Abatement Alternatives Evaluation

Introduction

The various alternatives potentially available for noise abatement presented earlier were analyzed in terms of applicability for reducing existing and future noise intrusion. In addition, comments and suggestions presented by the public in community meetings, Open Houses and personal communication, along with the alternatives directed for evaluation in the County Work Plan were measured against the alternatives presented in the previous chapter. Those have been categorized and are arranged according to the type of alternative it represents. The following alternatives were preliminarily determined to be applicable for noise abatement purposes and it is recommended that they be evaluated for the contribution each would make for noise abatement:

(1) Alternative A.1	Access Restriction on Stage 2 Jets.
(2) Alternative A.4	Complete or Partial Curfew.
(3) Alternative A.5	Noise Barriers/Ground Run-up Enclosure
(4) Alternative A.7	Acquisition of Land or Interest Therein.
(5) Alternative A.12	Noise and Compliance Monitoring Program.
(6) Alternative A.13	Noise Complaint/Citizen Liaison Program and Other Administrative Actions.
(7) Alternative B.1	Land Use Controls.
(8) Alternative C.1	Departure Thrust Cutback.
(9) Alternative C.2	Noise Abatement Procedures.
(10) New Alternative	Other Administrative Actions.

These Alternatives were renumbered for easier identification and to be consistent with additional evaluation. They are not listed in terms of priority. The new identification numbers appear in the parenthesis above. In addition, not all alternatives are subject to computer modeling, as some are not operational or facility changes that would affect the size or placement of the noise contours. These are to be considered as initial feasible alternatives that will be further refined and combined, which will result in final recommendations. There are several Alternatives presented below which are still being evaluated. The analysis will be presented in a subsequent Working Paper. The various suggestions for noise abatement recommended by citizens and the directions contained in the County Work Plan are arranged under the appropriate broad Alternatives presented. It is anticipated and encouraged, that additional Alternatives be recommended by the Committee for evaluation.

Noise Analysis Methodology

In order to evaluate the different noise abatement alternatives, various noise metrics are presented. These metrics include the traditional DNL, as well as supplemental noise metrics to better understand the character of the noise and how that noise may change with each alternative. The following are the different acoustical measures that will be presented in this analysis. All of the data is based upon year 2006 future conditions.

Noise Contour Analysis. Noise contours for each of the alternatives have been developed. These contours present areas representative of each noise level. This illustrates how the noise may change by the change in size of the contour and the shifting of the contour from one area to another.

DNL Noise Contours. The DNL noise contours are presented in terms of the 55, 60, 65 and 70 DNL noise value. These contours are the average annual DNL noise level.

Time Above Noise Contours. Noise contours presenting the Time Above noise level are also developed. These contours present the number of minutes per day that the noise is greater than 65 dBA. The contours presented are 5, 15, 30 and 60 minutes per day contour.

Representative Receptor Analysis. To illustrate the change in noise levels in the different communities around the airport, the noise levels at representative locations around the airport have been determined. The location of these representative locations are shown in Figure G5c. A number of different noise metrics have been calculated at each of these receptor locations. Generalized levels of significance are shown for each metric. These include;

DNL Noise Level.	The DNL noise levels are presented in Table F2. Significance=1.5 dB change.
Nighttime LEQ	The nighttime LEQ noise levels are presented in Table F3. Nighttime is from 10 pm to 7 am. Significance=1.5 dB change.
Time Above 65 dBA	The Time Above noise levels are presented in Table F4. These are in terms of minutes per day above 65 dBA. Significance=10-20% change.
Maximum Noise Level	The maximum noise level is presented in Table F5. This is the maximum or peak noise level reached by the worst-case (loudest) flight at each location. It is independent of the number of flights. Significance=5 dB change.
Noise Event Count	The number of noise events at each location above a specified level is presented in Table F6. This table presents the number of events that are above 75 SEL, 80 SEL, 85 SEL, 90 SEL and 95 SEL. Significance=10-20% change.

Alternative 1-Access Restriction Based on Part 36 Standards. This Alternative would entail the modeling of a restriction ***on all Stage 2 aircraft at the airport***. It would assume that all Stage 2 aircraft, except those exempt such as military, emergency flights and state and Federal government aircraft, would be prohibited from using the airport.

Since January 2000, all Stage 2 aircraft over 75,000 pounds in the civilian fleet have been prohibited from operating in the United States. Therefore, only those civilian Stage 2 aircraft under 75,000 pounds are still operating. These generally comprise the business jet fleet. At the present time there is no phase out requirement for these aircraft. To implement such a restriction, an FAR Part 161 Study would have to be prepared. This is an expensive cost/benefit and land use study that must evaluate the cost of the restriction on the user against the benefit to the community. The cost/benefit methodology must be acceptable to the Federal Aviation Administration, the noise and land use analysis must be consistent with FAR Part 150 and there must be proper notice given prior to actual implementation of the restriction, but the FAA *does not have to approve* the restriction.

This Alternative (A1a) was modeled and the DNL contours are shown in Figure F1a, entitled *ALTERNATIVE 1A, TOTAL RESTRICTION OF STAGE 2 OPERATIONS, DNL CONTOURS* and the Time Above contours are shown in Figure F1b, entitled *ALTERNATIVE 1A, TOTAL RESTRICTION OF STAGE 2 OPERATIONS, TA CONTOURS.* The represented receptor analysis is presented in Tables F2 through F6. The results show a reduction in noise levels. However, the existing Stage 2 aircraft at the airport, Stage 2 corporate jets, are not large in number nor are they significantly louder than other aircraft at the airport.

This type of restriction is consistent with FAR Part 161 requirements concerning Stage 2 restrictions that will require FAA agreement on the cost/benefit methodology and will not require FAA approval of the restriction. The alternative assumes that these aircraft are replaced by Stage 3 corporate jets or hush kitted corporate jet aircraft. There are roughly 10 operations per day that are affected by this alternative.

A variation of this Alternative is a ban on all non-manufactured Stage 3 (in other words, no hush kitted Stage 2) aircraft or a restriction of aircraft *types.* These types of restrictions may not be acceptable to the FAA since they are discriminatory. The FAA has identified specific noise levels that qualify an aircraft to be certified as Stage 3. It does not matter whether the noise levels are achieved through the use of hush kits, new engines or manufactured to meet Stage 3 requirements. In other words, a Stage 3 aircraft is a Stage 3 aircraft, regardless of how an aircraft achieves Stage 3 compliance. To restrict certain types of Stage 3 aircraft would raise issues of discrimination, and would trigger the more restrictive Stage 3 requirements of FAR Part 161, including the requirement of FAA *approval of the proposed restriction.* Restricting aircraft by type has been litigated and has been found to be discriminatory. Because of these uncertainties and very real legal implications, these types should be carefully considered. This variation was modeled in two ways; the first was a ban on hush kitted Stage 2 or louder aircraft at night and the second was a total ban on Stage 2 or louder aircraft at all hours. This Alternative (A1b) was modeled and the DNL contours are shown in Figure F1c, entitled *ALTERNATIVE 1B, NO HUSH KITTEDOR LOUDER AIRCRAFT OPERATIONS, DNL CONTOURS* and the Time Above contours are shown in Figure F1d, entitled *ALTERNATIVE 1B, NO HUSH KITTED OR LOUDER AIRCRAFT OPERATIONS, TA CONTOURS.* The represented receptor analysis is presented in Tables F2 through F6. The results show a reduction in noise levels.

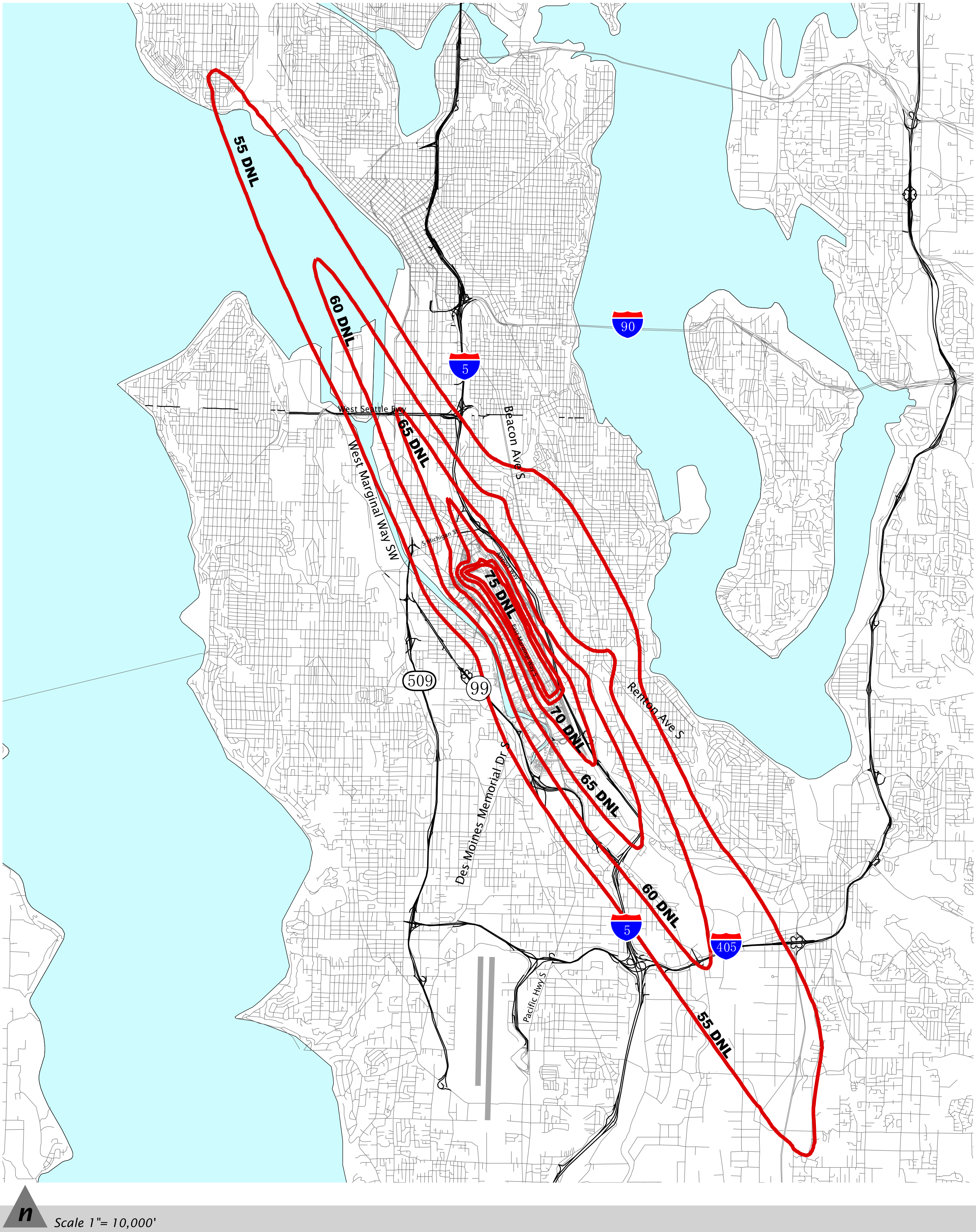

Figure F1a ***Alternative 1a, Total Restriction of Stage 2 Operations DNL Contours***

Noise Contour

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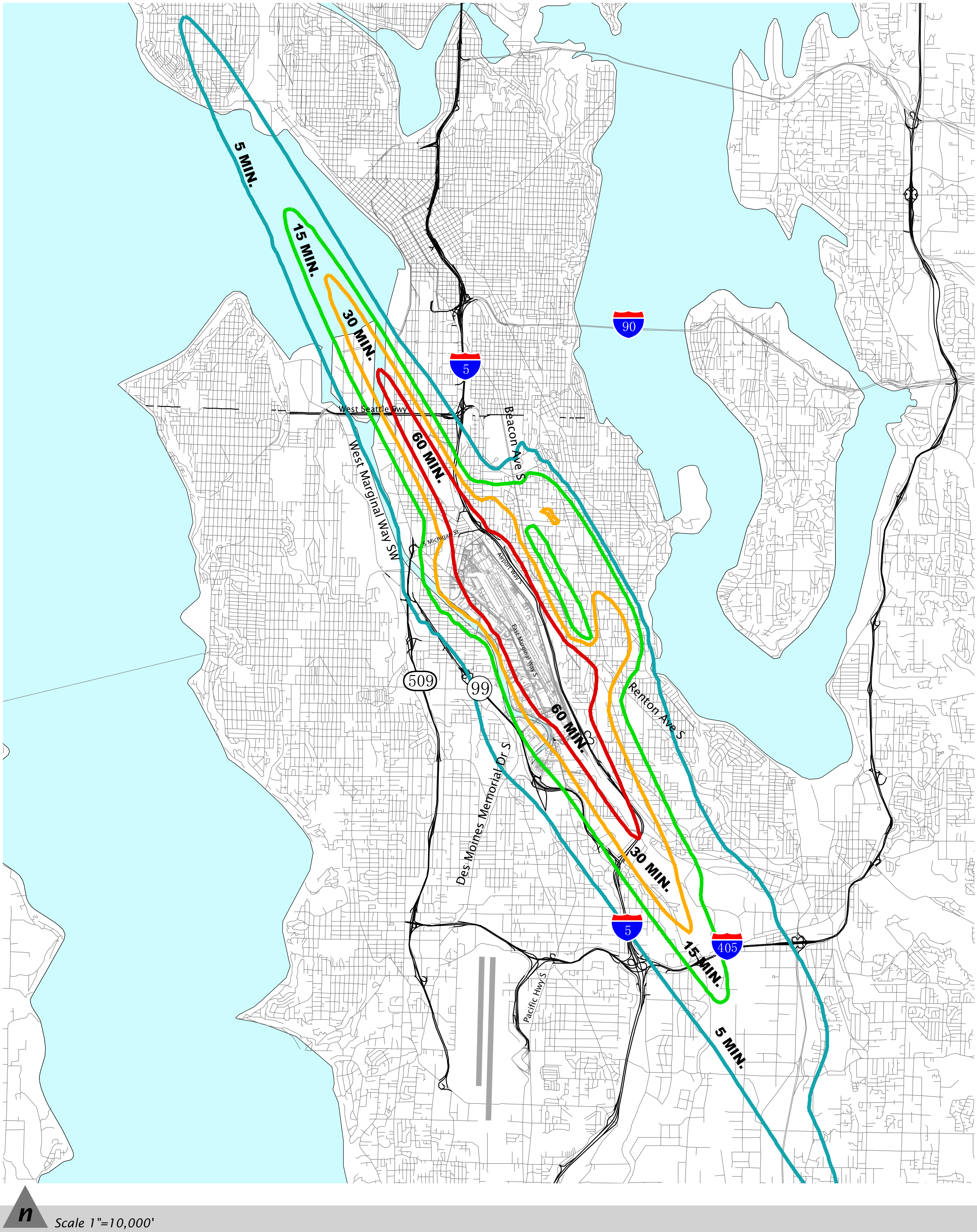

Figure F1b **Alternative 1a, Total Restriction of Stage 2 Operations TA Contours**

- 60 minutes
- 30 minutes
- 15 minutes
- 5 minutes

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FAR Part 150 Study

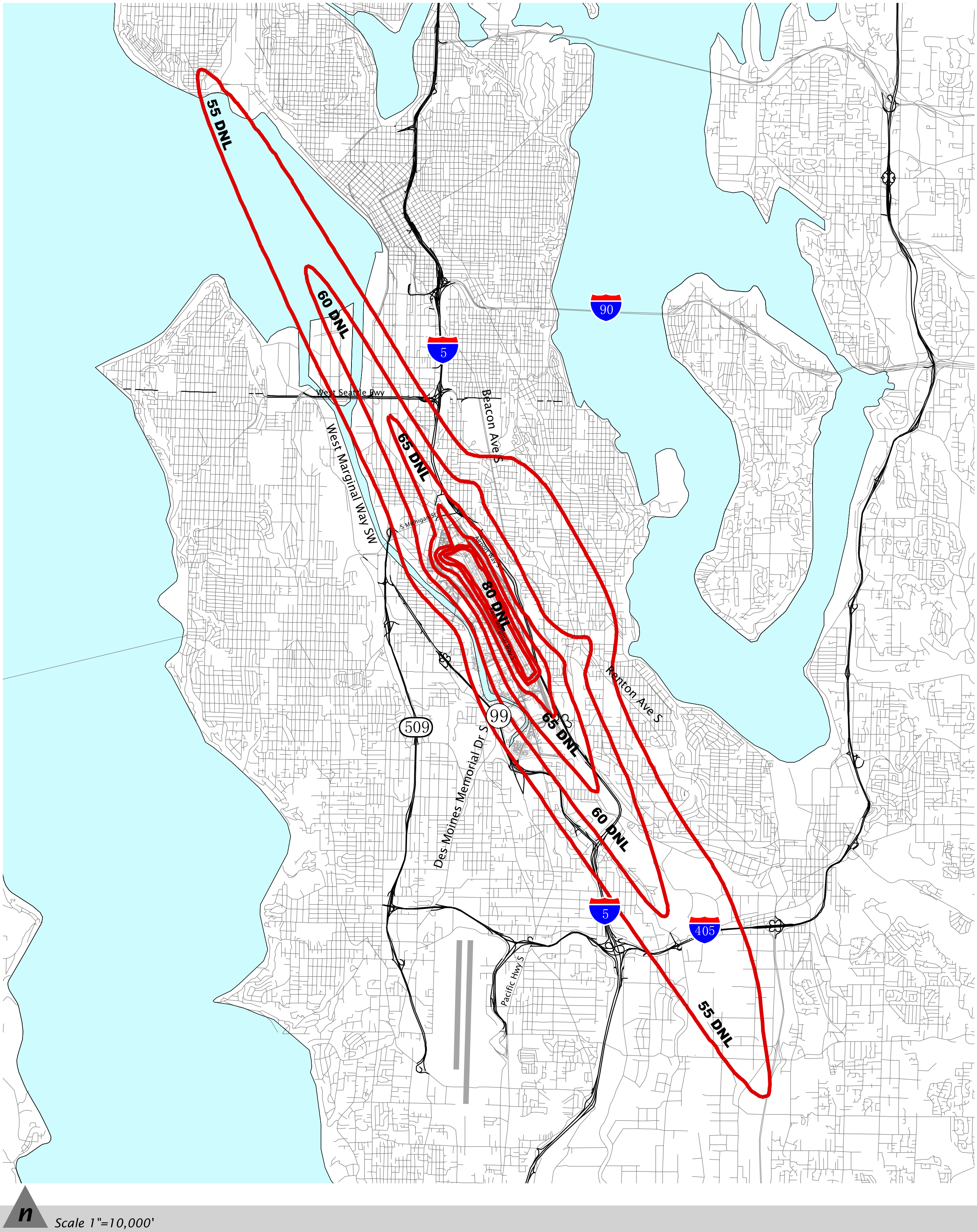
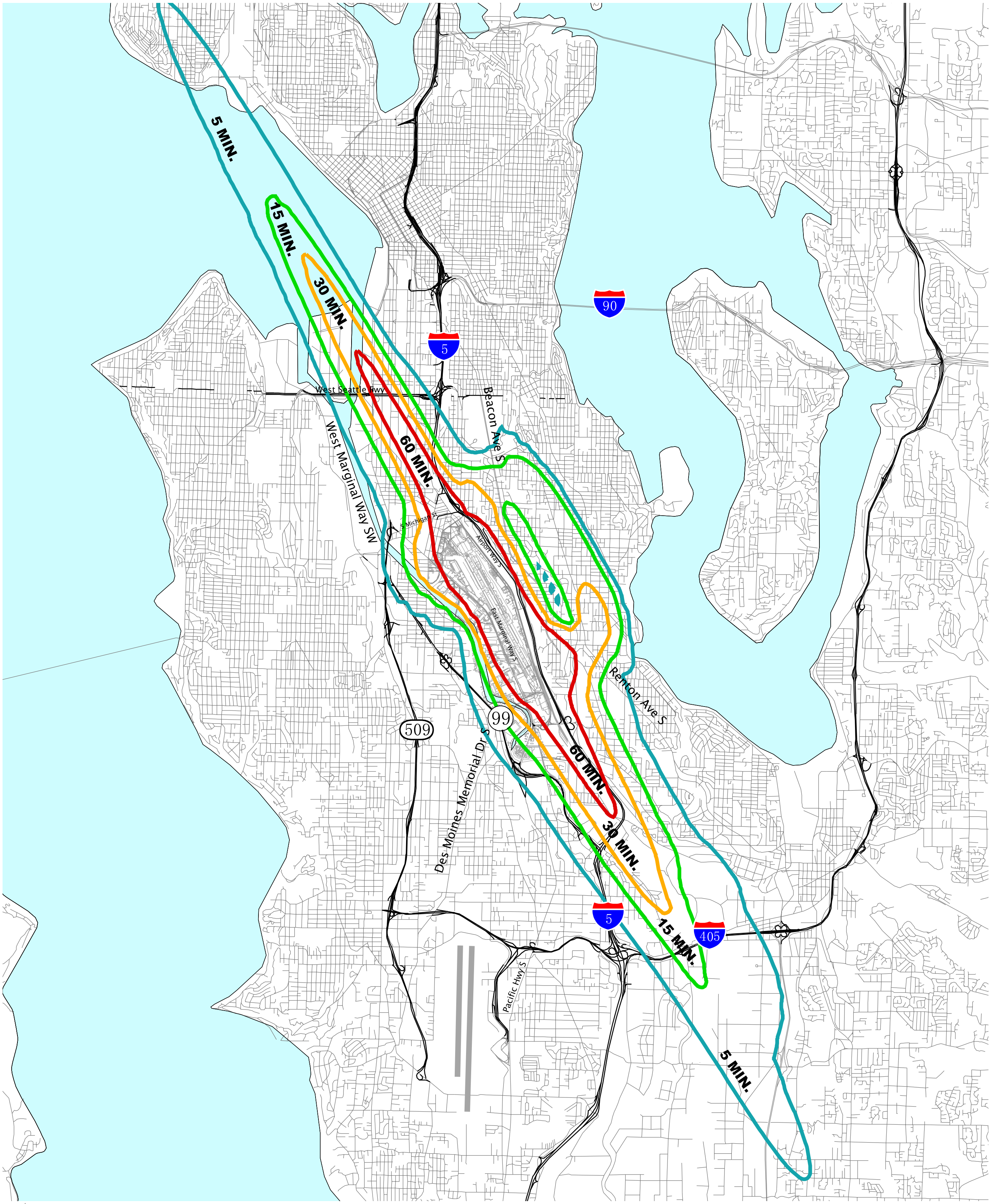


Figure F1c ***Alternative 1b, No Hush Kitted or Louder Aircraft Operations, DNL Contour***

Noise Contour

KingCounty INTERNATIONAL AIRPORT/Boeing Field FAR Part 150 Study



n Scale 1"=10,000'

Figure F1d ***Alternative 1b, No Hush Kitted or Louder Aircraft Operations, TA Contours***

- 60 minutes
- 30 minutes
- 15 minutes
- 5 minutes

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Another recommended restriction is to cap the cumulative noise levels at some acceptable and agreed upon level. With this alternative, a maximum cumulative impact (such as the total area within the existing DNL 65, 70 or 75 contour) is established as the baseline cumulative impact and then the airport's operations are adjusted or limited so as not to exceed that maximum in the future. This is accomplished through "capacity limitations", whereas either the aircraft types, based upon their "noisiness", or the numbers and mix of aircraft, are limited or adjusted so as not to exceed the identified noise impact. This has been accomplished at other airports (Sea-Tac, Jackson Hole) through the use of a "Noise Budget" or similar device where the total identified noise is allocated to different carriers and the carriers must adjust their schedule and aircraft types so as not to exceed their noise allocation, which in turn will not exceed the total allowable noise cap. This is only feasible with scheduled passenger service, due to the schedule and control that an airport could have over such carriers. It is not feasible at an airport without significant scheduled passenger service. Since King County International Airport/Boeing Field has only minimal scheduled passenger service, this Alternative should be considered carefully before implementation.

Alternative 2- Complete or Partial Curfew. This Alternative is a derivative of the previous Alternative. Instead of a total ban on Stage 2 aircraft, this Alternative would be ***to impose a nighttime restriction on Stage 2 operations***. This Alternative pertains to the nighttime hours (10 pm to 7 am, or some variation thereof) and would restrict the use of the airport during this time period to Stage 3 aircraft only. For reasons stated above, the restriction would apply only to Stage 2 aircraft, and not Stage 2 aircraft with hush kits to meet Stage 3 criteria. The restriction would be written to include only those aircraft less than 75,000 pounds and would also require the preparation of an FAR Part 161 Study. As stated in the previous section, the implementation and enforcement of such an ordinance, known as an access restriction, would require the preparation of a cost/benefit study known as an FAR Part 161 Study. Such a study identifies the costs and benefits that would result from the implementation of such a restriction. The cost/benefit methodology must be acceptable to the Federal Aviation Administration, the noise and land use analysis must be consistent with FAR Part 150 and there must be proper notice given prior to actual implementation of the restriction, but the FAA *does not have to approve* the restriction. This is a very costly and time consuming study, which is only eligible for FAA funding participation if it is included as a recommendation in an FAR Part 150 Study. However, since it is just a partial curfew, it maybe easier to implement. A partial curfew may not generate the same conflicts as a total ban on Stage 2 aircraft and may result in a better cost/benefit analysis. The alternative assumes that these aircraft are replaced by Stage 3 corporate jets or hush kitted corporate jet aircraft. There are 1.3 nighttime Stage 2 corporate jet operations per day that are affected by this alternative.

This Alternative (A2a) has been modeled and the DNL contours are shown in Figure F2a, entitled *ALTERNATIVE 2A, NIGHTTIME RESTRICTION OF STAGE 2 OPERATIONS, DNL CONTOURS* and the Time Above contours are shown in Figure F2b, entitled *ALTERNATIVE 2A, NIGHTTIME RESTRICTION OF STAGE 2 OPERATIONS, TA CONTOURS.* The represented receptor analysis is presented in Tables F2 through F6. The results show a reduction in the nighttime noise and overall noise levels. This reduction is less than shown for Alternative One.

Another variation of this Alternative is to ban only hush kitted Stage 2 aircraft at night. This Alternative (A2b) was modeled and the DNL contours are shown in Figure F2c, entitled *ALTERNATIVE 2B, NO HUSH KITTED OR LOUDER OPERATIONS AT NIGHT, DNL CONTOURS* and the Time Above contours are shown in Figure F2d, entitled *ALTERNATIVE 2B, NO HUSH KITTED OR LOUDER OPERATIONS, TA CONTOURS.* The represented receptor analysis is presented in Tables F2 through F6.

A third variation of this Alternative is a total ban of all aircraft at night. This Alternative (A2c) was modeled and the DNL contours are shown in Figure F2e, entitled *ALTERNATIVE 2C, TOTAL RESTRICTION OF NIGHT OPERATIONS, DNL CONTOURS* and the Time Above contours are shown in Figure F2f, entitled *ALTERNATIVE 2C, TOTAL RESTRICTION OF NIGHT OPERATIONS, TA CONTOURS.* The represented receptor analysis is presented in Tables F2 through F6. The results show a reduction in noise levels. However, the existing Stage 2 aircraft at the airport, Stage 2 corporate jets, are not large in number nor are they significantly louder than other aircraft at the airport.

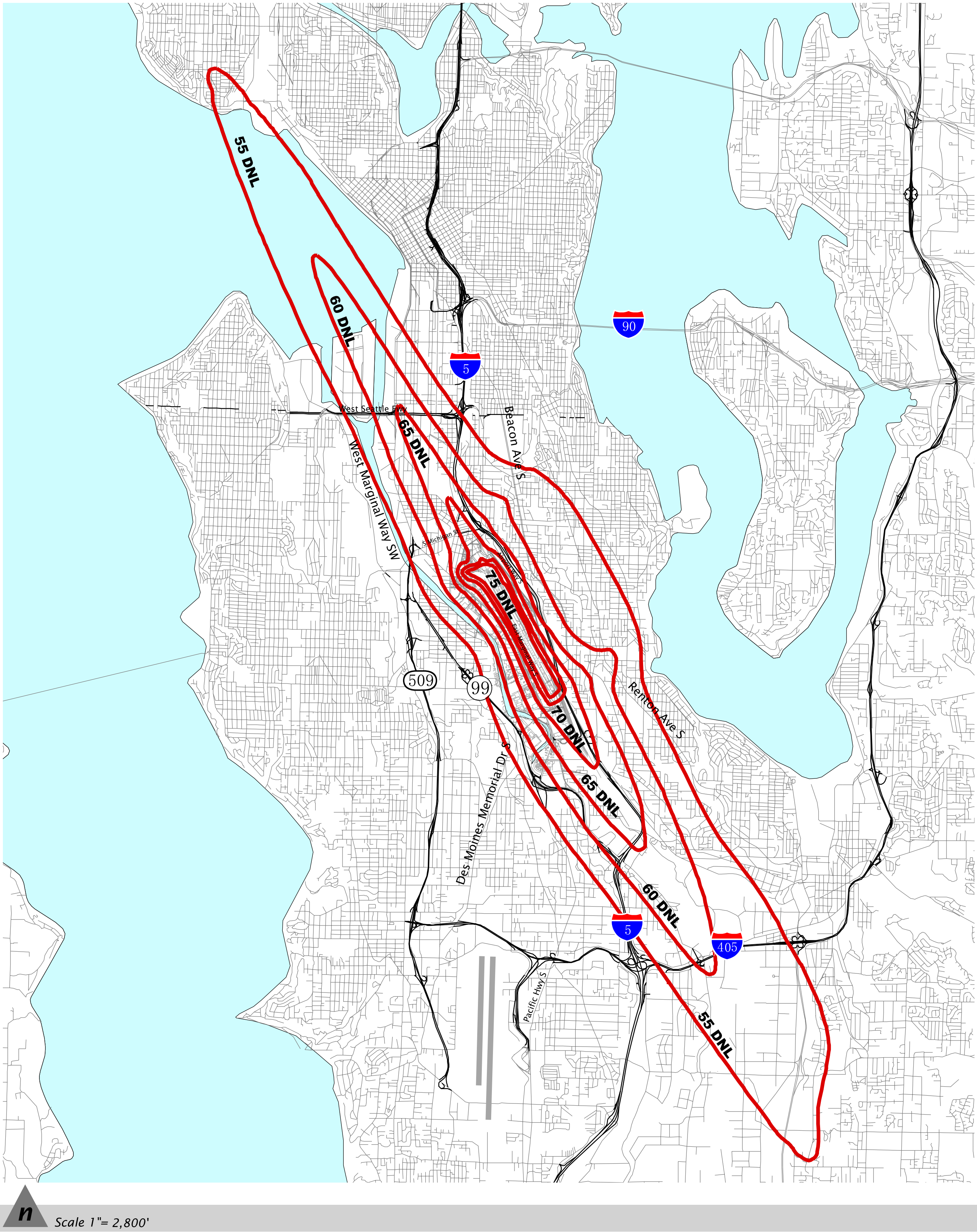

Figure F2a ***Alternative 2a, Nightime Restriction of Stage 2 Operations DNL Contours***

Noise Contour

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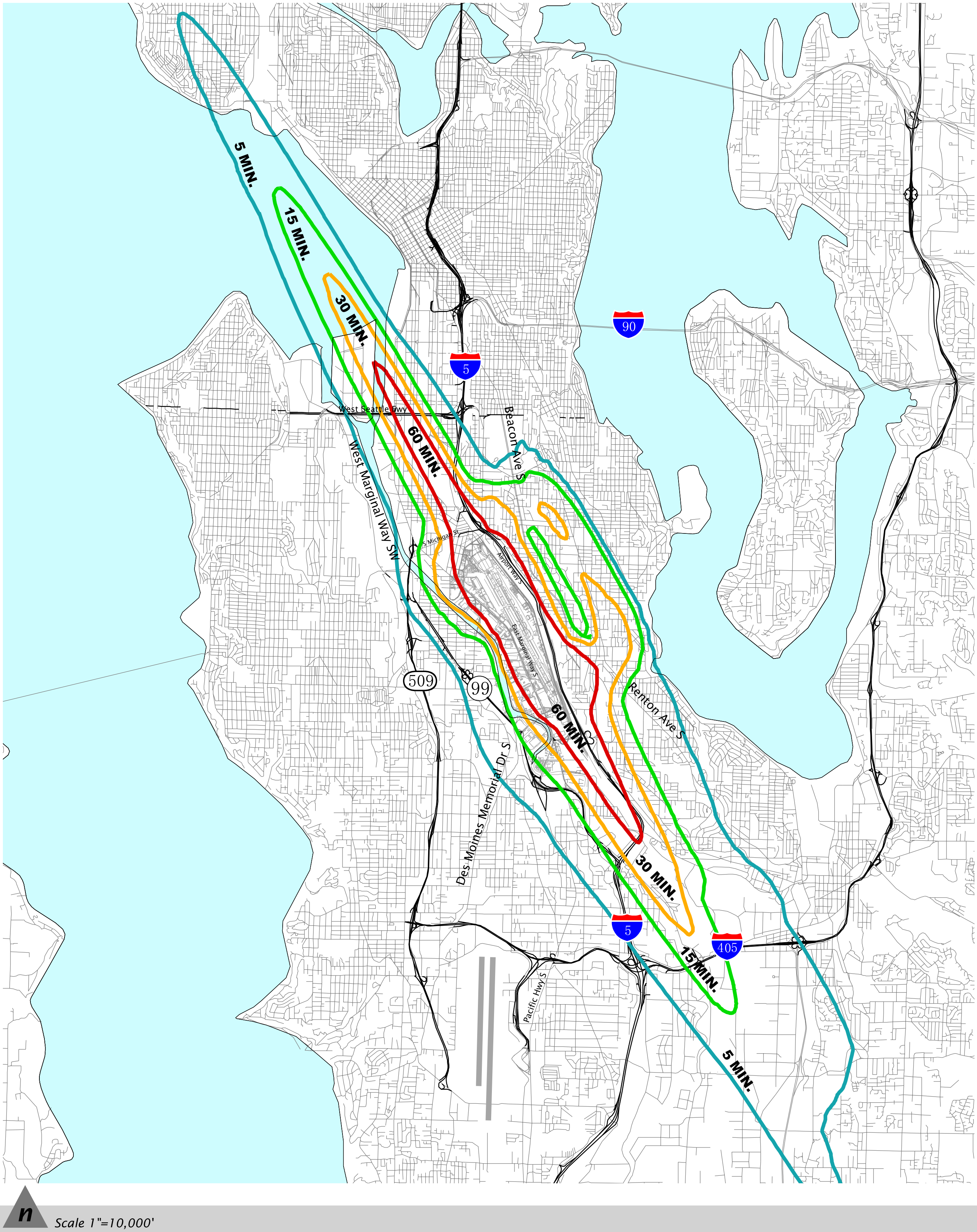

Figure F2b **Alternative 2a, Nightime Restriction of Stage 2 Operations TA Contours**

- 60 minutes
- 30 minutes
- 15 minutes
- 5 minutes

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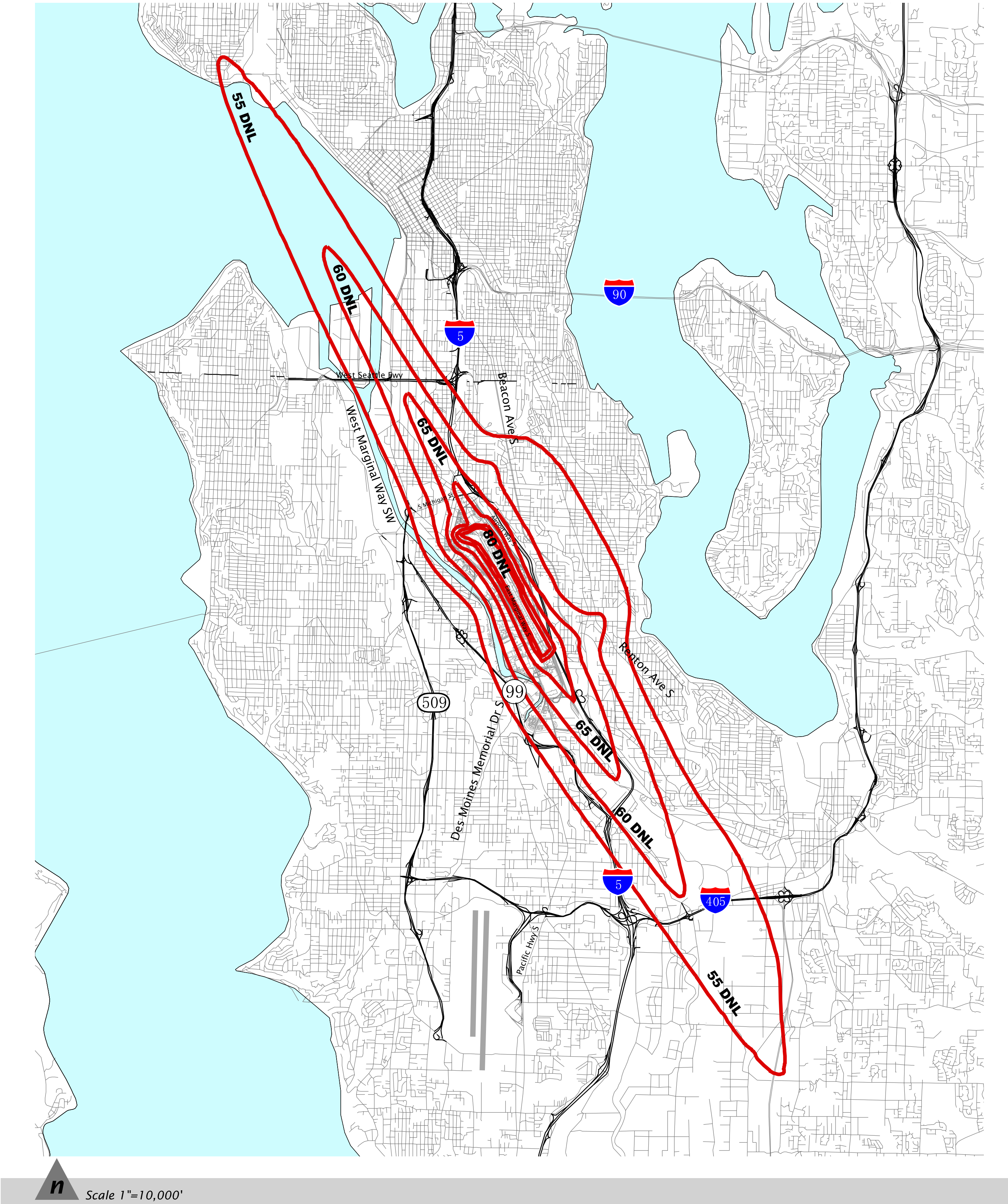
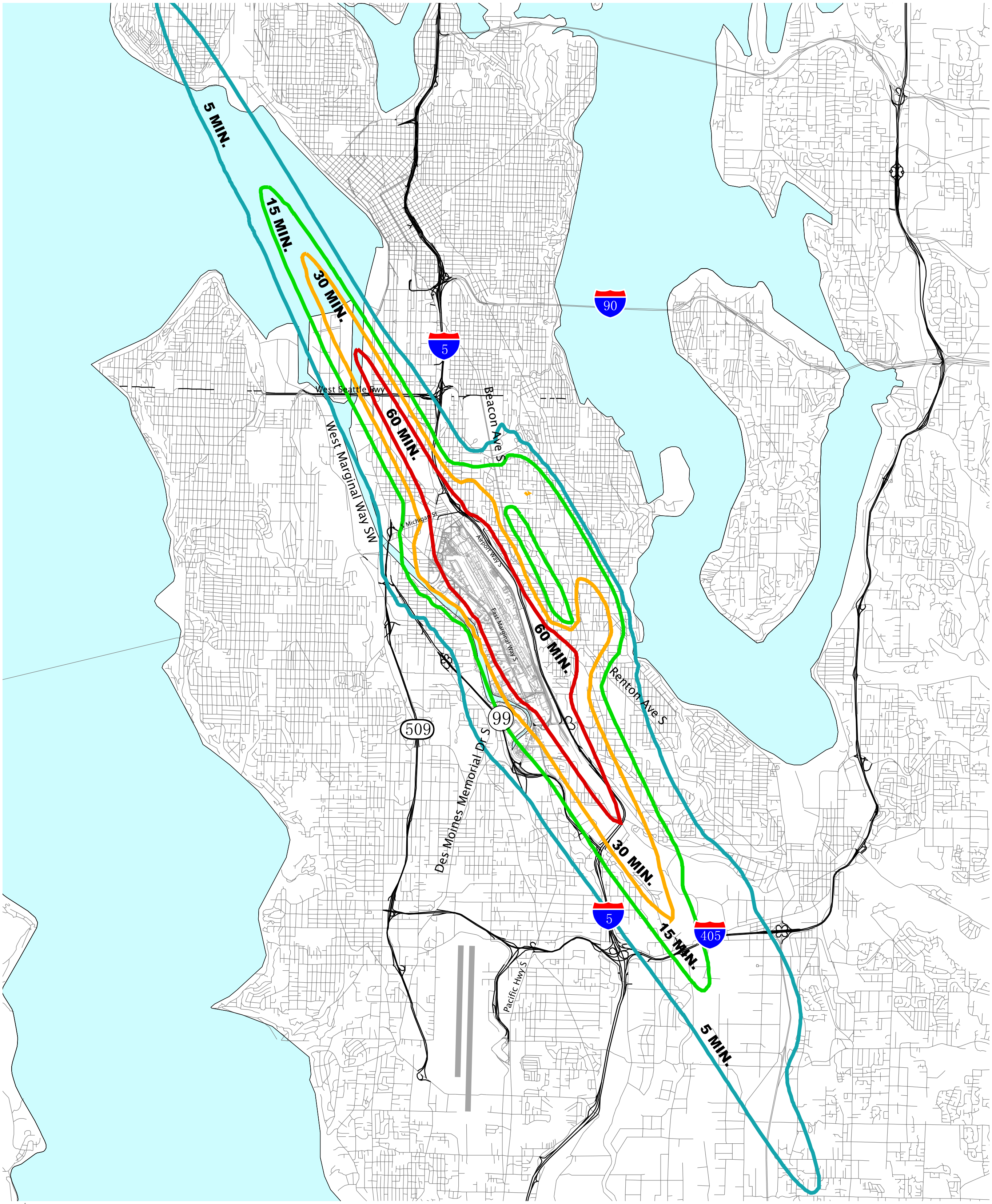


Figure F2c ***Alternative 2b, Restriction of Hush Kitted or Louder Operations At Night, DNL Contours***

Noise Contour

King County INTERNATIONAL AIRPORT/Boeing Field FAR Part 150 Study



Scale 1"=10,000'

Figure F2d ***Alternative 2b, Restriction of Hush Kitted or Louder Operations At Night, TA Contours***

- 60 minutes
- 30 minutes
- 15 minutes
- 5 minutes

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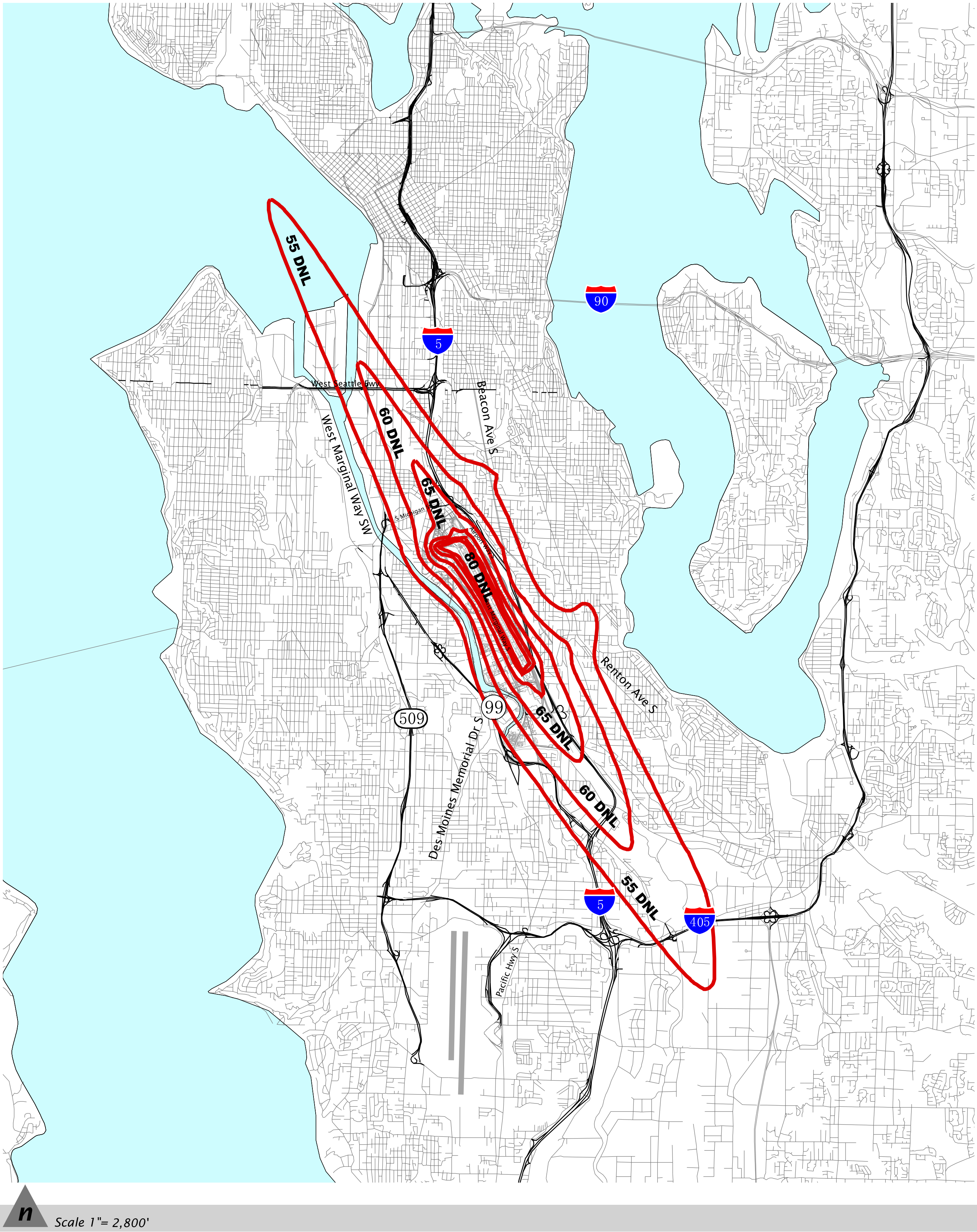

Figure F2e ***Alternative 2c, Total Restriction of Night Operations, DNL Contours***

Noise Contour

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FAR Part 150 Study

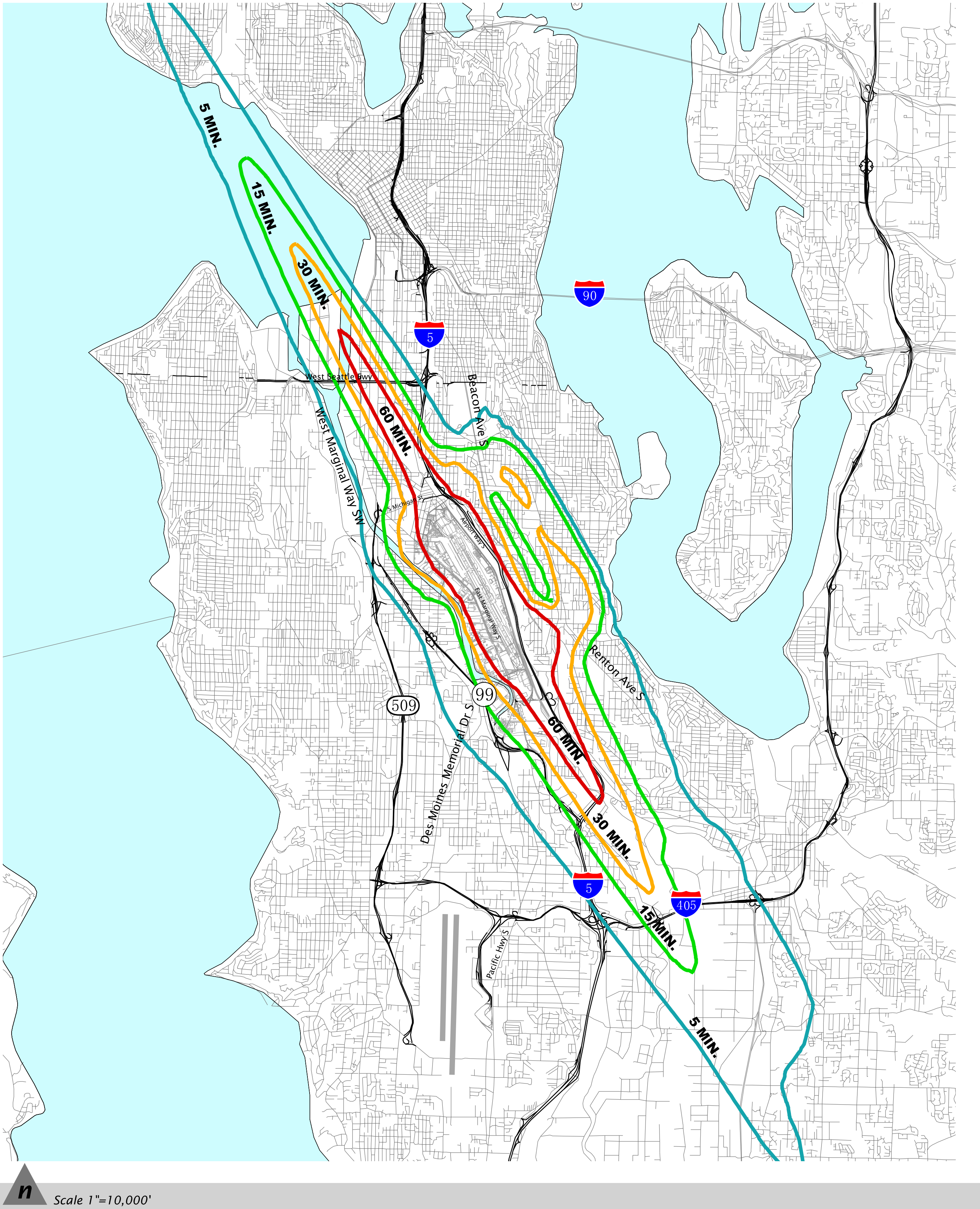


Figure F2f *Alternative 2c, Total Restriction of Night Operations, TA Contours*

- 60 minutes
- 30 minutes
- 15 minutes
- 5 minutes

King County INTERNATIONAL AIRPORT/Boeing Field FAR Part 150 Study

Alternative 3-Noise Barrier/Ground Run-up Enclosure. This Alternative is to evaluate the need and placement of a Ground Run-up Enclosure at the airport. Such a facility would be used for maintenance and testing of engines so that they would take place in a facility designed to reduce noise levels associated with such operations. The sizing, placement and direction of such a facility is very important, as they are very site and aircraft specific. In addition, the use of barriers along the perimeter of the airport will be evaluated and recommended, as necessary, for implementation.

Background on Aircraft Run-up Noise

Introduction. Noise associated with jet aircraft maintenance run-ups is a major issue of concern to the citizens living near King County International Airport. Engine run-ups that occur during the daytime and evening can result in significant noise levels and complaints from citizens in communities near the airport. The extent of the noise problem from run-ups is difficult to quantify because of the random nature of maintenance run-ups and the large variability in the noise levels that are generated by these run-ups.

Sources of Run-ups. There are three basic sources of run-ups that occur at the airport. These are all from jet aircraft. Run-ups from other types of aircraft occur less often and generate lower noise levels than occur with jet aircraft. Each of the general categories of sources aircraft run-ups are listed below:

- Airline (cargo) Maintenance
- Boeing Aircraft Corporation Maintenance
- General Aviation Maintenance

Airline (cargo) Maintenance. Cargo carriers must occasionally complete maintenance repair on aircraft. For certain types of maintenance, the aircraft must conduct an engine run-up in order to demonstrate that the aircraft's in-flight systems are working properly. The only type of airline maintenance work at KCIA is unscheduled special repairs associated with cargo aircraft. The unscheduled special repair is a maintenance repair on aircraft that are in service and require preflight repair. Of the aircraft that require some type of service, 10% are estimated to require maintenance that will include an engine run-up. Most of these run-ups are conducted at less than full power. An estimated 20% of all maintenance run-ups require a full power run-up. All cargo carriers operating at KCIA will occasionally need this type of maintenance. Because of the small number of cargo only carriers that at operate at KCIA and because there are no maintenance facilities at the airport for these airlines, very little maintenance work is done at this airport.

Boeing Aircraft Corporation Maintenance. As part of the overall procedure on aircraft being prepared for delivery, Boeing conducts run-up tests on the engines. However, these runs are typically done at the airport where the aircraft is assembled, not KCIA. The run-ups that occur at KCIA are related to special projects that can be summarized as follows;

- Run-ups for aircraft returning to service from storage
- Normal cycle run-ups after repairs for evaluation

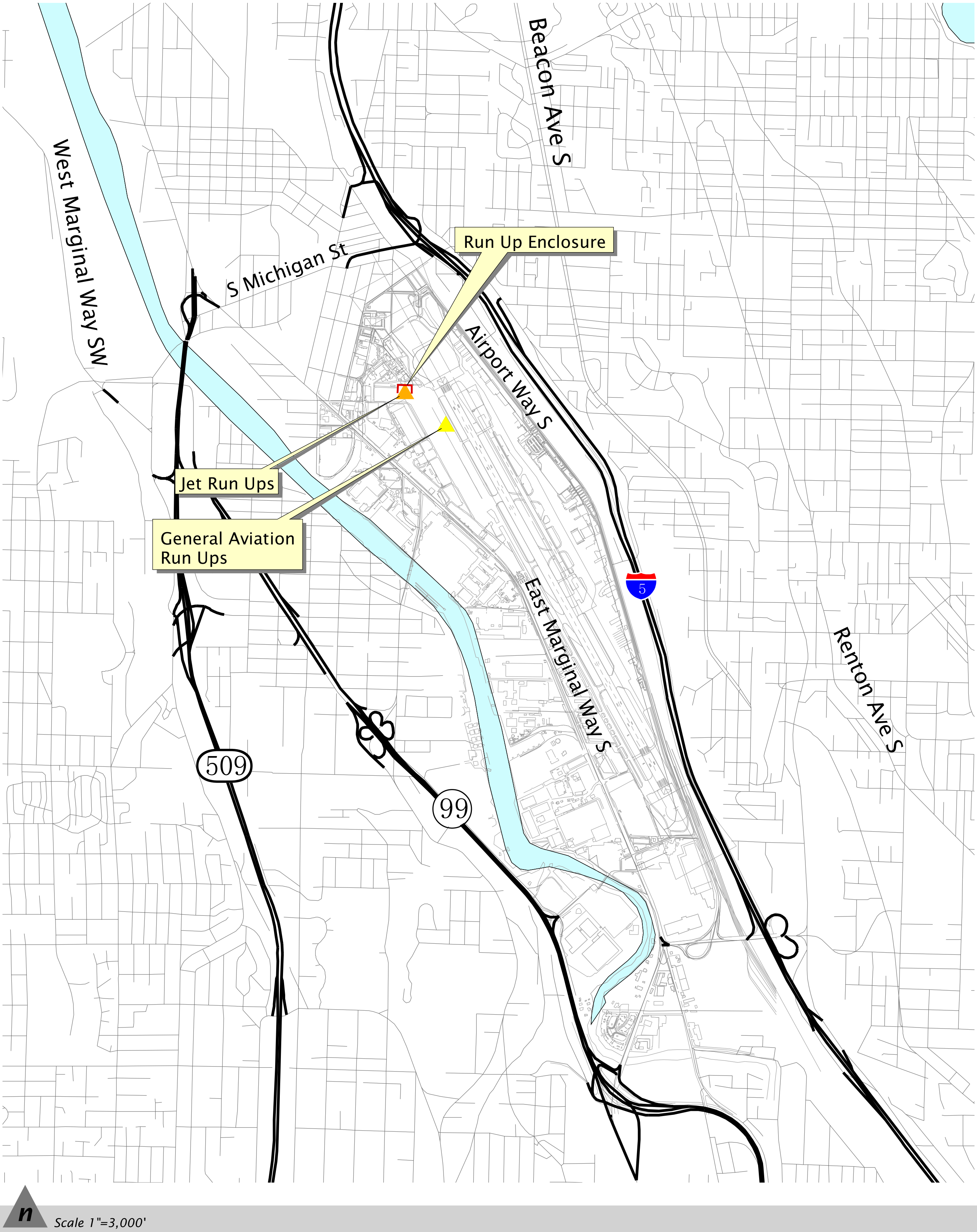
- Fan balancing run-ups

Run-ups are normally required after aircraft have been in storage for some period and returned to service in order to ensure all engine systems are functioning properly. Run-up operations can take several minutes to complete to allow a thorough inspection of all mechanical and electrical systems. Normal cycle run-ups that are completed after special repairs are conducted as evaluation tests on aircraft. Fan Balancing run-ups are runs to test and ensure that an engine fan is balanced properly.

General Aviation Maintenance at KCIA. General Aviation aircraft must also occasionally complete maintenance repair on aircraft. The types of general aviation maintenance work at KCIA are scheduled and unscheduled special repairs. Most of these run-ups are conducted at less than full power. The maintenance work will be completed by one of the local FBOs. This will include a wide variety of aircraft including corporate jets, turbo props and piston aircraft. The aircraft with the greatest potential for generating noise off-airport are the corporate jet aircraft. There are also a wide variety of corporate jet aircraft types that may conduct run-ups at KCIA.

King County International Airport Regulations. King County has regulations concerning the time of aircraft run-ups. All run-ups must be conducted during the hours of 7 am to 10 pm. No run-up can occur during the nighttime hours.

Run-up Locations: The run-up locations are not specifically delineated. However, there are two primary locations where the run-ups occur. The commercial aircraft run-up operations take place on the Boeing Company apron (Apron 1) located west of the north end of Runway 13R-31L. General Aviation and cargo run-ups take place toward the north end of Taxiway B on the west side of Runway 13R-31L. Locations are presented in Figure F3a.



Scale 1"=3,000'

Figure F3a ***Run Up Locations***

Run-up Procedures. A typical run-up at KCIA starts with the maintenance personnel notifying the tower of the run-up and in the case of general aviation or airlines, then contacting the Tower for permission to taxi to the run-up location. Once the aircraft has reached this position, the brakes are set and the maintenance personnel start the engine run. The type of run-up varies widely depending upon the type of repairs that have been completed. Each airline has manuals that describe the specific procedure for the run-up that must be followed as part of the test. Most maintenance runs last less than 20 minutes at power levels ranging from idle to below 80%. A number of maintenance repairs require a run-up at full power. Full power runs usually last five minutes or less. Some procedures require several full power runs conducted intermittently over a long period of time. Occasionally, a specific test does require a run-up at full power that lasts longer than 10 minutes.

Details of Run-ups. The number of run-ups, aircraft types, power levels and durations that occur at KCIA has been estimated based upon conversations with Boeing Aircraft Corporation and operators at the airport. These operations are summarized below:

> The normal cycle operations include operating the engines at idle power. These operations are conducted by the B-737, B-747, and B-757 series of aircraft and typically last from fifteen (15) to thirty (30) minutes. Currently Boeing conducts about eight (8) normal cycle run-ups per month that are thirty minutes in duration, half of which involve B-737 aircraft and the other half involve B-757 aircraft.
>
> Boeing also conducts an estimated four (4) normal cycle run-ups per month that are fifteen minutes in duration and these involve the B-737, B-747, and B-757 aircraft. In the past the number of these run-ups was higher. The run-up operations at King County International Airport would be conducted by any of the several types of commercial aircraft being prepared for delivery, including the B-737, B-747, and B-757 series of aircraft.
>
> The Boeing fan balancing run-up operations consist of cycling the engines from idle power up to full power and back to idle power. These types of operations can last up to about seventy-five (75) minutes and during these types of run-ups, the engine will be at full power for approximately 20% of the time with a number of cycles to full power. An estimated two (2) fan balancing run-ups occur per month. These run-ups have the greatest potential for impacting the nearby communities.
>
> Corporate jet aircraft also must complete engine maintenance run-ups as with any other commercial jet aircraft. These run-ups may involve scheduled or unscheduled maintenance on the aircraft. Heavy maintenance is not done at KCIA. The majority of these run-ups would be at idle power, however about 20% may be at full power. For this type of operation, the engines are brought up to full power while all of the required systems are checked for proper operation. These types of run-ups will last about five to 20 minutes. There are an estimated three (3) run-ups per month.
>
> Run-ups by airlines such as the cargo operators are rare. There are no maintenance facilities for these airlines at KCIA. It would only be necessary for an unscheduled repair that had to be completed prior to putting an aircraft back

into service. The majority of these run-ups would be at idle power. The exact number of these run-ups is not know, but is believed to be less than 1 per every 3 months.

Time of Day of Run-ups. There are no exact data as to the time of day that run-ups occur at KCIA. The regulations restrict these run-ups to daytime hours (7 am to 10 pm). The majority of the run-ups are thought to occur from 7 am to 4 pm.

Noise Complaints from Run-ups. Noise complaints from run-ups do occur. Although not specifically categorized, airport staff reports that the complaints from run-ups are lower today than in the past. Some forms of run-up noise are very difficult to distinguish from other sources of aircraft noise on the airport. Many complaints from run-ups may be as a result of other sources of aircraft noise.

Noise Characteristics of Run-ups

Overview. Noise from aircraft engine run-ups has varying characteristics depending upon the type of run-up procedure, the power level, the engine type and the orientation of the plane. Full power run-ups present the greatest potential for noise impacts. The characteristics of engine run-up noise are summarized below:

- Varying duration noise events that can last many minutes.
- Quick onset and drop-off of the noise.
- Dominate low-frequency characteristics that attenuate slowly.
- Magnitude of the noise is similar to departure ground roll.
- Some run-ups include a number of cycles of full power.
- Greatest potential for impact is sideline to the airport and near the Boeing plant.

Direction and Frequency Characteristics of Run-up Noise. Two important factors to be considered in the evaluation of aircraft run-up noise are the direction and frequency characteristics of the engine run-up noise. These factors influence the location of the noise impact and the potential for mitigation.

Noise generated from engine run-ups is not equally distributed in all directions. The noise levels increase with power. The noise levels under full power are significantly greater than under lower power levels. Under idle and 80% power, the noise levels are approximately equal in all directions. At full power, the noise levels are significantly greater toward the rear of the aircraft at angles of approximately 150 and 210 degrees back from the front of the plane.

A second important aspect of the impacts from run-up noise is that the frequency characteristics of the noise are not equal in all directions. There are frequency differences between the front of the aircraft and the rear of the aircraft. The noise from the front of the aircraft is dominated by high-frequency fan and compressor noise. The noise from the rear part of the aircraft is dominated by low-frequency combustor noise and turbulence mixing.

Run-up Contours. Of all the commercial aircraft types the loudest would probably be the B747-400. Noise contour plots were calculated for the B747-400. There are several types of corporate jets that utilize King County International Airport. One of the loudest corporate jets would be the Gulfstream II, which is one of the older general aviation jets that uses the lower bypass ratio engines. As a worst case, this type of aircraft was used to show the loudest levels generated by corporate jet run-up operations.

BridgeNet International has developed custom software specifically for calculating the noise levels generated by stationary aircraft operating under various power settings. The software is also designed to calculate the effect of a noise barrier, or a run-up enclosure. Noise contours from this noise model will be used to assess the potential impact to the adjacent noise sensitive land uses.

The B-747 aircraft was modeled as if it was located at the north end of the Boeing company apron (Apron 1), with a heading of 180 degrees, which is consistent with the primary wind conditions at the airport. The engines were modeled as one engine operating at take-off power and a second engine at a balancing power of 80%. The corporate jet was modeled as if located on Taxiway B with a heading of 130 degrees, and the engines were modeled as operating at take-off power.

The unmitigated noise levels generated by the B747-400 were calculated and the results are shown in Figure F3b as contours of equal loudness. The exhibit shows the location of the unmitigated 65 dB, 70 dB, 75 dB, 80 dB, and 85 dBA maximum noise level contours for the proposed run-up operations. These contours do not take into account the existing buildings or hangars located at this end of the airport.

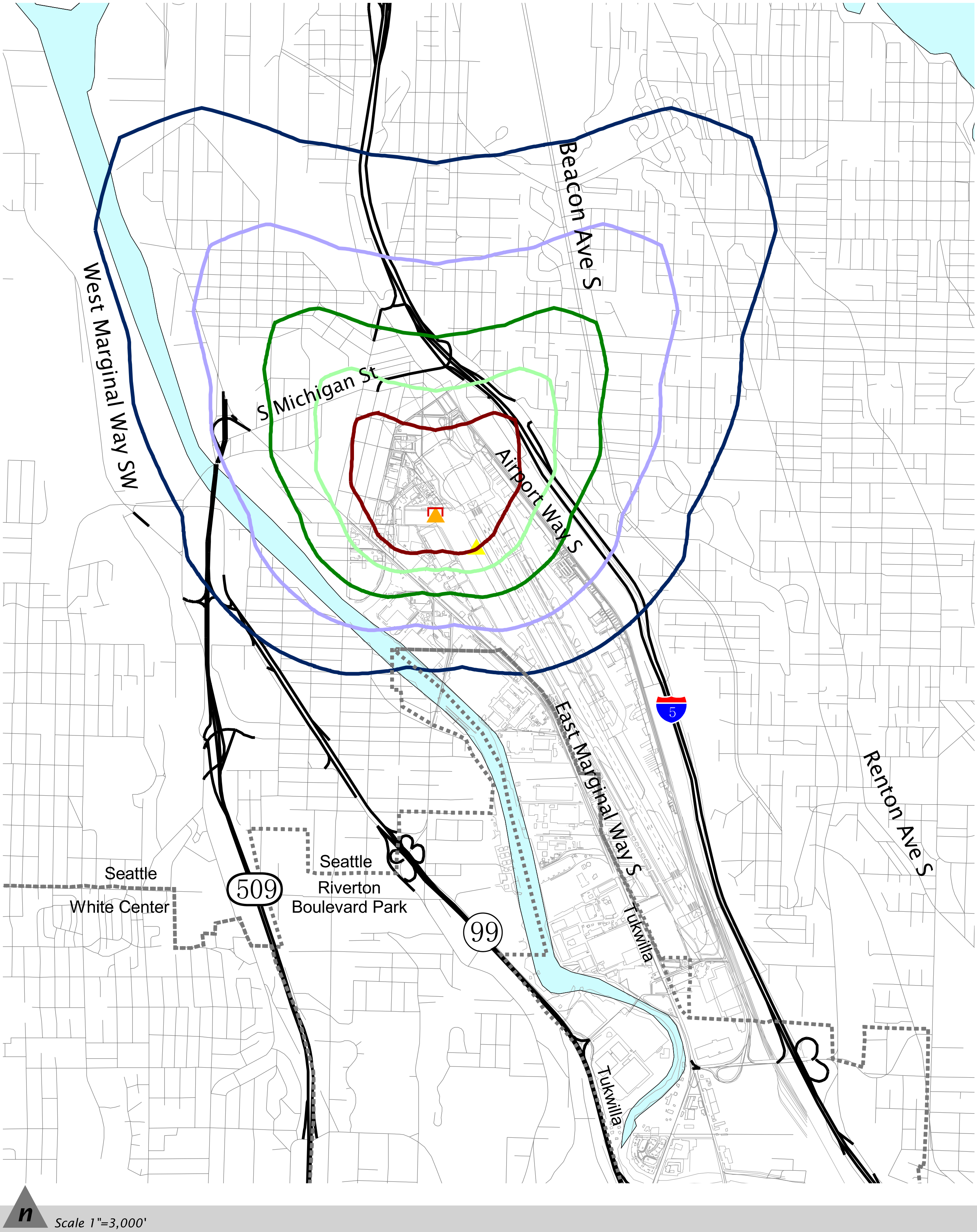


Figure F3b ***Run Up Noise Contours B 747 Non-Mitigated***

- 65 DBA
- 70 DBA
- 75 DBA
- 80 DBA
- 85 DBA

The unmitigated noise levels generated by the GII were calculated and the results are shown in Figure F3c as contours of equal loudness. The exhibit shows the location of the unmitigated 65 dB, 70 dB, 75 dB, 80 dB, and 85 dBA maximum noise level contours for the proposed run-up operations. These contours do not take into account the existing buildings or hangars located at this end of the airport.

The unmitigated noise levels generated from both the B-747 and the G II at full power are significant. The greatest amount of noise coming from a jet engine is produced by the turbulence between the high velocity exhaust gases exiting the engine and the low velocity static air surrounding the engine. This turbulence is most significant at a location normally between 30 and 45 degrees off the rear centerline of the aircraft.

Run-up noise that is predominately daytime usually does not alter the DNL noise contour level. DNL is more dominated by aircraft overflight noise. Because run-ups are less frequent than overflights so they do not have as great of an affect on the DNL contour. Mitigating run-up noise is more design to reduce single event disturbance, and not DNL.

Airports with GREs, generally require that the facility be used for all run-ups as much as possible. The only limitation on that requirement is that the wind conditions must be suitable for use of a GRE (because of aerodynamics, GREs can not be used under all conditions). When there are the need for more than one aircraft run-up at a time, then that is accommodated on a first come first serve basis. Usually there is a time limit as well, such as 1 hour.

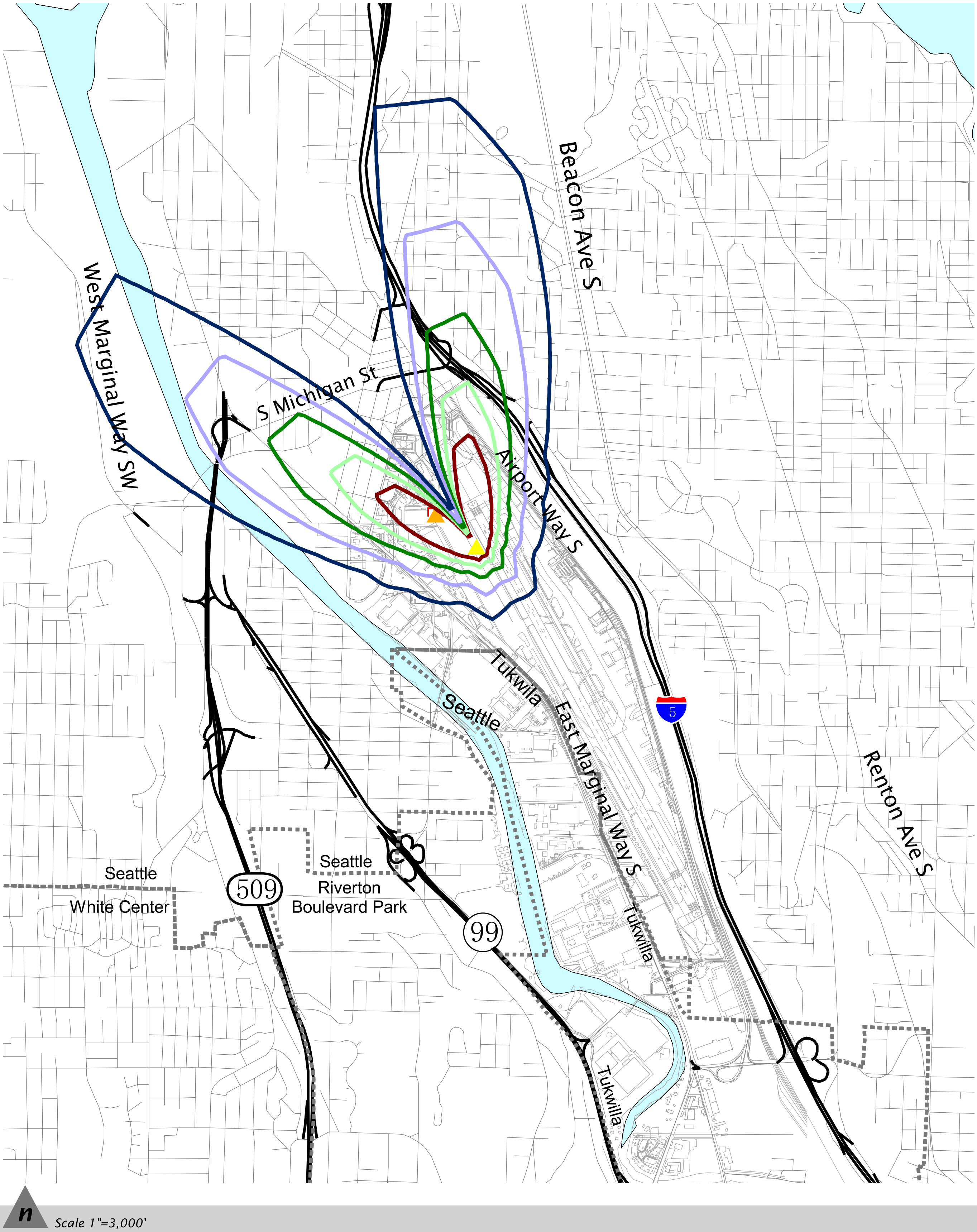


Figure F3c ***Run Up Noise Contours GII Un-Mitigated***

- 65 DBA
- 70 DBA
- 75 DBA
- 80 DBA
- 85 DBA

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Run-Up Noise Summary

The following summary presents some of the findings concerning noise impacts from run-up noise from jet aircraft at KCIA.

- Aircraft run-ups can generate a wide range of noise levels. Important factors affecting noise levels are the type of aircraft, the level of power of the run-up, and the meteorological conditions.
- Low-frequency noise from the aft portion of the aircraft is the greatest impact from run-up noise. This is critical because low-frequency noise: (1) is the most difficult to mitigate with a barrier, (2) has the lowest atmospheric absorption rate, and (3) more easily penetrates the interior of building structures.
- The potential of impacts from aircraft run-ups are greatest for the full (*takeoff*) power runs. Run-ups at lower power levels generate significantly less noise.
- Long duration run-ups may often include a number of high power cycles that increase the annoyance and impact from the run-ups.
- A significant portion of the run-ups at KCIA are by Boeing Corporation aircraft. The number of run-ups per year varies widely depending upon special projects that may occur at the airport. Currently the number of run-ups are lower averaging an estimated 15 per month.

Run-up Noise Attenuation.

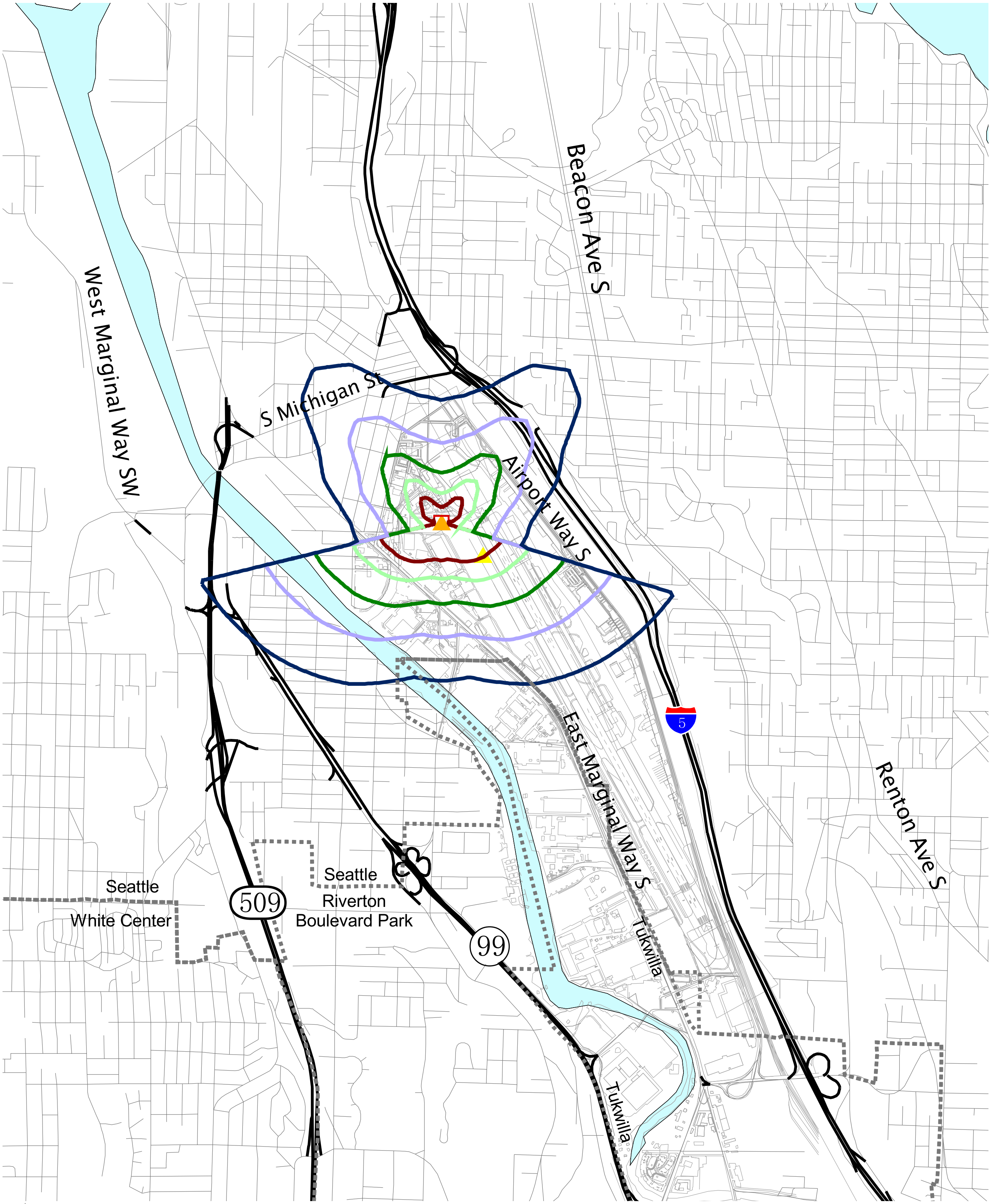
The most effective method of reducing the noise from stationary aircraft is with the use of either a barrier or an enclosure. The effectiveness of a complete enclosure is dependent upon several factors such as location and orientation. The location must be such that the aircraft can be either taxied or towed easily in and out of the structure. The enclosure must also be properly oriented in order to allow proper airflow into the engines and to be most effective in reducing noise sensitive land uses most heavily impacted by the noise.

The run-up enclosure was modeled as if located at the north end of the Boeing company apron (Apron 1) with the back of the enclosure parallel to the north property line. The proximity to the apron where the aircraft are serviced would allow fairly easy access into and out of the enclosure. This location also allows for the enclosure to be opened to the south that will allow unrestricted airflow into the aircraft engines for the predominant wind direction of the airport.

The ground run-up enclosure was modeled to be 300 feet wide, which is sufficient to accommodate the wingspan of a B747-400 aircraft. The sidewalls were estimated to be 180 feet long, which is sufficient to provide mitigation from engine noise while allowing access around the front of the enclosure. The height of all three sides of the enclosure was modeled as 45 feet high.

The aircraft was modeled backed into the structure with the tail located about 20 feet from the rear wall. The mitigated noise levels generated by the B747-400 were calculated and the results are shown in Figure F3d as contours of equal loudness. The exhibit shows the location of the mitigated 65 dB, 70 dB, 75 dB, 80 dB, and 85 dBA maximum noise level contours for the proposed run-up operations. These contours take into account the mitigation effects of the run-up enclosure only, but do not take into account the effect of any existing buildings or hangars located at this end of the airport.

The figure shows that under these conditions, the noise level reduction of a three-sided enclosure will provide about 15 dB of noise reduction. This level of reduction is based only upon the shielding characteristics of the perimeter walls. In addition, no airfield evaluation was conducted as to the actual availability of the modeled site for accommodation of such an enclosure. Additional information concerning Ground Run-up Enclosures in contained in the Appendix.



n Scale 1"=3,000'

Figure F3d ***Run Up Noise Contours***
B 747 Mitigated

65 DBA
70 DBA
75 DBA
80 DBA
85 DBA

Alternative 4-Acquisition of Land or An Interest Therein. This Alternative will evaluate the feasibility of sound attenuation for noise sensitive uses within both the 65 and 60 DNL noise contours. Noise sensitive uses (residences, schools, religious facilities, hospitals) within the 65 and greater DNL noise contours are eligible for Federal funding participation for sound attenuation to reduce inside noise levels. However, the County has determined that this Study should go beyond the Federal guidelines and eligibility requirements, by evaluating the feasibility of sound attenuating residential uses within the 60 DNL noise contour. Thus this Alternative will evaluate and consider the sound attenuation of residences within both 60 DNL contour as well as the 65 DNL and greater contours. This will be evaluated based on the number of residences within those contours and generalized costs of sound attenuation. As a requirement for sound attenuation, the County would receive an avigation easement as consideration. In addition, land acquisition will be evaluated as to the feasibility for noise mitigation purposes.

As stated above, the County wishes to evaluate the feasibility of sound attenuating noise sensitive structures within the 60 and 65 DNL noise contours. There are approximately 4,918 housing units within the existing 60 DNL noise contour. This number most likely will be reduced by various noise abatement actions, however, it is a good number to start the evaluation. Based on the average cost to sound attenuate houses within the 65 DNL contour associated with Sea-Tac (approximately $20,000 per home), the cost to sound attenuate all of the homes within the 60 DNL contour at King County International Airport would be approximately 99.5 million dollars. Based on the same information, the approximate cost to sound attenuate the homes within the 65 DNL only (1,327 homes) would be approximately 26.5 million dollars. For information purposes,
the approximate cost to sound attenuate the homes within the 70 DNL (158 homes) would be approximately 3.2 million dollars.

This even becomes more costly when using the Base Case future noise contours to identify residences. There are approximately 6,827 homes within the 60 DNL noise contour in the future. The cost to sound attenuate this many homes would be approximately 136.5 million dollars. The approximate cost to sound attenuate the homes within the future Base Case 65 DNL contour (approximately 1,955) would be 39.1 million dollars. The approximate cost to sound attenuate the homes inside the 70 DNL contour would be about 7.0 million dollars.

The actual number of housing units and other noise sensitive uses within the 60 and greater DNL noise contours will depend upon the noise abatement/mitigation programs adopted as part of the Noise Compatibility Program. It is quite possible that the final noise contour to be used as the basis for the Noise Compatibility Program will be smaller than either the existing or future contours. However, the foregoing comparison can be used to identify magnitude of costs when considering sound attenuation programs.

Alternative 5-Noise and Compliance Monitoring Program. This Alternative is concerned with on-going activities at the airport including measuring noise levels on and around the airport and monitoring compliance with the noise abatement programs implemented as a result of this FAR 150 study. There are two purposes to this alternative: one is to measure changes in noise exposure over time, and the second is to monitor compliance with specific operational programs. A pre-requisite to this alternative is a noise monitoring system (which may be supplemented from time to time with portable monitors) to keep track of noise levels at specific points around the airport.

Fly Quiet

Using the data produced by a noise monitoring system, the airport will be able to produce reports covering a variety of topics. These monitoring activities and reports, as a group, are called a "Fly Quiet" program, because they provide incentives for airlines and pilots to operate at quietly as is physically possible. The key to Fly Quiet is the availability of information both to the operators and to the public. This information is gathered from noise monitors, quantified and then prepared into reports providing comparative data for each quarter at KCIA.

Continuous Feedback/Continuous Training

Distribution and publication of Fly Quiet reports provides continuous feedback to aircraft operators about how well they are complying with noise abatement regulations and procedures. And, these reports allow the interested public around KCIA access to information about which operators are achieving the highest level of compliance with noise abatement procedures and which need improvement. Fly Quiet reports will be publicized and distributed in a variety of ways including:

- Posted in the public areas at KCIA and in the FBO waiting areas
- Published in KCIA newsletters
- Distributed to local libraries
- Press releases sent to local papers
- Distributed to Roundtable members, public and elected officials in the County.

Using this information, KCIA staff will be able to meet with airlines, pilots and FBOs to work through problems and improve compliance. In addition to encouraging pilots to score well compared to similar operators, KCIA can choose to offer specific incentives to high achievers. Awards, prizes, publicity and similar ideas may be used to encourage the best possible noise abatement techniques.

A Voluntary Program Avoids Time Consuming Regulations

Because Fly Quiet is a voluntary program, it has the advantage of reinforcing desirable flight procedures without going through the time consuming regulatory requirement of FAR Part 161 filing process, or it can be used in conjunction with a Part 161 analysis. In addition, the program would build a database for future updates of the FAR Part 150 Study. A Fly Quiet Program has the potential of reducing single event noise levels and encouraging greater compliance with preferential flight corridors and procedures, and could potentially result in continued overall reductions in cumulative noise levels for areas around the airport.

Fly Quiet Components

A Fly Quiet Program can have several components. At KCIA it would likely include monitoring:

- Compliance with noise abatement flight tracks
- Adherence to noise abatement departure climb profiles
- Monitoring late night departure procedures
- Analysis of noisiest single event flights/aircraft
- Quantifying runway use
- Monitoring run-up regulations

Monitoring Elliott Bay Procedures

Examples of how these Fly Quiet components would be analyzed and treated include:

- Measured single event operations producing the highest, lowest, mean, and average levels.
- Measured distance from ideal flight path, identifying operations in or out of compliance with a procedure and rating the quality of the flight in meeting that procedure.
- Measured flight profile identifying operations producing the highest, lowest, mean, and average altitudes at different points along a flight path
- Categorize operations by time of day (day or night)
- Categorize operations under different weather conditions

Tailoring Fly Quiet to KCIA

Many of these Fly Quiet Program elements will be refined as the Noise Compatibility Program is finalized. Special attention will need to be devoted to the question of applying Fly Quiet to a primarily general aviation airport rather than a scheduled air carrier airport where operators are easily identified. Defining the specifics of this program as well as the nature of the reports generated will be one of the challenges facing the airport and the Part 150 committee.

As an example of how the Fly Quiet program would work, a contour combining two Alternatives is presented below. Both alternatives involve flight paths directed toward Elliott Bay: the charted visual approaches and the departure procedures. The Fly Quiet program would be designed to specifically measure adherence to those procedures to maximize compliance and effectiveness. Fly Quiet would be designed to measure not only how often each procedure is followed, but also how well it is followed.

The Fly Quiet Alternative (A5) DNL contours are shown on Figure F5a, entitled *ALTERNATIVE 5, FLY QUIET PROGRAM, DNL CONTOURS,* and the Time Above contours are shown on Figure F5b, entitled *ALTERNATIVE 5, FLY QUIET PROGRAM, TA CONTOURS.* The represented receptor analysis is presented in Table G2 through G6, and the receptor sites are shown on Figure F5c. The results show reduction in noise in the Magnolia and Queen Anne areas when the noise abatement flight track is flown properly.

By analyzing a quantity of data such as all Elliott Bay flight tracks for each quarter, it will be possible to determine which aircraft habitually follow the noise abatement procedures correctly and which deviate from the ideal flight track. KCIA staff would then follow up with a two-pronged approach. The best operators would receive praise, good publicity and perhaps an award or other incentive, and poor performers would receive further instruction on how to fly the procedure properly. At the end of the year, the best operator would be determined, using a full year's worth of flight track data. A specific award or incentive, such as operator or FBO of the year, would be granted, preferably by the Airport Director or another high-ranking King County official in a public ceremony.

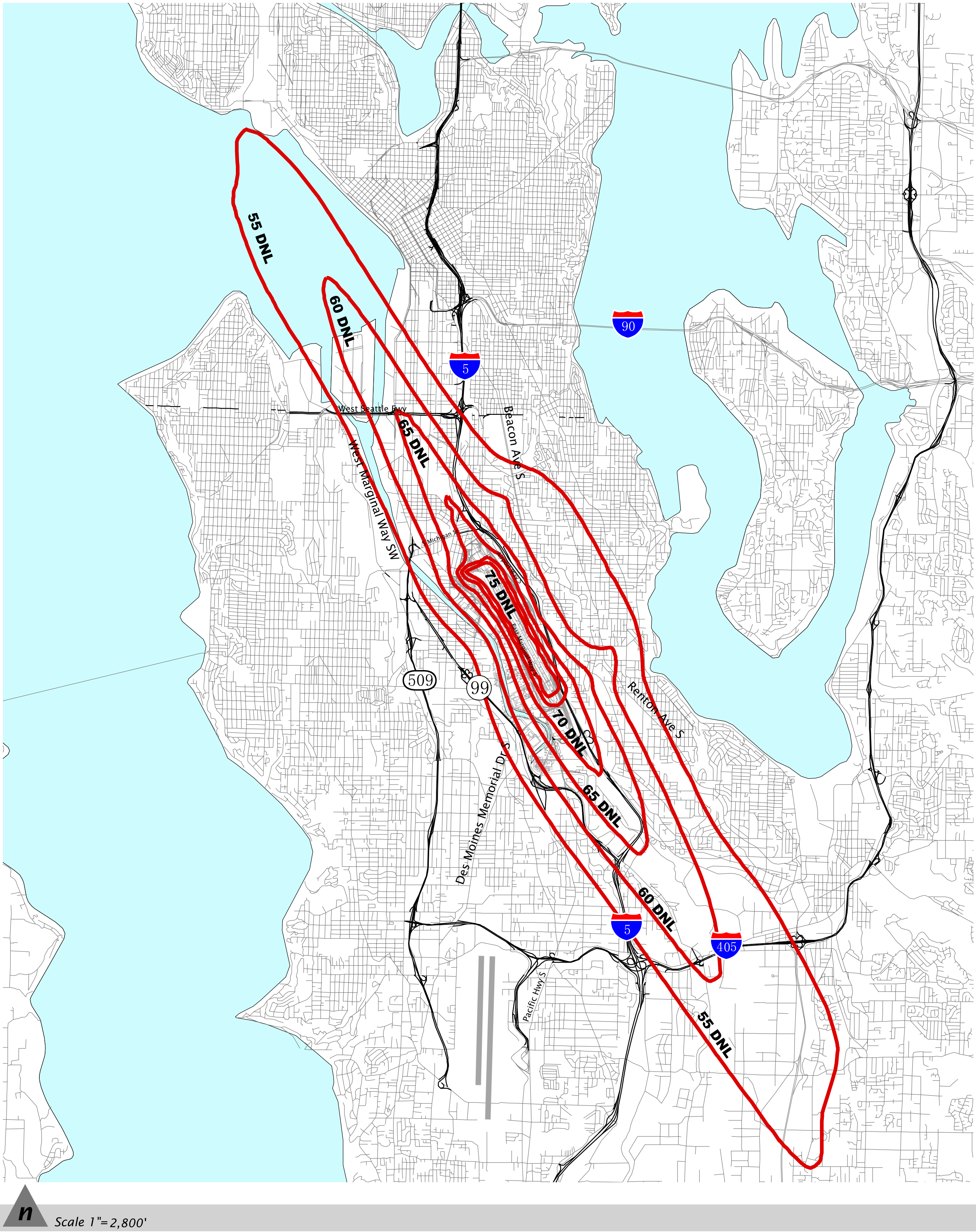


Figure F5a *Alternative 5, Fly Quiet Program, DNL Contours*

Noise Contour

KingCounty
INTERNATIONAL AIRPORT/Boeing Field
FAR Part 150 Study

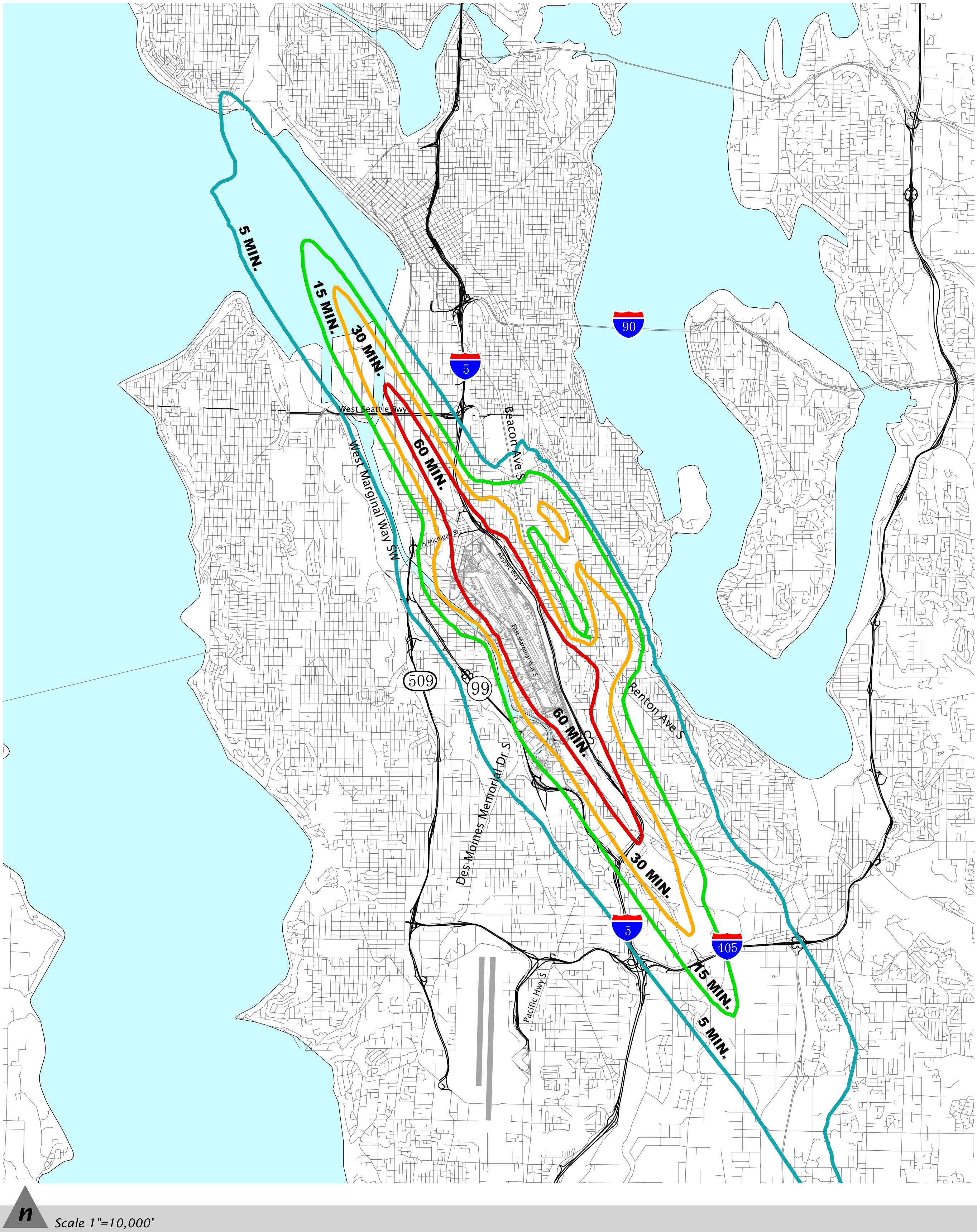
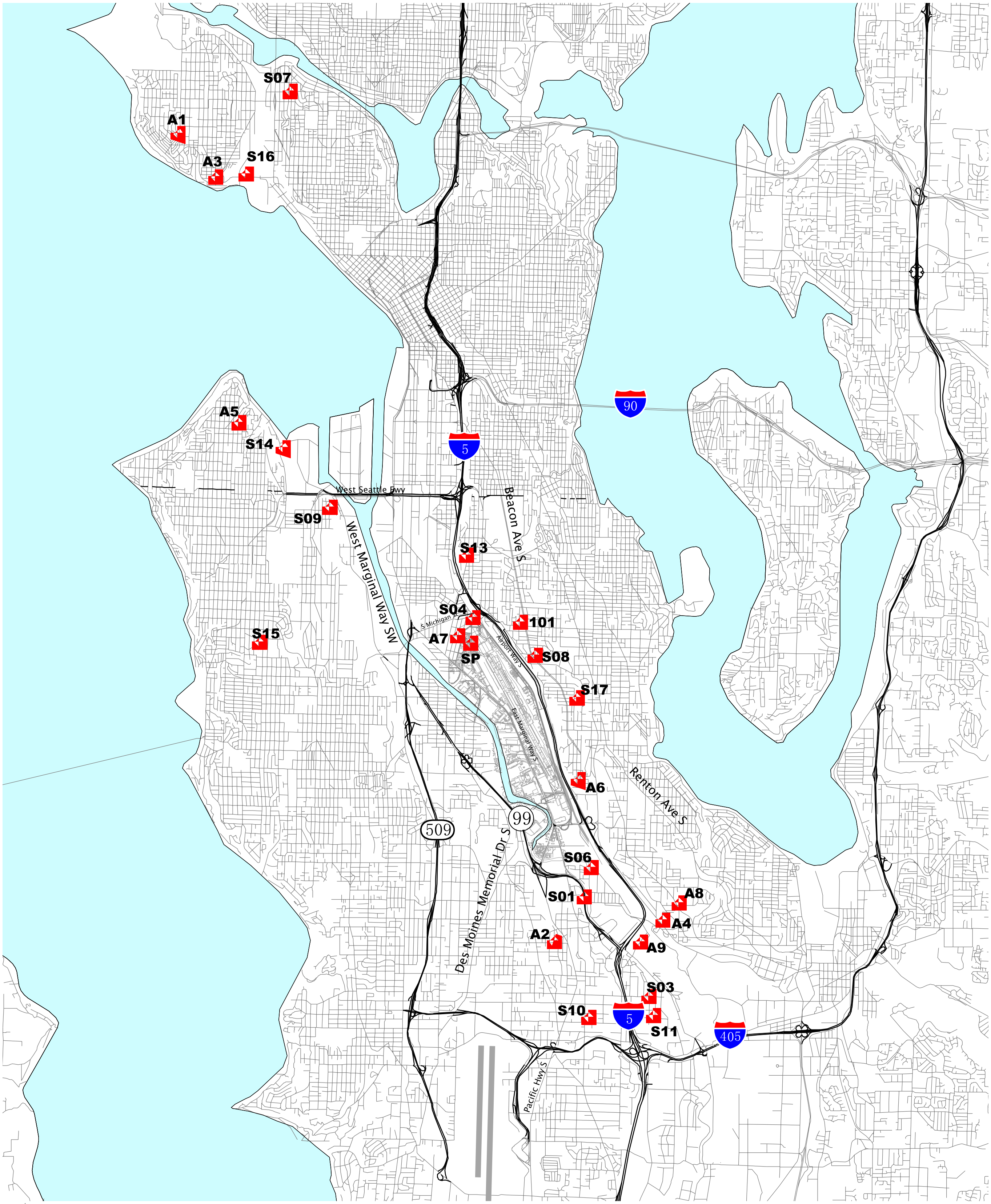


Figure F5b **Alternative 5, Fly Quiet Program, TA Contours**

- 60 minutes
- 30 minutes
- 15 minutes
- 5 minutes

King County INTERNATIONAL AIRPORT/Boeing Field FAR Part 150 Study



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Scale 1"=10,000'

Figure F5c ***Representative Receptors***

Receptor Site

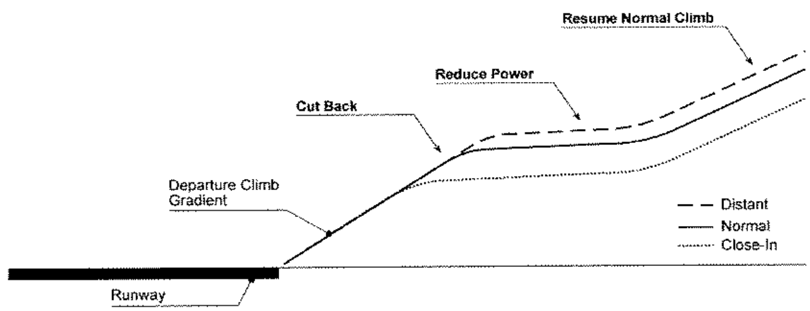
KingCounty
INTERNATIONAL AIRPORT/Boeing Field
FAR Part 150 Study

Alternative 6-Noise Complaint/Citizen Liaison Program and Other Administrative Actions. This Alternative involves the continuation of the existing Noise Complaint Hotline system in place at the airport. The objective of this system is to record all noise concerns received from citizens. This will assure that personnel can explain the nature of the concern and, in most instances, what caused the concern. This will assist in the annual review of the FAR Part 150 Study to determine the effectiveness of the noise abatement recommendations. In addition, this Action should continue independently of what ever other operational modifications are recommended as part of this planning effort, and is not contingent upon the implementation of any other action. This is especially important in relationship to the noise monitoring program. This current system will be reviewed and evaluated during the course of the Study, and recommendations may be made at the conclusion to improve the system. **Additional analysis will be presented in a subsequent Working Paper.**

Alternative 7-Land Use Controls/Planning. Some residents living within the environs of the airport have expressed significant concern with aircraft over-flights and the noise intrusion associated with them. This is true even though many are outside the 65 DNL noise contour, as they are experiencing noise intrusion associated with single event operations. The communities should be cognizant of this fact and take aircraft noise levels, and over flight patterns, into consideration in the land use planning and development actions taken by these entities. It is evident from historical data that many residents are annoyed beyond the 65 DNL noise contour, thus it may be advantageous to use a large contour for land use planning purposes. In addition, it may be wise for future noise sensitive uses, such as schools, hospitals, rest homes, religious facilities, etc. to be avoided within the approach and departure paths of the runways for a distance of approximately two miles. It is much easier to avoid problems in the future than to solve them once they have occurred. One of the unique problems facing the airport is the reality of inter-jurisdictional issues. In other words, the airport is surrounded by jurisdictions that have land use control but are not the Sponsor of the airport and the airport has not land use control authority.

In addition, the requirement for sound attenuation in new structures would be appropriate for new or in-fill development in those communities that do not presently have such requirements. It is recognized that most of the area surrounding the airport is presently developed, and that it is the intent of both the County and the Airport to help preserve those areas of existing residential development. Therefore, sound attenuation programs for existing structures may be an important element of the Study, as described in Alternative 4. Specific land use recommendations will be made subsequent to the identification of the Future Noise Exposure Map, taking into consideration the adopted Future Land Use plans of the various communities.

Alternative 8-Departure Thrust Cutback. Many citizens have complained about departure noise levels. The Federal Aviation Administration has developed specific departure procedures for aircraft and have directed the Airlines to develop specific procedures for the specific aircraft types they operate. These procedures are known as the "close in" and "distant" procedures. The business jet manufacturers and operator organizations have developed specific "fly quiet" procedures for many aircraft.



A departure thrust cutback is a procedure where the aircraft's thrust or power setting is reduced soon after departure in an effort to reduce noise levels on the ground. Although use of a power cutback procedure can reduce noise at certain locations, it can also shift noise from close in to further away from the Airport or vice-versa. Since all Noise Abatement Departure Profiles (NADPs) involve a power cutback, this analysis explores the impact of alternative altitudes where this cutback could occur in the Seattle region.

The FAA has worked to develop and standardize aircraft noise abatement departure profiles called Noise Abatement Departure Profiles (NADPs). FAA Advisory Circular 91-53A (FAA AC 91-53A) establishes standards and operational guidelines for implementation of these procedures. Key features of AC 91-53A are:

- Each aircraft operator may develop a maximum of two NADPs for each airplane type. These are designated as either a "Close-in community NADP" or a "Distant community NADP". The terms "Close-in" and "Distant" refer to the physical distance from the Airport runway to the community. A "Close-in community NADP" is designed to reduce noise at locations close to the Airport. A "Distant community NADP" is designed to reduce noise at locations distant from the Airport. These terms are relative, and allow each operator to develop procedures that provide the greatest noise benefit to their individual destinations.

- For each NADP the operator should specify the altitude above field elevation (AFE) at which takeoff thrust or airplane configuration change, excluding landing gear retraction, is initiated. The absolute minimum altitude at which throttle reduction may be initiated is 800 feet AFE.

- The minimum thrust setting for each aircraft type is to be determined based upon the minimum engine out- climb gradients.

- The thrust reduction will be maintained to an altitude of 3,000 feet AFE or until the airplane has been fully transitioned to the en route configuration (whichever occurs first), then transition to normal en route climb procedures may be initiated.

- Airports may request airlines to use the appropriate NADP to reduce noise for either a close-in or a distant community.

Although NADPs are defined in terms of community location, the actual point of thrust reduction is determined by aircraft altitude. This is a key safety consideration as aircraft climb performance varies by aircraft type and weight. The designation of altitude to determine the location at which the reduction in thrust takes place ensures that departing aircraft are at a safe altitude prior to reducing power.

At King County International Airport, the NADP is determined by each airline. Currently the cutback is in between the close-in and distant procedure. Data indicates that at KCIA, a power cutback occurs at about 1,200 feet (versus the 800 feet for the close-in or 1,500 feet for the distant procedures).

In response to the requirements of AC 91-53A major airlines have developed NADPs. These standardized procedures recommend that thrust reductions commence at 800 feet above field elevation (AFE) for the close-in and 1,500 feet AFE for the distant community NADP. Although the actual location on the ground of thrust reduction varies from flight to flight, as a practical matter, thrust reductions typically occur in the vicinity of one nautical mile (nm) from brake release for the close-in procedure and at approximately three nautical miles (nm) from brake release for the distant procedure.

The departure thrust cutback significantly decreases aircraft noise emissions in the vicinity of the cutback, but the decrease in noise levels is accompanied by a corresponding decrease in aircraft climb performance. Changes in climb performance result in lower flyover altitudes compared to a typical or normal departure procedure. The amount of decrease in altitude can be assessed through computer simulation.

Noise levels at any given receptor are primarily a function of the loudness of the noise source, and the distance from the noise source to the receiver. Thus, noise levels increase as the distance between the source and the receptor decreases, and reducing departure thrust also reduces aircraft altitude. Therefore, departure thrust cutback reduces noise on the ground when the reduction in noise at the source (power cutback) is greater than the detrimental effect caused by the decrease in distance between the noise source and the receptor (reduced altitude).

AC 91-53A specifies that normal climb power will be re-applied at an altitude of 3,000 feet AFE, or when the airplane has been fully transitioned to the en route configuration, whichever occurs first. At King County International Airport, the re-application of normal climb thrust would occur in the vicinity of three to six nautical miles (nm) from the beginning of takeoff.

Locations where normal climb thrust is re-applied may experience an increase in noise above what would be experienced during a typical departure due to lower aircraft altitude and the re-application of normal climb thrust.

To assess the cumulative effect of alternative NADPs, single event noise levels were determined along the departure path for three departure procedures:

- A typical departure with no noise abatement power cutback,
- The close-in noise abatement departure procedure and
- The distant noise abatement departure procedure.

Alternative 8a. The Integrated Noise Model (INM), validated to conditions at King County International Airport by means of field noise measurement data, was used to predict and compare noise levels from these procedures. The results of this analysis (Alternative 8a) for the DC9 Hush Kit aircraft are shown in the Figures F8a through F8d for north flow departures and Figures F8e through F8g for south flow departures.

As shown in these figures, single event departure noise levels would be reduced at locations near the Airport if a close-in noise abatement departure procedure were implemented at King County International Airport; however, noise levels in the more distant communities would increase. Implementation of a distant noise abatement departure procedure would increase the noise levels closer to the Airport, while reducing them further away.

Alternative 8b. A similar Alternative is to evaluate the noise reduction associated with delaying the deployment of flaps until residential areas are avoided. This was modeled for a southern approach where flap deployment was delayed until passing Magnolia, at which time flaps are set to normal. SEL contours depicting normal and delayed flap deployment are shown on Figure F8e, entitled *ALTERNATIVE 8B, NORMAL FLAP DEPLOYMENT,B757 SEL CONTOURS* and Figure F8f, entitled *ALTERNATIVE 8B, DELAYED FLAP DEPLOYMENT,B757 SEL CONTOURS,* for north flow departures. South flow departures are illustrated on Figures F8k and F8l.

Alternative 8c. Another similar Alternative is to evaluate the noise reduction associated with an increase in the angle of approach. In other words, instead of a 3 degree approach while using the ILS, could a steeper approach of 3.5 degrees reduce noise impacts. SEL contours were developed for both the 3 and 3.5 degree approach angle for a southern approach to the north end of the main runway. Approaches from the south would reflect the same degree of change. Figure F8m, entitled *ALTERNATIVE 8C, THREE DEGREE APPROACH ANGLE* and Figure F8n, entitled *ALTERNATIVE 8C, THREE AND ONE-HALF DEGREE APPROACH ANGLE*, for south flow approaches, show the SEL contours associated with these approach angles.

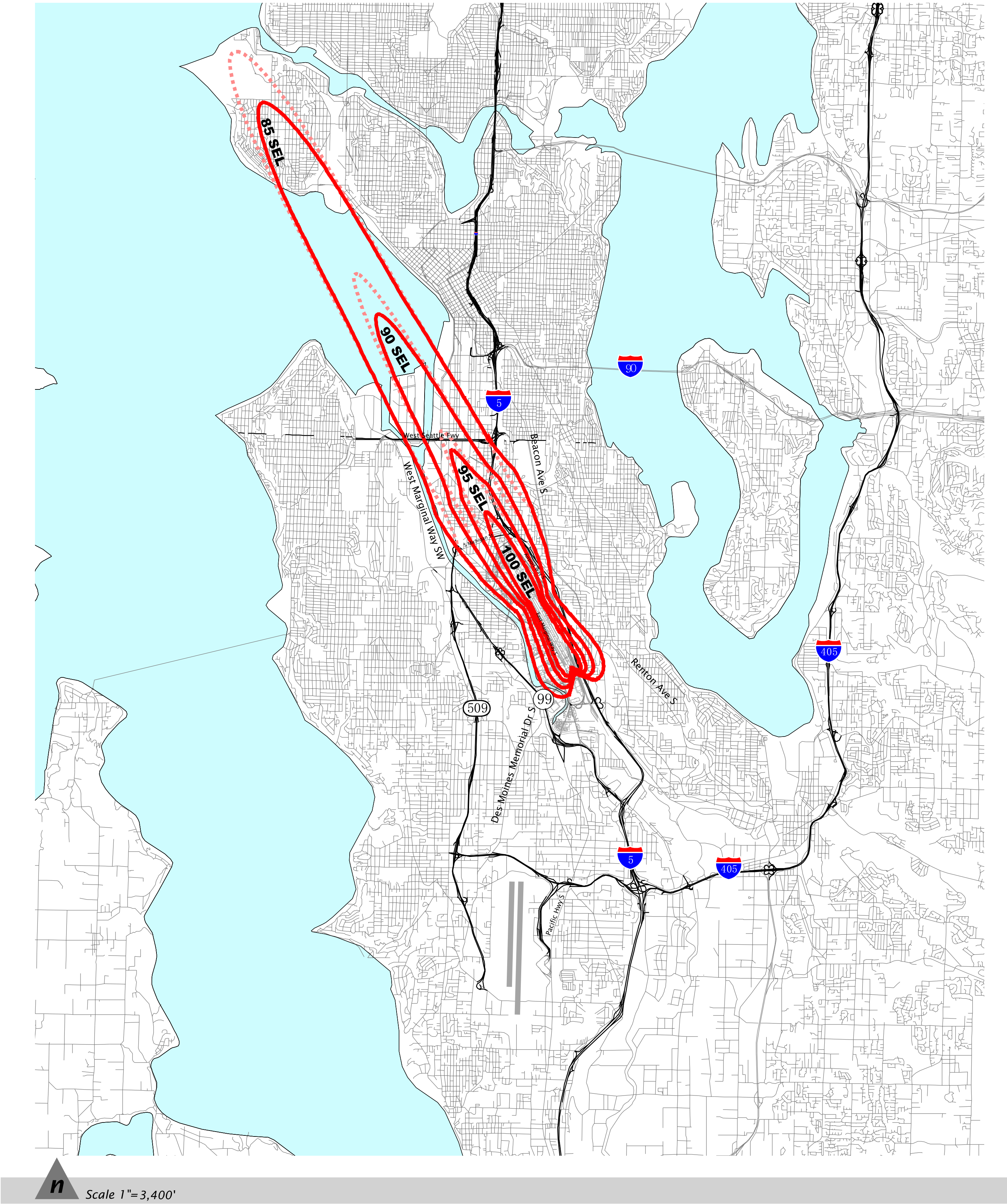


Figure F8a **Alternative 8a, Distant and Normal Departure (North) SEL Contours**

Distant SEL Noise Contour
Normal SEL Noise Contour

KingCounty
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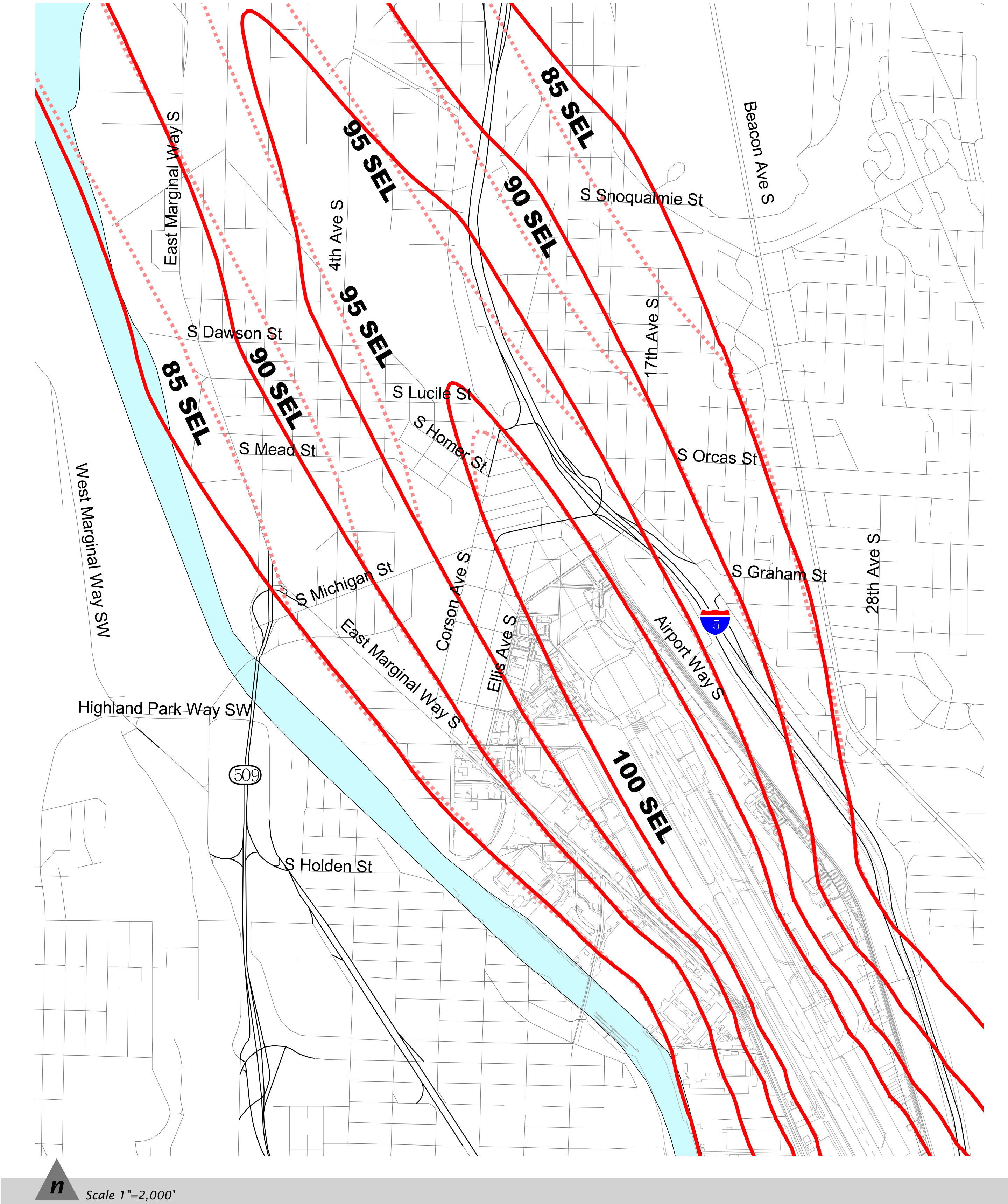

Figure F8b ***Alternative 8a, Distant and Normal Departure (North) SEL Contours - Detail View***

Distant SEL Noise Contour
Normal SEL Noise Contour

King County INTERNATIONAL AIRPORT/Boeing Field
FAR Part 150 Study

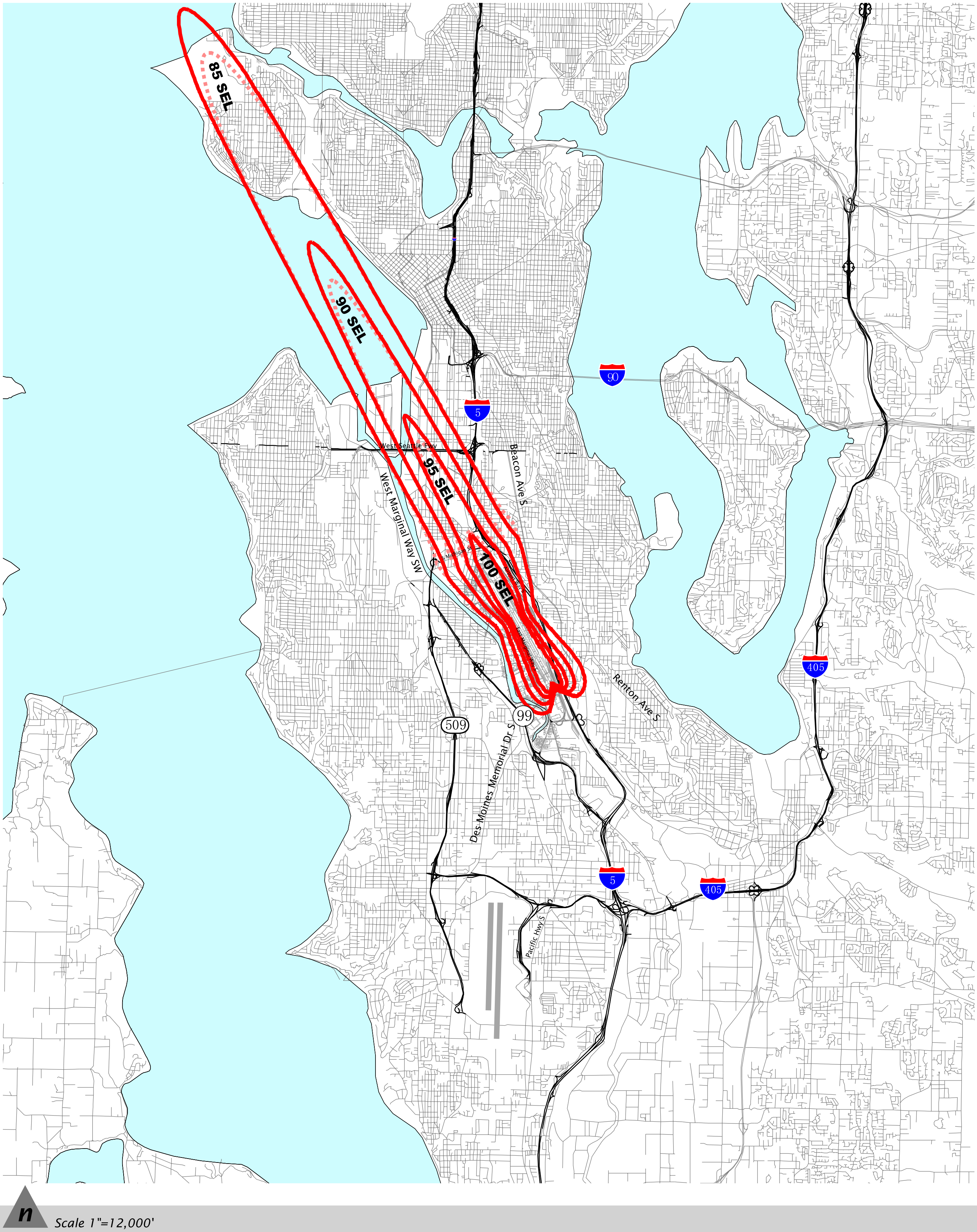

Figure F8c ***Alternative 8a, Close In and Normal Departure (North) SEL Contours***

Close In SEL Noise Contour
Normal SEL Noise Contour

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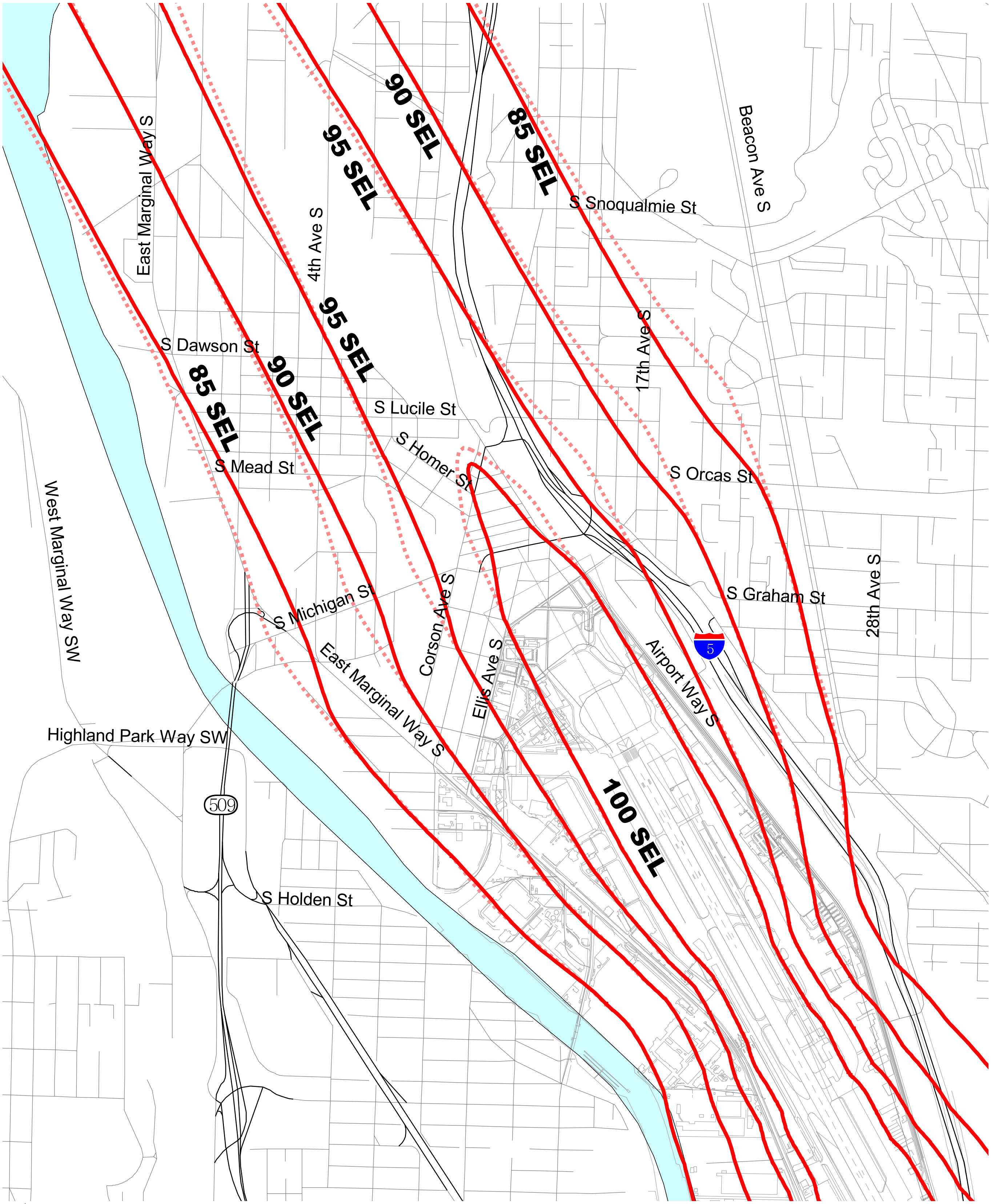
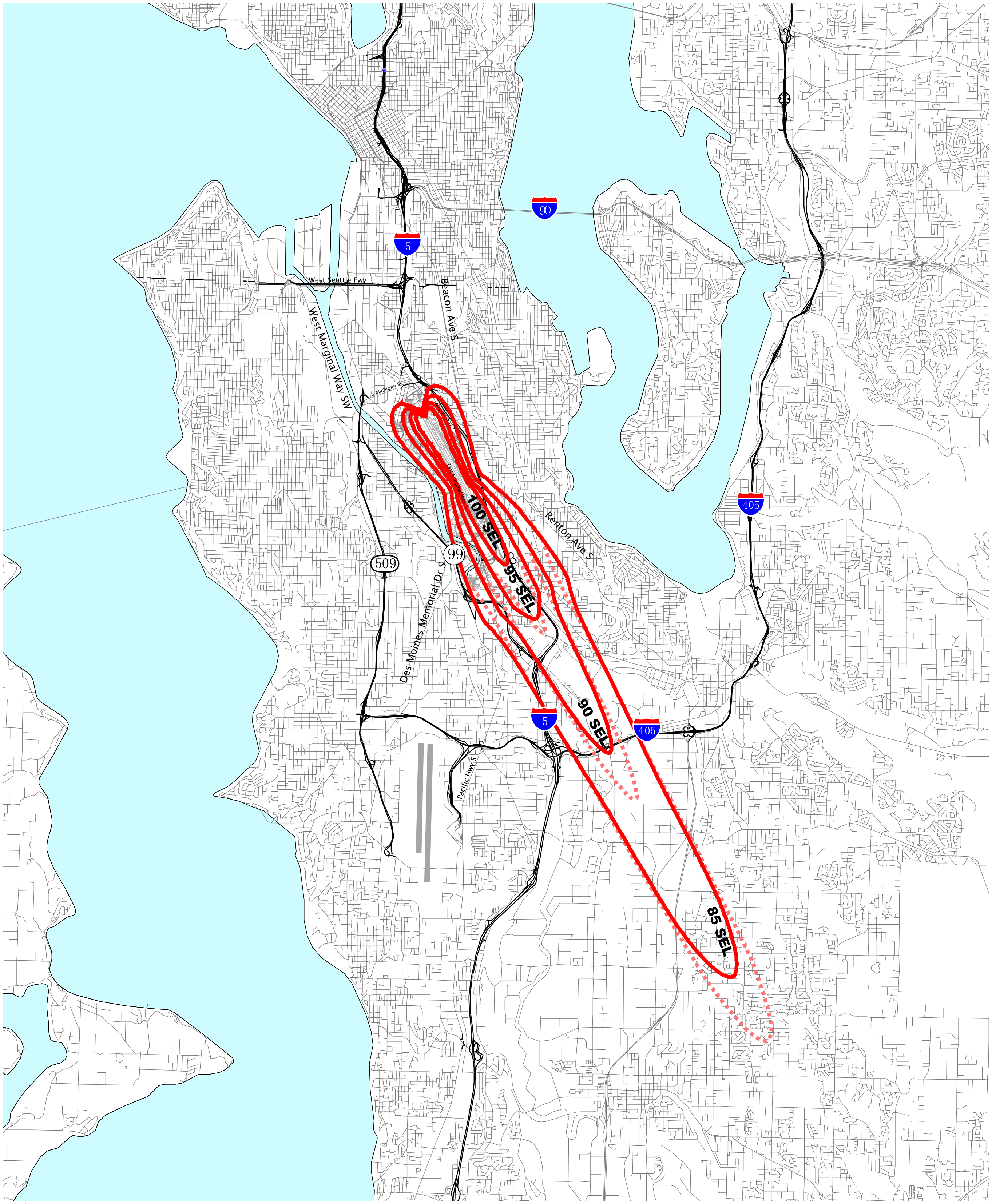


n Scale 1"=2,000'

Figure F8d **Alternative 8a, Close In and Normal Departure (North) SEL Contours - Detail View**

Close In SEL Noise Contour
Normal SEL Noise Contour

KingCounty INTERNATIONAL AIRPORT/Boeing Field FAR Part 150 Study



n Scale 1"= 3,400'

Figure F8e ***Alternative 8a, Distant and Normal Departure (South) SEL Contours***

Distant SEL Noise Contour
Normal SEL Noise Contour

King County INTERNATIONAL AIRPORT/Boeing Field
FAR Part 150 Study

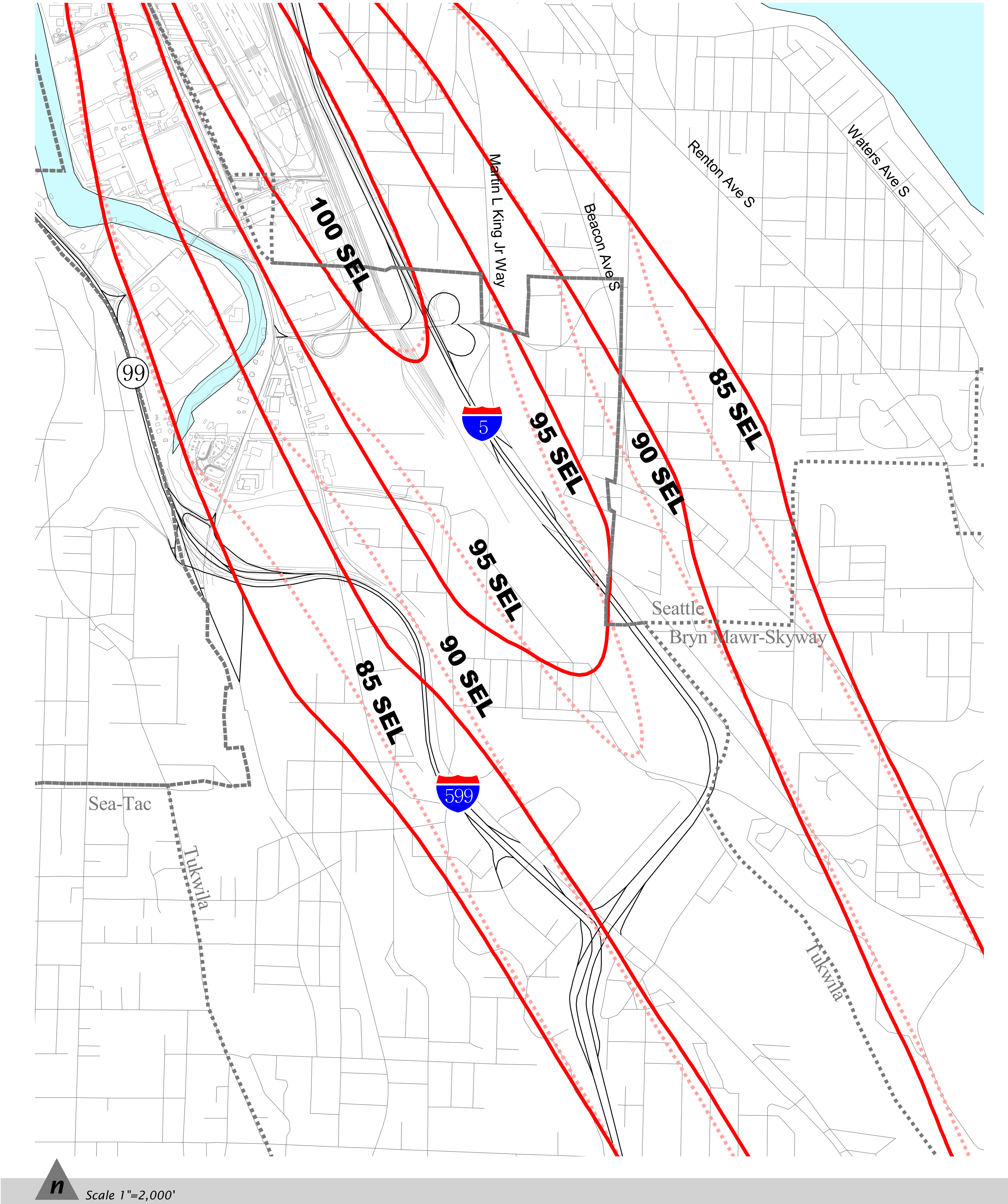
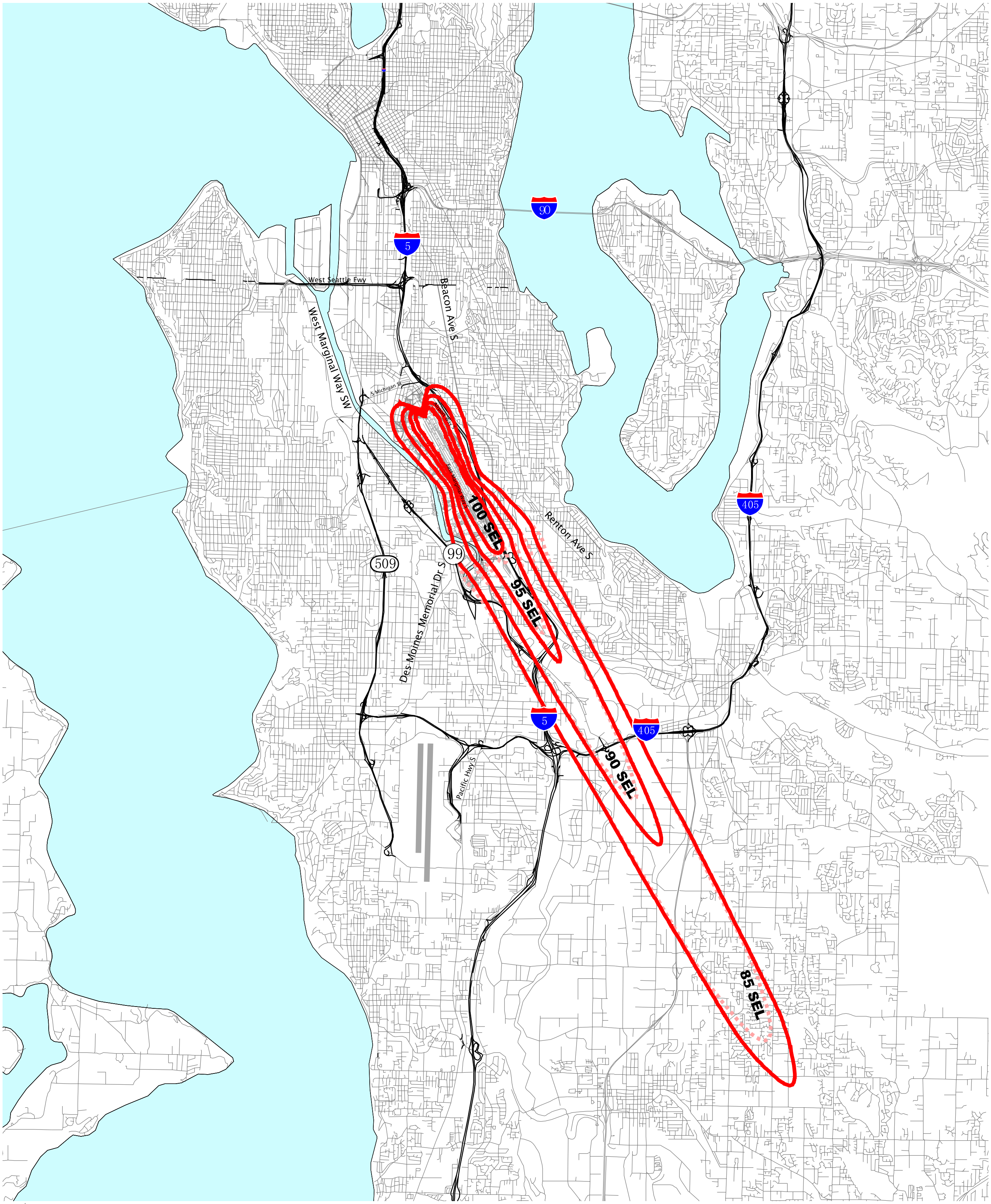


Figure F8f ***Alternative 8a, Distant and Normal Departure (North) SEL Contours - Detail View***

Distant SEL Noise Contour

Normal SEL Noise Contour

KingCounty INTERNATIONAL AIRPORT/Boeing Field FAR Part 150 Study



Scale 1"=12,000'

Figure F8g **Alternative 8a, Close In and Normal Departure (South) SEL Contours**

Close In SEL Noise Contour
Normal SEL Noise Contour

KingCounty INTERNATIONAL AIRPORT/Boeing Field FAR Part 150 Study

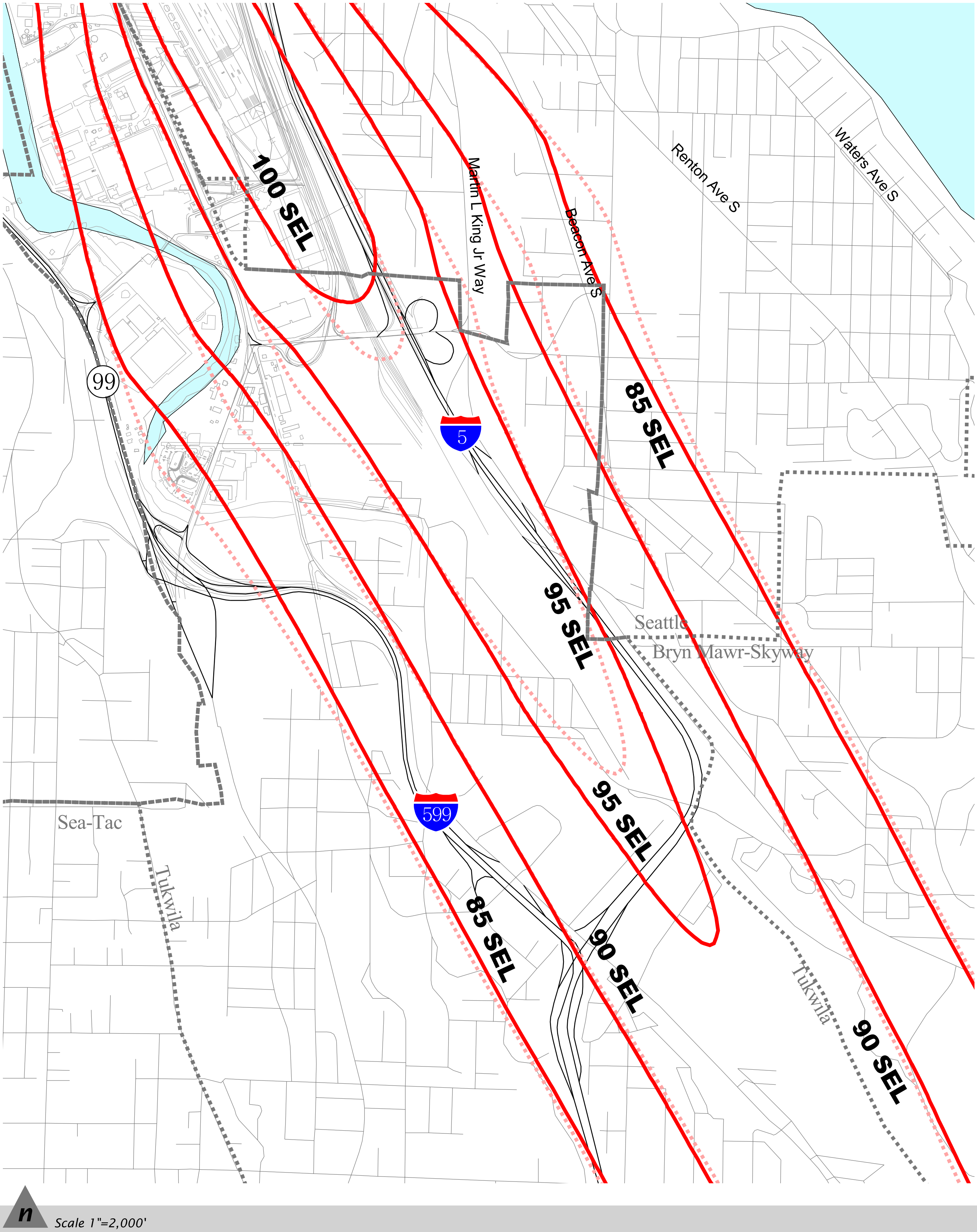
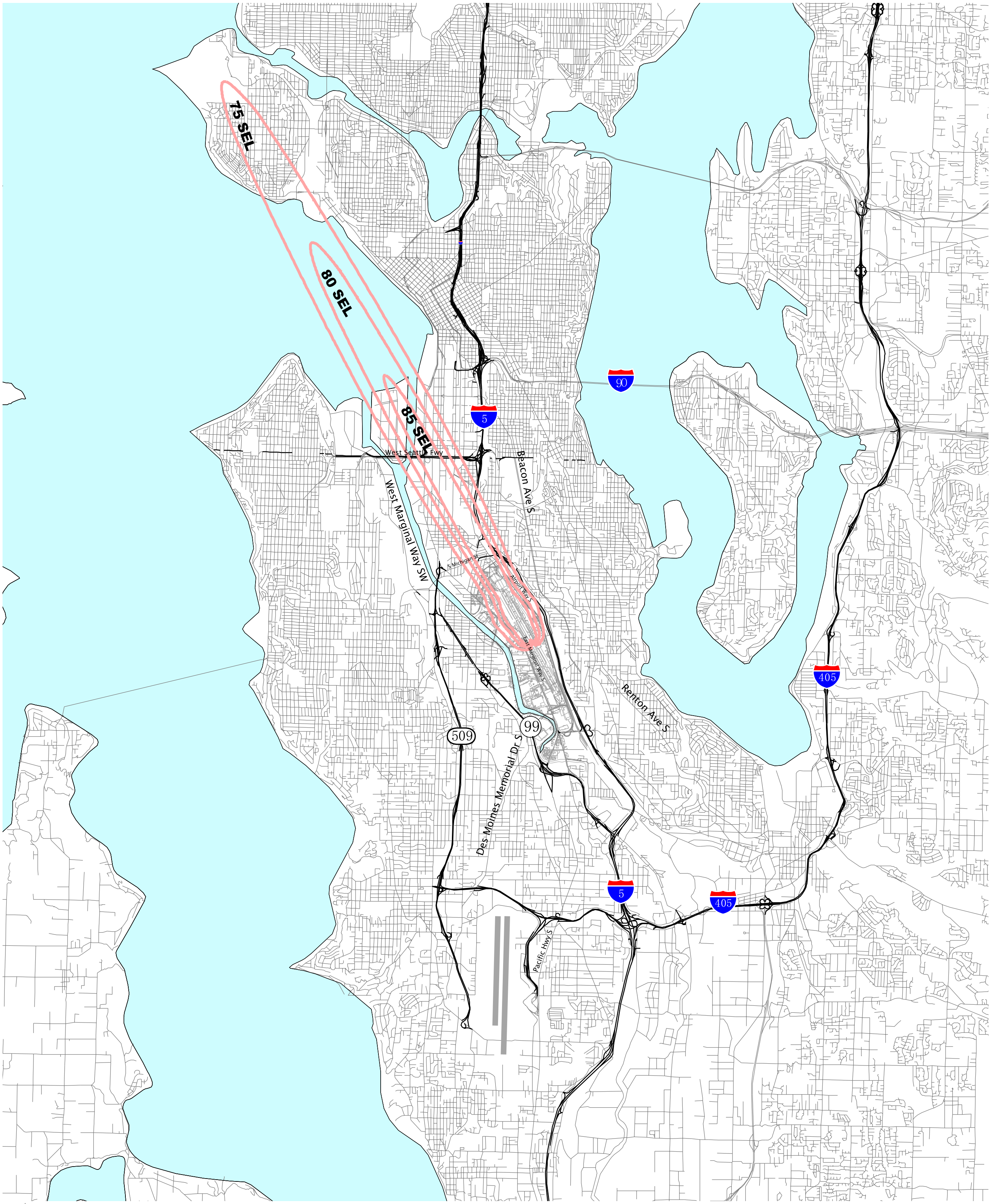


Figure F8h ***Alternative 8a, Close In and Normal Departure (South) SEL Contours - Detail View***

Close In SEL Noise Contour
Normal SEL Noise Contour

King County INTERNATIONAL AIRPORT/Boeing Field
FAR Part 150 Study



n Scale 1"=12,000'

Figure F8i ***Alternative 8b, Normal Flap Deployment (North) B757 SEL Contours***

SEL Noise Contour

KingCounty INTERNATIONAL AIRPORT/Boeing Field FAR Part 150 Study

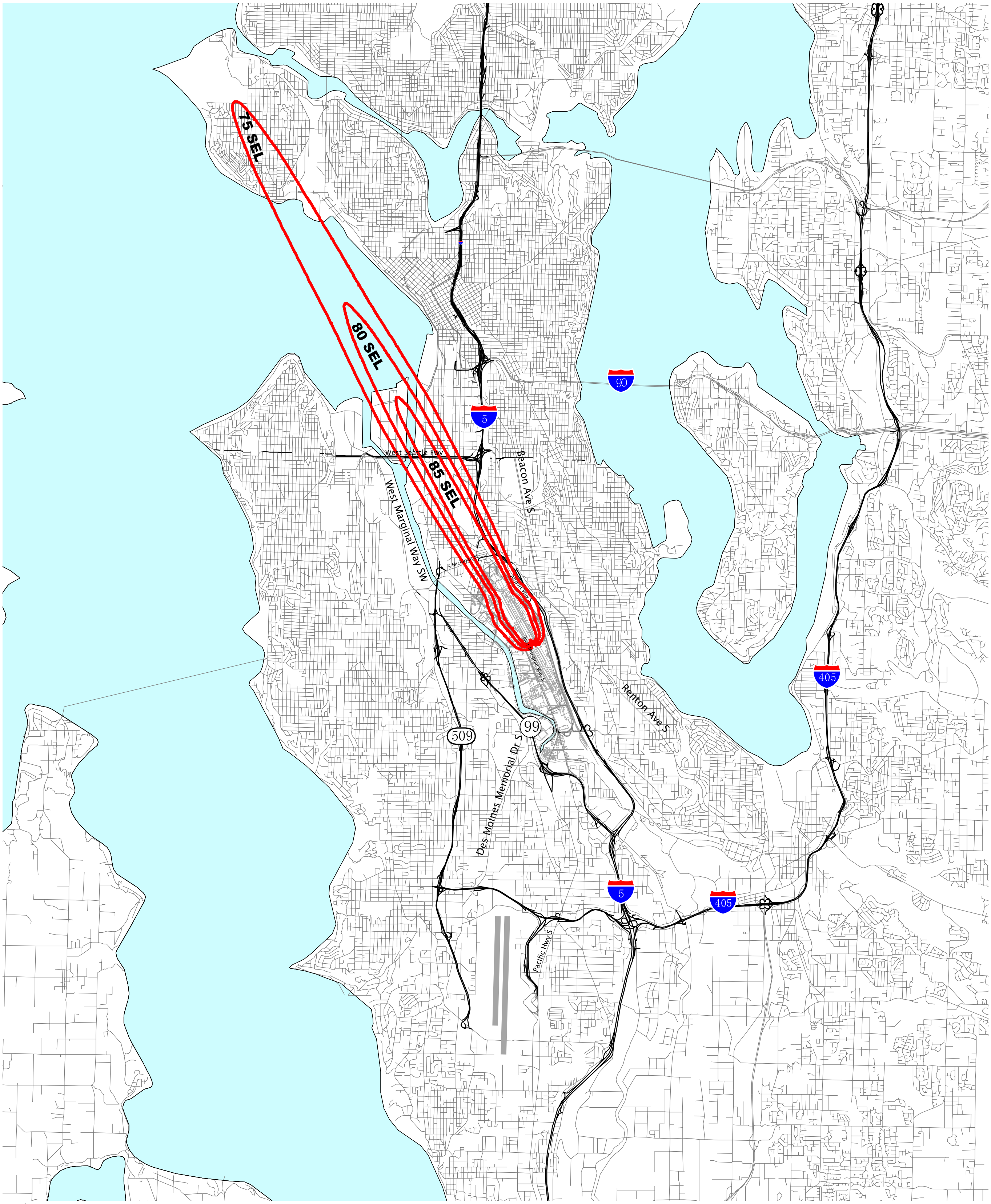
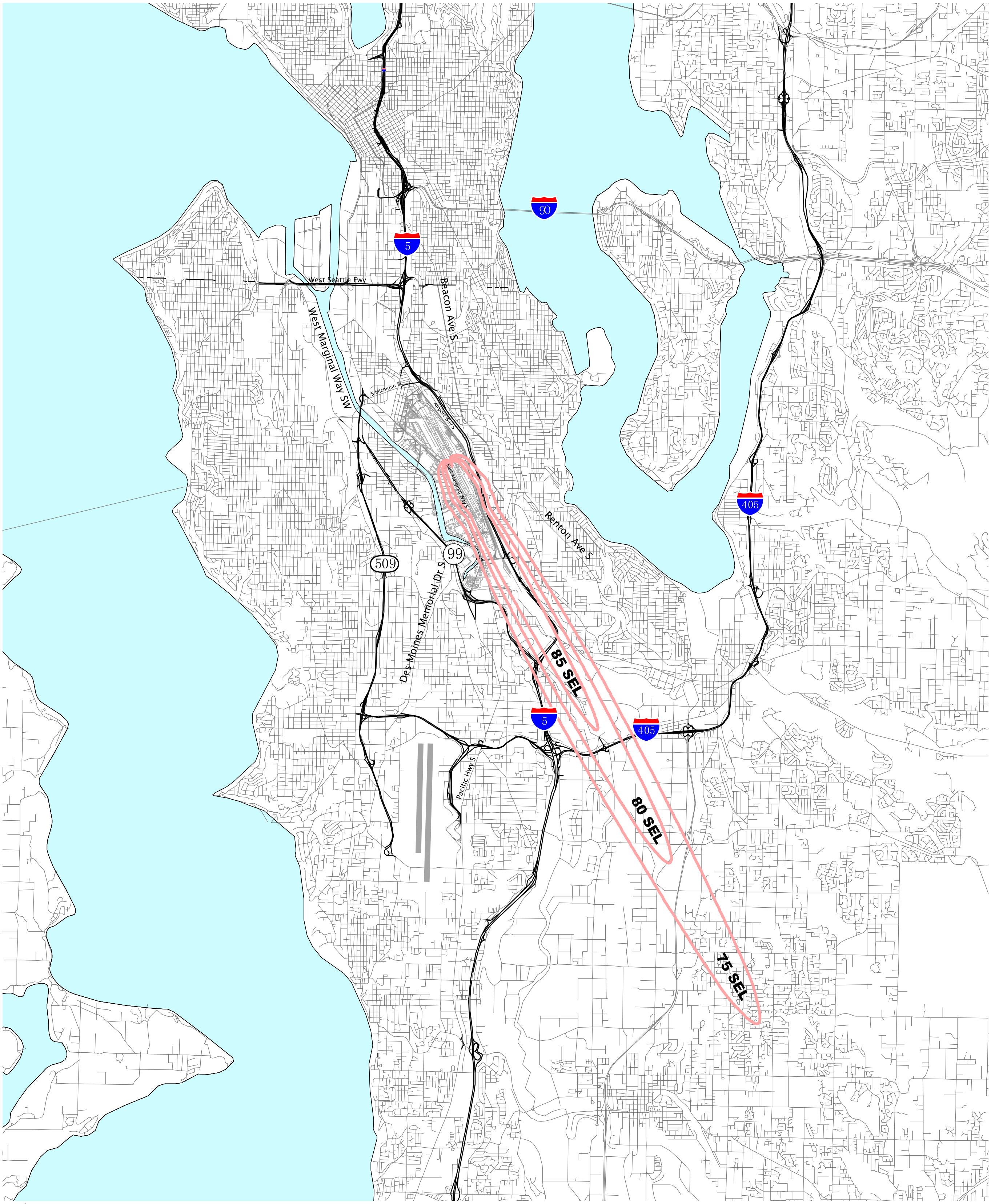


Figure F8j **Alternative 8b, Delayed Flap Deployment (North)**
B757 SEL Contours

SEL Noise Contour

King County INTERNATIONAL AIRPORT/Boeing Field FAR Part 150 Study



Scale 1"=12,000'

Figure F8k ***Alternative 8b, Normal Flap Deployment (South)***
B757 SEL Contours

SEL Noise Contour

KingCounty
INTERNATIONAL AIRPORT/Boeing Field
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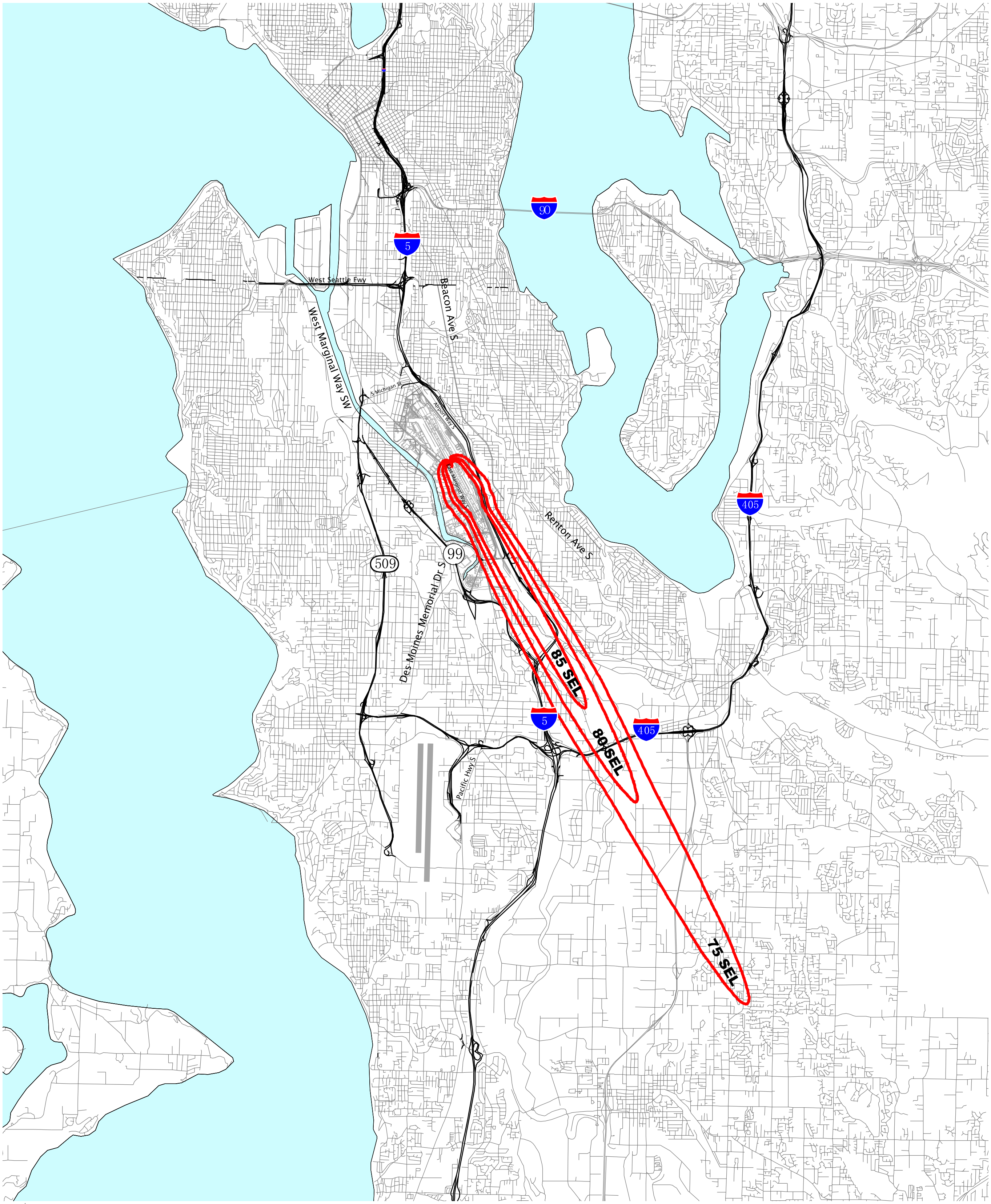
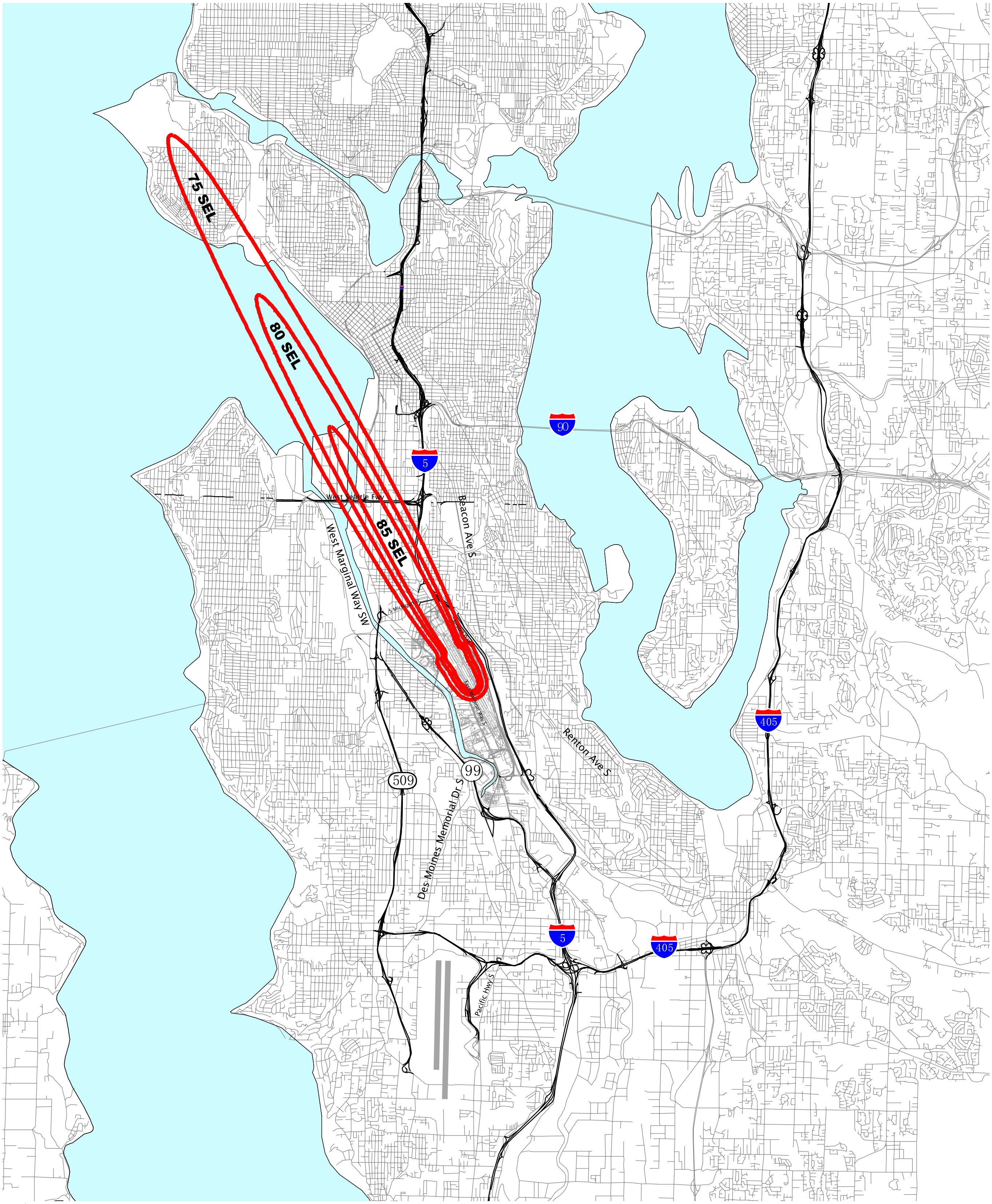


Scale 1"=12,000'

Figure F8l **Alternative 8b, Delayed Flap Deployment (South)**
B757 SEL Contours

SEL Noise Contour

King County
INTERNATIONAL AIRPORT/Boeing Field
FAR Part 150 Study

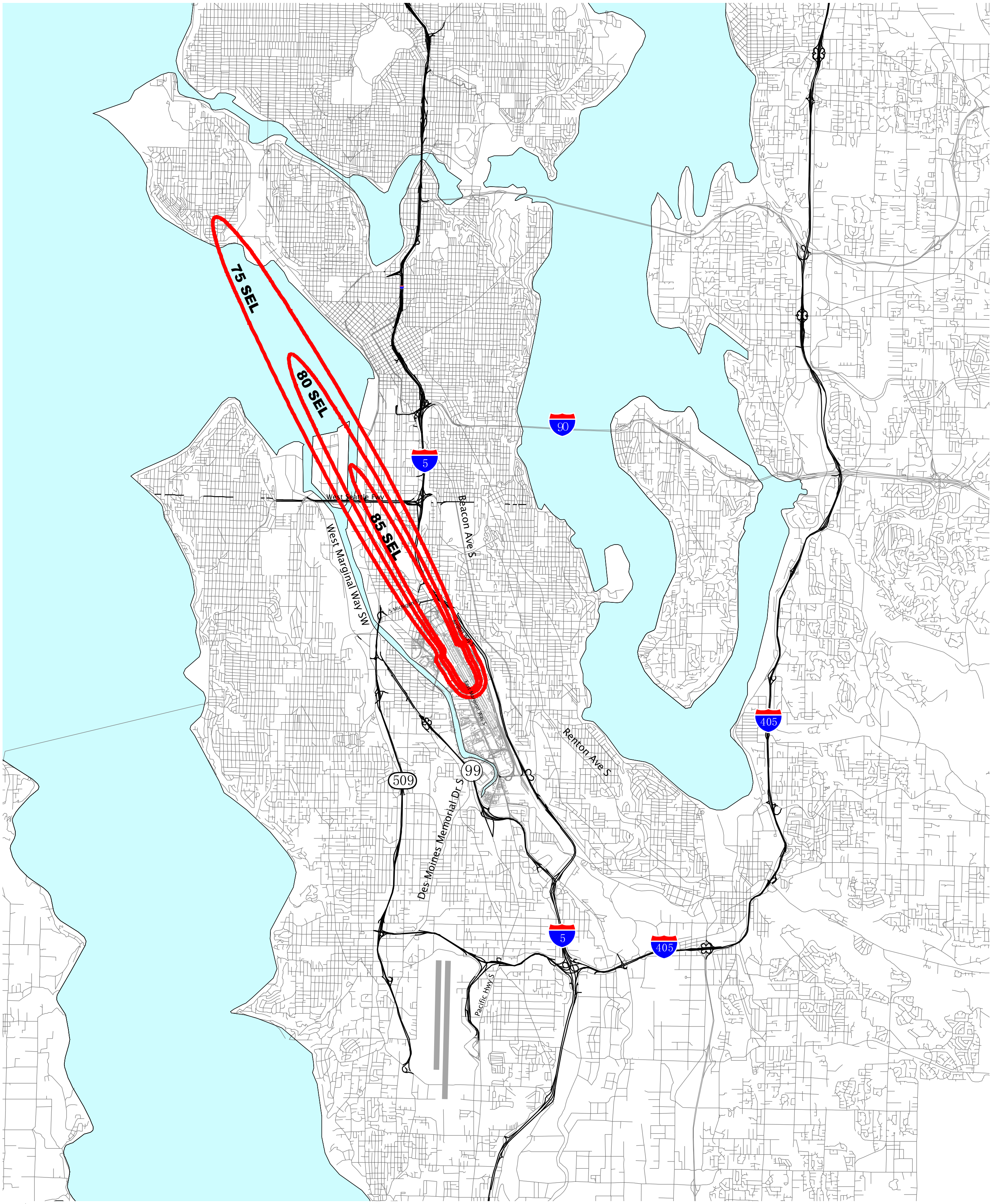


Scale 1"=12,000'

Figure F8m ***Alternative 8C, Three Degree Approach Angle***

SEL Noise Contour

KingCounty INTERNATIONAL AIRPORT/Boeing Field FAR Part 150 Study



Scale 1"=12,000'

Figure F8n ***Alternative 8C, Three and One-half Degree Approach Angle***

SEL Noise Contour

KingCounty INTERNATIONAL AIRPORT/Boeing Field FAR Part 150 Study

Alternative 9-Noise Abatement Procedure (Flight Track Changes). The Federal Aviation Administration has direct control over each aircraft as it leaves the ground and proceeds to its destination. The direction and orientation that an aircraft takes as it departs or arrives at an airport, as projected on the ground, is referred to as the aircraft flight track. This Alternative intends to evaluate the implementation of several new flight tracks for the Airport. These will include the Bay Visual Approach, use of Flight Management Systems (FMS) for departure, West Seattle flight tracks for small planes, southern departure variations, minimal population tracks, transponder landing system and possible altitude evaluation. Any such flight track change will require the preparation of environmental documentation and evaluation prior to implementation. This process can normally take several years. These Alternatives would be modeled in various forms.

Alternative 9a. The first Alternative in this series involves the use of the Charted Visual approach for operations to Runway 13R for all hours during both the day and night. This alternative affectively shifts the flight path from a long straight-in approach to arriving through Elliot Bay. This is labeled as Alternative 9a and a description of this procedure is shown in Figure F9a. Because of weather, this procedure cannot be utilized all the time. There may also be times when, due to capacity constraints, this procedure may be difficult to implement. The analysis assumes that this procedure could be used about 50% of the time. Thus, 50% of the operations on the straight-in approach are shifted to this procedure. The Alternative 9a DNL contours are illustrated in Figure F9b, entitled *ALTERNATIVE 9A, CHARTED VISUAL ALL HOURS, DNL CONTOURS,* and the Alternative 9a Time Above contours are illustrated in Figure F9c, entitled *ALTERNATIVE 9A, CHARTED VISUAL ALL HOURS, TA CONTOURS.* The results show some reduction in noise in the Magnolia and Queen Anne area.

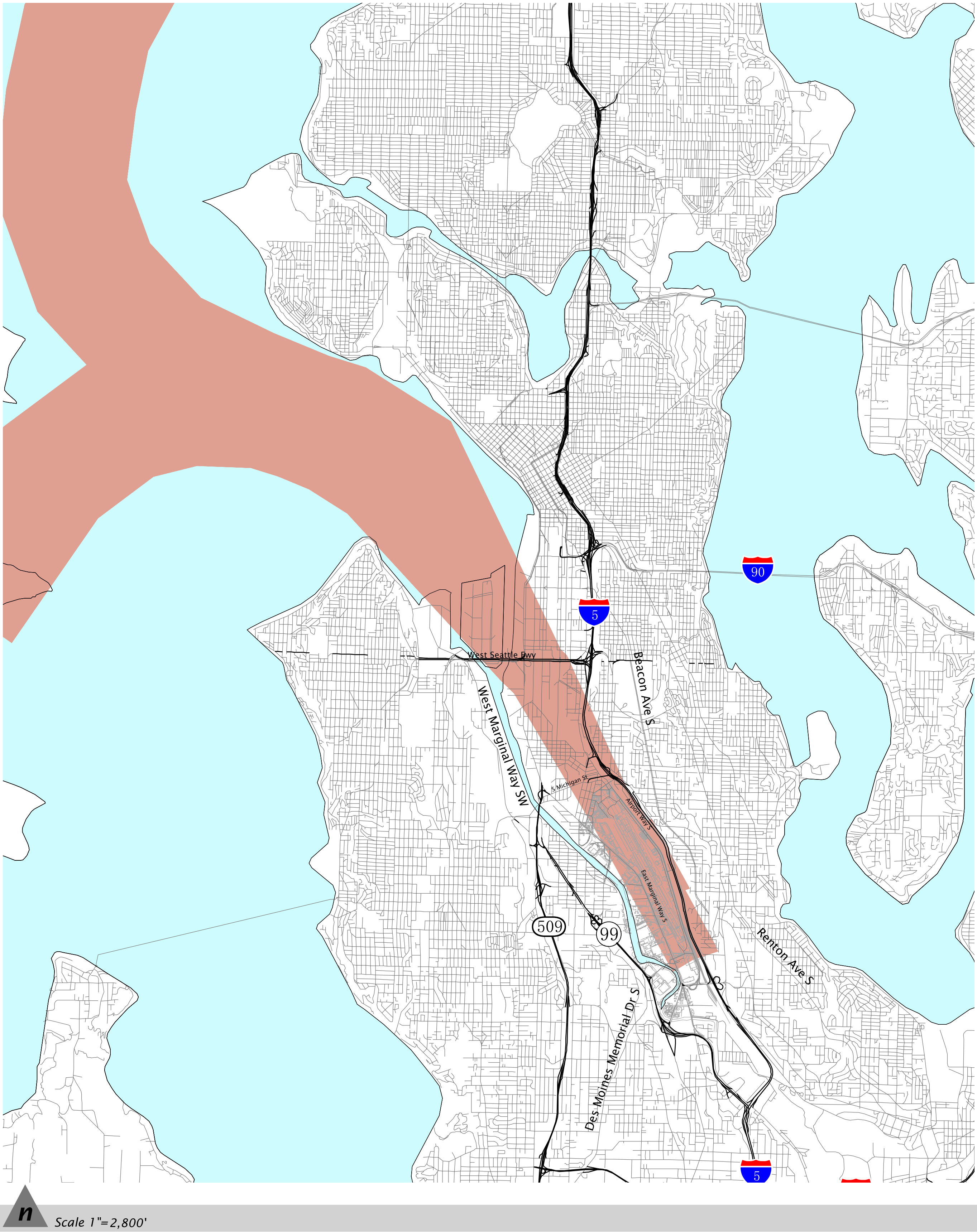


Figure F9a **Alternative 9a Approach Tracks**

Flight Tracks

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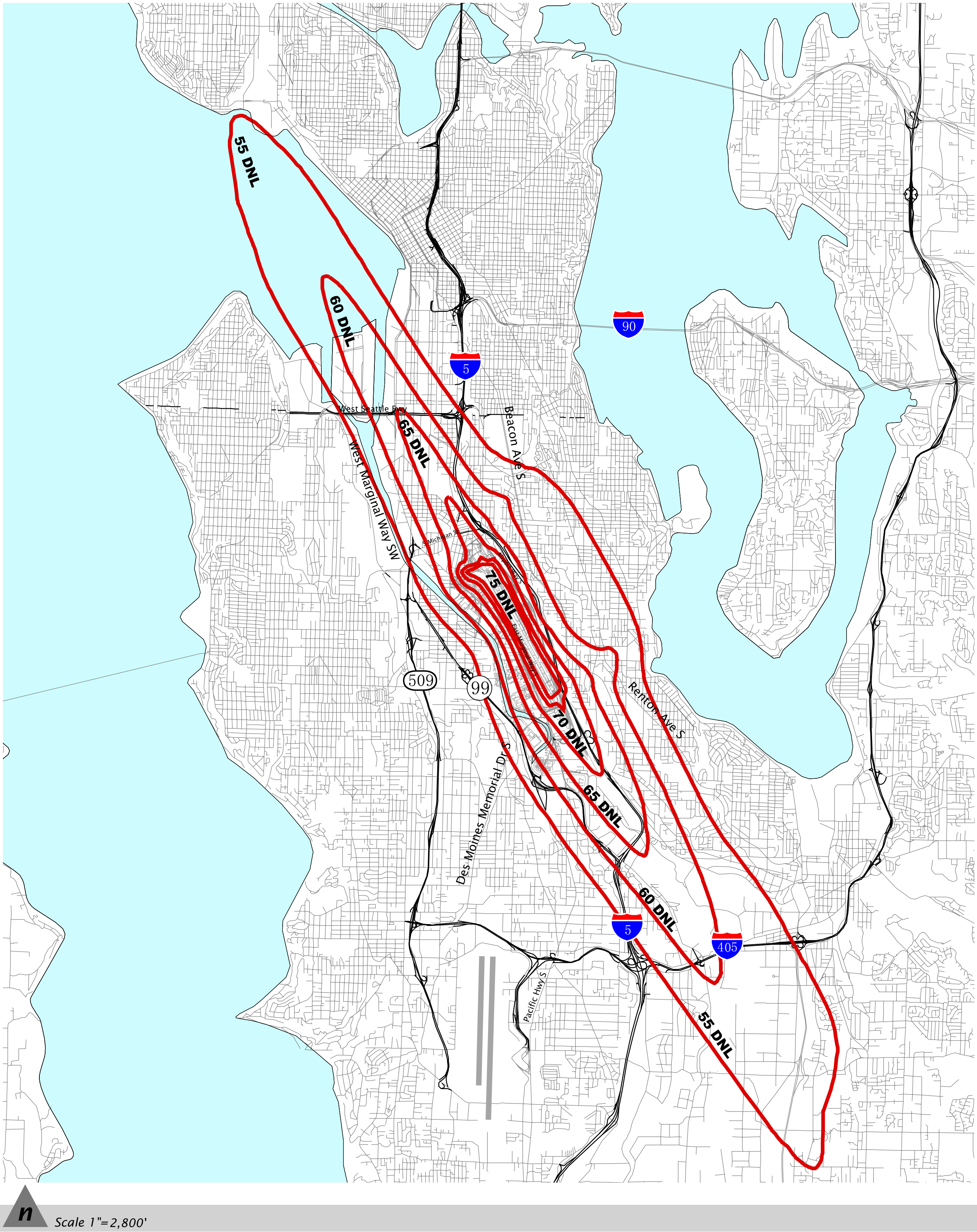
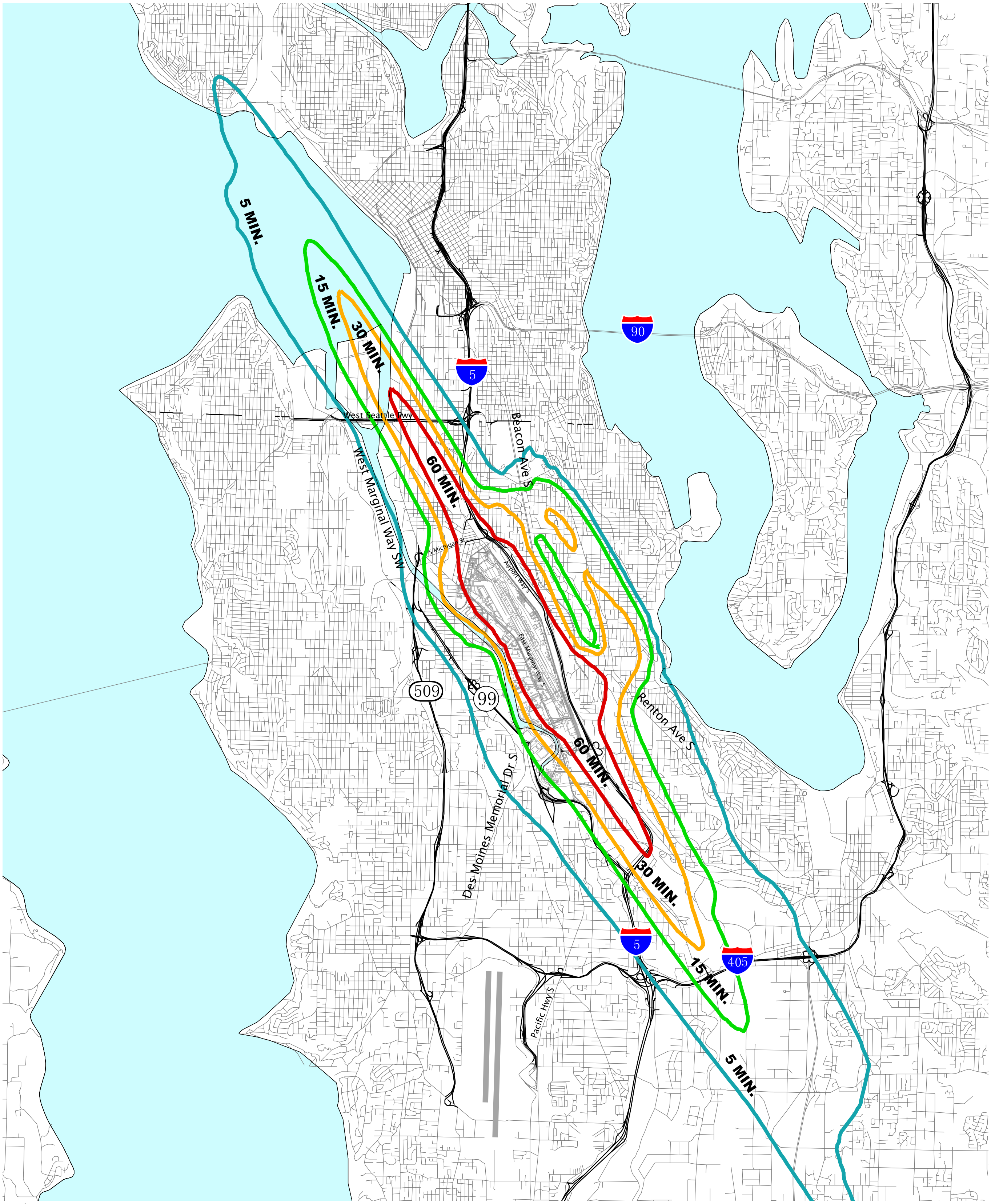


Figure F9b **Alternative 9a, Chartered Visual Approach, All Hours DNL Contour**

Noise Contour

KingCounty
INTERNATIONAL AIRPORT/Boeing Field
FAR Part 150 Study



Scale 1"=10,000'

Figure F9c **Alternative 9a, Chartered Visual Approach, All Hours TA Contours**

- 60 minutes
- 30 minutes
- 15 minutes
- 5 minutes

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Alternative 9b. The second Alternative in this series involves the use of the Charted Visual approach for operations to Runway 13R during the nighttime hours only. This is the same as Alternative 9a, except that it is used only during the nighttime hours when airport operations are lower. This Alternative affectively shifts the flight path from a long straight-in approach to arriving through Elliott Bay. Because of weather, it is assumed that only 50% of the operations are shifted from the straight-in procedure to this procedure. The Alternative 9b DNL contours are shown in Figure F9d, entitled *ALTERNATIVE 9B, CHARTED VISUAL NIGHTTIME ONLY, DNL CONTOURS*, and the Alternative 9b Time Above contours are shown in Figure F9e, entitled *ALTERNATIVE 9B, CHARTED VISUAL NIGHTTIME ONLY, TA CONTOURS*. The represented receptor analysis is presented in Tables F2 through F6 and show some reductions in noise in the Magnolia and Queen Anne area, although it is less than Alternative 9a.

Alternative 9c. The third Alternative in this series involves directing north flow departures through Elliott Bay for all hours of the day and night. Currently many aircraft already utilize this procedure and turn through Elliott Bay. This alternative would more formally establish a procedure to better define that path and direct the aircraft toward the center of the Bay. It would also be designed to monitor and maintain the traffic so that it does not shift too far south over West Seattle. This Alternative is called Alternative 9c, and a description of this procedure is shown in Figure F9f. This figure shows the relative location of the Elliott Bay departure path. The Alternative 9c DNL contours are shown on Figure F9g, entitled *ALTERNATIVE 9C NORTH FLOW ELLIOTT BAY DEPARTURES, ALL HOURS, DNL CONTOURS*, and the Alternative 9c Time Above contours are shown on Figure F9h, entitled *ALTERNATIVE 9C NORTH FLOW ELLIOTT BAY DEPARTURES, ALL HOURS, TA CONTOURS*. The represented receptor analysis is presented in Tables F2 through F6. The results show some reduction in noise in the Magnolia and Queen Anne area.

Alternative 9d. The fourth Alternative in this series involves directing north flow departures through Elliott Bay during the nighttime hours only. Currently many aircraft do turn toward Elliott Bay. This alternative would more formally establish a procedure to better define that path and direct the aircraft toward the center of the Bay. It would also be designed to monitor and maintain the traffic so that it does not shift too far south over West Seattle. This is essentially the same as Alternative 9c, except that it would occur only during the nighttime hours when activity is less. The Alternative 9d DNL contours are shown on Figure F9i, entitled *ALTERNATIVE 9D NORTH FLOW ELLIOTT BAY DEPARTURES, NIGHT ONLY, DNL CONTOURS*, and the Alternative 9d Time Above contours are shown on Figure F9j, entitled *ALTERNATIVE 9D NORTH FLOW ELLIOTT BAY DEPARTURES, NIGHT ONLY, TA CONTOURS*. The represented receptor analysis is presented in Table F2 through F6 and the results show some reduction in noise to the Magnolia and Queen Anne area.

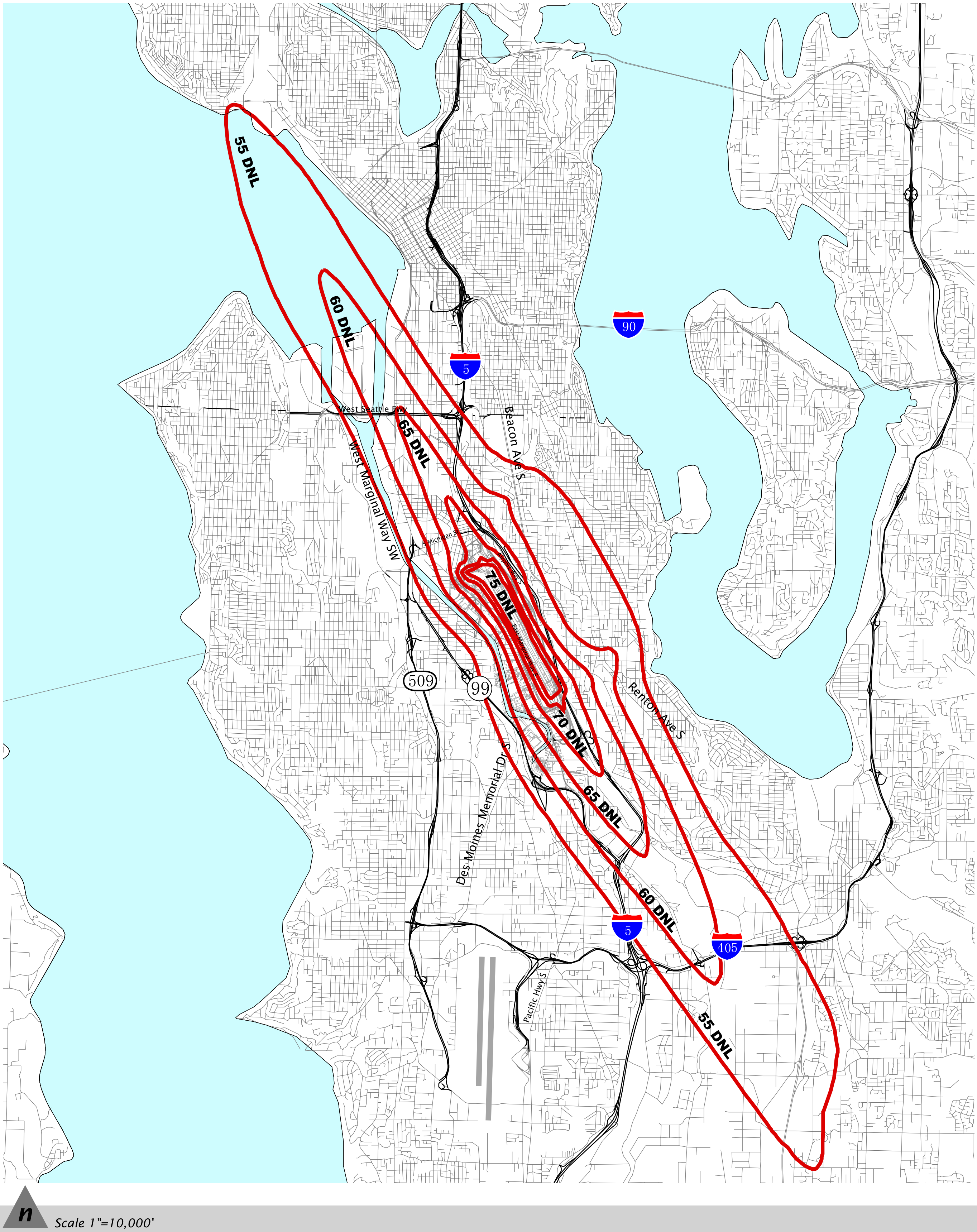

Figure F9d ***Alternative 9b, Chartered Visual Approach, Nighttime only DNL Contours***

Noise Contour

KingCounty
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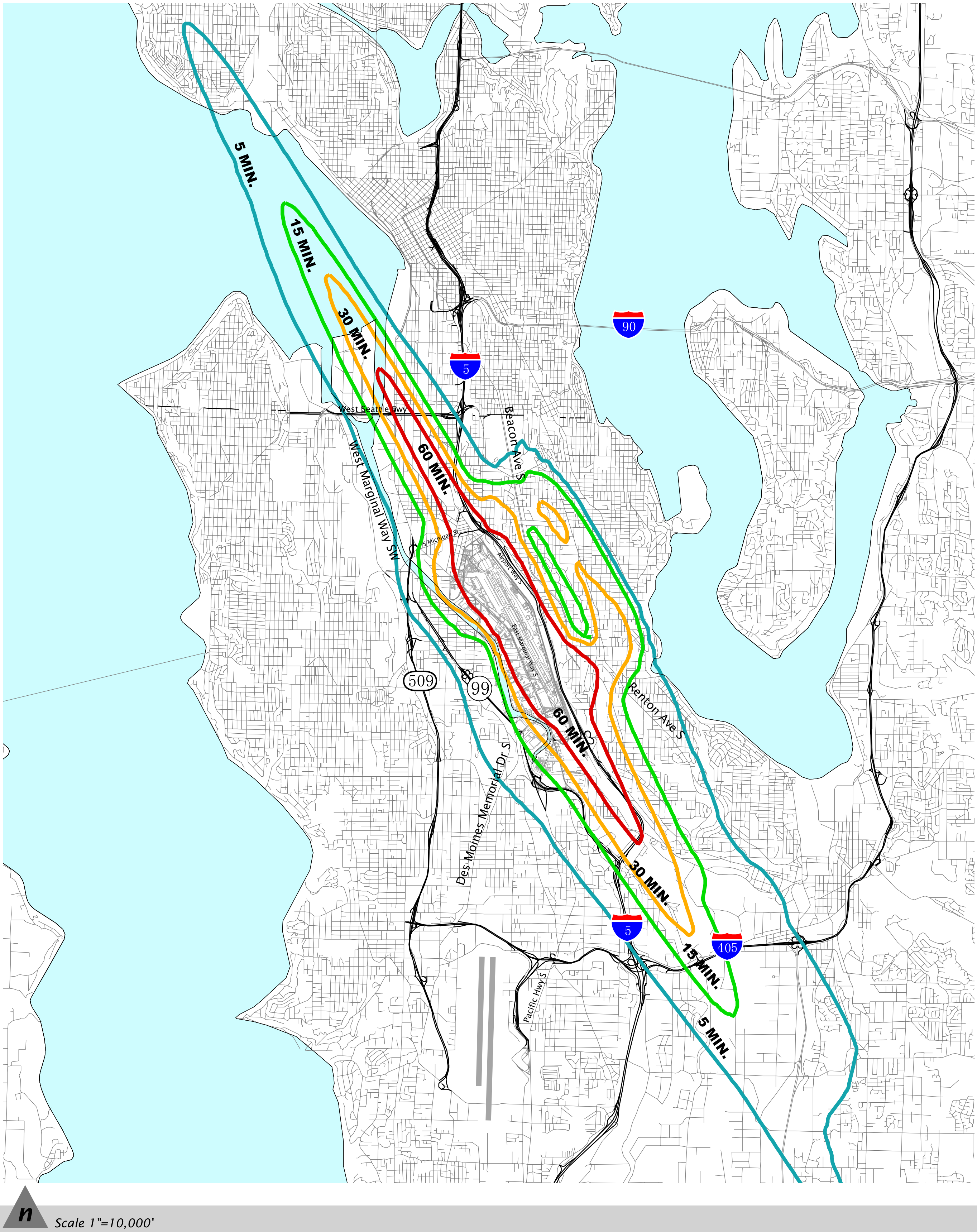

Figure F9e *Alternative 9b, Chartered Visual Approach, Nighttime Only TA Contours*

- 60 minutes
- 30 minutes
- 15 minutes
- 5 minutes

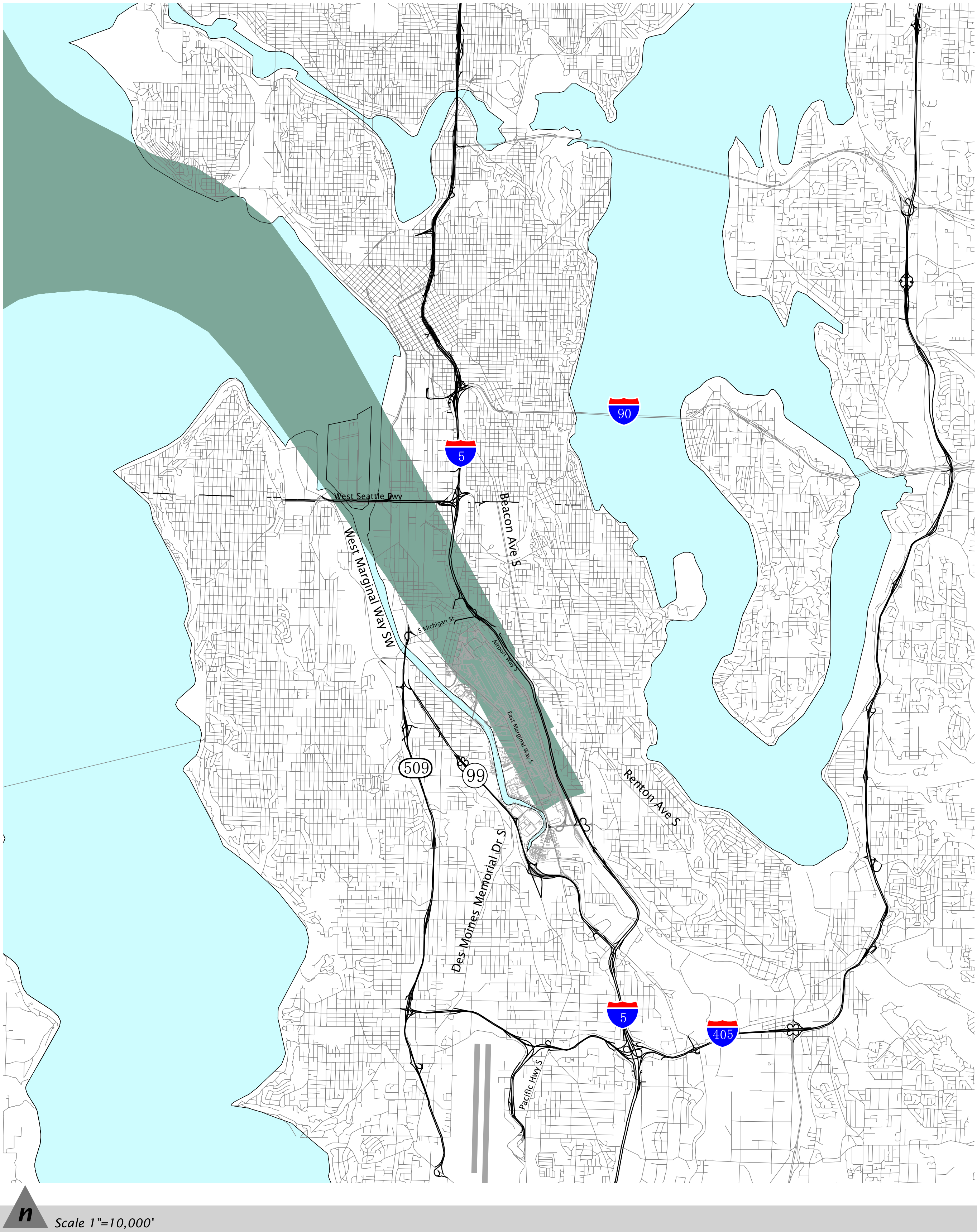

Figure F9f **Alternative 9c, North Flow Elliot Bay Departure, All Hours Departure Tracks**

Flight Tracks

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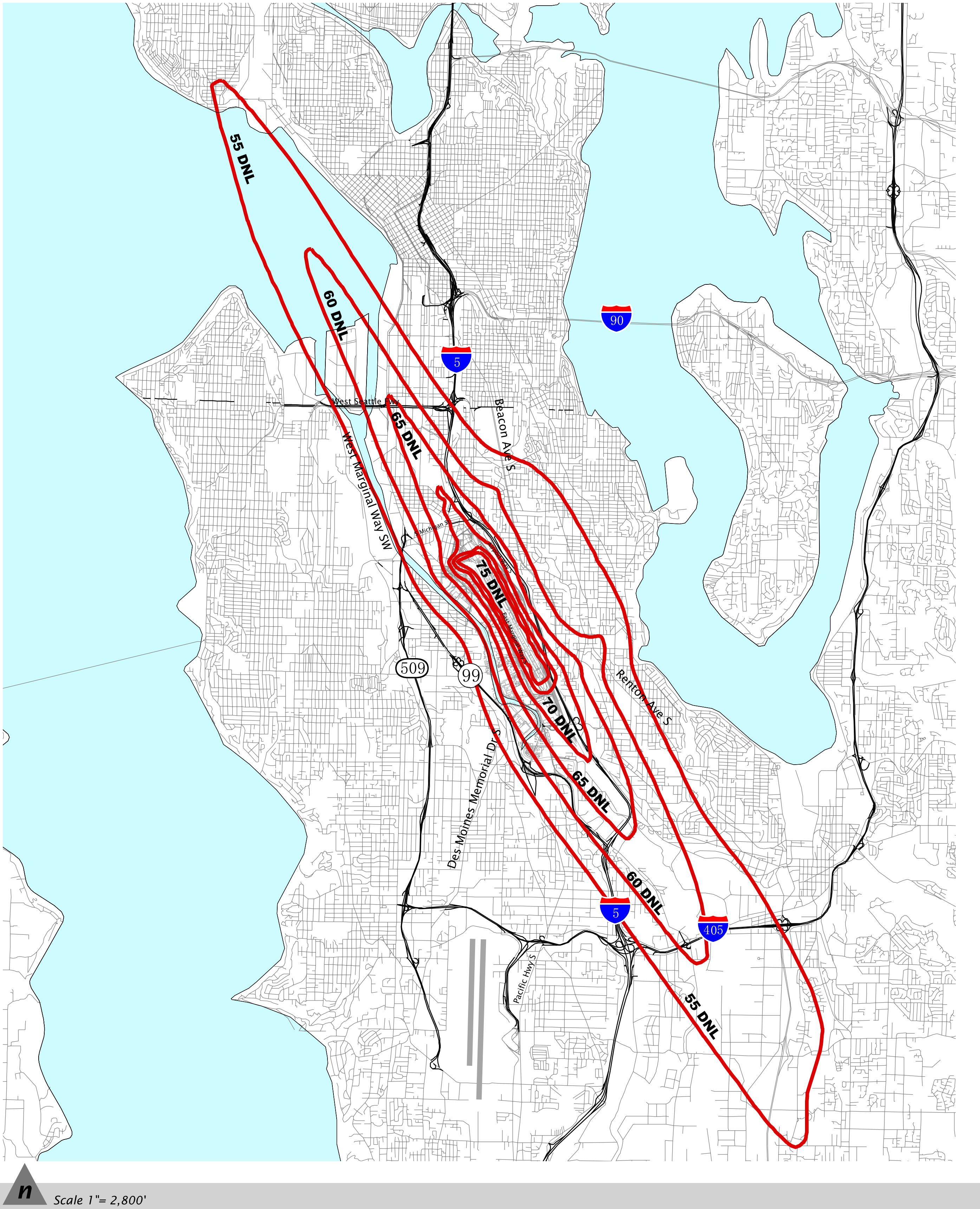


Figure F9g ***Alternative 9c, North Flow Elliot Bay Departure, All Hours DNL Contours***

Noise Contour

KingCounty INTERNATIONAL AIRPORT/Boeing Field FAR Part 150 Study

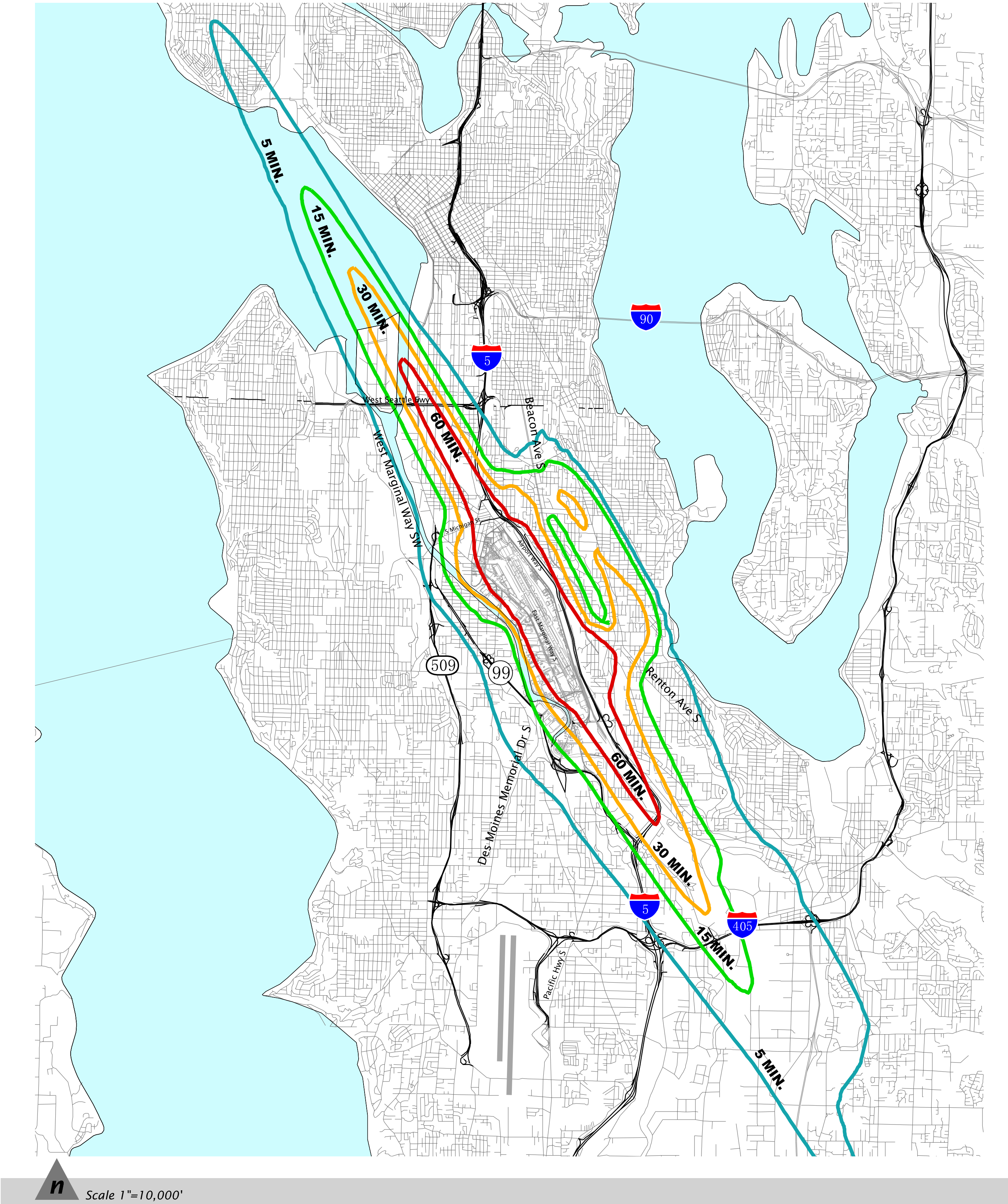


Figure F9h ***Alternative 9c North Flow Elliot Bay Departure, All Hours TA Contours***

- 60 minutes
- 30 minutes
- 15 minutes
- 5 minutes

KingCounty INTERNATIONAL AIRPORT/Boeing Field FAR Part 150 Study

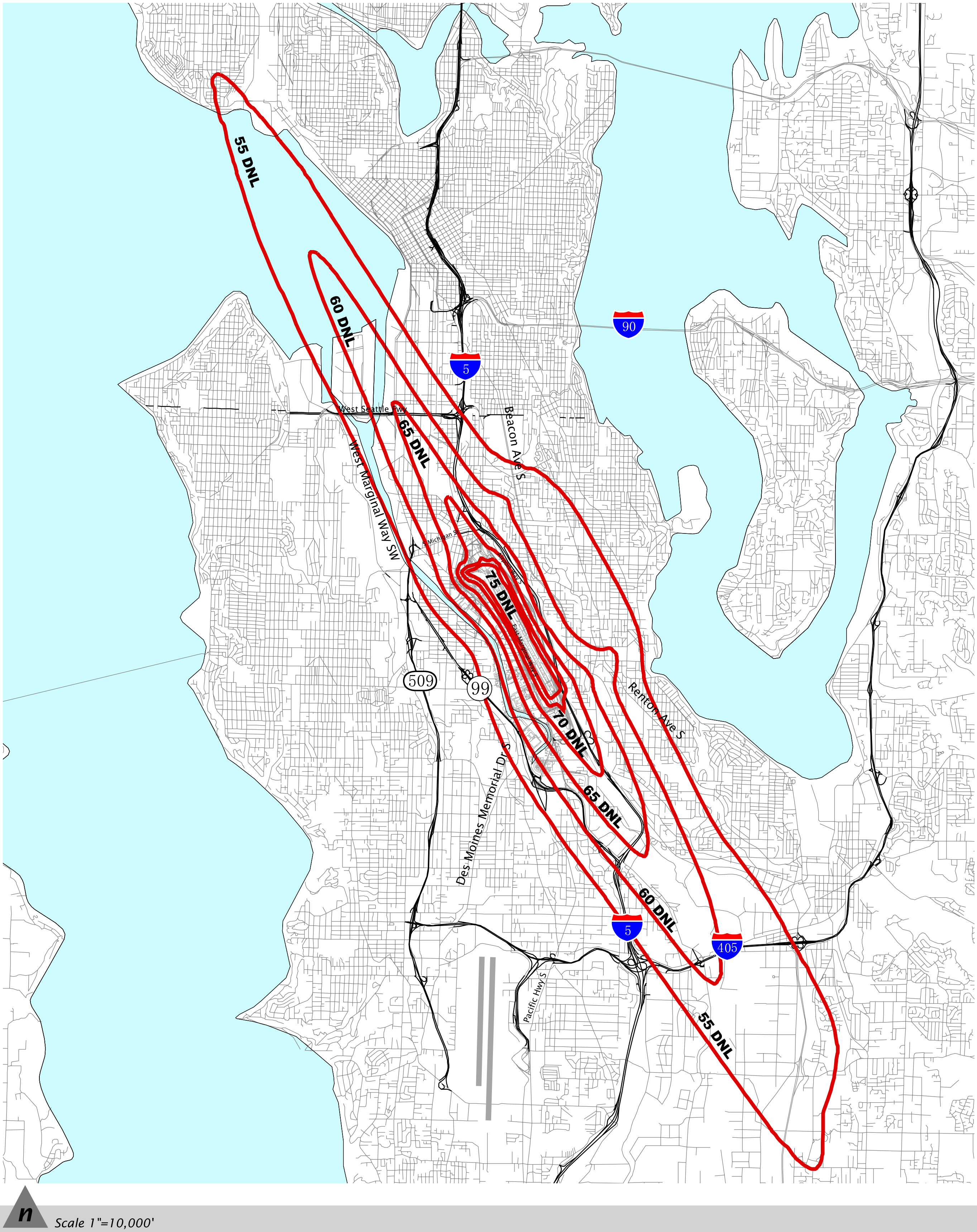


Figure F9i ***Alternative 9d North Flow Elliot Bay Departure, Nighttime DNL Contours***

Noise Contour

KingCounty INTERNATIONAL AIRPORT/Boeing Field FAR Part 150 Study

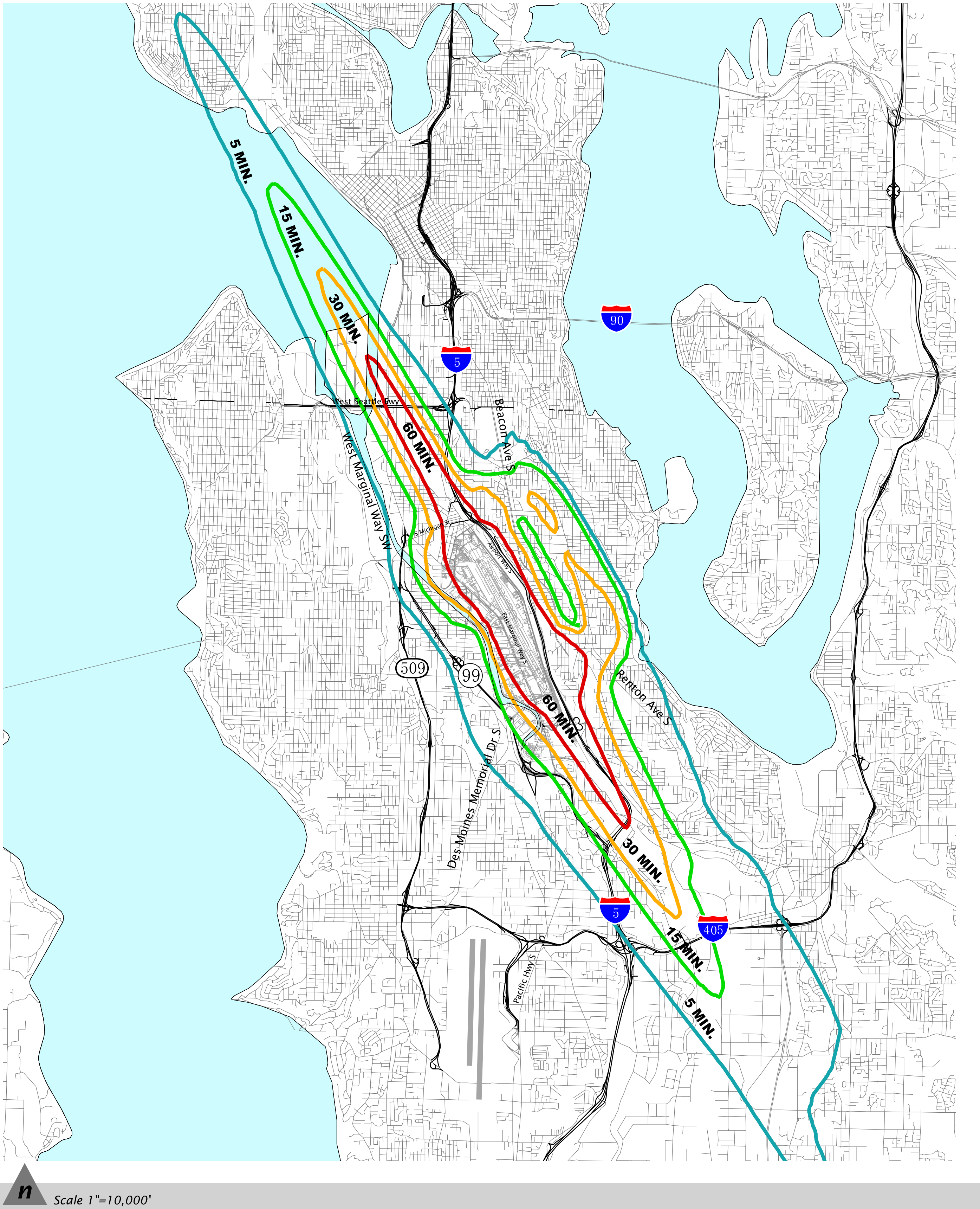


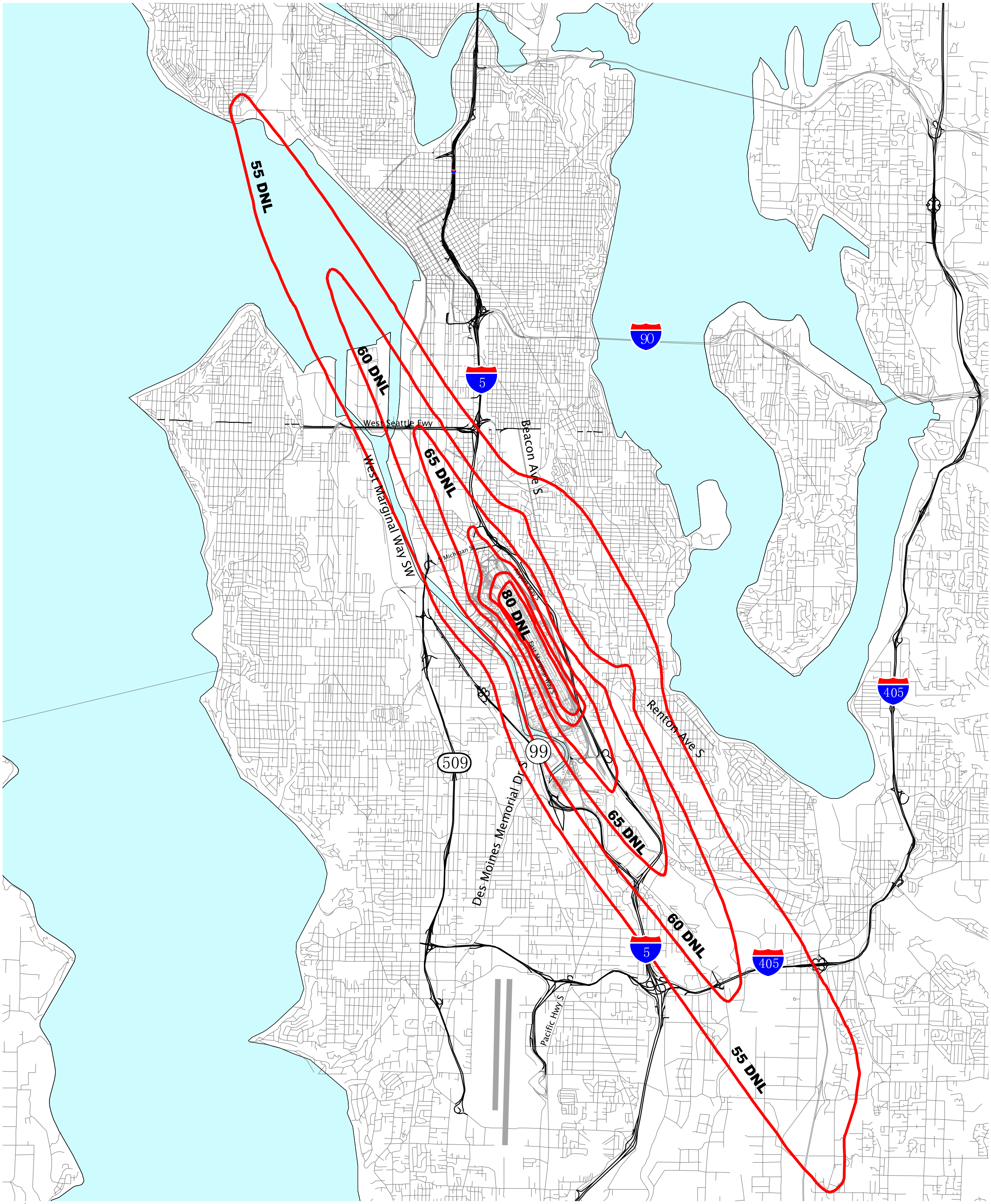
Figure F9j *Alternative 9d North Flow Elliot Bay Departures, Nighttime TA Contours*

- 60 minutes
- 30 minutes
- 15 minutes
- 5 minutes

King County INTERNATIONAL AIRPORT/Boeing Field FAR Part 150 Study

Alternative 9e. The fifth Alternative in this series involves establishing a Global Positioning Satellite (GPS)/Flight Management System (FMS) departure procedure for north flow operations. These procedures would be established to direct the departure operations through the center of Elliott Bay. The Alternative assumes that approximately ninety percent of the departures could comply with this procedure and ten percent would continue with a straight-out departure. As with all departure procedures, this would require close coordination by FAA with the Sea-Tac departures. The Alternative 9e DNL contours are shown on Figure F9k, entitled *ALTERNATIVE 9E NORTH FLOW ELLIOTT BAY GPS/FMS DEPARTURES, DNL CONTOURS*, and the Alternative 9e Time Above contours are shown of Figure F9l, entitled *ALTERNATIVE 9E NORTH FLOW ELLIOTT BAY GPS/FMS DEPARTURES, TA CONTOURS*. The represented receptor analysis is presented in Table F2 through F6.

Alternative 9f. This Alternative is to implement a Transponder Landing System (TPS) at the airport. This is intended to operate in a south flow condition, at least in the initial stages, for approaches from the north. The TLS is a new type of instrument landing system that could allow aircraft to utilize a non-linear approach to the airport in all weather conditions. The system is brand new and no operating procedures have been approved by the FAA yet. The system utilizes the transponder in the aircraft and equipment on the ground to provide vertical and horizontal guidance. Each aircraft using the system would be given a specific transponder code. This requires an attended to provide such a code to approaching aircraft and requires airport personnel as the operator of the TLS. This and other details are still being developed for implementation. However, when it is finally operational, it is reasonable to assume that the noise contours associated with aircraft using the system would be very similar to those associated with an ILS, at least until a curved approach could be implemented. Since this system is not yet operational, no specific contours have been generated.



n Scale 1"= 2,800'

Figure F9k ***Alternative 9e, North Flow Elliot Bay GPS/FMS Departure DNL Contour***

Noise Contour

KingCounty INTERNATIONAL AIRPORT/Boeing Field FAR Part 150 Study

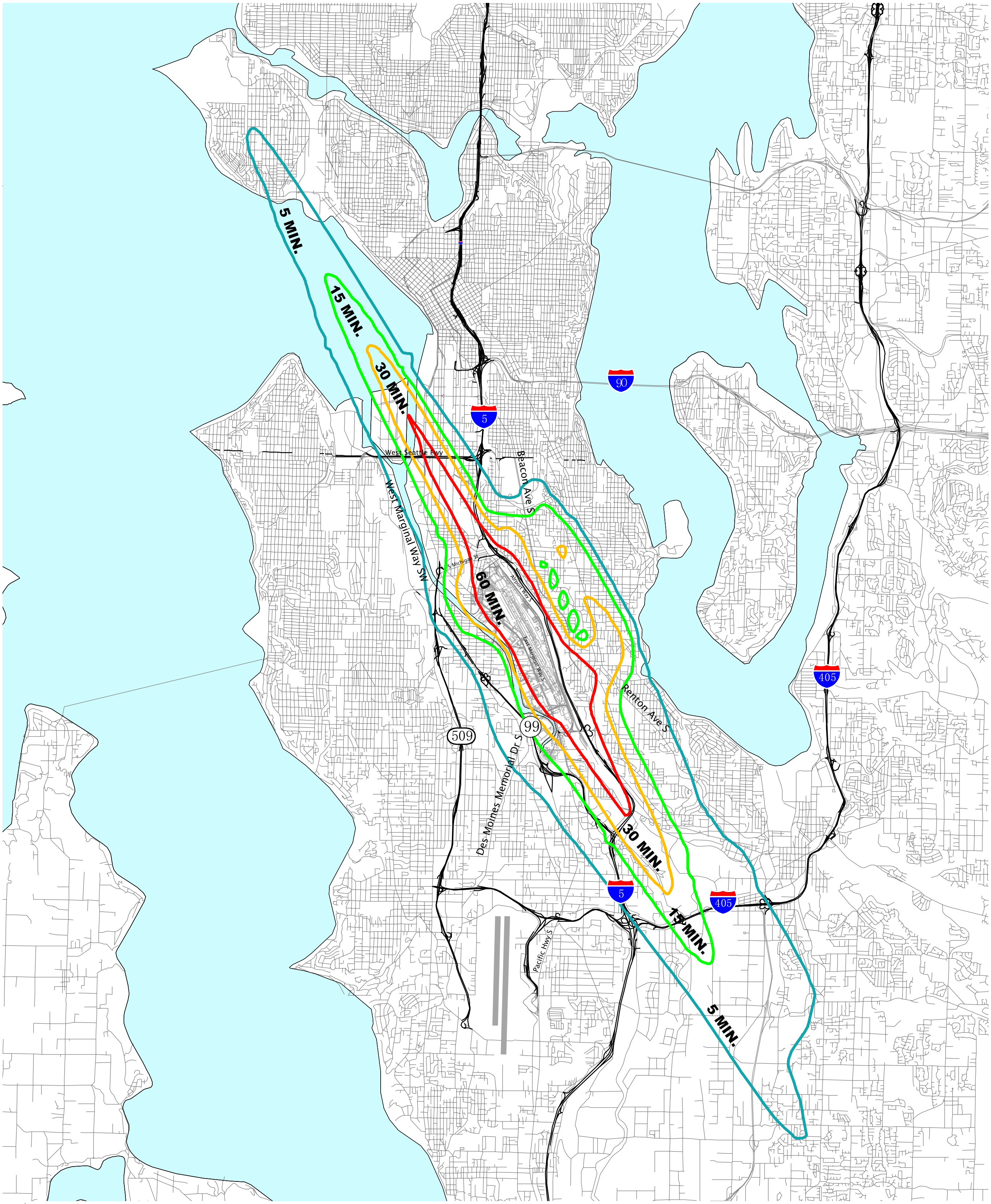


Figure F9l *Alternative 9e, North Flow Elliot Bay GPS/FMS Departure TA Contours*

- 60 minutes
- 30 minutes
- 15 minutes
- 5 minutes

KingCounty INTERNATIONAL AIRPORT/Boeing Field FAR Part 150 Study

Alternative 10-Administrative Actions. This Alternative includes several Administrative actions other than those described above. These could include a Fly Quiet Program, use of ground leases to encourage use of quiet aircraft, as well as other educational efforts and the continuation of the Advisory Committee. The Fly Quiet Program has several components, with the aim being to encourage operators to use quiet aircraft, fly in a responsible manner, recognize operators who operate consistently in a responsible manner and monitor compliance with both voluntary and regulatory noise abatement procedures. Various pilot and operational educational programs, through the FBO's, pilots groups, and national organizations can be used to inform pilots of noise sensitive uses, preferred operating procedures and the Fly Quiet Program. This can be accomplished through various means including noise abatement brochures, Jeppesen Manual chart inserts, publication in national manuals, video programs and corporate discussions.

Use of Leases or Other Fees. Using leases or airport fees to positively affect noise levels around airports is an idea that has been much discussed, but rarely implemented in the U.S. In theory, fees could be used as an incentive to change behavior from undesirable to desirable in such areas as night flights and/or aircraft types. The basic principle in variable fees would be to charge less for a quieter operation and more for a noisier one. Clearly for this approach to have any measurable impact on operations, the variation in fees charged would need to be sufficient to motivate an operator to make a change. Depending on the relative operating costs of each aircraft type, the amount of additional "noise fee" would need to be substantial (probably in the thousands of dollars for a jet aircraft) if it is to successfully influence fleet assignment or schedule decisions. This paper will discuss how such an approach might conceivably apply at KCIA.

Relevant Factors

Before considering any specific ideas, the question of variable fees, as any other noise abatement alternative, needs to be put into a legal and procedural context. According to DOT and FAA regulations, fee schedules need to be consistent, non-discriminatory, based on a defensible economic and acoustic framework (meaning that they are not arbitrary and are tailored towards solving a specific noise problem), and consistent with applicable laws, policies and grant assurances. In addition, military flights, which are among the noisiest operations at KCIA, are exempt from any airport noise regulations, and jets (including corporate aircraft) weighing less than 75,000 pounds are exempt from federal regulations phasing out older and noisier aircraft types. Another important factor for an airport such as KCIA is the fact that most operations are unscheduled, and, therefore, both unpredictable and difficult to regulate. Finally, a change in fee structure for environmental purposes would almost certainly require a Part 161 study. The extent of that study would depend on the specific nature and application of the fee proposed – specifically whether it only applied to Stage 2 aircraft or to Stage 3 aircraft also.

Possible Fee Areas

At KCIA, there are two areas where variable fees might apply: leases and landing fees.

Leases At KCIA all tenants have leases of some kind, which vary considerably in nature and duration. Many leases are for non-aeronautical uses and would not logically be included in any noise abatement program. Two categories of lease holders might be responsive to noise abatement fees: airlines/cargo carriers and fixed base operators (FBOs), who handle the unscheduled corporate and itinerant aircraft. FBOs are companies servicing all types of aircraft for general aviation, corporate, charter and other operators without permanent facilities at KCIA. FBOs provide parking, fuel, maintenance, and other services for hire.

For airlines/cargo carriers, lease rates could theoretically be an incentive for quieter operations; however, for FBO tenants this concept is more difficult. By definition FBOs service all kinds of aircraft and do not have the ability to influence their customers' decisions on aircraft type or time of operation. Changing either the rates per square foot, or any other provision in the overall lease, is unlikely to affect the behavior of the FBO's customer base and is probably too blunt an instrument to create the changes desired by local area residents.

Airlines operating at KCIA range from cargo operators in large aircraft to small commuter and helicopter operators. Their varying operating characteristics, noise levels and financial strength would seem to make any consistent price incentive per square foot in ground rents both difficult to calculate and highly unlikely to affect aircraft operations. The relative scale of the cost structures of these airline tenants is simply too wide to achieve a consistent approach to lease rates that would achieve any environmental benefit.

In addition, from a practical standpoint, leases at KCIA run for different terms. Although a few are up for re-negotiation within the period considered during this Part 150 Study, most run for long periods of time – in some cases decades beyond this Study's completion. For these reasons, variable rental rates in leases are not likely to be fruitful as a topic for additional analysis or consideration in the area of noise mitigation. It is also explicit in the regulation that noise provisions in leases are subject to FAR Part 161.

Landing and Similar User Fees. At KCIA landing fees are charged to all commercial operators; that is all flights that carry passengers and/or cargo for a fee. As at all U.S. airports, landing fees are charged at a fixed price per 1,000 pounds of landed aircraft weight. Aircraft are not literally weighed on arrival; rather weights are taken from standard aircraft operating documents, and the appropriate fee is then applied.

Again, although there has been occasional discussion in the U.S. about varying landing fees according to the noise characteristics of aircraft, little has actually been implemented. The few examples that do exist have been at air carrier airports, where operations are scheduled and therefore more easily tracked. Even these examples have largely become moot as of January 1, 2000 when the entire U.S. fleet became all Stage 3. However, they may be useful to review as historical precedents and possible partial models for KCIA.

Palm Beach International Airport (PBIA)

Perhaps the most innovative and extensive variable fee program was instituted at PBIA more than a decade ago. This date is important, because the regulation was implemented before the Aviation Noise and Capacity Act (ANCA) legislation was enacted making it "grandfathered" for Part 161 purposes meaning that the airport did not need to complete a Part 161 Study in order to implement the regulation. The premise of the PBIA fee structure was to radically increase landing fees both for less desirable (Stage 2) aircraft and for nighttime operations and to simultaneously reduce or credit landing fees for carriers operating the quietest aircraft types.

The fee structure at PBIA is set out in the following matrix.

Aircraft Part 36 Stage	Time of Day Operation Type	Multiplier	Fee Amount
2	Night Landing	13	$260.00
2	Night Departure	130	$2600.00
2	Day	1.3	$26.00
3	Night	1.0	$20.00
3	Day	NA	Credit based on % Stage 3 operations

During the last decade this fee structure combined with publicity about the Stage 3 percentage each carrier maintained at Palm Beach caused the airport to hasten the transition towards a totally Stage 3 fleet. Now that all air carrier aircraft greater than 75,000 pounds are Stage 3, the only flights paying the multiplier costs at night are general aviation flights. These fees are collected through the FBOs , which has caused some logistical issues including tracking non-scheduled flights and collecting the fees. These logistics are important to consider for application at KCIA as well.

Minneapolis/St. Paul International Airport

In 1990, MSP instituted an environmental fee or surcharge on the regular landing fee as part of their general terminal lease to help fund an extensive noise abatement program. This lease provision was superceded at the end of 1999 when the U.S. fleet became 100% Stage 3. The fee was calculated by determining the cost of the airport's noise abatement programs and then charging each airline a percentage in proportion to their scheduled Stage 2 operations. Stage 3 operations were charged a lower rate. This program has been replaced by a straight assessment negotiated with the airlines for the noise abatement program.

Stapleton Airport – Old Denver

As part of a "noise budget" program established during the late 1980s, Stapleton allocated a fixed amount of noise to each carrier based on its projected schedule, aircraft and engine types and time of day. Every six months the airport calculated whether or not each airline had exceeded this allocation, and if they did, the excess would be converted to "equivalent aircraft flights", which were then charged $2,000.00 each. Of course, Stapleton airport was closed in 1995, when the new Denver International Airport was opened, so this rule ceased to exist.

Lessons From These Examples

In one sense this short list of variable fees for noise abatement is a microcosm of the situation which led Congress to adopt ANCA. Airlines complained heatedly that there were too many different and uncoordinated regulations being created at the local level. The airlines' position was (and is) that aviation is a national system requiring consistency, since aircraft must move about through many local jurisdictions. Responding to this argument, Congress agreed to the national phase out of Stage 2 aircraft to reduce noise nationally in a consistent fashion, and in exchange passed the Part 161 regulation making it very difficult (some would argue impossible) for local airport proprietors to write local noise regulations.

Possible Application at KCIA

The landing fee at KCIA has not been changed for some time, so there might be an argument that it needs updating with or without noise as a consideration. However, if a noise component were to be added to the landing fee, FAA would most likely require a Part 161 Study. The extent and stringency of the required cost benefit analysis would depend on whether the proposed noise fee applied to Stage 2 aircraft only or to all aircraft. Equally important is the clearly identified purpose for such a fee, and what goals it is intended to achieve.

Among possible goals for a variable fee program are:

- Reducing the number of operations at night
- Changing the type of aircraft operating at night
- Improving the noise characteristics of the fleet in general
- Raising revenue for noise abatement programs.

To assess the probably effectiveness of a variable fee or noise surcharge in achieving any of these goals, an economic analysis would need to consider a variety of factors:

- How does the proposed fee relate to the general operating costs of the aircraft in question?
- Would the amount of the proposed fee be sufficient to affect the desired change; for example, what kind of fee would be required to motivate a carrier to hush kit an aircraft or purchase a new, quiet aircraft?
- Is the desired change possible to achieve in any circumstances; for example, would any fee cause an airline to move a cargo flight out of the nighttime period?
- Would a fee of sufficient magnitude to affect the desired change be consistent with existing federal policies on airport rates and charges?
- Would the user costs of the program be in proportion to the environmental benefits achieved?

Hypothetical Example of Nighttime Fee for Stage 2 Operations at KCIA

For purposes of discussion, the following example demonstrates how a variable landing or similar fee might be applied at KCIA and how it would be evaluated for effectiveness. The goal of this theoretical example would be to reduce the number of Stage 2 operations at night by either moving these flights out of the nighttime period, or by causing an operator to replace a Stage 2 aircraft with a Stage 3 model. All Stage 2 aircraft in the U.S. are below 75,000 pounds, and at KCIA, these are either commuter flights or older, corporate jets. Projections for 2006 indicate about one nighttime flight per night in Stage 2 corporate jets.

The fee proposed in this discussion example is not a landing fee, but an operations fee, because as the name implies, landing fees are only charged on arrival. Night noise is, of course, as much a departure problem as an arrival one. Therefore, whatever the basis for the fee, to be successful in affecting nighttime noise, it would have to apply to both arrivals and departures. This would be considered an operations rather than a landing fee.

Again for purposes of discussion, let us assume that the nighttime operations fee would be a multiple of the daytime landing fee. If a regular landing fee was $50.00, a nighttime fee might be a multiple of 10, or 20 ($500 or $1,000). For operators not subject to a daytime landing fee, specifically non-commercial flights, two options are theoretically possible: either institution of a 24 hour landing fee for non commercial flights subject to the same multiplier at night as would apply to commercial operators, or a specific fee that would only apply to flights during the nighttime period.

For purposes of analyzing the environmental benefit of such a fee, an economic analysis would consider several factors including: the hourly operating cost for each aircraft to see whether a nighttime operations fee would likely cause a flight to be re-scheduled. On average, it costs about $3,000 an hour to operate a business jet of this size. A price elasticity analysis would help predict what the impact on actual flight times might be for a nighttime operations charge of $500 or $1,000.

Another variable to consider is the development of retrofit or hush kits for some of the Stage 2 business jets. Similar to the hush kits now installed on previously Stage 2 passenger and cargo aircraft (737s, DC9s and 727s in particular), these engine installations serve to lower noise levels sufficiently to allow an aircraft to be re-certified by FAA as meeting the Stage 3 noise standards. Although these kits are not yet available on the market, they are being developed and tested.

One possible outcome of a nighttime operations fee might be to encourage operators of Stage 2 business jets to purchase and install hush kits once they are certified. To evaluate the probability that a nighttime noise charge would motivate operators to install hush kits, one would need to know their initial cost (probably in the $1 million range for a Gulfstream 2), as well as any other operational factors such as decreased gross takeoff weight and/or reduced power settings that might be involved in their operation. Then a calculation might be made as to how operators of Stage 2 business jets might respond to the question of whether to pay the additional nighttime fee, reschedule the flight, or install a hush kit. Purchase of a new Gulfstream model is in the range of $20 million, so there is no conceivable noise fee which could affect a decision of that magnitude.

In considering an airport's desire to enact a nighttime operations fee, the FAA will require a clear identification of the noise problem to be solved and a thorough cost benefit analysis showing the relative scale of the economic impact compared to the environmental benefit. If the benefit to be achieved is merely the rescheduling of one flight per night, for example, there will need to be a compelling argument in favor of such a fee. That argument might turn around the concept of future protection; that is the introduction of an insurance policy, so to speak, during a period when the economic costs to operators are low, because there are few operations. The environmental benefit might be to protect the nighttime hours from future operations noisy aircraft. Whether this or any similar argument would prevail is, of course, unknown.

<u>On-Going Committee</u>. An additional administrative action is recommended for consideration. Some variation of the Study Advisory Committee should remain in place subsequent to the completion of this study and meet on a regular basis to discuss noise abatement issues at the airport. This is especially true concerning the community planning representatives and their role in keeping the airport, citizens, communities and others informed on land use issues that concern the airport environs as well as Air Traffic Control tower personnel in discussing aircraft procedures. It is recognized that the Roundtable is an on-going Committee, however, the expanded Roundtable that is serving as the Study Advisory Committee may be advantageous to

continue. This on-going committee structure has been successful elsewhere in the form of a "Planners Forum" that involves both citizens and staff representatives. This is especially important due to the inter-jurisdictional issues involved. Considerable time and effort will be expended, by both the airport and the Committee, in the development of this Study, especially in the "learning curve" effort, that is too valuable a tool for communication to risk loosing at the end of this process.

Closure of the Airport. Another administrative action requested by the Committee is the impact of closing the Airport. Closure of King County International Airport, if possible, would require King County to meet several terms related to its past acceptance of grants of funds administered by the Federal Aviation Administration. Over the years, King County has accepted funding for various projects from the Airport and Airway Improvement Trust Fund, which requires the County to meet several assurances (referred to as Grant Assurances). Upon acceptance of the grant funds, these assurances are incorporated into the contractual agreement between King County and the FAA.

The grant assurances are numerous and include:

> "The terms, conditions and assurances of the grant agreement shall remain in full force and effect throughout the useful life of the facilities developed or equipment acquired for an airport development or noise compatibility program project, or throughout the useful life of the project items installed within a facility under a noise compatibility program project, but in any event not to exceed twenty (20) years from the date of acceptance of a grant offer of Federal funds for the project. However, there shall be no limit on the duration of the assurances regarding Exclusive Rights and Airport Revenue so long as the airport is used as an airport. There shall be no limit on the duration of the terms, conditions and assurances with respect to real property acquired with Federal funds...." (B.1.)
>
> "It will make the airport available as an airport for public use on reasonable terms and without unjust discrimination to all types, kinds and classes of aeronautical activities, including commercial aeronautical activities offering services to the public at the airport." (C.22.a)
>
> "In any agreement, contract, lease or other arrangement under which a right or privilege at the airport is granted ... to conduct or to engage in any aeronautical activity for furnishing services to the public at the airport, the sponsor will insert and enforce provisions requiring the contractor to (1) furnish said services on a reasonable and not unjustly discriminatory, basis to all users thereof, and (2) charge reasonable, and not unjustly discriminatory, prices ....."(C.22b.)

As a result, the closure of KCIA as a public use airport would find King County in default of its grant assurances. Theoretically, the County could reimburse the FAA for the receipt of all federal grants received, in current dollars, in addition to the cost of acquiring all lease interests that have been granted over the years. However, the cost to do so would be substantial. Further, because of the Boeing Company's dependence on use of the airfield, it is likely that the facility would remain an airport, but be designated as a private facility. While in theory, this could limit the Airport's use to Boeing Company activities, it is possible that the Boeing Company could then lease lands within its landholdings to other aircraft operators (airlines, cargo operators, and general aviation operators). The end product theoretically could be the Airport as it exists today, without the governmental oversight provided by King County.

The closure of KCIA would have an economic impact on the Puget Sound Region. Today, the Airport generates about 10,600 jobs within the Puget Sound Region and contributes about $1.5 billion to the economy. If the Airport were closed, it has been estimated that there would be a loss of 75-80 percent of these benefits – or a loss of 7,687 jobs and impact of about $1.2 billion in economic impact. Although it can be debated as to how the closure of the Airport would affect the economy, some of the effects would be re-distributed within the Puget Sound Region while others would be exported from the region and possibly from the State. The University of Washington estimates that about 87 percent would be exported from the region.

Contour Evaluation

Each modeled alternative has been evaluated and compared not only to each other, but to the Base Case Future noise contours. The DNL evaluation will compare the number of residents and acres of residential land uses within the 55 and greater noise contours, other noise sensitive uses within those contours and overall size of the contours. The DNL contour comparison is shown in Table F1, and the Representative Receptor comparisons are shown in Tables F2 thought F6 which address the supplemental noise metrics described earlier.

Table F1

CONTOUR COMPARISON FOR EACH MODELED ALTERNATIVE

King County International Airport FAR Part 150 Study

Land Use	Existing	Base Case	A1a	A2a	A5	A9a	A9b	A9c	A9d	A9e	A2c	A2b	A1b
DNL 55													
Residences	15,770	21,197	19,015	19,698	20,096	20,055	20,054	20,305	20,433	20,233	8,768	16,359	15,674
People	39,366	57,265	47,214	48,873	49,983	49,920	49,923	50,429	50,682	50,225	21,261	41,135	39,566
Schools	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Acres	13,880	17,100	16,010	16,505	17,144	17,177	17,180	17,150	17,166	17,139	8,519	13,910	13,244
DNL 60													
Residences	4,649	6,862	5,631	5,952	6,430	6,437	6,437	6,429	6,428	6,420	2,588	4,368	3.907
People	11,095	17,616	13,518	14,299	15,442	15,454	15,451	15,440	15,420	15,432	6,104	10,572	9,535
Schools	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Acres	5,436	6,833	6,241	6,493	6,852	6,839	6,845	6,882	6,876	6,875	3,531	5,237	4,905
DNL 65													
Residential	290	459	361	400	463	461	460	463	460	533	126	240	200
Residences	1,227	2,011	1,511	1,638	1,852	1,844	1,844	1,853	1,842	1,844	586	995	843
People	2,751	4,890	3,310	3,623	4,166	4,152	4,151	4,163	4,141	4,155	1,263	2,168	1,865
Schools	1	1	0	0	0	0	0	0	0	0	0	0	0
Com/Retail	145	186	164	172	189	188	188	189	188	267	116	166	149
Manufacture	655	863	773	810	860	861	861	864	865	1,224	596	857	810
Other	1,176	1,357	1,268	1,304	1,354	1,354	1,356	1,354	1,355	844	639	779	716
Total Acres	2,266	2,865	2,566	2,686	2,866	2,864	2,865	2,870	2,868	2,868	1,477	2,042	1,875

A1a Ban Stage 2 Aircraft **A2a** Ban Stage 2 Aircraft at Night **A5** Example Fly Quiet Program **A9a** Chartered Visual Approach, All Hours **A9b** Chartered Visual Approach, Nighttime Only **A9c** Elliot Bay Departure, All Hours **A9d** Elliot Bay Departures, Nighttime Only **A9e** North Flow Elliott Bay GPS/FMS Departure **A2c** No Night Flights **A2b** No Night Hush Kitted or Louder

A1b No Hush Kitted or Louder, All Hours.

Table F1 Continued

CONTOUR COMPARISON FOR EACH MODELED ALTERNATIVE

King County International Airport FAR Part 150 Study

Land Use	Existing	Base Case	A1a	A2a	A5	A9a	A9b	A9c	A9d	A9e	A2c	A2b	A1b
DNL 70													
Residential	40	66	47	54	68	65	65	67	65	73	10	29	23
Residences	143	356	238	267	326	326	326	324	325	334	18	112	80
People	304	762	466	538	678	670	669	668	663	693	46	234	170
Schools	0	0	0	0	0	0	0	0	0	0	0	0	0
Com/Retail	55	83	70	76	84	84	84	84	84	81	8	42	31
Manufacture	210	322	248	274	308	311	310	306	310	363	163	221	206
Other	570	689	618	643	684	686	686	686	686	616	423	495	483
Total Acres	875	1,160	983	1,047	1,144	1,146	1,145	1,143	1,145	1,133	604	787	743
DNL 75													
Residential	0	0	0	0	0	0	0	0	0	4	0	0	0
Residences	0	0	0	0	0	0	0	0	0	6	0	0	0
People	0	0	0	0	0	0	0	0	0	14	0	0	0
Schools	0	0	0	0	0	0	0	0	0	0	0	0	0
Com/Retail	0	2	0	0	11	9	7	10	9	0	0	0	0
Manufacture	49	79	50	60	79	74	74	78	74	59	41	41	38
Other	363	418	367	380	405	403	403	405	403	409	308	336	332
Total Acres	412	499	417	440	484	477	477	483	477	472	334	377	370

A1a Ban Stage 2 Aircraft **A2a** Ban Stage 2 Aircraft at Night **A5** Example Fly Quiet Program **A9a** Chartered Visual Approach, All Hours **A9b** Chartered Visual Approach, Nighttime Only **A9c** Elliot Bay Departure, All Hours **A9d** Elliot Bay Departures, Nighttime Only **A9e** North Flow Elliott Bay GPS/FMS Departure **A2c** No Night Flights **A2b** No Night Hush Kitted or Louder

A1b No Hush Kitted or Louder, All Hours.

Contour totals do not include rights-of-way or bodies of water.

The following tables, F2 through F6 show changes in noise levels for the representative receptor locations for the following metrics; DNL, nighttime Leq, Time Above, Lmax and SEL. The significant changes, as presented on page F.1, are shown in **red type** in each of the tables.

Table F2
Representative Receptor Analysis (DNL)

Site	Description	DNL Noise Level												
		Ex 1999	**Base 2006**	A1a 2006	A2a 2006	A5 2006	A9a 2006	A9b 2006	A9c 2006	A9d 2006	A9e 2006	A2c 2006	A2b 2006	A1b 2006
A1	Magnolia	52.0	**53.5**	53.3	53.4	51.2	52.0	52.4	53.1	52.9	53.0	49.0	53.0	52.9
A2	West Seattle	51.3	**52.6**	52.0	52.2	52.6	52.6	52.6	52.6	52.6	52.6	48.7	50.5	50.0
A3	Magnolia	54.2	**55.7**	55.5	55.6	53.5	54.3	54.6	55.4	55.2	55.2	51.2	55.1	55.0
A4	Tukwila	62.1	**63.3**	62.7	62.9	63.3	63.3	63.3	63.3	63.3	63.3	59.5	61.0	60.3
A5	Skyway	45.7	**47.1**	46.5	46.8	47.8	47.4	47.4	47.4	47.5	47.7	43.4	45.8	45.5
A6	Seattle	69.1	**70.6**	69.6	70.0	70.6	70.6	70.6	70.6	70.6	70.6	67.1	68.4	68.1
A7	Georgetown	66.4	**67.7**	66.9	67.2	67.9	67.8	67.8	67.8	67.8	67.9	64.5	65.6	65.2
A8	Skyway	58.6	**59.8**	59.1	59.4	59.8	59.8	59.8	59.8	59.8	59.8	56.1	57.7	57.1
A9	Foster	63.8	**65.0**	64.5	64.7	65.0	65.0	65.0	65.0	65.0	65.0	60.9	63.2	62.7
S01	Tukwila	61.1	**62.3**	61.7	62.0	62.3	62.3	62.3	62.3	62.3	62.3	58.4	59.9	59.1
S03	Tukwila	58.6	**60.0**	59.3	59.6	60.0	60.0	60.0	60.0	60.0	60.0	56.2	58.2	57.8
S04	Georgetown	70.0	**71.4**	70.9	71.1	71.2	71.3	71.3	71.4	71.3	71.3	67.3	69.9	69.6
S06	Tukwila	66.9	**68.2**	67.5	67.8	68.2	68.2	68.2	68.2	68.2	68.2	64.3	65.6	64.8
S07	Magnolia	47.4	**48.7**	48.6	48.7	48.3	48.5	48.6	48.6	48.5	48.4	44.9	48.5	48.5
S08	Beacon Hill	60.4	**61.7**	61.2	61.4	61.7	61.7	61.7	61.7	61.7	61.7	58.2	60.8	60.6
S09	West Seattle	51.2	**52.6**	51.9	52.2	53.0	52.7	52.7	52.8	52.9	53.0	48.9	50.9	50.6
S10	Tukwila	48.6	**50.0**	49.3	49.6	50.0	50.0	50.0	50.0	50.0	50.0	46.4	48.3	48.0
S11	Tukwila	57.2	**58.6**	57.9	58.2	58.6	58.6	58.6	58.6	58.6	58.6	54.8	56.9	56.5
S13	Beacon Hill	59.5	**60.9**	60.3	60.5	60.7	60.9	60.9	60.8	60.7	60.6	57.1	59.0	58.5
S14	West Seattle	49.1	**50.6**	49.9	50.2	51.2	50.9	50.8	50.8	50.9	51.1	46.8	49.0	48.8
S15	West Seattle	40.2	**41.5**	41.3	41.3	41.5	41.5	41.5	41.5	41.5	41.5	37.7	40.6	40.3
S16	Magnolia	53.4	**54.9**	54.7	54.8	53.0	53.6	54.0	54.6	54.4	54.4	50.6	54.4	54.3
S17	Beacon Hill	55.8	**57.2**	56.9	57.0	57.2	57.2	57.2	57.2	57.2	57.2	53.6	56.5	56.4
		Change in Noise Relative to Base Case 2006												
A1	Magnolia	--	--	-0.2	-0.1	-2.3	-1.5	-1.1	-0.4	-0.6	-0.5	-4.5	-0.5	-0.6
A2	West Seattle	--	--	-0.6	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	-3.9	-2.1	-2.6
A3	Magnolia	--	--	-0.2	-0.1	-2.2	-1.4	-1.1	-0.3	-0.5	-0.5	-4.5	-0.6	-0.7
A4	Tukwila	--	--	-0.6	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	-3.8	-2.3	-3.0
A5	Skyway	--	--	-0.6	-0.3	0.7	0.3	0.3	0.3	0.4	0.6	-3.7	-1.3	-1.6
A6	Seattle	--	--	-1.0	-0.6	0.0	0.0	0.0	0.0	0.0	0.0	-3.5	-2.2	-2.5
A7	Georgetown	--	--	-0.8	-0.5	0.2	0.1	0.1	0.1	0.1	0.2	-3.2	-2.1	-2.5
A8	Skyway	--	--	-0.7	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	-3.7	-2.1	-2.7
A9	Foster	--	--	-0.5	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	-4.1	-1.8	-2.3
S01	Tukwila	--	--	-0.6	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	-3.9	-2.4	-3.2
S03	Tukwila	--	--	-0.7	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	-3.8	-1.8	-2.2
S04	Georgetown	--	--	-0.5	-0.3	-0.2	-0.1	-0.1	0.0	-0.1	-0.1	-4.1	-1.5	-1.8
S06	Tukwila	--	--	-0.7	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	-3.9	-2.6	-3.4
S07	Magnolia	--	--	-0.1	0.0	-0.4	-0.2	-0.1	-0.1	-0.2	-0.3	-3.8	-0.2	-0.2
S08	Beacon Hill	--	--	-0.5	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	-3.5	-0.9	-1.1
S09	West Seattle	--	--	-0.7	-0.4	0.4	0.1	0.1	0.2	0.3	0.4	-3.7	-1.7	-2.0
S10	Tukwila	--	--	-0.7	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	-3.6	-1.7	-2.0
S11	Tukwila	--	--	-0.7	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	-3.8	-1.7	-2.1
S13	Beacon Hill	--	--	-0.6	-0.4	-0.2	0.0	0.0	-0.1	-0.2	-0.3	-3.8	-1.9	-2.4
S14	West Seattle	--	--	-0.7	-0.4	0.6	0.3	0.2	0.2	0.3	0.5	-3.8	-1.6	-1.8
S15	West Seattle	--	--	-0.2	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	-3.8	-0.9	-1.2
S16	Magnolia	--	--	-0.2	-0.1	-1.9	-1.3	-0.9	-0.3	-0.5	-0.5	-4.3	-0.5	-0.6
S17	Beacon Hill	--	--	-0.3	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	-3.6	-0.7	-0.8

A1a Ban Stage 2 Aircraft, A2a Ban Stage 2 Aircraft at Night, A5 Fly Quiet Example, A9a Charted Visual, All Hours
A9b Charted Visual Approach, Nighttime Only, A9c Elliot Bay Departure, All Hours, A9d Elliot Bay Departures, Night
A9e GPS/FMS Departure A2c No Night Flights, A2b No Night Hush Kitted or louder, A1b No Hush Kitted or louder, All Hours

Table F3
Representative Receptor Analysis (Nighttime LEQ)

Site	Description	Nighttime LEQ Noise Levels (10 pm to 7 am)												
		Ex 1999	**Base 2006**	A1a 2006	A2a 2006	A5 2006	A9a 2006	A9b 2006	A9c 2006	A9d 2006	A9e 2006	A2c 2006	A2b 2006	A1b 2006
A1	Magnolia	44.6	**46.3**	46.1	46.1	43.9	44.7	44.7	45.8	45.8	45.8	0.0	45.6	45.6
A2	West Seattle	43.7	**45.0**	44.4	44.4	45.0	45.0	45.0	45.0	45.0	45.0	0.0	42.1	42.2
A3	Magnolia	46.9	**48.5**	48.3	48.3	46.3	46.9	46.9	48.0	48.0	48.0	0.0	47.7	47.7
A4	Tukwila	54.5	**55.7**	55.1	55.1	55.7	55.7	55.7	55.7	55.7	55.7	0.0	52.2	52.3
A5	Skyway	37.9	**39.4**	38.9	38.9	40.2	39.8	39.8	39.8	39.8	40.0	0.0	37.7	37.7
A6	Seattle	61.2	**62.6**	61.7	61.7	62.6	62.6	62.6	62.6	62.6	62.6	0.0	59.7	59.8
A7	Georgetown	58.3	**59.6**	58.8	58.8	59.8	59.7	59.7	59.8	59.8	59.8	0.0	56.4	56.5
A8	Skyway	50.9	**52.1**	51.4	51.4	52.1	52.1	52.1	52.1	52.1	52.1	0.0	49.0	49.1
A9	Foster	56.3	**57.5**	57.1	57.1	57.5	57.5	57.5	57.5	57.5	57.6	0.0	55.0	55.0
S01	Tukwila	53.5	**54.8**	54.2	54.2	54.8	54.8	54.8	54.8	54.8	54.8	0.0	51.2	51.3
S03	Tukwila	51.0	**52.3**	51.7	51.7	52.3	52.3	52.3	52.3	52.3	52.3	0.0	49.9	50.0
S04	Georgetown	62.5	**64.0**	63.5	63.5	63.7	63.8	63.8	63.9	63.9	63.9	0.0	61.9	61.9
S06	Tukwila	59.3	**60.6**	59.9	59.9	60.6	60.6	60.6	60.6	60.6	60.6	0.0	56.7	56.8
S07	Magnolia	39.8	**41.1**	41.0	41.0	40.6	40.9	40.9	40.9	40.9	40.7	0.0	40.8	40.8
S08	Beacon Hill	52.5	**53.8**	53.3	53.3	53.8	53.8	53.8	53.8	53.8	53.8	0.0	52.6	52.6
S09	West Seattle	43.5	**44.9**	44.2	44.2	45.3	45.0	45.0	45.2	45.2	45.3	0.0	42.6	42.6
S10	Tukwila	40.8	**42.2**	41.5	41.5	42.2	42.2	42.2	42.2	42.2	42.2	0.0	39.9	40.0
S11	Tukwila	49.5	**50.9**	50.3	50.3	50.9	50.9	50.9	50.9	50.9	50.9	0.0	48.6	48.6
S13	Beacon Hill	51.9	**53.2**	52.7	52.7	53.1	53.3	53.3	53.1	53.1	53.0	0.0	50.6	50.6
S14	West Seattle	41.3	**42.9**	42.2	42.2	43.5	43.2	43.2	43.2	43.2	43.4	0.0	40.9	40.9
S15	West Seattle	32.4	**33.8**	33.6	33.6	33.8	33.8	33.8	33.8	33.8	33.9	0.0	32.5	32.5
S16	Magnolia	46.1	**47.6**	47.5	47.5	45.7	46.2	46.2	47.2	47.2	47.2	0.0	47.0	47.0
S17	Beacon Hill	48.0	**49.4**	49.1	49.1	49.4	49.4	49.4	49.4	49.4	49.4	0.0	48.5	48.5

Site	Description	Change in Noise Relative to Base Case 2006												
A1	Magnolia	--	--	-0.2	-0.2	-2.4	-1.6	-1.6	-0.5	-0.5	-0.5	-46.3	-0.7	-0.7
A2	West Seattle	--	--	-0.6	-0.6	0.0	0.0	0.0	0.0	0.0	0.0	-45.0	-2.9	-2.8
A3	Magnolia	--	--	-0.2	-0.2	-2.2	-1.6	-1.6	-0.5	-0.5	-0.5	-48.5	-0.8	-0.8
A4	Tukwila	--	--	-0.6	-0.6	0.0	0.0	0.0	0.0	0.0	0.0	-55.7	-3.5	-3.4
A5	Skyway	--	--	-0.5	-0.5	0.8	0.4	0.4	0.4	0.4	0.6	-39.4	-1.7	-1.7
A6	Seattle	--	--	-0.9	-0.9	0.0	0.0	0.0	0.0	0.0	0.0	-62.6	-2.9	-2.8
A7	Georgetown	--	--	-0.8	-0.8	0.2	0.1	0.1	0.2	0.2	0.2	-59.6	-3.2	-3.1
A8	Skyway	--	--	-0.7	-0.7	0.0	0.0	0.0	0.0	0.0	0.0	-52.1	-3.1	-3.0
A9	Foster	--	--	-0.4	-0.4	0.0	0.0	0.0	0.0	0.0	0.1	-57.5	-2.5	-2.5
S01	Tukwila	--	--	-0.6	-0.6	0.0	0.0	0.0	0.0	0.0	0.0	-54.8	-3.6	-3.5
S03	Tukwila	--	--	-0.6	-0.6	0.0	0.0	0.0	0.0	0.0	0.0	-52.3	-2.4	-2.3
S04	Georgetown	--	--	-0.5	-0.5	-0.3	-0.2	-0.2	-0.1	-0.1	-0.1	-64.0	-2.1	-2.1
S06	Tukwila	--	--	-0.7	-0.7	0.0	0.0	0.0	0.0	0.0	0.0	-60.6	-3.9	-3.8
S07	Magnolia	--	--	-0.1	-0.1	-0.5	-0.2	-0.2	-0.2	-0.2	-0.4	-41.1	-0.3	-0.3
S08	Beacon Hill	--	--	-0.5	-0.5	0.0	0.0	0.0	0.0	0.0	0.0	-53.8	-1.2	-1.2
S09	West Seattle	--	--	-0.7	-0.7	0.4	0.1	0.1	0.3	0.3	0.4	-44.9	-2.3	-2.3
S10	Tukwila	--	--	-0.7	-0.7	0.0	0.0	0.0	0.0	0.0	0.0	-42.2	-2.3	-2.2
S11	Tukwila	--	--	-0.6	-0.6	0.0	0.0	0.0	0.0	0.0	0.0	-50.9	-2.3	-2.3
S13	Beacon Hill	--	--	-0.5	-0.5	-0.1	0.1	0.1	-0.1	-0.1	-0.2	-53.2	-2.6	-2.6
S14	West Seattle	--	--	-0.7	-0.7	0.6	0.3	0.3	0.3	0.3	0.5	-42.9	-2.0	-2.0
S15	West Seattle	--	--	-0.2	-0.2	0.0	0.0	0.0	0.0	0.0	0.1	-33.8	-1.3	-1.3
S16	Magnolia	--	--	-0.1	-0.1	-1.9	-1.4	-1.4	-0.4	-0.4	-0.4	-47.6	-0.6	-0.6
S17	Beacon Hill	--	--	-0.3	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	-49.4	-0.9	-0.9

A1aBan Stage 2 Aircraft, A2a Ban Stage 2 Aircraft at Night, A5 Fly Quiet Example, A9a Charted Visual, All Hours
A9b Charted Visual Approach, Nighttime Only, A9c Elliot Bay Departure, All Hours, A9d Elliot Bay Departures, Night
A9e GPS/FMS Departures A2c No Night Flights, A2b No Night Hush Kitted or louder, A1b No Hush Kitted or louder, All Hours

Table F4
Representative Receptor Analysis (Time Above 65 dBA)

Site	Description	Time Above 65 dBA (Minutes per Day)												
		Ex 1999	**Base 2006**	A1a 2006	A2a 2006	A5 2006	A9a 2006	A9b 2006	A9c 2006	A9d 2006	A9e 2006	A2c 2006	A2b 2006	A1b 2006
A1	Magnolia	1.8	**2.5**	2.1	2.4	1.2	1.8	2.2	2.4	1.9	2.0	2.5	1.9	1.7
A2	West Seattle	3.3	**4.6**	3.6	4.5	4.6	4.6	4.6	4.6	4.6	4.6	4.6	3.2	2.1
A3	Magnolia	6.5	**9.4**	8.8	9.3	5.0	5.6	8.3	9.3	8.8	8.9	9.4	8.7	8.3
A4	Tukwila	23.9	**32.5**	31.1	32.3	32.5	32.5	32.5	32.5	32.5	32.5	32.5	30.6	29.7
A5	Skyway	1.0	**1.4**	1.1	1.4	1.5	1.4	1.4	1.4	1.5	1.6	1.4	1.0	0.6
A6	Seattle	81.8	**108.9**	106.9	108.7	108.9	108.9	108.9	108.9	108.9	109.0	108.9	105.9	104.8
A7	Georgetown	59.4	**72.3**	70.7	72.1	73.3	73.2	72.5	72.4	72.5	72.6	72.3	70.4	69.4
A8	Skyway	9.2	**13.0**	11.9	12.8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	11.3	10.5
A9	Foster	41.5	**54.6**	53.3	54.5	54.6	54.6	54.6	54.6	54.6	54.6	54.6	52.8	51.9
S01	Tukwila	13.7	**19.2**	18.1	19.0	19.2	19.2	19.2	19.2	19.2	19.2	19.2	17.4	16.3
S03	Tukwila	12.4	**17.7**	16.4	17.5	17.7	17.7	17.7	17.7	17.7	17.7	17.7	16.0	15.1
S04	Georgetown	100.7	**126.5**	125.2	126.3	125.3	125.5	126.3	126.5	126.3	126.2	126.5	124.9	124.4
S06	Tukwila	43.5	**57.4**	56.2	57.2	57.4	57.4	57.4	57.4	57.4	57.4	57.3	55.5	54.2
S07	Magnolia	0.2	**0.3**	0.2	0.3	0.2	0.3	0.3	0.3	0.2	0.1	0.3	0.2	0.1
S08	Beacon Hill	29.5	**38.8**	37.0	38.6	38.9	38.8	38.8	38.8	38.9	38.8	38.8	35.9	35.0
S09	West Seattle	2.2	**3.1**	2.6	3.0	3.3	3.1	3.1	3.1	3.2	3.3	3.1	2.4	2.0
S10	Tukwila	2.3	**3.2**	2.4	3.1	3.2	3.2	3.2	3.2	3.2	3.2	3.2	2.1	1.4
S11	Tukwila	9.0	**12.9**	11.6	12.7	12.9	12.9	12.9	12.9	12.9	12.9	12.9	11.2	10.4
S13	Beacon Hill	10.7	**14.8**	14.1	14.7	15.4	15.6	15.0	14.7	14.6	14.4	14.8	13.7	13.0
S14	West Seattle	1.6	**2.3**	1.8	2.2	2.5	2.3	2.3	2.3	2.4	2.5	2.3	1.6	1.3
S15	West Seattle	0.1	**0.1**	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
S16	Magnolia	3.9	**5.6**	5.1	5.5	3.1	3.6	4.9	5.5	5.0	5.0	5.6	4.9	4.6
S17	Beacon Hill	5.1	**7.2**	5.9	7.0	7.2	7.2	7.2	7.2	7.2	7.2	7.2	5.2	4.0
		Change in Noise Relative to Base Case 2006												
A1	Magnolia	--	--	-0.4	-0.1	-1.3	-0.7	-0.3	-0.1	-0.6	-0.5	0.0	-0.6	-0.8
A2	West Seattle	--	--	-1.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.4	-2.5
A3	Magnolia	--	--	-0.6	-0.1	-4.4	-3.8	-1.1	-0.1	-0.6	-0.5	0.0	-0.7	-1.1
A4	Tukwila	--	--	-1.4	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.9	-2.8
A5	Skyway	--	--	-0.3	0.0	0.1	0.0	0.0	0.0	0.1	0.2	0.0	-0.4	-0.8
A6	Seattle	--	--	-2.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-3.0	-4.1
A7	Georgetown	--	--	-1.6	-0.2	1.0	0.9	0.2	0.1	0.2	0.3	0.0	-1.9	-2.9
A8	Skyway	--	--	-1.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.7	-2.5
A9	Foster	--	--	-1.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.8	-2.7
S01	Tukwila	--	--	-1.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.8	-2.9
S03	Tukwila	--	--	-1.3	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.7	-2.6
S04	Georgetown	--	--	-1.3	-0.2	-1.2	-1.0	-0.2	0.0	-0.2	-0.3	0.0	-1.6	-2.1
S06	Tukwila	--	--	-1.2	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-1.9	-3.2
S07	Magnolia	--	--	-0.1	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.2	0.0	-0.1	-0.2
S08	Beacon Hill	--	--	-1.8	-0.2	0.1	0.0	0.0	0.0	0.1	0.0	0.0	-2.9	-3.8
S09	West Seattle	--	--	-0.5	-0.1	0.2	0.0	0.0	0.0	0.1	0.2	0.0	-0.7	-1.1
S10	Tukwila	--	--	-0.8	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.1	-1.8
S11	Tukwila	--	--	-1.3	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.7	-2.5
S13	Beacon Hill	--	--	-0.7	-0.1	0.6	0.8	0.2	-0.1	-0.2	-0.4	0.0	-1.1	-1.8
S14	West Seattle	--	--	-0.5	-0.1	0.2	0.0	0.0	0.0	0.1	0.2	0.0	-0.7	-1.0
S15	West Seattle	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S16	Magnolia	--	--	-0.5	-0.1	-2.5	-2.0	-0.7	-0.1	-0.6	-0.6	0.0	-0.7	-1.0
S17	Beacon Hill	--	--	-1.3	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.0	-3.2

A1aBan Stage 2 Aircraft, A2a Ban Stage 2 Aircraft at Night, A5 Fly Quiet Example, A9a Charted Visual, All Hours
A9b Charted Visual Approach, Nighttime Only, A9c Elliot Bay Departure, All Hours, A9d Elliot Bay Departures, Night
A9e GPS/FMS Departure A2c No Night Flights, A2b No Night Hush Kitted or louder, A1b No Hush Kitted or louder, All Hours

Table F5
Representative Receptor Analysis (Lmax)

Site	Description	Maximum Noise Level (dBA)												
		Ex 1999	**Base 2006**	A1a 2006	A2a 2006	A5 2006	A9a 2006	A9b 2006	A9c 2006	A9d 2006	A9e 2006	A2c 2006	A2b 2006	A1b 2006
A1	Magnolia	81.4	**81.4**	81.4	81.4	74.5	81.4	81.4	81.4	74.5	74.5	81.4	81.4	80.1
A2	West Seattle	82.5	**82.5**	82.5	82.5	82.5	82.5	82.5	82.5	82.5	82.4	82.5	82.5	77.9
A3	Magnolia	83.1	**83.1**	83.1	83.1	77.4	83.1	83.1	83.1	77.4	77.4	83.1	83.1	82.0
A4	Tukwila	100.7	**100.7**	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.6	100.7	100.7	94.6
A5	Skyway	76.9	**76.9**	76.9	76.9	76.9	76.9	76.9	76.9	76.9	76.9	76.9	76.9	76.9
A6	Seattle	106.6	**106.6**	106.6	106.6	106.6	106.6	106.6	106.6	106.6	106.6	106.6	106.6	101.4
A7	Georgetown	108.4	**108.4**	108.4	108.4	108.3	108.4	108.4	108.4	108.3	108.3	108.4	108.4	102.5
A8	Skyway	97.7	**97.7**	97.7	97.7	97.7	97.7	97.7	97.7	97.7	97.6	97.7	97.7	92.0
A9	Foster	99.7	**99.7**	99.7	99.7	99.7	99.7	99.7	99.7	99.7	99.7	99.7	99.7	94.5
S01	Tukwila	97.4	**97.4**	97.4	97.4	97.4	97.4	97.4	97.4	97.4	97.3	97.4	97.4	91.7
S03	Tukwila	90.6	**90.6**	90.6	90.6	90.6	90.6	90.6	90.6	90.6	90.6	90.6	90.6	89.8
S04	Georgetown	108.6	**108.6**	108.6	108.6	108.6	108.6	108.6	108.6	108.6	108.6	108.6	108.6	102.8
S06	Tukwila	104.1	**104.1**	104.1	104.1	104.1	104.1	104.1	104.1	104.1	104.1	104.1	104.1	98.1
S07	Magnolia	72.1	**72.1**	72.1	72.1	72.1	72.1	72.1	72.1	72.1	72.1	72.1	72.1	71.4
S08	Beacon Hill	87.5	**87.5**	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5
S09	West Seattle	86.0	**86.0**	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	85.1
S10	Tukwila	77.9	**77.9**	77.9	77.9	77.9	77.9	77.9	77.9	77.9	77.9	77.9	77.9	76.2
S11	Tukwila	89.2	**89.2**	89.2	89.2	89.2	89.2	89.2	89.2	89.2	89.2	89.2	89.2	88.8
S13	Beacon Hill	97.6	**97.6**	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	93.2
S14	West Seattle	81.4	**81.4**	81.4	81.4	81.3	81.4	81.4	81.4	81.3	81.3	81.4	81.4	81.4
S15	West Seattle	66.8	**66.8**	66.8	66.8	66.8	66.8	66.8	66.8	66.8	66.8	66.8	66.8	66.8
S16	Magnolia	82.5	**82.5**	82.5	82.5	79.1	82.5	82.5	82.5	79.1	79.1	82.5	82.5	81.4
S17	Beacon Hill	77.3	**77.3**	77.3	77.3	77.3	77.3	77.3	77.3	77.3	77.3	77.3	77.3	77.3

		Change in Noise Relative to Base Case 2006												
A1	Magnolia	--	--	0.0	0.0	-6.9	0.0	0.0	0.0	-6.9	-6.9	0.0	0.0	-1.3
A2	West Seattle	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-4.6
A3	Magnolia	--	--	0.0	0.0	-5.7	0.0	0.0	0.0	-5.7	-5.7	0.0	0.0	-1.1
A4	Tukwila	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-6.1
A5	Skyway	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A6	Seattle	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-5.2
A7	Georgetown	--	--	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	-5.9
A8	Skyway	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-5.7
A9	Foster	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-5.2
S01	Tukwila	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-5.7
S03	Tukwila	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8
S04	Georgetown	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-5.8
S06	Tukwila	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-6.0
S07	Magnolia	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7
S08	Beacon Hill	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S09	West Seattle	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.9
S10	Tukwila	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.7
S11	Tukwila	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4
S13	Beacon Hill	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-4.4
S14	West Seattle	--	--	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0
S15	West Seattle	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S16	Magnolia	--	--	0.0	0.0	-3.4	0.0	0.0	0.0	-3.4	-3.4	0.0	0.0	-1.1
S17	Beacon Hill	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

A1aBan Stage 2 Aircraft, A2a Ban Stage 2 Aircraft at Night, A5 Fly Quiet Example, A9a Charted Visual, All Hours
A9b Charted Visual Approach, Nighttime Only, A9c Elliot Bay Departure, All Hours, A9d Elliot Bay Departures, Night
A9e GPS/FMS Departures A2c No Night Flights, A2b No Night Hush Kitted or louder, A1b No Hush Kitted or louder, All Hours

Table F6
Noise Event Counts (Number of Events Above SEL Noise Level)

Site	Description	Base 2006	A1a 2006	A2a 2006	A5 2006	A9a 2006	A9b 2006	A9c 2006	A9d 2006	A9e 2006	A2c 2006	A2b 2006	A1b 2006
		Average Daily Noise Events (>75 SEL)											
A1	Magnolia	**47**	44	46	26	24	41	46	45	43	48	46	46
A2	West Seattle	**12**	11	12	12	12	12	12	12	12	13	11	11
A3	Magnolia	**67**	63	67	42	38	61	67	63	64	67	65	63
A4	Tukwila	**200**	199	200	200	200	200	200	200	200	201	201	200
A5	Skyway	**4**	4	4	4	5	4	4	5	4	4	3	3
A6	Seattle	**450**	449	450	450	450	450	450	450	450	477	476	476
A7	Georgetown	**220**	217	219	221	221	220	220	220	220	221	220	219
A8	Skyway	**111**	111	111	111	111	111	111	111	111	111	111	110
A9	Foster	**281**	281	281	281	281	281	281	281	281	281	281	281
S01	Tukwila	**118**	117	118	118	118	118	118	118	118	137	136	135
S03	Tukwila	**134**	133	134	134	134	134	134	134	134	135	134	134
S04	Georgetown	**538**	537	538	527	527	537	538	538	538	538	536	534
S06	Tukwila	**284**	284	284	284	284	284	284	284	284	286	285	284
S07	Magnolia	**2**	2	2	2	1	2	2	1	2	2	1	1
S08	Beacon Hill	**328**	327	328	328	328	328	328	328	328	328	327	327
S09	West Seattle	**19**	18	19	19	21	19	19	20	19	19	18	18
S10	Tukwila	**9**	7	8	9	9	9	9	9	9	9	6	5
S11	Tukwila	**119**	118	119	119	119	119	119	119	119	121	120	120
S13	Beacon Hill	**126**	122	126	123	121	125	126	124	126	129	125	122
S14	West Seattle	**9**	9	9	10	11	9	9	10	9	9	9	9
S15	West Seattle	**4**	4	4	4	4	4	4	4	4	4	4	3
S16	Magnolia	**66**	62	66	41	38	59	66	64	63	66	63	62
S17	Beacon Hill	**144**	143	144	144	144	144	144	144	144	145	142	143
		Average Daily Noise Events (>80 SEL)											
A1	Magnolia	**6**	5	5	4	3	5	5	5	5	5	3	3
A2	West Seattle	**7**	6	7	7	7	7	7	7	7	7	5	3
A3	Magnolia	**9**	8	9	6	6	8	9	8	8	9	7	7
A4	Tukwila	**39**	38	39	39	39	39	39	39	39	39	38	38
A5	Skyway	**3**	2	3	3	3	3	3	3	3	3	2	1
A6	Seattle	**259**	258	259	259	259	259	259	259	259	259	258	258
A7	Georgetown	**141**	137	141	143	143	142	141	140	140	141	137	137
A8	Skyway	**19**	18	19	19	19	19	19	19	19	19	17	17
A9	Foster	**109**	109	109	109	109	109	109	109	109	109	109	109
S01	Tukwila	**29**	28	29	29	29	29	29	29	29	29	28	28
S03	Tukwila	**41**	39	40	41	41	41	41	41	41	41	39	38
S04	Georgetown	**415**	414	415	410	409	414	415	414	414	415	414	414
S06	Tukwila	**124**	123	124	124	124	124	124	124	124	124	124	123
S07	Magnolia	**1**	1	1	1	0	1	1	0	0	1	0	0
S08	Beacon Hill	**113**	113	113	113	113	113	113	113	113	113	111	113
S09	West Seattle	**4**	4	4	4	5	4	4	5	5	4	3	3
S10	Tukwila	**6**	5	6	6	6	6	6	6	6	6	4	2
S11	Tukwila	**21**	19	21	21	21	21	21	21	21	21	19	19
S13	Beacon Hill	**24**	23	24	24	23	24	24	24	24	24	21	20
S14	West Seattle	**4**	3	3	4	4	4	4	4	4	4	3	2
S15	West Seattle	**0**	0	0	0	0	0	0	0	0	0	0	0
S16	Magnolia	**6**	6	6	5	4	6	6	6	6	6	4	3
S17	Beacon Hill	**11**	10	11	11	11	11	11	11	11	11	8	8

A1aBan Stage 2 Aircraft, A2a Ban Stage 2 Aircraft at Night, A5 Fly Quiet Example, A9a Charted Visual, All Hours
A9b Charted Visual Approach, Nighttime Only, A9c Elliot Bay Departure, All Hours, A9d Elliot Bay Departures, Night
A9e GPS/FMS Departures A2c No Night Flights, A2b No Night Hush Kitted or louder, A1b No Hush Kitted or louder, All Hours