Federal Aviation Administration

Airspace Management Handbook

Version 2.2 December 2005

NAR
NATIONAL AIRSPACE REDESIGN

Executive Summary

The Airspace Management Handbook provides guidance on all phases of the airspace design process from characterizing the initial problem to post-implementation evaluation including the parallel environmental review process. Important components of the airspace design process are the metrics, tools and data sources used in the airspace design process. Guidance on the appropriate metrics, selection and use of tools and data sources is also provided.

Airspace Design Process

The eight steps of the Airspace Design Process, shown in Figure ES-1, are summarized as follows.
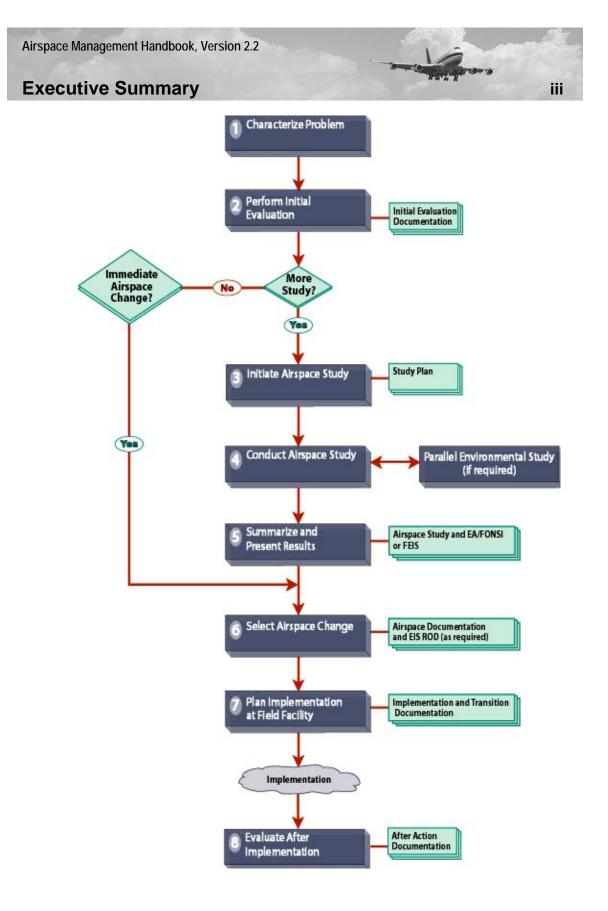
Characterize Problem

A problem is identified by members of the NAS stake holder community, either FAA or airspace customer. An initial characterization of the problem is made including identifying stake holders, stating the problem in terms of metrics (e.g., departure delays), and describing potential cost and benefits if the problem is resolved.

Perform Initial Evaluation

The identified problem is assessed to determine if airspace redesign could help mitigate the problem and whether the solution to the problem is likely to be cost beneficial. If it is an airspace problem which should be mitigated and the proposed solution is already in compliance with any applicable regulations, including safety and environmental requirements, then an assessment is made on whether additional analysis is required to determine the most efficient airspace solution or whether an immediate airspace change can be implemented.

Initiate Airspace Study

An airspace design team is designated and a study plan is developed. Coordination activities are initiated, or expanded, with customers, the environmental community and other related FAA and government organizations.

Figure ES -1. Airspace Design Process

Conduct Airspace Study

This step and its associated environmental study, if needed, are the major pieces, including time and resources, of most airspace design studies. During this step, the problem is expressed in terms of metrics; baseline and alternative scenarios are developed; a model of each scenario is developed; metrics for the baseline and each of the alternatives are generated; and the results analyzed. Throughout this step, operational experts are involved to provide operational specifics to the process. If an environmental study is required, it is conducted in parallel. As part of Safety Management, a safety risk management analysis should be conducted on each alternative.

Summarize and Present Results

When the airspace analysis is complete (e.g., metrics have been generated and analyzed for all of the proposed alternatives and all environmental and safety assessments have been performed), the substance of the analysis, including conclusions and/or recommendations are documented. As discussed in Appendix D, for any change that could affect NAS safety, a Safety Risk Management Document (SRMD) must be written, accepted and approved for the airspace change. This documentation, along with the Environmental Assessment (EA) and Finding of No Significant Impact (FONSI), or Final Environmental Impact Statement (FEIS), as required, are presented to decision makers.

Select Airspace Change

The decision makers decide on the option to be implemented (e.g., no-action or a selected alternative) and the decision is documented. As discussed in Appendix D, for any change that could affect NAS safety, a Safety Risk Management Document (SRMD) must be written, accepted and approved for the airspace change. If an environmental impact statement was required, the Record of Decision (ROD) is produced. Plan Implementation at Field Facility.

Plan Implementation at Field Facility

An implementation plan is developed describing the activities necessary to implement the change with minimum impact to the customers while providing timely and effective notification of changes to all affected stakeholders. In addition, this implementation planning should address potential implementation and transition risk mitigation strategies identified in the SRMD.

Evaluate After Implementation

After implementation of an airspace change, the effects of the change are monitored in order to evaluate whether the initial problem has been resolved, what benefits can be measured from the change and whether the change has created any unexpected follow-on issues. The tracking on monitoring of hazards should follow the strategies as documented in the SRMD.

Table of Contents

List of Figures

List of Tables

1. Introduction

Background

In 1999 the Federal Aviation Administration (FAA) published the *Airspace Management Handbook Version 1,* consisting of the *Airspace Management Handbook: Checklist*, *Airspace Management Handbook: Guidelines*, and the *Airspace Management Handbook: Metrics*. These documents contained the first systematic description of the processes involved in analyzing proposed changes to the structure of airspace. The previous version, Version 2.1, presented the combined content of the previous documents and provided revised supporting information along with environmental considerations. This version, Version 2.2, has been revised to include the supporting information for the safety risk management considerations.

Purpose

The purpose of the Airspace Management Handbook is to improve the efficiency of the airspace design process. This handbook describes a step-by-step procedure for airspace design management where each step contains specific data requirements and defined products. The handbook distills the experiences of many years of studies and recommends actions for avoiding problems that have been encountered in the past. It is designed to support both novice and experienced study teams.

Handbook Organization

This handbook is divided into two major parts. The first part is a narrative of the eight steps that compose the Airspace Design Process (see Figure 1). The steps are:

1. Characterize Problem;
2. Perform Initial Evaluation;
3. Initiate Airspace Study;
4. Conduct Airspace Study;
5. Summarize and Present Results;
6. Select Airspace Change;
7. Plan Implementation at Field Facility; and
8. Evaluate After Implementation.

The second part of the handbook covers topics that apply throughout the airspace design process. These topics are: metrics, tools, and data sources.

"Metrics" describes the aspects of the problem and its potential solutions that can be measured with operational data or estimated by modeling tools. "Tools" describes the variety of modeling tools available, and discusses appropriate uses of these tools. "Data Sources" describes what sources are available, and the appropriate use of the data.
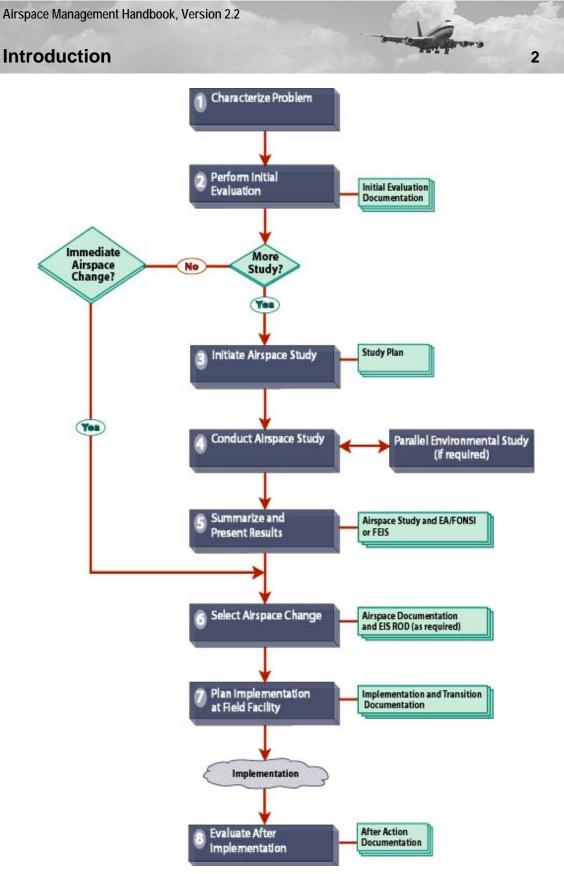
Figure 1. Airspace Design Process Overview

Additional details on the environmental activities associated with the airspace study are contained in the appendices. Note that these appendices are not a substitute for FAA Order 1050.1, *Policies and Procedures for Considering Environmental Impact* (hereafter referred to as FAA Order 1050.1).

The Program Management activities described in an appendix are overarching throughout an airspace study's life cycle. These activities include development of an airspace management project charter, planning and scheduling of activities and updating, as required, of the charter, planned activities and schedules.

This handbook was designed to be read either in paper or electronic format. The terms that appear in blue in the printed copy become cross references or hyperlinks in the electronic format that can be navigated by a "click."

2. Airspace Design Guidelines

The following eight sections present descriptions of the tasks to be performed for each step in the Airspace Management Checklist (see Table 1). These steps correspond to the numbered boxes in the Airspace Design Process Overview (see Figure 1).

In Step 1, Characterize Problem, the Oversight Team develops a concise problem statement, and takes the first steps to quantify the impact of the problem. In Step 2, Perform Initial Evaluation, the team obtains enough information about the problem to recommend one of three broad courses of action: take no further action, implement an immediate change to the National Airspace System (NAS), or begin a detailed airspace study to discover and assess potential changes to the NAS that will mitigate the problem. The team also evaluates the need for safety risk management. If either an immediate action or more study is recommended, the team determines whether an environmental study is needed. If additional study is the option selected at Step 2, then in Step 3, Initiate Airspace Study, the Oversight Team selects the Design Team, and produces a Study Plan. A Safety Risk Management Panel should be formed to analyze the safety hazards and risks.

Step 4, Conduct Airspace Study, is carried out by the Design Team and consists of five main tasks:

- Express the problem in terms of metrics;
- Develop the baseline and alternative scenarios;
- Build a model of each scenario;
- Generate metrics and analyze;
- Assess with operations experts; and
- Assess the safety risks.

If an environmental study is needed, it should be conducted in parallel with the airspace study. The same assumptions and definitions used in the baseline and alternative scenarios are to be used both for the operational analysis and the environmental study. Additional detail on the environmental activities associated with the airspace study are contained in Appendices A and B.

In Step 5, Summarize and Present Results, the Design and Oversight teams prepare and present the study's results to decision makers and other interested parties. Step 6, Select Airspace Change, consists of finalizing any required documentation including the Safety Risk Management Document (SRMD).

In Step 7, Plan Implementation at Field Facility, the Oversight Team works with facility personnel and other stakeholders to develop a final definition of system changes and defines the required transition steps. Safety risk management strategies should be supported as documented in the SRMD.

In Step 8, Evaluate After Implementation, the Oversight and Design Teams assess to what extent the original problem has been mitigated by the implemented changes. The tracking and monitoring of hazards should be supported as documented in the SRMD. Step 8 has much in common with Step 1, Characterize Problem and Step 2, Perform Initial Evaluation and may employ metrics and techniques developed in Step 4, Conduct Airspace Study.

An outline of the program management activities associated with the airspace design process is found in Appendix C, Program Management.

Table 1. Airspace Management Checklist

Step 1   **Characterize Problem**

Find the true nature and extent of the problem.

Step 2   **Perform Initial Evaluation**

Evaluate the importance of the problem, consider environmental and safety implications, and recommend next action.

Step 3   **Initiate Airspace Study**

Establish airspace design team;
Develop a study plan;
Initiate coordination activities;
Initiate a preliminary environmental review; and
Initiate the Safety Risk Management Panel

Step 4   **Conduct Airspace Study**

Express problem in terms of metrics;
Develop baseline and alternative scenarios;
Build model of each scenario;
Generate metrics and analyze;
Assess with operations experts; and
Conduct the environmental study in parallel; and
Conduct Safety Risk Management analysis in parallel .

Step 5   **Summarize and Present Results**

Develop study documentation including the EA/FONSI or FEIS
 if required; and
Explain the study results and environmental and safety impacts to decision makers and stakeholders.

Step 6   **Select Airspace Change**

Document alternative selected, including the environmental Record of Decision if required and the Safety Risk Management Document .

Step 7   **Plan Implementation at Field Facility**

Work with field facility and stakeholders to develop an implementation and transition plan.

Step 8   **Evaluate After Implementation**

Make sure the change accomplishes its intended purpose.

2.1 **Step 1: Characterize Problem**

Step 1 of the Airspace Design Process (Figure 2) is the responsibility of the Oversight Team, which has the responsibility to identify possible airspace problems, investigate these problems, and recommend an appropriate response.
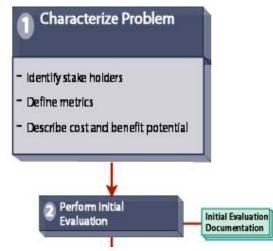
Figure 2. Airspace Design Process: Step 1

2.1.1 Identifying Problems – Concerns

Many airspace problems are perceived when concerns are raised by the members of the stakeholder community. These may come from within the FAA or from an airspace user. A few examples of concerns that may be expressed by air traffic controllers:

A sector has too much traffic on a route or over a fix.

A sector is too complex with multiple transitions or merge points.

A sector lacks sufficient airspace for holding, vectoring, or merging traffic.

A miles-in-trail (MIT) restriction imposes a frequent need to absorb excessive delay.

An airport is receiving traffic at less than its arrival capacity.

The relationship of routes and sector boundaries creates too many pointouts.

Air carriers have a different perspective, and report different problems:

Arrival or departure delays are excessive.

There is not enough flexibility in filing alternative routes.

The distance traveled between origin and destination is much greater than the minimum.

Air Traffic Control (ATC) imposes excessive vectoring or holding.

ATC forces aircraft on undesirably low altitudes, resulting in poor fuel efficiency.

Access to airspace is denied for aircraft not equipped for special procedures.

Concerns may also come from other stakeholders: airport authorities, general aviation, citizen's groups, federal, state, and local agencies, and manufacturers of airframes or avionics equipment.

It should be clear that the definition of a problem depends on the point of view of the group experiencing it. For example, clearances to low altitudes may move traffic into different sectors, to avoid "too much traffic in a sector," but causes "poor fuel efficiency" for the air carriers.

As part of the Oversight team's investigation into the concerns, the concerns should be documented and may provide potentially early safety hazard (what can go wrong?) input to a safety risk management analysis of the airspace problem.

2.1.2   Identifying Problems – Foresight and Planning

Another class of airspace problems for study are identified not as a reaction to a concern, but when the FAA wants to exploit a planned change or avert a potential difficulty. Examples are:

> When an airport is planning to add a new runway, the airspace may need redesign to exploit the new runway's extra capacity.

> An airport is installing new equipment to increase options for arrival procedures and the airspace needs to be optimized.

> Air carriers are adding regional jets to their fleets and retiring turbo-prop aircraft, which may change loading on jet routes.

> Air carriers are equipping their fleets with improved navigation or communications equipment, which could enable new procedures.

2.1.3   Stating a Problem – Metrics

The most effective way to decide whether a problem is worthy of additional investigation is to measure its impact. Can this problem be stated in terms of one or more readily available metrics? A section on metrics in this handbook discusses metrics for airspace and presents examples. Suitable metrics for describing a problem may already be available in one of the available data sources.

2.1.4   Conclusion of Step 1

Step 1 of the Airspace Design Process concludes when the Oversight Team can characterize the potential problem in enough detail to allow for evaluation at Step 2.

To prepare this characterization:

- Give a brief description of the potential problem to be investigated, including any safety related concerns.

- Identify which stakeholders may be affected by this problem.

- Describe the benefits that may follow if this problem is mitigated, or the costs that may be incurred if this problem is not mitigated. Quantify these costs and benefits whenever possible.

2.2 **Step 2: Perform Initial Evaluation**

At Step 2, (Figure 3) in the Airspace Management Checklist, the Oversight Team performs an initial evaluation of the problem identified in Step 1.
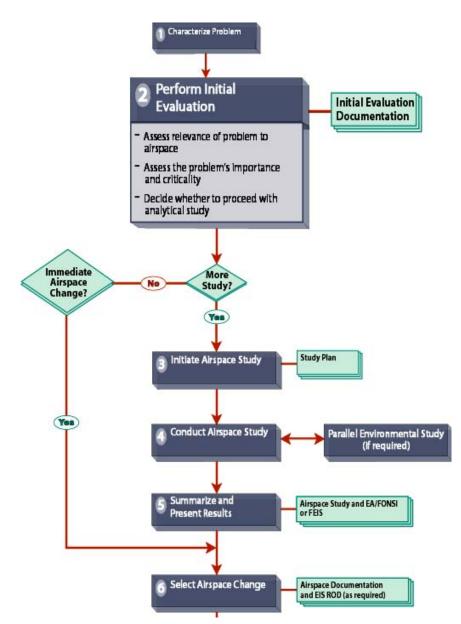
Figure 3. Airspace Design Process: Step 2

This evaluation should not incur large expenses of time or other resources, but should investigate the problem sufficiently to allow the decision makers to choose one of three courses of airspace-related action in response to the problem:

- Take no airspace action.
- Implement a change without further analytical study.
- Initiate an analytical study to obtain more detailed knowledge of the problem and possible responses to the problem.

This evaluation should also address the safety related hazards (what can go wrong) of the airspace problem, and the Oversight team should decide whether a Safety Risk Management Document (SRMD) will be required. If the change is implemented without a full SRMD, then a SRM Decision Memo (DM) signed by the manager is required as discussed in the SMS Manual Chapter 3.

The evaluation should proceed in stages, as shown in Figure 4.
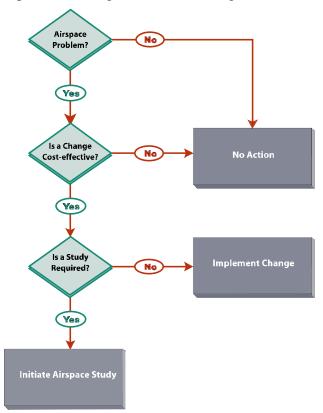
Figure 4. Initial Evaluation Process

1. Is the problem really an airspace problem?

    Examine the description of the problem and associated metrics. Is there objective evidence that a problem exists? Is this a problem of airspace rather than the effect of constraints elsewhere in the NAS? If the answer to both these question is "no," then "Take no airspace action" is the appropriate response, otherwise proceed to the next question.

2. Is this problem serious enough that an airspace change will be cost-effective?

    Predict the benefits and costs of not responding to the problem. Then predict the benefits and costs of designing and implementing an airspace change for comparison.

    The technique used in making these predictions does not need to be as complex as study techniques that might be used at Step 4, but they should use a comparison of metrics in addition to beliefs and opinions that are not supported with metrics. In other words, the reasoning should be quantitative as well as qualitative.

    What is the time-frame of this problem? Might the problem eventually go away as a consequence of other changes that have already been planned?

    Identify possible interventions and estimate both the costs and benefits of those interventions. If the value of the benefit appears small relative to the costs, then "Take no action" is the appropriate response, otherwise proceed to the next question.

3. Is the problem sufficiently complicated that a detailed study is the most appropriate response for selecting a suitable solution?

    A study is usually needed whenever any of the following conditions is true:

    - Competing solutions to the problem have been proposed.
    - Multiple facilities will be affected by proposed solutions.
    - A proposed solution involves multiple changes to airspace or procedures.
    - A proposed solution may require an environmental study.
    - Even when a proposed change is confined to a single facility and the effects appear to be well understood, a detailed analytical study can reduce the risk that an overlooked problem will emerge during human-in-the-loop (HITL) testing or implementation.

    A study may be needed unless all of the following conditions are true:

    - The problem is near-term.
    - There is consensus among the stakeholders on the appropriate solution to the problem.
    - The proposed airspace solution makes few changes in airspace or procedures, and will not require staffing changes.
    - The proposed airspace solution is already in compliance with any applicable regulations, including environmental requirements.

At the conclusion of the evaluation, the decision and the reasoning used to arrive at that decision should be documented as described in the following section.

Outline for an Initial Evaluation Report

The following list is a recommendation of the content to include in an initial evaluation report:

Problem Statement
>What is the nature and severity of the problem?
>What are the issues associated with this problem?

Background
>What is the background of the problem?
>Who are the key stakeholders and what are their concerns?

Scope
>What is the scope of the initial evaluation?
>How long did it take?
>What was the cost in total resources?

Stakeholders
>Which stakeholders were consulted in the course of the initial evaluation?
>What were their responses?

Technical Approach
>What metrics, tools, and data were used during the initial evaluation?
>What techniques were used to evaluate environmental issues?
>What techniques were used to evaluate the safety issues?

Results and Conclusions
>What results were produced during the initial evaluation?
>What conclusions were based on those results?

Recommendations
>What action is recommended as a consequence of the initial evaluation?

2.2.1 Conclusion of Step 2

Step 2 of the Airspace Design Process concludes when the decision on the next action step has been made and documented. Although the reporting of the initial evaluation could consist of a memorandum or a collection of meeting minutes, it is a good practice to write a report following the outline above. The outline can be used as a checklist, to ensure that all the questions are addressed. If the questions relating to stakeholders and environmental issues are not given sufficient attention at this stage, any future actions might be hampered by the need to address these questions retroactively.

The step that follows depends on which decision has been reached. If the decision is for "no action," then the Airspace Design Process is complete for this problem. If the decision is to implement an immediate change in the NAS, then the next step is Step 6: Select Airspace Change. If the decision is to pursue further analytical study, then the next step is Step 3, Initiate Airspace Study.

2.3 **Step 3: Initiate Airspace Study**

If Step 2 concluded with a decision to pursue an analytic airspace study, then the Oversight Team proceeds to Step 3, see Figure 5, in the Airspace Management Checklist.
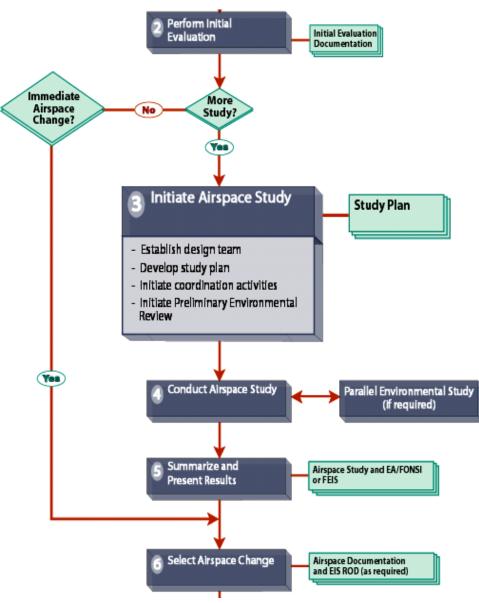
Figure 5. Airspace Design Process: Step 3

There are five parts to this step:

- Establish the Design Team to perform the study;

- Develop a study plan describing the objectives of the Design Team, and how it is to accomplish those objectives;

- Initiate any coordinating activities that are preconditions for proposed airspace changes; and

- Initiate the Preliminary Environmental Review.

- Initiate a Safety Risk Management Panel.

2.3.1   Establish Design Team

At this stage, the Oversight Team has the responsibility to name a Design Team to conduct the airspace study. The composition of the Design Team will vary depending on the number of facilities and stakeholders affected by the airspace problem. The membership should include, as appropriate:

- FAA personnel
  At least one manager and air traffic controller's representative from the affected facility and other personnel from FAA headquarters, regions, and affected facilities, as needed.

- Other federal personnel
  Representatives from other organizations within the federal government (for example, Department of Defense (DoD)) who control or share the airspace being studied.

- Stakeholders
  Representatives from state, county, or local governments, air carriers, and other parties who are potentially affected by the airspace problem.

- Analytical experts
  Analysts with experience in airspace analysis and design. These may be FAA or contractor personnel.

2.3.2   Develop Study Plan

The purpose of writing a study plan is to develop and record the structure and goals of the Design Team. The study plan is the major coordination document for the airspace study (see Step 4: Conduct Airspace Study). Because many of the details in the study plan are not yet known when the initial study plan is written, it may be necessary to modify the study plan once the study proper has begun. It is extremely important that any modifications to the study plan be coordinated with the entire Design Team, to prevent misunderstandings and subsequent waste of time and other resources.

2.3.2.1   Outline for a Study Plan

Although much of the content of the study plan is similar to what was written for the Initial Evaluation Report it may be possible to provide additional detail. The following list is a recommendation for the study plan content.

Problem Statement
   What is the nature and severity of the problem?
   What are the issues associated with this problem?

Background
   What is the background of the problem?
   Who are the key stakeholders and what are their concerns?
   What operational details are relevant to this airspace study?

Scope
   What is the scope of this airspace study?
   What are the constraints of time and other resources?
   How does the scope reflect the complexity of the problem, the size of the airspace under study, and the potential impact of airspace design changes?
   What are the criteria and plan for the safety risk management effort?

Stakeholders, Decision Makers and their Roles and Responsibilities
   Who are the members of the Design Team?
   What is the role and responsibility of each member of the Design Team?
   What is the role and responsibility of the Design Team as a whole?
   What stakeholders will participate in the airspace study, and what role will they play?
   Which regions or facilities are involved?
   Who will make the decisions about whether alternatives will be implemented?
   Who will take part in the Safety Risk Management Panel?

Schedule and Products
   What products will the Design Team deliver?
   What is the schedule for completing these products?
   What interim products will be delivered before the airspace study is complete?

Resources
   What resources (staff-years, data, tools, safety risk analysts, environmental review, etc.) will be required to conduct the study?
   What particular skills or types of knowledge will be required?

Alternatives
   What alternative courses of action will be considered in the airspace study?

Technical Approach
   What metrics will be used to evaluate the alternatives?
   What tools will be used to estimate the values of the metrics?
   What data sources will be used?

What key technical limitations are predicted?
How will environmental issues be addressed?
How will safety risk management be addressed?

Metrics and Alternatives
What is the relationship between values of the metrics and the alternative courses of action?
What threshold values of the metrics will change the preferred course of action?

2.3.3   Initiate Coordination Activities

Airspace design does not take place in a vacuum, but has many dependencies. These coordination activities are initiated as part of the planning for airspace design, and continue until implementation.

2.3.3.1   Coordination with Environmental Study

It is important to understand exactly what analysis will be necessary to meet environmental reporting requirements for any proposed airspace changes. If the appropriate information is not generated during Step 4, and the omission is not noticed until later in the process, lengthy delays and additional costs may be incurred. The Oversight Team should include the FAA Regional Environmental Specialist who will be responsible for coordinating with the Design Team, FAA facilities, and other agencies with jurisdiction over affected resources, as appropriate. These agencies may include:

- Airport proprietors (if the proposed airspace design actions affect airports),
- State and local government agencies (to meet state or local environmental requirements),
- Community representatives,
- U.S. Environmental Protection Agency,
- U.S. Army Corps of Engineers,
- U.S. Fish and Wildlife Service and National Park Services,
- Advisory Council on Historic Preservation,
- DoD, and
- Bureau of Indian Affairs.

For more information about meeting the requirements of the National Environmental Policy Act (NEPA), see Appendix A, Environmental Analysis.

Proposed airspace (or procedural) changes above 10,000 feet above ground level (AGL) are not subject to the requirements of NEPA and do not normally require an environmental study.

2.3.3.2 Coordination with Other Airspace Projects

The problem under study may be affected by projects already underway in the region or in another part of the NAS. Therefore it is important to coordinate with the regional office or headquarters to learn about other projects that are taking place or ones that have recently been completed. It is possible that another group has done work that can contribute towards a solution for the problem under study. If a similar study is underway, it could be beneficial to both projects to plan for occasional exchanges of personnel and findings.

2.3.3.3 Coordination with Existing Orders

As early as possible, both the Oversight Team and the Design Team should become familiar with all regulations or other guidance that may affect the airspace design options for the problem under study. The regulations and guidance may come from inside or outside of the FAA. Any proposed solution to the airspace problem will need to be compliant with existing Orders, environmental regulations, Master Plans, and any other legally-binding documents applying to airspace. Making changes to these documents can be a lengthy process. If a potential solution will require changes in any existing legally-binding documents, the change process should be initiated as soon as possible.

2.3.3.4 Coordination with Area Navigation (RNAV) Route Development

If one of the solutions being considered for an airspace problem requires definition of new RNAV procedure, the lead time for creating these procedures should be factored into any action plans. The process for defining a new RNAV procedure can take over a year, so it would be expedient to initiate the process for defining terminal RNAV procedures as early as possible. (See FAA Order 7100.9 *Standard Terminal Arrival Program and Procedures* and other references contained in Appendix E.)

2.3.3.5 Coordination with Stakeholders

The problem under study may also be affected by changes on the part of stakeholders. For example, new technology being installed in the cockpit may solve, or further complicate, the problem. As the stakeholders are identified, make sure that their input is included in the study process.

2.3.4 Initiate Preliminary Environmental Review

The first part of environmental study is a Preliminary Environmental Review, which is used to determine the potential extent of the environmental impacts of proposed airspace changes. During this step, the Design Team in coordination with the FAA's Regional Environmental Specialist and Oversight Team should initiate the Preliminary Environmental Review. This review usually focuses on noise impacts, since these are the most frequent environmental effects of airspace changes.

The Preliminary Environmental Review usually leads to one of three outcomes:

- The proposed action is identified as a Categorical Exclusion (CATEX) and no further environmental analysis is required.
- The proposed action requires an Environmental Assessment (EA).
- The proposed action requires an Environmental Impact Statement (EIS).

The initial environmental review is intended to provide some basic information about the proposed airspace project to better assist in preparing for the environmental analysis phase. An Initial Environmental Review checklist (see Appendix B) has been developed to assist in the determination of the potential level of the environmental review (EA or EIS) and expected costs.

Completion of the Preliminary Environmental Review and determination of its outcome is not always possible during this step. It may require further analysis during the Airspace Study to complete the Preliminary Environmental Review (see Section 2.4.6, Conduct Environmental Study in Parallel).

2.3.5   Initiate Safety Risk Management Panel

The Oversight team should establish a Safety Risk Management Panel representative of the stakeholders involved that can address safety related hazards (what can go wrong?), and analyze, assess and treat the associated risks with the current and proposed airspace alternatives.

As described in the Air Traffic Safety Oversight Order 1100.161, all proposed changes to the NAS must meet the full Safety Management System (SMS) requirements for safety risk assessment unless the following conditions are met:

1) The office proposing the change has not received SMS training and is not yet operating under the purview of the SMS

2) The change does not affect any safety standard as described in the 1100.161 Order.

3) The change is documented per the direction of the ATO Safety Service.

4) The change is made in accordance with orders and operating practices in place immediately prior to SMS implementation.

Waivers to safety standards require approval by the AOV.

2.3.6 Conclusion of Step 3

Step 3 of the Airspace Design Process concludes when the Design Team is ready to begin the airspace study, implying that:

- The Oversight Team has selected the Design Team and designated the roles of the members of the Design Team.

- The Oversight Team, in consultation with the Design Team, has produced a Study Plan describing the objectives that the airspace study is meant to accomplish. The Study Plan includes a schedule and specifics of the resources available to the Design Team.

- The Oversight Team has identified any coordinating activities, including environmental study that are preconditions for proposed airspace changes and initiated these activities to proceed in parallel with the airspace study.

- The Oversight Team has established the members of the Safety Risk Management Panel, and designated the roles of the members of the panel.

2.4 **Step 4: Conduct Airspace Study**

Step 4, shown in Figure 6, in the Airspace Management Checklist is the responsibility of the Design Team, which was selected by the Oversight Team in Step 3, Initiate Airspace Study.
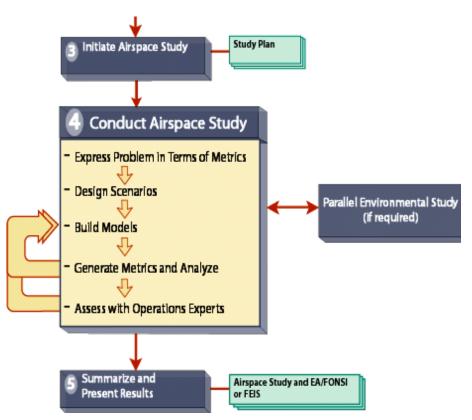
Figure 6. Airspace Design Process: Step 4

Because conducting an airspace study is a process in its own right, Step 4 has its own process chart, shown in Figure 7.

The five airspace study tasks in Step 4 are:

- Express Problem in Terms of Metrics;
- Develop the Baseline and Alternative Scenarios;
- Build Model of Each Scenario;
- Generate Metrics and Analyze; and
- Assess with Operations Experts.
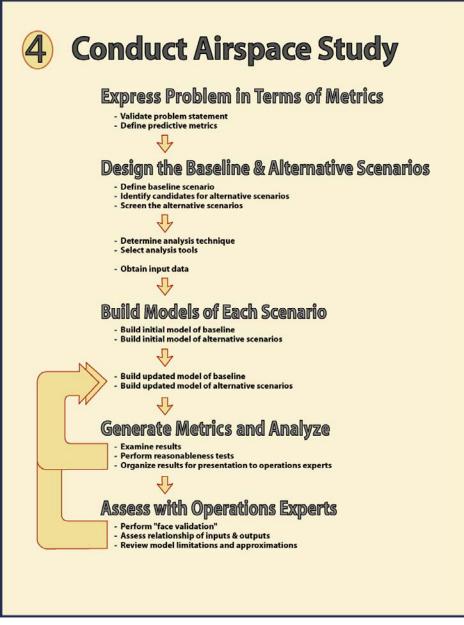
Figure 7. Airspace Study Process in Detail

It is extremely important to perform the first two tasks before commencing the third task, "Build Model of Each Scenario." In a typical airspace study, there is a temptation to believe that the goals and metrics are thoroughly understood, that the right tools, techniques, and data are obvious, and that no time is to be lost before starting the process of building the various models. Unfortunately, it is also typical for a review of the partly-built models to reveal that there are important misunderstandings about which scenarios should be studied and which metrics need to be calculated. The Design Team contains

people with diverse skills who may have difficulty understanding each other's technical terminology. Any time that seems to be saved by immediate model-building can be lost many times over if it turns out that the fundamental modeling assumptions are incorrect.

After the first two tasks are complete, and the initial models of the baseline and alternative scenarios have been reviewed, the final three tasks, build model of each scenario, analyze, and assess with operations experts, are iterative. The appropriate number of iterations will vary for different projects.

Additionally, it is important to conduct the environmental study in parallel (see Appendix A), since the alternatives development and analyses portion of the environmental document is the heart of the environmental process.

2.4.1 Express Problem in Terms of Metrics

This task contains two parts. The first is to validate the problem statement, that is, confirm that the problem statement is current, complete, and correct. The second part of this task is to define and select the study metrics, making sure that the problem statement translates into questions about metrics which can be estimated or modeled.

2.4.1.1 Validate Problem Statement

Examine the problem statement, which may have been re-stated in the course of the initial evaluation, and validate the content. When examining the problem statement, address the following questions:

- Is there evidence that the problem does exist?
- What assumptions are incorporated into the problem statement?
- What assumptions have been made about the existence of particular data?

The goal of validating the problem statement is to find any unintended omissions or misstatements before investing in modeling work.

2.4.1.2 Define Predictive Metrics

The problem statement usually contains a direct reference to the values of particular metrics; however these may not be the only, or the best, metrics to use in modeling. For a more detailed discussion of quantifying characteristics of airspace, see Section 3.3 on metrics.

The process of metrics definition should include the airspace users and stakeholders as well as the entire Design Team. Because there is a close relationship between the choice of metrics and the definition of the alternative scenarios, it is important to draw on all possible sources of expertise to avoid omissions and misunderstandings.

The purpose of the metrics is to support and clarify decision making. Because each additional metric adds to the complexity and cost of a study, it is important to define only the metrics that will illuminate an aspect of the problem statement.

2.4.2 Develop the Baseline and Alternative Scenarios

The activities in this task are highly interdependent. The choices of analytical tools and techniques, and availability of input data impose limitations of what scenarios can be represented. It can be very tempting to select the tools and techniques first and craft the scenario definition to fit within what is possible with those tools and techniques. However, it is better practice to define first what scenarios will best address the quantitative problem identified in the previous task and then, if necessary, modify those scenarios to work with a particular tool.

Each scenario should contain a description of the assumptions made in the following five categories:

- Airspace geometry, that is, the boundaries of sectors or control volumes;
- Air traffic control procedures, including applicable miles-in-trail, speed, and altitude restrictions, departure and arrival procedures;
- State of technology in use, such as surveillance, navigation, and communications equipment;
- Environmental conditions, such as visibility (visual meteorological conditions [VMC] or instrument meteorological conditions [IMC]), wind velocity, and temperature; and
- Air traffic demand for the airspace.

A challenging part of defining scenarios is to characterize the traffic demand, which is discussed at greater length in the "Obtain input data" section (Section 2.4.2.6.)

2.4.2.1 Define Baseline Scenario

Before it makes sense to investigate alternatives, there must be a baseline to which the alternatives can be compared. The differences captured between the baseline and alternative scenarios allow us to understand the impacts of the proposed change. If the airspace problem affects current airspace, the baseline will probably correspond to the current configuration. For some problems, the current configuration may be a candidate for a baseline to represent a case where conditions external to the airspace have changed without a corresponding change in the airspace (sometimes called the "No Action" alternative). For other problems, the baseline may already incorporate differences from the current configuration.

2.4.2.2 Identify Alternative Scenarios

The Design Team ought to investigate several candidates for alternative scenarios before making a final selection, but attempt to keep the total number of alternatives as small as possible. Because each additional scenario can increase the total modeling effort, it is important to make sure each scenario has a bearing on the ultimate decisions.

It is important to determine whether any proposed alternative scenario is within the envelope of any previous environmental Record of Decision (ROD). A scenario that

goes beyond what is covered in an existing ROD may trigger additional environmental review (see Appendix A).

Although this list is not all inclusive, airspace modifications generally take the form of one or more of the following actions:

Change Sectors:

- Modify the shape of existing sectors (en route) or arrival and departure corridors (terminal);
- Add a new sector or corridor;
- Implement dynamic sector boundary changes; or
- Reallocation of airspace between facilities.

Change Routes:

- Modify existing air routes, Standard Instrument Departures (SIDs) or Standard Terminal Arrival Routes (STARs);
- Add new routes for daily use; or
- Add new routes to add flexibility in bad weather.

Change Restrictions:

- Modify miles-in-trail restrictions; or
- Modify altitude restrictions.

Apply New Procedures:

- Introduce Reduced Vertical Separation Minima (RVSM);
- Introduce Area Navigation (RNAV);
- Introduce Required Navigational Performance (RNP);
- Introduce Navigation Reference System (NRS);
- Introduce dynamic reroutes; or
- Modify Special Use Airspace (SUA) procedures.

It should be possible to summarize each candidate scenario with a brief phrase, such as: "West Flow with projected 2015 traffic," or "New Runway, Dependent Parallel Operations, VMC." Behind that phrase, there should be enough description to clarify the purpose of defining this particular scenario. It is important to state any underlying assumptions, such as percentage of aircraft that have RNAV capability.

Even if an airspace change can be stated simply, the effect on air traffic can be profound. Because the airspace structures are so interdependent, it is difficult to change any feature of the airspace without affecting other features. Part of the value of building a model of the system is to investigate both intentional and unanticipated effects and estimate their magnitudes.

2.4.2.3 Screen Alternative Scenarios

It is important to resist the temptation to define too many scenarios for detailed study. There is a real danger that resources can be diluted by attempting to represent too many alternatives. The definition of each scenario should bear directly on making decisions about airspace design.

The following list of questions in three key categories is helpful for screening candidate alternative scenarios:

- **Distinguishability**: Can this scenario be readily distinguished from the other scenarios being studied?

- **Plausibility**: Are the conditions that define this scenario really plausible in the specified time frame?

- **Impact**: Will the conditions that define this scenario occur frequently enough that it is worthwhile to study?

The Design Team should keep a record of all the assumptions made about baseline and alternatives. The environmental review process requires documentation of "other alternatives considered" and why each alternative was or was not investigated. Also it is important to document any rejected alternatives. If the underlying assumptions in the study change, it can save a great deal of time to retrieve the description of a rejected scenario candidate rather than developing a new one.

2.4.2.4 Determine Analysis Technique

There is no single approach that is effective for all airspace design problems. The following list describes various techniques that individually, or in combination, may be suitable for a particular problem.

Consult Expert Judgment

Approach: Have key experts examine all the available information and draw conclusions. If the experts come to agreement on the preferred interpretation or alternative, the amount of subsequent analysis can be reduced.

Strengths: Qualified experts have insight into operations that is difficult to obtain in other ways.

Drawbacks: The appropriate experts may not be available in a timely way. Differences of opinion between the experts may have no satisfactory resolution without resort to other techniques.

Analyze Historical Data

Approach: Analyze data to identify relationships between the important variables. For example, examine the values of a metric ("delay," or "number of operations"): the average, extreme values, and relationships with other variables. The changes in the values of metrics over time can be used to project continuation of current trends.

Strengths: The objectivity of the underlying data makes any conclusions free of bias.

Drawbacks: The desired data is not always available and is not always of appropriate quality. Trend analysis and correlations may give a misleading impression of the relationship between causes and effects.

Apply Modeling and Visualization Tools

Approach: Use modeling tools (see the section on tools) to simulate aircraft flights with airspace, airports, procedures, and weather conditions represented with varying degrees of detail. These tools can show the effects of varying any of a large number of inputs. The output of these tools can be numeric or a visualization illustrating air traffic and NAS features.

Strengths: Can represent complex scenarios with controlled alternatives. Allows exploration of the effects of changing multiple input values. Visualizations are an excellent way to communicate spatial and dynamic information and the relationship of causes to effects.

Drawbacks: Some of these tools have lead times of weeks or months. Depending on the level of detail desired, the modeling techniques can consume more resources than any other technique except Human-in-the-Loop (HITL) experiments.

Perform Human-in-the-Loop (HITL) Experiments

Approach: HITL experiments simulate aircraft flights and air traffic control behavior with varying degrees of fidelity of airspace, airports, procedures, and environmental conditions. HITL experimentation can be combined with other analysis techniques which are used to screen the alternatives to use for HITL experimentation. (Examples of HITL experiments include those that are conducted on the human factor systems at the FAA Technical Center or on the GRAIL system at MITRE.)

Strengths: HITL experiments can provide insights into airspace workability and manageability that are not available with purely analytic techniques.

Drawbacks: The results from HITL experiments tend to be qualitative rather than quantitative. HITL exercises tend to be costly and resource intensive.

2.4.2.5   Select Tools

In general, the study metrics and selection of analysis technique should drive the choice of the analysis tool or combination of tools to be used. Practical considerations also affect the choice of tools. A tool is not suitable for use unless all the following statements are true:

- The tool is available to the Design Team.
- The Design Team contains members trained in the use of the tool, or has access to trained users, or there is sufficient time in the schedule to train new users.

- Appropriate input data can be obtained within schedule constraints.
- The Design Team has access to the hardware and software necessary to support the tool.
- The tool can produce one or more of the study metrics with an appropriate level of reliability.

The level of detail that a tool can represent is an important consideration. In general, it is a good idea to use as little detail as is possible to perform the analysis. A greater amount of detail does not necessarily produce a more convincing result and a small increase in desired fidelity or changes in assumptions can result in a very large increase in analysis effort. For a list of tools that have been used for airspace studies, see the section on tools.

2.4.2.6   Obtain Input Data

The choice of input data depends on the desired study metrics, the level of detail to be modeled and the tools that will be used. It is very common to discover that a great deal of pre-processing is required before data from operational sources can be used as input to the selected analysis tool. In particular, building the data samples representing air traffic demand can be extremely time-consuming, requiring the use of auxiliary tools. For a list of data sources see the section on data sources.

Building a data sample to represent air traffic demand reflects assumptions made in the scenario definitions about:

- Proportion of each aircraft type in the sample;
- Proportion of aircraft in the sample equipped (or not) with particular communications, navigation, surveillance, and warning systems;
- Cities of origin and destination, and the routes desired;
- The date of the sample (current year, past or future years); and
- The time interval being modeled: minutes, hours, or longer time periods.

Depending on the objectives of the study, it may be appropriate to use the traffic that was recorded for a particular day, or the "peak traffic" day from a particular month or year, or to engineer a synthetic sample from several historical traffic days. For future scenarios, a synthetic sample is necessary.

2.4.3   Build Model of Each Scenario

Because the alternative scenarios usually differ from the baseline in only a few ways, it is usually a good strategy to build and review an initial model of the baseline before constructing models of the alternatives.

2.4.3.1 Build Initial Model of Baseline Scenario and Review

The initial model does not need to include every detail of the design, just enough of the representation of the system so that preliminary output can be obtained for review by the entire Design Team. This and subsequent reviews should focus on answers to the following questions:

- Is the input data complete, accurate and correctly applied?
- If there is target data for calibrating the model output, does the output come close to the target?
- Do changes in the model inputs result in appropriate changes in the output?
- Do the operational experts agree that the baseline model captures the essential features?

Because the modeling is preliminary, it may not be possible to get definitive answers to these questions. But it is often possible to uncover problems and inconsistencies at this stage. It may be necessary to revisit the "Develop Baseline" task after the review; therefore it is desirable to schedule the first review as soon as possible so the problems can get resolved early.

2.4.3.2 Build Initial Models of Alternative Scenarios and Review

The review of the models of the alternative scenarios will focus on the same questions as for the baseline, but can often be conducted more quickly because only the differences from the baseline require scrutiny. However, it may also be necessary to revisit the "Develop Baseline" task for the alternative scenarios, so once again it is best to schedule an early review.

2.4.3.3 Refine Models of all Scenarios and Review

Once the preliminary models have undergone the scrutiny of the entire Design Team, it is time to incorporate all the details and identify any issues that arise on account of missing data, inconsistent data, and the limitations of a particular modeling approach.

2.4.4 Generate Metrics and Analyze

After establishing confidence in the definition of the models and their input, generate and analyze the output metrics. The differences in the values of the metrics for the various alternatives should have a coherent explanation. It should also be possible to estimate the impact of any modifications of the model assumptions on the dependability of the output.

2.4.5 Assess With Operations Experts

The participation of operations experts is valuable at each part of the study, but it is particularly important to have any conclusions reviewed for difficulties not visible to the modelers and data analysts. In fact, before Step 4 can be considered complete, operations experts must consider the models to be valid. If necessary, the process of updating the models and generating metrics may have to be repeated many times. It is possible that the data, tools, or techniques chosen by the study team are eventually deemed inadequate.

In this case, it may be necessary to revisit earlier tasks in Step 4 and define new metrics or scenarios.

2.4.6 Conduct Environmental Study in Parallel

The environmental study process is summarized below and should be conducted in parallel, if required. For greater detail on the environmental process, see Appendix A.

2.4.6.1 Environmental Impact Process vs. Airspace Design Process

The Preliminary Environmental Review, which was initiated in the previous step, should be completed in this step.

If the outcome of the Preliminary Environmental Review requires further environmental analysis, (either an Environmental Assessment (EA) or an Environmental Impact Statement (EIS)) the FAA Regional Environmental Specialist will be responsible for coordinating with the Design Team, FAA facilities and identifying other agencies with jurisdiction over affected resources.

An EA or EIS will require an accurate description of the alternatives being proposed and coordination with the FAA Regional Environmental Specialist. The process is lengthy and whenever possible should take place in parallel with the rest of the airspace study. The Design Team will need to judge when the baseline and alternative scenarios are well enough defined that it makes sense to begin evaluating the environmental effects of the alternatives. Once the environmental process has started, there will be little flexibility to make further changes to the scenarios without affecting the progress and schedule of both the environmental study and the airspace design study.

2.4.6.2 Inputs for Noise Analysis

The noise impacts for an environmental analysis can be assessed using an approved FAA aircraft noise model, listed in Appendix A. Typical input data requirements for noise impacts are:

- The layout of the new generalized flight tracks (including key waypoints and altitudes);
- Flight traffic assignment to flight tracks;
- 24-hour Annual Average Day flight activity, including counts of arrivals and departures, the mix of equipment types in use, and a Day-to-Night split based on flight arrival and departure times; and
- Land use, population and demographic data.

2.4.7   Conduct Safety Risk Management Analysis in Parallel

For each alternative, the hazards should be identified and risk analyzed and assessed by the Safety Risk Management Panel.

- The hazards are identified for the alternatives in terms of what things could "go wrong" and the possible causes are identified and documented.

- To analyze the risk, each hazard and the system state in which it potentially exists is evaluated to determine what exists to prevent or reduce the hazard's effects or occurrence.

- To assess the risk, each hazard's risk is compared to and plotted on a risk assessment matrix that takes into account likelihood and severity as described in the SMS Manual.

  The risk analysis may also include options for controlling or mitigating the risks for each alternative.

This material is documented in a SRMD as described in Appendix D.

2.4.8   Conclusion of Step 4

Step 4 is complete when each scenario of interest has been described in a model and the operations experts have accepted that the models are adequate representations of the underlying problems. The metrics resulting from exercising these models have all been calculated and any required environmental modeling and analysis and safety risk analysis have been completed.

The environmental process will be completed with a determination that the EA results in a Finding of No Significant Impact (FONSI), or that an EIS must be completed. If the EA will result in a FONSI, it should be completed at this time.

2.5   **Step 5: Summarize and Present Results**

When the airspace study is complete, the substance of the analysis, including conclusions and recommendations, should be recorded in a study report (see Figure 8). This report should specify any recommended airspace actions, sector realignments, route adjustments, and procedural changes that will be necessary to implement the recommendations. The EA/FONSI or final EIS (FEIS) (see Appendix A) should be included as an attachment or appendix to the study report. The study report should also include the SRMD as defined in Appendix D. The study report conveys the key findings of the airspace and environmental study to decision makers and stakeholders, and documents the analysis for historical reference.
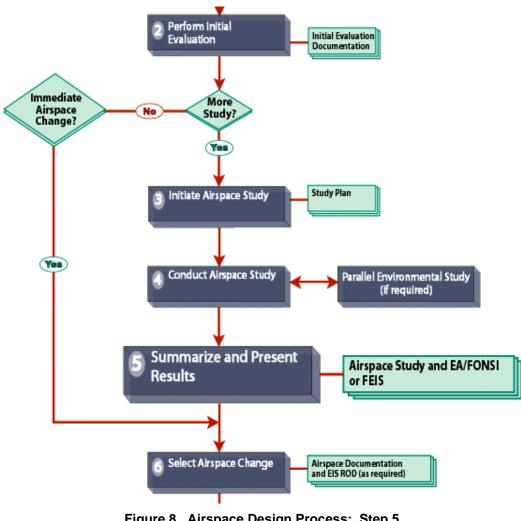
Figure 8. Airspace Design Process: Step 5

The formal report can be presented in different forms: as a written study report or a study briefing, or both. The briefing is an effective way to present key information to decision makers and stakeholders quickly, but a written report is more suitable for capturing the details of the analysis. After a briefing, the decision makers may want to refer to these details before arriving at a decision about implementation.

2.5.1 Outline for an Airspace Study Presentation

The following list is a recommendation of the content to include in an Airspace Study presentation to decision makers and stakeholders. When preparing a presentation, consider what information the audience needs and how they might want to use it.

- What was the original problem considered?
- Has the statement of this problem changed? Why?
- What are the key issues and concerns surrounding this problem?
- What technical approach was used for the analysis?
- What are the implications of any simplifying assumptions?
- What were the limitations of the data, methodology, and tools used in the study?
- How were the baseline and alternative cases defined?
- What are the comparisons between the results for the baseline and alternative cases (including any environmental and safety impacts)?
- Are there qualitative differences between results for each case as well as quantitative differences in the corresponding metrics?
- Do the comparisons favor one alternative over another? Are the results inconclusive? Why? If they are conclusive, are there caveats?

2.5.2 Outline for an Airspace Study Report

The following list is a recommendation of the content to include in an Airspace Study report following an Executive Summary which contains a brief, stand-alone summary of the study. Supply reference material or detailed numerical results in appendices.

Problem Statement

What is the nature and severity of the problem?
What elements of the NAS are affected by this problem (procedures, automation and infrastructure)?
What traffic characteristics are assumed?
If the problem depends on planned changes to the NAS, what changes are being assumed, with what timetable?

Background

What is the background of the problem?
Who are the key stakeholders and what are their concerns?
What chain of events has led to the decision to conduct an airspace study?

Scope

What was the study scope?
What were the constraints of time, resources, and tools?

Study Objective(s)

What was the original study objective?
Did that objective change, and if so, for what reasons?

Stakeholders and Decision Makers

What stakeholders were involved with this study?
What was the relationship of the airspace Design Team to other organizational
entities, including other regions and other study teams?
What input was received from the stakeholders?

Alternatives

What alternatives were considered throughout the study?
Which alternatives were rejected early in the study and why?
Which alternatives were selected for detailed development?
How does each alternative represent a feasible course of action?
What are the potential environmental impacts for each alternative?
What are the potential safety impacts for each alternative?

Technical Approach

What technical approach was used for this study?
What metrics were used to evaluate the alternatives?
What model or models were used?
What data sources were used?
What were the limitations of this approach?
How were environmental issues evaluated?
How were safety issues evaluated?

Results

What results were obtained from the study?
How are those results expressed using the study metrics?

Conclusions

What are the key observations resulting from this study?
What conclusions can be drawn from any part of this study, including the
initial evaluation, discussions among stakeholders, and analysis of the
alternatives?
Are any of the conclusions pertaining to matters outside the specific scope of
this study?

Recommendations

> Based on the study, what is the recommended course of action?
> Should additional alternatives be considered?
> Does the analytical approach used for this study need improvement?

If the recommended alternative contains additional sectors, positions or staff, a separate report may be required for "sector validation." Sector validation reports that have been well-received by decision makers in the past have clearly articulated the overall benefits and modeling information of the study including study data, tools, and metrics used. Additionally they have included, for each sector: operational justification, new sector description, modeling results, benefits, and required resources (including equipment, staffing, and training). Further guidance on the "sector validation" process is currently under development and will be incorporated into future editions of this handbook.
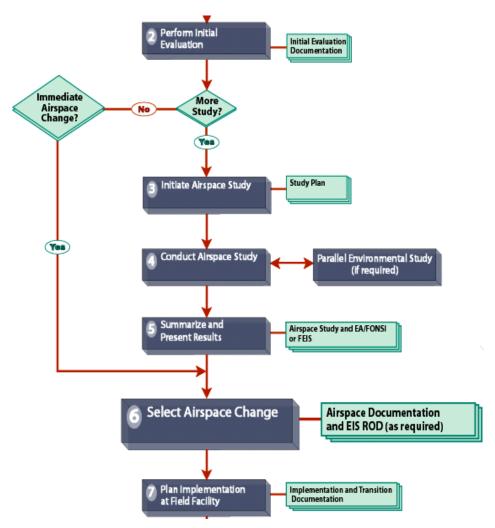
2.6 Step 6: Select Airspace Change

When the airspace study is complete and the results provided to the decision makers, a decision should be made as to the next step (Step 6 of the Airspace Design Process, see Figure 9). The decision makers may select a proposed alternative, a combination of alternatives or even decide further analysis is needed or to take no-action at this time. The selected decision should be documented.

If an EIS was prepared during this airspace study, a Record of Decision (ROD) should be developed. The ROD is a concise public record of decision, which may be integrated into any other record (such as a rule) prepared by the agency (see Appendix A).
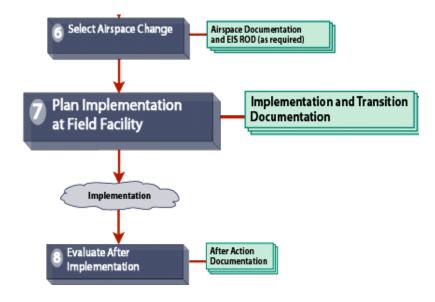
An SRMD for a selected airspace change should be finalized and should include a description of the current system, proposed change, identified hazards, risk analysis, and the hazard mitigation strategies and control efforts as described in Appendix D. An SRMD must be approved and risks accepted as discussed in Appendix D.

Figure 9. Airspace Design Process: Step 6

2.7   **Step 7: Plan Implementation at Field Facility**

When the decision makers have approved airspace changes based on the study results, it is time for the Oversight Team to develop the Implementation Plan (Step 7 of the Airspace Design Process, see Figure 10). Step 7 corresponds to the conclusion of Phase 4 in the project life cycle (see Appendix C) of an airspace redesign program.

Figure 10. Airspace Design Process: Step 7

Although implementation issues should be considered throughout the entire study process, the detailed planning process should await approval for a particular change. The primary concerns of the planning are to:

- Avoid any interruption of air traffic services;
- Minimize disruptions of air traffic;
- Give timely and effective notification of changes to all affected parties; and
- Establish clear direction in the event of transition problems.

Each facility participating in the change should develop an Implementation Plan describing all the implementation activities including the cutover to the new configuration. It is important to identify any elements of the Implementation Plan with long lead times and schedule activities so that these elements are completed in a timely way. It is especially important to maintain active communication with the airspace users in developing the plan, because their cooperation is essential to a successful change.

For major airspace changes, a phased implementation is a worthwhile option when:

- The risks associated with the change are high;

- The complete airspace change is dependent on future events or installations, but some NAS users or service providers would benefit if a partial change is implemented sooner;

- Certain elements of the airspace change are ready for implementation and would produce a partial benefit, but other elements need more planning and risk mitigation; and/or

- System-wide implementation would create avoidable complexity.

Outline for an Implementation Plan

The plan contains the following parts describing the activities that are needed during the transition:

- Coordination,

- Scheduling,

- Infrastructure Management,

- Procedures,

- Logistics Support,

- Training,

- Performance Metrics,

- Risk Mitigation, and

- Transition Planning.

Coordination

Coordinating the exact timing of changes and communicating the complete scope and magnitude of the changes to all affected parties is critical for a successful transition.

Any change to standard instrument departure procedures and standard terminal arrival routes requires coordination between the affected control tower, terminal radar approach control, and en route center. While all facilities would have been involved in the airspace design and analysis, it is still essential for close coordination of scheduling, training, implementation timing, procedures, and staffing.

If there is a shift in flight patterns, causing either an increase or decrease in traffic to adjacent airspace, the change should be carefully coordinated with the appropriate authorities so that they can make staffing decisions. In the course of the airspace study, the Design Team ought to have coordinated with all the facilities involved, so the main concern for transition planning should be coordinating timing. The timing applies to any training, procedural changes, or agreements between facilities. Similarly, any changes having an impact on FAA-delegated airspace must be closely coordinated with the authority of affected entities so that the timing of the changes is synchronized.

Provide adequate notice of airspace changes to all affected parties including:

- Service providers,
- Aircraft operators, and
- Any affected stakeholders.

Coordinate with FAA and non-FAA facilities experiencing traffic flow changes such as:

- Increases,
- Decreases,
- New pattern,
- New routing, and
- Different hand-off points.

Ensure that these facilities have plans for any required responses to the traffic flow changes such as:

- Internal traffic management,
- Staffing, and
- Workload balancing.

Coordinate with FAA regional and headquarters personnel about procedures and logistics and coordinate the transition timing and schedules with all affected facilities.

Scheduling

Develop a schedule for the airspace change and identify milestones for the required activities.

The schedule should include the exact time of cutover and the exact changes taking place so that directly affected parties can prepare for the change. The preferred time for a cutover is during a period with a minimum level of traffic.

Check the schedule to make sure that any dependent sequence of events occurs in the correct order and that overall implementation delays are minimized.

Identify the critical path events.

Infrastructure Management

Identify what changes are to be made to relevant aspects of the airspace infrastructure, including:

- Airspace classification,
- Airways,
- Standard Instrument Departures (SIDs),
- Standard Terminal Arrival Routes (STARs),
- Navigation aids,

- Communications,
- Surveillance, and/or
- Automation.

NAS users and FAA service providers should be able to make a transition smoothly from base case to the changed airspace. To support a seamless transition, all required equipment or software should be in place, and any changes in displays or formatting should be complete before cutover. All affected facilities should have the updated maps, charts, and other documentation associated with the change. By the time of cutover, updated materials should be available to FAA service providers and NAS users.

Within the FAA, the documentation of changes to airspace, procedures, airways, standard instrument departure procedures, standard terminal arrival routes, and sectorization should be coordinated with the organization that maintains the airspace baseline, and with regional offices. This documentation includes maps, charts, displays, and airspace usage documents.

Procedures

Identify and coordinate procedural changes necessitated by the airspace change, both to the controlling facility's airspace and in adjacent airspace.

Logistics Support

Identify and obtain support requirements, including:

- Installation or facility modification or rearrangements;
- Updates to maps, charts, and other documentation; and/or
- Other preparations for the new configuration.

Training

If the airspace change includes new operational procedures, then training and human factors evaluations should be complete so that FAA service providers and NAS users are fully prepared to operate in the changed environment. Before any airspace change, ensure that all FAA facilities affected by the change conduct appropriate training for:

- New flight patterns,
- Procedures,
- Workload requirements, and/or
- Other operational activities.

Performance Metrics

Define the tools and means to monitor the performance of the airspace change, as recommended by the Design Team. The metrics used are often subsets of the metrics used in the airspace analysis.

Risk Mitigation

Design all the steps for action in this Implementation Plan so that following the steps will minimize the risk factors associated with airspace and procedural changes.

Make a thorough test of all new procedures using

- Planning,
- Coordination,
- Simulation, and/or
- Assessment by operations experts.

For every risk identified in this Implementation Plan, define a course of action to reduce the probability of occurrence and to minimize the impact if the risk does occur. Hazard mitigation should follow the strategies as documented in the SRMD.

Transition Planning

Define the schedule and plans for the transition to full implementation, including any intermediate steps and decision points.

2.8 **Step 8: Evaluate After Implementation**

Step 8 of the Airspace Design Process is to conduct a post-implementation evaluation of the change (see Figure 11) in order to determine:

Are the conditions that gave rise to the problem still in effect?
What benefits can be attributed to the changes?
Have the changes created any follow-on problems?
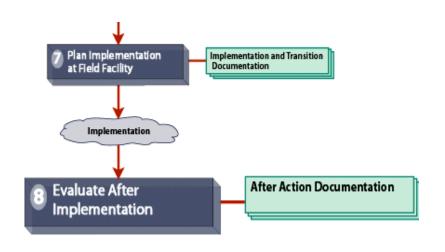
Figure 11. Airspace Design Process: Step 8

The techniques for addressing these questions are similar to those originally used to define the problem in the first place (see Step 1: Characterize Problem). The main difference is that after implementing a change, the Oversight Team should actively solicit feedback from airspace users and air traffic control personnel to determine what adjustments may be necessary. The Oversight Team should also monitor the values of performance metrics to determine to what extent the predicted improvements have been realized. Hazard and mitigation plan tracking and monitoring should follow the strategies as documented in the SRMD.

Questions about the evaluation

Has there been a change in the airspace performance in the area for which the problem in Step 1 was reported?

What are the metrics associated with any performance changes?

Can the observed changes be attributed to the airspace design change?

Are there other factors contributing to airspace usage other than the airspace design changes?

3.   Airspace Design Overarching Topics

The following three sections (data sources, tools, and metrics) contain information about special topics which are relevant throughout the Airspace Design Process.

Metrics are central to analyzing airspace and are referred to directly or indirectly at every step in the Airspace Design Process. All metrics are ultimately derived from data sources describing characteristics or behavior of the NAS. The data sources section, Section 3.1, describes a collection of sources frequently used in airspace analysis. Almost all of these data must undergo some process of refinement and calculation in order to produce useful metrics. Sometimes a process will be invented for a particular case, but many tools have been developed that can simplify and speed up the derivation of metrics. The tools section, Section 3.2, describes examples of these tools that have been used for airspace analysis. The metrics section, Section 3.3, describes examples of metrics with reference to their underlying tools and data sources.

3.1   Data Sources

Data sources (recorded observations of NAS operations) have a close relationship with metrics (measurements that characterize aspects of the NAS) and tools (the means by which metrics are derived or predicted from data sources). Some of the metrics that characterize an airspace problem or remediation of a problem can be obtained directly from a data source; others will require derivation and correlation (see the sections on metrics and tools).

3.1.1   Traffic Data Sources

3.1.1.1   System Analysis Recording (SAR)

SAR provides all non-voice information including radar reports within an Air Route Traffic Control Center (ARTCC) and flight plan messages. The data sets can be large (approximately 5 MB per day). Because of the size of the SAR data sets, each ARTCC normally retains only the most recent fifteen days. For a few selected days, SAR data archives exist for every ARTCC in the NAS.

A new system, designated the Offload system, is being developed to extract and archive a subset of SAR data for all en route centers on a daily basis. When this program is completed, it will be a valuable and complete source for en route track and flight plan data.

3.1.1.2   Automated Radar Terminal System (ARTS)

ARTS provides track information on flights within a 60-mile radius of a terminal radar. The information includes position reports approximately every 5 seconds. The data sets can be very large (approximately 60 MB per day). Because of the size of the ARTS data sets, each TRACON normally retains data for only the previous fifteen days. The Offload program will collect and archive a subset of ARTS data for the major terminal areas.

3.1.1.3   Enhanced Traffic Management System (ETMS)

ETMS provides map data, aircraft situation data, monitor/alert data, and weather messages. The amount of data recorded per day is smaller than for ARTS or SAR, and most of the ETMS data for recent years is available as archives. The aircraft situation Host Z messages recorded in ETMS include information about flight plans and amendments, arrival and departure times, cancellations, tracks, and center boundary crossings.

3.1.1.4   Official Airline Guide (OAG)

OAG contains information about domestic and international scheduled air carrier and air taxi flights. Archives of several years of OAG data are available. The information for each flight includes the air carrier, arrival and departure airport and times, and days of service.

3.1.1.5   Comparison of Traffic Data Sources

Characteristics of the different traffic data sources are summarized in Table 2.

Table 2. Comparison of Traffic Data Sources

Source	Tracks	Flight Plans	Fidelity	Availability
SAR	Complete: ARTCC	Depends on processing	High	Previous 15 days Limited historical data
ARTS	Complete: TRACON	None	High	Previous 15 days Limited historical data
ETMS	Partial: (1 min update)	Most complete	Moderate	Historical data available
OAG	None	None	Minimal	Historical data available

3.1.2   Delay Data Sources

3.1.2.1   Airline Service Quality Performance (ASQP)

ASQP data includes the scheduled and actual departure and arrival times of each flight of reporting airlines. The data collection is required by 14 CFR (Code of Federal Regulations) Part 234. In general, carriers with at least one per cent of domestic schedule service passenger revenues are required to report data for flights involving any airport in the 48 contiguous states that accounts for at least one percent or more of the domestic scheduled service passenger enplanements. Most of the ASQP data is based on automatic reporting systems on board the aircraft and is very accurate. However, not all the airlines that report ASQP have installed automatic reporting systems, so the times inferred from ASQP may not be strictly comparable between airlines.

3.1.2.2   Aviation System Performance Metrics (ASPM)

ASPM data contains a detailed breakdown of delay for major airports. The data includes airport configuration, wind direction and speed, visibility and ceiling, instrument flight rules (IFR) or visual flight rules (VFR), and aircraft operations by hour and quarter hour.

3.1.2.3   Air Traffic Operations Network (OPSNET)

OPSNET data gives reports of delay applying to all air traffic including commercial, military, and general aviation aircraft. The reportable delays for OPSNET are those of 15 minutes or more, experienced by individual aircraft and tracked by the ATC system. Delays are tracked at the gate, on a taxiway, or holding in the air. OPSNET excludes cancelled flights and delays due to mechanical problems or other airline factors. Also excluded are taxi times under the control of non-FAA entities such as airport or airline ramp control.

3.1.2.4   Comparison of Delay Data Sources

Characteristics of the different delay data sources are summarized in Table 3.

Table 3. Comparison of Delay Data Sources

Source	Airports	Traffic	Delay Definition
ASQP	Major Airports	Major Carriers	Compares actual time with scheduled times and reports full difference
ASPM	Major Airports	Major Carriers	Several types available
OPSNET	All Airports	All Traffic	Reports only delays greater than 15 contiguous minutes

3.1.3   Counts

3.1.3.1   Airport Arrival and Departure Rates

Facility logs or Air Traffic Control System Command Center (ATCSCC) logs typically include the airport arrival rate (AAR) and the airport departure rate (ADR) information. These AARs and ADRs represent the minimum and maximum hourly arrival and departure rates for a specific airport for a specific date and time. These rates are reported from the facility and take into account the airport's configuration and weather conditions.

3.1.3.2   Operational Error and Deviation Reports

FAA Order 7210.3, *Facility Operation and Administration,* provides information concerning reporting of operational errors and deviations. This information can provide an indication of the current level of safety associated with a specific airspace. These are sensitive reports and are not readily available.

3.2   Tools

Several different tools may be required in the course of the eight steps of the airspace design process. While Step 1 (Characterize Problem) and Step 8 (Evaluate After Implementation) call for tools that can derive metrics directly from operational data, Step 2 (Perform Initial Evaluation) and Step 4 (Conduct Airspace Study) require tools that can predict the values of metrics based on assumptions about conditions in the future.

No single tool can perform every possible airspace analysis task. Tools have several characteristics that make them suitable for different uses:

- Level of detail;

- Domain coverage;

- Domain interdependence;

- Underlying assumptions;

- Ability to work in conjunction with other tools; and

- Ability to generate metrics of interest.

Table 4 presents tools that have been used in the past to analyze airspace. For several reasons, this list should not be considered exhaustive. First, many of the tools used in airspace analysis are not specialized for aviation: spreadsheets and graphing software can be very useful in conducting airspace studies. Another reason is that tools still under development are not included. Finally, all these tools depend on the use of front-end and back-end auxiliary tools to manage the data. The auxiliary tools are typically small, created by analysts for their own use, and not widely distributed.

Table 4. Airspace Analysis Tools

Tool Name	Description
ArcInfo	A geographical information system. Useful for drawing routes and sectors, visualizing simulation output, doing database analyses of traffic and calculating route lengths.
Air Traffic Noise Screening Model (ATNS)	A noise screening tool derived from INM. Used to determine if extraordinary circumstances exists for a CATEXed action.
Enhanced Airfield Capacity Model (EACM)	An analytical model for estimating airport capacity. If an airspace change affects separations or runway usage, this model gives quick estimates of the capacity benefits.
Integrated Noise Model (INM)	A tool to compute noise levels and areas of affected population around airports.
MapInfo	A geographical information system. Useful for drawing routes and sectors, visualizing simulation output, doing database analyses of traffic and calculating route lengths.
Noise Integrated Routing System (NIRS)	A noise model derived from INM. Used to assess noise impact of airspace changes over a broad area.

Tool Name	Description
Performance Data Analysis and Reporting System (PDARS)	A tool to capture and play back, and analyze radar tracks and NAS messages.
Post-Operation Evaluation Tool (POET)	A graphical query and reporting tool for ETMS and related data. The user can select flights, display tracks, and planned routes on a map, compute statistics and replay traffic.
Reorganized Air Traffic Control Mathematical Simulator (RAMS)	A fast-time simulation tool focuses on en route airspace environments. RAMS generates a wide range of statistics, including throughput and delays.
SDAT	Presents visualization of airspace, routes, and traffic. Reads ACES data from Host and SAR, ARTS, or ETMS for traffic. Can edit airspace in three dimensions.
SIMMOD	A fast-time simulation tool that can model ground, terminal, and en route airspace environments. SIMMOD generates a wide range of statistics, including throughput and delays.
Total Airspace and Airport Modeller (TAAM)	A fast-time simulation tool that can model ground, terminal, and en route airspace environments. TAAM generates a wide range of statistics, including throughput and delays.
Terminal Area Route Generation, Evaluation, and Traffic Simulation (TARGETS)	A tool for designing RNAV routes based on overlays of current TRACON traffic patterns and assessing flyability of those routes.

Table 5 presents a list of airspace analysis application categories and the names of tools useful in those areas.

Table 5. Airspace Tools by Category

Category	Tools		
Analyze noise impacts	INM	ATNS	NIRS
Estimate airport capacity	EACM	TAAM	SIMMOD
Display tracks or flight plans	ArcInfo	MapInfo	PDARS
	POET	SDAT	TARGETS
Show effects of adding new sectors	PDARS	SDAT	RAMS
	TAAM		
Generate metrics from current track data or model output	PDARS	SDAT	RAMS
	TAAM	POET	TARGETS
Show effects of new routes without considering delay	SDAT	TARGETS	
Show effects of new routes including delay	TAAM	RAMS	SIMMOD

3.3 **Metrics**

3.3.1 Types of Metrics

Informally, a metric measures some characteristic of the NAS. Defining a metric allows parts of the NAS to be compared in a meaningful way. There are two types of metrics, one based on observations of historical events, referred to as *empirical metrics*, the other predicting future aviation characteristics, commonly referred to as *predictive metrics*. Both types of metrics are important for airspace analysis.

3.3.1.1 Empirical Metrics

The first type of metric is the empirical metric: one that is derived from measurements of NAS operations (see the section on data sources). An example of an empirical metric is the number of aircraft that arrived at O'Hare International Airport (ORD) on October 15, 2002 between noon and midnight. Empirical metrics are useful for Step 1 (Characterize Problem), Step 2 (Perform Initial Evaluation) and Step 8 (Evaluate after Implementation). Depending on the definition of the desired metric, it may be a quantity tracked by a reporting system and directly available from an existing data source. Other empirical metrics need to be derived or inferred from data found in one or many data sources.

3.3.1.2 Predictive Metrics

The second type is a predictive metric: one that applies to a feature of the NAS taking its value from a mathematical model (see the section on tools). That model transforms assumptions about current NAS structure and behavior into estimates of future NAS behavior. An example of a predictive metric is an estimate of the number of aircraft that will arrive at ORD between noon and midnight on a hypothetical day with similar weather and traffic demand to October 15, 2002, following the introduction of proposed landing procedures.

Predictive metrics are used when no operational data is available, for example, when estimating the behavior of potential airspace changes. Predictive metrics appear primarily for Step 4 (Conduct Airspace Study) but also play a part for Step 2 (Perform Initial Evaluation), and Step 3 (Initiate Airspace Study).

3.3.1.3 Comparing Metrics

Empirical metrics and predictive metrics should not be compared directly. The assumptions and idiosyncrasies behind the observation, recording, and presentation of the empirical metrics can lead to significant problems in interpretation. Similar concerns arise in the computation and interpretation of predictive metrics. Metrics should be compared only when they are of the same type, share a common source, and a common history of development. In other words, it is best to compare observed data to observed data, and modeled results to other modeled results.

3.3.2 NAS Performance Categories

Table 6 identifies categories of the NAS performance that are often characterized using metrics.

Table 6. NAS Performance Categories

Categories	Definitions of NAS Performance Categories
System Safety	The ability to maintain standards that define spacing distances between multiple aircraft; aircraft and physical structures; and between aircraft and designated airspace. For examples, see System Safety Metrics.
System Delay, Efficiency, and Flexibility	Delay: The duration by which a flight activity does not occur within the planned, expected, or scheduled time. Flexibility: The ability of the system to permit users and ATC to adapt their operations to changing conditions. For examples see System Delay, Efficiency and Flexibility Metrics.
System Predictability	The degree of uncontrollable variation in the system as experienced by the user. This category does not have a special section of examples because every airspace metric can be more or less predictable. The predictability is quantified using the statistical qualifiers described below under Qualifiers to Define Individual Metrics.
User Access	The ability of the users to access classes of airspace. For examples, see User Access Metrics.
System Productivity	The extent of aviation activity associated with a part or whole of the NAS. For examples, see System Productivity Metrics.
System Capacity	The ability of the system to support the number of users entering and exiting the system. For examples, see System Capacity Metrics.
Environmental Impact	Generally, the level of noise associated with the airspace action or route. For examples, see FAA Order 1050.1.

3.3.3 Qualifiers to Define Individual Metrics

The examples of metrics given above contain two parts: a general description: "arrivals at an airport", and several qualifiers, such as a location (e.g., O'Hare International Airport), and a time interval (e.g., between noon and midnight.) In order to fulfill its purpose, every definition will contain one or more qualifiers, such as are listed in Table 7.

Table 7. Qualifiers for Metrics

Qualifiers	Examples of Qualifiers for Individual Metrics
Statistical	Maximum, minimum, mean, variance, variability over a time interval
Time Interval	By hour, quarter hour, "morning push," "evening push," day, month, season, or by year
Geography	Traffic through a specified region of the country: "East Coast," "LA Basin"
ATC Feature	Traffic over a specified fix, traffic through a specified sector, traffic originating at a particular airport, traffic taking off or landing on specified runways
Aviation Category	Air carrier, military, cargo, air taxi, general aviation, specified airlines
Aircraft Type	Heavy, jet, turboprop, piston, tilt-rotor
Equipage	RNP, Mode S
Weather	IMC, VMC, particular wind conditions

3.3.4   System Safety Metrics

The system safety empirical metrics (see examples in Table 8) examine the number of operational errors or deviations and the amount of time that elapsed between an aircraft crossing a sector boundary and a reported error involving that aircraft.

Table 8. System Safety: Empirical Metrics

Safety Metric	Definition	Data Sources (Examples)
Operational error count	Number of operational errors per sector of applicable airspace.	• ARTCC or Facility Logs • ARTS/SAR
Time from sector boundary to location of operational error	Estimate of the time from when an aircraft crosses a sector boundary until the time of an operational error involving that aircraft.	• ETMS • ARTS/SAR
Operational deviation count	Number of operational deviations per volume of applicable airspace.	• ARTCC or Facility Logs • ARTS/SAR
Time from sector boundary to location of operational deviation	Estimate of the time from when an aircraft crosses a sector boundary until the time of an operational deviation involving that aircraft.	• ETMS • ARTS/SAR

The system safety predictive metrics (see examples in Table 9) show whether the number of convergence pairs (that is, the number of potential conflicts) changes value for a proposed airspace change and estimates the time from sector crossing to the convergence. These metrics can be also used to signify the current level of safety associated with a specific airspace, and may be used to signify a sector that should be evaluated for possible redesign to maintain a safe system.

Table 9. System Safety: Predictive Metrics

System Safety Metric	Definition	Tools for Predicting Metrics (Examples)
Convergence pairs	Number of convergence pairs (or potential conflicts) identified.	• TAAM • RAMS • SDAT
Time to converge	Time between an aircraft crossing a sector boundary and time when potential loss of separation is detected.	• TAAM • RAMS • SDAT

System Safety Metric	Definition	Tools for Predicting Metrics (Examples)
Aircraft convergence position	Indicates position and movement of the two aircraft (such as overtaking, crossing, both climbing, one climbing and one cruising) at time of possible loss of separation.	• TAAM • RAMS
Closest point of approach	Distance between two aircraft at their closest point of approach.	• TAAM • RAMS

3.3.5   System Delay, Efficiency and Flexibility Metrics

The system delay empirical metrics quantify user impacts captured in delays and flight time. Delays associated with an airport can signify delays associated with the airline because of scheduling, or they can indicate an airspace problem. Trends in the values of the taxi-out and taxi-in times can signify levels of ground delay.

The users of the NAS would like the capability to optimize their operations based on their own objectives and constraints. These can vary from flight to flight and from user to user to follow winds and meet economic objectives. For climbs and descents, ideal operations would permit departures to climb quickly to cruise altitude, where they would remain as long as possible, then descend in the least possible time or with the least possible fuel usage to the destination airport. Long average climb and descent times may signify that aircraft are facing altitude restrictions because of congested airspace. However, there may be a tradeoff for the aircraft between an ideal climb or descent profile and being able to take off or land in accordance with a schedule. To define a metric to signify time flexibility as opposed to profile flexibility requires knowledge of the value air carriers place on being able to meet particular schedule objectives, which is generally unavailable.

Data from the sources listed in Table 10 can be processed efficiently with tools that characterize empirical data, including POET, PDARS, and SDAT.

Table 10. System Delay, Efficiency and Flexibility: Empirical Metrics

Delay, Efficiency or Flexibility Metric	Definition	Data Sources (Examples)
Arrival delays	Difference between actual arrival time and scheduled arrival time.	• ASPM • OPSNET
Airline arrival scheduling	Difference between airport capacity and scheduled arrival demand.	• OAG • ARTCC or Facility Logs • ASPM
Departure delays	Difference between actual departure time and scheduled departure time.	• ASPM • OPSNET

Delay, Efficiency or Flexibility Metric	Definition	Data Sources (Examples)
Airline departure scheduling	Difference between airport capacity and scheduled departure demand.	• OAG • ARTCC or Facility Logs • ASPM
Taxi-out times	Estimate of taxi-out time.	• ASPM
Taxi-in times	Estimate of taxi-in time.	• ASPM
Climb times	Time taken by a flight from departure to top of climb.	• ETMS • ARTS/SAR
Climb distances	Distance taken by a flight from departure to top of climb.	• ETMS • ARTS/SAR
Descent times	Time taken by a flight from top of descent to arrival.	• ETMS • ARTS/SAR
Descent distances	Distance taken by a flight from top of descent to arrival.	• ETMS • ARTS/SAR

Table 11 shows examples of predictive metrics for delay, efficiency and flexibility that can be predicted with working tools.

Table 11. System Delay, Efficiency and Flexibility: Predictive Metrics

Delay, Efficiency or Flexibility Metric	Definition	Tools for Predicting Metrics (Examples)
En route flight time	Time from take-off to landing.	• TAAM • RAMS • SIMMOD • SDAT
En route flight distance	Number of en route flight miles between two airports.	• TAAM • RAMS • SIMMOD • SDAT • ArcInfo • MapInfo
Arrival flight time	Time from where an aircraft crosses a fix or boundary common to the baseline and alternative airspace designs until the aircraft lands.	• TAAM • RAMS • SIMMOD • SDAT • TARGETS
Arrival flight distance	Distance from where an aircraft flies over any point common to the baseline and alternative airspace designs, until airport arrival.	• TAAM • RAMS • SIMMOD • SDAT • TARGETS • ArcInfo • MapInfo

Delay, Efficiency or Flexibility Metric	Definition	Tools for Predicting Metrics (Examples)
Descent Times	Time from top of descent until arrival.	• TAAM • RAMS • SIMMOD • SDAT • TARGETS
Departure flight time	Time from an aircraft's takeoff until crossing an airspace fix or boundary that is common to the baseline and alternative airspace designs.	• TAAM • RAMS • SIMMOD • SDAT • TARGETS
Departure flight distance	Distance from an aircraft's departure until crossing a point common to both the baseline and alternative airspaces.	• TAAM • RAMS • SIMMOD • SDAT • TARGETS • ArcInfo • MapInfo
Climb Times	Time from departure until top of climb.	• TAAM • RAMS • SIMMOD • SDAT • TARGETS
Taxi-out time	Time the aircraft takes to get from gate to take-off.	• TAAM • SIMMOD
Taxi-in time	Time the aircraft takes from landing to the gate.	• TAAM • SIMMOD
User cost	Fuel usage per flights.	• TAAM • RAMS

3.3.6   System Predictability Metrics

System Predictability is not associated with any single category of general description, but with the variability that can appear in any of the categories listed. Any of the metrics descriptions can be associated with predictability. For more discussion, see Section 3.3.3 on qualifiers to define individual metrics.

3.3.7 User Access Metrics

These metrics indicate changes in civilian use of SUA.

Data from the sources listed in Table 12 can be processed efficiently with tools that characterize empirical data, including POET, PDARS, and SDAT.

Table 12. User Access: Empirical Metrics

User Access Metric	Definition	Data Sources (Examples)
Civilian flights in Special Use Airspace	Number of non-military aircraft using specified SUA.	• ETMS • ARTS/SAR
Potential re-routes	Number of aircraft between certain origin-destination pairs which transit sectors adjacent to SUA	• ETMS • ARTS/SAR

Table 13 shows an example of a user access metric that can be predicted using modeling tools.

Table 13. User Access: Predictive Metrics

User Access Metric	Definition	Tools for Predicting Metrics (Examples)
Civilian flights in Special Use Airspace	Number of civilian flights which use SUA.	• TAAM • RAMS • SIMMOD • SDAT • ArcInfo • MapInfo

3.3.8 System Productivity Metrics

System Productivity metrics quantify several factors including sector throughput, convergence rates, and controller coordination activities. The system productivity metrics are not limited to the items listed in Tables 14 and 15. Other metrics could be developed to gauge any aviation activity associated with a part or whole of the NAS.

Data from the sources listed below can be processed efficiently with tools that characterize empirical data, including POET, PDARS, and SDAT.

Table 14. System Productivity: Empirical Metrics

Productivity Metric	Definition	Data Sources (Examples)
Number of aircraft in a sector	Number of aircraft per time unit per sector.	• ETMS • SAR
Aircraft entering sector	Number of aircraft entering a sector.	• ETMS • SAR

Productivity Metric	Definition	Data Sources (Examples)
Aircraft departing sector	Number of aircraft departing a sector.	• ETMS • SAR
Aircraft crossing a fix	Number of aircraft crossing a fix.	• ETMS • ARTS/SAR

Table 15. System Productivity: Predictive Metrics

Productivity Metric	Definition	Tools for Predicting Metrics (Examples)
Number of aircraft in a sector	Number of aircraft per time unit per sector.	• TAAM • RAMS • SIMMOD • SDAT
Time in a sector	Time between an aircraft entering and exiting the sector.	• TAAM • RAMS • SIMMOD • SDAT
Number of aircraft entering a sector	Number of aircraft entering the sector.	• TAAM • RAMS • SIMMOD • SDAT
Number of aircraft leaving a sector	Number of aircraft leaving the sector.	• TAAM • RAMS • SIMMOD • SDAT

3.3.9   System Capacity Metrics

Metrics that compute the ratio of arrival and departure operations to total capacity are of interest for airport operations. For existing configurations, the ATCSCC or facility logs typically include the AAR and ADR information. For a planned configuration, these capacities must be estimated using a predictive tool. Examples of System Capacity Metrics are given in Tables 16 and 17.

Table 16. System Capacity: Empirical Metrics

Capacity Metric	Definition	Examples of Data Sources
Airport arrival utilization	Ratio of arrival operations to arrival capacity for the selected airport.	• ATCSCC or Facility Logs • ASPM • ETMS • ARTS/SAR
Airport departure utilization	Ratio of departure operations to departure capacity for the selected airport.	• ATCSCC or Facility Logs • ASPM • ETMS • ARTS/SAR

Table 17. System Capacity: Predictive Metrics

Capacity Metric	Definition	Tools for Predicting Metrics (Examples)
Airport arrival utilization	Ratio of arrival operations to arrival capacity per airport.	• TAAM • RAMS • SIMMOD • EACM
Airport departure utilization	Ratio of departure operations to departure capacity per airport.	• TAAM • RAMS • SIMMOD • EACM

3.3.10   Environmental Impact Metrics

Although air traffic can create environmental impacts in several categories, (see FAA Order 1050.1), the predominant impact is aircraft noise, as listed in Tables 18 and 19.

Table 18. Environmental Impacts: Empirical Metrics

Environmental Impact Metric	Definition	Data Sources (Examples)
Day-night average sound level	Measure of historical daily noise level	Noise monitoring

Table 19. Environmental Impacts: Predictive Metrics

Environmental Impact Metric	Definition	Tools for Predicting Metrics (Examples)
Day-night average sound level	Measure of predicted daily noise level	• INM • ATNS • NIRS

Appendix A. Environmental Analysis

This appendix gives a brief overview of the process used to conduct the environmental analyses that are most likely to be necessary for airspace design or redesign actions. The purpose of this appendix is to provide some rough guidelines to assist the Oversight and Design Teams to recognize early in the Airspace Management Process whether or not the proposed airspace design or redesign action is likely to have significant impacts or extraordinary circumstances exist. If there are impacts or circumstances warrant, it is important to involve the FAA Regional Environmental Specialist as early in the process as possible.

This appendix is not a substitute for FAA Order 1050.1 *"Policies and Procedures for Considering Environmental Impacts"* hereafter referred to as FAA Order 1050.1.

A.1   Process to Determine Environmental Impacts

Figure 12 shows the process as described in FAA Order 1050.1. Since the main environmental impact from proposed airspace actions is aircraft noise, the following process will be addressed in more detail for noise impacts.
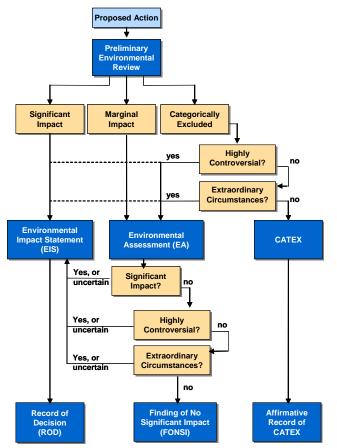
Figure 12. Process to Determine Environmental Impacts

A.1.1   Proposed Action

A Proposed Action refers to the airspace design or redesign action being proposed such as departure, approach and en route procedure changes.

Proposed actions that are limited to air traffic changes in airspace or procedures 10,000 feet or more above ground level (AGL) are not subject to the requirements of the National Environmental Policy Act (NEPA) and therefore an environmental review is not normally required.

A.1.2   Preliminary Environmental Review

The Preliminary Environmental Review is used to determine the potential extent of the environmental impacts of the proposed action or whether an action could be highly controversial on environmental grounds.

A preliminary environmental review of a proposed action generally results in one of three outcomes:

- The proposed action is identified to be a Categorical Exclusion (CATEX) requiring no further environmental review.

- Although the proposed action is not a CATEX, an Environmental Assessment (EA) is considered to be the appropriate level of review.

- The proposed action has potential to make a significant impact on the environment and requires the review process of an Environmental Impact Statement (EIS).

The Initial Environmental Review Checklist, contained in Appendix B, should be used for determining the potential level of environmental review (an EA or EIS) and to aid in developing the information needed to determine the costs associated with the environmental process.

A.1.3   Categorical Exclusion (CATEX)

Categorical exclusions are those types of Federal actions that meet the criteria contained in Council on Environmental Quality (CEQ) regulations. They represent actions that, based on past experience with similar actions, do not normally require an EA or EIS because they do not individually or cumulatively have a significant effect on the human environment, with the exception of extraordinary circumstances. FAA has identified different categories of CATEX actions in FAA Order 1050.1 that, with the exception of extraordinary circumstances, normally do not have significant effects, therefore, would not require an EA or EIS.

Air Traffic procedural actions that are normally categorically excluded include establishment of new or revised air traffic control procedures conducted at 3,000 feet or more above ground level (AGL); instrument procedures conducted below 3,000 feet (AGL) that do not cause traffic to be routinely routed over noise sensitive areas; modifications to currently approved instrument procedures conducted below 3,000 feet (AGL) that do not significantly increase noise over noise sensitive areas; and increases in

minimum altitudes and landing minima. For Air Traffic modifications to procedures at or above 3,000 feet AGL, the Air Traffic Noise Screening Model (ATNS) should be used to ensure the absence of potential extraordinary circumstances.

Some actions that would normally be categorically excluded could require additional environmental analysis to determine the appropriate NEPA documentation. A determination of whether a proposed action that is normally categorically excluded requires an EA or EIS depends on whether the proposed action involves extraordinary circumstances. Extraordinary circumstances exist when the proposed action (1) involves any of the following circumstances, and (2) may have a significant effect as defined in CEQ regulations. The presence of one or more of the following circumstance(s) in connection with a proposed action is not necessarily a reason to prepare an EA or EIS. The determination of whether a proposed action may have a significant environmental effect is made by addressing the requirements applicable to the specific resource and the factors contained in CEQ regulations. The circumstances are as follows:

- An adverse effect on cultural resources pursuant to the National Historic Preservation Act of 1966, as amended.

- An impact on properties protected under section 4(f) of the Department of Transportation Act.

- An impact on natural, ecological (e.g., invasive species), or scenic resources of Federal, Tribal, State, or local significance (for example: Federally listed or proposed endangered, threatened, or candidate species or designated or proposed critical habitat under the Endangered Species Act), resources protected by the Fish and Wildlife Coordination Act; wetlands; floodplains; prime, unique, State or locally important farmlands; energy supply and natural resources; and wild and scenic rivers, including study or eligible river segments and solid waste management.

- Cause a division or disruption of an established community, or a disruption of orderly, planned development, or an inconsistency with plans or goals that have been adopted by the community in which the project is located.

- Cause an increase in congestion from surface transportation (by causing decrease in Level of Service below acceptable level determined by appropriate transportation agency, such as a highway agency).

- An impact on noise levels of noise-sensitive areas.

- An impact on air quality or violate local, State, Tribal, or Federal air quality standards under the Clean Air Act Amendments of 1990.

- An impact on water quality, sole source aquifers, a public water supply system, or State or Tribal water quality standards established under the Clean Water Act and the Safe Drinking Water Act.

- Effects on the quality of the human environment are likely to be highly controversial on environmental grounds. The term "controversial" means a substantial dispute exists as to the size, nature, or effect of a proposed Federal

action. The effects of an action are considered highly controversial when reasonable disagreement exists over the project's risks of causing environmental harm. Reasonable disagreement regarding the effects of a proposed action may exist when the action is opposed on environmental grounds by a Federal, State, or local government agency or by a Native American Tribe or by a substantial number of the persons affected by the action.

- Has the likelihood to be inconsistent with any Federal, State, Tribal, or local law relating to the environmental aspects of the proposed action.

- Likely to directly, indirectly, or cumulatively create a significant impact on the human environment, including, but not limited to, actions likely to cause a significant lighting impact on residential areas or commercial use of business properties, likely to cause a significant impact on the visual nature of surrounding land uses, likely to be contaminated with hazardous materials based on Phase I or Phase II Environmental Due Diligence Audit (EDDA's), or likely to cause such contamination.

A.1.4   Environmental Assessment (EA)

According to FAA Order 1050.1, an EA is a concise document used to describe a proposed action's anticipated environmental impacts. It is a more thorough and public process than a Preliminary Environmental Review. An EA may result in a Finding of No Significant Impact (FONSI), or lead to the EIS process.

An EA, which results in a public disclosure document, analyzes various alternatives to the proposed action and their associated environmental impacts. An EA is used to determine whether any environmental impacts are significant and warrant preparation of an EIS.

An EA shall be conducted for any of the following air traffic actions:

- Actions that do not qualify as a CATEX.

- New or revised air traffic control instrument procedures that routinely route air traffic over noise sensitive areas at less than 3,000 feet AGL.

- Regulations (and exemptions and waivers to regulations) that may affect the human environment.

- Special Use Airspace if the floor of the proposed area is below 3,000 feet AGL, or if supersonic flight is anticipated at any altitude.

- An air traffic action that results in a 1.5 decibel (dBA) increase within the 65 or greater day-night average sound level (DNL) contour area.

- Arrival procedure changes between 3,000 and 7,000 feet AGL and departure procedure changes between 3,000 and 10,000 feet AGL that generate an increase of 5 dBA or more in the 45-65 DNL contour area over residential areas. (See FAA policy memo dated January 17, 2001, and related Federal Register notice, Vol. 65, No. 235, December 6, 2000, page 76339.)

Coordination with environmental agencies, applicants, and the public are key elements of an EA. When no significant impacts are found or if significant impacts can be mitigated, a FONSI is prepared to accompany the EA as documentation of the agency's decision.

A FONSI is a document by a Federal agency briefly presenting the reasons why an action, not otherwise excluded, will not have a significant effect on the human environment.

A.1.5   Environmental Impact Statement (EIS)

If significant impacts are anticipated, a complete EIS will be required. According to FAA Order 1050.1, an EIS is a clear, concise, and detailed document that provides the agency decision makers and the public with a full and fair discussion of significant environmental impacts of the proposed action and reasonable alternatives which may avoid or minimize adverse impacts and implements the requirement in NEPA for a detailed written statement. Following the review periods defined for an EIS, the agency shall prepare a Record of Decision (ROD).

A.1.6   Record of Decision (ROD)

According to FAA Order 1050.1, a ROD is a concise public record of decision, which may be integrated into any other record (such as a rule) prepared by the agency.

A.1.7   Environmental Impacts Analyzed in an EA or EIS

FAA Order 1050.1 lists environmental impact categories that need to be addressed in an EA or EIS. The impact categories most applicable to air traffic actions include, but are not limited to the following:

- Noise;

- Air Quality;

- Visual Impacts;

- Endangered/threatened Species;
- Compatible Land Use;
- Social Impacts;
- Environmental Justice (Includes EO 12898); *
- Section 303 lands (49 USC 303);
- Cumulative Impacts; and
- Historical and Cultural Resources.

* Note: Executive Order 12898, signed by President Clinton on 2/11/94, requires that federal agencies identify and address disproportionately high and adverse human health or environmental effects of its actions on low income and minority populations.

A.2   Determining Noise Impacts

Since one of the most common and significant impacts of airspace design actions, although not the only one, relate to changes in noise exposure, noise terminology and noise models will be discussed in further detail.

A.2.1   Significant Noise Impacts

If the noise comparisons show a Day-Night Average Sound Level (DNL) 1.5 dB or greater increase over a noise sensitive area within the DNL 65 dB contour, a level of significant noise has been reached. For the definition and discussion of the term "DNL," see below.

A.2.2   Aircraft Noise Levels

The FAA has determined that the cumulative noise energy exposure of individuals to noise (from aircraft) must be established in terms of yearly day/night average sound level (DNL). DNL was adopted formally by the FAA in 1981 when it issued 14 Code of Federal Regulations (CFR) part 150, *Airport Noise Compatibility Planning,* and established it as the descriptor of choice in FAA Order 1050.1. In order to better understand aircraft noise levels, it is best to first understand the following sound exposure metrics:

Day-Night Average Sound Level (DNL): Represents the average total sound energy of noise events occurring over a 24-hour period, with a penalty for noise events occurring at night. By convention, a 10 dB penalty is added to each sound event occurring during the nighttime, which for DNL calculation purposes is the time between 10:00 pm and 7:00 am. The resulting 24-hour average sound level, including the 10 dB penalty for night time events, is known as the day-night sound level.

Single Event Noise Analysis as a Supplementary Noise Metrics. Since DNL is a cumulative metric, it is often difficult for individuals to relate it to the perceived noise from a single occurrence. Thus the Single Event Noise Analysis attempts to describe noise impacts in the number of times that people would be disrupted of certain activities such as sleep, speech or the ability to hear a teacher in a classroom. These metrics are not required as part of the EA or EIS process but are more frequently being added as an appendix to the environmental document for additional information.

Maximum Sound Level (L_{max}): Maximum Sound Level refers to a sound's loudness. It is measured in A-weighted decibels (abbreviated dB or dBA). However, human response to noise is a result not only of its maximum intensity but also of its duration.

Sound Exposure Level (SEL): SEL takes both intensity and duration of a sound event into account. The amount of noise energy is normalized in one second. Thus SEL is explained as all the noise energy from a single event (e.g., an aircraft flying by), that is experienced in one second.

Equivalent Sound Level (L_{eq}): The maximum sound levels and sound exposure levels (mentioned above) measure the sound levels of individual events. When several noise events occur during a specified time period (such as a day), the time-average of the total sound energy over a specified period of time is referred to as the equivalent sound level.

A.2.3   Aircraft Noise Models

Integrated Noise Model (INM). The Integrated Noise Model has been the FAA standard for identifying noise levels in the vicinity of airports as required by 14 CFR Part 150 for EA and/or EIS environmental processes. It requires input of average daily characteristics at an airport including the type and number of aircraft operations, runway configuration and use, and flight track configuration and use.

Air Traffic Noise Screening Model (ATNS). The Air Traffic Noise Screening Model was developed by the FAA to replace FAA Notice 7210.360 "Noise Screening Procedures for Certain Air Traffic Actions Above 3,000 Feet AGL." It is a simplified tool to be used in Preliminary Environmental Reviews to help the design team determine if the proposed action would be categorically excluded or will require further environmental review (such as an EA or EIS).

Noise Integrated Routing System (NIRS). The Noise Integrated Routing System Model incorporates the same methodology as INM. However, NIRS is to be used when the nature of the analysis requires processing capabilities that are not a part of INM. NIRS allows for assessments of air traffic changes over a broad area encompassing multiple airports, using multiple operational configurations, and including a very large number of flight tracks.

A.3 Environmental Regulations, Policies, and Guidelines

The most significant environmental documents to be considered during Airspace Design Actions are listed below. Appendix D contains additional references and websites applicable to the environmental process.

40 Code of Federal Regulations (CFR) parts 1500-1508, *Council on Environmental Quality (CEQ) Regulations For Implementing the Procedural Provisions of the National Environmental Policy Act of 1969 (NEPA)*, are the implementing regulations for NEPA. They tell federal agencies what they must do to comply with the procedures and achieve the goals of NEPA.

FAA Order 1050.1, *Policies and Procedures for Considering Environmental Impacts,* establishes the policies and procedures for assuring that the FAA is in compliance with the CEQ implementing regulations for the NEPA, DOT Order 5610.1 and other related statues and directives. The procedures defined in this document are those that must be applied to determine the potential for environmental impact of airspace design or redesign actions.

FAA Order 5050.4, *Airport Environmental Handbook*, is a self contained document that includes the information essential to meeting procedural and substantive environmental requirements set forth by CEQ in its regulations implementing NEPA. Compliance with FAA 5050.4 constitutes compliance with FAA Order 1050.1 for airport actions (e.g., runway/taxiway extension and/or modifications, approach navaid realignment, terminal construction etc.).

14 CFR part 150, *Airport Noise Compatibility Planning,* is an effective noise abatement program that uses a balanced approach towards mitigating the noise impact of airports upon its neighbors, while protecting or increasing both airport access and capacity, as well as maintaining the efficiency of the NAS.

FAA-AEE-99-03, Integrated Noise Model (INM) Version 6.0 User's Guide and **FAA-AEE-97-04,** Integrated Noise Model (INM) Version 6.0 Technical Manual, provide information on the use of INM.

FAA-AEE-99-1, *Air Traffic Noise Screening Model, Version 2.0 User's Manual*, provides information on the use of ATNS.

FAA and Metron Corporation, *NIRS, Noise Integrated Routing System User's Guide, Version 6.0c.2*, June 2003 provides information on the use of NIRS.

FAA Policy Memo dated January 17, 2001 and related **Federal Register Notice, Vol.65, Number 235,** December 6, 2000, page 76339-76340, changed the altitude ceiling used in screening for noise exposures from 18,000 feet (AGL) to 10,000 feet (AGL).

Appendix B. Initial Environmental Checklist

Facility/Office: _____ Date: _____

Prepared by: _____ Phone: _____ Fax: _____

===

This initial environmental review is intended to provide some basic information about the proposed airspace management project to better assist in preparing for the environmental analysis phase. Although, it requests information in several categories, it is understood that all the data initially may not be available. However, it does represent information, in accordance with FAA Order 1050.1, *Policies and Procedures for Considering Environmental Impacts*, that ultimately will be needed for preparation of the environmental document.

I.   Project Description

A. Attach copy of the most recent Airspace Management Project Status Report.

B. Has airspace modeling been conducted using SDAT, TAAM, TARGETS, or other airspace/air traffic design tool?

☐ Yes   Model: _____   ☐ No

If yes, please provide a summary of the output from the modeling.

C. Describe the present (no action alternative) procedure in full detail. Provide the necessary chart(s) depicting the current procedure. Describe the typical fleet mix, quantifying (if possible) the number of aircraft on the route and depict their altitude(s) along the route.

D. Describe the proposed project, providing the necessary chart(s) depicting changes. Describe changes to the fleet mix, numbers of aircraft on the new route, and their altitude(s), if any.

  1.   Will there be actions affecting changes in aircraft flights between the hours of 10 p.m. – 7 a.m. local time?   ☐ Yes   ☐ No

  2.   Is a preferential runway use program presently in effect for the affected airport(s), formal or informal?   ☐ Yes   ☐ No   Will airport preferential runway configuration use change as a result of the proposed project?
☐ Yes   ☐ No

3. Is the proposed project primarily designed for Visual Flight Rules (VFR),
    Instrument Flight Rules (IFR) operations, or both?

    ☐ VFR   ☐ IFR   ☐ Both

    If this specifically involves a charted visual approach (CVA) procedure,
    provide a detailed local map indicating the route of the CVA, along with a
    discussion of the rationale for how the route was chosen.

4. Will there be a change in takeoff power requirements? ☐ Yes   ☐ No
    If so, what types if aircraft are involved, i.e., general aviation propeller-
    driven versus large air carrier jets?

5. Will all changes occur above 3,000 feet above ground level (AGL)?

    ☐ Yes   ☐ No   What is the lowest altitude change on newly proposed
    routes or on existing routes that will receive an increase in operations?

6. Will there be actions involving civil jet aircraft (heavier than 75,000 pounds
    gross weight) arrival procedures between 3,000-7,000 feet AGL or departures
    between 3,000-10,000 feet AGL? Attach a copy of the completed Air Traffic
    Noise Screening Model (ATNS) report.

7. If noise analysis was already performed using the FAA's Integrated Noise
    Model (INM) or Noise Integrated Routing System (NIRS), provide a
    summary of the results.

II. **Purpose and Need**

A. Describe the purpose and need for the proposed project. If detailed background
   information is available, summarize here and provide a copy as an attachment to
   this review.

B. What operational/economic/environmental benefits will result if this project is
   implemented?

   If a delay reduction is anticipated, can the reduction be quantified?
   ☐ Yes ☐ No ☐ N/A
   Can reduced fuel costs/natural energy consumption be quantified?

   ☐ Yes ☐ No ☐ N/A If not quantifiable, describe the approximate
   anticipated benefits in lay terms.

C. Is the proposed project the result of a user or community request or regulatory
   mandate? ☐ Community Request   ☐ Regulatory Mandate   If not, what
   necessitates this action?

III. Describe the Affected Environment

    A. Provide a description of the existing land use in the vicinity of the proposed project.

    B. Will the proposed project introduce air traffic over noise sensitive areas not now affected? ☐ Yes ☐ No Will they be affected to a ☐ greater or ☐ lesser extent? Note: An area is noise sensitive if aircraft noise may interfere with the normal activities associated with the use of the land. See FAA Order 1050.1 for full definition of noise sensitive areas.

    C. Are wildlife refuge/management areas within the affected area of the proposed project? ☐ Yes ☐ No If so, has there been any communication with the appropriate wildlife management regulatory (federal or state) agencies to determine if endangered or protected species inhabit the area? ☐ Yes ☐ No

       1. At what altitude would aircraft overfly these habitats?
       2. During what times of the day would operations be more/less frequent?

    D. Are there cultural or scenic resources, of national, state, or local significance, such as national parks, outdoor amphitheaters, or stadiums in the affected area? ☐ Yes ☐ No If so, during what time(s) of the day would operations occur that may impact these areas?

    E. Has there been communication with air quality regulatory agencies to determine if the affected area is a non-attainment area (an area which exceeds the National Ambient Air Quality Standards for ozone, carbon monoxide, lead, particulate matter, sulfur dioxide, or nitrogen dioxide) or maintenance area (an area which was in non-attainment but subsequently upgraded to an attainment area) concerning air quality? ☐ Yes ☐ No If yes, please explain:

    F. Are there reservoirs or other public water supply systems in the affected area? ☐ Yes ☐ No

IV.   **Community Involvement**

Formal community involvement or public meetings/hearings may be required for the proposed project. A determination should be made if the proposed project has potential to become highly controversial. A proposed federal action is considered highly controversial when the action is opposed by a federal, state, or government agency or by a substantial number of persons affected by such action on environmental grounds.

Have persons/officials who might have some need to know about the proposed project by reason of their location relative to the project or by their function in the community, been notified, consulted, or otherwise informed of this project?
☐ Yes   ☐ No

   1. Are local citizens and community leaders aware of the proposed project?
     ☐ Yes   ☐ No   Are any ☐ opposed to or ☐ supporting it?

     a. If they are opposed, what is the basis of their opposition?

     b. Has the FAA received one or more comments objecting to the proposed project on environmental grounds from local citizens or elected officials?
       ☐ Yes   ☐ No

   2. Are the airport proprietor and users providing general support for the proposed project? ☐ Yes   ☐ No

   3. Is the proposed project consistent with local plans and development efforts?
     ☐ Yes   ☐ No

   4. Has there been any previous aircraft-related environmental or noise analysis, including FAR Part 150 Studies, conducted at this location?
     ☐ Yes   ☐ No
     If so, was it reviewed as a part of this initial review?
     ☐ Yes   ☐ No   ☐ N/A

V.   <u>**Extraordinary Circumstances**</u> (See FAA Order 1050.1 for additional information, i.e., significant thresholds.)

Will implementation of the proposed project result in any of the following extraordinary circumstances?

- Likely to have an adverse effect on Native American Indian lands, Native Hawaiian organizations, or properties protected under Section 106 of the Historic Preservation Act of 1966, as amended.
  ☐ Yes   ☐ No   ☐ Possibly
  Comment:

- Likely to result in adverse effects due to use of public property under section 4(f) of the Department of Transportation Act (recodified as 49 USC 303).
  ☐ Yes   ☐ No   ☐ Possibly
  Comment:

- Likely to be highly controversial on environmental grounds raised by a Federal, State, or local agency or by parties having an interest in the action.
  ☐ Yes   ☐ No   ☐ Possibly
  Comment:

- Likely to have significant impact on ecological or scenic resources of Federal, State, or local significance including, for example, Federally listed endangered or threatened species; wetlands; wild and scenic rivers; floodplains; coastal zones; national parks; prime, unique, State, or locally important farmlands; energy supplies and natural resources; and solid waste management.
  ☐ Yes   ☐ No   ☐ Possibly
  Comment:

- Likely to be highly controversial with respect to the availability of adequate relocation housing. ☐ Yes   ☐ No   ☐ Possibly
  Comment:

- Likely to cause substantial division or disruption of an established community, or disrupt orderly, planned development, or is likely to be not reasonably consistent with plans or goals that have been adopted by the community on which the project is located.
  ☐ Yes   ☐ No   ☐ Possibly
  Comment:

- Likely to cause a significant increase in surface transportation congestion (by causing decrease in Level of Service (LOS) below the acceptable level determined by the appropriate transportation agency; i.e., highway).
  ☐ Yes   ☐ No   ☐ Possibly
  Comment:

- Likely to have a significant impact on noise levels of noise-sensitive areas.
  ☐ Yes   ☐ No   ☐ Possibly
  Comment:

- Likely to have a significant impact on or violate air quality or violate local, State, or Federal air quality standards.   ☐ Yes   ☐ No   ☐ Possibly
  Comment:

- Likely to have a significant impact on water quality, sole source aquifers, contaminates a public water supply system, or violate State water quality standards. ☐ Yes   ☐ No   ☐ Possibly
  Comment:

- Likely to be inconsistent with any Federal, State, or local law relating to the environment. ☐ Yes   ☐ No   ☐ Possibly
  Comment:

- Likely to have a significant impact on the visual nature of the surrounding land uses. ☐ Yes   ☐ No   ☐ Possibly
  Comment:

- Likely to have any hazardous materials contamination revealed during Phase I or Phase II Environmental Due Diligence Audits (EDDAs) or cause such contamination. ☐ Yes   ☐ No   ☐ Possibly
  Comment:

- Likely to exceed applicable American National Standards Institute (ANSI/IEEE) guidelines for electromagnetic emissions.   ☐ Yes   ☐ No   ☐ Possibly Comment:

- Likely to cause a significant lighting impact on residential areas or interfere with commercial use of business property.   ☐ Yes   ☐ No   ☐ Possibly
  Comment:

- Likely to cause a disproportionately high and adverse human health or environmental effect on minority or low income populations.
  ☐ Yes   ☐ No   ☐ Possibly
  Comment:

VI. Alternatives

A. Are there alternatives to the proposed project?   ☐ Yes   ☐ No
   If yes, describe the uniqueness of the project by comparing the existing (no action) and the proposed alternative(s).

B. Please provide a summary description of alternatives that have been eliminated and why they were eliminated.

VII. Mitigation

Are there measures that may also be implemented that might mitigate any of the potential impacts, i.e., GPS/FMS plans, NAVAIDS, etc.?
☐ Yes   ☐ No   ☐ N/A

VIII. Cumulative Impacts

What other projects (FAA, non-FAA, or non-aviation) are known to be planned, have been recently implemented, or are ongoing in the affected area that would contribute to the proposed project's environmental impact?

IX. References/Correspondence

Attach written correspondence, summarized phone contacts using Memorandums for the File, etc.

X. Additional Preparers

The person(s) listed below, in addition to the preparer indicated on page 1, are responsible for all or part of the information and representations contained herein:

Name	Title	Facility	Agency	Company

XI.   **Facility/Regional Conclusions**

This initial review and analysis indicates that extraordinary circumstances or other reasons exist that would cause the responsible federal official to believe that the proposed project might have the potential for causing significant environmental impacts.

The undersigned have determined that the proposed project may not qualify as a categorically excluded action in accordance with FAA Order 1050.1, and on this basis, recommend that further environmental review be conducted before the proposed project is implemented.

The undersigned recommend that the proposed project be submitted for airspace management environmental funding for preparation of an ☐ EA ☐ EIS ☐ Not sure – more analysis is needed.

Facility Manager Review/Concurrence

Signature: _____ Date: _____

Title: _____

Address: _____

_____

Phone: _____   Fax: _____

Regional Environmental Specialist Review/Concurrence

Signature: _____ Date: _____

Title: _____

Address: _____

_____

Phone: _____   Fax: _____

Regional Airspace Branch Manager Review/Concurrence

Signature: _____ Date: _____

Title: _____

Address: _____

_____

Phone: _____ Fax: _____

Regional Air Traffic Division Manager Review/Concurrence

Signature: _____ Date: _____

Title: _____

Address: _____

_____

Phone: _____ Fax: _____

Appendix C. Program Management

C.1   Methodology

This appendix describes the life cycle methodology to be used by airspace redesign projects. A project's life cycle defines the time span of a project from inception to completion. This life cycle methodology includes overarching project management processes, tools, and techniques at its core. The processes support implementation and operational aspects of planning, scheduling, and reporting project status. Tools include approved templates, guidelines, and software used to develop and communicate project information. Techniques are the practical methods employed in combining the tools and processes. Implementation of the methodology at the project level provides the benefit of standardization across the entire program.

The project life cycle closely parallels the airspace design process. Where the airspace design process has eight "steps," the project life cycle has five similar "phases." Each phase contains one or more milestones, which are associated with a project deliverable. Many of the deliverables correspond directly with report outlines contained in the main body of this document. Program management carefully builds upon and integrates with the airspace design guidelines, tools and techniques.

C.2   Project Life Cycle Overview

There are five phases in the project life cycle. Providing phases allows project stakeholders an opportunity to consider project performance to date. Deliverables associated with the phase ending are appropriate to validate that the project's goals remain valid and its plans are on track.

The phased life cycle structure is integrated with the eight-step process described in the Airspace Design Guidelines. Along the path, project phases and deliverables directly correlate to handbook guidelines and checklists.

Table 20 illustrates how those relationships fit together and build upon each other. The first column lists the five project phases, the second column relates the key milestones to their deliverables, and the third column ties phases and corresponding airspace design steps.

Phase 1 – Planning – includes Steps 1 through 3, and has two milestones:

- Milestone 1: Airspace Management Project Chartered; and
- Milestone 2: Study Plan Completed

The Oversight Team and Focus Leadership Team leaders jointly develop the Airspace Management Project Charters from an approved template. Included in the template is a problem statement and approval sign off for the sponsor. The deliverable for Milestone Two is a Study Plan, which should follow the outline provided in Step 3: Develop Study Plan.

Table 20. Relationship of Project Life Cycle to the Airspace Management Checklist

Phase	Key Milestones (Deliverable)	Airspace Management Checklist Reference
1. Planning	1 – Airspace Management Project Chartered (Project Description) 2 – Study Plan completed (Study Plan)	Steps 1-3
2. Design, Modeling and Analysis	3 – Design, Modeling and Analysis completed (Design Report)	Steps 4-6
3. Environmental	4 – Environmental Study completed	Parallel to Steps 4 - 6
4. Implementation	5 – Implementation Planning completed (Implementation Plan which includes Transition Plan) 6 – Implementation completed (LOA or MOU)	Step 7
5. Post Implementation and Evaluation	7 – Project closed (After Action Report which includes lessons learned)	Step 8

Phase 2 – Design, Modeling and Analysis – includes Steps 4 and 5, and has one milestone:

- Milestone 3: Design, Modeling and Analysis Completed.

The deliverable for Milestone Three is a Design Report, which should follow the outline provided in Step 5: Outline for an Airspace Study Report.

Phase 3 – Environmental – takes place in parallel to Step 4, and has one milestone:

- Milestone 4: Environmental Completed.

Environmental concerns affect all airspace redesign projects. Impacts vary according to the type of project, e.g., terminal or en route. En route projects often receive a categorical exclusion (CATEX). Terminal projects on the other hand may be subject to extensive studies, which can extend the schedule by two years or more. The deliverable for Milestone Four is a FONSI (generated in Step 5) or a ROD (generated in Step 6) as appropriate. See Appendix A for environmental guidance.

Phase 4 – Implementation – includes Step 7, and has two milestones.

- Milestone 5: Implementation Planning Competed; and
- Milestone 6: Implementation Complete.

Implementation planning deliverables should include an Implementation Plan and Transition Plan as outlined in Step 7: Plan Implementation at Field Facility. These plans include developing new procedures, conducting rulemaking, validating equipment needs, stakeholder coordination, transitioning, training, and negotiating memorandums of understanding and letters of agreements. Most of the work in Phase 4 is in the planning. Milestone 6 represents operational completion of the new design.

Phase 5 – Post Implementation/Evaluation – includes Step 8, and has one milestone:

- Milestone 7: Project Closed.

After implementation, a period is included to evaluate the project. Evaluation includes measuring appropriate metrics. Comparison of post implementation metrics to baseline metrics provides a measurement of effect brought about by the redesign. The deliverable for Milestone 7 is a Lessons Learned document that provides guidance for future projects.

Milestone deliverables and phases are part of a logical flow designed to ensure proper definition of the *product* of the project. Although the phases are generally sequential, certain activities span and iterate within and among the phases. Examples of spanning activities include planning related to the project, environmental studies or implementation. Such planning activities occur as needed to achieve the goals of the project. Iterative activities are common in airspace redesign projects, particularly in the design and modeling phase. Changes in design occur due to any number of reasons, including environmental studies, staff studies, risk mitigation activities, and others. These proposed design changes usually require additional modeling and testing. Planning and scheduling techniques reflect the cost, time and technical impacts of spanning and iterative activities

Appendix D. Safety Management System Requirements

D.1   Introduction

The Safety Management System (SMS) is comprised of Safety Risk Management (SRM), Documentation of SMS Outcomes, Safety Assurance and Measurement and Safety Promotion. An overview of these components is discussed in the following subsections based on material in the SMS Manual. The SMS Manual (refer to Safety Management System references in Appendix E) provides a complete description of these topics. This appendix provides only a high level review and actual SRM practitioners are required to use the SMS Manual and receive the 3-day SRM practitioner training.

D.2   Safety Risk Management Overview

As part of these SMS requirements, when a change to the NAS is proposed, a decision must be made by the Oversight Team to decide if SRM is required. SRM is always required if the specific type of change is one that requires approval or acceptance by either AOV or the ATO Safety Service Unit. Figure 13 (from the SMS Manual) shows a general process to decide if SRM is required. All decisions regarding whether SRM is required must be documented and can be audited by the ATO Safety Service Unit and/or AOV.
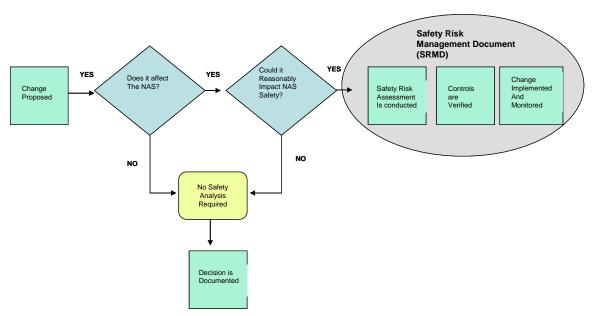

Figure 13. Safety Risk Management Decision Process

Examples of changes that require SRM are shown in Table 21.

Table 21. SRM Examples

Examples that Require SRM	Type of Change	Examples that may not require SRM
En Route Route Changes	**Airspace Change**	Change to a jet airway number
High Altitude Redesign En route Airspace Redesign Terminal Airspace Redesign	**Airspace Changes**	
Land and Hold Short Operations (LAHSO) RNP-RNAV Simultaneous Offset Instrument Approaches (SOIA)	**Change to ATC Procedures and Standards**	Change amended clearance phraseology from "change to read" to "amend to read"
En Route Automation Modernization (ERAM) Standalone Terminal Automation Replacement System (STARS) Potomac Consolidated TRACON	**Introduction of New NAS Equipment or Facilities**	Limited Dynamic Resectorization (LDR) NIMS

An SRM process proceeds through five general phases: describe the system, identify the hazards, analyze the risk, assess the risk, and treat the risk. These phases are described below.

D.2.1   Describe The System

The "system" will always be a sub-component of some larger system. Even if the analysis encompasses all services provided within an entire Air Route Traffic Control Center, this can be thought of as a sub-set of a larger body of airspace, which in turn, is a subset of the NAS. In describing the system the scope of the problem or change is characterized and documented, stakeholders are identified and the SRM process is planned. The system and operation are described in sufficient detail for the safety assessment to proceed to the next stage – identifying hazards.

D.2.2   Identify the Hazards

Once the system is described, hazards are identified. During this phase, things that can "go wrong" and the possible causes are identified and documented. The level of detail required in the hazard identification process depends on the complexity of the change being considered and the stage at which the assessment is being performed. A more comprehensive hazard identification process leads to more rigorous SRM.

D.2.3   Analyze the Risk

All safety significant, new and modified systems, procedures, and operations are evaluated for safety risk. It is management's responsibility, in accordance with the SMS Manual, to decide if the impact on safety is such that SRM is required.

If a determination is made that the proposed change does not require SRM, a written statement including the decision and supporting argument is signed by the manager and kept on file for a period equivalent to the lifecycle of the system or change as discussed in the SMS Manual Chapter 3.

At a minimum, the safety risk of the following general changes is evaluated and managed, following the SRM process documented in Chapter 4, Safety Risk Management Guidance of the SMS Manual:

- Safety significant airspace changes, including:
    - reorganization of air traffic services route structure
    - resectorization of an airspace

- Safety significant changes to air traffic services procedures and standards, including:
    - reduced separation minima applied to airspace
    - new operating procedures, including departure, arrival, and approach procedures
    - waivers to existing procedures, requirements, or standards

- Safety significant changes to airport procedures and standards, including:
    - reduced separation minima applied at an airport
    - physical changes to airport runways, taxiways, or the airport operations area

- The introduction of new safety significant equipment, systems (hardware and software), or facilities used in the provision of air traffic services

- Safety significant modifications to critical equipment, systems (hardware and software), or facilities used in the provision of air traffic services.

Note that since established operations, procedures, and performance of routine maintenance pre-date the implementation of the SMS, they were not evaluated using the SRM processes described in this document. However, they were evaluated during initial design and development (prior to implementation) using the processes that existed at that time and are deemed to be safe based on the FAA's exemplary safety record.

D.2.4   Assess the Risk

In this phase, each hazard's risk is compared to and plotted on a pre-planned risk acceptability matrix. A hazard's priority is determined by its location on this risk matrix. Higher priority hazards receive the greatest attention in the treatment of risk. For more information on assessing the risk, refer to Section 4.41 in the SMS Manual.

Risk is the composite of the predicted severity and likelihood of the outcome or effect (harm) of the hazard in the worst credible system state. In order to assess the risk of a hazard occurring, severity and likelihood are first determined. Severity is determined by the worst credible potential outcome. Less severe effects may be considered analytically in addition to this, but at a minimum, the most severe effects are considered. Determination of severity is independent of likelihood.

D.2.5   Treat the Risk

In this phase, options for dealing with risk are developed and managed. The risk management activity identifies feasible options to control or mitigate risk, which may include:

- Avoidance: by selecting a different approach or not participating in the operation, procedure, or system development

- Transfer: to shift the risk to another area

- Assumption: to accept the likelihood and probability, and consequences associated with the risk

- Research and Knowledge: to mitigate risk through expanding research and experience

- Control: to develop options and alternatives and/or take actions to minimize or eliminate the risk

The desired approach is selected and implemented. Prior to operational use, the mitigation strategy is validated and verified, and becomes an existing element of the system or operation. Table 4.4 - *Safety Order of Precedence* in Section 4.52 in the SMS Manual provides an overview of the preferred order for developing risk mitigation controls. For more information on treating the risk, refer to Section 4.43

D.3   Safety Risk Management Document (SRMD)

A Safety Risk Management Document (SRMD) is a report that thoroughly describes the SRM process for a given proposed change and documents the evidence to support that the proposed change to the system is acceptably safe. That is to say, that the risk associated with the proposed change is acceptable. Section D.6 provides a checklist of information that is needed to develop the SRMD.

D.3.1   Safety Risk Management Acceptance and Approval Requirements

The approvals in SRM (including approval of SRMDs) are dependent on the span of the program, its associated risk, and the mitigation(s) used to control the risk. In general, the person who approves the SRMD certifies that the documentation was developed properly, hazards have been systematically identified, and the risk has been appropriately estimated and mitigated. This approval *does not* constitute acceptance of the risk associated with the change or approval to implement the change. The acceptance of the safety risk is dependent on the span of the program, its associated risk, and the mitigation used to control the risk. The risk acceptance and approval requirements are shown in Tables 22 and 23.

D.4   Safety Assurance and Measurement

An essential function of the SMS is ensuring that safety objectives have been met. Safety assurance includes monitoring (i.e., safety reviews, evaluations, audits, and inspections), data tracking and analysis, and investigations. Chapters 6 and 7 of the SMS manual describe the monitoring and safety data tracking and analysis.

D.5   Safety Promotion

Safety promotion consists of Safety Promotion training, sharing safety data and dissemination of lessons learned. Chapters 9 and 10 in the SMS Manual describe the SMS training standards and safety culture

Table 22. Safety Risk Management Approval Requirements

By AOV z	SRMD Approved by ATO Safety Service Unit	SRMD Approved at the Service Director/Manager Level

• SMS processes and changes to SMS processes (as defined in this manual)
• Changes to provisions of ATO documents related to separation minima (including waivers)
• Controls used by ATO to mitigate hazards with high **initial** safety risk
	• Items or changes that require AOV approval
	• Any change that has high **initial** safety risk
	• Changes to, or replacement of, a system that if lost or malfunctioning would require application of contingency procedures involving increased separation standards or would result in "ATC Zero" status (e.g., Advanced Technology and Oceanic Procedures (ATOP) or Common Automated Radar Terminal System (C-ARTS))
	• Changes in the periodicity of maintenance or inspection (including flight inspection) of systems described above (in 3rd bullet)
		• Changes with medium or low **initial** safety risk, where safety risk and controls/mitigations:
		  - stay within ATO Service Unit, the SRMD is approved within the Service Unit
		  - span ATO Service Units, the SRMD is approved within each affected Service Unit
		  - go outside of ATO (i.e., to the Airports Office (ARP) and/or Office of Regulation and Certification (AVR)), the SRMD is approved by each affected Line Of Business (LOB)

Table 23. Risk Acceptance Requirements

	High Initial Risk	Medium or Low Initial Risk
Safety Risks and/or Controls	**Risk Accepted by**	**Risk Accepted Within**
Stay within a Service Unit	Service Unit Vice President (VP)	Service Unit
Spans Service Units	Each Affected Service Unit VP	Each Affected Service Unit
Affect LOBs outside the Airports Office (ATO) (e.g., ARP and/or Aviation Standards (AVS))	Each Affected Service Unit VP and Each Associated Administrator	Each Affected Service Unit and LOB

D.6   Safety Risk Management Checklist

This checklist is intended to provide the information about the airspace alternative(s) needed for the safety risk management analysis. Although, it requests information in

several categories, it is understood that all the data initially may not be available. However, it does represent information, in accordance with the SMS Manual, that ultimately will be needed for preparation of the SRMD.

I.   Describe the System

A. Describe the airspace alternative(s).
- i. Describe a summary of the output of any modeling conducted using SDAT, TAAM, TARGETS, or other airspace/air traffic design tool.
- ii. Describe any limitations to the airspace alternative(s).
- iii. Describe the organizations or stakeholders impacted by the airspace alternative(s). Example of stakeholders may include airlines, FAA and Civil Air Traffic Organizations, and Military operators.

B. Describe the environment for the airspace alternative(s).
- i. Describe the mission of the airspace alternative(s).
- ii. Describe the (human) environment related to the airspace alternative(s) (i.e., controller pilots, affected communities, etc.).
- iii. Describe the machine environment related to the airspace alternative(s) (i.e., what technology is necessary or will be impacted).
- iv. Describe the management environment related to the airspace alternative(s) (i.e., Letters of Agreement (LOAs), Standard Operating Procedures (SOPs), training, publications).

  Describe the media/environment related to the airspace alternative(s) (i.e., Runways, facilities, regions, towers, etc.).

C. Describe the data that will be considered as part of the analysis to for the airspace alternative(s) (i.e., metrics).

D. Determine how the system be bounded for the analysis. Provide an explanation for why an element is included or excluded.

E. Identify sources of the hazards associated with the airspace alternative(s) (i.e., equipment, operating environment, human operator, human machine interface, operational maintenance procedures, external services, terrain, communication, procedures, training, weather, etc.).

F. Determine the potential hazards associated with the airspace alternative(s).

G. Analyze the risk of each hazard and document including the severity, likelihood, and mitigation controls in place for the airspace alternative(s).

H. Plot the initial risk on the risk assessment matrix for the airspace alternative (s).

I. Discuss what mitigation strategies will be used, how you will monitor and communicate the risk, and identify existing controls and recommended requirements for the airspace alternative(s).

J. Develop a plan for implementing a mitigation strategy for the airspace alternative(s). How should Tracking Risk Resolution be conducted?

This information should be used to generate the SRMD. After completion, the signatures for acceptance and approval should be collected. In general, the management official(s) who approves the SRMD certifies that the document was developed properly, hazards are systematically identified, and risk is appropriately estimated and mitigated. The signature for acceptance l signifies that the risk associated with the change is acceptable.

Appendix E. Bibliography

1.   14 Code of Federal Regulations (CFR) part 234, *Airline Service Quality Performance Reports.*

2.   FAA, *Airspace Management Handbook: Checklist.*

3.   FAA, *Airspace Management Handbook: Metrics.*

4.   FAA, *Airspace Management Handbook: Guidelines.*

5.   FAA Order 7100.9D, *Standard Terminal Arrival Program and Procedures.*

6.   FAA Order 7130.3, *Holding Pattern Criteria.*

7.   FAA Order 7210.3, *Facility Operation and Administration.*

8.   FAA Order 7210.60, *Policies and Procedures for Validating New/Revised Sectors/Positions in Terminal and Enroute Air Traffic Facilities.*

9.   FAA Order 7400.2, *Procedures for Handling Airspace Matters.*

10. FAA Order 8260.3, *United States Standard for Terminal Instrument Procedures (TERPS).*

11. FAA Order 8260.40, *Flight Management System (FMS) Instrument Procedures Development.*

12. FAA Order 8260.44, *Civil Utilization of Area Navigation (RNAV) Departures Procedures.*

13. FAA Order 8260.46, *Instrument Departure Procedure (DP) Program.*

14. FAA Order 8260.48, *Area Navigation (RNAV) Approach Construction Criteria.*

15. MITRE Corporation, *TAAM Best Practices,* MTR01-W92, September 2001.

16. RTCA, *Government and Industry Guidelines and Concepts for NAS Analysis and Redesign.* RTCA Document RTCA/DO-244, 8 June 1998

Environmental References

1.   14 CFR part 150, *Airport Noise Compatibility Planning.*

2.   40 CFR parts 1500-1508*, Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act of 1968 (NEPA).*

3.   FAA Order 1050.1, *Policies and Procedures for Considering Environmental Impacts.*

4.   FAA Order 5050.4, *Airport Environmental Handbook.*

5. Department of Transportation (DOT) Order 5610.1, *Procedures for Considering Environmental Impacts.*

6. FAA-AEE-97-04, *Integrated Noise Model (INM) Version 6.0 Technical Manual.*

7. FAA-AEE-99-03, *Integrated Noise Model (INM) Version 6.0 User's Guide.*

8. FAA-AEE-99-01, *Air Traffic Noise Screening Model, Version 2.0 User's Manual.*

9. FAA and Metron Corporation, *NIRS, Noise Integrated Routing System User's Guide, Version 6.0c.2*, June 2003.

Safety Management System References

1. Order 1100.161, Air Traffic Safety Oversight.

2. FAA SMS Manual-Version 1.1, May 21, 2004, http://intranet.faa.gov/ats/atq.

Internet/Web Links

1. FAA's Air Traffic Environmental Programs - Contains information on Air Traffic environmental programs and NIRS information.
http://www.faa.gov/ats/ata/ata300/index.html

2. FAA's Flight Procedure Standards (AFS-420) – Contains links to guidance on the design of IFR en route and terminal instrument approach and departure procedures.
http://av-info.faa.gov/terps/

3. FAA's Office of Energy and Environment – Contains guidance on FAA's compliance with applicable regulations including the current version of INM.
http://www.aee.faa.gov/

4. Federal Register Notice, Vol.65, Number 235, December 6, 2000, page 76339-76340, can be found under the FAA Notices – Air Traffic Noise Screen on the Government Printing Office web page at:
http://www.access.gpo.gov/su_docs/fedreg/a001206c.html
or directly at:
http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=2000_register&docid=00-31090-filed

5. NEPA CEQ Task Force – Contains information on NEPA and CEQ regulations and guidance to federal agencies for implementation.
http://ceq.eh.doe.gov/nepa/nepanet.htm

6. FAA's Office of Airport and Planning – Community and Environmental Needs Division (APP-600) – Contains guidance and assistance to airports in implementing the NEPA and other Federal environmental laws and regulations.
http://www.faa.gov/arp/600home.cfm

Appendix F. Glossary

AAR	Airport Arrival Rate
ACES	Adaptation Controlled Environment System
ADR	Airport Departure Rate
AGL	Above Ground Level
AOV	Office of Safety Information and Promotion
ARP	Airports Office
ARTCC	Air Route Traffic Control Center
ARTS	Automated Radar Terminal System
ASPM	Aviation System Performance Metrics
ASQP	Airline Service Quality Performance
ATC	Air Traffic Control
ATNS	Air Traffic Noise Screening Model
ATCSCC	Air Traffic Control System Command Center
ATOP	Advanced Technology and Oceanic Procedures
AVR	Office of Regulation and Certification
AVS	Aviation Standards
C-ARTS	Common Automated Radar Terminal System
CATEX	Categorical Exclusion
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
dBA	Decibels (A-weighted)
DNL	Day-Night Average Sound Level
DoD	Department of Defense
EA	Environmental Assessment
EACM	Enhanced Airfield Capacity Model
EDDA	Environmental Due Diligence Audit
EIS	Environmental Impact Statement
ERAM	En Route Automation Modernization
ETMS	Enhanced Traffic Management System

FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
FONSI	Finding of No Significant Impact
GRAIL	Grail Real Time Air Traffic Management Infrastructure Laboratory
HITL	Human-in-the-Loop
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
INM	Integrated Noise Model
LAHSO	Land and Hold Short Operations
$\mathbf{L_{eq}}$	Equivalent Sound Level
$\mathbf{L_{max}}$	Maximum Sound Level
LOA	Letter of Agreement
LOB	Line Of Business
LOS	Level of Service
NAS	National Airspace System
NEPA	National Environmental Policy Act
NIRS	Noise Integrated Routing System
OAG	Official Airlines Guide
OEP	Operational Evolution Plan
OPSNET	Air Traffic Operations Network
PDARS	Performance Data Analysis and Reporting System
POET	Post-Operations Evaluation Tool
RAMS	Reorganized Air Traffic Control Mathematical Simulator
RNAV	Area Navigation
RNP	Required Navigation Performance
ROD	Record of Decision
SAR	System Analysis Recording
SDAT	Sector Design and Analysis Tool
SEL	Sound Exposure Level
SID	Standard Instrument Departure
SMS	Safety Management System

SOIA	Simultaneous Offset Instrument Approaches
SOP	Standard Operating Procedures
SRM	Safety Risk Management
SRMD	Safety Risk Management Document
STAR	Standard Terminal Arrival Route
STARS	Standalone Terminal Automation Replacement System
SUA	Special Use Airspace
TAAM	Total Airspace and Airport Modeller
TARGETS	Terminal Area Route Generation, Evaluation, and Traffic Simulation Tool
TRACON	Terminal Radar Control
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
VP	Vice President