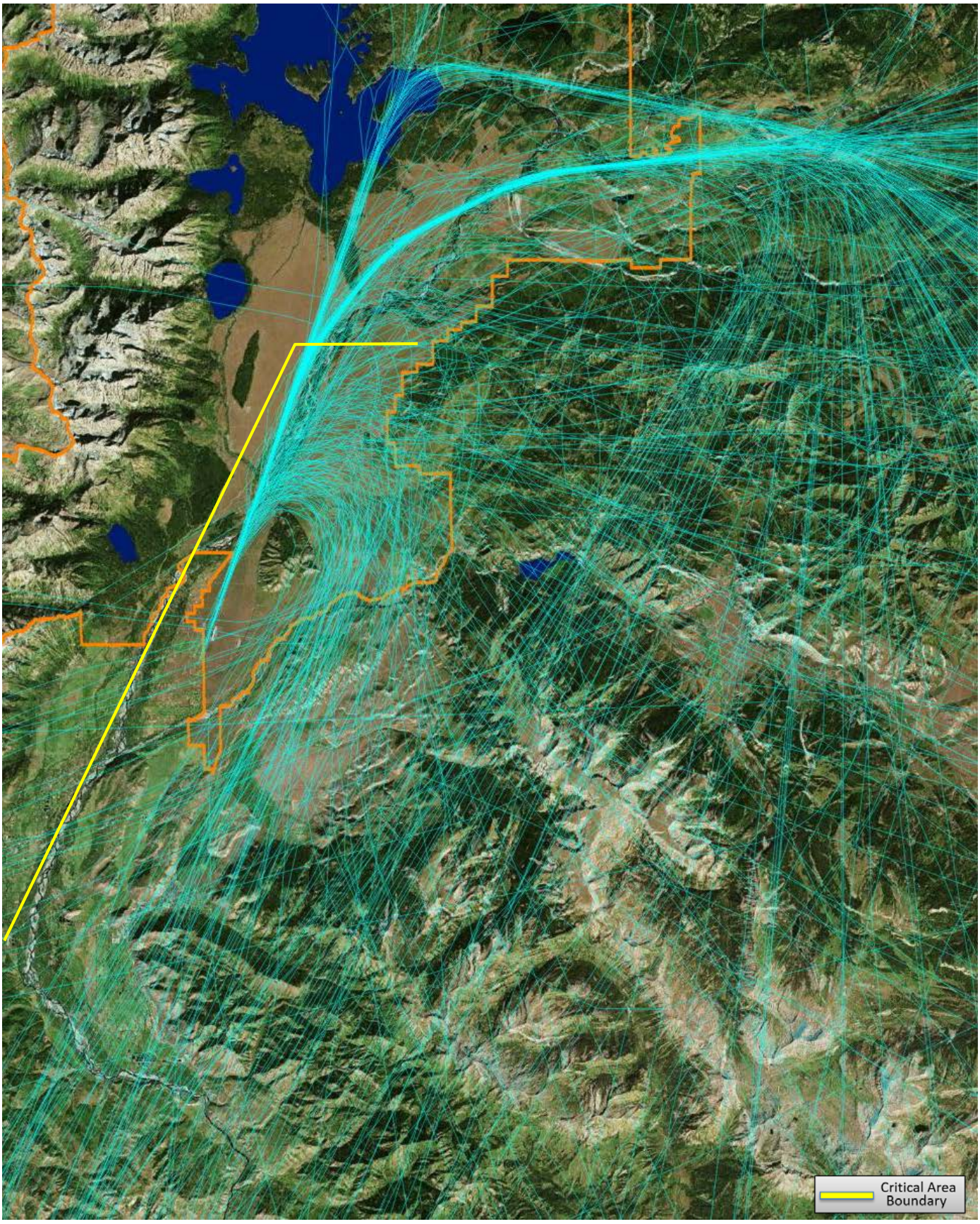
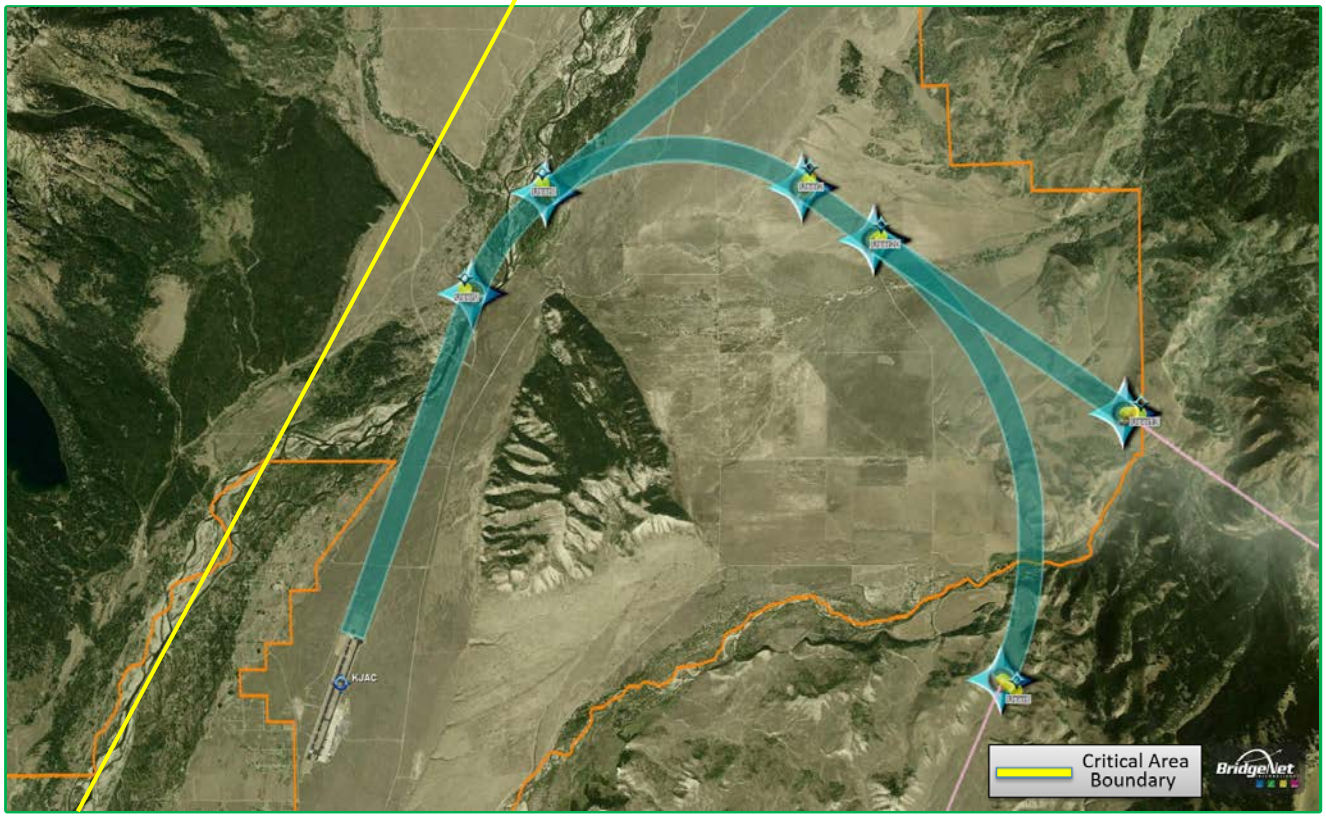


Figure 7-2a

Alternative A1 – Existing Jet Arrival Flight Tracks
Runway 19 (all weather conditions)



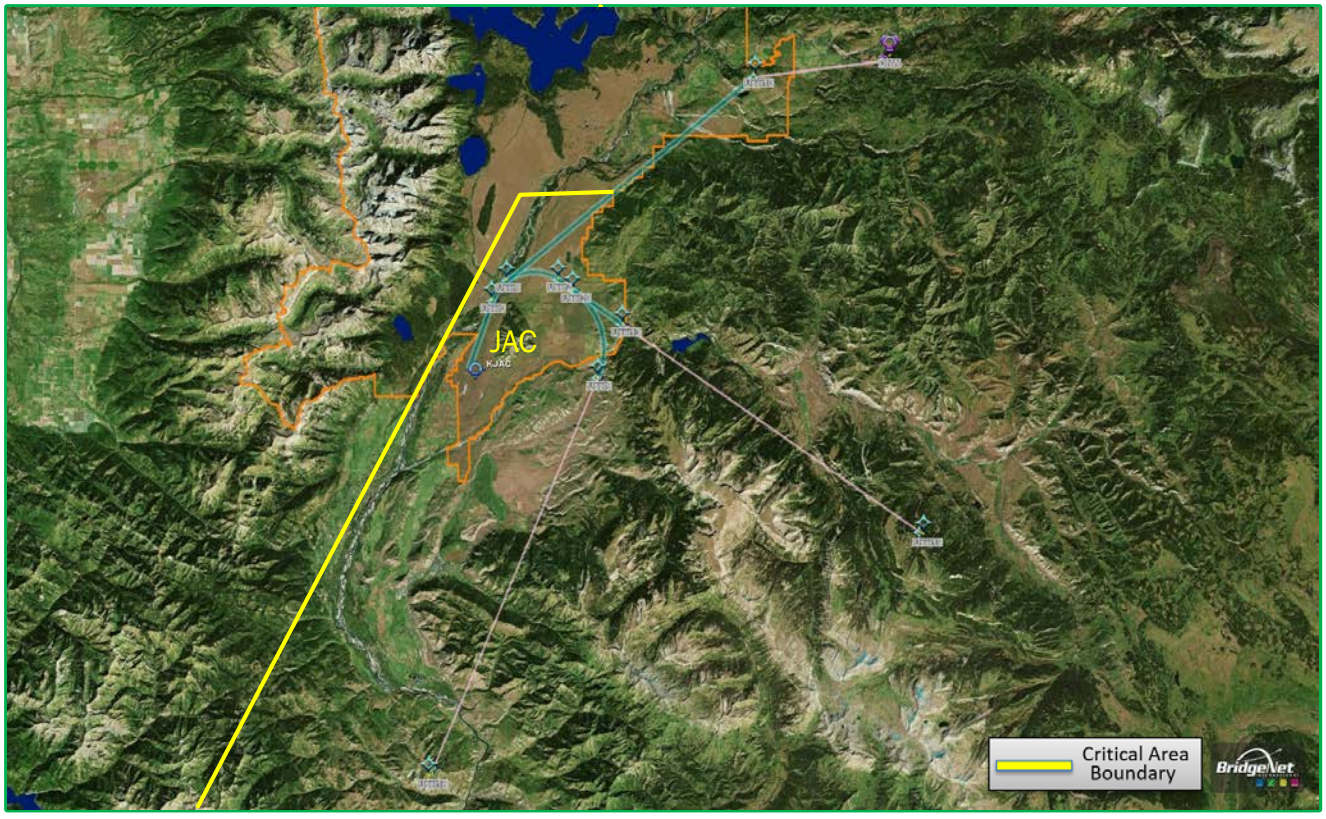


Figure 7-2b

Alternative A1 – RNP-AR Arrival Procedures for Runway 19

7.2.1.1 Modeling Assumptions for New Procedure.

This noise abatement path can be implemented using RNP-AR. The AR stands for "Authorization Required," which means the aircraft, operator, and pilot must be equipped and authorized to fly the procedure. RNP-AR would be flown primarily by commercial carriers. Currently, the Boeing fleet of commercial aircraft that fly into JAC are RNP capable. The Airbus aircraft are equipped, but the airlines have not exercised the option to use it on these aircraft. It is assumed that 100% of the commercial fleet would be RNP capable by 2020. However, it is conservatively estimated that 50% of the commercial traffic at JAC will fly the procedure. RNP-AR procedures can't be flown in all conditions; limitations include weather that is below the procedure minimums and higher traffic periods. Given that RNP-AR procedures provide enhanced safety and a more stable landing that is more efficient, the consultant team assumed it could be used by pilots as much as weather and traffic permit. Regional jets have not currently adopted the technology while business jets have a very small percentage of the fleet that is equipped.

The assumptions for the percentage of aircraft equipped to fly these procedures is shown in **Table 7-2**. The 2020 conditions include aircraft that fly the published RNP-AR procedure, which would be used during visual and instrument meteorological conditions.

Table 7-2 - Alternative A1 – RNP-AR Usage, Future Year 2020

Aircraft Category	Percent of RWY 19 Arrivals Using RNP
COMMERCIAL JET	50%
REGIONAL JET	0%
BUSINESS JET	0%
COMMUTER PROPELLER	0%
GENERAL AVIATION PROPELLER	0%

Source: BridgeNet International

7.2.1.2 Analysis of New Procedure.

DNL NOISE ANALYSIS. The average annual DNL noise contours for the future 2020 time-period for Alternative A1 were compared to the base case 2020 noise contours (**Figure 7-2c**). For comparative purposes this figure also presents the baseline 2020 DNL noise contours.

Table 7-1 summarizes the noise changes resulting from this alternative on population and housing within the 65 DNL and greater noise exposure contours in comparison with the 2020 base case. As this table notes, this alternative would not increase or decrease overall population exposed to 65 DNL, relative to the 2020 base case. The population and park acreages within the 65 DNL contour are both zero, which is the same as the base case.

COMPLIANCE WITH USE AGREEMENT: This alternative would not result in a violation of the noise limits contained in the Use Agreement.

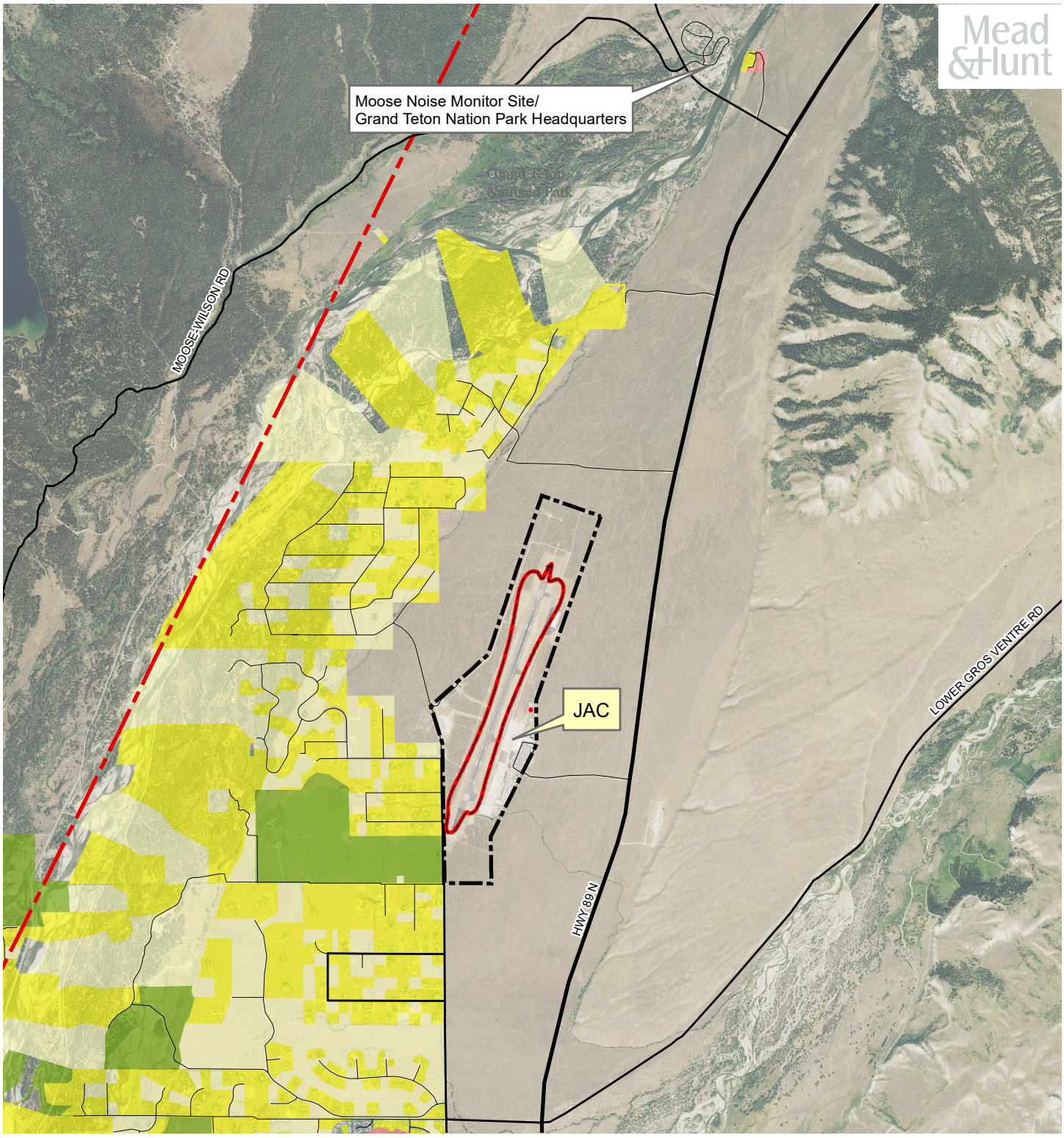
SUPPLEMENTAL NOISE ANALYSIS. The change in noise from this alternative on the supplemental metrics used in this study can be found in **Appendix D**.

OTHER ISSUES. The following issues could result from implementation of this alternative. Also, the agencies are identified that would have a role in assisting in the implementation of this alternative.

- ***Airport and Air Traffic Control Operational Considerations (safety and efficiency issues):*** The FAA has ultimate responsibility for the control of aircraft flight. ATC would need to evaluate this alternative to ensure proper altitudes and separation for aircraft arriving and departing in the valley.

- ***Other Environmental Issues (NEPA, etc.):*** Implementation of noise abatement flight procedures requires compliance with the NEPA. This procedure could reduce fuel and the associated emissions with a more direct and optimized flight path.

- ***Barriers to Implementation:*** The rate that commercial airlines will equip their aircraft to be RNP-AR capable is uncertain. At the time of this study, RNP-AR is a costly technology to install and involves training crews. Commercial airlines are adopting this technology at a measured pace; regional jets and business jets are not adopting this technology at the same rate. With the improved efficiency and stability of these procedures, commercial airlines would have an incentive to use these procedures if they were implemented.



Aerial Souce: 2012 NAIP WY039

N

0 2,000 4,000 8,000 Feet

Noise Contour Legend

DNL_65 | 2020 Base Case Contours | Critical Boundary Area

Generalized Land Use (Teton County GIS)

Residential | Commercial | Airport Property

Res Vacant Land | Agricultural

FIGURE 7-2c

Alternative A1
2020 DNL Noise Contours

7.2.2 Alternative A2 - Charted Visual RNAV/Company Special RNAV Arrival Procedure (Runway 19)

NOISE ABATEMENT PROCEDURE GOAL. The goal of this alternative is to create a procedure that further enhances noise abatement options for arriving aircraft when landing on Runway 19 in visual conditions. Similar to Alternative A1, this alternative would use a curved arrival path that would keep aircraft east of the Snake River and Highway 89 and minimize flying over or near the Critical Area Boundary and the Snake River (See **Figure 7-3b**). Given that there are sensitive park areas around JAC, it is not possible to entirely avoid overflying the park, but it is possible to minimize operations over and west of the Snake River. This includes a path for aircraft arriving from the south to fly around Blacktail Butte. These aircraft would not fly as far to the north as they do today. This alternative would reduce overflights over the central area of the Snake River. As part of Alternative A2, a notional procedure would be created that would be distributed to airlines that operate at JAC. The airlines would be responsible for the ultimate procedure design and implementation within their fleet. Airlines commonly have special procedures for mountainous airports such as JAC that use conventional navigation. This alternative proposes to encourage airlines to update those procedures to be satellite-based procedures.

CURRENT PROCEDURE. During visual meteorological conditions (VMC) aircraft use radar vector headings issued to pilots by ATC and use local ground-based landmarks as guides for navigation. JAC is in VMC approximately 80% of the time. Aircraft land, using a visual approach, approximately 40% of the time. Note that even in visual weather conditions, aircraft will often fly one of the instrument procedures. **Figure 7-3a** shows existing flight tracks during visual conditions. The new proposed procedures are roughly overlays of these existing visual procedures.

PROPOSED ALTERNATIVE CHANGE. This alternative would create a new procedure that would follow a similar path to today's visual path used during good weather using a Charted Visual RNAV or Company Special RNAV. For purposes of this alternative, Charted Visual RNAV and Company Special RNAV are used interchangeably. The procedure would have the same transitional areas and follow the same general paths as Alternative A1 for the three most common arrival regions; Salt Lake City to the south, Denver to the southeast, and Chicago to the east.

Figure 7-3b graphically shows Alternative A2 with the three transitions as described below:

1. Curved path flight with transition from the south around Blacktail Butte for arrivals from Salt Lake City,
2. Curved path flight with transition from the southeast around Blacktail Butte for arrivals from Denver, and
3. Curved path flight with transition from the northeast flying further to the east than the current instrument procedure, for arrivals from the east.

Alternative A2 uses RNAV technology, which has been widely adopted by commercial, business jet, and general aviation sectors. The difference between Alternative A1 and Alternative A2 is that RNAV criteria aren't as restrictive as RNP-AR; aircraft using the Charted Visual will have a slightly larger dispersion of flights and have more flexibility closer to JAC. For example, Alternative A2 can be farther to the east closer in to JAC than Alternative A1, shifting noise away from the Moose noise monitor site and park headquarters area.

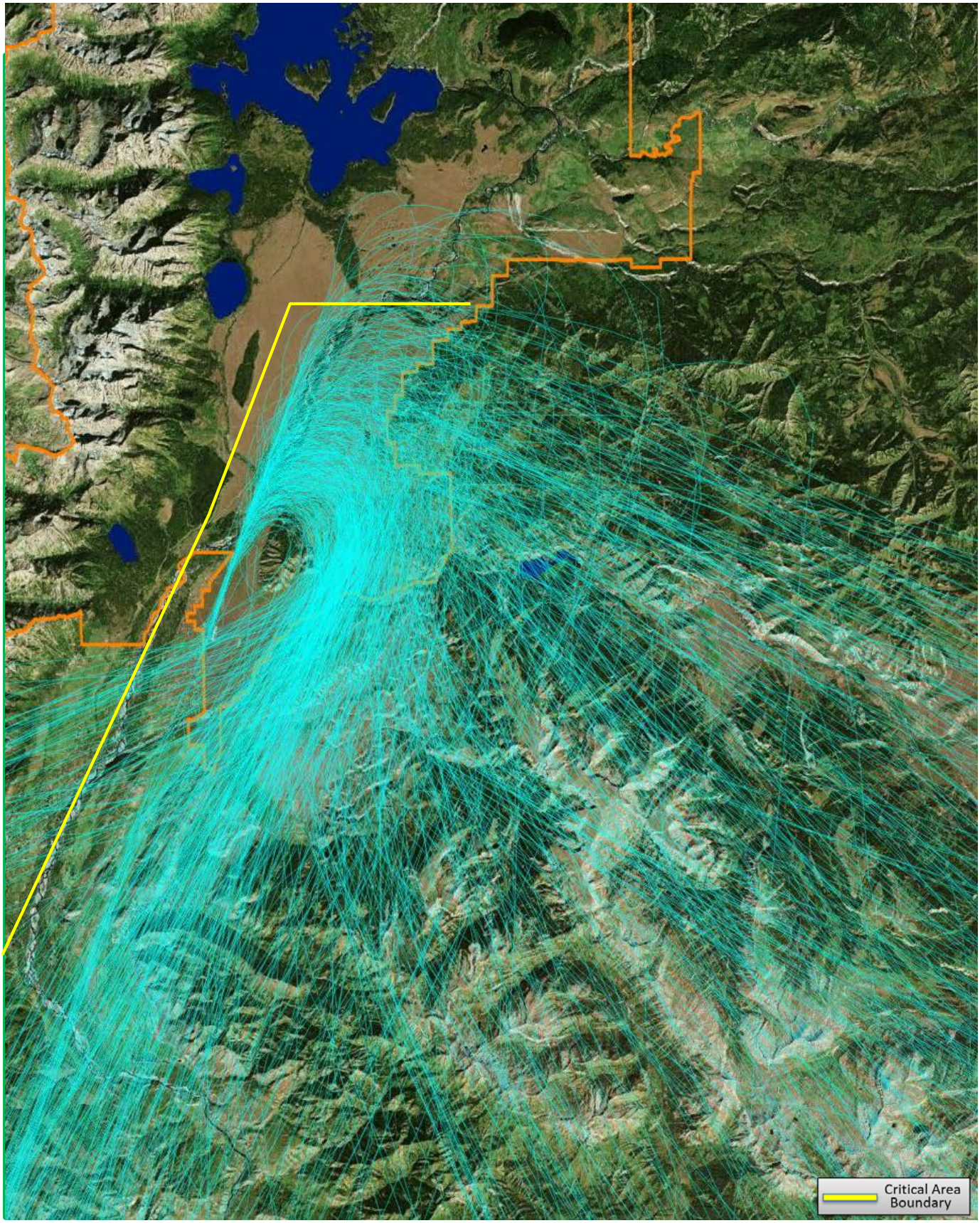
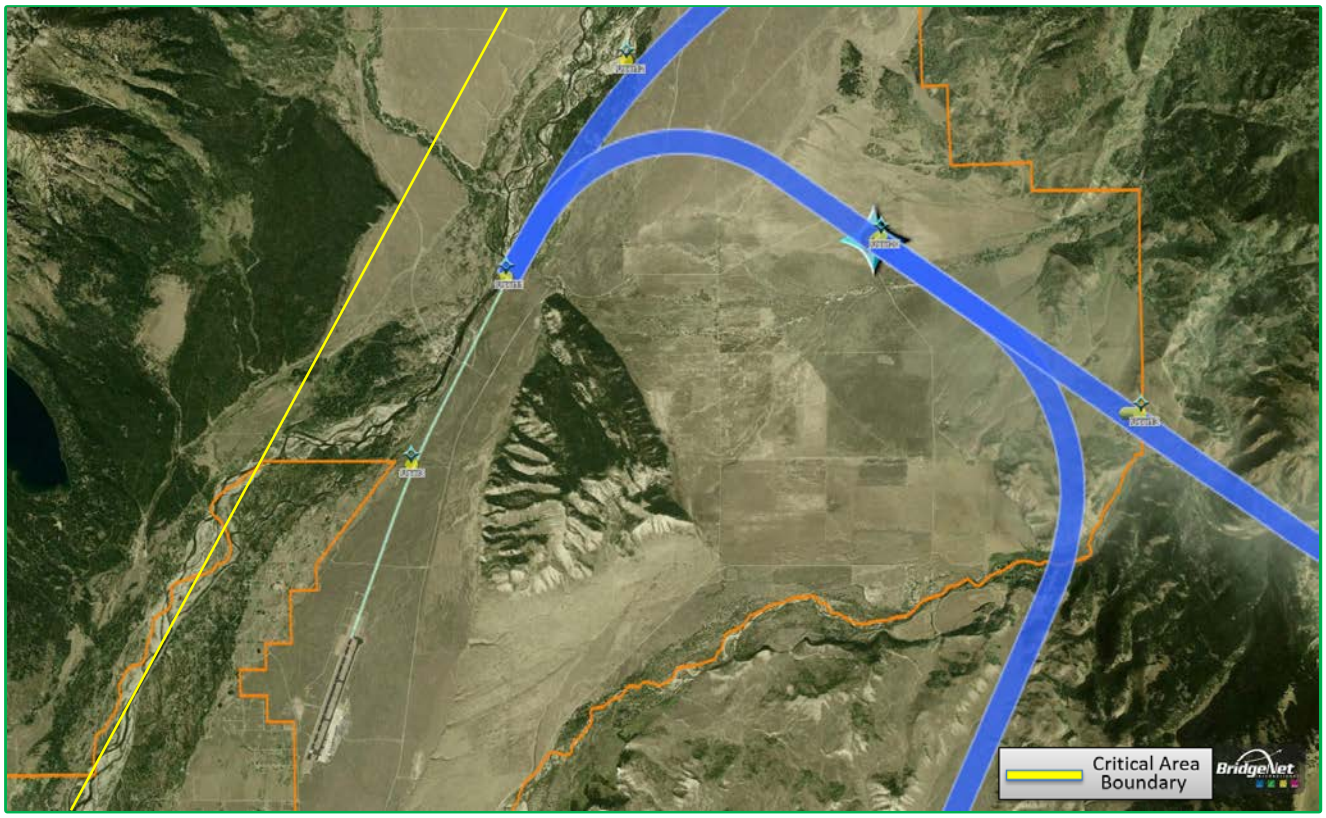


Figure 7-3a

Alternative A2 – Existing Jet Arrival Flight Tracks Runway 19 (Visual Conditions)



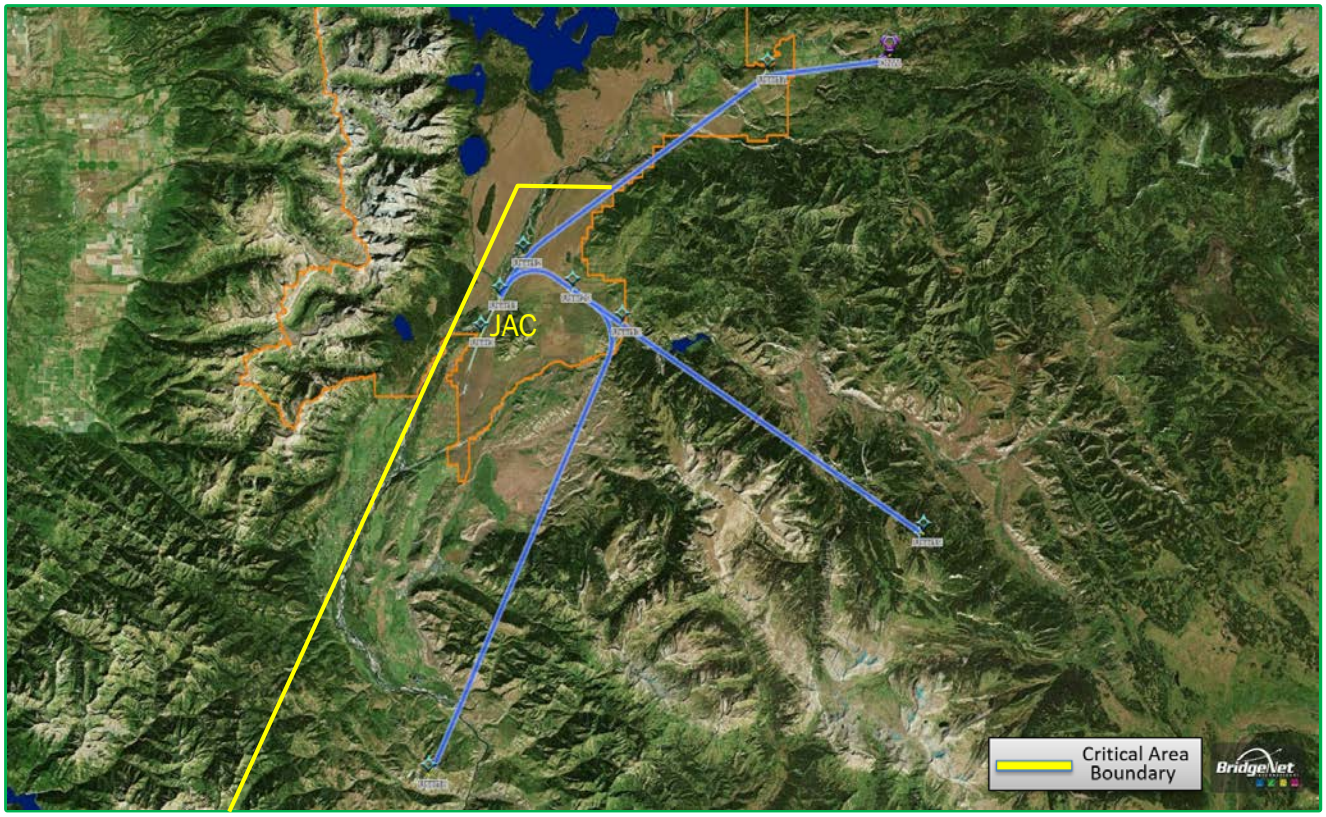


Figure 7-3b

Alternative A2 – Charted Visual RNAV/Special RNAV Arrival Procedures (Rwy 19)

7.2.2.1 Modeling Assumptions for New Procedure.

The three transition areas for Alternative A2 are in the same general location as Alternative A1. Each of the three procedures from the south, southeast, and east will approach JAC in a similar manner from different locations. The new paths generally keep aircraft further to the southern end of the GTNP. Over the south end of the Snake River, the path is roughly the same. The central area of the Snake River will have fewer over fights, and the north end of the Snake River will have even fewer.

This noise abatement path can be implemented using RNAV. The majority of high performance aircraft using JAC today are equipped to fly RNAV (commercial aircraft, business jets and high-performance piston). It can be flown by all classes of aircraft, but would be flown primarily by commercial carriers and business jets. It is estimated that at least 95% of the commercial and business jet traffic at JAC are equipped and can fly the procedure. The charted visual could be flown by nearly every high-performance aircraft that currently flies into JAC (commercial, corporate jet, and high-performance propeller).

The assumptions for the percentage of aircraft that would fly these procedures are shown in **Table 7-3**. The analysis assumes 40% of the arrivals of jet and large turbo-prop aircraft on Runway 19 will use the new procedures. This procedure is weather dependent and is designed to be used during VMC. Based on historic weather data, JAC operates in VMC approximately 80% of the time. It is assumed that the procedure would be flown half of that time.

Table 7-3 - Alternative A2 – Procedure Use, Runway 19 RNAV Arrivals

Aircraft Category	Percent of RWY 19 Arrivals Using RNAV
COMMERCIAL JET	40%
REGIONAL JET	40%
BUSINESS JET	40%
COMMUTER PROPELLER	40%
GENERAL AVIATION PROPELLER	0%

Source: BridgeNet International.

7.2.2.2 Analysis of New Procedure.

DNL NOISE ANALYSIS. The average annual DNL noise contours for the future 2020 time period that is associated with Alternative A2 were compared to the base case 2020 noise contours (**Figure 7-3c**). Noise contours for the 65 DNL noise levels were generated. For comparative purposes this figure also presents the base case 2020 DNL noise contours.

This alternative does not change the population or the park acreages within the 65 DNL; the population and park acreages within the 65 DNL contour are both zero, which is the same as the base case.

COMPLIANCE WITH USE AGREEMENT: This alternative would not result in a violation of the noise limits contained in the Use Agreement.

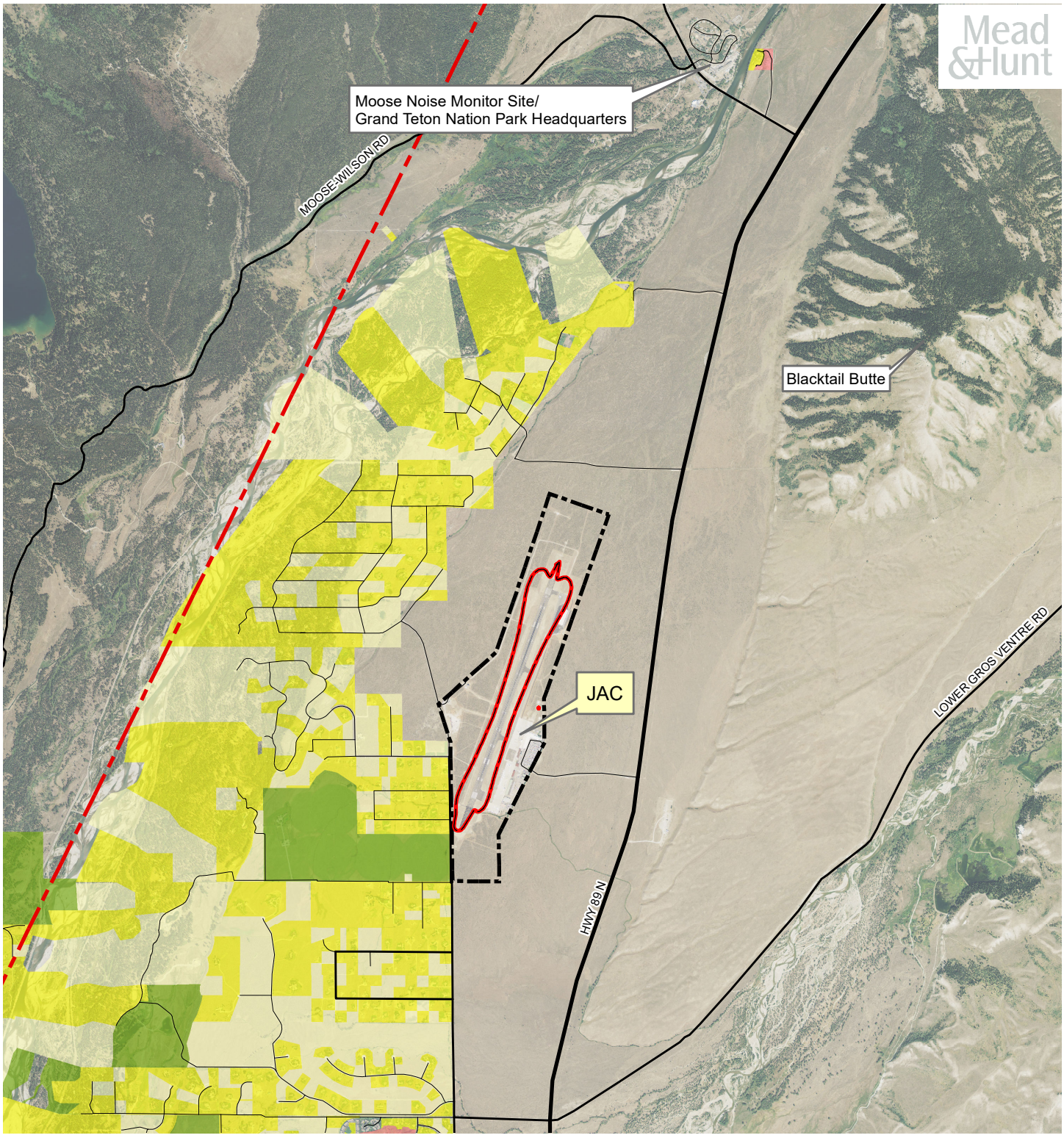
SUPPLEMENTAL NOISE ANALYSIS. The change in noise from this alternative on the supplemental metrics used in this study can be found in **Appendix D**.

OTHER ISSUES. The following issues could result from implementation of the alternative. Also, the agencies are identified that would have a role in assisting in the implementation of this alternative.

- ***Airport and Air Traffic Control Operational Considerations (safety and efficiency issues):*** The FAA has ultimate responsibility for the safe, orderly and expeditious flow of air traffic. ATC would need to evaluate this alternative to ensure proper altitudes and separation for aircraft arriving and departing in the valley.

- ***Other Environmental Issues (NEPA, etc.):*** Implementation of noise abatement flight procedures requires compliance with NEPA. This procedure could reduce fuel burn and the associated emissions with a more direct and optimized flight path.

Barriers to Implementation: Nearly all commercial, regional and corporate jet aircraft are equipped to fly RNAV procedures. At time of this study, the FAA is not supporting the development of Charted Visual procedures. Many airports and operators are proposing that such procedures be available for implementation because they are valuable for improving safety, access and noise. It is expected that this would happen within the time frame of this study.



Aerial Souce: 2012 NAIP WY039

N

0 2,000 4,000 8,000 Feet

Noise Contour Legend

DNL_65 | 2020 Base Case Contours | Critical Boundary Area

Generalized Land Use (Teton County GIS)

Residential | Commercial | AirportProperty

Res Vacant Land | Agricultural

FIGURE 7-3c

Alternative A2
2020 DNL Noise Contours

7.2.3 Alternative A3 - Increased Use of Runway 01 for Arrivals

NOISE ABATEMENT PROCEDURE GOAL. The goal of this alternative is to increase use of Runway 01 for arrivals as part of JAC's existing noise abatement goals.

CURRENT PROCEDURE. Aircraft on approach to JAC on Runway 01 conduct arrivals using a published IAP or fly a visual approach. There are three types of instrument approaches to Runway 01 used in addition to visual conditions:

- *RNP*: The RNAV (RNP) Y & Z procedures are satellite-based approaches that use advanced technology to guide aircraft on a straight-in path and do not use ground-based navigational aids.
- *LPV:* The RNAV (GPS) X procedure is a GPS-based approach used to guide aircraft on a straight-in approach and does not use ground-based navigational aids; it is used during poor weather. This procedure is used by General Aviation aircraft.
- *VOR/DME:* The VOR/DME procedure is a conventional procedure that uses on-board navigation with ground-based NAVAIDS to navigate on a straight-in approach.

Currently Runway 01 is used approximately 20% of the time for arrivals. Runway 19 is used more frequently due to the availability of better instrument approaches during poor weather. Often in poor weather the winds also dictate the preferred use of Runway 19. **Figure 7-4a** shows existing flight tracks. Due to terrain and approach criteria, aircraft generally fly a straight path into JAC. This path is not proposed to change as part of this alternative, only the use will increase due to an optimized procedure.

PROPOSED ALTERNATIVE CHANGE. This alternative would not create a singular new procedure, but would promote the implementation of new procedures as technology evolves, optimizing the existing procedure. Because of terrain constraints, the published approaches to Runway 01 do not have low approach minimums. The lower approach minimums, the more useful a runway is in poor weather conditions. If a runway has high approach minimums, a pilot must be able to see the runway further away; if the pilot can't see the runway at a certain distance from the runway end, they must perform a missed approach.

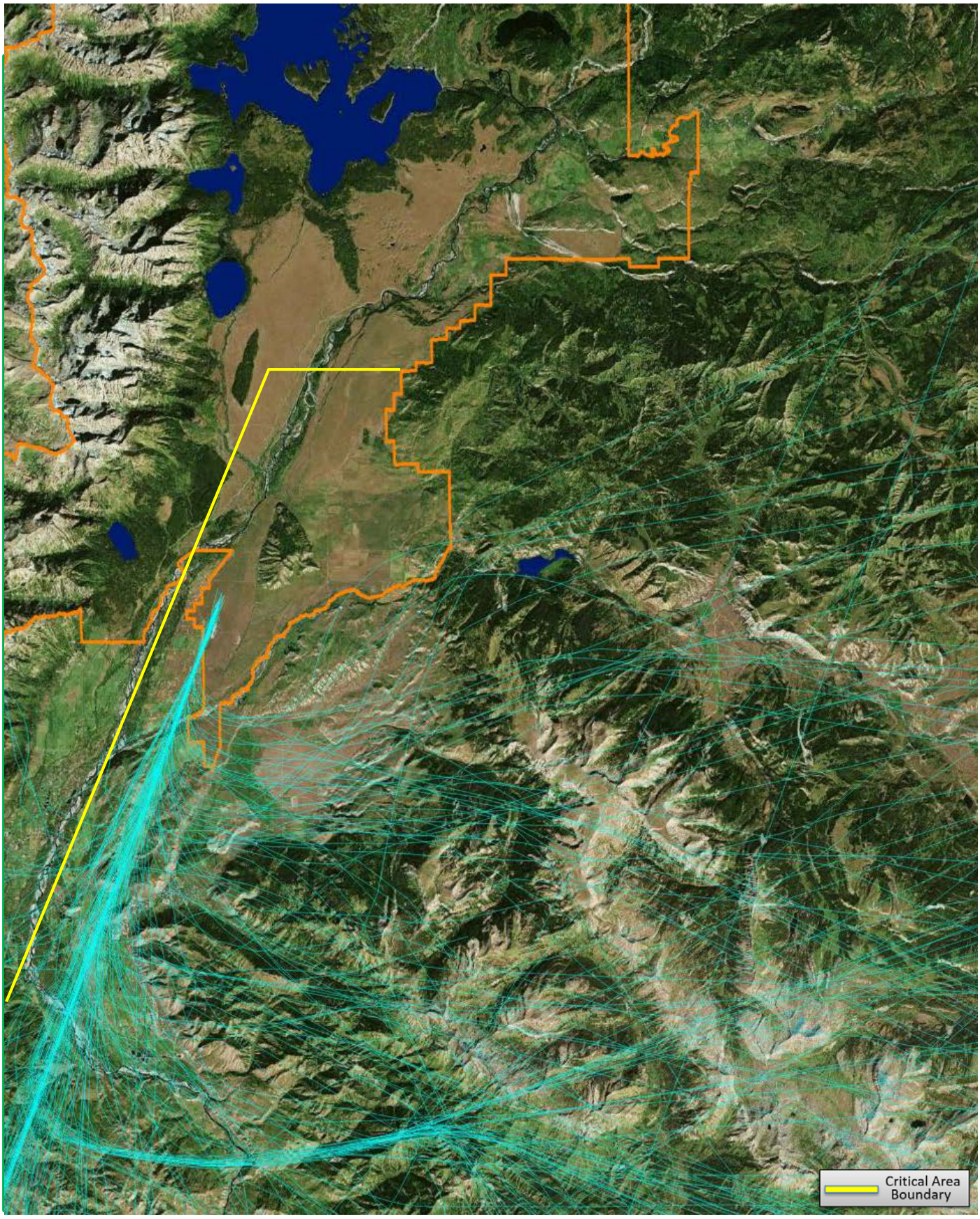


Figure 7-4a

Alternative A3 – Existing Jet Arrival Flight Tracks Runway 01 (All Weather Conditions)

With the evolution of satellite-based navigation technology over the next five years, it is anticipated that criteria may evolve that could allow for enhanced poor weather operations for Runway 01. While not promoting any specific procedure, there are three types of satellite-based navigation approaches that are likely to provide improved access to Runway 01, listed below. Again, with the constraints of terrain, these paths are expected to remain the same straight-in paths that they are today. **Figure 7-4b** shows Alternative A3 flight tracks:

- LPV Arrival Procedure
- RNP Arrival Procedure
- GBAS Arrival Procedure

7.2.3.1 Modeling Assumptions/New Procedure.

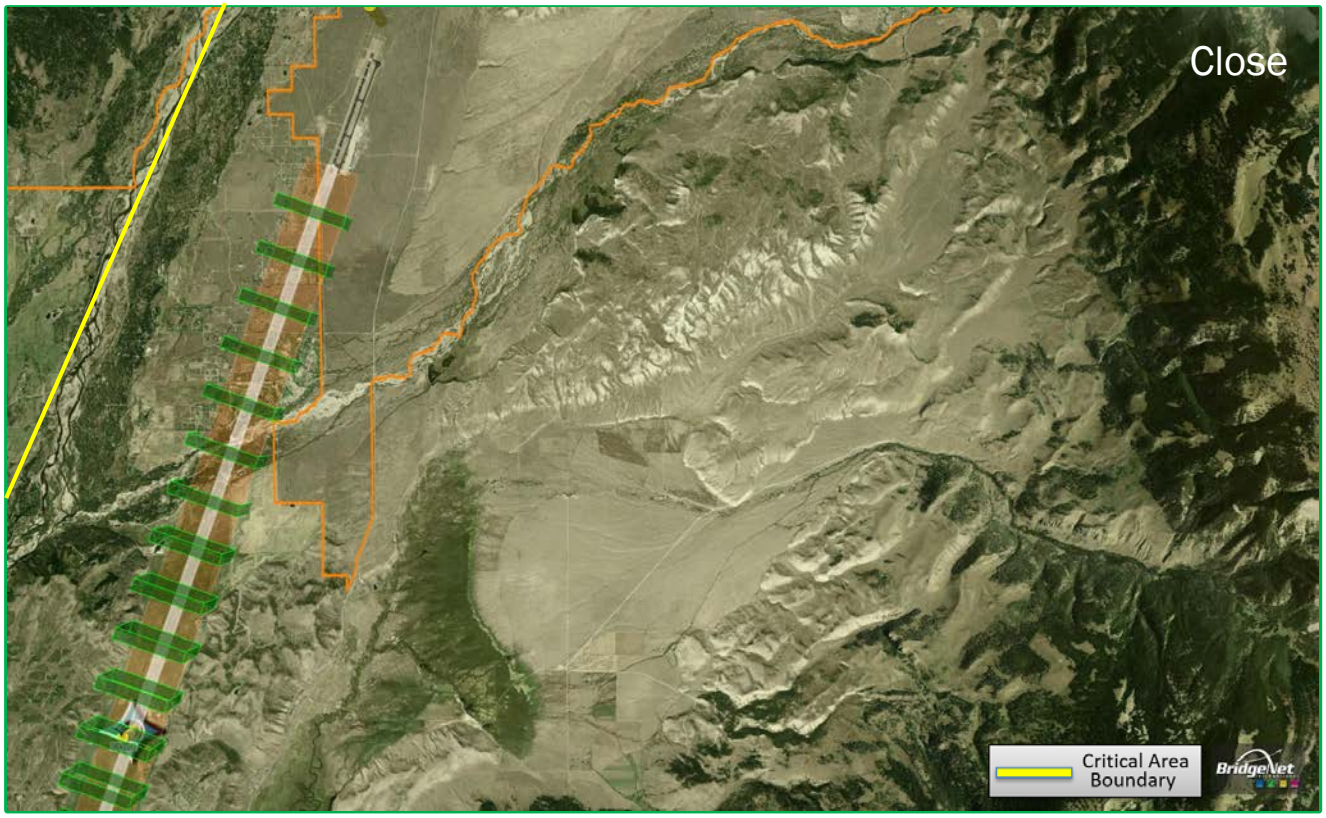
Aircraft would follow a similar path as today's arrivals, establishing a straight-in approach. The assumptions for the percentage of aircraft that would land on Runway 01 are shown in **Table 7-4**. The analysis assumes that this percentage would increase by 10% for those aircraft equipped. Using historic wind data, it was assumed aircraft can operate on Runway 01 within tailwind tolerances a greater percentage of time. The existing conditions include aircraft that fly the existing visual arrival procedure.

Table 7-4 - Alternative A3 – Procedure Use, Runway 01 Arrivals

Aircraft Category	Existing Conditions	A3 Percent of Arrivals
COMMERCIAL JET	20%	30%
REGIONAL JET	23%	33%
BUSINESS JET	17%	27%
COMMUTER PROPELLER	23%	23%
GENERAL AVIATION PROPELLER	15%	15%

Source: BridgeNet International

Source: BridgeNet International 2016



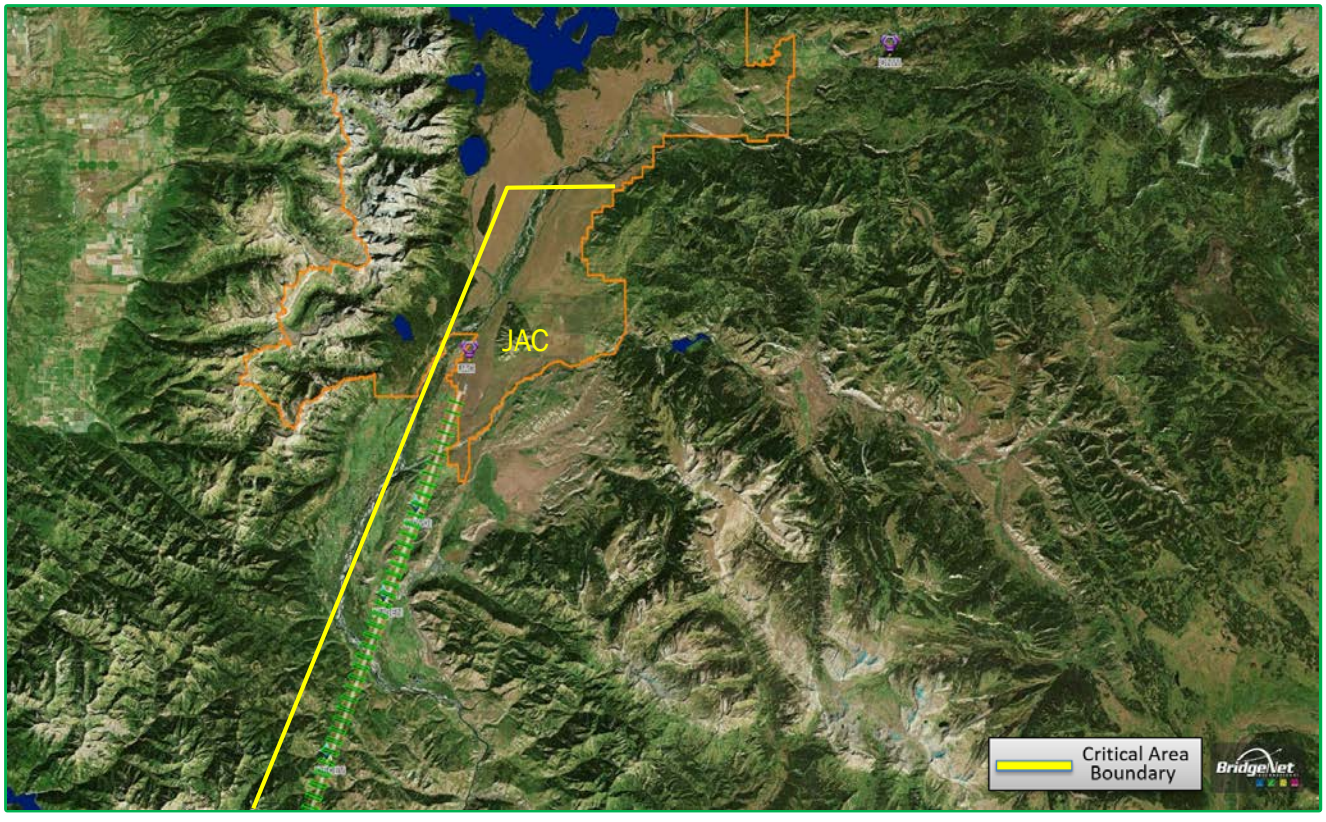


Figure 7-4b

Alternative A3 – Increased Use of Runway 01 for Arrivals

7.2.3.2 Analysis of New Procedure.

DNL NOISE ANALYSIS. The average annual DNL noise contours for the future 2020 time period that is associated with Alternative A3 were compared to the base case 2020 noise contours (**Figure 7-4c**). Noise contours for the 65 DNL noise level were generated. For comparative purposes this figure also presents the base case 2020 DNL noise contours.

Table 7-1 summarizes the noise changes of this alternative on population and housing within the 65 DNL and greater noise exposure contours in comparison with the 2020 base case. As this table notes, this alternative would not increase or decrease overall population exposed to 65 DNL, relative to the 2020 base case. The population and park acreages within the 65 DNL contour are both zero, which is the same as the base case.

COMPLIANCE WITH USE AGREEMENT: This alternative would not result in a violation of the noise limits contained in the Use Agreement.

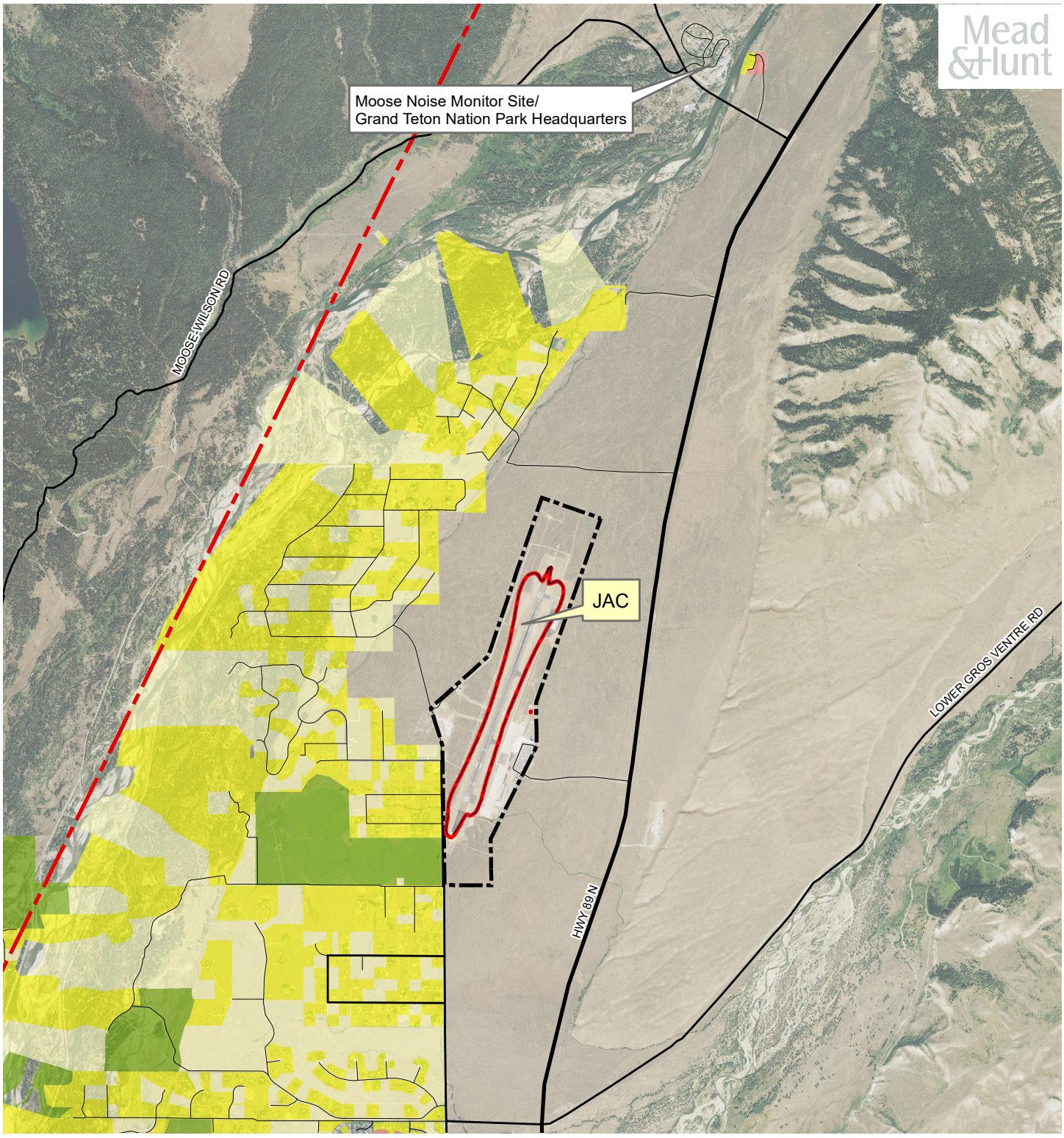
SUPPLEMENTAL NOISE ANALYSIS. The change in noise from this alternative on the supplemental metrics used in this study can be found in **Appendix D**.

OTHER ISSUES. The following issues could result from implementation of the alternative. The agencies are also identified that would have a role in assisting in the implementation of this alternative.

- ***Airport and Air Traffic Control Operational Considerations (safety and efficiency issues):*** The FAA has ultimate responsibility for the safe, orderly and expeditious flow of air traffic. ATC would need to evaluate this alternative to ensure proper separation for aircraft arriving and departing in the valley in that there may be times that aircraft are departing and landing in the same airspace.

- ***Other Environmental Issues (NEPA, etc.):*** Implementation of noise abatement flight procedures requires compliance with the NEPA. This procedure also could reduce fuel and the associated emissions with a more direct and optimized flight path.

- ***Barriers to Implementation:*** Current approach criteria will not provide for better access from the south over what is available today with the current procedures. However, it is anticipated that criteria will evolve by the 2020 timeframe to allow for new and enhanced approaches from the south. Given the increased efficiency in south landings, it would be likely that operators would fly them if they were available.



Aerial Souce: 2012 NAIP WY039

N

0 2,000 4,000 8,000 Feet

Noise Contour Legend

DNL_65 2020 Base Case Contours Critical Boundary Area

Generalized Land Use (Teton County GIS)

Residential Commercial Airport Property

Res Vacant Land Agricultural

FIGURE 7-4c

Alternative A3
2020 DNL Noise Contours

7.2.4 Alternative A4 - RNAV Standard Instrument Departure (SID) for Runway 19

NOISE ABATEMENT PROCEDURE GOAL. The goal of this alternative is to create a procedure that further enhances noise abatement options for aircraft when departing on Runway 19 in instrument and visual conditions. For aircraft with destinations to the east and southeast, this alternative would use a left turn on departure that would keep aircraft east of the golf course and residential areas immediately to the southwest of JAC and minimize overflying communities to the south.

CURRENT PROCEDURE. Aircraft on departure from JAC on Runway 19 typically fly straight-out to the south on runway heading until reaching a point to turn east or west to their destination or continue south. When traffic permits, aircraft will depart and fly runway heading until reaching a point approximately 10 miles south of JAC, then are radar vectored by air traffic control.

There are two published departure procedures listed below for JAC; while these are the published procedures, most aircraft are given radar vectors to turn before reaching the initial turn. **Figure 7-5a** shows existing jet departure flight tracks on Runway 19 during all weather conditions.

- Teton Three Departure – aircraft depart Runway 19 and fly straight for approximately 27 miles, then turn to the west for radar vectors to join a Victor airway.
- Alpine One Departure – aircraft depart Runway 19 and fly straight for approximately 27 miles, then turn east or west for radar vectors to join a Victor airway.

PROPOSED ALTERNATIVE CHANGE. This alternative would create a new RNAV procedure that would keep aircraft east of the residential areas as much as possible to the south of JAC and Jackson Hole Golf & Tennis Club. The procedure could include aircraft departing and flying runway heading until reaching a prescribed altitude, and then turning eastward using RNAV navigation. At that point aircraft would either remain on a straight-out climb via runway heading or turn to the east or southeast. Aircraft would remain on a straight-out departure going to destinations to the west, including Salt Lake City. The analysis assumes that some aircraft with destinations to the east and southeast, including Chicago and Denver, respectively, would turn left. There are terrain and engine out requirements that will limit when aircraft can fly this procedure. **Figure 7-5b** shows Alternative A4 with the three transitions.

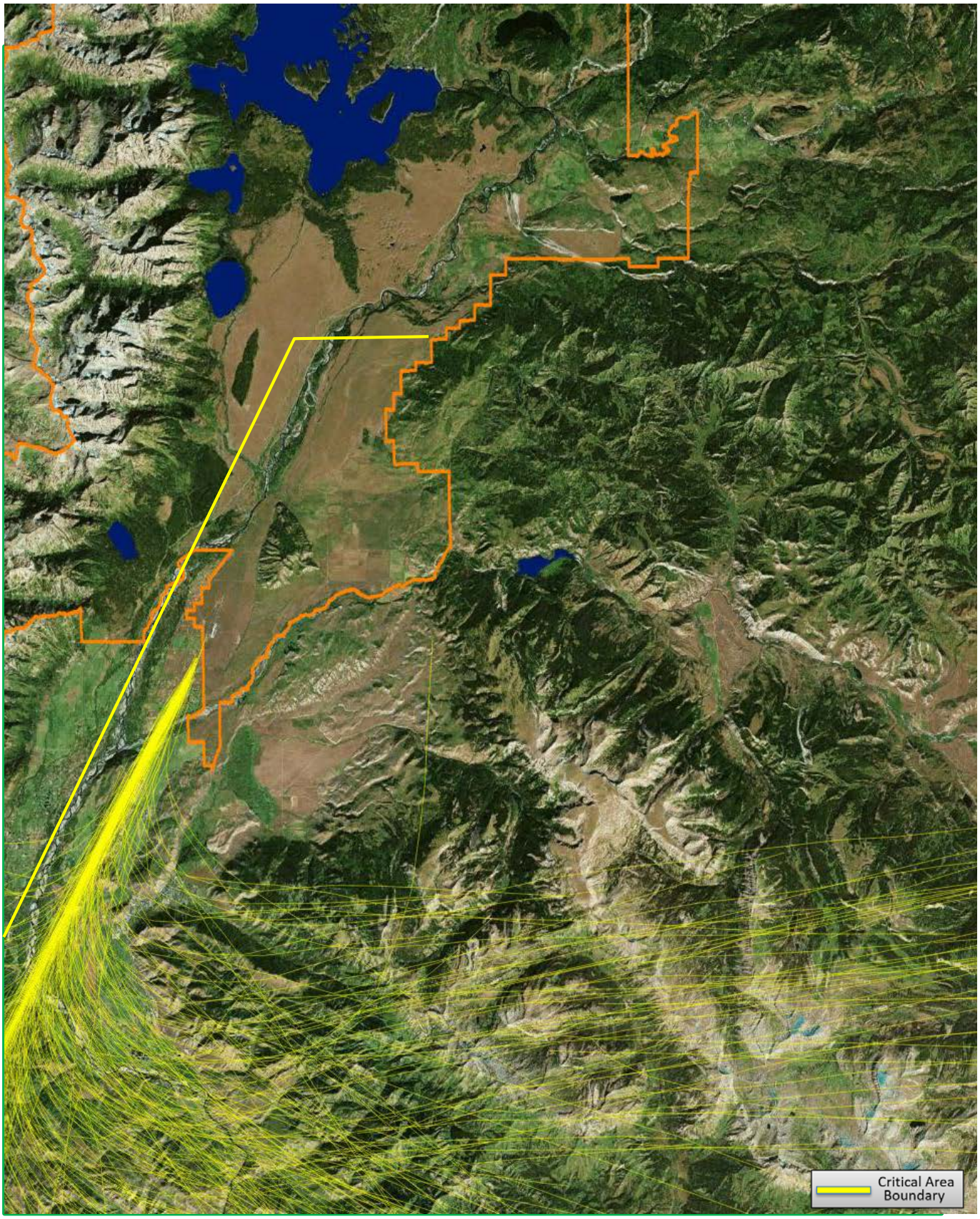
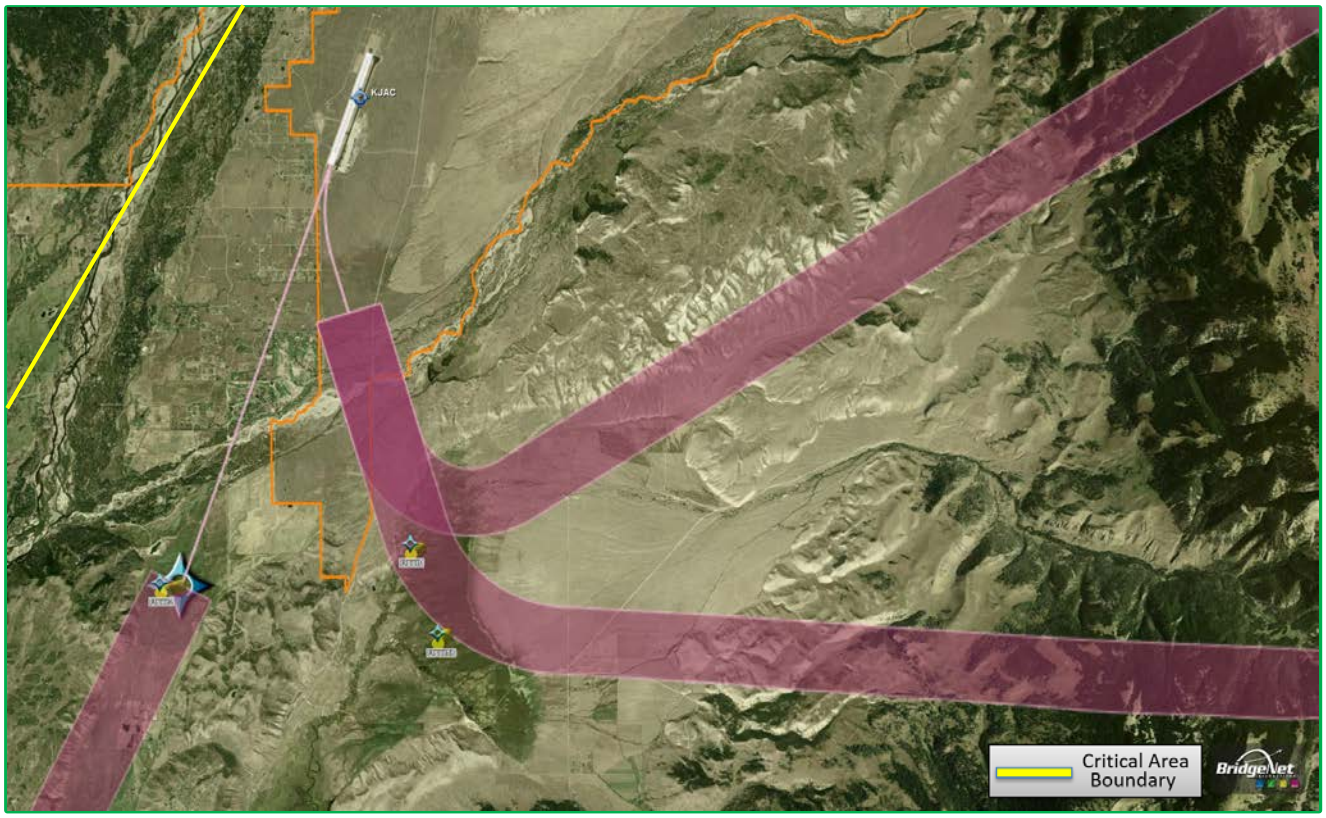


Figure 7-5a

Alternative A4 – Existing Jet Departure Flight Tracks Runway 19



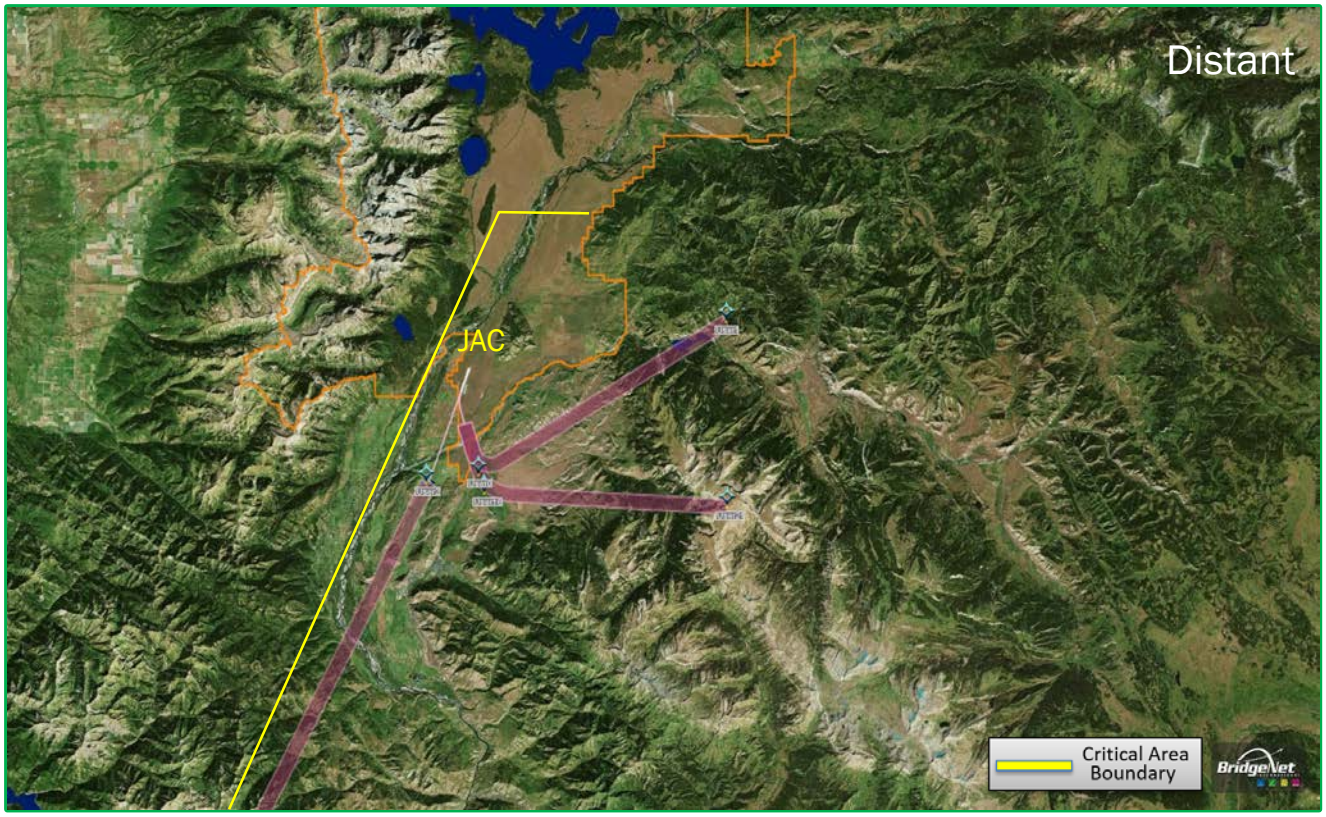


Figure 7-5b

Alternative 4 – RNAV SIDs Departure Procedures (Runway 19)

7.2.4.1 Modeling Assumptions/New Procedure.

This alternative assumes that 100% of aircraft with destinations to the west and south would continue to depart straight out. For aircraft with destinations to the east and southeast, it is assumed aircraft would turn left 50% of the time and continue straight 50% of the time. There is not a precedent to determine the exact percentage of time specific departure headings will be used; this can change with updated FAA guidance, airline engine out evaluations, weather, and traffic volumes. There could be a wide range of adoption; the consultant team is using a conservative estimate of 50%.

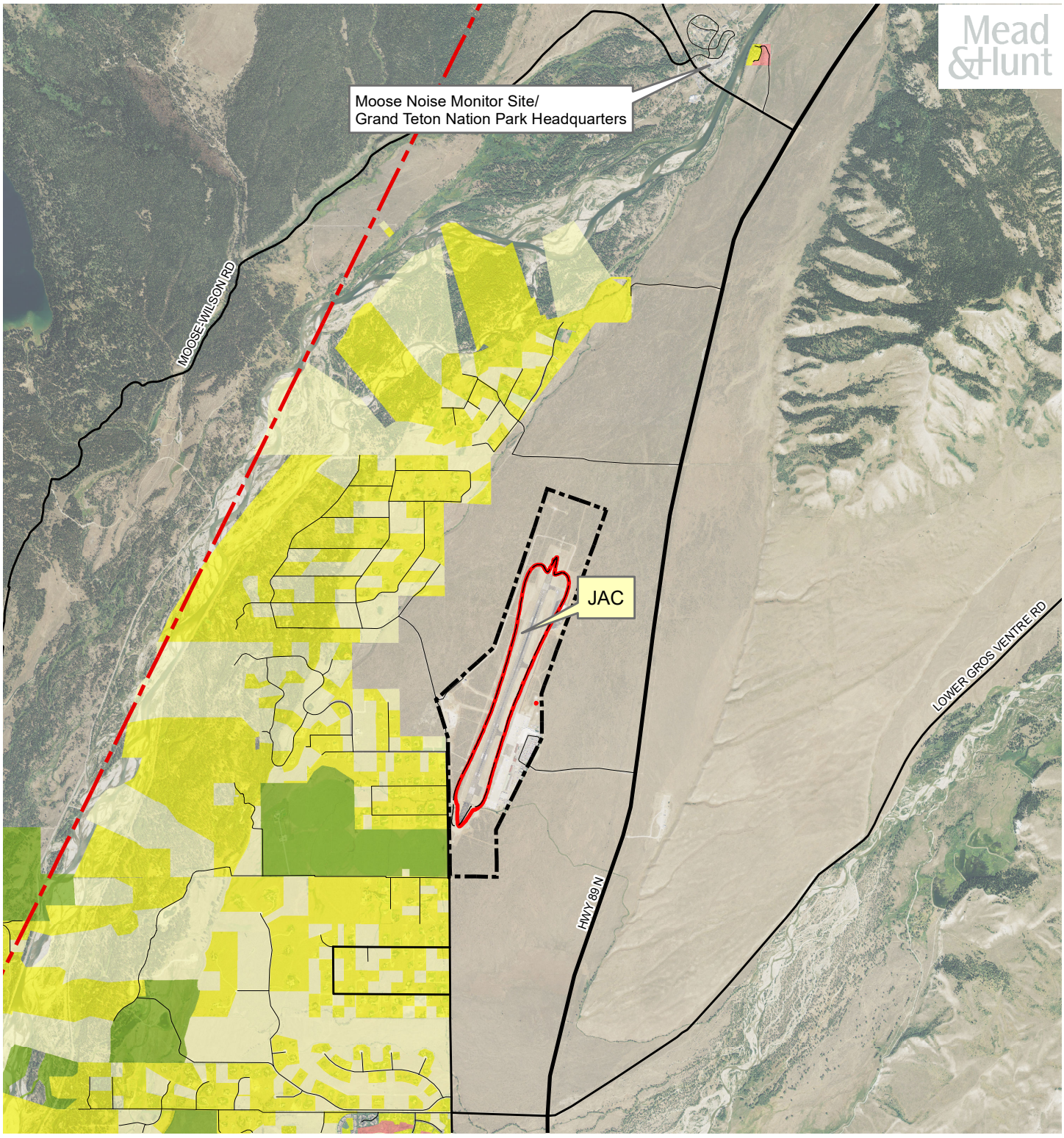
This noise abatement path can be implemented using RNAV. The majority of aircraft flying at JAC today are equipped to fly RNAV. RNAV can be flown by all classes of aircraft but would be flown primarily by commercial carriers and business jets. It is estimated that at least 95% of the commercial and business jet traffic at JAC are equipped to fly the procedure.

7.2.4.2 Analysis of New Procedure.

DNL NOISE ANALYSIS. The average annual DNL noise contours for the future 2020 time period that is associated with Alternative A4 were compared to the base case 2020 noise contours (**Figure 7-5c**). Noise contours for the 65 DNL noise level were generated. For comparative purposes this figure also presents the base case 2020 DNL noise contours.

Table 7-1 summarizes the noise changes of this alternative on population and housing within the 65 DNL and greater noise exposure contours in comparison with the 2020 base case for informational purposes. As this table notes, this alternative would not increase or decrease overall population exposed to 65 DNL, relative to the 2020 base case. The population and park acreages within the 65 DNL contour are both zero, which is the same as the base case.

COMPLIANCE WITH USE AGREEMENT: This alternative would not result in a violation of the noise limits contained in the Use Agreement.



Aerial Souce: 2012 NAIP WY039

N

0 2,000 4,000 8,000 Feet

Noise Contour Legend

DNL_65 | 2020 Base Case Contours | Critical Boundary Area

Generalized Land Use (Teton County GIS)

Residential | Commercial | AirportProperty

Res Vacant Land | Agricultural

FIGURE 7-5c

Alternative A4
2020 DNL Noise Contours

SUPPLEMENTAL NOISE ANALYSIS. The change in noise from this alternative on the supplemental metrics used in this study can be found in **Appendix D**.

OTHER ISSUES. The following issues could result from implementation of the alternative. Also, the agencies are identified that would have a role in assisting in the implementation of this alternative.

- ***Airport and Air Traffic Control Operational Considerations (safety and efficiency issues):*** The FAA has ultimate responsibility for the safe, orderly and expeditious flow of air traffic. ATC would need to evaluate this alternative to ensure proper altitudes and separation for aircraft arriving and departing in the valley.

- ***Other Environmental Issues (NEPA, etc.):*** Implementation of noise abatement flight procedures requires compliance with NEPA. This procedure could reduce fuel and the associated emissions with a more direct and optimized flight path.

- ***Barriers to Implementation:*** Nearly all jet and commuter turbo-prop aircraft are equipped and capable of flying these procedures. However, the severe terrain to the east may limit the ability of aircraft to meet required engine out performance. Airlines can adopt special criteria to manage the engine out criteria that may make flying these procedures more feasible. Corporate jets may be more restricted in their ability to fly these procedures. Given the increased efficiency of these procedures, it would be likely that operators would fly them if they were available.

7.2.5 Alternative A5 – RNAV Standard Instrument Departure (SID) for Runway 01

NOISE ABATEMENT PROCEDURE GOAL. The goal of this alternative is to create a procedure that further enhances noise abatement options for departing aircraft on Runway 01 in instrument and visual conditions. In reverse of Alternative A1, this alternative would use a curved departure path that would keep aircraft east of the Snake River and Highway 89 and minimize flying over or near the Critical Area Boundary. These aircraft would not fly as far to the north as they do today. This alternative would reduce overflights over the central area of the Snake River.

CURRENT PROCEDURE. Aircraft on departure from JAC on Runway 01 typically fly runway heading to Moose, approximately three miles north of JAC, turn slightly to the east and then proceed to the north and are radar vectored to a Victor airway. **Figure 7-6a** shows existing flight tracks during instrument and visual conditions. There is one published departure procedure for Runway 01:

- Geyser Four Departure – aircraft depart Runway 01 and fly straight for approximately three miles, then turn to the east approximately 30 degrees. Aircraft are then radar vectored to join a Victor airway.

PROPOSED ALTERNATIVE CHANGE. Alternative A5 would create a new procedure that would follow a similar path to today's visual departure path used during good weather using an RNAV Standard Instrument Departure (RNAV SID). For this alternative, aircraft would depart Runway 01 and fly runway heading until reaching a prescribed altitude and then would turn slightly to the east along an RNAV GPS path until reaching Blacktail Butte. At this point aircraft would then fly an RNAV GPS path to their destination. **Figure 7-6b** shows Alternative A5 with the three transitions listed below:

- Eastbound
- Southbound
- Northbound

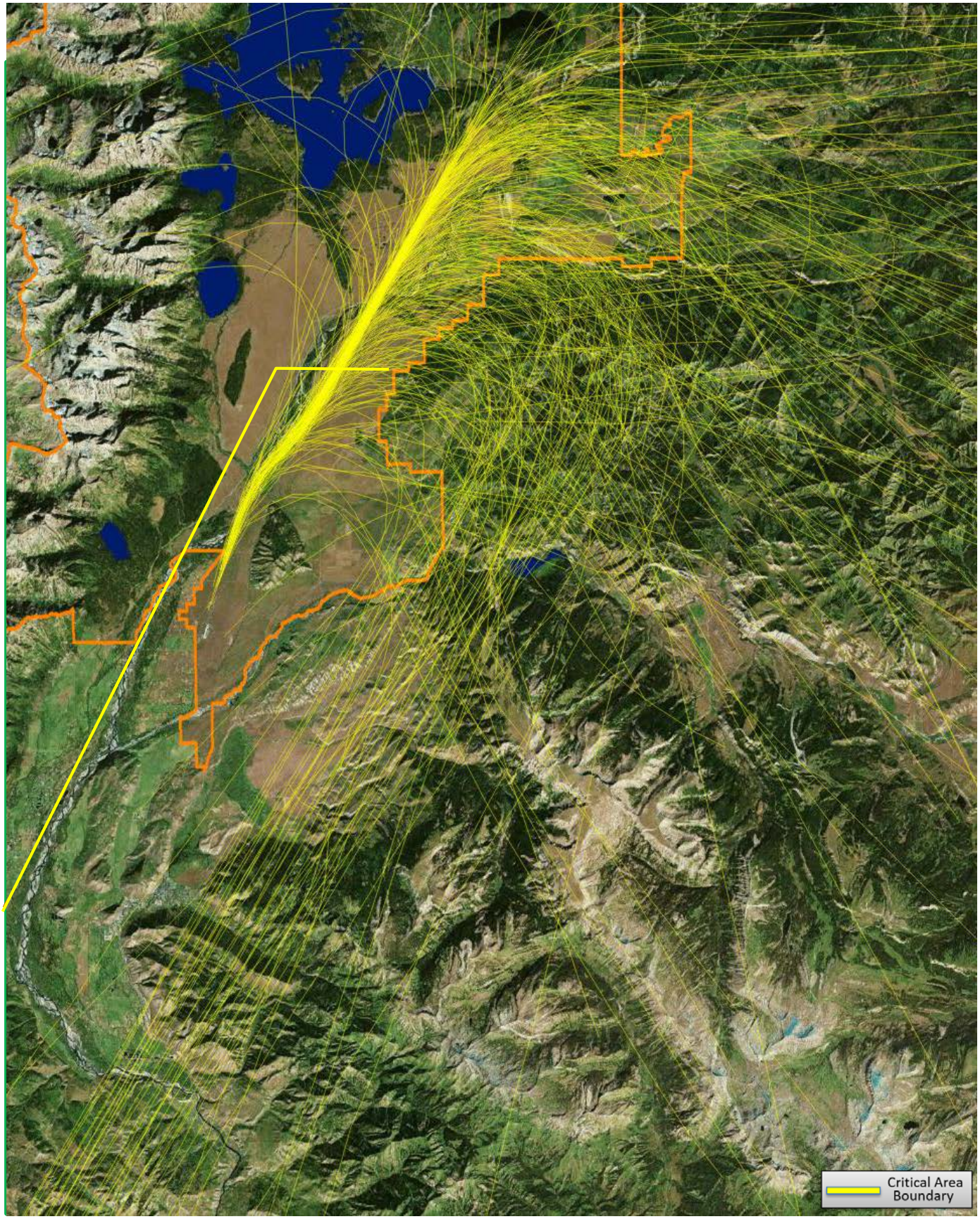


Figure 7-6a

Alternative A5 – Existing Jet Departure Flight Tracks Runway 01

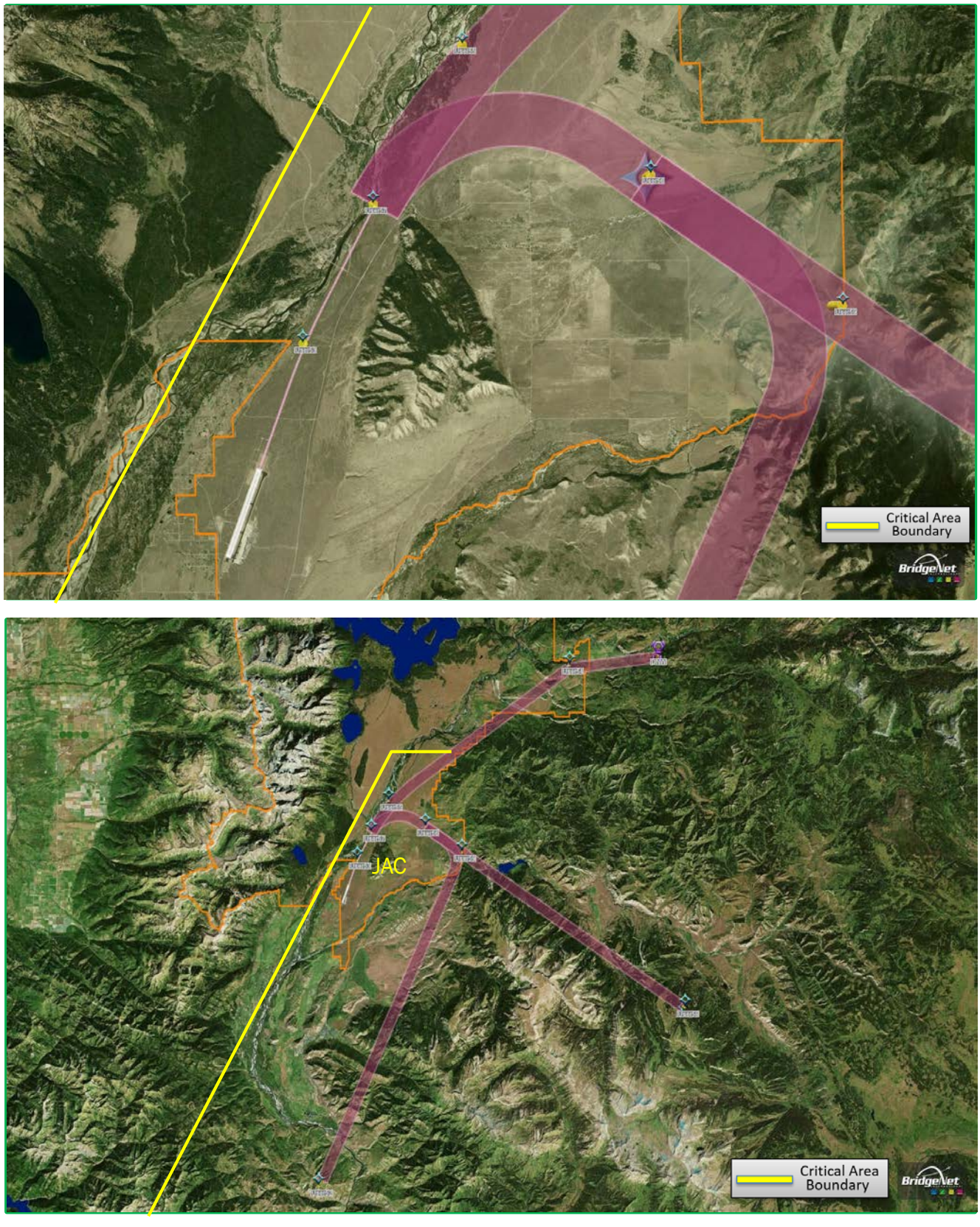


Figure 7-6b

Alternative 5 – RNAV SIDs Departure Procedure for Runway 01

7.2.5.1 Modeling Assumptions/New Procedure.

The transition for Alternative A5 is at a point approximately three miles north of JAC; all aircraft will fly to this point and then transition to the east, south, or north. Aircraft will turn to the east sooner with this procedure than the existing Geyser Four departure.

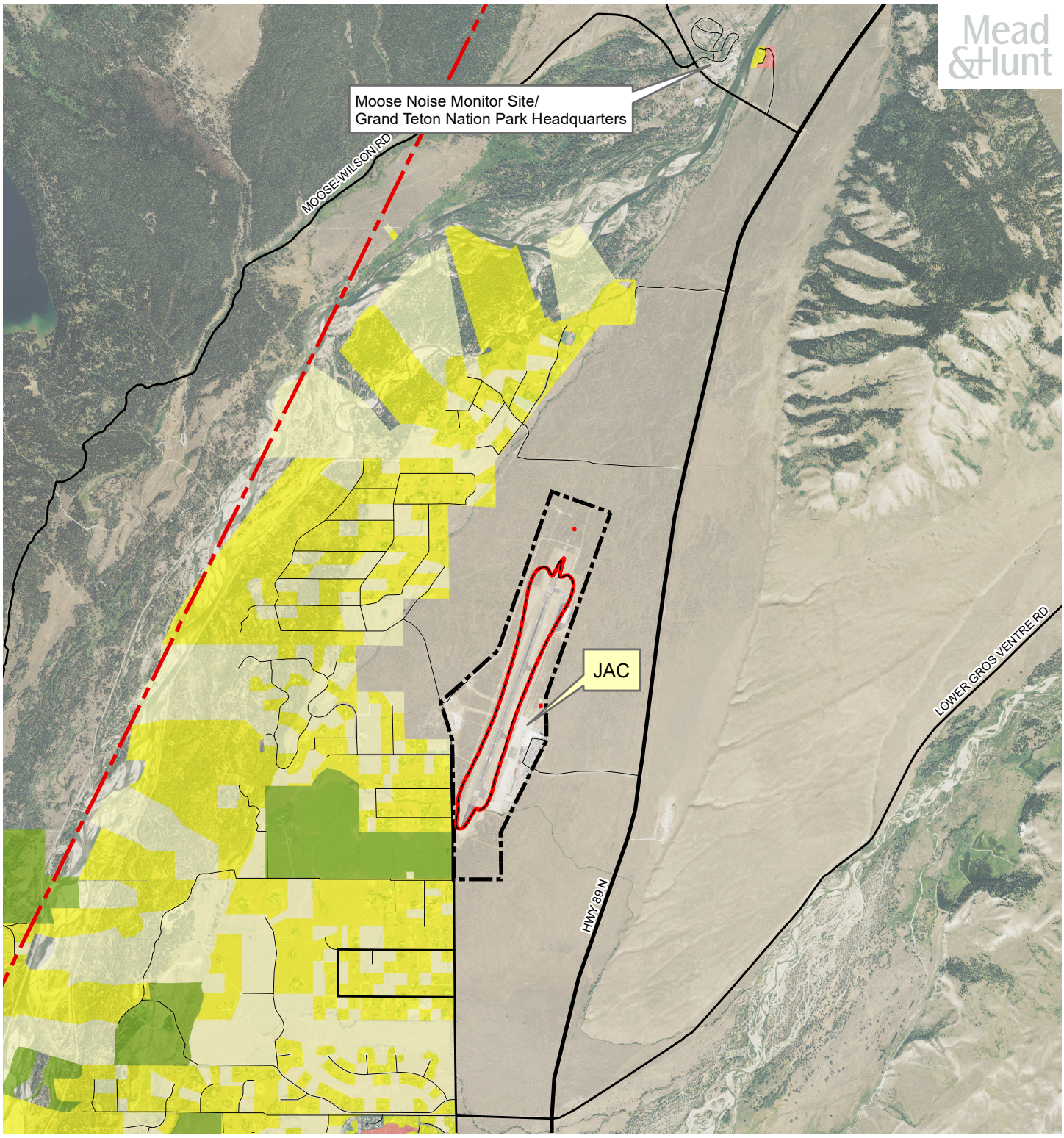
The RNAV GPS technology is available and used by the large majority of commercial, regional, commuter, corporate jet, and high-performance piston aircraft. For the purposes of this study, the future 2020 analysis assumes 80% of all jet aircraft departures on Runway 01 would use this new procedure. Aircraft currently fly the conventional navigation of this procedure 80% of the time; the consultant team is assuming the usage would remain consistent in the future. Since these paths are more efficient than the current procedure, operators would have incentive to use them.

7.2.5.2 Analysis of New Procedure.

DNL NOISE ANALYSIS. The average annual DNL noise contours for the future 2020 time period that is associated with Alternative A5 were compared to the base case 2020 noise contours (**Figure 7-6c**). Noise contours for the 65 DNL noise level were generated. For comparative purposes this figure also presents the base case 2020 DNL noise contours.

Table 7-1 summarizes the noise changes of this alternative on population and housing within the 65 DNL and greater noise exposure contours in comparison with the 2020 base case. As this table notes, this alternative would not increase or decrease overall population exposed to 65 DNL, relative to the 2020 base case. The population and park acreages within the 65 DNL contour are both zero, which is the same as the base case.

COMPLIANCE WITH USE AGREEMENT: This alternative would not result in a violation of the noise limits contained in the Use Agreement.



Aerial Souce: 2012 NAIP WY039

N

0 2,000 4,000 8,000 Feet

Noise Contour Legend

DNL_65 | 2020 Base Case Contours | Critical Boundary Area

Generalized Land Use (Teton County GIS)

Residential | Commercial | AirportProperty

Res Vacant Land | Agricultural

FIGURE 7-6c

Alternative A5
2020 DNL Noise Contours

SUPPLEMENTAL NOISE ANALYSIS. The change in noise from this alternative on the supplemental metrics used in this study can be found in **Appendix D**.

OTHER ISSUES. The following issues could result from implementation of the alternative. Also, the agencies are identified that would have a role in assisting in the implementation of this alternative.

- ***Airport and Air Traffic Control Operational Considerations (safety and efficiency issues):*** The FAA has ultimate responsibility for the safe, orderly and expeditious flow of air traffic. ATC would need to evaluate this alternative to ensure proper altitudes and separation for aircraft arriving and departing in the valley.

- ***Other Environmental Issues (NEPA, etc.):*** Implementation of noise abatement flight procedures requires compliance with NEPA. This procedure could reduce fuel and the associated emissions with a shorter flight.

- ***Barriers to Implementation:*** There are no known barriers to implementation for Alternative A5. Given the increased efficiency and stability of these procedures, it would be likely that operators would fly them if they were available.

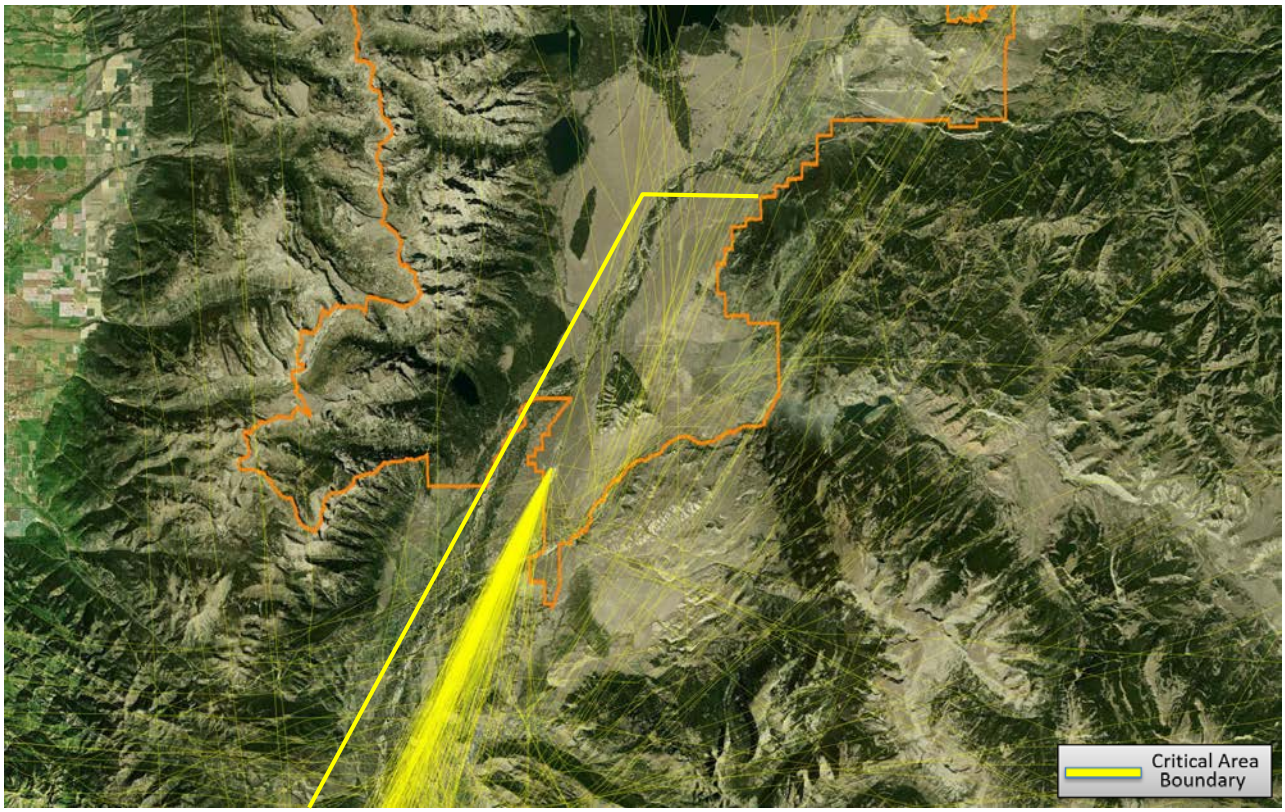
7.2.6 Alternative A6 - Waypoint Noise Abatement Flight Paths

NOISE ABATEMENT PROCEDURE GOAL. The goal of this alternative is to define preferred noise abatement paths in visual conditions for smaller general aviation aircraft using specific flight paths based upon GPS waypoints. The paths are designed to avoid the residential areas to the south and overflying the core of GTNP, including the Snake River area.

CURRENT PROCEDURE. Small general aviation aircraft operate at JAC under IFR and VMC. The majority of general aviation flights are in VMC. Aircraft use the existing IFR, VOR/DME, and visual flight procedures for departing and arriving Runway 19 and Runway 01. Procedures in Alternative A6 would be used in VMC only. **Figure 7-7a** and **7.7b** show existing flight tracks during instrument and visual conditions for general aviation aircraft.

PROPOSED ALTERNATIVE CHANGE. Alternative A6 proposes specific flight paths based upon GPS waypoints that define noise abatement paths for smaller general aviation aircraft. This waypoint information can be shared with the pilot community to show the preferred noise abatement paths for the different destinations.

This can be through an airport-sponsored iPad application or other methods that pilots can use to put this information into their flight management systems. iPads are commonly used by pilots for flight planning, flight procedures and flight information known as notice(s) to airman (NOTAMs). Many of them also are integrated with a GPS unit to have flight following capabilities. The iPad application can provide information on noise abatement at JAC as well as the proposed paths (with waypoint coordinates) of where to fly to minimize noise impacts.



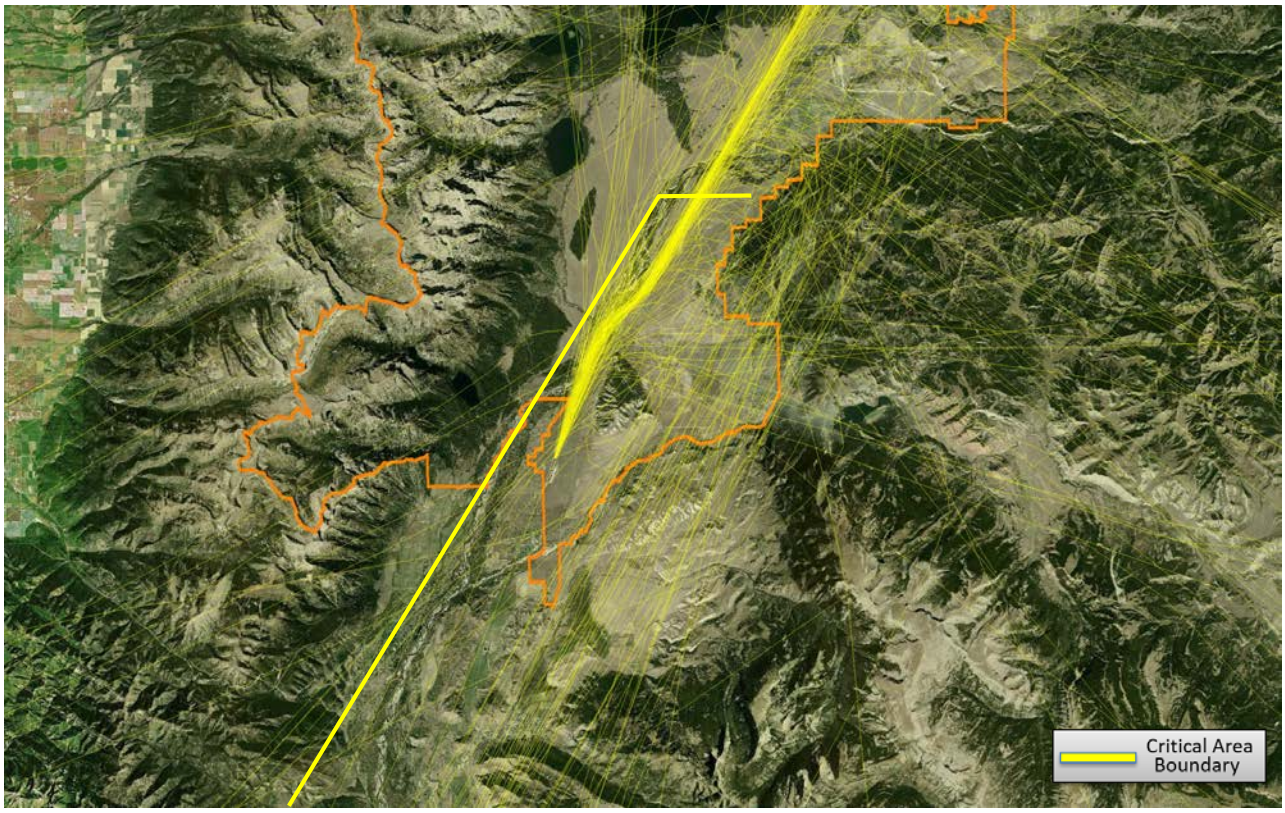
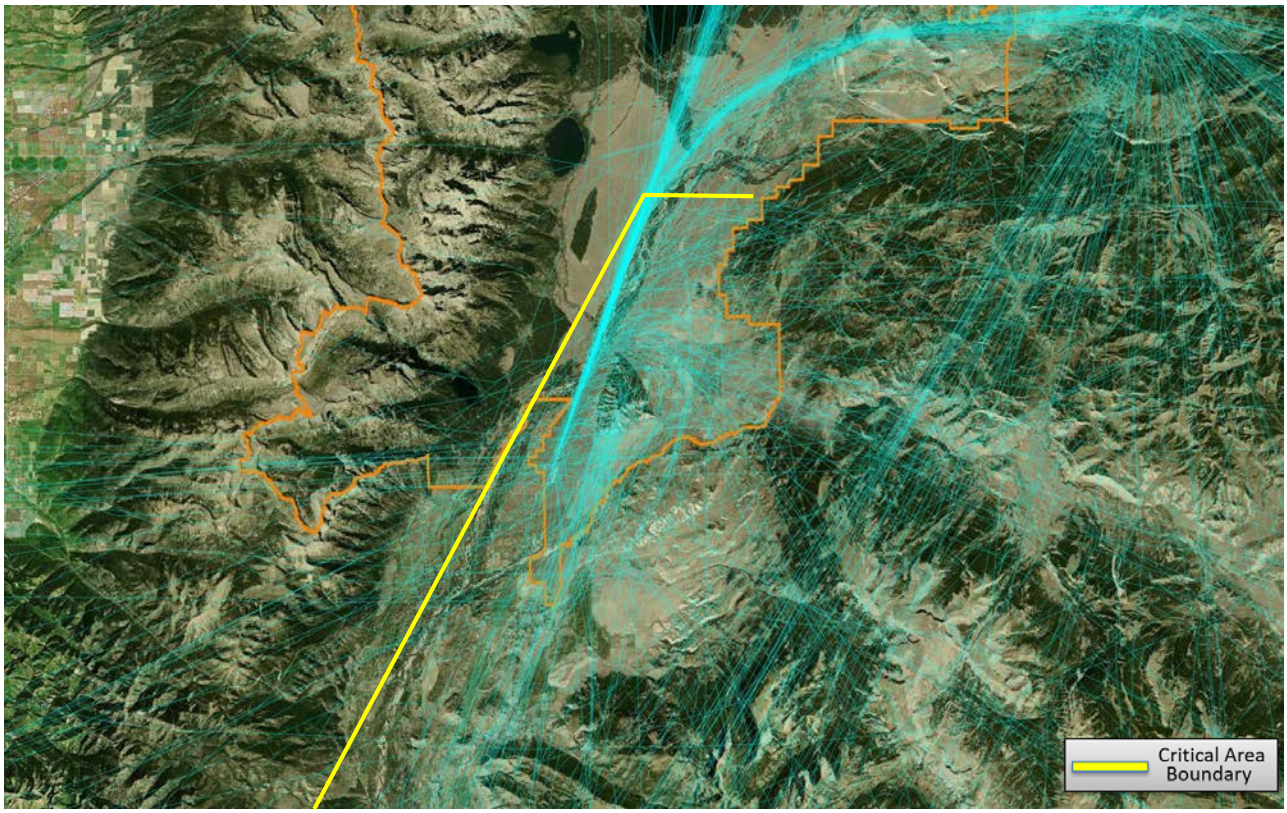


Figure 7-7a

Alternative A6 – Existing Propeller Aircraft Departure Flight Tracks



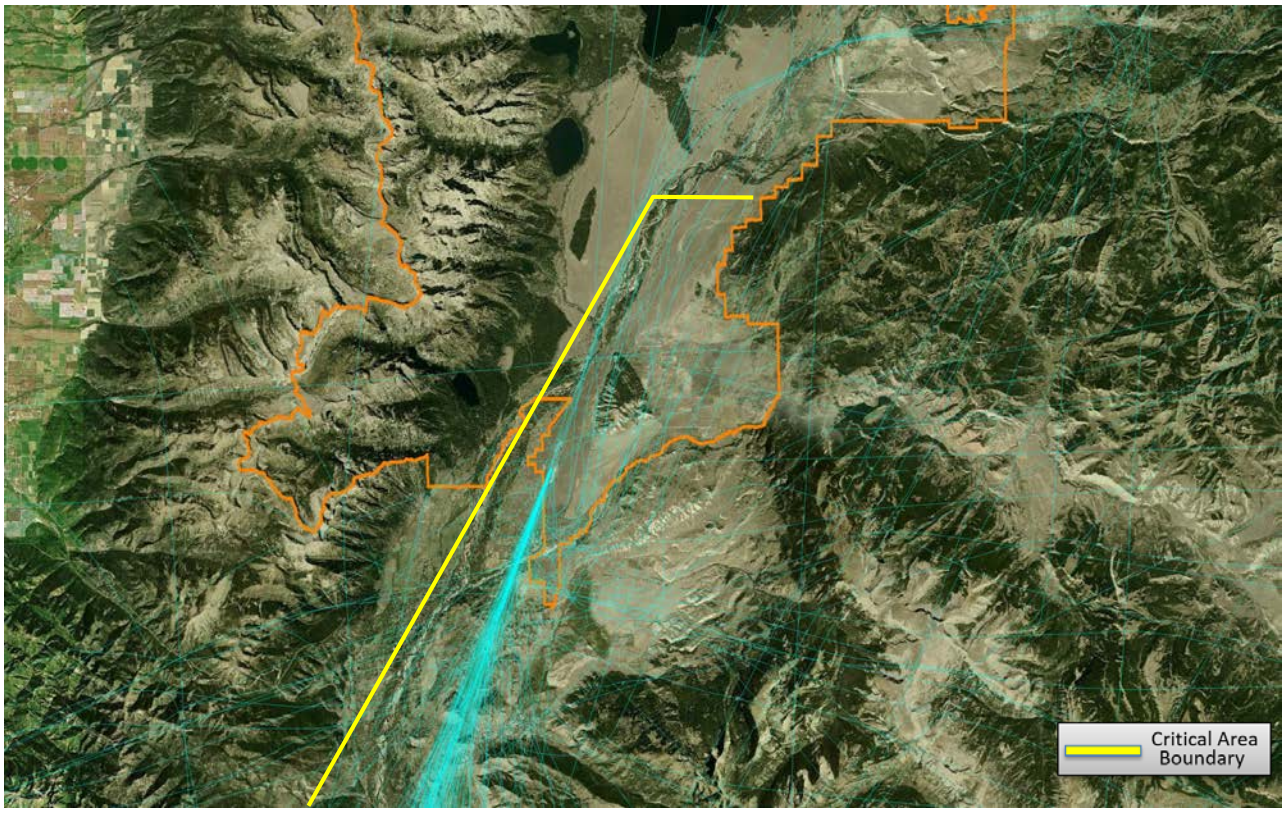


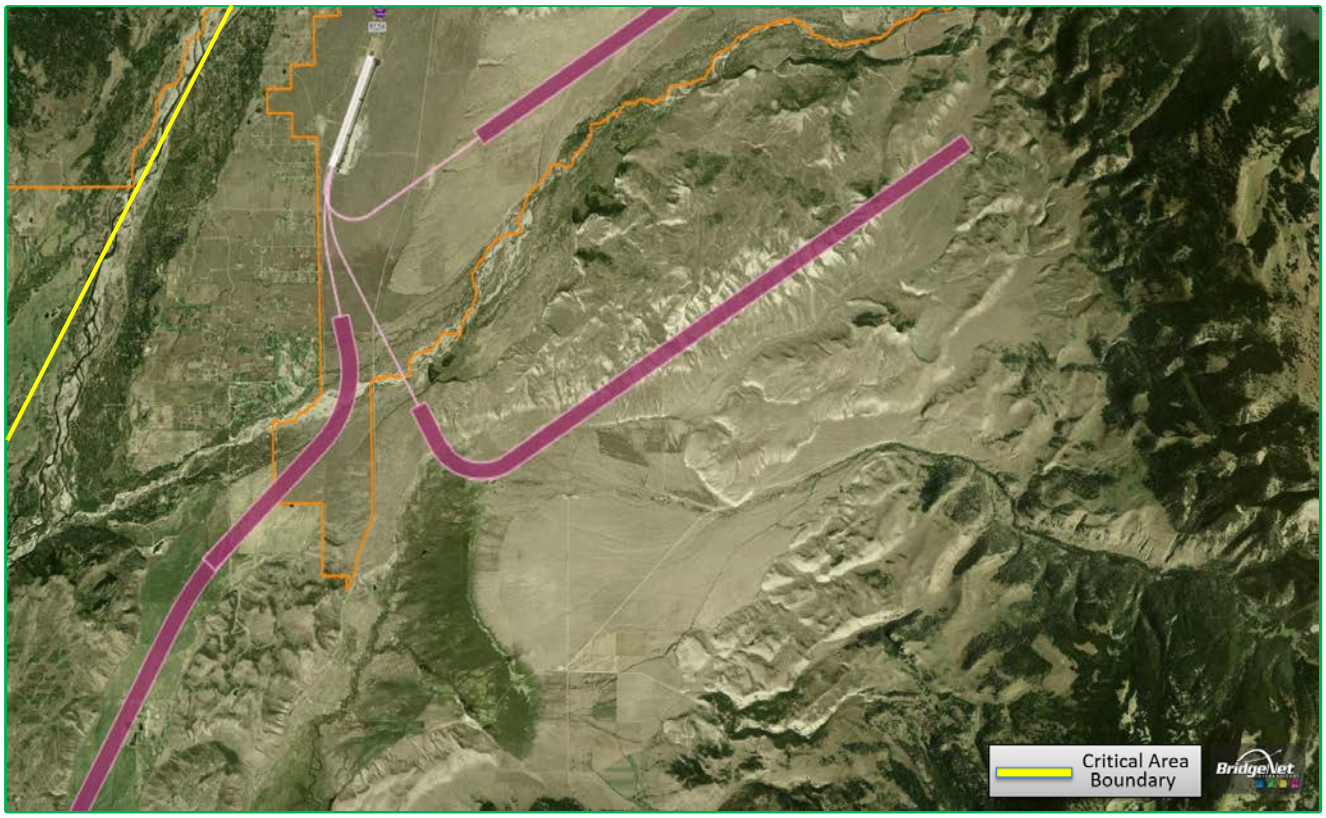
Figure 7-7b

Alternative A6 – Existing Propeller Aircraft Arrival Flight Tracks

Alternative A6 would create noise abatement flight paths that would follow historic noise abatement tracks that are difficult to follow precisely using conventional navigation. These departure and arrival paths can be used during good weather using waypoints that can be programmed into a hand-held GPS or cockpit GPS unit. **Figures 7-7c** through **7-7e** show Alternative A6 with the three options for arrivals and departures and one arrival condition that is not included as a graphic but would apply to small aircraft under visual conditions.

- Runway 19 Departures – This procedure could include aircraft departing and flying runway heading until reaching a prescribed altitude. At that point aircraft would transition to different headings, either turn slightly east to fly east of the Jackson Hole Golf & Tennis Club or turn directly to the east or southeast destinations. The aircraft would fly this new departure procedure to enroute transitions and their destinations.
- Runway 01 Departures – Aircraft would depart Runway 01 and fly runway heading until reaching a prescribed altitude and then would turn slightly east along an RNAV GPS path until reaching Blacktail Butte. At this point aircraft would then fly an RNAV GPS path to their destination or vectors to a Victor airway. Some aircraft would also turn to the south or east before Blacktail Butte.
- Runway 19 Arrivals – Aircraft would fly a curved approach to Runway 01 or Runway 19. This curved approach would avoid overflying core areas of the park and stay east of the Snake River.
- Runway 01 Arrivals – Small aircraft under visual conditions would fly a curved approach to Runway 01. This curved approach would avoid overflying core areas of the park and stay east of the Snake River.

DESCRIPTION OF THE ISSUE. The issue being addressed by Alternative A6 is to identify a noise abatement path for departing and arriving general aviation aircraft that can be accomplished by waypoints instead of relying on a specific type of technology. It can be very costly to equip a small propeller aircraft to fly PBN procedures; this type of approach gives general aviation pilots access to similar procedures.



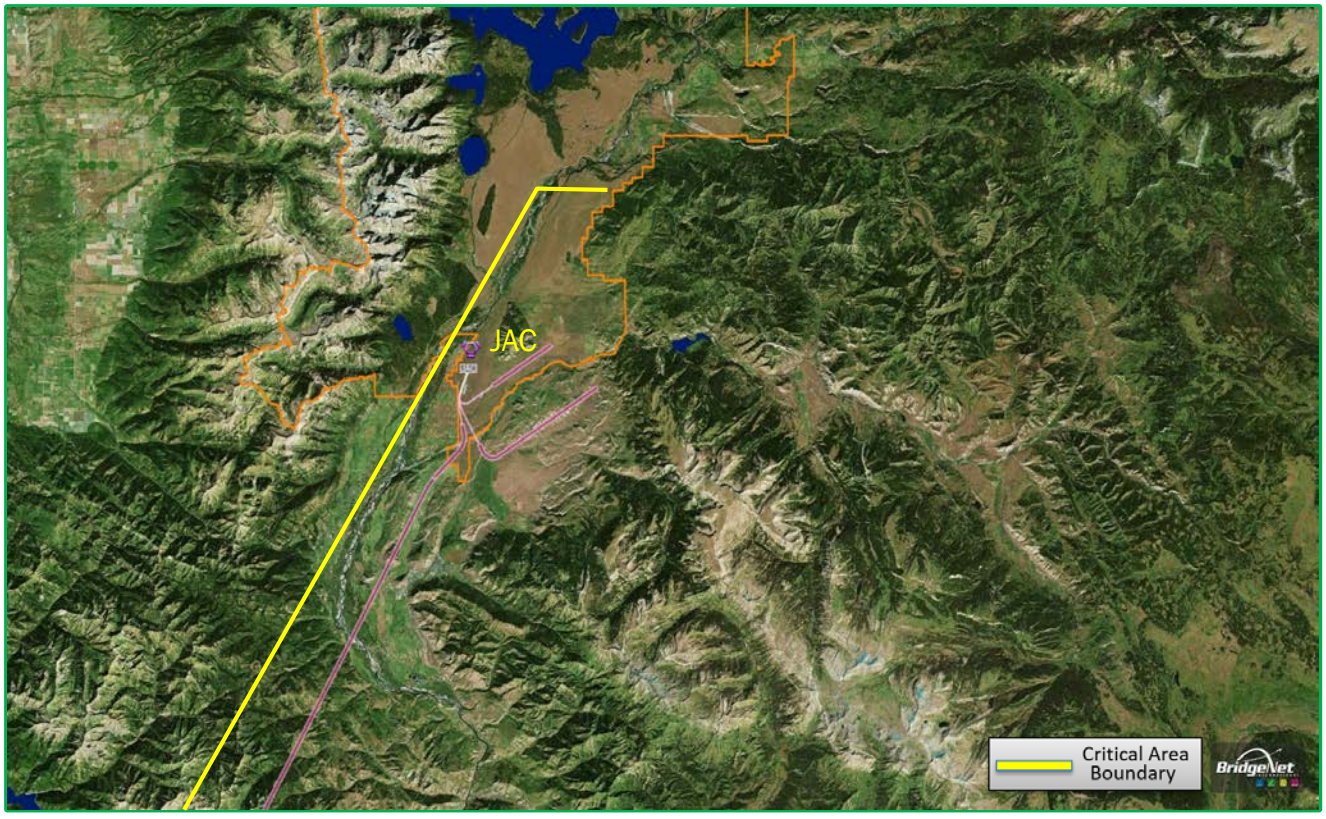
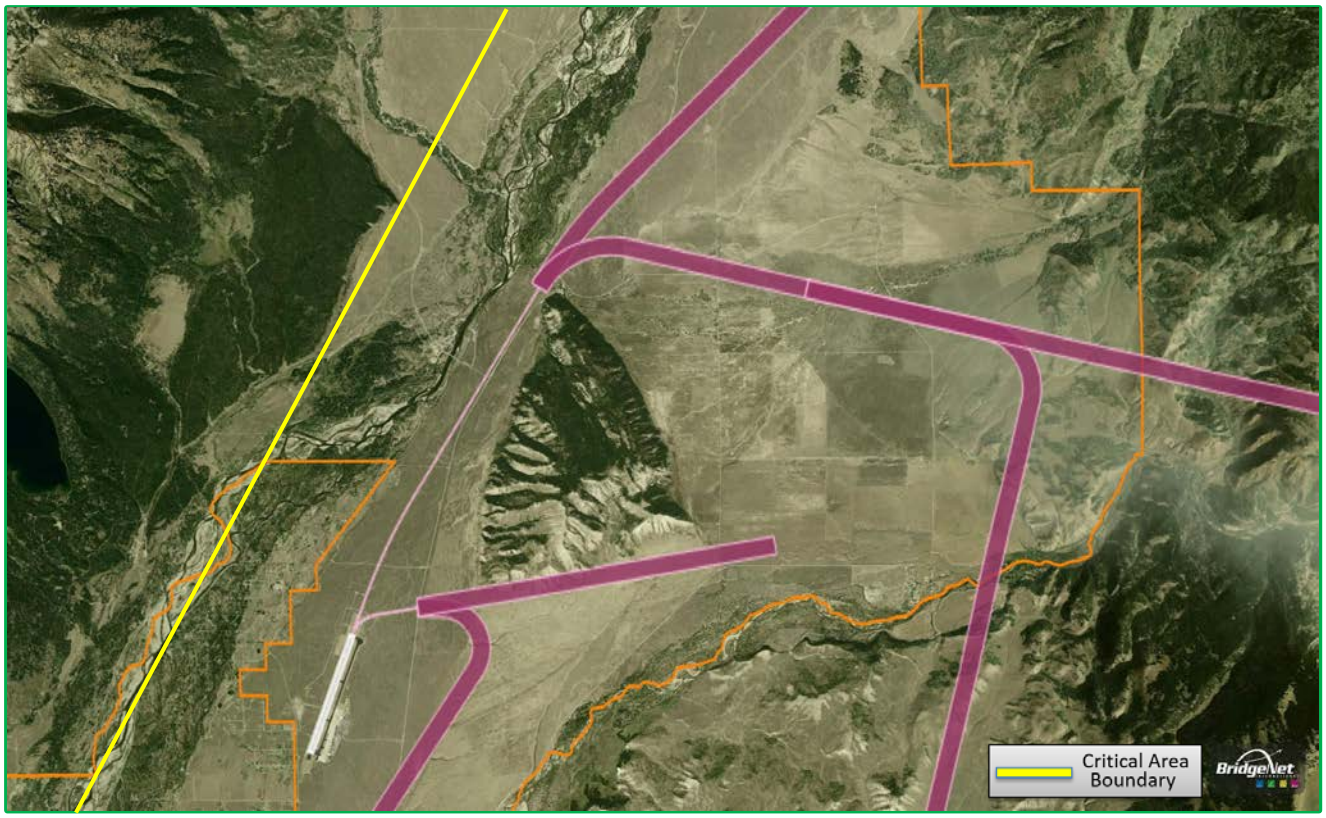


Figure 7-7c

Alternative A6 – Waypoint Departure Paths for Small Aircraft (Runway 19)



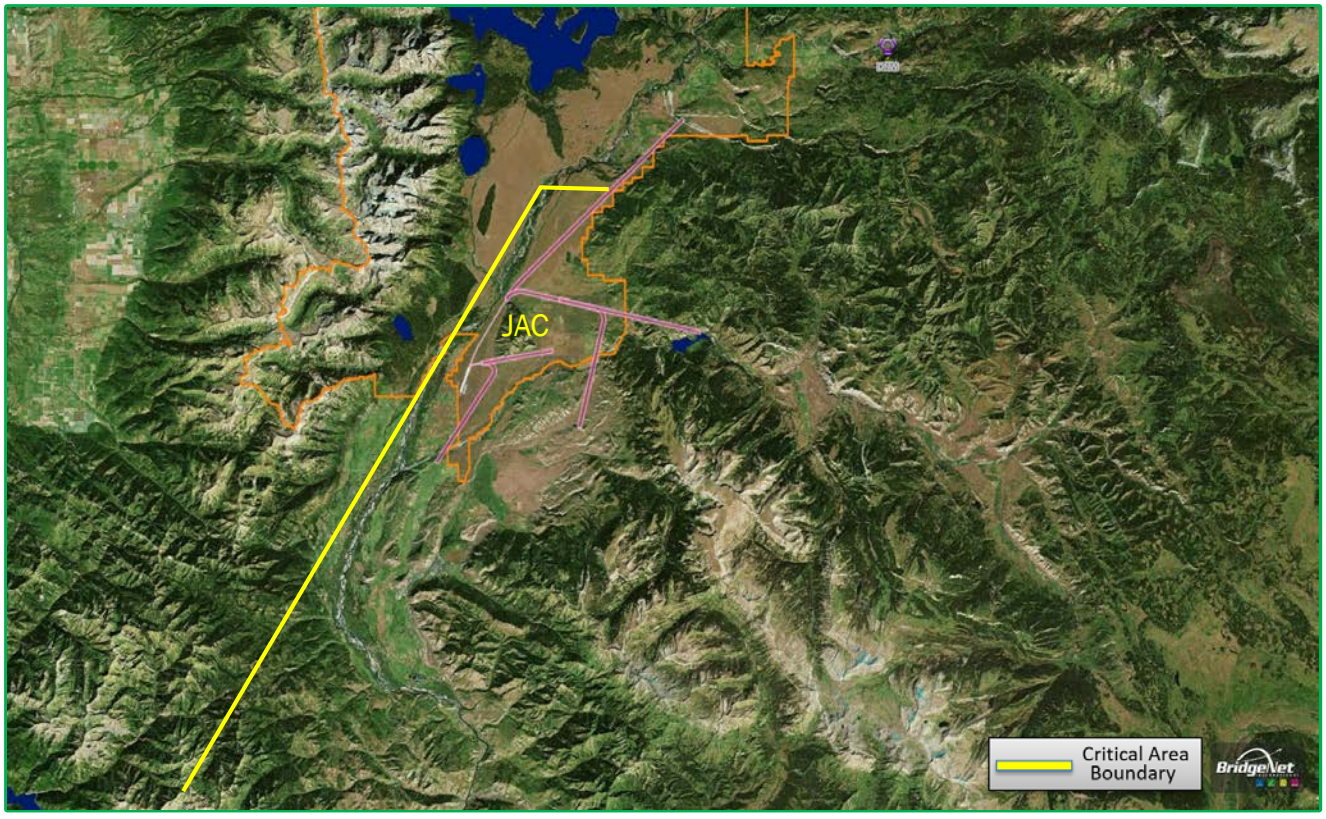
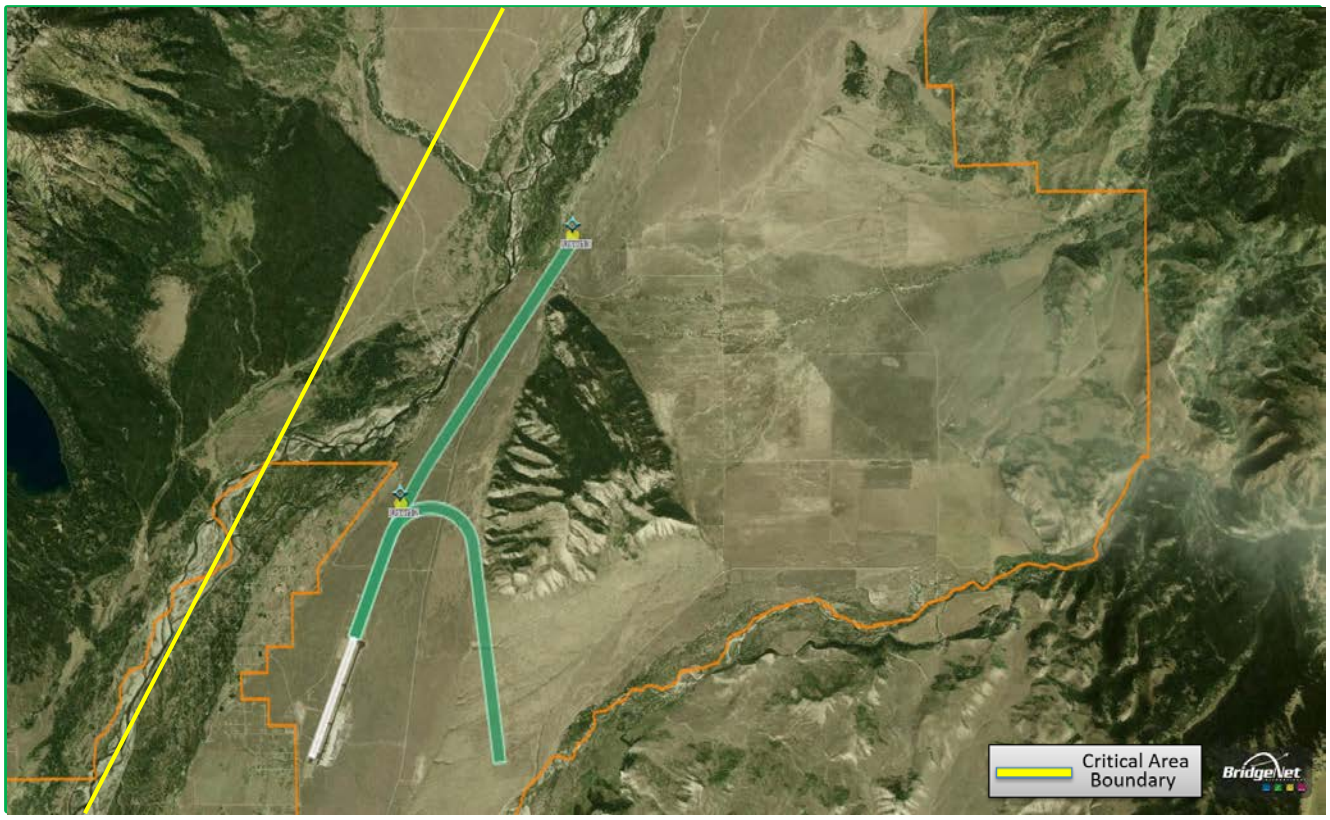


Figure 7-7d

Alternative A6 – Waypoint Departure Paths for Small Aircraft (Runway 01)



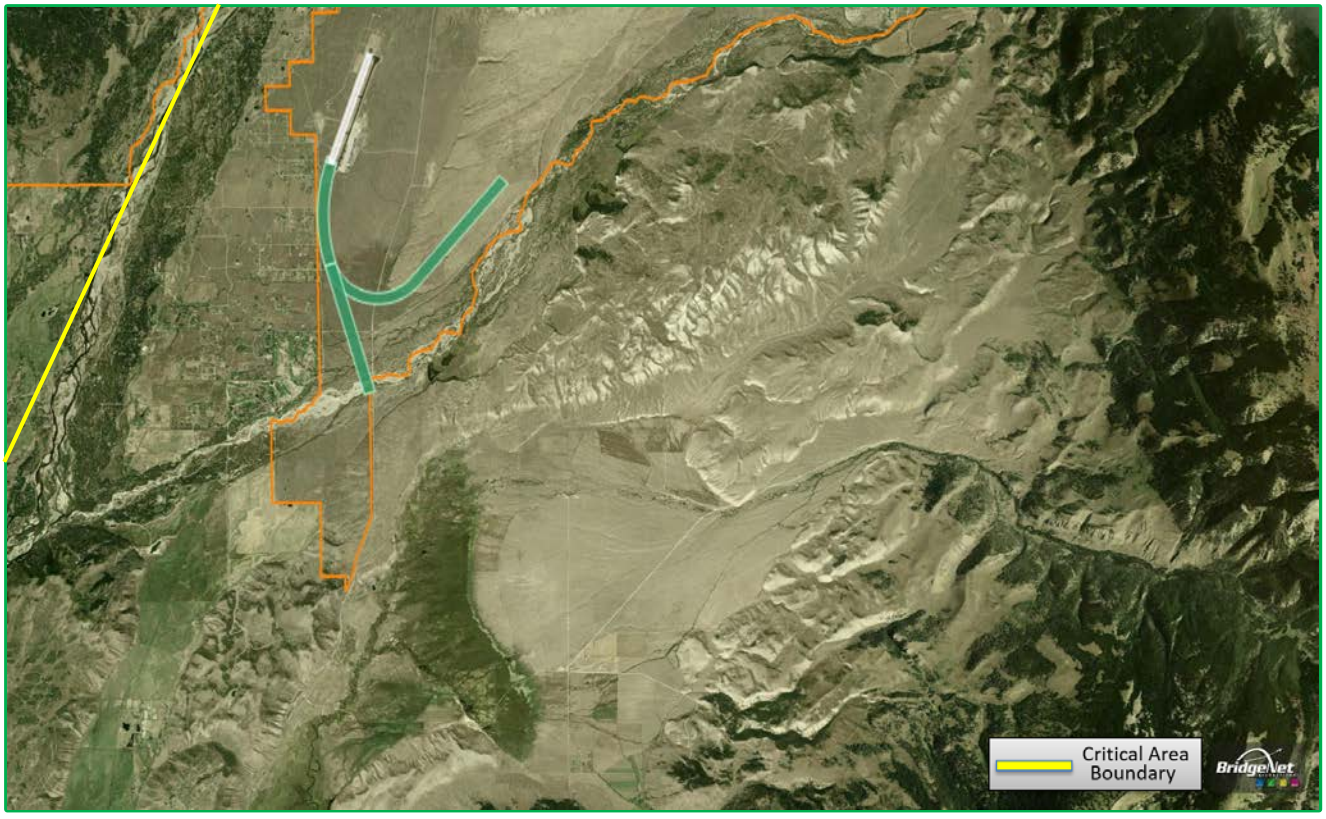


Figure 7-7e

Alternative A6 – Waypoint Arrival Paths to Runways 01/19

7.2.6.1 Modeling Assumptions/New Procedure.

GPS technology is available and used by a large majority of general aviation piston aircraft. For the purposes of this study, the future 2020 analysis assumes 30% of small general aviation aircraft will use these waypoints. Since this is a voluntary procedure, there will be a level of uncertainty as to the number of aircraft that will fly it. Historically, noise abatement procedures were charted as a conventional procedure or given vector headings by the ATC. This new procedure would transition pilots from using conventional technology to satellite based technology for noise abatement procedures.

7.2.6.2 Analysis of New Procedure.

DNL NOISE ANALYSIS. The average annual DNL noise contours for the future 2020 time period that is associated with Alternative A6 were compared to the base case 2020 noise contours (**Figure 7-7f**). Noise contours for the 65 DNL noise level were generated. For comparative purposes this figure also presents the base case 2020 DNL noise contours.

Table 7-1 summarizes the noise changes of this alternative on population and housing within the 65 DNL and greater noise exposure contours in comparison with the 2020 base case. As this table notes, this alternative would not increase or decrease overall population exposed to 65 DNL, relative to the 2020 base case. The population and park acreages within the 65 DNL contour are both zero, which is the same as the base case.

COMPLIANCE WITH USE AGREEMENT: This alternative would not result in a violation of the noise limits contained in the Use Agreement.

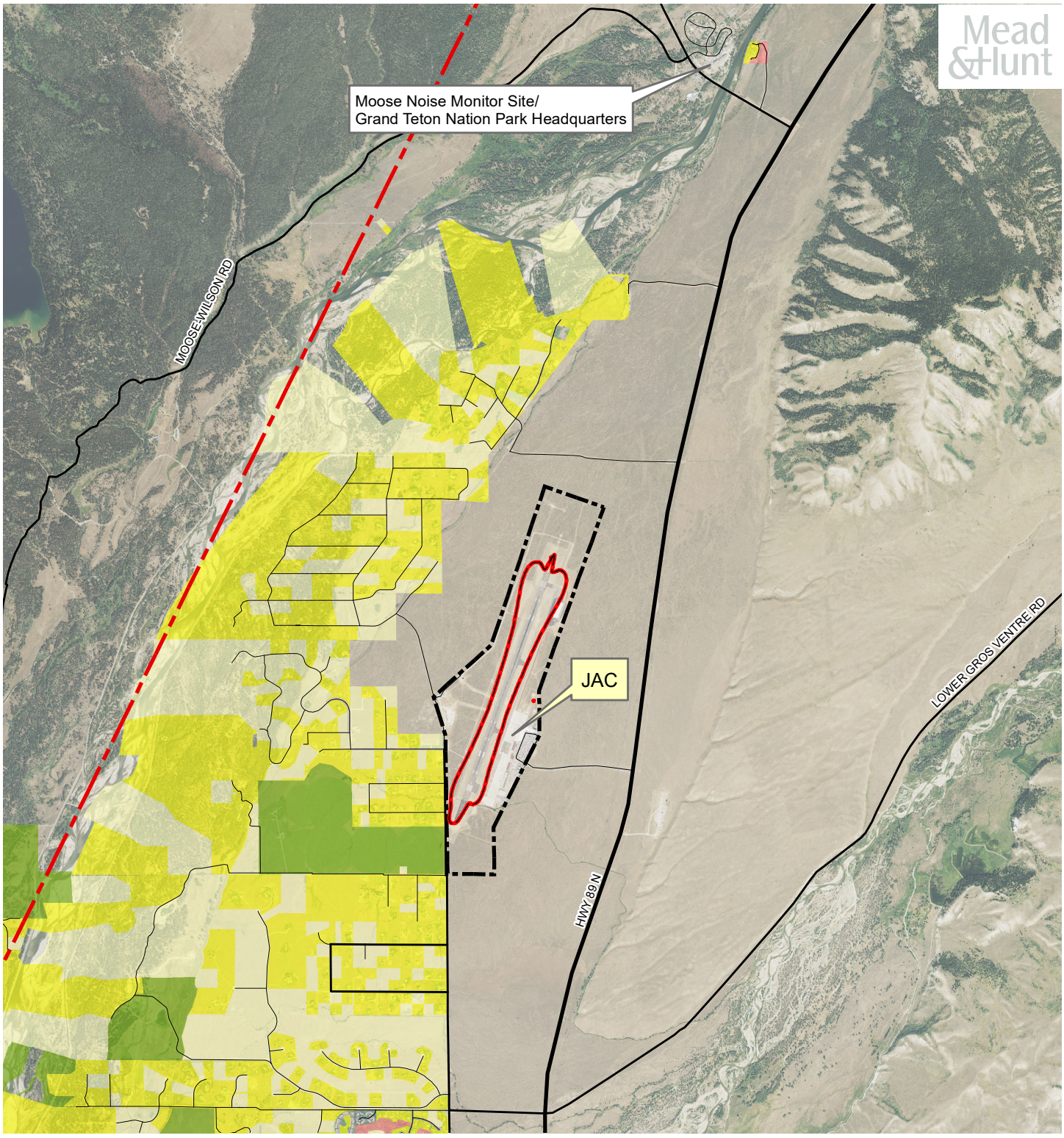
SUPPLEMENTAL NOISE ANALYSIS. The change in noise from this alternative on the supplemental metrics used in this study can be found in **Appendix D**.

OTHER ISSUES. The following issues could result from implementation of the alternative. The agencies are also identified that would have a role in assisting in the implementation of this alternative.

- ***Airport and Air Traffic Control Operational Considerations (safety and efficiency issues):*** The FAA has ultimate responsibility for the safe, orderly and expeditious flow of air traffic. ATC would need to evaluate this alternative to ensure proper altitudes and separation for aircraft arriving and departing in the valley.

- ***Other Environmental Issues (NEPA, etc.):*** Implementation of noise abatement flight procedures requires compliance with NEPA. This procedure could reduce fuel and the associated emissions with a shorter flight.

- ***Barriers to Implementation:*** There are no known barriers to implementation for Alternative A6. However, since this alternative is proposing the development of non-published procedures, the difficulty will be getting high use of the procedures by the general aviation community.



Aerial Souce: 2012 NAIP WY039

N

0 2,000 4,000 8,000 Feet

Noise Contour Legend

DNL_65 2020 Base Case Contours Critical Boundary Area

Generalized Land Use (Teton County GIS)

Residential Commercial AirportProperty

Res Vacant Land Agricultural

FIGURE 7-7f

Alternative A6
2020 DNL Noise Contours

7.2.7 Alternative A7 – Avoid Low Flying Aircraft Operations Over GTNP

NOISE ABATEMENT PROCEDURE GOAL. The goal of this alternative is to promote methods to reduce the overflights of aircraft and helicopters over noise sensitive areas (as defined in the Use Agreement) of GTNP. This includes all operations, specifically addressing transient aircraft flying to and from JAC, as well as sightseeing flights that may occasionally transition over noise sensitive areas of the park to reach tour destinations outside the park. Implementation of this alternative will minimize aircraft from flying over the noise sensitive areas of the park (west and northwest of JAC along the base of the Tetons).

CURRENT PROCEDURE. Aircraft operate at JAC under IFR and VFR conditions. This alternative is primarily focused on aircraft flying in VFR conditions. The majority of the aircraft that overfly the park, fly in areas directly north of JAC along the runway centerline and transition to/from arrival and departure procedures to/from the east. A limited number of flights operate over the park west of the runway centerline. Aircraft flying paths to the west of the runway centerline include occasional sightseeing flights transitioning to routes west of the park boundary (Idaho boundary) and transient flights of both fixed wing and helicopters that are flying to/from their destinations. This alternative focuses on opportunities to proactively reduce the number of these overflights and any other aircraft overflights of the noise sensitive area now and in the future.

Currently, JAC restricts overflights over the park including over the Critical Area Boundary as part of any contract for aircraft based out of JAC airport. These aircraft fly a defined path that avoids the noise sensitive areas. There are occasional instances of sightseeing charter aircraft and helicopters operating over the noise sensitive areas of the park. In addition to sightseeing aircraft, transient aircraft flying to and from JAC occasionally fly paths west and northwest of the runway centerline. These may be transient flights flying an unofficial "sightseeing" path or flying to airports such as West Yellowstone that are in that direction.

An example of flight paths for aircraft operating on the flight paths described above is presented in **Figure 7-8**. Note, that this represents a sample of radar data from January 1, 2014 through June 1, 2016. Also, not all aircraft are recorded by JAC noise monitoring system radar source. For example, transient helicopter operations are often not in the radar data source. This source is primarily aircraft that file a flight plan.

PROPOSED ALTERNATIVE CHANGE. This alternative is proposed to proactively help reduce overflights of all aircraft types over the noise sensitive areas of GTNP to the extent possible. Alternative A7 does not propose any new specific flight paths, but is designed to improve methods to reduce the number of aircraft from flying west and northwest of the runway centerline along the foothills. These measures are listed below.

1. Provide controllers at the JAC Tower with a BI-6 repeater scope that gives local controllers the ability to positively identify VFR traffic by assigning transponder codes and to provide advisories to local visual flying aircraft. This could potentially allow the controllers to provide accurate traffic advisories to the airlines, corporate jets, and air taxis that are on IFR flight plans and separated from one another (by Salt Lake Center) and from VFR traffic. It would involve developing a Memorandum of Understanding (MOU) with all controllers to recommend east turns and paths for all operations to avoid the defined noise sensitive areas.
2. Incorporate these goals into the "Fly Quiet" program that is a separate Alternative under consideration. This also includes voluntary measures that all operators can employ to reduce noise (as described in **Chapter 8**). This could include options for working with operators that occasionally overfly the noise sensitive areas of the park.
3. Work with the sightseeing operator or other recurring operators (private, etc.) to provide a GPS path to better define their operations when transitioning from JAC to the tour destinations just outside the park boundary. This path would effectively be the route that they primarily fly today, but would also include the transition paths defined in Alternative A6.

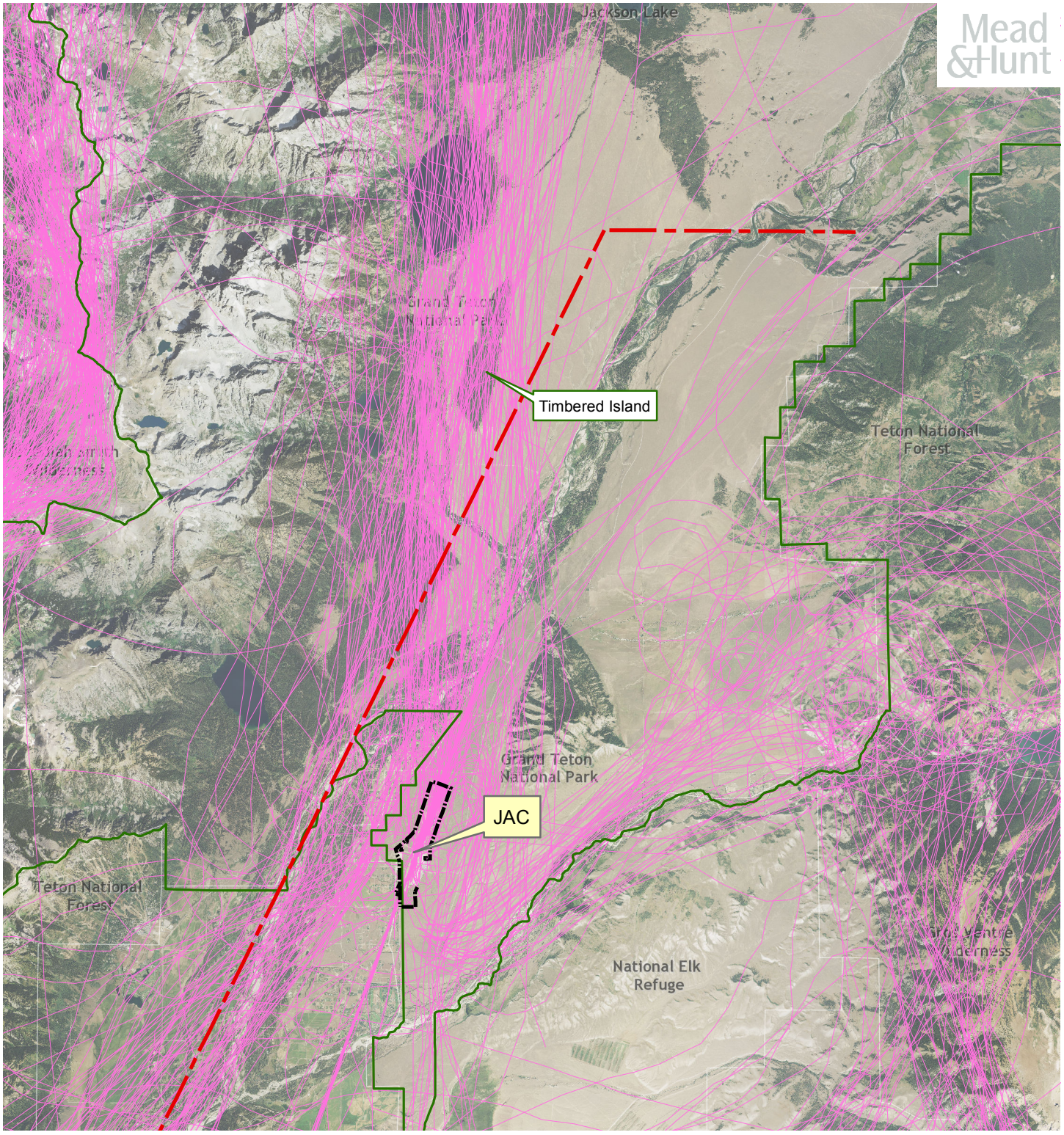


FIGURE 7-8

Aircraft Flight Paths

DESCRIPTION OF THE ISSUE. Alternative A7 would reduce the number of aircraft that fly west of JAC and runway centerline in the Critical Area Boundary. The alternative proposes several options to improve compliance with this noise abatement goal. However, it is important to note that these options would be voluntary.

7.2.7.1 Modeling Assumptions.

Since this is a voluntary option that would require a MOU with the JAC Contract Tower, there will be a level of uncertainty as to the number of aircraft that would fly as recommended in this alternative. The analysis assumes that the small number of aircraft that do turn toward the defined noise sensitive areas of GTNP will fly paths that are on or east of runway centerline, away from the noise sensitive areas.

7.2.7.2 Analysis of Alternative.

DNL NOISE ANALYSIS. The average annual DNL noise contours for the future 2020 time period associated with Alternative A7 were compared to the base case 2020 noise contours for the 65 DNL. There were no changes to the DNL noise contours as the changes occur outside the noise contour area. Therefore, they are not reproduced in the document. The contours for this alternative would be the same as the base case conditions (2020).

The population and park acreages within the 65 DNL contour are both zero, which is the same as the base case.

COMPLIANCE WITH USE AGREEMENT: This alternative would not result in a violation of the noise limits contained in the Use Agreement.

SUPPLEMENTAL NOISE ANALYSIS. The change in noise from this alternative on the supplemental metrics used in this study can be found in **Appendix D**.

OTHER ISSUES. The following issues could result from implementation of the alternative. The agencies are also identified that would have a role in assisting in the implementation of this alternative.

- ***Airport and Air Traffic Control Operational Considerations (safety and efficiency issues):*** The FAA has ultimate responsibility for the safe, orderly and expeditious flow of air traffic. ATC would need to evaluate this alternative to ensure proper altitudes and separation for aircraft arriving and departing in the valley.

- ***Other Environmental Issues (NEPA, etc.):*** Implementation of noise abatement flight procedures requires compliance with NEPA. This alternative would not likely trigger NEPA.

- ***Barriers to Implementation:*** There are many options under consideration for enhancing the compliance of this alternative that will have varying degrees of difficulty to implement including pilot reluctance, ATC evaluation, and time to coordinate and update the MOU. These barriers could limit the use and effectiveness of this alternative.

JACKSON HOLE AIRPORT
CFR Part 150 Study

8
Land Use Facility and Administrative Alternatives

Chapter 8 – Land Use, Facility, and Administrative Alternatives

INTRODUCTION. The previous chapter presented the evaluation and analysis of airport operational noise abatement procedures. This chapter presents the evaluation, analysis, and alternatives relative to land use measures, as well as administrative and facility measures.

- **Land use measures** represent mechanisms that local land use officials can undertake to improve the compatibility of areas exposed to various noise levels.
- **Administrative measures** are those that JAC can implement and are solely within the airport's discretion. These measures will not result in noise reduction (as can be expected from the implementation of the operational noise abatement procedures), but will enable JAC to monitor the success of the program and to provide enhanced community response to issues of concern.
- **Facility measures** include direct changes to the airport facilities that could reduce noise. These measures generally do not result in noise reductions that would be evident in the Average Day Night Noise Level (DNL).

Many of the typical land use alternatives that are examined in a Part 150 Study are not applicable at JAC (i.e., sound insulation programs are not applicable because there must be homes located within the 65 DNL and greater noise contours in order to be eligible for these types of federal programs). JAC has no non-compatible land uses located within either the existing or future 65 DNL noise contours. Additionally, facility alternatives, such as a runway extension, are limited by the Use Agreement.

The following land use and facility measures were considered in **Chapter 6**, but were dismissed as not being applicable to JAC for the reasons elaborated in that Chapter:

Land Use Alternatives Dismissed

- Aquisition of property
- Sound insulation
- Acquisition of avigation easements; voluntary sales assistance

Facility Alternatives Dismissed

- Noise Barriers (Sheilding, including earth berms and walls)
- Construction of a new runway in a different orientation
- Runway Extensions
- High Speed Taxiways

This chapter focuses on applicable land use options that can protect non-compatible land uses at JAC through local planning, as well as administrative alternatives such as enhancing the noise monitoring program and creating a Fly Quiet Program. Additionally, due to the focus of this Study on operational NextGen alternatives, one facility alternative was examined relative to ground based equipment that could be beneficial to JAC.

The analysis includes several measures that arose as a result of the public outreach process and discussions that have taken place at the Study Input Committee (SIC) and public meetings, as well as those measures that were included in the previous NCP, approved by the FAA. The following table summarizes the land use, administrative, and facility options that are examined in this chapter.

Table 8-1 - Land Use, Administration and Facility Alternatives

Options	Responsible Party	Relationship to Previous Part 150 Study
Land Use Alternatives		
Zoning Code Changes/Noise Overlay Zone/Disclosure Statements/Construction Requirements	Local Jurisdiction	Continued Measure (2004)
Comprehensive Plan Amendments	Local Jurisdiction	New Measure
Administrative and Facility Alternatives		
Development of Fly Quiet Report Card and Pilot Awareness Program	JAC	New Measure
Continuation of Study Input Committee	JAC	New Measure
Installation of a BI-6 Repeater in Jackson Hole Tower	JAC	New Measure
Noise Monitoring/Flight Tracking	JAC	Continued Measure (1985)
Noise Complaint Response and Investigation	JAC	Continued Measure (1985 and 2004)
Review and Update Part 150 Study	JAC	Continued Measure (1985 and 2004)
GBAS Upgrade	JAC	New Measure

Source: Mead & Hunt, 2016.

8.1 Land Use Alternatives

This analysis focuses on the evaluation of land use measures designed to reduce non-compatible land use. Land use compatibility actions can be placed in two groups:

- **Preventive:** Prohibiting certain land uses from developing within the aircraft noise exposure contours. Preventive actions do not affect existing land uses, but are targeted at preventing future noise sensitive uses and generally have to be implemented by the land use authority, such as the County. Preventive actions include zoning, building codes/subdivision regulation provisions, granting of avigation easements, sound attenuation requirements for new construction, buyer disclosure statements, and comprehensive plan amendments.

- **Remedial or Corrective:** Remedial or corrective actions are directed at correcting existing non-compatible land uses. Remedial actions may include sound insulation of single family structures, multi-family structures, sleeping portions of fire stations, hospitals, assisted living facilities, religious facilities, schools, and libraries; purchase of non-compatible land uses within high noise contours; purchase of avigation easements; and sales assistance programs.

Remedial measures are within the authority of the FAA to fund for existing non-compatible land uses inside the 65 DNL noise contour. Remedial actions were determined to not be applicable at JAC because there are no non-compatible land uses within the 65 DNL or greater noise contours. Preventative measures are within the authority of the local jurisdiction and usually of lesser concern to citizens living near JAC because they apply only to new construction. The alternatives below focus on preventative measures.

8.1.1 Zoning Code Changes/Noise Overlay Zone/Buyer Notification/Construction Requirements

GOAL: To protect the health, safety, and welfare of the public through the prevention of new non-compatible land uses within the vicinity of JAC; to reduce the annoyance of aircraft noise intrusion to prospective residents by providing direct notice of the possibility of such intrusion prior to home purchase; and to provide mandatory construction requirements for new structures within the airport environs.

DESCRIPTION: This measure is continued from the previous Study (Measure 7: Reduction of Noise Intrusion to Sensitive Land Uses in the Airport Environs from 2004 Study Record of Approval (ROA)).

Teton County currently has adopted the Jackson Hole Airport Resolution as part of the County Development Regulations. The Resolution contains the Height Hazard zoning ordinance and the Airport Noise Exposure regulations. The noise exposure regulations state that if any part of a subdivision is to be located within two miles of the centerline of the runway, subdivision plats shall be annotated to indicate the immediate proximity to JAC. This Action will notify potential residents within JAC environs of possible noise intrusion. In addition, recommended noise reduction measures for construction are presented in an effort to reduce inside noise levels by 25 dB for properties within the 65 or 70 DNL. It is recommended that these regulations remain part of any future County regulatory scheme.

DISCUSSION: Potential property buyers should be notified of the potential for noise. Additionally, noise reduction measures may be included for the construction of any future residential structures within a certain contour.

The future base case 65 DNL noise contour is located entirely on JAC property. Therefore, it might be in the County's interest to put these construction requirements in place for a larger contour (such as the 60 DNL) or for the same area defined for the notice requirement in the Code.

SUMMARY: Zoning can be a very effective means of controlling land use development and is the most widely used land use control. This measure has already been implemented by Teton County. It is therefore recommended that the Jackson Hole Airport Resolution be kept in place so that any zoning revisions in the future will continue to apply preventative zoning measures and buyer notification. The airport director should file the updated NEMs with the County.

8.1.2 Comprehensive Plan Amendments

GOAL: To prevent the introduction of new non-compatible land uses through the land use planning and development policy process.

DESCRIPTION: Comprehensive plans are prepared by local jurisdictions to 1) identify current conditions in a community, 2) identify community goals and policies, and 3) identify plans for that community to achieve the goals. This measure proposes that the Town and County Planners consider JAC in any future comprehensive plan update to achieve long-term land use compatibility of the jurisdiction's lands.

These plans are particularly important in the area around JAC that may experience noise levels that could affect certain types of residential structures or public buildings, and may be outside the 65 DNL noise contour. It is desirable that each community develop its plans and policies to be compatible with existing and future aircraft noise levels. This approach will help ensure that compatible development occurs in the future, as it is much easier to avoid the creation of land use incompatibilities than it is to remedy incompatibilities already in existence.

DISCUSSION: The Town of Jackson and Teton County adopted the Jackson/Teton County Comprehensive Plan in April 2012 to serve as a guide for future development within Jackson and Teton County.

The Comprehensive Plan recognizes the importance of JAC as a key gateway to destinations in the area such as the GTNP. The Plan also recognizes that the areas west and south of JAC serve as gateways to these major destinations and should be carefully planned accordingly.

The Comprehensive Plan includes a Future Land Use Plan to envision what the community will look like upon full implementation of the themes and goals of the Comprehensive Plan. Regarding directions for future development, the Comprehensive Plan classifies the subareas west of JAC as primarily Preservation and Conservation-oriented subareas. These subarea types are focused on preserving existing infrastructure with no change to undeveloped open space, scenic resources, or wildlife habitat; and focuses on improved conservation through increasing the amount of such resources, respectively. Based upon these classifications, and due to the prevalence of protected natural lands in the region, future land use changes can be expected to have little impact on land use development and change within the airport vicinity. These recommendations within the plan focus on conservation and are consistent with long-term compatible land uses.

SUMMARY: As stated earlier, a comprehensive plan by itself does not reduce aircraft noise levels nor does it control the use of land, as it is just a policy statement of the intended future use of land. However, comprehensive plans do influence the development or change in use of any particular piece of property. They also serve as a guide for future development. As described above, the Jackson/Teton County Comprehensive Plan focuses on conservation within the area surrounding JAC. This, paired with the Jackson Hole Airport Noise Resolution, provides good preventative land use measures. It is recommended that any future comprehensive plan from Teton County or planning studies from NPS would continue to examine the future land use plans near JAC and take into account the NEMs contained within this Study.

8.2 Administrative and Facility Alternatives

Administrative and facility measures are those that JAC can implement, with or without FAA funding. These measures will generally not result in noise reduction or would result in small changes relative to single events that would not affect the DNL contours. These alternatives enable JAC to monitor the success of the program and to provide enhanced response to community concerns and pilot coordination on issues of concern. They are not dependent upon other measures to be implemented.

8.2.1 Development of Fly Quiet Program and Pilot Awareness Program

GOAL: To reduce the effect of single event noise levels and to increase awareness of noise sensitive uses and noise abatement procedures for pilots operating at JAC.

DESCRIPTION: This measure involves the creation of a Fly Quiet Program for JAC. The Fly Quiet Program's purpose is to encourage individual airlines, fractional jet operators, and individual business jet operators to operate as quietly as possible at JAC. One of the features of the program would be a Report Card that acknowledges those operators that attempt to follow the noise abatement goals of JAC. The program may have different award categories for different categories of operators. For example, the program could include one category for airlines, one for fractional operators like NetJets, and one for individual business jet operators. A goal for the Fly Quiet Program could be for fractional operators to schedule their quietest aircraft into JAC. These newer, quieter aircraft are also typically equipped with more modern cockpit management systems capable of flying precise procedures that can avoid noise sensitive land uses. The program creates a participatory atmosphere of the operators working with JAC and the community to actively reduce noise by grading an airline's operator's performance, adding the grades to the Report Card, and making the scores available to the public via an airport tablet application, newsletters, publications, and/or public meetings.

The participation of NPS, pilots, affected communities, as well as users of GTNP would be required to develop and initiate a Fly Quiet Program. The Fly Quiet Program is intended to grow and change as new procedures and new technologies are incorporated into JAC's noise abatement program. For example, a goal of the program could be for airlines to operate Stage 5 aircraft at JAC, which are also typically equipped to fly NextGen procedures. These goals would be voluntary. Scores would be computed and reports would be generated quarterly and yearly.

The Fly Quiet Program offers a dynamic venue for implementing new noise abatement initiatives by praising and publicizing active participation rather than a system that admonishes violations of mostly voluntary procedures. This would build upon the existing voluntary procedures described in **Chapter 1**.

DISCUSSION: Pilot education is very important with regards to single event levels. A Fly Quiet Program distributed to pilots can help educate them on "good neighbor" procedures, which would reduce the effect of fly-overs on noise sensitive uses. This is particularly applicable as it relates to the noise sensitive areas of GTNP and the specifications of the Use Agreement

Comments received during this Study have indicated that a Fly Quiet Program would be highly valued to examine additional methods to reduce overflights of noise sensitive areas.

SUMMARY: A Fly Quiet Program is focused on education. Experience with these programs across the nation has indicated that education can be an important tool for reducing single event noise near airports (particularly related to general aviation operations) and can be more easily updated than a Part 150 Study.

8.2.2 Continuation of Study Input Committee

GOAL: To assist in implementation of the Part 150 Study Noise Compatibility Program, the Fly Quiet Program, and identify and address noise issues with an ongoing method.

DESCRIPTION: This measure involves the continuation of the SIC established for this Study. It is recommended that noise concerns are addressed through a continuation of committee meetings.

DISCUSSION: Noise metrics and mitigation is a complex subject and the SIC members and airport staff have invested a significant amount of time in the development of this Study, particularly in the "learning curve" effort and building of relationships. This is particularly important for JAC with the partnership between the airport staff and NPS staff. The continuation of the committee in one format or another could assist on-going implementation efforts once the NCP is approved by the FAA. The balance of interested parties is very important for the successful implementation of the NCP. Current members include stakeholders such as citizens, the Elk Refuge, Teton County representatives, pilots, ATC, among others. These members could continue as part of the committee and additional new members could be added to represent additional interests as needed.

SUMMARY: Continuation of the SIC in some format can ensure that the "body of knowledge" gained during the Study process is not lost and can continue to foster relationships between the stakeholders as the program gets implemented.

8.2.3 Installation of a BI-6 Repeater in Jackson Hole Tower

GOAL: To provide the JAC Tower with enhanced ability to offer additional guidance for aircraft to avoid, as much as possible, noise sensitive areas of the within the GTNP and surrounding areas.

DESCRIPTION: This measure involves installing a repeater of the existing BI-6 radar feed that is already installed at JAC. The B1-6 radar system is a state-of-the-art monopulse secondary surveillance radar that is able to interrogate transponder equipped aircraft to determine aircraft range, azimuth, assigned code, altitude, Mode-S identification, and emergency status. It would provide controllers at the JAC Tower with a BI-6 repeater scope that gives local controllers the ability to positively identify visual flight rules (VFR) traffic by assigning transponder codes and then providing advisories to local visual flying aircraft. This could potentially allow the controllers the ability to provide accurate traffic advisories to the airlines, corporate jets, and air taxis that are on instrument flight rules (IFR) flight plans and separate from one another (by Salt Lake Center) and from VFR traffic. This would include developing a Memorandum of Understanding (MOU) with all controllers to recommend east turns and paths for all operations to avoid the defined noise sensitive areas.

DISCUSSION: At JAC, the Tower uses long-range radar, which does not provide information for smaller aircraft due to the nature of long-range radar not being as precise as a more local radar feed. Due to this, aircraft operate on a “one-in”, “one-out” basis, meaning aircraft operate in an environment that uses the same separation standards as if there was not radar available for the air traffic controllers. The JAC radar is a beacon interrogator feed (BI-6 feed) that updates every 12 seconds based upon beacon code responses; this allows JAC to see aircraft flight tracks, even smaller aircraft as long as the aircraft beacon receives the radar interrogation. The BI-6 repeater scope will provide this same information in a display scope to the Tower that currently is displayed at Salt Lake Center. The radar will give the air traffic controllers better accuracy when knowing where an aircraft is in relation to GTNP and especially sensitive noise areas. This increased situational awareness will allow controllers to guide aircraft away from the Critical Area Boundary within GTNP as well as areas around JAC which would typically be outside of the 65 DNL but that receive overflights. This could help reduce overflights of the noise sensitive areas of GTNP and surrounding areas.

SUMMARY: Installation of a repeater at JAC will provide greater aircraft location accuracy for the air traffic controllers, allowing them to guide aircraft away from noise-sensitive uses within GTNP and other areas.

8.2.4 Noise Monitoring/Flight Tracking

GOAL: To track single noise events around JAC.

DESCRIPTION: This measure was not specifically outlined in the 2004 Study ROA; however, JAC has one of the most extensive noise monitoring systems in the country. This alternative would look at ways to improve on this system and integrate it with a potential Fly Quiet Program.

DISCUSSION: In 2003, JAC installed a noise monitoring system consisting of six permanent noise monitoring sites, as shown in **Chapter 1**. Prior to installation of the permanent system, JAC completed seasonal monitoring from 1984 to 2003. The permanent monitoring system is state-of-the-art and complies with all specific International Electrotechnical Commission (IEC) standards and measurement standards established by the American National Standards Institute (ANSI) for Type 1 instrumentation.

The data collected by the permanent monitors include the continuous measurement of 1-second average or equivalent (LEQ) noise levels. This type of measurement system allows for a more accurate measurement of lower aircraft noise levels that are typical of the sites in GTNP. Analysis of this data resulted in the SEL noise levels from each individual flyover, the hourly LEQ noise levels, and the daily DNL noise levels for the measurement period.

In fall of 2008, the FAA installed a BI-6 radar system at JAC. With the installation of radar, the noise monitoring system was also upgraded. The BI-6 radar data connection allows for the noise monitoring system to correlate an aircraft noise event to the aircraft causing the event. The upgrade allows the noise monitoring system to more accurately measure the aircraft noise levels at the noise measurement points.

JAC maintains a live feed of all of the IFR aircraft activity in the United States directly from the FAA center data as a secondary information source compiled by ITT Corp. These data are fused from multiple sensors, including en-route data, ADS-B transponders, and the BI-6 radar located at JAC. VFR operations are determined from the FAA's Terminal Area Forecast and OpsNet databases. When possible, VFR data are correlated with the noise event data using custom software.

Each flight is assigned a unique identification track number, so all of the data for any particular flight can be compiled. The flight information includes data such as the ARTS aircraft type, ARTS airline code, departing and arriving airport codes, and flight number. The position information includes the X and Y coordinates as well as the altitude of the aircraft at each point.

Another new data source JAC should consider is the FAA's System Wide Information Management System (SWIM). SWIM is a mechanism to access a wide array of Air Traffic Management (ATM) data, including near-live flight tracks. Accessing SWIM data does not require connectivity to other FAA facilities such as Air Route Traffic Control Centers (ARTCC), TRACONS or BI-6 systems. Instead, authorized data consumers make software requests over the Internet (through a VPN) to get all available data in the vicinity of JAC.

The data can contain other information not included in the BI-6 feed, such as detailed flight plans and planned routes. SWIM data that covers the Jackson Hole area is just now starting to come online and be available for use. This should improve JAC's ability to track and report on operations that currently are not available from the current radar feed. For example, transient helicopter and fixed wing tour flights that are now unknown, can be tracked from their departure/arriving airport. The data will also include ADS-B data so that the operator of that aircraft will also be known. While not all aircraft are now ADS-B equipped, the mandate is to have nearly all aircraft equipped by 2020.

SUMMARY: JAC is actively using their noise monitoring system, and it is recommended they continue to do so to report on supplemental metrics and tracking for use by JAC and GTNP. This measure recommends that the noise monitoring system be upgraded when necessary to continue this important program. Additionally, it is recommended that during the Fly Quiet Program, specific attention is paid to ways to integrate the Fly Quiet Program with the noise monitoring system to accurately track the effectiveness of the Program over time and identify ways to improve the program and the system, particularly with respect to integrating new technology opportunities noted above.

8.2.5 Noise Complaint Response and Investigation

GOAL: To collect and examine aircraft noise comments and increase ability to respond to public and GTNP concerns based on comments received.

DESCRIPTION: This measure is a continuation of an approved measure from a previous Study. Under this alternative, JAC would continue its Noise Complaint system approved in 1985 as part of the initial NCP, recording noise complaints received from citizens to monitor the noise abatement plan described in **Chapter 1**.

As part of this measure, airport staff receives a report from Flight View, showing N-numbers and time of aircraft operations at JAC. The airport staff proactively looks up the addresses and companies that operate during the curfew (with the exception of life-flights). For any aircraft that do not conform to the voluntary curfew (regardless of whether there is a complaint), JAC sends them a notification letter. Although the curfew is voluntary, JAC finds that the letter notifications can help reduce the number of nighttime operations during the curfew.

If there is a complaint filed relative to an event, after finding the cause of the violation, JAC follows up with the person who submitted the complaint. Due to the process of proactively contacting all companies that operate during the curfew, and the other noise mitigation processes in place, JAC receives few noise complaints.

DISCUSSION: Stakeholder comments can be very important for the relationship between JAC, GTNP, and the public. This measure should be continued and could be integrated with the recommended Fly Quiet Program alternative to provide a cohesive approach.

SUMMARY: Tracking noise comments or complaints can help JAC better understand the location and type of operations that are most annoying to the public. Additionally, it could be integrated with a Fly Quiet Program to provide additional links to metrics/reporting.

8.2.6 Review and Update Part 150 Study

GOAL: To update the Part 150 Study when appropriate to ensure the NEMs and NCP are adjusted as conditions change over time.

DESCRIPTION: This measure would involve the update of the NEMs or the Part 150 Study, when needed, or when dictated by the Use Agreement with the Park Service.

DISCUSSION: A Part 150 Study is intended to be a "living document" to be used as a tool to monitor and guide program development, and evaluate aircraft types and operations. The Study should be reviewed and updated, as appropriate. The general guideline is whenever the actual operations are approximately 15% different from the forecast operations, the NEMs should be reviewed.

In addition, any time there are significant new non-compatible land uses within the 65 DNL or greater contours, or if there are airport facility changes which may affect the contours, consideration should be given to reviewing the maps. At the end of the five-year study period (after the date of NCP approval), the operations and mix should be re-evaluated to identify the extent to which they have changed to determine if a Part 150 Study Update is warranted.

SUMMARY: This measure will ensure that the NEM is updated. The NCP would be updated and adjusted only if non-compatible land uses are identified during the NEM update.

8.2.7 Upgrade JAC's Ground Based Augmentation System (GBAS)

GOAL: Use the most updated ground based technology that supports NextGen procedures.

DESCRIPTION: This measure would involve the upgrade of JAC's existing Ground Based Augmentation System (GBAS) to support proposed NextGen procedures. JAC previously purchased a GBAS, which is a NextGen landing system. The GBAS is like an ILS, but uses the GPS signal along with local ground-based augmentation to allow aircraft to land in instrument weather conditions. It is different than an ILS in that it can be used on both runway ends and can support multiple approach procedures without installing an ILS at each runway end. The current system at JAC is not active, but JAC can request an upgrade at any time from the manufacturer. The upgrade would be at no cost; however, there would be some one-time construction costs and on-going maintenance that are currently not reimbursable by the FAA. Below is a list of the advantages of GBAS.

- It is a very precise and accurate landing system that is less influenced by poor weather than an ILS. It would enhance the safety for aircraft landing at JAC when using this landing system.
- Aircraft that use this technology are flying a very precise and stabilized approach. The approach can be designed to be optimized so that minimum thrust is required to give the aircraft a continuous descent, and a quieter landing can be attained without the need for power adjustments that often occur with a conventional ILS approach.
- The system would provide for an instrument approach from the south (Runway 01) that would have better minimums than can be achieved today, which means aircraft could land in poor weather conditions. In the future, the minimums may even be improved over the current minimums for aircraft landing from the north (Runway 19).

This could increase the ability for aircraft to land from the south, reducing overflights over GTNP (see Alternative A5 in **Chapter 7**, which proposes increased use of landings on Runway 01). However, as presented in the noise analysis alternatives section, this could increase noise over residences to the south.

- Currently the only operator at JAC that has GBAS-capable aircraft equipped to use this technology is Delta's 737-700 aircraft. New generation aircraft such as the 737 MAX and A320 NEOs will be equipped to fly this type of landing system. This includes the 737-MAX aircraft ordered by both Delta and United. Thus, having this landing system may encourage airlines to operate these aircraft at JAC, which could be beneficial from a noise perspective because these new generation aircraft are quieter than current aircraft.

DISCUSSION: Currently, the FAA does not reimburse the annual maintenance for GBAS landing systems. The recommendation is to work with airlines that have shown interest in the technology to do a preliminary analysis that would document the performance benefits of a GBAS at JAC. Generally, the benefits would be difficult to precisely determine in terms of the DNL noise contours, but could help increase the use of future NextGen procedures, more stabilized quieter landings, and promote the use of new generation, quieter aircraft at JAC. This recommendation pursues the upgrade to the GBAS if and when FAA provides annual maintenance support.

SUMMARY: This measure would help provide support for NextGen procedures through the upgrading of ground based technology.

JACKSON HOLE AIRPORT
CFR Part 150 Study

9
Issues/Actions and Recommendations

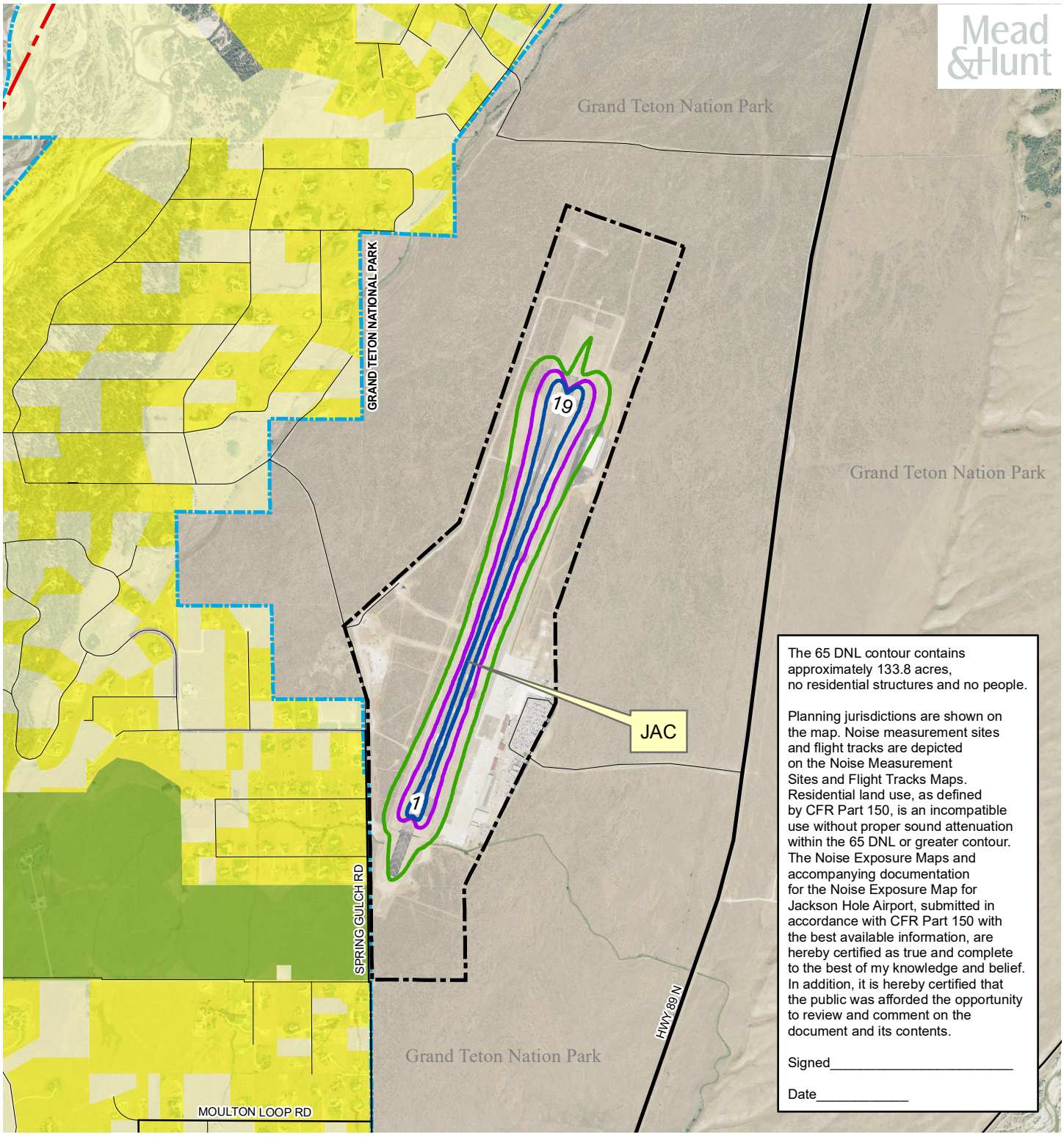
Chapter 9
Issues, Actions, and Recommendations

INTRODUCTION. This chapter contains the recommendations of this Part 150 NCP for JAC, which is an update to the NCP completed in 2004. The time-period for this NCP is through the year 2020, which is the future year serving as the basis for the Future NEM. The Future NEM is presented in this chapter along with the affected population and acreage associated with it. This is the NEM used as the basis for this NCP.

The individual recommendations of the NCP identified in this chapter are composed of noise abatement (operational recommendations), land use compatibility recommendations, and program management recommendations. One combined recommendation contour is included to show the changes that would result if all the operational recommendations were implemented. However, since these recommendations would not necessarily all be completed due to various issues to be resolved, the official 2020 Future NEM does not include the recommendations provided in this chapter and it is the same as the future baseline contour.

9.1 Future Noise Exposure Map

Part 150 requires the evaluation of future noise conditions and the identification of a Future NEM. This study includes a future baseline noise exposure contour map that served as the basis for considering the effectiveness of each noise abatement option. The Future NEM reflects the 2020 forecast of aviation activity. The Future NEM is illustrated in **Figure 9-1**. The future NEM represents future noise conditions with none of the operational recommendations implemented because the timing for implementation is not known. The land use types and population within the Future NEM are detailed in **Table 9-1**.



Aerial Souce: 2012 NAIP WY039

N

0 1,000 2,000 4,000 Feet

Noise Contour Legend

65 DNL 70 DNL 75 DNL

Generalized Land Use (Teton County GIS)

Airport Property
GTNP Boundary
Critical Boundary Area
Residential
Res Vacant Land
Agricultural

FIGURE 9-1

Future Noise Exposure Map (2020)

Table 9-1 - Existing Land Use within Future Noise Exposure Map Contours

Land Use	Base Case (2020)	Recommendations						ALL
		1	2	3 (Alt 4)	4 (Alt 5)	5 (Alt 6)	6 (Alt 7)	
65 DNL Contours								
National Park	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Airport*	131.0	131.0	131.0	132.3	132.4	131.0	131.0	133.8
Residential Acres	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Persons**	0	0	0	0	0	0	0	0
Housing Units	0	0	0	0	0	0	0	0
Residential Vacant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Agricultural	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Total Land Use Acres 65 DNL	131.0	131.0	131.0	132.3	132.4	131.0	131.0	133.8

Source: BridgeNet International, 2017; Existing Land Use, 2010 Census Data and Aerial Photography, Mead & Hunt Analysis.

Note: Acres rounded to the nearest tenth.

*Airport property is the area that is leased from the National Park and is located within GTNP.

**U.S. Census data, 2010, 2.34 individuals per household.

9.2 Future Combined Recommendations Map

There are several operational recommendations that could reduce noise and potentially provide benefits to residences and GTNP outside of the 65 day-night average sound level (DNL) contours. Therefore, this chapter includes a Combined Recommendations contour that assumes the implementation of all operational recommendations. However, as noted above, since these recommendations have barriers and require additional study or development, they do not constitute the future NEM, but are included for planning purposes. These recommendations are included in the Combined Recommendations contour:

Recommendation 1: RNP-AR Arrival Procedure for Runway 19

Recommendation 2: Chartered Visual RNAV/Company Special RNAV Arrival Procedure for Runway 19

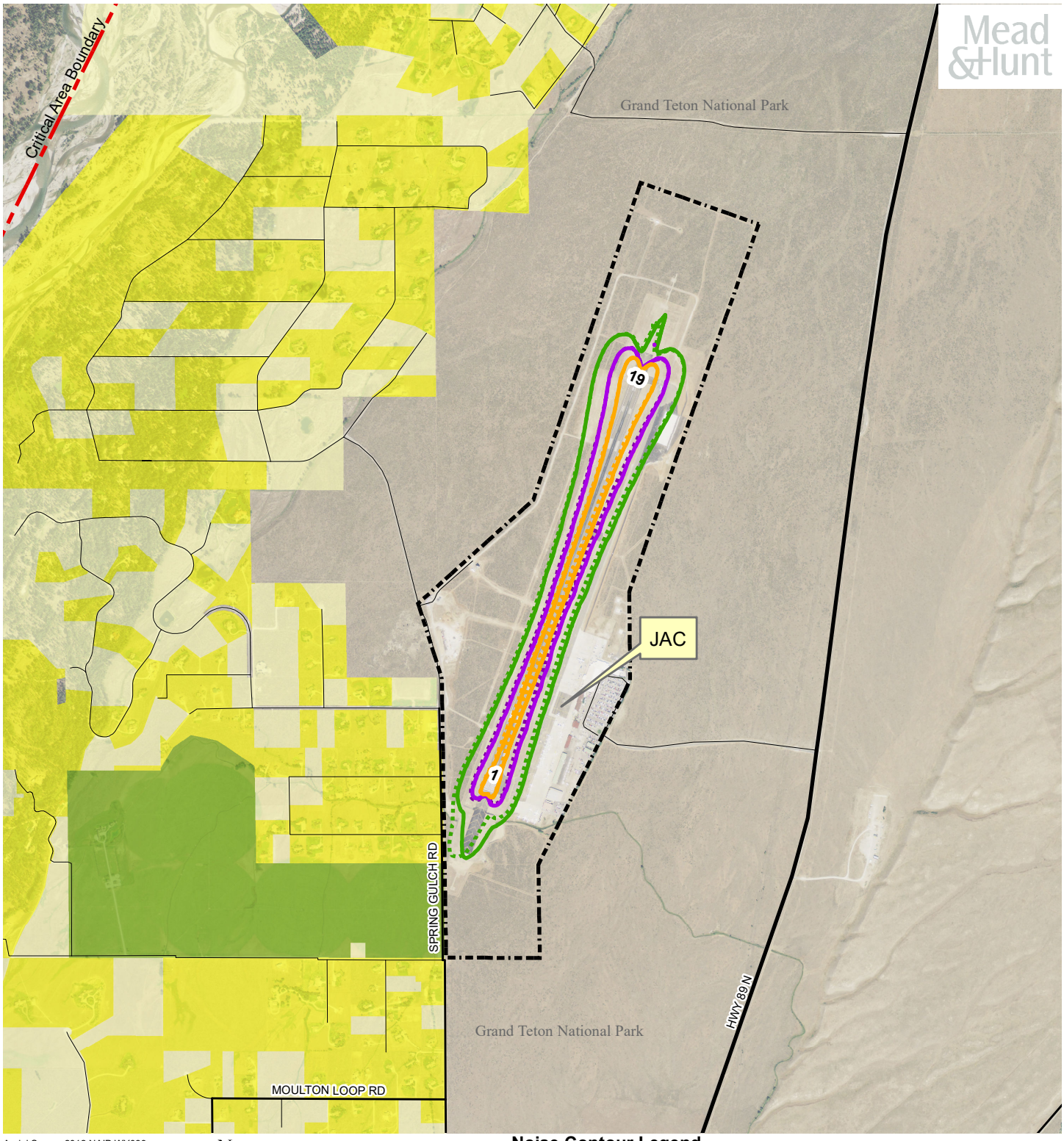
Recommendation 3: RNAV Standard Instrument Departure (SID) for Runway 19 (Alternative A4 from **Chapter 7**)

Recommendation 4: RNAV Standard Instrument Departure (SID) for Runway 01 (Alternative A5 from **Chapter 7**)

Recommendation 5: Waypoint Noise Abatement Flight Paths (Alternative A6 from **Chapter 7**)

Recommendation 6: Avoid Low Flying Aircraft Operations Over Grand Teton National Park (Alternative A7 from **Chapter 7**)

These recommendations are detailed below, and the effects (population and housing units) of the Combined Recommendations contour is included in **Table 7-1**. Alternative A3 was not carried forward into the recommendations, based on comments received from the public relative regarding a potential increase in operations over residences. Therefore, the rest of the recommendations have been renumbered relative to this removal. The Combined Recommendations contour, illustrated in **Figure 9-2**, shows an increase in the 65 DNL (entirely on Airport property), but shows a decrease in noise relative to the more noise sensitive areas in GTNP (west of JAC) and the residences to the south. There is an increase in noise in some areas within the GTNP; however, this increase is in the area to the south that is considered less noise sensitive. The Combined Recommendations map is included because the combined operational alternatives were not included in the official NEM, as the timing of implementation is not known. However, a Combined Recommendation map is helpful for planning purposes.



Aerial Souce: 2012 NAIP WY039

N

0 1,000 2,000 4,000 Feet

Noise Contour Legend

Combined Alts	2020 Base Case	
DNL_75	DNL_75	Critical Boundary Area
DNL_70	DNL_70	
DNL_65	DNL_65	

Generalized Land Use (Teton County GIS)

Residential | Res Vacant Land | Agricultural | Airport Property

FIGURE 9-2

Combined Recommendations (2020)

9.3 Recommendations

Operational recommendations have the potential to affect the DNL noise exposure contours; however, there are several other recommendations for implementation that would not alter the size or location of the contours, but may reduce single event noise or help prevent additional noise issues in the future. All the noise abatement recommendations are summarized in the sections below.

The remainder of this chapter no longer uses the same numbering system that was used to differentiate among the options in other chapters (i.e., Alternative A1). Instead, this chapter uses recommendation numbers that are a sequential listing of NCP recommendations within each category (noise abatement, land use management, and program management). The recommendations are not listed in order for priority of implementation. Priorities and conditions are subject to change over time, are based on availability of funding, and should be set annually along with JAC's Capital Improvement Plan (CIP). The recommendations developed for this Study are summarized in **Table 9-2** and note where recommendations are continued from previous Records of Approval. Recommendations from the 2004 and 1985 studies.

While implementation of the recommendations is not required and is highly dependent upon available funding and resources, JAC intends to implement the proposed NCP. The inclusion of any proposed project in this NCP is subject to eligibility, what is allowable, and the justification requirements in place at the time the project is proposed for JAC's CIP. FAA approval of any measure is not a commitment to funding or of eligibility. Airport Improvement Plan (AIP) eligibility will be determined when the project is ready to be implemented.

Table 9-2 –Noise Compatibility Study Recommendations Comparison

1985 ROA	Change 1985-2004	2004 ROA	Change 2004-2018	Recommendation 2018	Status and FAA Action Requested
Noise Abatement					
Access Plan Elements **1985 FAA Determination:** Approved **Status:** Implemented	In place, no future recommendation required	---	In place, no future recommendation required	---	**Status:** Currently in place **FAA Requested Action:** None
Continue Existing Curfew **1985 FAA Determination:** Approved **Status:** Implemented	In place, no future recommendation required	---	In place, no future recommendation required	---	**Status**: Currently in place **FAA Requested Action:** None
Impose Curfew on Any New Airlines **1985 FAA Determination:** Disapproved; all curfew restrictions will be based on the existing curfew in previous measure. **Status**: not implemented	Removed	---	Removed	---	**Status**: Not implemented, not brought forward. **FAA Requested Action:** None
Single Event Limit **1985 FAA Determination:** Approved **Status:** Implemented	In place, no future recommendation required	---	In place, no future recommendation required	---	**Status**: Implemented **FAA Requested Action:** None

1985 ROA	Change 1985-2004	2004 ROA	Change 2004-2018	Recommendation 2018	Status and FAA Action Requested
Noise Abatement					
Departure Routes **1985 FAA Determination:** Approved; **Status:** Implemented	In place, no 2004 recommendation	---	Revised to include NextGen procedure recommendations	Recommendations 1-6 of the 2018 NCP	FAA determination requested for **Recommendations 1-6** of 2018 NCP
Preferential Runway **1985 FAA Determination:** Approved; **Status:** Implemented	In place, no 2004 recommendation	---	Revised to include NextGen procedure recommendations	Recommendations 1-6 of the 2018 NCP	FAA determination requested for **Recommendations 1-6** of 2018 NCP
---	New	Restriction of Aircraft Generating Highest Noise Levels, Stage 3 Exempt [1] **2004 FAA Determination:** No FAA determination necessary for restrictions or prohibitions on Stage 2 restrictions due to Vision 100 act. **Status**: not implemented	Removed	---	**Status**: Not Implemented **FAA Requested Action:** None
---	New	Restriction of Aircraft Generating Highest Noise Levels [1] **2004 FAA Determination:** No FAA determination necessary for restrictions or prohibitions on Stage 2 aircraft; Disapproved for restriction of Stage 3 aircraft. **Status**: not implemented	Removed	---	**Status**: Not Implemented **FAA Requested Action:** None

1985 ROA	Change 1985-2004	2004 ROA	Change 2004-2018	Recommendation 2018	Status and FAA Action Requested
Noise Abatement					
---	New	Restriction of Aircraft Generating Highest Noise Levels, a Stage 3 Requirement [1] **2004 FAA Determination:** No FAA determination necessary for restrictions or prohibitions on Stage 2 aircraft. **Status**: Not implemented	Removed	---	**Status**: Not Implemented **FAA Requested Action:** None
---	New	Restriction of Aircraft Generating Highest Noise Levels or a Stage 2 Ban, Part 161 Analysis Funding **2004 FAA Determination:** Disapproved regarding Stage 2; Disapproved regarding Stage 3 pending additional information. **Status**: not implemented	Removed	---	**Status**: Not Implemented **FAA Requested Action:** None
---	---	---	New	RNP-AR Arrival Procedure for Runway 19 (pp. 9.16 - 9.18)	**Status**: Not implemented **FAA Requested Action:** FAA approval of new measure
---	---	---	New	Chartered Visual RNAV/Company Special RNAV Arrival Procedure for Runway 19 (pp. 9.18 - 9.20)	**Status**: Not implemented **FAA Requested Action:** FAA approval of new measure

1985 ROA	Change 1985-2004	2004 ROA	Change 2004-2018	Recommendation 2018	Status and FAA Action Requested
Noise Abatement					
---	---	---	New	RNAV Standard Instrument Departure (SID) for Runway 19 (pp. 9.20 - 9.22)	**Status**: Not implemented **FAA Requested Action:** FAA approval of new measure
---	---	---	New	RNAV Standard Instrument Departure (SID) for Runway 01 (pp. 9.22 - 9.23)	**Status**: Not implemented **FAA Requested Action:** FAA approval of new measure
---	---	---	New	Waypoint Noise Abatement Flight Paths (pp. 9.23 - 9.25)	**Status**: Not implemented **FAA Requested Action:** FAA approval of new measure
---	---	---	New	Avoid Low Flying Aircraft Operations Over Grand Teton National Park (pp. 9.25 - 9.27)	**Status**: Not implemented **FAA Requested Action:** FAA approval of new measure

1985 ROA	Change 1985-2004	2004 ROA	Change 2004-2018	Recommendation 2018	Status and FAA Action Requested
Land Use					
Transfer of Development Rights (TDR) **1985 FAA Determination:** Approved; **Status:** Not implemented	Not included in 2004 recommendations	---	Not included in 2018 recommendations	---	**Status**: Not implemented **FAA Requested Action:** None
Zoning Changes **1985 FAA Determination:** Approved; **Status:** Not implemented	Not included in 2004 recommendations		Added back in in 2018	Zoning Code Changes/Noise Overlay Zone/Buyer Notification/Construction Requirements (pp. 9.27—9.28)	**Status**: Not implemented **FAA Requested Action:** FAA approval of continued 1985 measure
Subdivision Regulations **1985 FAA Determination:** Approved; **Status:** Not implemented	Not included in 2004 recommendations	---	Not included in 2018 recommendations	---	**Status**: Not implemented **FAA Requested Action:** None
Building Code **1985 FAA Determination:** Approved **Status:** Not implemented	Not included in 2004 recommendations	---	Not included in 2018 recommendations	---	**Status**: Not implemented **FAA Requested Action:** None

1985 ROA	Change 1985-2004	2004 ROA	Change 2004-2018	Recommendation 2018	Status and FAA Action Requested
Land Use					
Acoustical Survey/Noise Attenuation **1985 FAA Determination:** Approved **Status:** Not implemented	Not included in 2004 recommendations	---	Not included in 2018 recommendations	---	**Status:** Not implemented, no noncompatible land uses **FAA Requested Action:** None
Purchase of Noise Easement or Fee Title **1985 FAA Determination:** Approved **Status:** Not implemented	Not included in 2004 recommendations	---	Not included in 2018 recommendations	---	**Status:** Not implemented, no noncompatible land uses **FAA Requested Action:** None
Comprehensive Planning **1985 FAA Determination:** Approved **Status:** Not implemented	Not included in 2004 recommendations	---	New from 2004	Comprehensive Plan Amendments (pp.9.28-9.30)	**Status**: Not implemented **FAA Requested Action:** FAA approval of continued measure from 2004
---	---	Reduction of Noise Intrusion to Sensitive Land Uses in the Airport Environs [2] **2004 FAA Determination:** Disapproved; FAA does not intend to interfere with local land use decisions.	Removed	---	**Status**: Not implemented **FAA Requested Action:** None

1985 ROA	Change 1985-2004	2004 ROA	Change 2004-2018	Recommendation 2018	Status and FAA Action Requested
Administrative					
Automatic weather Observation System **1985 FAA Determination:** Approved **Status:** Implemented	Not included in 2004 recommendations	---	Not included in 2004 recommendations	---	**Status**: Implemented **FAA Requested Action:** None
Pilot Education Services **1985 FAA Determination:** Approved **Status:** Implemented	Not included in 2004 recommendations	---	Revised to combine voluntary noise abatement and pilot education into one Fly Quiet Recommendation	Development of a Fly Quiet Report Card and Pilot Awareness Program (pp. 9.30- 9.31)	**Status**: Initiated **FAA Requested Action:** FAA approval of continued measure from 1985
Voluntary Noise Abatement Procedures **1985 FAA Determination:** Approved **Status:** Implemented	Not included in 2004 recommendations	---			
Lease Requirements **1985 FAA Determination:** Approved **Status:** Implemented	Not included in 2004 recommendations	---	Not included in 2018 recommendations	---	**Status**: Implemented **FAA Requested Action:** None

1985 ROA	Change 1985-2004	2004 ROA	Change 2004-2018	Recommendation 2018	Status and FAA Action Requested
Administrative					
Noise Complaint System **1985 FAA Determination:** Approved **Status:** Partially implemented	Continued	Noise Complaint Response and Investigation **2004 FAA Determination:** Approved **Status:** Implemented	Continued	Noise Complaint Response and Investigation (pp. 9.34 - 9.35)	**Status**: Implemented **FAA Requested Action:** FAA approval of continued measure from 1985 and 2004
Noise Monitoring Program **1985 FAA Determination**: Approved **Status**: Implemented	Not included in 2004 recommendations	---	Updated from 1985 to reference new technology	Noise Monitoring/Flight Tracking (pp. 9.32 - 9.33)	**Status**: Implemented **FAA Requested Action:** FAA approval of continued measure from 1985
Update and Review the Part 150 Study **1985 FAA Determination**: Approved **Status**: Implemented	No change	Update and Review the Part 150 Study **2004 FAA Determination:** Approved; **Status:** Implemented	No change	Review and Update Part 150 Study (pp. 9.35 - 9.37)	**Status**: Implemented **FAA Requested Action:** FAA approval of continued measure from 1985 and 2004
---	---	---	New	Continuation of Study Input Committee (pp. 9.31 - 9.32)	**Status**: Not implemented **FAA Requested Action:** FAA approval of new measure

1985 ROA	Change 1985-2004	2004 ROA	Change 2004-2018	Recommendation 2018	Status and FAA Action Requested
Administrative					
---	---	---	New	Installation of a BI-6 Repeater in Jackson Hole Tower (pp. 9.33 - 9.34)	**Status**: Not implemented **FAA Requested Action:** FAA approval of new measure
---	---	---	New	Future Ground-Based Augmentation System (GBAS) Upgrade when Viable (pp. 9.37 - 9.38)	**Status**: Not implemented **FAA Requested Action:** FAA approval of new measure

Source: Jackson Hole Airport Part 150 Record of Approval 1985, 2004 and Mead & Hunt, 2018.

1. In its findings which addressed the first three alternative noise abatement recommendations in a single determination, the FAA specified that the noise abatement recommendations were disapproved regarding restrictions or prohibitions on operations by Stage 3 aircraft for purposes of the Part 150 Study, pending a submission of additional information and compliance with Part 161, because Vision 100 did not authorize JAC to restrict Stage 3 aircraft operations, only Stage 2 operations.

2. Note: the Jackson Hole Airport Resolution had already been adopted by Teton County at the time of the previous Study, and is still currently in force. The Resolution created the Jackson Hole Airport Height Regulations and the Jackson Hole Airport Noise Regulations – discussed in the *Airport Environs* section of this chapter. Green cells indicate new 2018 recommendations

9.4 Existing Actions – Previous Part 150 Study NCP

This NCP is an update of the 2004 Part 150 Study adopted by the Airport Board. The NEMs were accepted and the NCP was approved by the FAA in 2003 and 2004, respectively. The summary of the Record of Approval is included in **Tables 1-4 and 9-2**, and the tables detail noise abatement/mitigation measures contained in that document that the FAA approved and JAC has implemented. The previous Record of Approval is in **Appendix F** of this Study. Many of the recommendations of this Study are continued from the previous NCP or revised/updated based on additional considerations and new conditions. Although some of the recommendations, particularly those addressing land use, have been revised or combined to reflect current conditions, these continued or revised measures are included in the recommendations of this report and are explained in the next section.

9.5 Noise Abatement Recommendations

The individual recommendations of the NCP identified in this section are composed of noise abatement, land use management, and program management recommendations. For each recommendation of the NCP, this section identifies: the issue that the recommendation is intended to address; the proposed, revised, or new action recommended to address it; comments concerning the recommendation; the estimated cost of implementation of the recommendations; the parties responsible for the implementation; the role of JAC; and the estimated implementation time frame. The recommendations listed within this section are voluntary and are not enforceable or mandatory.

Noise Abatement Recommendation 1: RNP-AR Arrival Procedure for Runway 19

ISSUE. Overflights over the central area of Snake River near the visitor core of GTNP.

PROPOSED ACTION. This recommendation further enhances noise abatement flight tracks for arriving aircraft when landing on Runway 19 by building upon the satellite-based procedures that were implemented previously. This recommendation would use a curved arrival path that would keep aircraft east and south of the Snake River and Highway 89, and would minimize flying over the core of the park. Given that there are sensitive park areas around much of JAC, it is not possible to entirely avoid over-flying the park, but it is possible to minimize operations over and west of the Snake River. For this procedure aircraft would not

fly as far to the north as they do today. This recommendation would reduce overflights over the central area of the Snake River.

This recommendation involves three new arrival path transitions for aircraft landing on Runway 19 that are based upon RNP-AR navigation. RNP-AR allows aircraft to fly a more precise flight path with curved flight segments that can precisely follow desired noise abatement paths. The AR stands for "Authorization Required," which means the aircraft, operator, and pilot must be equipped and authorized to fly the procedure. These flight paths are designed to be flown in both visual and poor weather conditions. Generally, over the south end of the Snake River, the path is roughly the same. The central area of the Snake River will have fewer over flights and the north end of the Snake River would have even fewer overflights. As detailed in **Chapter 7**, these three new arrival paths reflect different common locations from which aircraft fly:

1. Curved path flight with transition from the south around Blacktail Butte for arrivals from Salt Lake City;
2. Curved path flight with transition from the southeast around Blacktail Butte for arrivals from Denver; or
3. Curved path flight with transition from the northeast flying further to the east than the current instrument procedure, for arrivals from the east.

COMMENTS. This noise abatement path can be implemented using RNP-AR. RNP-AR would be flown primarily by commercial carriers. Currently, the Boeing fleet of commercial aircraft that fly into JAC are RNP capable. The Airbus aircraft are equipped, but the airlines have not exercised the option to use it on these aircraft. It is assumed that 100 percent of the commercial fleet would be RNP capable by 2020. For example, Delta Airlines has updated its avionics on their Boeing 757 aircraft to be RNP capable. However, it is conservatively estimated that 50 percent of the commercial traffic at JAC will fly the procedure. This is because RNP-AR procedures cannot be flown in all conditions. Limitations to following RNP-AR procedures include weather that is below the procedure minimums and higher traffic periods. Given that RNP-AR procedures provide enhanced safety and a more stable and efficient landing, the consultant team assumed pilots will use it as much as weather and traffic permit. Regional jets have not currently adopted the technology and business jets have a very small percentage of the fleet that is equipped for using it.

COST. The rate at which commercial airlines will equip their aircraft to be RNP-AR capable is uncertain. At the time of this study, RNP-AR is a costly technology to install and involves training crews; however, there are operational cost savings that outweigh the implementation costs. Commercial airlines are adopting this technology at a measured pace, but regional jets and business jets are not adopting this technology at the same rate. With the improved efficiency and stability of these procedures, commercial airlines would have an incentive to use these procedures if they were implemented.

RESPONSIBLE PARTIES. The FAA has ultimate responsibility for the control of aircraft flight. The Airport Traffic Control Tower (ATCT) would need to evaluate this recommendation to ensure proper altitudes and separation for aircraft arriving and departing in the valley. Implementation of noise abatement flight procedures requires compliance with the National Environmental Policy Act (NEPA).

AIRPORT ACTION. JAC would be responsible for coordinating the specific procedures.

TIME FRAME. There are no known timing barriers to implementation for this recommendation. Given the increased efficiency and stability of these procedures, it would be likely that operators would fly them if they were available and their aircraft were equipped.

Noise Abatement Recommendation 2: Chartered Visual RNAV/Company Special RNAV Arrival Procedure for Runway 19

ISSUE. Overflights over the central area of Snake River near the visitor core of GTNP.

PROPOSED ACTION. Create a notional procedure that further enhances noise abatement options for arriving aircraft when landing on Runway 19 in visual conditions.

COMMENTS. Similar to Recommendation 1, this recommendation would use a curved arrival path that would keep aircraft east of the Snake River and Highway 89 and minimize flying over the core of the park and the Snake River. Given that there are sensitive park areas around much of JAC, it is not possible to entirely avoid over-flying the park, but it is possible to minimize operations over and west of the Snake River. This includes a path for aircraft arriving from the south to fly around Blacktail Butte. These aircraft would not fly as far to the north as they do today. This recommendation would reduce overflights over the central

area of the Snake River. As part of Recommendation 2, a notional procedure would be created that will be distributed to airlines that operate at JAC. The airlines would be responsible for the ultimate procedure design and implementation within their fleet. Airlines commonly have special procedures for mountainous airports such as JAC that use conventional navigation. This recommendation proposes to encourage airlines to update those procedures to be satellite-based procedures.
The three transition areas for Recommendation 2 are in the same general location as Recommendation 1, as detailed in **Chapter 7**. Each of the three procedures from the south, southeast, and east will approach JAC in a similar manner from different locations. The new paths generally keep aircraft further to the southern end of the GTNP. Over the south end of the Snake River, the path is roughly the same. The central area of the Snake River will have fewer over fights, and the north end of the Snake River will have even fewer.

This noise abatement path can be implemented using are RNAV. Most high-performance aircraft using JAC today are equipped to fly RNAV (commercial aircraft, business jets, and high-performance piston). RNAV can be flown by all classes of aircraft but would be flown primarily by commercial carriers and business jets. It is estimated that at least 95 percent of the commercial and business jet traffic at JAC is equipped to and can fly the procedure. The charted visual could be flown by nearly every high-performance aircraft that currently flies into JAC (commercial, corporate jet, and high-performance propeller).

COST. Most commercial and regional airlines and corporate jets have this technology in their cockpit. Since these paths are more efficient than the current procedure, operators could realize a financial benefit to flying them. There are also costs for the FAA to implement and maintain any new flight procedure.

RESPONSIBLE PARTIES. The FAA has ultimate responsibility for the control of aircraft flight. ATCT would need to evaluate this recommendation to ensure proper altitudes and separation for aircraft arriving and departing in the valley. Implementation of noise abatement flight procedures requires compliance with NEPA. This procedure could reduce fuel consumption and the associated emissions with a shorter flight.

AIRPORT ACTION. JAC would be responsible for coordinating the specific procedures.

TIME FRAME. There are no known timing barriers to implementation for this recommendation. Given the increased efficiency and stability of these procedures, it would be likely that operators would fly them if they were available.

Noise Abatement Recommendation 3: RNAV Standard Instrument Departure (SID) for Runway 19 (Alternative A4 from Chapter 7)

ISSUE. Aircraft on departure from JAC on Runway 19 typically fly straight out to the south on runway heading until reaching a point to turn east or west to their destination or continue south. This results in overflights of residential areas to the south.

REVISED ACTION. A new RNAV procedure would keep aircraft east of the residential areas as much as possible to the south of JAC and Jackson Hole Golf & Tennis Club.

COMMENTS. There are two published departure procedures listed below for JAC. While these are the published procedures, most aircraft are given radar vectors to turn before reaching the initial turn. Both procedures are generally straight-out departures paths flying runway heading.

1. Teton Three Departure – aircraft depart Runway 19 and fly straight for approximately 27 miles, then turn to the west for radar vectors to join a Victor airway.
2. Alpine One Departure – aircraft depart Runway 19 and fly straight for approximately 27 miles, then turn east or west for radar vectors to join a Victor airway.

This alternative would create a new RNAV procedure that would keep aircraft east of the residential areas as much as possible to the south of JAC and Jackson Hole Golf & Tennis Club. The procedure could include aircraft departing and flying runway heading until reaching a prescribed altitude, and then turning eastward using RNAV navigation. At that point aircraft would either remain on a straight-out climb via runway heading or turn to the east or southeast. Aircraft would remain on a straight-out departure going to destinations to the west, including Salt Lake City. The analysis assumes that some aircraft with destinations to the east and southeast, including Chicago and Denver, respectively, would turn left. There are terrain and engine out requirements that will limit when aircraft can fly this procedure.

Based upon Board recommendation, aircraft flying to the south would also have the option of turning eastward along the same initial path as the East path, before turning back on course to the south.

For aircraft with destinations to the east and southeast, it is assumed aircraft would turn left 50 percent of the time, and continue straight 50 percent of the time. Aircraft with destinations to the west and south would also turn to the east, flying east of the Town of Jackson before turning back on course. This procedure is assumed to be flown 25 percent of the time with the remaining aircraft flying straight out as they do today.

There is not a precedent to determine the exact percentage of time specific departure headings will be used; this can change with updated FAA guidance, airline engine out evaluations, weather, and/or traffic volumes. There could be a wide range of adoption; a conservative estimate of 50 percent or less is used in this study. The procedure is to be designed so that the initial turn is not so severe that thrust noise is directed back toward the community.

Most aircraft flying at JAC today are equipped to fly RNAV. RNAV can be flown by all classes of aircraft but would be flown primarily by commercial carriers and business jets; it is estimated that at least 95 percent of the commercial and business jet traffic at JAC are equipped to and can fly the procedure. Nearly all jet and commuter turbo-prop aircraft are equipped to and are capable of flying these procedures. However, the severe terrain to the east may limit the ability of aircraft to meet required engine out performance. Airlines can adopt special criteria to manage the engine out criteria that may make flying these procedures more feasible. Corporate jets may be more restricted in their ability to fly these procedures.

COST. Most commercial airlines and corporate jets already have this technology in their cockpit. Since these paths are more efficient than the current procedure, operators could have a financial benefit to use these procedures. There would be costs for the FAA to implement and maintain any new flight procedure.

RESPONSIBLE PARTIES. The FAA has ultimate responsibility for the control of aircraft flight. The ATCT would need to evaluate this recommendation to ensure proper altitudes and separation for aircraft arriving and departing in the valley. Implementation of noise abatement flight procedures requires compliance with NEPA. This procedure also could

reduce fuel consumption and the associated emissions with a more direct and optimized flight path.

AIRPORT ACTION. JAC would be responsible for coordinating the specific procedures.

TIME FRAME. This recommendation could be initiated immediately, but it can take several years to develop a procedure. Given the increased efficiency of these procedures, operators would likely fly them if they were available.

Noise Abatement Recommendation 4: RNAV Standard Instrument Departure (SID) for Runway 01(Alternative A5 from Chapter 7)

ISSUE. Aircraft on departure from JAC on Runway 01 typically fly runway heading to Moose, approximately three miles north of JAC, turn slightly to the east and then proceed to the north and are radar vectored to a Victor airway. This results in flights over the Snake River and areas of the GTNP.

NEW ACTION. Create a new procedure that would follow a similar path to today's visual departure path used during good weather using an RNAV Standard Instrument Departure (RNAV SID).

COMMENTS. The goal of this recommendation is to create a procedure that further enhances noise abatement options for departing aircraft on Runway 01 in instrument and visual conditions. In reverse of Recommendation 1, this recommendation would use a curved departure path that would keep aircraft east of the Snake River and Highway 89 and minimize flying over the core of the park. These aircraft would not fly as far to the north as they do today. This recommendation would reduce overflights over the central area of the Snake River.

Recommendation 4 would create a new procedure that would follow a similar path to today's visual departure path used during good weather using a RNAV SID. For this recommendation, aircraft would depart Runway 01 and fly runway heading until reaching a prescribed altitude, and then would turn slightly to the east along an RNAV Global Positioning System (GPS) path until reaching Blacktail Butte. At this point, aircraft would then fly an RNAV GPS path to their destination, by one of these three transitions:

1. Eastbound
2. Southbound
3. Northbound

COST. Most commercial airlines and corporate jets already have this technology in their cockpit. Since these paths are more efficient than the current procedure, operators would have a financial benefit to using these procedures. There are also costs for the FAA to implement and maintain any new flight procedure.

RESPONSIBLE PARTIES. The FAA has ultimate responsibility for the control of aircraft flight. The ATCT would need to evaluate this recommendation to ensure proper altitudes and separation for aircraft arriving and departing in the valley. Implementation of noise abatement flight procedures requires compliance with NEPA. This procedure could reduce fuel consumption and the associated emissions with a shorter flight.

AIRPORT ACTION. JAC would be responsible for coordinating the specific procedures.

TIME FRAME. There are no known barriers to implementation for this recommendation. Given the increased efficiency and stability of these procedures, operators would likely fly them if they were available.

Noise Abatement Recommendation 5: Waypoint Noise Abatement Flight Paths (Alternative A6 from Chapter 7)

ISSUE. Create a preferred noise abatement paths in visual conditions for smaller general aviation aircraft using specific flight paths based upon GPS waypoints to help prevent overflights of residential and park areas.

NEW ACTION. The new procedure would transition pilots from using conventional technology to satellite-based technology for noise abatement procedures. It would involve developing specific GPS waypoints to define noise abatement paths for small general aviation aircraft.

COMMENTS. Noise Abatement Recommendation 5 proposes specific flight paths based upon GPS waypoints that define noise abatement paths for smaller general aviation aircraft. This

waypoint information can be shared with the pilot community to show the preferred noise abatement paths for the different destinations.

This information can be received through an airport-sponsored iPad application, or other methods by which pilots can input this information into their flight management systems. iPads are commonly used by pilots for flight planning, flight procedures and flight information known as notice(s) to airman (NOTAMs). Many of them also are integrated with a GPS unit for flight following capabilities. The iPad application can provide information on noise abatement at JAC, as well as the proposed paths (with waypoint coordinates) to minimize noise impacts.

Recommendation 5 would create noise abatement flight paths that would follow historic noise abatement tracks that are difficult to follow precisely using conventional navigation. Noise abatement departure and arrival paths can be used during good weather using waypoints that can be programmed into a hand-held GPS or cockpit GPS unit. Recommendation 5 has two options for arrivals, and two for departures:

- **Runway 19 Departures**: The procedure could include aircraft departing and flying runway heading until reaching a prescribed altitude. At that point aircraft would transition to different headings, either turn slightly east to fly east of the Jackson Hole Golf & Tennis Club, or turn directly to the east or southeast destinations. The aircraft would fly this new departure procedure to en route transitions and their destinations.
- **Runway 01 Departures**: Aircraft would depart Runway 01 and fly runway heading until reaching a prescribed altitude and then would turn slightly east along an RNAV GPS path until reaching Blacktail Butte. At this point aircraft would then fly an RNAV GPS path to their destination or vectors to a Victor airway. Some aircraft would also turn to the south or east before Blacktail Butte.
- **Runway 19 Arrivals**: Aircraft would fly a curved approach to Runway 01 or Runway 19. This curved approach would avoid overflying core areas of the park and stay east of the Snake River.
- **Runway 01 Arrivals**: Small aircraft under visual conditions would fly a curved-like approach to Runway 01. This curved approach would avoid overflying core areas of the park and stay east of the Snake River.

Implementation of noise abatement flight procedures requires compliance with NEPA. This procedure could reduce fuel consumption and the associated emissions with a shorter flight.

COST. GPS technology is available and used by the large majority of general aviation piston aircraft. There will be some cost for JAC to develop these procedures and make them available to the pilot community.

RESPONSIBLE PARTIES. The FAA has ultimate responsibility for the control of aircraft flight. The ATCT would need to evaluate this recommendation to ensure proper altitudes and separation for aircraft arriving and departing in the valley.

AIRPORT ACTION. JAC would be responsible for coordinating the specific procedures.

TIME FRAME. While there are no known barriers to implementation, since this recommendation is proposing the development of non-published procedures, the difficulty will be getting high usage of the procedures by the general aviation community. It would involve outreach to the pilot community.

Noise Abatement Recommendation 6: Avoid Low Flying Aircraft Operations Over Grand Teton National Park (Alternative A7 from Chapter 7)

ISSUE. Overflights of aircraft and helicopters over noise sensitive areas (as defined in the Use Agreement) of GTNP.

REVISED ACTION. This recommendation is proposed to proactively help reduce overflights of all aircraft types over the noise sensitive areas of GTNP to the extent possible. Recommendation 6 does not propose any new specific flight paths, but is designed to improve methods to reduce the number of aircraft from flying west and northwest of the JAC centerline along the foothills. These measures are listed below.

1. Provide controllers at the JAC ATCT with a BI-6 repeater scope that gives local controllers the ability to positively identify visual flight rules (VFR) traffic by assigning transponder codes. Then, provide advisories to local visual flying aircraft. This could potentially allow the controllers to provide accurate traffic

advisories to the airlines, corporate jets, and air taxis that are on instrument flight rules (IFR) flight plans and separated from one another (by Salt Lake Center) and from VFR traffic.

2. Develop a Memorandum of Understanding (MOU) with all controllers to recommend east turns and paths for all operations to avoid the defined noise sensitive areas.
3. Incorporate these goals into the voluntary "Fly Quiet" program that is a separate Recommendation under consideration. This also includes voluntary measures that all operators can employ to reduce noise (as described in **Chapter 8**). This could include options for working with operators that occasionally overfly the noise sensitive areas of the park.
4. Work with the sightseeing operator or other recurring operators (private, etc.) to provide a GPS path to better define their operations when transitioning from JAC to the tour destinations just outside the park boundary. This path would effectively be the route that they primarily fly today, but would also include the transition paths defined in Recommendation 5.

COMMENTS. The issue being addressed by Recommendation 6 is to reduce the number of aircraft that fly west of JAC and the runway centerline in the defined noise sensitive areas of GTNP. This recommendation will include extensive coordination with the ATCT, pilots, and other stakeholders.

COST. The cost to identify potential paths and procedures for this alternative is estimated to be less than $50,000. However, in addition to the procedure development, many of the potential costs are included as part of other alternatives such as the flight tracking system, "Fly Quiet" program, and the BI-6 repeater recommendations detailed in the Administration Recommendations of this chapter. The BI-6 repeater is not needed for the implementation of this recommendation; however, it could make this alternative more effective.

RESPONSIBLE PARTIES. The FAA has ultimate responsibility for the control of aircraft flight. The ATCT would need to evaluate this recommendation to ensure proper altitudes and separation for aircraft arriving and departing in the valley.

AIRPORT ACTION. JAC would be responsible for coordinating the specific procedures. There are many options under consideration for enhancing the compliance of this recommendation that

will have varying degrees of difficulty to implement including pilot reluctance, ATCT evaluation, and time to coordinate and update the MOU.

TIME FRAME. This recommendation could be initiated immediately upon approval of this Study, coordination with the ATCT, and updating the MOU.

9.6 Land Use Management Recommendations

Land Use Management Recommendation 1: Zoning Code Changes/Noise Overlay Zone/Buyer Notification/Construction Requirements

ISSUE. This recommendation seeks to protect the health, safety, and welfare of the public through the prevention of new non-compatible land uses within the vicinity of JAC. This recommendation also seeks reduce the annoyance of aircraft noise intrusion to prospective residents by providing direct notice of the possibility of such intrusion prior to home purchase, and to provide mandatory construction requirements for new structures within the airport environs.

REVISED ACTION. Zoning can be a very effective means of controlling land use development and is the most widely used land use control. This measure has already been implemented by Teton County. It is therefore recommended that the Jackson Hole Airport Resolution be kept in place in any zoning revisions to continue to apply preventative zoning measures and buyer notification. The future base case 65 DNL noise contour is located entirely on JAC property. This action would notify any owners within a 2-mile radius of the centerline of the proximity of the airport.

In addition, current recommended noise reduction measures for construction are presented to help reduce inside noise levels by 25 dB for properties within the 65 or 70 DNL. However, since no homes are within the 65 or 70 DNL, it might be in the County's interest to put construction requirements in place for a larger contour (such as the 60 DNL) or for the same area defined for the notice requirement in the Code (2 miles radius from centerline).

COMMENTS. Teton County adopted the Jackson Hole Airport Resolution as part of the County Development Regulations. The Resolution contains the Height Hazard zoning ordinance and the Airport Noise Exposure regulations. The noise exposure regulations state that if any

part of a subdivision is to be located within two miles of the centerline of the runway, subdivision plats shall be annotated to indicate the immediate proximity to JAC.

This Action will notify potential residents within the airport environs of possible noise intrusion within the 2 miles of the runway centerline. It is recommended that these regulations remain part of any future County regulatory scheme.

COST. There would be no direct cost to JAC associated with this recommendation, because it is a policy measure dependent upon adoption by the local jurisdiction. It would require time from JAC for coordination with Teton County, as needed.

RESPONSIBLE PARTIES. Teton County would be responsible for implementing policy measures by adopting changes or additions to the building code, and/or the zoning ordinance if the measure were adopted in conjunction with an airport overlay zone. JAC would be responsible for assisting the local jurisdiction with identifying the noise level basis for the boundaries and supplying them with the proper maps.

AIRPORT ACTION. The airport director would file the new NEMs with Teton County and coordinate as needed.

TIME FRAME. Due to processes at the local level related to implementation of comprehensive planning, implementation of this measure could take several years.

Land Use Management Recommendation 2: Comprehensive Plan Amendments

ISSUE. Prevent the introduction of new non-compatible land uses through the land use planning and development policy process.

NEW ACTION. This recommendation would utilize land use planning and development policy processes to achieve long-term land use compatibility of the jurisdictions with aircraft noise exposure from JAC.

COMMENTS: Comprehensive plans are prepared by local jurisdictions to 1) identify current conditions in a community, 2) identify community goals and policies, and 3) identify plans

for that community to achieve the goals. The Town of Jackson and Teton County adopted the Jackson/Teton County Comprehensive Plan in April 2012 to serve as a guide for future development within Jackson and Teton County. The Comprehensive Plan recognizes the importance of JAC as a key destination in the area along with GTNP. The Plan also recognizes that the areas west and south of JAC serve as gateways to these major destinations and should be carefully planned accordingly. The Comprehensive Plan includes a Future Land Use Plan to envision what the community will look like upon full implementation of the themes and goals of the Comprehensive Plan.

Regarding directions for future development, the Comprehensive Plan classifies the subareas west of JAC as primarily Preservation and Conservation-oriented subareas. These subareas are focused on preserving existing infrastructure with no change to undeveloped open space, scenic resources, or wildlife habitat. They focus on improved conservation through increasing the amount of such resources, respectively. Based upon these classifications, and due to the prevalence of protected natural lands in the region, future land use changes can be expected to have little impact on land use development and change within the airport vicinity. These recommendations within the plan focus on conservation and are consistent with long-term compatible land uses.

A comprehensive plan by itself does not reduce aircraft noise levels, nor does it control the use of land, as it is just a policy statement of the intended future use of land. However, comprehensive plans do influence the development or change in use of any piece of property. They also serve as a guide for future development. As described above, the Comprehensive Plan focuses on conservation within the area surrounding JAC. This, paired with the Jackson Hole Airport Noise Resolution, provides good preventative land use measures. It is recommended that any future comprehensive plan from Teton County would continue to examine the future land use plans near JAC within consideration of the new NEMs contained within this study.

COST. There would be no cost to JAC associated with this recommendation, because it is a policy measure dependent upon adoption by the local jurisdiction. There would be the cost of airport staff time to coordinate with Teton County, as needed. There would not be significant cost for implementation to the local jurisdiction, because airport compatibility issues would be taken into consideration as part of the normal comprehensive plan updating process.

RESPONSIBLE PARTIES. The local jurisdiction having land use authority over the area around JAC would be responsible for implementation of this recommendation. JAC would provide technical assistance and the proper noise exposure maps as needed.

AIRPORT ACTION. JAC would assist the local jurisdiction with providing proper identification of the prescribed boundaries (NEM) or other technical Airport-related information needed to properly inform the comprehensive planning process.

TIME FRAME. Due to political issues and processes at the local level related to implementation of comprehensive planning, implementation of this measure is not definite, and could take several years, and may not be not achieved during the time frame of this Study.

9.7 Program Management Recommendations

Program Management Recommendation 1: Development of Voluntary Fly Quiet Program Report Card and Pilot Awareness Program

ISSUE. Reduce effect of single-event noise levels, and increase awareness of noise sensitive uses and noise reducing procedures for pilots operating at JAC.

NEW ACTION. This recommendation would create a voluntary Fly Quiet Program for JAC.

COMMENTS. The Fly Quiet Program's purpose is to voluntarily encourage individual airlines, fractional jet operators, and individual business jet operators to operate as quietly as possible at JAC by recognizing those airlines that attempt to follow the noise abatement goals of JAC. The program may have different award categories for different categories of operators.

COST. Funding sources could be borne by JAC along with Federal funding assistance, if available. The cost to prepare and print the Fly Quiet Brochure for JAC would be approximately $65,000-$75,000. If additional help was needed to update, raise awareness, or track success of the Fly Quiet Program in the future, the associated costs for this recommendation would be approximately $55,000-$65,000 per year.

RESPONSIBLE PARTIES. JAC would be responsible for applying for FAA funding for the recommendation, planning for the programs, and implementing them. If the Fly Quiet/Pilot Awareness programs were to be carried out by a consultant, JAC would be responsible for hiring the consultant and managing the project; this management could require about five hours monthly of a staff member's time for about 8-12 months during development. Subject to eligibility, what is allowed, and justification requirements in place at the time the project is proposed for JAC's CIP, FAA could provide funding for this recommendation. Aircraft operators, the ATCT, and the public would be responsible for providing input and participating in the program development.

AIRPORT ACTION. JAC would plan and implement the programs, or hire and manage a consultant to do so.

TIME FRAME. The recommendation could be initiated immediately upon approval of this Study, but would likely take time to implement because the formation of Fly Quiet/Pilot Awareness programs is a complex process involving many stakeholders. The full implementation timeframe would be approximately 1-2 years and then updated on an annual basis.

Program Management Recommendation 2: Continuation of Study Input Committee

ISSUE. Assist in implementation of the Part 150 Study Noise Compatibility Program and identify and address noise issues with an ongoing method.

NEW ACTION. This recommendation involves the continuation of the Study Input Committee established for this Study. It is recommended that noise concerns are addressed either through a continuation of a similar committee or via an addition of these discussions to existing planning meetings.

COMMENTS. Stakeholder updates can be very important for the relationship between JAC and the surrounding communities. Continuation of the committee also makes sure that the knowledge on noise issues developed as part of this Study is not lost.

COST. There would be no expected additional direct cost for this recommendation, as the cost would fall within existing airport staff functions and budgets. It would require airport staff time for coordination.

RESPONSIBLE PARTIES. JAC would be responsible for continuing to update noise information on its website as necessary, and for continuing its public information program briefings. Stakeholders would commit time to addressing airport noise concerns.

AIRPORT ACTION. JAC would update its website and provide public information briefings.

TIME FRAME. This recommendation could be implemented at any time.

Program Management Recommendation 3: Noise Monitoring/Flight Tracking

ISSUE. Track single noise events around JAC to meet the Use Agreement requirements.

CONTINUED ACTION. JAC is actively using their noise monitoring system, and it is recommended they continue to do so to report on supplemental metrics and tracking for use by JAC and the GTNP. This measure recommends that the noise monitoring system be upgraded when necessary to continue this important program. Additionally, it is recommended that during the Fly Quiet Program, specific attention is paid to ways to integrate the Fly Quiet Program with the noise monitoring system to accurately track the effectiveness of the Program over time and identify ways to improve the program and the system.

COMMENTS. This measure was not specifically outlined in the 2004 Part 150 Study Record of Approval; however, JAC has one of the most extensive noise monitoring systems in the country. This program management recommendation would look at ways to improve on this system and integrate it with a potential Fly Quiet Program.

COST. The cost to maintain and operate the current noise monitoring system along with the Use Agreement reporting requirements is approximately $80,000 per year. This is anticipated to continue at the same cost in the future, even with the anticipated enhancements. The cost of enhancements versus technology efficiency improvements should balance out.

RESPONSIBLE PARTIES. JAC would be responsible for developing the specifications of the updated system, budgeting for equipment and services needed, applying for FAA funding, and for hiring a consultant to perform the necessary work involved. JAC would also be responsible for ensuring that data received from the systems are properly downloaded and stored, and for making the data available and usable by airport staff, and potentially the public. Subject to eligibility, what is allowed, and justification requirements in place at the time the project is proposed for the Airport's CIP, the FAA could provide funding for this recommendation.

AIRPORT ACTION. JAC would budget for flight tracking, apply for funding, hire a consultant to update the system, properly store and manage data received, and utilize the data when responding to noise comments, where applicable.

TIME FRAME. This recommendation is ongoing. Updates could be implemented immediately upon approval of this Study.

Program Management Recommendation 4: Installation of a BI-6 Repeater in Jackson Hole Tower

ISSUE. Installation of a repeater at JAC could provide greater aircraft location accuracy for the air traffic controllers, allowing them greater ability to guide aircraft away from noise-sensitive uses within GTNP and other areas. This could provide the JAC Tower with enhanced ability to offer additional guidance to aircraft to avoid, as much as possible based on safety and other limits and avoid noise sensitive areas of the GTNP and surrounding areas. The issue being addressed by this recommendation is to reduce the number of aircraft that fly west of JAC and the runway centerline in the defined noise sensitive areas of GTNP.

NEW ACTION. This measure involves installing a repeater of the existing BI-6 radar feed that is already installed at JAC. It could provide controllers at the JAC Tower with a BI-6 repeater scope that gives local controllers the ability to positively identify VFR traffic by assigning transponder codes and then providing advisories to local visual flying aircraft.

This could potentially allow the controllers the ability to provide accurate traffic advisories to the airlines, corporate jets, and air taxis that are on IFR flight plans and separate from one another (by Salt Lake Center) and from VFR traffic. However, it is important to note that

this alternative would need to be cleared with ATCT and would still be limited by safety and other air traffic considerations. Because of these limitations, this alternative would likely need to include developing a MOU with all controllers to recommend east turns and paths for all operations to avoid the defined noise sensitive areas. It could improve effectiveness of some of the operational recommendations, such as Recommendation 6, but is highly dependent on air traffic considerations.

COMMENTS: This alternative could give controllers an increased ability to monitor new procedures and potentially enhance compliance with existing and proposed noise abatement procedures. However, it would be highly dependent on coordination with ATCT and safety considerations.

COST. The cost of a BI-6 repeater is not certain now, but could potentially reach several hundreds of thousands of dollars, which may make this alternative impractical in the short term.

RESPONSIBLE PARTIES. The FAA has ultimate responsibility for the control of aircraft flight. The ATCT would need to evaluate this recommendation to ensure proper altitudes and separation for aircraft arriving and departing in the valley, so ability to divert aircraft away from the park may be limited due to safety considerations.

AIRPORT ACTION. JAC would be responsible for coordinating the specific procedures. There are many options under consideration for enhancing the compliance of this recommendation that will have varying degrees of difficulty to implement including pilot reluctance, cost, ATCT evaluation, and time to coordinate and update the MOU.

TIME FRAME. This recommendation could be initiated immediately upon approval of this Study, coordination with the ATCT, and updating the MOU.

Program Management Recommendation 5: Noise Complaint Response and Investigation

ISSUE. Collect and examine aircraft noise comments and increase ability to respond to public and GTNP concerns based on comments received.

REVISED ACTION. This measure is a continuation of an approved measure from the previous Study. JAC would continue its Noise Complaint system approved in 1985 as part of the initial NCP, recording noise complaints received from citizens to monitor the noise abatement plan described in **Chapter 1**. All records of complaints are reviewed for any non-compliance with the noise abatement plan and comment records are provided for an annual update to the Airport Board and the GTNP.

COMMENTS. Stakeholder comments can be very important for the relationship between JAC, GTNP, and the public. This measure should be continued and, as with the noise monitoring program, could be integrated with the recommended Fly Quiet Program to provide a cohesive approach. Integration could provide additional links to metrics and reporting. Tracking noise comments or complaints can help JAC better understand the location and type of operations that are most annoying to the public.

COST. There would be no expected additional cost for this recommendation, as the cost would fall within existing airport staff functions and budgets.

RESPONSIBLE PARTIES. JAC would be responsible for distributing responsibilities amongst staff members for review and response to comments. JAC would be responsible for regularly reviewing comments and/or complaints and responding when requested. Portions of this program could also be integrated into the Fly Quiet Program.

AIRPORT ACTION. JAC would monitor noise comments and respond to them when requested.

TIME FRAME. This recommendation is currently ongoing.

Program Management Recommendation 6: Review and Update Part 150 Study

ISSUE. Update the Part 150 Study when appropriate to ensure the NEM and NCP are adjusted as conditions change over time.

CONTINUED ACTION. This recommendation would involve the update of the NEMs or the Part 150 Study, when needed, or when dictated by the Use Agreement with the GTNP. The NCP

would only be updated if there were new non-compatible land uses found within the 65 DNL on any future NEMs.

COMMENTS. A Part 150 Study is intended to be a "living document," to be used as a tool to monitor and guide program development, and evaluate aircraft types and operations. The Study should be reviewed and updated as appropriate.

The general guideline notes that NEMs should be reviewed whenever the actual operations differ by approximately 15 percent or more from the forecasted operations. In addition, anytime there are significant new non-compatible land uses within the 65 DNL or greater contours, or if there are airport facility changes that may affect the contours, consideration should be given to reviewing the maps. At the end of the five-year study period (after date of NCP approval), the operations and mix should be re-evaluated to determine the extent to which they have changed and be updated as appropriate. Additionally, the Part 150 Study for JAC should be updated any time new technology is available that may result in noise reductions, which is a condition of the Use Agreement. The decision to update the NEM and NCP would be made in consultation between JAC, the FAA, and the NPS. The NEM would likely be updated first to determine if an updated NCP is warranted.

COST. The cost to monitor operational and aircraft type information would fall within existing airport staffing and budgeting constraints. The cost to hire a consultant to update independent elements, such as running some test noise contours, would be approximately $50,000. The cost to update the entire Part 150 Study would be approximately $1-$1.5 million. It would cost approximately $500,000 to update the NEMs.

RESPONSIBLE PARTIES. JAC would be responsible for applying for FAA funding for the Study Update and for initiating and managing the Study. Subject to eligibility, what is allowed, and justification requirements in place at the time the project is proposed for JAC's CIP, FAA will be responsible to provide funding for this recommendation.

AIRPORT ACTION. Using the monitoring systems discussed above in Program Management Recommendation 3, JAC would reevaluate the program when there is a significant change in operations, aircraft types, or at the end of the five-year time frame. If an update to the Part 150 Study is justified, JAC would initiate and carry out the Study Update, likely with assistance from a consultant.

TIME FRAME. JAC would continue its ongoing monitoring of operational and aircraft type information. Based on that information, JAC would consider a Part 150 Study Update as necessary per FAR Part 150 regulations, at the end of the five-year period after the date of submittal of this Study, or whenever any technological changes occur that might trigger a Part 150 Study Update per the Use Agreement.

Program Management Recommendation 7: Future Upgrade to JAC's Ground-Based Augmentation System (GBAS)

ISSUE. Use the most updated ground based technology that supports NextGen procedures.

NEW ACTION. This alternative is a new alternative developed as part of this Study. While JAC has a GBAS system, the link of the GBAS to further support NextGen procedures was not addressed in the previous Study. Therefore, this is a new recommendation under the Part 150 Study.

COMMENTS: This measure would involve the upgrade of JAC's existing GBAS to support proposed NextGen procedures. JAC previously purchased a GBAS. GBAS is a NextGen landing system, like an ILS, but uses the GPS signal along with local ground-based augmentation that allows aircraft to land in instrument weather conditions. It is different than an ILS in that it can be used on both runway ends and can support multiple approach procedures. The current system at JAC is not active, but JAC can upgrade at any time from the manufacturer to an up-to-date system. The upgrade is at no cost, but there are some one-time construction costs and on-going maintenance currently not reimbursable by the FAA.

The recommendation is to work with airlines that have shown interest in the technology to complete a preliminary analysis to document the performance benefits of a GBAS at JAC. Generally, the benefits would be difficult to precisely determine in terms of the DNL noise contours, but the upgrade could help increase the use of future NextGen procedures, result in more stabilized, quieter landings, and promote the use of new generation, quieter aircraft at JAC. This measure recommends pursuing the upgrade to the GBAS if and when FAA provides annual maintenance support. This measure would help provide support for NextGen procedures through upgrading of ground-based technology.

COST: While the upgrade would occur at no cost to JAC, the FAA does not currently reimburse the annual maintenance for GBAS landing systems. This cost is estimated to be $100,000 per year.

RESPONSIBLE PARTIES. JAC would be responsible for working with the FAA to discuss funding eligibility for the GBAS maintenance. If FAA determines that GBAS maintenance should be eligible in the future, the FAA could provide funding for this recommendation. If it is not determined to be eligible, JAC would be responsible to provide funding for this recommendation.

AIRPORT ACTION. JAC would need to work with FAA to determine eligibility of maintenance for the upgraded GBAS system.

TIME FRAME. At the current time, GBAS system maintenance is not eligible for FAA funding. If this becomes eligible in the future, this recommendation could be implemented at any time.

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10
Consultation/ Coordination

Chapter 10 - Consultation

INTRODUCTION. The Jackson Hole Airport 14 CFR Part 150 Noise Study Update involved an extensive stakeholder and public participation process, in accordance with the requirements of the regulation. The Airport set an inclusive tone by requesting that the community and users be actively involved in the process. Many opportunities were presented to solicit public and key stakeholder input during the study process. The type of outreach conducted during the process is summarized below and further information from these meetings is compiled in **Appendix G**.

10.1 Study Input Committee

A Study Input Committee was developed to provide input during the Study process. The Committee met five times over the course of the study (June 2014, October 2014, February 2015, May 2015 and March 2017). The Committee was composed of National Park Service representatives, airport users, aviation representatives, community representatives, members of the public, FAA representatives, and other interested parties. Materials from the Committee meetings and comments throughout the process are contained in **Appendix G**. At each meeting, a working paper was presented and discussed and comments were addressed. The Committee meetings were open to the public, and members of the public attended several meetings.

10.2 Public Meetings and Comments

In addition to the Committee meetings, two public workshops were held to present information to the public and receive comments from the public (June 2014 and March 2017). Prior to each workshop, an advertisement informing the public of the date, location, and content of the workshop was placed in the local paper. Additionally, comments were received via the website and submitted to JAC over the course of the Study. Comments received at the public workshops and through the Study website were addressed and considered during the Study process and documented through meeting notes and presentations. Responses to comments were provided in subsequent meetings and working papers, and through the Frequently Asked Questions section on the website (comments and responses included in the Frequently Asked Questions are included in **Appendix G**). Additionally, the comments were used to help guide the design of the alternatives, particularly the operational alternatives to consider public concern over location of flight paths.

10.3 Public Hearing and Official Public Comment Period

A Public Hearing was held on November 20, 2017. One comment was received. The comment, hearing materials, and proof of publication are included in **Appendix H**. The official public comment period was from October 20, 2017 through December 1, 2017.

10.4 Coordination Requirements

Per 14 CFR Part 150, it is mandatory to include in the report a description of public participation and the consultation with officials of public agencies and planning agencies in areas surrounding the airport. Public and planning agencies include FAA regional officials, other Federal officials having local responsibility for land uses depicted on the map, any air carriers and other users of the airport. The NEMs and NCP must be provided to the public for review and comment during the development of the noise contours. Several opportunities were afforded for comment on the project, as noted above, during public and study input committee meetings, and during the pending release of the Draft. There was one comment submitted during the official public comment period (**Appendix H**).

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Appendices

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