Final Environmental Assessment
for
Greener Skies Over Seattle;
Proposed Arrival Procedures to
Seattle-Tacoma International Airport

Volume 1 – Main Document

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United States Department of Transportation
Federal Aviation Administration

Renton, Washington
Executive Summary

Overview

This Final Environmental Assessment (FEA) addresses the potential environmental impacts associated with the implementation of proposed new arrival procedures into Seattle-Tacoma International Airport (SEA). Designed to increase air traffic control efficiencies through the use of new Area Navigation (RNAV) and Optimized Profile Descent (OPD) procedures, the project is popularly referred to as “Greener Skies”. Elements of the project include the following major additions to the set of existing approach procedures into SEA:

- **A new Standard Terminal Arrival procedure (STAR) for traffic arriving from the northwest to land on any of the six runway ends at SEA.** The new procedure is expected to increase slightly the number of flight miles flown for some aircraft, taking them further north than at present. Instead of overflying northern portions of Kitsap County as now, more of that traffic would approach the runways from over Hansville and Puget Sound south of Island County. However, compensating benefits derived from aircraft operating at slightly higher altitudes, undergoing fewer level-off segments, and maintaining lower thrust settings during the approach offset the disbenefit of increased flight miles.

- **A new STAR for aircraft arriving from the southwest that would reduce the number of flight miles flown when landing on any of the six runway ends.** In particular, the removal of a significant “dog leg” to the west over Olympia, Washington would be replaced by more direct routings generally over the former Fort Lewis Military Reservation and to either side of the former McChord Air Force Base, the two installations now collectively merged and known as Joint Base Lewis-McChord (JBLM).

- **Implementation of new Required Navigation Performance (RNP) and RNP-to-Instrument Landing System (ILS) procedures northwest and southwest of SEA.** New approach procedures would provide high-precision extensions of the STARs onto curved approach paths and short straight-in final approaches to touchdown with less need for intervening interaction by air traffic controllers.
  - Fifteen of the RNP procedures would provide instrument guidance for landings on runways 16L, 16C, and 16R (five to each runway end). Twelve of the 15 would lead aircraft in over Elliott Bay and the industrial area south of Harbor Island, and the other three would provide guidance to aircraft generally overflying areas of north Seattle subject to overflights now but guided by instructions from Air Traffic Control (ATC).
  - An additional six RNP procedures would guide aircraft along curved approach paths over the Port of Tacoma, keeping them north of Interstate Route I-5 and lining them up to land on runways 34L, 34C and 34R. Three other procedures represent transitions to longer straight-in instrument approaches very similar to now.

- **Optimized Profile Descents from both the northwest and southwest.** Appropriately-equipped aircraft would begin their descents at cruise altitudes with near-idle thrust (referred to as “flight idle”) and concomitant reductions in fuel burn, and would largely be able to maintain those thrust and fuel burn conditions along the STARs and RNP procedures all the way to touchdown.

Guidance for considering environmental impacts of aviation projects is found within FAA Order 1050.1E, entitled “Environmental Impacts: Policies and Procedures”\(^1\), and also in the Council on Environmental Quality’s (CEQ’s) “Regulations for Implementing NEPA.”\(^2\) Specifically, FAA Order 1050.1E requires

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\(^1\) FAA Order 1050.1E, Chg. 1. FAA National Policy, Subj: Environmental Impacts: Policies and Procedures, March 20,2006

\(^2\) 40 Code of Federal Regulations (CFR), Part 1500.
environmental assessment of any new instrument approach procedures, departure procedures, en route procedures, or modifications to currently approved instrument procedures which routinely route aircraft over noise-sensitive areas at less than 3,000 feet above ground level (AGL). Several such routings are considered in this assessment, but no changes are being proposed to alter the runways, taxiways, navigational aids or other infrastructure on SEA itself. Thus, a number of environmental resource categories are unaffected by the proposed action.

Public Participation

Under 40 CFR 1501.7 (NEPA and Agency Planning), scoping for a Draft Environmental Assessment (DEA) is optional, but because the FAA considered an open public process to be an important component of the Greener Skies DEA, the Agency decided to conduct scoping with the following specific goals in mind:

- Identify significant issues to be analyzed in greater depth;
- Clarify legal responsibilities and areas of environmental analysis requiring special expertise;
- Encourage the public to provide their input and concerns;
- Identify and eliminate from detailed study any issues that are insignificant or which have been covered by prior environmental review;
- Establish the extent of the Study Area; and identify available technical information.

The process included two public scoping meetings – one held south of SEA on January 25, 2012 in Federal Way and one north of SEA on January 26, 2012 in Shoreline – as well as an Agency scoping session and a Tribal scoping session each held at FAA’s offices on January 26, 2012 in Renton. The content for all four meetings was the same -- FAA and its consultant participated in an introductory workshop session, disseminated project information, made two formal presentations and solicited comments. Primary issues and concerns raised by members of the public focused on potential noise impacts, the NEPA process, and air quality. A complete record of the outreach process, including public notices, copies of the boards and PowerPoint presentations, and comments received and their responses, is contained in Chapter 7 and Appendices K and L of this FEA.

In addition, throughout the development of the RNAV and RNP procedures, the FAA met frequently with other agencies, airport sponsors, cities and counties, as well as interested citizen groups to disseminate information on the procedure development and to better understand potential concerns regarding the proposed procedures.

Following completion of the resource analyses in the environmental assessment process, a DEA was released for public comment on August 7, 2012. That was followed by new Tribal and Agency meetings and by two public workshops, which were held to present the findings of the analyses and give attendees the opportunity to discuss concerns with subject matter experts. The Tribal and Agency meetings were held consecutively on the morning of September 5, 2012. The first public workshop was held later that evening from 6:00 to 7:30 p.m. at the main library in Federal Way. The second workshop was held the
following evening September 6, 2012 at the Ballard Branch Library, also from 6:00 to 7:30 p.m. Similar to the scoping meetings, the content of each session was identical and consisted of an initial 30 minutes for informal question and answers at a series of workstations with boards and members of the FAA and consulting team in attendance. That was followed by a 30-minute presentation explaining the proposed new procedures, the resulting noise, and fuel burn findings. The final 30 to 45 minutes was again open to informal questions and answers at the workstations. A court reporter was in attendance at both workshops to take verbatim transcripts of public comments as one of several means available for submitting formal comments on the draft document.

A total of 205 comments were received on the DEA, many of them criticizing the meeting format at the Ballard Branch Library. Others raised questions regarding the magnitude of the expected changes in noise exposure, and still others asked about getting noise monitoring stations in their neighborhoods. Further details on the final set of meetings and workshops is contained in Chapter 7. Copies of sign-in sheets for each meeting, the workstation boards, a representative power point presentation, and a compilation of every comment received and the FAA’s response to each comment are included in Appendix L.

Purpose and Need

The FAA’s mission is “to provide the safest, most efficient aerospace system in the world”\(^3\). The “need” faced in the complex airspace surrounding SEA is the lack of efficiency associated with existing standard instrument arrival procedures into SEA, both in terms of the throughput of traffic to the runways as well as the significant need for controller interaction to maintain safe separation standards between aircraft arriving on closely-spaced parallel runways. Current instrument procedures and related airspace management tools and structure do not provide the flexibility and predictability that current space-based technologies can offer. During periods of high traffic demand, the lateral and vertical separation between arrival and departure flight routes is not sufficient for the airspace to be used without controllers carefully observing aircraft activity along the proximate or crossing flight routes and actively managing aircraft to maintain safe separations. Inefficiencies include level-offs, vector headings, speed changes, and added communications potentially leading to “hear-back/read-back” errors and corrections. All of these contribute to interrupted climbs and descents, increased flight times and additional fuel burn and emissions.

The “purpose” of the Greener Skies project is therefore to provide a partial solution to the inefficiencies of the existing air traffic control system. Greener Skies seeks to achieve this purpose by leveraging existing NextGen performance-based technology enhancements to reduce controller and pilot workloads, reduce the complexity of operations within the Seattle airspace, and increase system flexibility and predictability. The proposed new procedures accomplish this by providing:

- More efficient lateral and vertical flight profiles that reduce the need for level-offs during descent to land, also reducing energy consumption, engine emissions, and noise
- Increased options for arrival paths, which will remove bottlenecks for aircraft approaching SEA from the northwest and southwest during busy times of day
- Reduced frequency of long downwind legs and extended final approaches that require extra flying miles

\(^3\) FAA web site: [http://www.faa.gov/about/mission/](http://www.faa.gov/about/mission/)
- Increased precision of the procedures to land under Instrument Meteorological Conditions (IMC) on runways that normally cannot accommodate traffic during more adverse weather
- Implementation of more direct flight paths that will reduce flight times and have the added benefit of reducing fuel consumption and engine emissions
- New RNAV/RNP arrival routes and RNP/RVFP approaches that will permit ATC to issue simpler instruction and let the aircraft’s Flight Management System (FMS) fly the preprogrammed route, including vertical and lateral track information all the way to the landing runway.

**Alternatives**

FAA’s development of alternatives for Greener Skies began in 2010. Evolving from a preliminary identification of measures aimed at reducing flight times, level-off segments, and confliction points in the Seattle-Tacoma airspace, concepts for airspace efficiencies tended to focus on measures that would minimize difficulties with implementation. Proposals that reduced the likelihood of adverse environmental impacts, particularly noise, thus focused on areas west of SEA where 70 percent of the arriving aircraft were already flying over large expanses of water. Along the three- to five-mile wide band of Puget Sound, FAA began to examine the feasibility of various measures, eliminating options that created unresolvable conflicts or did not otherwise improve inefficiencies. Additional measures were added for consideration if they resulted in fewer level-off segments and reduced radio communications while still maintaining safe separation standards.

Ultimately, this screening and evaluation of individual proposals resulted in the elimination of measures found to be ineffective, while those found to be viable and effective at reducing inefficiencies collectively became the Proposed Action. The No Action and Proposed Action scenarios are described in detail in Chapter 4 of this FEA and no other alternative is under consideration.

**Summary of Environmental Consequences**

Chapter 6 of this FEA describes the effects of the Proposed Action compared to No Action on the following environmental resource categories:

- Noise
- Compatible Land Use
- Air quality
- Climate
- Natural resources and energy supply (fuel usage)
- Socioeconomic effects
- Secondary (induced) impacts
- Historical, architectural, archeological, and cultural resources
- Department of Transportation Act 4(f) sites (parks and natural areas)
- Fish, wildlife and plants (flyways for migratory birds)
- Light emissions and visual impacts

Other resource categories were considered for their potential environmental impacts but are unaffected by the Proposed Action and are not addressed further.

Noise was examined for three study years – 2014, 2018 and 2023 – using the FAA’s Noise Impact Routing System (NIRS) noise model. Computations of noise exposure were made at 40,788 population centroids and nearly 15,000 additional points disassociated with population but useful for representing
noise levels in more remote areas such as parks or wildlife refuges. Several hundred additional points were selected to represent schools, specific historic sites and several locations directly under proposed flight paths or in areas of variable terrain representative of additional potentially sensitive locations.

Conclusions from the noise analysis are that:

- Of the 3,171,686 residents represented by the 40,788 population centroids in the Study Area, no one would be exposed to an increase in noise exposure that exceeds FAA’s criterion for significant impact (a 1.5 dB or greater increase to a DNL of 65 dB or greater) as a result of the Greener Skies Proposed Action for any of the study years examined.

- No one would be exposed to increases in noise exposure from the Proposed Action that exceed any of FAA’s other criteria for reportable changes – either a 3 dB or greater change in DNL from 60 to 65 dB, or a 5 dB or greater change in DNL from 45 to 60 dB – for any of the study years examined.

- In each of the three study years, there are residents exposed to noise greater than DNL 45 who will experience slight increases in exposure due to the Proposed Action, and others who will experience slight decreases, none of them greater than approximately ± 1 dB. Those experiencing decreases outnumber those experiencing increases by more than 2 to 1.

- For each study year, there are population centroids that are newly exposed to DNL values greater than 65 dB as a result of the Proposed Action. Two occur in 2014, and one each in 2018 and 2023. Three of those locations are 3 to 3½ miles north of the runway ends and one is about 3¼ miles to the south. All are on extended runway centerlines where there is expected to be slightly less dispersion in flight tracks as aircraft make their approach to land. However, the maximum increase in DNL attributable to the Proposed Action along these final approach paths is only 0.1 dB in 2014 and 2018 and only 0.2 dB in 2023. Such changes are extremely small and not likely even to be noticed. The results are summarized in the table that follows and shown graphically in a set of 16 figures in Section 6.1.

<table>
<thead>
<tr>
<th>Study Year</th>
<th>Greatest Change in DNL Relative to No Action</th>
<th>Population Experiencing Change</th>
<th>Population Exceeding FAA Order 1050.1E Criteria</th>
<th>Population Newly Exposed to DNL 65 or above</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Increase</td>
<td>Decrease</td>
<td>Increase</td>
<td>Decrease</td>
</tr>
<tr>
<td>2014</td>
<td>0.9dB</td>
<td>-0.8dB</td>
<td>120,386</td>
<td>277,754</td>
</tr>
<tr>
<td>2018</td>
<td>0.9dB</td>
<td>-0.8dB</td>
<td>123,081</td>
<td>290,391</td>
</tr>
<tr>
<td>2023</td>
<td>1.1dB</td>
<td>-0.7dB</td>
<td>132,484</td>
<td>311,122</td>
</tr>
</tbody>
</table>

Because the expected increases in noise levels are not significant, no mitigation of the Proposed Action is necessary and there are no related effects of noise on land use compatibility; historical, architectural, archeological, and cultural resources; or parks and natural areas. Even in areas where natural quiet is valued, noise exposure in the three National Wildlife Refuges (NWRs) in the Study Area are at levels of 35 dB DNL or lower and in the case of the Dungeness and Nisqually NWRs, those levels are even projected to decrease slightly under the Proposed Action.

Fuel burn and resultant greenhouse gas emissions in the form of equivalent metric tons of CO2 are also summarized here.
Table ES-2. NIRS Model Output for Daily Fuel Burn and CO2 Emissions

<table>
<thead>
<tr>
<th>Condition</th>
<th>No Action</th>
<th>Proposed Action</th>
<th>Percent Change (Proposed Action vs. No Action)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fuel (kg)</td>
<td>MT CO2e</td>
<td>Fuel (kg)</td>
</tr>
<tr>
<td>2014</td>
<td>1,197,628</td>
<td>3778.5</td>
<td>1,184,022</td>
</tr>
<tr>
<td>2018</td>
<td>1,315,623</td>
<td>4150.8</td>
<td>1,301,919</td>
</tr>
<tr>
<td>2023</td>
<td>1,519,014</td>
<td>4792.5</td>
<td>1,503,814</td>
</tr>
</tbody>
</table>

Notes: MT CO2e denotes metric tons of CO2-equivalent.

The Proposed Action, with its shorter routes of flight and use of Optimized Profile Descents, reduces daily fuel usage by 13,000 to 14,000 kilograms per day (approximately 30,000 pounds), representing a decrease of 1.00 to 1.14 percent compared to No Action for each of the three study years 2014, 2018, and 2023. During the same periods, carbon dioxide emissions are reduced by 43 to 48 metric tons daily, or approximately 15,700 to 17,500 metric tons annually. Reductions are not large for airport operations as a whole because no changes are being proposed for arrivals from the east side of SEA nor are any changes proposed for departures. New arrival tracks do, however, provide large individual benefits, reducing fuel burn as much as 30 to 32 percent on the new HAWKZ STAR entering the Seattle airspace from the southwest to land on runways 34L, 34C, or 34R.

These and other analyses of the Proposed Action discussed in the body of the FEA indicate that there are no significant environmental impacts associated with the Proposed Action.
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1 PROJECT INTRODUCTION AND BACKGROUND

1.1 Introduction

The Federal Aviation Administration (FAA) has prepared this Final Environmental Assessment (FEA) to identify the potential environmental effects associated with adding Area Navigation (RNAV) procedures and implementing Optimized Profile Descents (OPDs) at Seattle-Tacoma International Airport (referred to in this document by the FAA’s three-letter identifier, SEA). The project is referred to as the “Greener Skies over Seattle” initiative or, more popularly, just “Greener Skies”.

Federal actions such as the addition of the new procedures proposed by the FAA at SEA must be reviewed for compliance with the National Environmental Policy Act of 1969 (NEPA), the Airport and Airway Improvement Act of 1982 as amended and other pertinent laws. Guidance for considering environmental impacts of aviation projects is found within FAA Order 1050.1E, entitled “Environmental Impacts: Policies and Procedures”\(^4\), and also in the Council on Environmental Quality’s (CEQ’s) “Regulations for Implementing NEPA.”\(^5\) Specifically, FAA Order 1050.1E requires environmental assessment of any new instrument approach procedures, departure procedures, en route procedures, or modifications to currently approved instrument procedures which routinely route aircraft over noise-sensitive areas at less than 3,000 feet above ground level (AGL). Several such routings are being considered in this assessment, but no changes are being proposed to alter the runways, taxiways, navigational aids or other infrastructure on SEA itself.

The FEA provides background to the proposed project, describes the Purpose and Need for the Proposed Action, identifies and evaluates reasonable alternatives to the proposed action, and provides full disclosure of the potential environmental impacts associated with implementation of the Proposed Action.

1.2 Project Background

Seattle-Tacoma International Airport serves the cities of Seattle and Tacoma, Washington, as well as the western portion of the entire state. SEA is the primary hub for Alaska Airlines, whose headquarters are located in the immediate vicinity, and also for its low-cost sister company Horizon Air. SEA has service to destinations throughout North America, Europe and East Asia. In 2011, SEA served over 32.5 million passengers, making it the 17th busiest airport in the United States. It ranks 24\(^{th}\) in total annual aircraft operations (311,791) and 21\(^{st}\) in total cargo volume (279,625 metric tons)\(^6\). The top five airlines operating at SEA, in terms of the percentage of passengers carried in 2011, were Alaska Airlines (35.7%), Horizon Air (14.1%), Delta Air Lines (11.6%), United Airlines (11.3%), and Southwest Airlines (8.9%). Together, the carriers account for more than 80% of the total passenger traffic there.

In 2009, Alaska Air Group (AAG, the holding company for Alaska Airlines and Horizon Air) and Seattle-Tacoma International Airport staff, in cooperation with The Boeing Company and the FAA, developed a plan to evaluate new flight procedures that would utilize the latest navigational technologies and allow all appropriately equipped operators, which included Alaska Airlines and Horizon Air, to fly optimal descent paths, while reducing their environmental impact during approaches to land at SEA. The “Greener Skies” project is a prime example of an initiative where key industry stakeholders have innovatively combined their expertise to maximize use of new technologies for efficient direct approaches into SEA, and also reduce aviation’s impact on the environment.

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\(^5\) 40 Code of Federal Regulations (CFR), Part 1500.
\(^6\) Airports Council International – North America (ACI-NA), Airport Traffic Reports, http://aci-na.org/content/airport-traffic-reports
In 2010, the FAA took over responsibility for completing the final design and implementation of the procedures, consistent with the Agency’s functional role in controlling aircraft, and also to assure broad availability of the new procedures to all appropriately equipped aircraft advancing the use of the technology in a complex airspace. Since 2010, the preliminary design has been finalized and this FEA has been prepared to identify potential environmental effects associated with the proposed new procedures and their future usage.

1.3 Project Context – the National Airspace System

The Federal Aviation Act of 1958, re-codified as 49 U.S.C. 40101 et seq., delegates various responsibilities to the FAA. These include controlling the use of the nation’s navigable airspace and regulating civil and military operations in that airspace in the interest of the safety and the efficiency of each 7. The National Airspace System (NAS) now includes a combination of infrastructure (such as air traffic control facilities), people (such as air traffic controllers, maintenance and support personnel), and technology (sensors such as radar, communications equipment, weather gathering instrumentation, lighting, etc.), as well as rules and regulations that govern the operation of the system.

Because the NAS comprises one of the most complex aviation networks in the world, the FAA’s primary mission is always to assure aviation safety, security, and efficiency. When changes are proposed to the NAS, FAA’s priorities are to (1) maintain or improve system safety; (2) improve efficiency and reduce delays; (3) increase system flexibility and predictability; and (4) promote aviation advancement through implementation and evolution of emerging technologies. The FAA’s Air Traffic Organization (ATO) is the division within the FAA responsible for the safe and efficient use of navigable airspace. In designing or redesigning airspace and procedures for use in the NAS, ATO must comply with NEPA and other applicable laws and regulations.

1.3.1 Current Air Traffic Control within the NAS

The combination of people and the software, hardware, and facilities they use to guide or direct aircraft on their route of flight is collectively referred to as “air traffic control,” or ATC. ATC is responsible for separating aircraft operating under Instrument Flight Rules 8 (IFR) to maintain safety and expedite the flow of traffic operating in the NAS. ATC maintains the separation of aircraft by directing pilots to fly specific routes, altitudes and airspeeds. As aircraft move from origin to destination, ATC personnel function as a team and transfer control of aircraft from controller to controller.

Air traffic control of a typical commercial aircraft flight begins with a controller, in an Airport Traffic Control Tower (ATCT), issuing departure instructions to the pilot. Each instruction issued by a controller (throughout a flight) is read back by the pilot, confirming that the instruction was heard properly. “Hear-back/read-back” errors, when they occur, are corrected immediately, and the pilot carries out the instruction promptly. Tower personnel control departing and arriving flights that are normally within a few miles of the airport as well as aircraft moving on the ground (“taxiing”). The controllers use visual contact as the primary means to identify and track aircraft in the ATCT’s airspace and when taxiing to and from the runways.

Once the aircraft leaves the vicinity of the airport, a Terminal Radar Approach Control (TRACON) facility normally assumes responsibility for guiding the flight. Air traffic controllers in TRACONs use

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7 Title 49 United States Code, Section 40101(d)(4).
8 Instrument Flight Rules are a set of regulations and procedures for flying aircraft when separation from other aircraft and terrain is maintained with reference to aircraft instruments. It is an alternative to Visual Flight Rules (VFR), where the pilot is responsible to “see-and-avoid.” All commercial air carrier aircraft are required to operate under Instrument Flight Rules. (See Appendix A)
short-range radar to identify and track aircraft out to a distance of approximately 50 miles from the airport. Airspace assigned to a TRACON is divided into sectors\(^9\) and a controller, or a team of controllers, manages the safe, orderly and expeditious flow of air traffic within the sector. As aircraft move through the TRACON controlled airspace, management responsibility is transferred and the aircraft is “handed off” from a controller in the previous sector to the controller in the new sector. Within the TRACON (or “terminal”) airspace, FAA typically requires three nautical mile\(^{10}\) (NM) lateral and 1,000-foot vertical separation of aircraft.\(^{11}\)

As the aircraft proceeds further from the airport and climbs to higher cruising altitudes, control is passed to an Air Route Traffic Control Center (ARTCC). Air traffic controllers in ARTCCs or “Centers” use long-range radar to identify and track aircraft. Within Center or “enroute” airspace, FAA typically requires a larger lateral separation of five nautical miles (approximately six statute miles)\(^{12}\). This is because the update rate on long-range radar is not as frequent as with the short-range radar used by TRACONs that manage smaller volumes of airspace. As the aircraft continues towards its destination, control is typically transferred to succeeding Centers along the flight route and then to a TRACON and ATCT as the aircraft approaches its destination airport.

Figure 1.3-1 illustrates these various phases of flight as currently structured within the NAS.

![Figure 1.3-1. Current Phases of Flight within the National Airspace System](http://www.betterairportsnow.org/2009/10/the-analog-airspace-existing-air-traffic-control.html)

The Greener Skies initiative considered in this FEA consists of procedural changes that begin in the Seattle ARTCC (designated by the three letter identifier ZSE), continue into the Seattle TRACON (S46)\(^{13}\), and eventually end in the airspace controlled by Seattle Tower as aircraft descend from cruising altitude all the way to landing on one of SEA’s six runway ends.

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\(^9\) A sector is a portion of airspace having defined geographic and altitude boundaries. (See Appendix A)

\(^{10}\) 6,080 feet, as opposed to a statute mile whose length is 5,280 feet. (See Appendix A)

\(^{11}\) Aeronautical Information Manual, Change 1, August 3, 2006, Chapter 4.

\(^{12}\) Ibid.

\(^{13}\) ZSE and S46 are facilities that control or direct air traffic in the enroute and terminal airspace environments.
1.3.2 Efficiency of the NAS

As aircraft transition between runways and areas of airspace managed by different ATC facilities, inefficiencies in air traffic control during any phase of flight can affect the efficiency on the NAS. These include the need for controllers to vector aircraft (give the pilot manual headings to avoid other traffic, thunderstorms, etc.), change aircraft speed to maintain safe separation distances, hold aircraft in the air or on the ground, or require level off of an aircraft during ascent or descent.

Other inefficiencies exist due to runway and taxiway configurations.

At an airport such as SEA, which is served by three runways (six runway ends), runway operating configurations are established to accommodate arriving and departing aircraft under different operating conditions including weather, prevailing winds, predominance of arrivals or departures, and total volume of traffic. Typically only one end of a runway is used in an operating configuration to accommodate departing and/or arriving aircraft to ensure that all aircraft are operating in the same direction, termed flow. Furthermore, to ensure safe separation of aircraft on arrival or departure, the use of one runway end for an operation may be dependent on how another runway end is being used. Additional complexities to the runway operating configurations can occur throughout the day as ATC adjusts to changing weather, wind, and traffic conditions. Therefore, both the throughput of a single runway as well as the airfield throughput can vary as the runway operating configuration varies.

1.3.3 Next Generation Air Transportation System

Over the next two decades the FAA will face major challenges meeting future demand while improving safety, reducing delays, and protecting the environment. The Next Generation Air Transportation System (NextGen) represents the FAA’s chief means of transforming the national air transportation system — from a ground-based system of air traffic control to a space-based system using the Global Positioning Satellite (GPS) system and aircraft sensing and communications technologies to accommodate these challenges. Figure 1.3-2 summarizes the major technology improvements anticipated throughout the phases of flight described in Section 1.3.1.
In September 2009, the FAA received an industry task force report containing recommendations to expedite implementation of NextGen’s top initiatives. A key component of the recommendations was the formation of study teams to leverage FAA and industry expertise to facilitate the design and implementation of optimized airspace. The new technology arrival and departure procedures that are required to implement the optimized airspace designs are referred to generally as Performance Based Navigation (PBN).

PBN encompasses a variety of specific procedure types including RNAV procedures, which, themselves include OPDs, and Required Navigation Performance (RNP) procedures. All rely on GPS guidance rather than radar and air traffic control interaction for point-to-point navigation; and on-board instrumentation now permits aircraft to make curved flight paths between points. The characteristics of each procedure type are described briefly below.

- **RNAV Procedures**: A suitably-equipped aircraft flying an RNAV procedure is able to fly on any desired flight path within tighter tolerances than previously able, as long as the aircraft is within...
the coverage of ground- or space-based navigation aids, or within the limits of its own self-contained system, or a combination of both. As such, RNAV aircraft have better access and flexibility for efficient point-to-point operations in all phases of flight, including departure, enroute, arrival, and approach to land.

- **RNP Procedures**: RNP is RNAV with the addition of an on-board performance monitoring and alerting capability. A suitably-equipped aircraft on an RNP procedure is able to monitor its own navigational performance and alert its crew if the procedure is not being flown within its design tolerance. The increased situational awareness means that the aircraft are usually on an even narrower course than those associated with standard RNAV procedures. In fact, certain Authorization Required (AR) RNP procedures can only be flown using advanced features of the on-board navigation functions if the aircrews have undergone approved training and certification.

- **OPD Procedures**: As a component of its Trajectory-Based Operations initiative, FAA has authorized development of arrival procedures with vertical profiles optimized to facilitate a continuous descent from the top of descent to touchdown. OPDs are designed to reduce fuel consumption, air emissions, and noise during descent by allowing pilots to set aircraft engines near idle throttle while they descend, instead of flying the more typical “step-down” approaches with intervening level flight segments, increased throttle settings, and added fuel burn.

Figure 1.3-3 illustrates a simple comparison between the step-down approach and an Optimized Profile Descent.

![Step-down vs. OPD](image)

Figure 1.3-3. Illustration of a Typical Step-Down Approach Compared to an OPD

Greener Skies proposes to add each of these new procedure types to the set of existing approaches into SEA.
1.4 Document Organization

The format and content of this FEA conforms to requirements established in CEQ regulations that implement the procedural provisions of NEPA and also to the requirements of FAA Order 1050.1E. Listed below is a summary of the contents of each section of this document.

- **Chapter 1. Introduction & Background** – Introduces the project and provides a general description of the navigational elements that comprise the Proposed Action. It also provides an overview of how the proposed procedures fit within the FAA’s plans to update the NAS for the next generation Air Traffic Control System.

- **Chapter 2. Proposed Action** – Describes the Proposed Action and the federal actions that are required to implement it.

- **Chapter 3. Purpose & Need** – Provides a discussion of the need for the Proposed Action and the purpose that the action must fulfill.

- **Chapter 4. Alternatives** – Describes the No Action alternative as well as the proposed new procedures that comprise the Proposed Action. The chapter also addresses the implementation process and schedule.

- **Chapter 5. Affected Environment** - Provides a discussion of existing environmental conditions of the potentially affected geographic area.

- **Chapter 6. Environmental Consequences** - Provides a comparative discussion of the potential direct, indirect and cumulative environmental impacts associated with the alternatives.

- **Chapter 7. Agency and Public Coordination** - Provides a discussion of the coordination and public involvement opportunities associated with the FEA. This section includes a list of Federal, state, and local agencies and other interested parties that were consulted during the FEA process.

- **Chapter 8. List of Preparers** - Provides a list of the key individuals, their titles and their role in preparing the FEA.

- **Appendices** – Appendices are bound in a separate document and contain detailed background or technical information that has been used to support the main body of the FEA. Specific appendices include:
  - **Appendix A. Acronyms, Abbreviations, and a Glossary of Terms** - Provides a common list of the acronyms and other terminology used in the document.
  - **Appendix B. Categorical Exclusion for Limited Testing** - Contains the document authorizing the testing of the procedures for purposes of evaluating.
  - **Appendix C. Current Published Approach Procedures Affected By The Proposed Action**
  - **Appendix D. FAA TARGETS Files for the New Proposed Routes** - Includes maps and tables of waypoints used in the development of the Proposed Action and from which all noise, air quality, and fuel burn modeling was developed.
• **Appendix E. NIRS Aircraft Substitution Request and FAA Response** – Contains copies of letters to and from the FAA regarding the use of certain aircraft types for use in modeling special procedures.

• **Appendix F. Noise and its Effects on People** – Includes a general summary of noise effects on annoyance, speech interference and sleep disturbance.

• **Appendix G. Noise Modeling Technical Report** – Presents a technical memorandum outlining the aircraft operations and operational conditions at SEA that were used as inputs to the NIRS noise model.

• **Appendix H. Detailed NIRS Calculations** – Presents a summary table and information on how to obtain an electronic copy of the NIRS output at grid locations used in the noise analysis.

• **Appendix I. Historic Resources** – Presents a listing of historic sites in the Greener Skies Study Area that were examined for noise effects.

• **Appendix J. Endangered Species Act Compliance** – Includes a copy of the memorandum to the U.S. Fish and Wildlife Service regarding the effects of the project on listed species.

• **Appendix K. Agency Coordination and Outreach** – Contains information distributed or made available to federal, state and local agencies and tribes describing the project and its effects. Appendix K also includes all Agency comments received on the DEA and responses to those comments. No comments were received from tribes.

• **Appendix L. Public Outreach** – Contains information distributed or made available to the general public describing the project and its effects. Appendix L also includes all comments received on the DEA from the general public and responses to those comments.