SEA-TAC INTERNATIONAL AIRPORT IMPACT MITIGATION STUDY

INITIAL ASSESSMENT AND RECOMMENDATIONS
FEBRUARY 1997

PREPARED UNDER A GRANT FROM
THE STATE OF WASHINGTON FOR THE:

CITY OF BURIEN, WASHINGTON
CITY OF DES MOINES, WASHINGTON
CITY OF FEDERAL WAY, WASHINGTON
CITY OF NORMANDY PARK, WASHINGTON
CITY OF TUKWILA, WASHINGTON
HIGHLINE SCHOOL DISTRICT
HIGHLINE COMMUNITY HOSPITAL

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The City of Burien wishes to thank all elected officials; local, state, federal and special purpose districts; and citizens that provided assistance during the course of this assessment.

Executive Summary

EXECUTIVE SUMMARY

There is no doubt that the expansion of Sea-Tac International Airport will have a positive economic benefit for the region and the State. However, the costs associated with these improvements are disproportionately borne by those communities immediately surrounding the Airport. Communities such as Burien and Des Moines are projected to be impacted by noise, traffic congestion, and socio-economic hardship merely because of their location near the Airport. Of the estimated $2.95 billion in potential mitigation costs, $2.3 billion (almost 80%) is projected to be required for Burien and Des Moines alone. Other environmental, transportation, and socio-economic costs have not yet been calculated.

This study does not assign mitigation costs to any particular agency. While the Port of Seattle and the Federal Aviation Administration will be financially responsible for a portion of the mitigation costs, funding from other sources is also expected. For example, increased transportation funding is available through the Washington State Department of Transportation and the Federal Highway Administration. Some environmental mitigation costs may be eligible for State and Federal EPA funding. Costs associated with acquisition and redevelopment may be shared between private and public-sector interests.

This study also does not dispute the projections included in the EIS, such as noise contours and future flight-tracks. It recommends that these projections be assumed as accurate and that any required mitigation program(s) be based on the Airport meeting - not exceeding - these projections. For example, a permanent noise monitoring program should be established to verify that the projected noise contours are not exceeded. Should these or other parameters be exceeded, the EIS should be re-conducted and additional mitigation programs be developed, This approach positively works with the Port of Seattle to assure both the Airport and Airport-area communities that the EIS will be a valid document.

The study also recommends the need for an overall planning approach to development in Southern King County. The study recommends the development of a "South King County Comprehensive Plan" to weave together a plan that addresses the needs of all interests in the area - communities, residents, businesses, schools, hospitals, the environment, and the Airport.

Project Parameters

This report was produced under a grant from the State of Washington to analyze the proposed Third Runway project at Sea-Tac International Airport. The City of Burien, acting in the capacity of the grant manager, supervised the consultant team. The study examined the potential impacts of the Airport project on neighborhoods in the surrounding communities of Burien, Des Moines, Federal Way, Normandy Park, and Tukwila. Potential impacts on facilities owned and operated by the Highline School District and Highline Hospital were similarly examined.

Mitigation of potential impacts was based on the preservation and protection of neighborhood integrity. The consultants conducted an independent investigation into the potential impacts of the proposed project and how these potential impacts could be most appropriately mitigated.

Several other parameters guided this study:

- The basic premise of this study was that the Third Runway project would be constructed. This premise was clearly stipulated in the State grant which states that the funding for the study could not be *"expended directly or indirectly for litigation, public relations, or for any consulting services for the purposes of opposing the construction of the proposed Third Runway"*.

- Neighborhood boundaries were established by each community through their comprehensive planning process.

- The economic importance of Sea-Tac International Airport was never questioned. The Airport is an important economic factor to the Seattle metropolitan area, the Puget Sound Region, and the State of Washington.

- Given the study's budget and schedule, the consultants agreed to utilize as much existing information as possible. No new data was developed as part of this study. Information was primarily taken from the Master Plan Update Environmental Impact Statement, with additional information coming from other agencies including King County, the Puget Sound Regional Council, and various State and Federal agencies.

- The study investigated potential impacts associated with the proposed Third Runway and its associated facility improvements. Mitigation for existing impacts associated with the existing runways and airport operations were not included.

During the course of this study (April 1996 through March 1997), the consultants conducted over 100 meetings, interviews, presentations, workshops, and question-and-answer sessions with: local elected and appointed officials and staff members; the Port of Seattle staff and its consultants; County and State elected officials; representatives from various City, County, State, regional and Federal agencies; and the general public.

Potential Environmental Impacts

The study examined 8 general environmental areas and 26 specific potential impacts.

Potential Environmental Impacts Studied

Area	Specific Impact
Noise and vibration	LDN SEL Overflights (TA) Vibration
Air quality	Air emissions (aircraft) CO emissions (vehicles) HC emissions (vehicles) Air toxics Fugitive emissions Point source pollution
Surface water quality/hydrology	Runoff volume Erosion and sediment Spills
Ground water quality/hydrology	Aquifer recharge Contamination
Wetlands	Wetlands
Floodplains	Encroachment Reduced flood storage capacity Increased flow rate and volume
Aesthetics and visual	Ground shadow Visibility (aircraft) Visibility (fill)
Other	Special status species habitat Cultural resources Coastal zones DOT Section 4(f) resources

Of these 26 parameters, the consultants estimated the costs of mitigating the potential noise and vibration impacts. These costs are estimated to be approximately $2.4 billion, which primarily occur in 5 neighborhoods in 2 communities.

Neighborhoods Identified for Potential Acquisition and Redevelopment

City	Neighborhoods
Burien	North East
Des Moines	West Central North Central East Central South Des Moines

Mitigation of these neighborhoods are estimated to be approximately $1.9 billion - 80% of the total environmental impacts. These 5 neighborhoods are the closest to the proposed project and will experience significant impacts, due primarily to noise and vibration of aircraft operations. The $1.9 billion figure represents the cost to relocate neighborhood residents and redevelop the area.

Acquisition and redevelopment is the most far-reaching mitigation measure for these areas, but it will also fundamentally change these neighborhoods. The study recommends that a "specific area plan" be developed for each of these 5 neighborhoods in order to determine if other mitigation measures are appropriate. Acquisition and redevelopment is recommended only if all other mitigation measures are unsuccessful.

For the other communities, it was estimated that Federal Way would require mitigation due to LDN contours and overflights ($148 million), and that Normandy Park and Tukwila would require mitigation due to LDN and SEL noise, and overflights ($56 million and $114 million, respectively). Mitigation in these 3 communities would involve primarily sound abatement insulation and the purchasing of avigation easements.

The study also recommended the replacement or relocation of 8 schools in 3 communities.

Schools Identified for Potential Replacement or Relocation

Area	Elementary Schools	Middle Schools	High Schools
Burien	Sunnydale Cedarhurst	(none)	(none)
Des Moines	Midway	Pacific	Mount Rainier
Unincorporated King County	Beverly Park White Center	(none)	Satellite Alternate

Twenty-six other schools in the Highline School District were identified for sound abatement insulation and avigation easements. Costs involved with both the replacement and insulation/easement programs were not estimated by this study. Additional structural studies will be required in order to determine the costs involved with school mitigation.

Given the amount of information available and the project's budget and time constraints, it was not possible to calculate the mitigation costs for potential impacts associated with the remaining environmental measures (wetlands, floodplains, aquifer, air quality, etc.). Additional studies should be commissioned to determine the potential impacts associated with the Airport's proposed project.

Potential Transportation Impacts

The study examined 4 general environmental areas and 21 specific potential impacts.

Potential Transportation Impacts Studied

Area	Specific Impact
Congestion	Level of service Accidents School bus operations Transit bus operations Police and emergency vehicle operations Parking and pedestrian access Traffic noise (LEQ)
Physical damage	Local streets State roads State bridges Increased maintenance and reconstruction
Construction impacts	Truck haul routes Barge/rail/conveyor system Traffic diversion Traffic control Construction staging and phasing Work-force traffic Concurrent construction projects
Post-construction impacts	Additional traffic Increased operation and maintenance costs Master plan update

Of these 21 parameters, potential mitigation costs are estimated to be approximately $479 million. Tukwila accounts for $192 million (40%), due primarily to the number of State-jurisdiction roads and bridges in the City. Burien and Des Moines were projected to have the second and third highest mitigation costs ($117 million and $73 million respectively), due to their close proximity to the Airport's west and south sides. Normandy Park and Federal Way had the lowest potential mitigation costs due to their location relative to the Airport.

An advantage with many transportation mitigation measures is that one measure may concurrently address multiple potential impacts. For instance, improvements to a roadway to increase its capacity simultaneously addresses congestion, accident, and pollution impacts.

While the EIS did a good job of analyzing transportation impacts, it did not study a large enough area. The Airport serves the entire Central Puget Sound Region, yet the transportation impacts studied in the EIS stopped at the Airport's "driveways" - the roadways leading directly into the Airport property. Additional studies are needed to determine the true scope of the transportation-related impacts.

Given the amount of information available and the project's budget and time constraints, it was not possible to distinguish between future traffic directly associated with the expanded Airport and future traffic as a function of the region's natural growth. Additional studies - such as an origin-destination survey, a select link analysis, and a cost allocation model - are needed in order to make this distinction and to appropriately assign costs to appropriate funding sources.

Potential Socio-Economic Impacts

There is an inequity regarding the benefit of the Airport to its immediate neighbors. While the study acknowledges the benefit of the Airport to the region and the State, these benefits are not experienced locally in the 5 impacted communities. Approximately 5% of the persons utilizing the Airport live in the area most impacted. The remaining 95% of Airport passengers and employees come from elsewhere in the region.

Socio-economic impacts tend to blur across neighborhood lines and impact entire communities. In general, communities closer to the Airport are expected to experience a relative "depression" of residential property values (property values do not rise as fast relative to other similar properties in the region). This will have a cascading affect on the population mix in these areas. Single-family homes that cannot be sold will become rental properties. Studies have reported that non-owner-occupied residential areas have a lower average household income and utilize more social services than other areas. While the property value and tax revenues are depressed in these areas, the cost of providing social services increases.

Overall, the 5 communities were projected to experience a loss of $39.9 million during the period 2000 through 2020 as a result of the proposed project. The loss of these revenues is compounded with the problem of increasing demand for community and social services.

The discrepancy between these two trends contributes to the "blighting" of the area. This "blighting" impact has already been observed. Homes take longer to sell in the neighborhoods adjacent to the Airport, and the local real estate market already acknowledges the impact of aviation activity on neighborhoods.

The study recommends that the Port of Seattle make partial off-setting payments to the 5 impacted communities in order to mitigate the loss of local government revenues over the project period (2000 through 2020). An analysis of similar revenue shortfalls in the Highline School District are also needed.

Principal Environmental Recommendations

The following recommendations are included in Section 7 of the study. Please refer to Section 7 for a complete description of the study's environmental recommendations.

- **Oversight Commission** - Establish a working group/oversight commission to interact with the Port of Seattle during Master Plan Update implementation.

- **Acquisition and Redevelopment Program** - A study should be conducted to consider each neighborhood and school to determine if there are other less disruptive alternatives to acquisition and redevelopment. This study should be completed prior to construction of the Third Runway.

- **Sound Insulation and Avigation Easement Program** - The neighborhoods and schools identified in Section 7 (Tables 7.03, 7.04, and 7.05) should be further studied to determine the full extent of the proposed insulation and easement program. This study should be completed prior to construction of the Third Runway.

- **Vibration** - Prior to the start of construction of activities associated with Master Plan Update implementation, additional information should be provided regarding the potential impacts of vibration from construction activities. Also expand the vibration analysis to include qualitative and quantitative information on whole body vibration, annoyance/interference to humans caused by building vibration, and building structural damage for residences, schools and hospitals in the Airport area.

- **Additional Noise and Vibration Recommendations** -
  - Run the latest version of the Integrated Noise Model.
  - Show the SEL contours for the preferred alternative.
  - Show the 55 LDN contour.
  - Expand the permanent noise monitoring program.
  - Use the Third Runway only for arrival flights during inclement weather.
  - Restrict runway use between 9:00 PM and 7:00 AM.
  - Provide additional information regarding the threshold above (TA) noise metric.
  - Use permanent/portable "hush houses" in conjunction with engine maintenance run-ups.
  - Keep departure tracks over water as much as possible.
  - Re-evaluate use of noise barriers.

- **Minimize Overflights** - Minimize low-altitude overflights of residential areas as discussed in the Flight Plan Project EIS.

- **New Technologies** - Consider implementation of new technologies such as Microwave Landing System and Global Positioning Satellite System to reduce noise impacts around the Airport.

- **Aircraft Operations** - Clarify both hourly operational capacity of Airport and the calculation of existing average daily operations.

- **Reduced Noise Levels** - Provide information on the ability to maintain the Airport's reduced noise level goals.

- **Dust and Particulate Matter** - Include a Dust Control Plan in the contractor's permit prior to construction of the Third Runway. Work with appropriate regulatory agencies to obtain PM_{10} data which is more representative of the Puget Sound Region. This should entail the establishment of additional air quality monitoring stations, in particular in the vicinity of the Airport.

- **Air Quality** - Add additional air quality monitors closer to the Airport. Construction vehicle air quality analysis should be re-evaluated and the dispersion analysis should be re-done to better predict potential air quality impacts prior to the start of construction. As part of construction activities, PM_{10} and CO should be monitored in the vicinity of the fill sources, along the haul routes and in the Airport construction area. Provide information on Master Plan Update implementation and conformity with the Clean Air Act. Provide information on the State of Washington's Certification of Compliance with Air Quality Standards and a copy of Governor's Air Quality Certificate. After one year of baseline data has been collected at the new air quality monitoring sites, the area dispersion analysis should be re-evaluated for both the existing and future conditions. Conduct additional studies regarding long-term exposure to air toxics associated with Airport operations.

- **Mobile Sources** - Re-evaluate the existing and future roadway intersection analysis to confirm the accuracy of the evaluation in the EIS and to correct for inconsistencies discussed by EPA. All vehicles associated with Airport operations should comply with required vehicle emissions inspections and maintenance programs.

- **Queuing and Taxiing** - Conduct a study to determine the possibility of reducing aircraft emissions by improving Airport operations associated with queuing and taxiing.

- **Master Plan Update** - Re-evaluate the air dispersion and roadway traffic analysis to accurately monitor potential impacts.

- **Geotechnical Engineer** - Hire a geotechnical engineer for the duration of construction of the Third Runway to ensure that fill is placed appropriately including compaction and to help detect and remove seismically unstable soils, such as in fill sources.

- **Toxic-Free Fill** - Provide evidence including appropriate certifications that all fill material is free of harmful levels of toxic and hazardous materials as defined by current Federal and State regulations. Prior to the start of construction, conduct baseline studies of any area surface waters and the ground water. This information should be used to describe the existing conditions and to help monitor potential changes after the earthwork activities are complete.

- **Plans for Review** - At least two months prior to construction, provide for review and approval the following:
  - Construction Stormwater Pollution Prevention Plan and Erosion/Sediment Control Plan.
  - Spill Prevention, Control and Countermeasure (SPCC) Plan.
  - Construction Management Plan.
  - Construction Waste Management Plan.
  - Geotechnical report.
  - Reclamation plan for proposed fill sources.
  - Earthwork specifications and drawings, in particular for the Third Runway.
  - A copy of the State of Washington Governor's Water Quality Certificate which indicates that there is reasonable assurance that the project will be designed, constructed and operated in compliance with applicable water quality standards.

- **Groundwater** - Prior to the start of construction, permanent, long term surface and groundwater monitoring stations should be established in the Airport area. The locations and number of these stations should be approved by a working group/oversight commission.

- **Highline Aquifer** - Ground water movement in the Airport area should be better defined prior to the start of construction. Additional studies should be reviewed for potential ground water contamination impacts on the Highline Aquifer and other area aquifers.

- **Miller/Des Moines Creek Monitoring Studies** - Provide results of creek monitoring studies prior to the start of construction.

- **Stormwater Detention** - If the preferred alternative is implemented, the hydrologic analysis and stormwater management facilities should be re-evaluated to support final design prior to the start of construction.

- **Wet Vaults/Biofiltration Swales** - Provide detailed information regarding the construction and operation of the wet vaults and biofiltration swales

- **Construction Fence** - Place a construction fence at the outside limits of the construction area.

- **Miller Creek Relocation** - Prior to the start of relocating any part of Miller Creek, provide information on the potential impact on the relocation of litigation concerning King County agreeing not to channelize the Creek except in limited amounts in connection with retention facilities.

- **Expansion Storm Drain System Report** - Provide a copy of the hydraulic analysis with the computer program for review and comment.

- **Surface/Groundwater Monitoring** - Continue the surface and groundwater monitoring prior to the start of construction.

- **Borrow Site Hydrology** - Continue the borrow site hydrology until adequate information is obtained for comparison with the EIS existing or baseline conditions.

- **Operations Erosion and Sediment Control Plan** - At least two months prior to the completion of construction on the Third Runway, provide an operations erosion and sediment control plan, and a stormwater pollution prevention plan.

- **Fuel Handling System** - Upgrade and modernize the Airport's fuel handling system.

- **Floodplains** - At least two months before the start of construction, provide: information on the relationship between the 100 and 500-year floodplains, recent storms in the Puget Sound region and the Master Plan Update implementation EIS analysis; a copy of the final monitoring plan for evaluating the effectiveness of the Miller Creek and Des Moines Creek relocations; and final design information for the Miller Creek and Des Moines Creek relocations including specifications and drawings.

- **Color Photographs** - Provide color photographs taken from the EIS viewpoints and additional viewpoints which show the existing and future conditions. The additional viewpoints should be selected based on discussions with a working group/oversight commission.

- **Landscape Plans** - Landscape plans should consider: landscape requirements from the City of SeaTac; planting temporary vegetation or a cover crop as construction is completed; and should include a variety of native vegetation which requires low maintenance and has a mixture of seedlings and more mature plants in order to avoid a monoculture.

- **Coastal Zone Mitigation** - Potential point sources for pollutants should be identified and a pollution control management plan developed for the neighborhoods identified in Section 7 (Table 7.15).

- **DOT Section 4(F) Resource Mitigation** - Significant open spaces, parks, and recreational areas should be preserved and protected from potential impacts, or should be relocated and replaced if possible.

- **Sub-Regional Comprehensive Plan** - Conduct a comprehensive plan for all communities in the South King County region in order to integrate all future plans for land development, transportation, infrastructure, parks and open space, environmental protection, economic development, and other similar plans.

Principal Transportation Recommendations

The following recommendations are included in Section 8 of the study. Please refer to Section 8 for a complete description of the study's transportation recommendations.

- **Origin-Destination (O-D) Survey** - Conduct an O-D survey to determine the amount of regional traffic attributable to Sea-Tac International Airport. The percentage of traffic attributable to the Airport should be projected to the Year 2020 in 5-year increments and be used for projecting cost-sharing of various transportation projects that serve and benefit the Airport.

- **Recalculate Mitigation Costs** - Estimated mitigation costs calculated in Section 8 of this report should be recalculated taking into consideration the O-D information recommended above. Costs for mitigation projects should be assigned to the Port of Seattle only if those impacts are attributable to traffic as a result of the Third Runway. Other transportation projects would be implemented by the appropriate local, county, State, and/or Federal agencies.

- **Level of Service** - Areas identified in Section 8 (Table 8.03) should be mitigated prior to construction of the Third Runway.

- **School Buses** - Any additional mitigation for Highline School District school bus impacts should be assessed and completed prior to commencement of construction of the Third Runway.

- **Transit** - Any additional transit impact mitigation should be assessed and completed prior to commencement of construction of the Third Runway.

- **Public Safety** - Public safety response times in the five impacted communities should be continually monitored during the construction phase of the Third Runway. Reductions in response times should be addressed by additional equipment, personnel, or new station locations.

- **Local Jurisdiction Roadways** - Areas identified in Section 8 (Table 8.04) for local street mitigation should be continually monitored for serviceability index (SI) decreases. Roadways where the SI decrease should be reconstructed as soon as possible.

- **State Jurisdiction Roadways** - It is recommended that the areas identified in Section 8 (Table 8.05) for State street mitigation be continually monitored for SI decreases. Roadways where the SI decrease should be reconstructed as soon as possible.

- **State Jurisdiction Bridges** - Establish the baseline conditions of the bridges and pavement on the freeway routes most likely to be used from the borrow pit locations to the construction site and establish a system of monitoring prior to any truck movements.

- **Maintenance and Reconstruction** - The areas identified in Section 8 (Table 8.07) for increased maintenance and reconstruction mitigation should be continually monitored for SI decreases. Roadways where the SI decrease should be reconstructed as soon as possible.

- **Fill Haul** - Establish contingency plans for the various alternatives for bringing in the fill material (trucks, barge, and/or conveyor).

- **Traffic Diversion Model** - Prepare a diversion model for the project which includes the network as shown in Section 8 (Figure 8.01). Improvements to the arterial system as a result of diversion should be implemented prior to the start of the hauling activity on the freeways. An arterial improvement program should be implemented prior to the construction of the Third Runway.

- **Additional Traffic** - Areas identified in Section 8 (Table 8.10) should be monitored for additional traffic impacts after the Third Runway is operational.

- **Expand EIS Analysis** - The EIS traffic analysis should be expanded to the entire network as shown in Section 8 (Figure 8.01).

- **Accidents** - Develop a Freeway Incident Management Plan for the construction phase and impose operational restrictions on the heavy trucks involved with the haul

- **Regulatory Compliance** - Comply with all appropriate Federal, State and local noise regulatory requirements for surface transportation of fill and other materials associated with Master Plan Update implementation.

- **Construction Restrictions** - Restrict all construction operations, including heavy equipment and trucks hauling fill, between the hours of 7:00 AM and 9:00 PM Monday through Friday and 9:00 AM to 9:00 PM on Saturdays.

- **Noise Control Devices** - Equip all construction equipment, including trucks hauling fill, with noise control devices.

- **Complaint-Driven Requirements** - If noise complaints are received during construction, implement one or more of the following:
  - Relocate stationary construction equipment as far from nearby noise sensitive properties as possible.
  - Shut off idling equipment.
  - Re-schedule construction operations to avoid periods of noise annoyance.
  - Notify nearby residents whenever extremely noisy work will be occurring.
  - Install temporary/portable acoustic barriers around stationary construction noise sources.
  - Place material stockpiles between crushing or screening operations and the affected dwelling(s).

- **Remodeling** - When the Master Plan Update implementation is started, remodel existing surface transportation noise with the most current version of STAMINA (or the most accepted program) and compare with the 1994 existing baseline conditions and the actual conditions at the start of construction.

- **Clarify Modeled Surface Traffic Noise** - In the Integrated Noise Model, distinguish between construction and other surface traffic, in particular traffic associated with hauling fill.

Principal Socio-Economic Recommendations

The following recommendations are included in Section 9 of the study. Please refer to Section 9 for a complete description of the study's socio-economic recommendations.

- **Additional Community Services/Facilities** - Provide additional services and facilities that match the needs of the changing residential demographic in the impacted communities.

- **Additional School Services/Facilities** - Provide additional services and facilities that match the needs of the changing residential demographic in the Highline School District.

- **Property Values** - Make a partial payment of property taxes for homeowners in the five impacted cities equal to an annuity of the present value of whose payments equal the property's loss of relative value caused by expansion of the Airport. If partial tax payments are not made, then make annual off-setting payments to each of the five impacted cities to compensate them for the relative declines in residential property values caused by construction of the Third Runway and related Airport facilities.

- **Promotion of Home Ownership** - Establish a revolving "Home Ownership Loan Fund" to facilitate the movement of persons living in Burien, Des Moines, Federal Way, Normandy Park and Tukwila from "renter" to "owner" housing tenure status.

- **School Tax Revenues** - Conduct a detailed analysis of the potential shortfall in Highline School District's property tax base that will result from construction of the Third Runway and related Airport facilities.

- **Changing Student Demographic Profile** - Additional research should be undertaken to develop quantitative estimates of the relationship between demographic shifts in the Highline School District's student population, levels of student performance and appropriate mitigation measures to maintain the District's traditional quality of education outcomes.

- **Public Safety Costs** - Establish a program which reimburses the Cities of Burien, Des Moines and Tukwila for the additional public safety requirements they will experience.

- **Cultural Resources Enhancement** - Each of the five impacted cities should develop a cultural resources enhancement plan specifically directed toward meeting the quality of life challenges that the Third Runway and related Airport facilities.

- **Social Services Plan** - Each of the five impacted communities should develop a Southwest King County integrated community social service resource and delivery plan.

- **Public Health Analysis** - It is recommended that the School of Public Health at the University be funded to conduct an Airport health impact assessment, and that if the assessment finds a positive correlation between adverse health impacts and levels of Airport operation, appropriate measures to mitigate these affects be funded.

- **Environmental Justice** - Establish a monitoring system in the area to the north of the Airport under the approach/departure flight track for the Third Runway to insure that the intent of Federal Executive Order 12898, "Environmental Justice" are met.

- **Quality of Life Indicator** - Create a quality of life indicator model for the five impacted cities and for areas in Northwest King County which are appropriate as a comparison area. The model should be used to identify changes in the impacted cities' relative quality of life over time and the major quality of life indicators which contributed to the decline.

- **Airport Operations Assessment** - Conduct an economic and engineering assessment of Airport operations to determine Airport functions which would have positive economic development benefits and could be shifted to the five impacted cities.

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SECTION 1

INTRODUCTION

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INTRODUCTION

1.01 - INTRODUCTION

The Seattle-Tacoma (Sea-Tac) International Airport is operated by the Port of Seattle and located in the City of SeaTac, Washington, in southwestern King County. Development of a third north/south runway (8,500 feet) has been proposed in order to expand the airport's capacity. Other airside, terminal and landside improvements have also been proposed as part of the Master Plan Update for Sea-Tac.

In response to concerns regarding the potential for increased aviation-related impacts upon the neighboring communities, the State of Washington initiated a grant in 1995 to assess the impacts of the proposed Third Runway. This grant was authored by State Senator Mike Heavey and was administered through the State's Department of Community, Trade, and Economic Development (CTED). The purpose of the study was to assess the projected impacts of the proposed Third Runway and to develop mitigation strategies for the Cities of Burien, Des Moines, Federal Way, Normandy Park, and Tukwila, the Highline School District, and the Highline Community Hospital. The study area is shown in Figure 1.01.

The provisions of this State grant stipulated that the study cannot be used to oppose the proposed Third Runway at Sea-Tac International Airport. Specifically, the grant stated:

> *"State appropriation is provided solely for distribution to the City of Burien for analysis of the proposed Port of Seattle third runway, including preparation of a draft environmental impact statement and other technical studies. The amount provided in this subsection shall not be expended directly or indirectly for litigation, public relations, or for any consulting services for the purposes of opposing the construction of the proposed third runway."*

1.02 - CONSULTANT SELECTION

Acting in the capacity of the grant manager, the City of Burien coordinated the consultant selection process and worked cooperatively with the Cities of Des Moines, Federal Way, Normandy Park, and Tukwila, the Highline School District, and the Highline Community Hospital. Requests for proposals were advertised both locally (metropolitan Seattle area) and nationally. A short-list of consultant teams was selected to be interviewed in November 1995. Upon conclusion of the interviews, the following firms were selected in December 1995 to conduct this study:

- **Hellmuth, Obata + Kassabaum, Inc.** (Dallas, Texas), with **Raytheon Infrastructure Services, Inc.** (Denver and Philadelphia). The HOK/Raytheon team provided environmental, transportation, and community compatibility analysis and mitigation approaches.

- **Thomas/Lane & Associates, Inc.** (Seattle, Washington) provided socio-economic analysis and mitigation measures.

- **Michael J. McCormick, AICP** (Olympia, Washington) provided inter-governmental affairs consulting.

HOK, Thomas/Lane, and Michael J. McCormick contracted individually with the City of Burien. (Raytheon provided professional consulting services as a subconsultant to HOK). The City of Burien coordinated the overall studies.

1.03 - PROJECT SCOPE

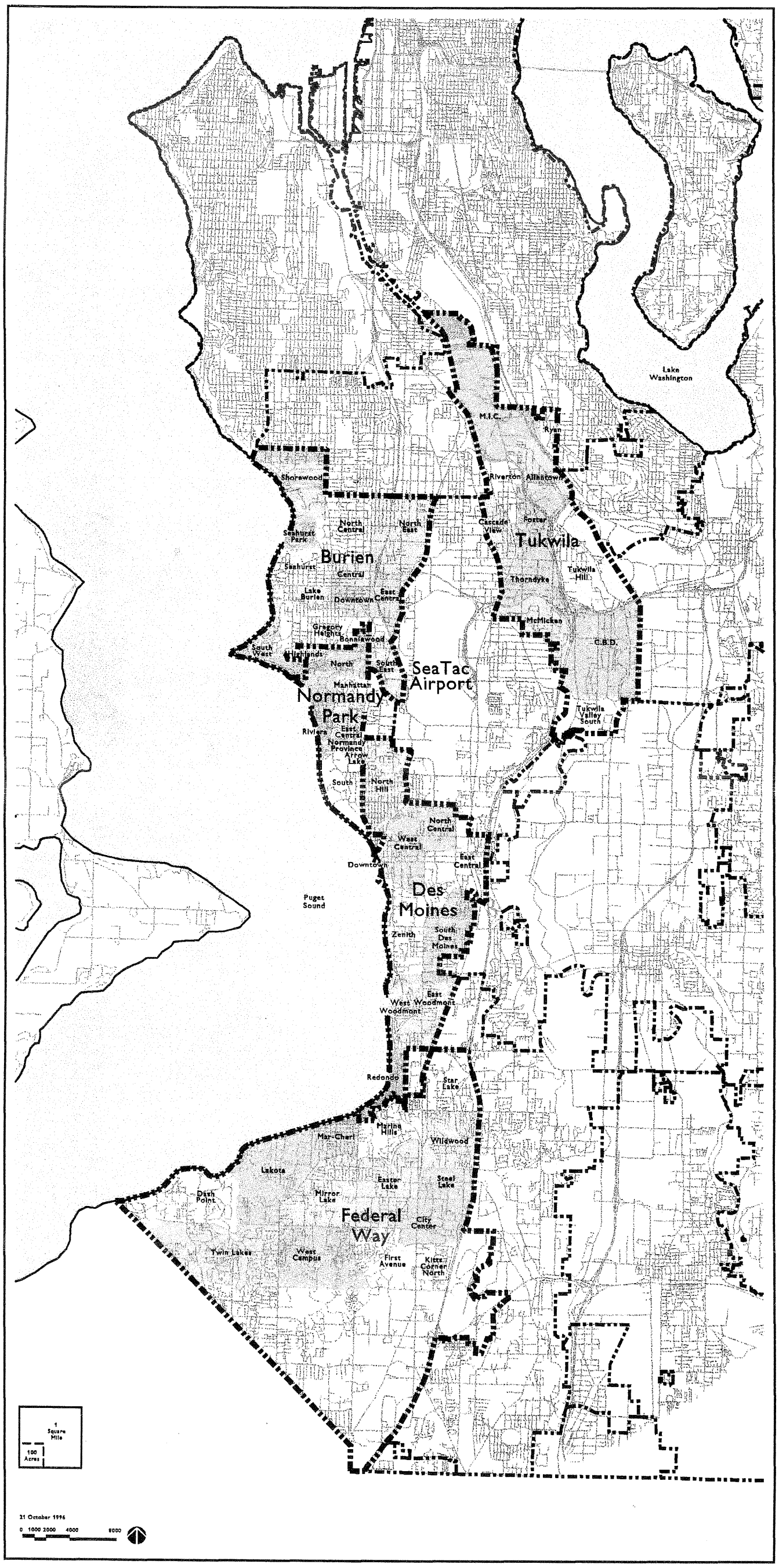
The Sea-Tac International Airport Impact Mitigation Study consisted of eight general tasks:

- **Project Initiation (Task 1)** - The consultants met with representatives of the Cities of Burien, Des Moines, Federal Way, Normandy Park, and Tukwila, the Highline School District, and the Highline Community Hospital to review the project scope and to gather base data, including information from the Federal Aviation Administration (FAA), the Port of Seattle (POS), the Sea-Tac Master Plan Update Environmental Impact Statement (EIS), and other sources of information.

- **Documentation/Discovery (Task 2)** - The consultants reviewed the information provided in Task 1, identified additional data needs, developed project base maps, and documented existing conditions.

- **Meetings, Presentations and Reviews (Task 3)** - During the course of the project, the consultants met five times in the project area and conducted informational meetings and addressed questions and comments from the Cities of Burien, Des Moines, Federal Way, Normandy Park, and Tukwila, the Highline School District, and the Highline Community Hospital. Meetings were also conducted with city councils, citizens, State and Federal agencies, and other interested parties. The consultants conducted over 100 meetings and presentations during 15-19 April 1996, 20-24 May 1996, 24-28 June 1996, 5-9 August 1996, 21-31 October 1996, and 10-20 March 1997. Project coordination meetings were conducted in Dallas with the consultants and representatives of the Cities of Burien and Federal Way on 16-20 September 1996 and 9-11 December 1996.

Figure 1.01
Study Area



- **Define Mitigation State-of-the-Art (Task 4)** - The consultants conducted a literature and Internet search and various telephone interviews to summarize airport mitigation experiences and mitigation precedents set by major projects within Washington State.

- **Environmental Analysis (Task 5)** - The consultants reviewed the Master Plan Update EIS and established a baseline for potential environmental impacts utilizing primarily existing information in the EIS and some additional data collected in Tasks 1 and 2. The potential environmental impacts were assessed and an environmental analysis technical memorandum was produced which was incorporated into the project report.

- **Traffic Analysis (Task 6)** - The consultants reviewed the Master Plan Update EIS and established a baseline for potential traffic impacts utilizing the existing information in the EIS and data collected in Tasks 1 and 2. The potential traffic impacts were assessed and a traffic analysis technical memorandum was produced which was incorporated into the project report.

- **Socio-Economic Analysis (Task 7)** - The consultants reviewed the EIS and established a baseline for projected socio-economic impacts utilizing the existing information in the EIS and data collected in Tasks 1 and 2. The potential socio-economic impacts were assessed and a socio-economic analysis technical memorandum was produced which was incorporated into the project report.

- **Mitigation Plan (Task 8)** - The consultants developed an approach to neighborhood mitigation which addressed the potential impacts of the proposed project. The draft mitigation approach was presented to city staff, citizens, the POS staff, and various State and Federal agencies for review and comment. The plan was revised and incorporated into the project report.

1.04 - PROJECT APPROACH

The approach to this study involved several assumptions:

- A basic assumption of the study was that the proposed Third Runway and associated airport improvements would be approved and constructed.

- The data developed by the Port of Seattle for the project's Environmental Impact Statement was the basis for the information to be analyzed. Additional supplemental information was provided by King County, the City of Seattle, various Washington State and Federal agencies, the Puget Sound Regional Council (PSRC), the Puget Sound Air Pollution Control Agency (PSAPCA), the study area cities, the Highline School District, and the Highline Community Hospital. No new information, data, studies, or models were generated as a component of this study.

- The proposed project at Sea-Tac International Airport consists of a new 8,500-foot north/south runway (west of the existing outboard runway) and associated terminal and capacity improvements necessary to accommodate projected airport demand through the Year 2020. This project was generally referred to as Alternative 3 in the EIS.

- The study analysis was based on individual neighborhood areas as defined by each of the five study area cities. Potential impacts were projected for each neighborhood based upon the above data. Various mitigation measures were developed to address the needs of each neighborhood, rather than just individual properties.

- Appropriate legislation from the State of Washington - specifically the Growth Management Act (GMA) and the State Environmental Policy Act (SEPA) - was utilized to evaluate and assess the mitigation necessary to address the potential impacts. The experience of other American airports and other major Washington State projects also was reviewed to determine appropriate mitigation approaches.

This report documents the consultant analysis which was conducted during the period April 1996 through February 1997. During the study, the consultants met regularly with citizens, city staff, elected officials, Highline School District and Highline Community Hospital representatives, staff from the Port of Seattle, and representatives from various city, County, regional, State, and Federal agencies.

Sections 2, 3 and 4 present an evaluation of the Environmental Impact Statement with respect to environmental (Section 2), transportation (Section 3) and socio-economic (Section 4) issues.

Sections 5 and 6 present a summary of case studies of mitigation at selected US airports (Section 5) and for major projects within Washington State (Section 6).

Sections 7, 8 and 9 project the potential impacts for the study area and propose mitigation measures for environmental impacts (Section 7), transportation impacts (Section 8) and socio-economic impacts (Section 9).

Section 10 presents a summary of the findings of this report. Several appendices are also included which address equity issues and socio-economic impacts (Appendix A), technical references (Appendix B), project contacts (Appendix C), and a glossary of terms (Appendix D).

SECTION 2

EIS ENVIRONMENTAL ANALYSIS

SECTION 2
EIS ENVIRONMENTAL ANALYSIS

2.01 - INTRODUCTION

Task 5 of the consultant scope of services focused on analysis of the Sea-Tac International Airport's EIS if Alternative 3 is implemented. The following areas were analyzed:

- Noise and vibration impacts.
- Air quality impacts.
- Impacts on water resources, water quality and hydrology, wetlands, and floodplains.
- Aesthetics and visual impacts.

For each of these areas, the scope of services involved the following:

- Evaluate the adequacy of the studies which were part of the Master Plan Update's Final EIS.
- Establish a baseline for potential project impacts.
- Assess the impacts for both project construction and operation.
- Identify issues in the EIS and recommend methodologies to enhance the analysis.

This environmental analysis will be the basis for formulating mitigation measures to minimize potential project impacts and to address the issues raised in this Section. In order to fully evaluate the appropriate areas of the EIS, each area was reviewed for the following:

- Methodology: assumptions; monitoring stations; baseline data/modeling.
- Existing conditions.
- Future conditions and impacts.
- Mitigation.

The evaluation is based on a review of the different EIS Chapters, appropriate literature information and discussions with the agencies and persons contacted. The specific EIS Chapters reviewed are shown in Table 2.01.

Table 2.01
EIS Chapters Reviewed for Environmental Issues

Chapter	Section	Title
--	--	Executive Summary
I	--	Project Background and Purpose and Need
II	--	Alternatives
III	--	Affected Environment
IV	1	Noise
IV	2	Land Use
IV	7	Human Health
IV	9	Air Quality
IV	10	Water Quality and Hydrology
IV	11	Wetlands
IV	12	Floodplains
IV	19	Earth
IV	20	Solid Waste
IV	21	Hazardous Substances
IV	23	Construction Impacts
IV	24	Aesthetics and Urban Design
V	--	Probable, Unavoidable, Adverse Environmental Impacts and Mitigation Measures
Appendix C	--	Noise Impacts
Appendix D	--	Air Pollutant Methodology
Appendix F	--	Stream Survey Report for Miller Creek
Appendix G	--	HSP-F Hydrological Modeling Analysis
Appendix H-A	--	Jurisdictional Wetland Delineation
Appendix H-B	--	Wetland Function and Values Assessment
Appendix N	--	Aesthetic Views and Photos
Appendix P	--	Natural Resource Mitigation Plan
Appendix Q	--	Water Studies
Appendix Q-A	--	Baseline Groundwater Study
Appendix Q-B	--	Preliminary Water Conservation Plan
Appendix Q-C	--	Concepts for Using a Constructed Aquifer to Manage Airport Stormwater
Appendix R	--	Responses to Public Comments

(Source: US Department of Transportation, Federal Aviation Administration, and Port of Seattle, February 1996)

2.02 - NOISE AND VIBRATION

Noise and vibration issues in the EIS are discussed in Chapter IV, Sections 1, 7 and 23, Chapter V, Appendix C and part of Appendix R. In Appendix C, standard aircraft noise descriptors or metrics are described as follows:

- **LDN (Day-Night Average Sound Level)** - "LDN" is the FAA specified noise descriptor; it employs the LEQ or equivalent sound level which is a single numerical noise rating in A-weighted decibels (dBA) which would contain the same noise energy as the time-varying sound level in a given period of time; the LDN provides a numerical description of the weighted 24-hour cumulative noise energy level using the A-weighted decibel scale over one year.

- **LEQ (Average Daily Sound Level)** - "LEQ" is used to define noise exposure without the penalty of nighttime activity over a specified period of time (e.g., 24 hours, a school day); in general, the closer the 24 hour LEQ and LDN values are to each other, the less the impact of nighttime activity; if the LDN is 3 dBA or greater than the LEQ, the nighttime noise is considered to be a major contributor to the overall noise environment.

- **SEL (Sound or Single Event Exposure Level)** - "SEL" is the noise associated with a single aircraft noise event either on the ground or while in flight. Noise complaints are generally a result of a SEL.

- **TA (Threshold or Time Above)** - "TA" represents the number of minutes per average annual day that a location is exposed to noise in excess of given decibel thresholds such as 65 dBA.

These metrics are used to describe sound pressure or amplitude and sound frequency. Sound pressure is a direct measure of the sound magnitude without consideration for other factors that may influence its frequency. A standard unit of measuring sound pressure is the decibel (dB). Because the range of sound pressures in the environment is so large, these pressures are expressed on a logarithmic scale. This scale compresses the wide range in sound pressures.

Sound frequency is expressed as Hertz (Hz) or cycles per second. Young adults normally have an audible frequency range of 2 to 16,000 Hz; whereas, aircraft noise is between 50 to 5,000 Hz. The human ear has different sensitivities to various frequencies, with some louder or quieter than others. Thus, methods for frequency weighting have been developed with the most common being the A-weighted noise curve or dBA. The A-weighted scale performs this compensation by discriminating against frequencies similar to the human ear. All Federal agencies dealing with community noise use the A-weighted sound level as the basic unit for environmental impact analysis.

In the EIS, it is indicated that noise levels in flight are regulated by the FAA's aircraft certification process. Certain non-flight activity at the Airport is regulated by state and local regulations.

Chapter 173-60 of the Washington Administrative Code (WAC) specifies maximum noise levels that one property can project onto another. However, under the code the following are exempt:

- Sounds created by aircraft engine testing and maintenance not related to flight operations between 7:00 AM and 10:00 PM, provided that testing and maintenance is conducted at a remote site, whenever possible.

- Sounds originating from aircraft in flight and sounds that originate at airports which are directly related to flight operations.

Therefore, the WAC applies only to aircraft engine testing and maintenance at night which are not related to flight activity.

King County has adopted the WAC regulations within their areas of jurisdiction as shown in Table 2.02.

Table 2.02
King County Maximum Permissible Noise Levels

Land Use Zone of Noise Source	Land Use of Receiving Property/dBA			
	Rural	Residential	Commercial	Industrial
Rural	49	52	55	57
Residential	52	55	57	60
Commercial	55	57	60	65
Industrial	57	60	65	70

(Source: Washington Administrative Code, March 1987)

The maximum permissible noise levels are:

- Reduced by 10 dBA at night (10:00 PM to 7:00 AM) when the receiving land use zone is residential.

- Reduced by 5 dBA at night for sounds that are periodic or contain pure tones..

- Increased by 15 dBA for up to 1.5 minutes, 10 dBA for up to 5 minutes, 5 dBA for up to 15 minutes (all per hour) for noises of short duration.

The US Environmental Protection Agency (USEPA) has identified the 55 LDN as the desirable noise level for protecting the public health and welfare with an adequate margin of safety (EPA, March 1974).

This is not a regulatory level, but as indicated by the Puget Sound Regional Council and Port of Seattle (October 1992):

> *"... the 55 LDN is indicative of a desired goal for the noise environment within the communities of the Puget Sound Region."*

2.03 - AIRCRAFT NOISE EFFECTS METHODOLOGY

In the EIS, aircraft noise effects represented:

> *"... the land area and number of people and residences above predetermined levels."*

These levels were defined by LDN (Day-Night Average Sound Level) contours of 60, 65, 70 and 75 LDN.

The LDN contours were developed by using FAA's Integrated Noise Model (INM), Version 4.11. This model version includes information on:

- Aircraft fleet mix.
- Flight track and runway use statistics.
- Flight profiles adjusted for ,local elevation and temperature.
- Aircraft ground activity including taxi movement noise and aircraft run-up noise.
- Ground terrain.

Each contour developed for the EIS assumes that the existing noise abatement program summarized below, will remain in effect in the future. The FAA considers airport noise impacts to be significant if the LDN noise levels increase 1.5 dBA or more within the 65 LDN noise contour.

In the United States, two computer-based noise simulation models are currently used which produce LDN contours. The INM was developed by the FAA and is most often used for civil airports; whereas, NOISEMAP was developed by the US Air Force and is generally used for military air bases. Thus, the INM, Version 4.11, was an appropriate model to use and was the latest version of the INM at the time the EIS was developed. Since the EIS was developed, two updated versions of the INM have been developed:

- **INM Version 5.0** - Version 5.0 is a Windows-based program which was released in August 1995. It included such enhancements as a new graphics user interface, new data preparation and input aids, new graphics and plotting capabilities, and improved and faster noise calculations algorithms. More accurate noise predictions also are supposed to be made.

- **INM Version 5.1** - Version 5.1 is a Windows '95-based program which was released in late 1996. It has the ability to plot noise contours on a street map and has an expanded data base of aircraft including the Boeing 777 and MD-90. At the time the EIS was done, noise data for a Boeing 767-200 with JJ-9-D was substituted for the Boeing 777 aircraft.

Because of at least the greater accuracy of the INM, Version 5.1 - the ability to plot noise contours on a street map and the expanded data base of aircraft information - the noise model should be rerun using Version 5.1. This will allow confirmation of the data from INM, Version 4.11 and the most up-to-date information available on the newer aircraft noise characteristics. The noise study did not include an extensive evaluation of sound exposure level (SEL). According to Horonjeff and McKelvey (1994):

> *"In addition to LDN contours, SEL contours can be helpful in addressing issues of sleep and speech interference and for analyzing the effects of noise abatement procedures, such as proposed noise abatement flight tracks. Graphical comparisons of SEL contours of various aircraft types can also provide powerful images for comparing noise emissions of different aircraft types."*

They also indicate that:

> *"Tabular listings for user-specified ground locations show not only the predicted LDN but also the SEL and LDN contribution of individual aircraft by runway and flight corridor. This information is invaluable to understanding the major contributors to the total LDN. It can also be used to compare the model predictions with data from noise-monitoring locations. Such comparisons often provide the basis for fine-tuning model inputs as well as promoting public confidence in the computer model and the contours it produces."*

In the EIS, the INM was used to show the SEL contours for one approach to Runway 16R and one departure from Runway 16L for five aircraft types which dominate the current and future fleet mixes at the Airport. Based on the comments by Horonjeff and McKelvey (1994), it appears as if it would be useful to have a more extensive discussion of the SEL contours; their relationship to the LDN contours; and their relationship to health problems, in particular, sleep and speech interference. Thus, this should be done concurrent with re-evaluating the noise data using INM, Version 5.1.

The EIS for the Flight Plan Project (Puget Sound Regional Council and Port of Seattle, October 1992), included noise assessment information associated with the 55 LDN level and a SEL of 80 dBA. This SEL was selected because it is often used to supplement the LDN analysis and 80 dBA corresponds to the level at which sleep disturbance and speech interference start to occur. This EIS used the following overall noise assessment criteria in the analysis:

- Population exposed to cumulative noise levels in excess of 55 LDN.
- Population that would be newly exposed to cumulative noise levels in excess of 55 LDN.
- Population exposed to cumulative noise levels in excess of 65 LDN.
- Population that would be newly exposed to cumulative noise levels in excess of 65 LDN.
- Population that would be exposed to single event SEL noise levels in excess of 80 dBA.

The assessment criteria related to the 65 LDN were used in the Master Plan Update Alternative EIS; but the other criteria were not. Since the Flight Plan Project included the proposed Third Runway as an Airport capacity enhancement measure, the results of this EIS and assessment criteria should have been included in the Master Plan Update EIS. A more detailed evaluation of the SEL information would be particularly relevant since the information in EIS Table C-28 shows numerous receptors with peak levels above 80 SEL. In Appendix R of the EIS, it is indicated that computation of noise contours below 60 LDN is unreliable using the INM. Thus, a combination of noise measurement methods may be required to evaluate population exposure at the 55 LDN. This will, in part, depend upon INM, Version 5.1 capabilities.

The EIS approach to aircraft noise focused mostly on flight noise impacts taking into consideration run-up noise and aircraft taxing noise. The South Aviation Support Area EIS used the previously mentioned NOISEMAP model to also look at aircraft run-up and taxing operations (US Department of Transportation, Federal Aviation Administration and Port of Seattle, March 1994). It would have been useful if this information also had been developed and discussed for the Master Plan Update implementation EIS. The run-up evaluation should include a discussion of line maintenance run-ups, base maintenance run-ups and run-up locations with particular reference to the proposed Third Runway and facilities proposed as part of Master Plan Update implementation.

Appendix C Noise impacts in the EIS indicates that existing aircraft operations were based on average daily operations. It is not completely clear how many operations per hour this equates to. The air quality analysis used an aircraft peak hour activity level of about 88 operations (43.9 arrivals and 43.9 departures). The relationship, if any, between the noise and air quality aircraft operations or activity levels should be explained better taking into consideration the noise and air quality analyses used the August and June 1994 Official Airline Guide (OAG), respectively. Also, the discussion should include comments on the Airport being able to accommodate 60 arrivals per hour which was recently mentioned by the Port of Seattle (26 March 1996; 1 August 1996).

Existing Conditions

The FAA has established the 65 LDN as the critical level for the determination of noise impacts. The 60 LDN level was provided in the EIS for information only to allow a better understanding of aircraft noise levels in the Airport area. It is of interest to note that for the Flight Plan Project EIS (Puget Sound Regional Council and Port of Seattle, October 1992), the 55 LDN level was used as one of the noise assessment criteria. In this EIS, it was observed that:

"A noise level of 55 LDN and greater indicates the population to which the aircraft noise will be noticeable and some degree of annoyance or adverse community response would be expected to occur. Experience at Sea-Tac showed most areas (but not all) where noise complaints occurred were exposed to LDN levels of 55 or greater. For a new airport site, the 55 LDN represents that area in which future residential land use development may consider land use zoning, and other land use control measures to avoid significant noise-related residential land use impacts."

Based on the 65 LDN contour the following was concluded in the EIS for the Master Plan Update implementation:

- This contour includes 12.23 square miles.

- The 65 LDN noise exposure contour extends from north to south from the Duwamish River (just south of the Boeing Field Plant to near 280th Street South); to the west of the Airport the contour tapers to the southeast from the vicinity of 188th Street and 8th Avenue to its southern end; to the east and north of the Airport the noise contour is generally east of and parallel to State Route 509; east and west of the runway ends, the contour bulges outward which reflects the areas from thrust at takeoff to begin the role for departing flights; the contour between the runway ends curves in toward the Airport.

- Approximately 31,800 people in 13,620 homes are impacted by noise levels 65 LDN and greater; this represents a 52% reduction in population exposure over the 1991 conditions.

- The predominant use of the southerly traffic flow and the prevailing winds results in the largest portion of the 65 LDN contour falling south of the Airport.

- Because of increased thrust levels during take-off, noise levels are several decibels higher than approaches and noise contours extend further into communities south of the Airport.

- When traffic is in south flow, the east parallel Runway 16L is used for most departures and the west Runway 16R is used for most arrivals; when traffic is in north flow, Runways 34L and 34R (west and east runways) are used for departures and approaches, respectively; the noise exposure contours show greater exposure along the centerline of the approaches to Runways 16R and 34R.

The existing runway utilization is shown in Table 2.03.

Based on a visual examination of the data and results for the existing conditions description, it appears as if the results are appropriate for INM, Version 4.11. As indicated above, the results of this analysis should be compared with data generated by the INM, Version 5.1. In addition, the existing conditions description should include a better discussion of the relationship between the LDN, SEL and TA calculations and contours. The EIS indicates that TA:

"... is helpful in determining the exposure of certain noise sensitive users (schools, sleeping quarters, etc.) to extended periods of noise at various levels which may be disruptive to the activity occurring there."

However, the EIS did not address in detail the TA or other noise metrics issues with respect to these sensitive receptors. As part of checking the noise contours generated by the INM, a comparison was made with the measured noise level at the eleven existing noise monitoring stations. The comparison indicated a relative close relationship between the INM and actual measured data.

Table 2.03
Existing Runway Utilization

Runway	Aircraft Category[a]	Arrivals Day[b]	Arrivals Night	Departures Day	Departures Night
South Traffic Flow - 65%					
16L	Heavy	17.7%	1.73%	62.6%	47.3%
	Jets	13.2%	20.0%	56.5%	58.2%
	Props	19.1%	29.4%	58.6%	57.1%
16R	Heavy	47.3%	47.7%	2.4%	17.7%
	Jets	51.8%	45.0%	8.5%	6.8%
	Props	45.9%	35.6%	6.4%	7.9%
North Traffic Flow: 35%					
34L	Heavy	2.2%	0.0%	21.0%	21.0%
	Jets	7.0%	8.4%	30.0%	29.9%
	Props	13.0%	8.8%	24.8%	27.4%
34L	Heavy	32.8%	35.0%	14.0%	14.0%
	Jets	28.0%	26.6%	5.0%	5.1%
	Props	22.0%	26.3%	10.2%	7.6%

A - Aircraft category use as follows: Heavy (jet-powered aircraft with a takeoff weight of 300,000 or more); Jets (jet-powered aircraft with a takeoff weight of less than 300,000 pounds); Props (all piston or turboprop-powered aircraft).
B - "Day" indicates 7:00 AM to 9:59 PM. "Night" indicates 10:00 PM to 6:59 AM.

(Source: US Department of Transportation, Federal Aviation Administration, and Port of Seattle, February 1996)

However, in Appendix R of the EIS, it is indicated that:

"Noise monitoring sites are not sufficient in numbers and are not located at distances far enough from the Airport to be used in the delineation of the noise exposure contours. Although there are sufficient sites near the Airport to provide information for input adjustment, the absence of sites at greater distance preclude the full array of data necessary for the modification of input information."

Based on this, it appears as if the number of permanent noise monitoring stations is inadequate and should be increased to help validate the INM noise contours.

In addition, the noise monitoring stations have inadequate coverage of the area surrounding the Airport, in particular, to the northwest, west, southwest and northeast of the Airport. The need for more monitoring stations will become particularly important as a result of Airport activities moving approximately 1/2 mile west with Master Plan Update implementation. As part of adding more noise monitoring stations, the system also should be upgraded to replace old noise monitoring equipment.

It should be noted that the Port of Seattle is currently evaluating the need for additional monitoring stations and upgrading their equipment (Port of Seattle, 1 August 1996). Representatives from the cities and concerned groups/citizens in the Airport area should participate with the Port of Seattle in the selection of appropriate monitoring sites that are not limited primarily to the north/south flight paths.

As part of the existing conditions discussion, the EIS provides information on the aircraft noise reduction/abatement programs. These include:

- **Noise Budget Program** - The Airport will move toward an all Stage 3 aircraft fleet by limiting the amount of noise airlines are allowed to make each year; the goal agreed to in the Noise Mediation Agreement (Port of Seattle and Mestre Greve Associates, 31 March 1990) is to reduce noise by the Year 2001.

- **Nighttime Limitations Program** - This program involves phasing out Stage 2 aircraft during nighttime hours; effective 1 October 1995, Stage 2 jet aircraft may not operate between 10:00 PM and 7:00 AM unless granted an exemption or variance (e.g., delays due to weather, air traffic control delays, etc.).

- **Ground Noise Control Program** - Airplanes are not allowed to back away from gates using engine power, instead they must be pushed away by "tugs"; run-ups during the daytime are allowed only at designated locations on the north and south ends of the Airport (aircraft must face into the wind so that jet blast is directed back across the airfield); between 10:00 PM and 7:00 AM run-ups are allowed only under special circumstances such as for a departure.

- **Overflight Noise Abatement Procedures** - Initial "straight-out" departure corridors are in a narrow flight path; Duwamish/Elliot Bay corridor for arriving and departing flights keep aircraft over water and industrial areas as much as possible; nighttime procedures to keep flights over Puget Sound waters as much as possible.

- **Flight Path Monitoring** - The Airport's Noise Abatement Office monitors jet flights in the noise abatement corridors.

- **Noise Monitoring** - Eleven station permanent noise monitoring system to record noise exposure levels in the Airport area.

- **24-Hour Noise Information Line** - Provides information on noise issues or accepts noise complaints.

In Appendix R of the EIS, it is indicated that the nighttime noise budget and limitations program is designed to address noise issues associated with aircraft categorized as having FAR Part 36 Stage 2 noise levels. Therefore, the program will expire with the completion of the scheduled phase out of these aircraft between 2000 and 2003. These two components are an integral part of the aircraft noise reduction/abatement programs and discussions should be held with the Port of Seattle about continuing the implementation of the nighttime limitations program beyond the Stage 2 phase out schedule. Depending on the status of the nighttime noise budget program in relation to Stage 3 aircraft, this program also should be continually evaluated and updated based on the different stages of aircraft.

INM Version 4.11 has the capability to compute noise levels due to airplane engine run-up operations. This is particularly useful for noise information around airplane maintenance facilities. Because concern has been expressed about noise levels associated with existing run-up and maintenance operations, and the proposed south aviation support area activities, a discussion of this feature and data for the Sea-Tac International Airport would be useful. This information should be provided for both the existing and future conditions.

Future Conditions

Future conditions were based on the following average day operations:

- Year 2000 - 1.038 average daily operations.
- Year 2010 - 1,112 average daily operations.
- Year 2020 - 1,210 average daily operations.

Based on these operations, the runway utilization was predicted as shown in Table 2.04 with Runways 16X and 34X indicating the south and north flow, respectively, on the new Third Runway. This utilization reflects the requirements for Stage 3 aircraft.

Under the future development condition flight tracks are not expected to differ from the existing flight tracks. These flight tracks also were duplicated for the new Third Runway 16X (south flow) and 34X (north flow). Conclusions concerning the future conditions were as follows:

- Alternative 3 and the other project alternatives would result in an increase of 5% to 7% in the 65 LDN noise exposure area over the "Do-Nothing" alternative.

- The length of the new runway would have little effect on the area within the noise pattern.

- The noise exposure pattern of each future alternative would be 42% to 50% smaller than the pattern of the existing condition.

- Of the 1,252 sites where LDN levels were computed, 33 sites would experience significant increases in the Year 2000, 40 in the Year 2010, and 47 in the 2020 with "significant" defined as a 1.5 LDN increase in aircraft noise.

- Aircraft noise levels of 65 LDN and greater would impact the following areas for Alternative 3:

  - Year 2000 - 2.86 square miles, 4,020 dwelling units, 9,890 persons.
  - Year 2010 - 2.98 square miles, 4,190 dwelling units, 9,860 persons.
  - Year 2020 - 3.34 square miles, 4,740 dwelling units, 11,240 persons.

Table 2.04
Future Runway Utilization

Runway	Arrivals	Departures
South Traffic Flow - 63.9%		
Runway 16L	31.9%	23.7%
Runway 16R	19.9%	37.6%
Runway 16X	12.1%	2.6%
North Traffic Flow - 35.1%		
Runway 16L	17.5%	14.2%
Runway 16R	15.3%	20.6%
Runway 16X	3.3%	1.3%

(Source: US Department of Transportation, Federal Aviation Administration, and Port of Seattle, February 1996)

Based on the review of the information presented in the EIS for the future conditions, the information appears reasonable. As part of the Final Decision on Noise Issues (Puget Sound Regional Council, 27 March 1996), the expert noise arbitration panel indicated that with respect to the INM, a number of assumptions must be made which can affect the outcome. Sensitivity tests can be used to evaluate how much change in a key input value or assumption might affect the outcome. A similar approach would be useful in evaluating the assumptions used in the future noise modeling and the resultant data. Thus, sensitivity tests should be conducted and evaluated. Also, if possible, information on the range and standard deviations of the LDN and other data in the EIS should be presented. The range and standard deviations of the data could provide an indication of potential impacts beyond the noise contours shown in the EIS.

As discussed in EIS Appendix R (and as previously mentioned), actual noise information for the Boeing 777 was not available and alternate information was used. The INM, Version 5.1 should be used to re-evaluate the future noise contours since it is supposed to contain this information.
The noise mediation agreement (Port of Seattle and Mestre Greve Associates, 31 March 1990) indicates that as technology with noise barriers develops, the Port of Seattle will evaluate their use. It is not clear if during the future conditions evaluation the use of noise barriers was

included. This may be particularly useful in the vicinity of any new maintenance facilities in addition to the use of "hushing" equipment. Appendix R of the EIS also mentions the use of vegetation to help reduce noise. The EIS indicates in Chapter 1 that as part of the Master Plan Update objectives, Airport noise is to be attenuated through the use of berms and barriers (Port of Seattle, May 1994).

2.04 - SURFACE TRANSPORTATION NOISE EFFECTS

Surface transportation noise effects focused on the noise issues associated with the proposed surface transportation.

Methodology

For this analysis, the Federal Highway Administration (FHWA) computer program STAMINA 2.0 was used. The model calculated roadway noise levels at 108 user-specified receivers. The input to the model included:

- **Roadway Description** - Sets of roadway requests were defined within a network of sixteen area thoroughfares.

- **Traffic Volume** - Traffic on each of the major roadway requests during the peak hour of the day was evaluated based on final Metropolitan Transportation Plan traffic volumes which were updated.

- **Vehicle Classification** - Proportion of vehicle type, passenger cars, medium trucks and heavy trucks.

- **Travel Speeds** - For minor arterial roads travel speeds were assumed to be equal to the posted speed limit; for major roads including freeways, theoretical speeds were obtained by performing capacity analysis calculations, which correspond to the traffic conditions on the road link; this procedure followed the techniques contained in the Highway Capacity Manual (Transportation Research Board, 1985).

The receiver locations modeled were approximately 50 to 500 feet from a road edge in noise sensitive residential areas or facilities. The selection of these locations was coordinated with the aircraft noise analysis.

The STAMINA program produces peak hour LEQ levels for each receiver location. A LEQ is approximately 3 to 4 decibels less than a LDN.

Noise levels were calculated for the base year, 1994 and compared to ambient noise measurements conducted as part of the State Route 509/South Access Road Corridor EIS Phase II Study. Following this comparison, the STAMINA model was calibrated to more closely represent existing conditions.

Use of the FHWA STAMINA 2.0 program was appropriate for the surface transportation noise effects study. The data which was used in the model based on the information in the EIS, also seems reasonable.

Existing Conditions

The following summarizes the existing transportation/road noise conditions:

- Peak hour surface traffic noise levels range from 48.5 to 73.5 dBA LEQ (peak-hr).
- Thirty-five sites were identified as being noise impacted according to the FHWA sensitivity criterion of 67 dBA or greater.
- A total of 51 sites experience a LEQ (peak-hr) in excess of 65 dBA.
- The highest noise levels are generally located along SR 518, SR 509, IH-5/Military Road South 154th Way, and International Boulevard.

The existing conditions of the roadway noise evaluation appears to be adequate and provides a good start from which to predict and evaluate future changes. Depending on when the Master Plan Update implementation is started, consideration should be given to remodeling the surface transportation noise with the then current version of STAMINA or the most accepted program. This will allow a comparison with the 1994 existing baseline conditions and the actual conditions at the start of construction. In order to plan for this re-evaluation, the following should be done:

- Specific roadway noise monitoring sites should be established at key locations, possibly some of the sites identified as being noise impacted by the FHWA noise sensitivity criterion; the locations of these sites should be coordinated with the establishment of additional aircraft noise monitoring sites; data collection from these noise monitoring sites should begin as soon as possible in order to provide up-to-date baseline information before Master Plan Update implementation construction starts; and,
- More accurate traffic information should be obtained for the roads in the Airport area (e.g., vehicle categories and road use); the EIS indicates that relevant data was available only on IH-5 and International Boulevard for surveys conducted on 3 August 1987; 8 July 1991; and 25 February 1992.

Future Conditions

For the "Do-Nothing" Alternative, the transportation analysis indicates that noise levels will continue to be in excess of 65 dBA at the existing locations plus the following:

- By the Year 2000 five additional sites would exceed the peak hour LEQ noise level of 65 dBA; these sites will be along Kent-Des Moines Road west of International Boulevard and along South 200th Street east of International Boulevard; increases at these sites would be 2 to 3 dBA.

- In the Year 2010 noise levels at the 108 receptor sites will range from 50.8 to 74.8 dBA LEQ (peak-hr); eight additional sites would exceed the 65 dBA sensitivity level; all new sites will be located on major arterials such as South 154th Way, Des Moines Memorial Drive South, South 160th Street/Military Road, and South 200th Street; all increases are less than 2 dBA increase over 2000 levels, except for along South 24th Avenue which is 2.7 dBA.

- By 2020, 71 of the 108 receptor sites will experience LEQ (peak-hr) sound levels in excess of 65 dBA; 57 sites will experience sound levels at or above the FHWA level of 67 dBA LEQ (peak-hr); noise levels would range from 54.1 to 74.7 dBA LEQ (peak-hr); the greatest roadway related noise increases would occur along the new State Route 509/South Access Road.

A comparison between the "Do-Nothing" alternative and Alternative 3 indicates that:

- In the Year 2000 the greatest increase in noise of 4.7 dBA LEQ (peak-hr) would occur in the vicinity of one receptor at 8th Avenue South, north of SR 518; other noise receptors generally had levels similar to or below the "Do-Nothing" alternative.

- In the Year 2010 the 8th Avenue South location exceeds the "Do-Nothing" alternative location noise level by 2.3 dBA LEQ (peak-hr); other noise levels at receptor sites generally continue to be below or at the "Do-Nothing" alternative levels.

- By the Year 2020 the 8th Avenue South receptor is 0.6 dBA LEQ (peak-hr) below the "Do-Nothing" alternative and other receptor sites continue to be at or below the some "Do-Nothing" alternative noise levels.

The traffic analysis also used the STAMINA 2.0 model to evaluate earthwork and site preparation activities noise levels. Information was provided on typical noise levels of different types of construction equipment. It was indicated that based on the fill haul routes discussed in the EIS, noise levels will increase as follows on the indicated streets:

- 200th Street - 5.5 dBA.
- Des Moines Memorial Drive between 200th Street and SR 509 - 3.6 dBA.
- 24th Street near 154th Street - 6.4 dBA.
- South 160th Street east of the SR 509 interchange - 7.6 dBA.

According to the State of Washington Department of Transportation, because these noise increases are temporary, they are not subject to their noise level criterion during the daytime. They are subject to the criterion between 10:00 PM and 7:00 AM and the Port of Seattle has indicated that the Construction and Earthwork Management Plan will include steps to minimize nighttime noise impacts along the haul routes. However, area residents west of the earthwork activities for the Third Runway will experience construction related noise.

The future conditions for the roadway impact analysis was adequate based on the information available and assumptions used. Like the existing conditions analysis, it is recommended that the future analysis be evaluated again in order to reflect more accurately the information available prior to the start of construction for Master Plan Update implementation. This, is in part, to reflect more accurately actual Sea-Tac International Airport area traffic information due to growth, changes in any traffic patterns, etc. The re-evaluation would benefit from the following:

- More accurate information on construction activities, in particular haul routes, so that construction traffic can be included in the roadway noise re-evaluation.

- More accurate information on vehicle classification and their use of the various roadways.

- The additional monitoring data obtained from the roadway noise monitoring sites.

The re-evaluated future conditions discussion also should include information on the relationship between Master Plan Update implementation and the Port of Seattle's ability to maintain its Airport's reduced noise level goals. This discussion is particularly relevant because of the recent concerns about the Port of Seattle not sufficiently reducing on-the-ground noise impacts by 1 April 1996 (Puget Sound Regional Council, 27 March 1996).

2.05 - VIBRATION

The EIS vibration analysis was qualitative. A comparison was made between decibel levels recorded in the frequencies between 1 and 80 Hertz (Hz) for several different aircraft currently operating at the Airport. The range of low frequency noise levels for Stage 2 and 3 aircraft were as follows:

- **Stage 2** - 75-90 dBA (takeoff), 70-85 dBA (climb-out), 61-70 dBA (approach).
- **Stage 3** - 66-84 dBA (takeoff), 65-78 dBA (climb-out), 53-71 dBA (approach).

Based on this comparison, it was concluded that the intensities of vibration will decline as the aircraft fleet becomes entirely Stage 3. This is because the decibel levels at the low frequency levels associated with vibration are less for the aircraft that will makeup the future fleet at the Airport.

This vibration analysis was cursory and was more of a qualitative than a quantitative approach. A more extensive evaluation should be done because of the numerous complaints about vibration from aircraft activities, in particular, in homes and schools. Some of these complaints have been reported in areas such as on 160th Street and 10th, where noise/ vibration impacts will move closer with construction of the Third Runway.

More information on vibration should be presented because, "These induced vibrations - caused by airborne sound or transmitted through ground or structures - may generate additional annoyance, beyond that due to simple audibility of the impulse, because of "house rattling" and "startle," as well as additional contributions to interference with speech or sleep" (Committee on Hearing, Bioacoustics and Biomechanics, Assembly of Behavioral and Social Sciences, and The National Research Council, 1977).

Vibration should be evaluated qualitatively and quantitatively for at least the following for residences, schools and hospitals:

- Human whole body vibration.
- Annoyance and interference to humans caused by building vibration.
- Building structural damage.

With respect to humans, the evaluation should look at impacts on working efficiency, health, safety and comfort. The evaluation should incorporate the information and methodology discussed by the International Organization for Standardization (ISO; International Organization for Standardization, 1985 a and b; 1989).

Cumulative Impacts

The cumulative impact discussion for noise indicated that until specific project plans are completed for several other developments, total cumulative impacts can not be developed. Thus, only the State Route 509/South Airport Access Road development was included in the Year 2020 "Do-Nothing" and other alternatives roadway noise analysis.

This was a cursory approach to discussing cumulative impacts. At least tentative plans for these other developments should be discussed with respect to Airport Master Plan Update implementation. Therefore, the cumulative impacts evaluation should be redone and re-evaluated.

Mitigation Measures

The EIS indicates that all noise mitigation measures currently in effect to reduce aircraft noise levels will be continued. This includes the previously mentioned noise abatement programs plus the following:

- Insulation treatment of homes.

- Home sales assistance in the most severely noise impacted areas to make sure that homes sell at fair market value based upon a Port of Seattle hired independent appraiser.

- Insulation of schools, health facilities and churches.

A home acquisition and relocation program was concluded in 1993. This program was conducted from 1974 to 1993 during which the Port of Seattle acquired 1,300 homes and relocated approximately 3,900 residents. Additional mitigation measures discussed in this Section include the need to improve and expand the Airport and road noise monitoring sites to obtain more information on area noise levels. These and other mitigation measures will be discussed in Section 9. It should be noted that the Port of Seattle (1 August 1996) in its Resolution No. 3212 calls for the following:

- Working with the FAA and airlines to continue various noise reduction practices and to evaluate potential additional actions.

- Seeking commitment from the FAA to evaluate actions needed to prevent apparent violations of the north flow nighttime departure noise abatement procedures.

- Working with communities and Airport users to update the Federal Aviation Regulation (FAR) ISO Noise Compatibility Plan.

- Working with the Highline School District to insulate public schools.

- Completing "sensitive-use" public buildings and multi-family home insulation pilot programs.

- Designing and implementing a noise compatible land use plan for Port of Seattle properties within the current noise acquisition area.

- Reviewing methods for mitigating the impacts of low frequency noise and vibration.

- Upgrading the permanent noise monitoring sites from eleven to approximately twenty-five monitoring sites by the end of 1998 (data will include LDN, SEL and TA metrics).

2.06 - AIR QUALITY

Air quality issues associated with current Airport operations and the proposed Master Plan Update improvements are of major concern to the surrounding areas. This is, in part, due to the close proximity to the Airport to numerous residential neighborhoods. Implementation of the proposed improvements, in particular, construction of the Third Runway, also will bring these issues closer to the businesses along First Avenue in the City of Burien and along the southwestern part of 188th Street in the City of SeaTac.

EIS Chapter IV, Sections 7, 9 and 23, Chapter V, Appendix D, and part of Appendix R, focus on the air quality issues of the proposed Master Plan Update improvements.

It should be noted that more than one regulatory agency is responsible for air quality issues in the Puget Sound region. Three agencies have jurisdiction: US Environmental Protection Agency (USEPA); Puget Sound Air Pollution Control Authority (PSAPCA); and Washington State Department of Ecology (DOE). Their functions are as follows:

- **USEPA** - Has established the National Ambient Air Quality Standards (NAAQS) for six criteria pollutants (ozone, carbon monoxide, nitrogen dioxide, particulate matter, sulfur dioxide and lead); air quality standards specify the maximum short-term and long-term concentrates of air contaminants; and EPA sets aircraft emissions standards.

- **PSAPCA and DOE** - Have state and local ambient air quality standards (AAQS) that are at least as stringent as the national standards; and operate thirty-two permanent air quality/meteorology monitoring stations in the Seattle-Tacoma Puget Sound area including seasonal stations (Puget Sound Air Pollution Control Agency, October 1995). EPA, Washington State and Puget Sound AAQS are shown in Table 2.05.

- **PSAPCA** - The primary agency for air quality in the region; responsible for enforcement of federal, state and local air quality standards for stationary sources; and responsible for developing plans and programs to attain and maintain NAAQS.

As indicated above, EPA has a NAAQS for particulate matter or PM. The current EPA standard for PM is 10 microns or less (i.e., PM_{10}) and for a 24-hour average is not to exceed 150 micrograms per cubic meter or an annual average not to exceed 50 micrograms per cubic meter as shown in Table 2.05. EPA is reevaluating the PM standard and may promulgate new standards which retain the PM_{10} standard and set a new $PM_{2.5}$ standard.

Research indicates that large particulate matter is cleared off by the lungs. However, smaller particulate matter, 10 microns or less, go deeper into the lungs and cause the most damage. This includes increased respiratory problems, short term mortality from specific air pollution episodes and long term mortality.

The EPA Office of Air Quality Planning and Standards has proposed that the 24-hour $PM_{2.5}$ standard be somewhere between 18 and 65 micrograms per cubic meter; the annual standard would be between 12.5 and 20 micrograms per cubic meter. The annual PM_{10} standard would be retained and would be between 40 to 50 micrograms per cubic meter.

Table 2.05
Ambient Air Quality Standards

Pollutant[a]	National		Washington State	Puget Sound Region
	Primary	Secondary		
Carbon Monoxide				
8 hour average	9 ppm[b]	N/A[b]	9 ppm	9 ppm
1 hour average	35 ppm	N/A	35 ppm	35 ppm
Particulate Matter (PM_{10})				
Annual arithmetic ave.[c]	50 $\mu g/m^3$[(b)]	50 $\mu g/m^3$	50 $\mu g/m^3$	50 $\mu g/m^3$
24 hour average[d]	150 $\mu g/m^3$	150 $\mu g/m^3$	150 $\mu g/m^3$	150 $\mu g/m^3$
Particulate Matter (TSP)				
Annual geometric average	N/A	N/A	60 $\mu g/m^3$	60 $\mu g/m^3$
24 hour average	N/A	N/A	150 $\mu g/m^3$	150 $\mu g/m^3$
Ozone				
1 hour average[e]	0.12 ppm	0.12 ppm	0.12 ppm	0.12 ppm
Sulfur Dioxide				
Annual average[f]	0.03 ppm	N/A	0.02 ppm	0.02 ppm
30 day average	N/A	N/A	N/A	0.04 ppm
24 hour average	0.14 ppm[h]	N/A	0.10 ppm[h]	0.10 ppm[f]
3 hour average	N/A	0.05 ppm	N/A	N/A
1 hour average[g]	N/A	N/A	0.25 ppm	0.25 ppm
1 hour average	N/A	N/A	0.40 ppm[h]	0.40 ppm[f]
Lead				
Calendar quarter average[f]	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$	N/A	1.5 $\mu g/m^3$
Nitrogen Dioxide				
Annual average[f]	0.053 ppm	0.053 ppm	0.053 ppm	0.053 ppm

a Annual, quarter and 30 day pollutant standards are never to be exceeded; short term standards are not to be exceeded more than once per year unless noted.

b ppm = parts per million; $\mu g/m^3$ = micrograms per cubic meter; N/A = no applicable standard.

c Standard attained when the expected annual arithmetic mean concentrations is less than or equal to 50 $\mu g/m^3$.

d Standard attained when the expected number of days per calendar year with a 24 hour average concentration above 150 $\mu g/m^3$ is equal to or less than one.

e Standard attained when expected number of days per calendar year with maximum hourly average concentration above 0.12 ppm is equal to or less than one.

f Never to be exceeded.

g Not to be exceeded more than twice in seven consecutive days.

h Not to be exceeded more than once a year.

(Source: US Department of Transportation, Federal Aviation Administration, and Port of Seattle, February 1996)

Methodology

In order to determine Airport Master Plan Update implementation potential construction and operation impacts, the air quality analysis involved the following:

- Preparation of airport emissions inventory using the Federal Aviation Administration's (FAA) Emissions and Dispersion Modeling System (EDMS) computer model.
- Area dispersion analysis using EDMS.
- Airport roadway intersection dispersion analysis using the CAL3QHC air quality computer model.
- Human health - air toxics evaluation.
- Construction vehicles air quality analysis using the CAL3QHC model.
- Clean Air Act conformity.
- Certification for compliance with air quality standards.

The methodology for each of these is evaluated below followed by information on results in the *Air Quality Results* section.

Airport Emissions Inventory

The FAA's EDMS computer model Version 944 was used to perform the air emissions inventory. Use of this model was confirmed with the EPA, PSAPCA and DOE. Aircraft and vehicle emission rates are included in the EDMS model and are based on information provided in EPA technical reports: Compilation of Air Pollutant Emission Factors (AP-42) and Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources. The EDMS model also includes vehicle emission factors provided through an EPA mobile source emission program, MOBILE5A.

As indicated above, the EDMS model includes information provided by AP-42. However, during the course of this evaluation, public comments were made indicating that AP-42 emissions data may not have been consistently used, in particular with respect to particulates. It also was indicated that there may not have been particulate data within EDMS and it may have been removed from the model.

The Airport emissions inventory is used to summarize the total quantity of each pollutant from Airport activity within a defined area. The EIS indicates that this is not comparable to ambient air quality standards. However, the EIS indicates that the:

"....inventory can provide an indication of the impact development will have on overall air quality."

The aircraft characteristics which were used to define the quantity of pollutants from aircraft activity for the emissions inventory were:

- Aircraft activity levels, fleet mix and engine types.
- Time in operations mode for taxi/idle/delay; takeoff; climbout; and approach.
- Emission factors from the EPA technical reports based upon engine classification and operational modes.

The EDMS computer model is an accepted tool for determining an aircraft emissions inventory. In addition, the aircraft characteristics or data which was used was appropriate and adequate.

The aircraft activity level for the air pollutant emissions inventory was based on a peak hour of about 88 operations (43.9 arrivals and 43.9 departures). The relationship between this activity level and a 60 airplane arrival level per hour recently mentioned by the Port of Seattle (26 March 1996; 1 August 1996) should be discussed in relation to the modeling.

Area Dispersion Analysis

The EDMS computer model evaluates the design and operation of an airport by modeling aircraft emissions during the different operational modes. This includes takeoff, climbout, approach and taxi/idle/delay. Emissions are calculated for up to an altitude of 3,500 feet since emissions above this altitude are not considered to have discernible impacts on ground level air quality.

Vehicle emission rates also are part of the EDMS model which includes MOBILE5A, an EPA mobile source emission program. The emission rates are used to predict air pollutant dispersion from vehicle sources on Airport area roadways and parking lots.

Initially, a screening dispersion analysis was done to determine where there might be potential ambient air quality standard (AAQS) exceedances. This analysis presents worst case conditions in terms of meteorological conditions and Airport operations. The meteorological conditions include: wind direction and speed; temperature; mixing height; and stability class or factor that determines the amount of pollution dispersion (i.e., low to high stability).

The screening analysis involved having a receptor grid in the Airport area for which emission levels were calculated. This receptor grid was confined to approximately 4,900 feet to the east and west of Airport property and approximately 3,000 feet north and south of Airport property not including the land owned by the Airport extending to the north and south of the existing runways.

The receptor grid consisted of 400 receptor locations in a rectangular area around the Airport. Based on this grid, pollutant contours for nitrogen dioxide (NO_2) and carbon monoxide (CO) were developed to determine the locations where the highest concentrations might be found.

NO_2 and CO were selected because according to the EIS they are the two primary parameters of concern around the Airport. However, the screening analysis also included particulate matter (PM_{10}) and sulfur dioxide (SO_2). For the receptor locations which showed a potential problem and receptor locations recommended by EPA, a refined dispersion analysis was done. The dispersion analysis involved the receptor locations for the draft (D) and final (F) EIS shown in Table 2.06.

Table 2.06
Refined Dispersion Analysis Receptor Locations

Receptors[a]	Location
4 (D)	Riverton Heights, SeaTac
4A (F)	Highline Nurseries
5D	Highline, Burien
5A (F)	SeaTac Reservoir
9 (D)	SW SeaTac
9A (F)	Sea-Tac Industrial Park
10 (D)	SeaTac Trailer Park
10A (F)	Des Moines Creek Park
1 (F)	Terminal South
13 (F)	Terminal Hotel
-(F)	Proposed North Unit Terminal
EPA Receptors	**Location**
A (F)	South 154th Street (existing and future)
B (F)	South 188th street on either side of Runway 34R Tunnel (east and west)

(a - Receptor locations are designated by D for Draft EIS and F for Final EIS.)

The purpose of the refined dispersion analysis was to provide a more detailed analysis of the receptor locations which indicated possible exceedances of the AAQS during the screening analysis. The screening analysis indicated that concentrations of NO_2 and CO were of concern and concentrations of PM_{10} and SO_2 were not. Therefore, no further analysis was performed for PM_{10} and SO_2.

This methodology of initially conducting a screening analysis to determine potential areas which exceed AAQS and then conducting a refined analysis of these areas, is an accepted and approved methodology. The data which was used in the modeling appears to be reasonable and the best data available. Also, the Final EIS incorporated changes in the air quality dispersion analysis recommended by EPA, PSAPCA and other groups.

With respect to the receptor locations, it is typical to select locations which are shown to potentially violate AAQS. However, it would have been interesting to have included more receptors in more areas which have experienced air quality complaints (i.e., residential areas) and additional areas with different terrain features in the Airport vicinity. The predicted emissions levels would be useful, even though the screening analysis did not show violations of AAQS.

As discussed below, analyses were also conducted for Airport roadway intersections and construction vehicles. However, it was not clear if the area dispersion analysis also included construction vehicles and aircraft operations together. This should be clarified. Comments from the public indicated that the EDMS area dispersion analysis did not include construction vehicles. Also, the construction haul truck analysis evidently did not include the intersections and EDMS data.

Airport Roadway Intersection Dispersion Analysis

Motor vehicles are believed to be a major source of air pollutants in the Airport area. Thus, a separate more detailed analysis was conducted for the following congested roadway intersections along International Boulevard:

- At South 160th Street.
- At South 170th Street.
- At South 188th Street.
- At South 200th Street.

In addition, the new employee parking area on 24th Street north of SR 518 was included.

EPA's approved model CAL3QHC was used to predict CO levels from motor vehicles. The model requires the following data:

- Traffic volumes for left and right turns and through traffic.
- Level of service determinations.
- Signal cycle lengths.
- Number of traffic lanes available.
- Vehicle speed.
- Vehicle emission rates.
- Meteorological conditions (temperature, wind speed, mixing height, and stability class).

Vehicle emission rates/factors were obtained from the EPA mobile source emission program MOBILE5A. CO levels were evaluated because it is the pollutant emitted in the greatest quantity by motor vehicles and for which short-term health standards exist. Pollutant concentrations were calculated for locations at 12 feet from the edge of a roadway in accordance with the EPA "Guidelines For Modeling Carbon Monoxide From Roadway Intersections." A total of thirty-two receptor locations were modeled in the vicinity of each intersection.

Like the area air quality dispersion analysis, the roadway intersection dispersion analysis in the Final EIS used acceptable methodology. This included incorporating comments on the Draft EIS in the Final EIS, from regulatory agencies, citizens and community organizations.

Human Health - Air Toxics Evaluation

Appendix D and Chapter IV, Section 7 of the Final EIS deals with air quality human health issues. The methodology involved:

- Using the results of the emissions inventory and dispersion modeling.
- Using data from the Port of Seattle's air toxic monitoring program; benzene and thirty-eight additional air toxics were monitored at thirteen on- and off-airport locations for four days during October through December 1993.
- Using information in the April 1993 EPA publication, "Estimation and Evaluation of Cancer Risks Attributed to Air Pollution in Southwest Chicago", which deals with the Chicago Midway Airport area.
- Comparing the toxic emissions information with the DOE's Acceptable Source Impact Levels (ASILs).
- An evaluation of residue samples for evidence of jet fuel related products.

This methodology was acceptable based upon the limited available information on potential air toxics health impacts. The methodology could have been improved as follows:

- The EIS indicates in Chapter IV, Section 7 Human Health: "As the air toxics monitoring program was a preliminary, short-term survey of air toxics over a four day period, it is difficult to assign meaningful significance to short-term measurements as compared to longer-term guidelines. Therefore, as the monitored data was for a limited, short-term period, it is not certain if the actual levels would be exceeded on an annual basis."

  Based on this statement, it would seem reasonable to collect additional, long-term air toxics data throughout different months of the year. Also, limited monitoring sites were off-airport and additional sites should be monitored in particular to the west of the Airport.

Recently a draft Memorandum of Understanding (MOA) was finalized between PSAPCA, EPA, DOE and the Port of Seattle establishing an air monitoring program which may include air toxics depending on the results of airplane engine exhaust residue sampling under flight paths (Puget Sound Air Pollution Control Agency, 24 October 1996).

- The DOE ASILs are established for known or probable carcinogens and other health risks. Thus, the EIS should have contained at least qualitative information on other health risks besides cancer. Based on discussions with citizens and community groups, some health problems appear to be more common in areas near the Airport such as asthma. This should be addressed in more detail.

- The EIS indicates that insufficient information was available to adequately conduct a meaningful cancer risk assessment for human health-air toxics. Data should be collected in order to allow this risk assessment to be conducted.

- The methodology should include an evaluation of potential health impacts on schools, hospitals, nursing homes, and other sensitive areas near the Airport.

- There have been reports or comments from the public concerning fuel odors being worse during periods of inclement weather. These reports need to be verified and evaluated further as part of the air toxics issues studies.

- During discussions with various groups as part of this environmental issues task, there has been repeated comments about vapor recovery at the Airport. This issue should be addressed further since it is unclear what vapor recovery operations there actually are at the Airport. Currently the following vapor recovery operations appear to be in place:

  - The main jet fuel storage tanks have vapor recovery.

  - Individual airlines have vapor recovery on their ground vehicle gasoline fueling operations if they meet PSAPCA throughput requirements.

  - There are PSAPCA regulatory requirements for floating roof tanks.

  - All of the car rental companies located within the Sea-Tac International Airport parking garage are registered with PSAPCA and their underground storage tanks have Stage 1 and 2 Vapor Recovery System equipment.

Construction Vehicles Air Quality Analysis

The construction vehicle air quality analysis also involved a dispersion analysis using the CAL3QHC model and vehicle emission rates from two EPA models: MOBILE5A and Part 5. The overall methodology used was the same as that used for the roadway intersection analysis.

The methodology for the construction vehicle air quality analysis was appropriate for the construction haul routes shown in the EIS. This involved nine haul routes:

- SR 509 - 160th Street on SR 509.
- SR 509 - Des Moines on 160th Street.
- 8th Avenue - 148th Street on Des Moines.
- 8th Avenue - 160th Street on Des Moines.
- 24th Avenue - 16th Avenue on 154th Street.
- 152nd Street to 154th Street on 24th Avenue.
- 200th Street - 188th Street on Des Moines
- 26th Avenue - Des Moines on 200th Street.
- On-airport unpaved haul routes on south side of airport.

However, it appears that the evaluation is based on the assumption that each of these haul routes may be used. Once the sources of fill material are known and the haul routes approved, the construction vehicle air quality analysis should be re-evaluated and dispersion analysis re-done in order to better predict potential air quality impacts.

Air Quality Analyses Results

- **Airport Emissions Inventory** - Airport related emissions are generated by a number of sources including the primary sources: motor vehicles on roadways and in parking lots, and aircraft. The largest source is believed to be vehicles on roadways. For the 1994 condition or base year, the emissions of CO, VOCs and NOx are below the SIP 1990 emissions inventory. The future emissions inventory also indicates that for each EIS alternative and time period, aircraft emissions will be below SIP levels.

  Based on the information presented in the EIS for the EDMS computer model, the existing and future emissions inventory appeared reasonable. Support for the existing conditions air quality was provided by a discussion of DOE/PSAPCA, Port of Seattle and Department of Labor and Industries monitoring programs. However, these are the following issues with these programs and in relation to overall Airport operations:

  - The closest DOE or PSAPCA permanent monitoring sites are approximately 5 miles from the Airport; there are no permanent monitoring sites west, northwest and southwest of the Airport; CO, PM_{10}, are the most frequently monitored parameters at the DOE or PSAPCA permanent monitoring sites.

- The Port of Seattle monitoring was only for compliance with Washington Industrial and Safety Health Act (WISHA) standards and primarily involved indoor air quality monitoring for CO and NO_2; there has been additional monitoring for CO in the main parking garage and the terminal area during late November 1991; it should be noted that the WISHA standards are set for employee, short-term exposure and do not readily apply to areas of public access such as baggage claim and curb front areas; the minimum detection limit for WISHA standards are higher than AAQS and thus are not meant to protect public health.

- The Department of Labor and Industries conducted limited screening for CO for WISHA compliance in seven on-Airport locations and eight off-airport locations during December 1992.

- PSAPCA collected only three samples of black residue for analysis in January 1995 in response to several public complaints.

In order to make monitoring information such as this more useful; permanent monitoring stations should be established in and around the Airport area for select pollutants. Parameters monitored should include the AAQS parameters as well as toxic pollutants of concern such as 1,3 - butadiene, formaldehyde and benzene. Additional comments are made on this monitoring in Section 7. The expanded monitoring to generate baseline data is supported by EPA, DOE and PSAPCA and is addressed by the MOA between these agencies discussed below. The previously mentioned MOA between PSAPCA, EPA, DOE and the Port of Seattle discusses an air monitoring program to be conducted over a 24 month period, commencing the winter 1997. The program that has been funded will focus on the following monitoring activities with the indicated schedule:

- 1996/1997 and 1997/1998 winter seasons: monitoring of CO at roadway intersections modeled in the EIS as creating future exceedances of the CO AAQS and elsewhere in the Airport area.

- Summer/Fall 1997: NO_x emissions monitoring associated with aircraft departure backup queues.

- Schedule to be determined for aircraft fuel particle or residue monitoring.

Depending on the results of the residue monitoring, additional monitoring for air toxics may be conducted. As part of implementing the MOA, public involvement will be solicited via participation in a working group.

It should be noted that funding and a schedule for conducting future fugitive dust measurements at Master Plan Update construction sites and near fill dirt haul routes are not identified in the MOA.

- **Area Dispersion Analysis** - The area dispersion analysis focused on a wider range of sources of air emissions than the air pollutant inventory, which focused solely on aircraft emissions. This dispersion analysis provided information on aircraft and support equipment; on- and off-airport parking lots; roadways; fuel systems; terminal heating and cooling; and aircraft maintenance activities.

The area dispersion analysis for the existing conditions showed the following:

- The highest concentrations of CO occur along the terminal curb front; there are no exceedances of 1- and 8-hour CO standards.

- An exceedance of the NO_2 AAQS was identified at one receptor location on South 154th Street approximately 650 feet north of Runway 162; this receptor is in an area surrounded by Airport property and probably reflected pollutant concentrations from aircraft takeoffs.

- The screening analysis indicated that concentrations of PM_{10} and SO_2 at all receptor locations were below AAQS; however, as discussed previously, public comments indicated that the EDMS data base may not have included information on particulate emissions and impacts from these emissions may be underestimated.

The results of the area dispersion analysis for the future conditions indicated the following:

- With implementation of the Master Plan Update some receptor locations may experience a slight increase in pollutant concentrations; these concentrations would be expected to be below AAQS.

- The highest NO_2 concentration would occur along South 154th Street; the maximum concentrations would be less than if the Third Runway is not built.

- The proposed improvements include extension of Runway 16L/34R and NO_2 concentrations would be expected to increase slightly along South 188th Street by the Year 2020.

- Alternative 3 would result in changes in traffic volumes and movements; therefore, the highest CO concentrations would occur in the terminal area; CO concentrations would be expected to be below AAQS.

This information presented in the EIS for the area dispersion analysis for both the existing and future conditions will provide a good baseline to evaluate impacts as the Master Plan Update is implemented, However, in order to do this the dispersion analysis will have to be periodically updated with data as it becomes available. Also, public comments indicated the following:

- The dispersion analysis underestimated the potential impacts of capacity enhancement.

- When reviewing the Draft EIS, EPA requested that the Final EIS increase peak takeoff figures by 20%; however, this evidently was not done.

- During the modeling, arbitrary adjustments were made to the fleet mix and mode which in combination with the above resulted in at least underestimates of NO_2 emissions.

These comments need to be addressed with respect to the original modeling and any future modeling.

- **Airport Vicinity Roadway Intersection Dispersion Analysis** - The Airport vicinity roadway intersection dispersion analysis identified CO concentrations for specific intersections for existing and future conditions. The purpose of the analysis was to evaluate the potential impacts on air quality given traffic volumes and patterns over time. For existing conditions all locations modeled are below the 1-hour CO standard of 35 ppm; however, these locations are modeled to exceed the 8-hour CO standard of 9 ppm with concentrations of approximately 10 to 18 ppm.

  Future conditions were evaluated for the Years 2000, 2010 and 2020. Like the existing conditions, CO concentrations were modeled to be below the 1-hour standard, but to exceed the 8-hour standard. The only exception would be the relocated employee parking area on 24th Street which would be below both standards. This parking area is scheduled to be in use in the Year 2000.

  EPA's technical review of the roadway intersection dispersion analysis raised some concerns about methodological inconsistencies (EPA, 6 June 1996). The EPA indicated the following:

  "The modeling results for air quality in the Sea-Tac Final EIS conflict with those from the Draft EIS for the SR 509/South Access Road Corridor Project at two intersections (both EISs used the same models). The two EISs model conflicting results for existing conditions and future action alternatives at South 188th and International Boulevard, and South 200th and International Boulevard for the average CO concentrations indicated on page 4-7 in the SR 509 EIS, as compared with the same analyses on page IV.9-11H in the Sea-Tac Final EIS. Both analyses model CO violations for existing conditions, but for future action alternatives the Sea-Tac analysis shows modeled CO violations where the SR 509 analysis does not."

  "Modeled air quality impacts at South 200th and International Boulevard are shown in the South Aviation Support Area Final EIS (pages 4-106 to 109 and 112), the 28/24th Street Arterial Final EIS (page 3.22) and the CTI Final EIS (page 4-7, 8). The results vary for each project ranging from 5.0 to 13.3 parts per million CO."

Based on these comments, the roadway intersection dispersion analysis should be re-evaluated at least for the EPA indicated intersections/roads.

- **Human Health - Air Toxics Evaluation** - As indicated previously, the human health - air toxics evaluation focused on potential changes in toxic emissions from Airport Master Plan Update implementation by conducting an air toxics emissions inventory and comparing the results with the Washington State Acceptable Source Impact Levels (ASILs). The results of the emissions inventory and dispersion modeling indicated the following with respect to volatile gases (TOG), benzene, 1,3-butadiene and formaldehyde:

  - There was insufficient information to conduct a meaningful risk assessment, as previously indicated.

  - The maximum air toxics concentrations at all modeled receptors (i.e., terminal/south, terminal/hotel, SeaTac Reservoir, Highline Nurseries, SeaTac Industrial Park and Des Moines Creek Park) exceeded the annual ASILs; the majority of emissions at each receptor are produced by motor vehicles which contribute about 70% of the toxic emissions, aircraft contribute about 20% (public comments indicated that these percentages need to be better documented since historical data does not support these results).

  - In the future, emissions from roadway sources are predicated to continue to contribute the majority of air toxic emissions; by the Year 2020, motor vehicles are expected to contribute 65% of the toxic emissions and aircraft approximately 25%.

  - Airport activity including heating plants, fuel facilities and surface coating activities, produce low levels of air toxic emissions.

  - By the Year 2000, air toxic emissions are expected to initially decrease as older aircraft are phased-out.

  - Implementation of Alternative 3 would generally result in similar or less air toxic emissions in comparison to the "Do-Nothing" alternative.

The results of the Port of Seattle's 4-day air toxic monitoring program in 1993 indicated the following based on Table 14 in Appendix D of the EIS:

  - The mean concentration of the following compounds exceeded the annual DOE Acceptable Source Impact Levels (ASILs): acetaldehyde, benzene; carbon tetrachloride; 1,2-dichloroethane; and dichloromethane.

  - Compounds detected which do not have annual or 24-hour ASILs were: CIS-1,2 - dichloroethylene; 1,3,5 - trimethylbenzene; and 1,2,4 - trimethylbenzene.

  - Highest concentrations for benzene were along International Boulevard.

  - Monitored concentrations for benzene were well below values predicted by a 1991 DOE Study.

- No significant differences in upwind versus downwind concentrations were observed.

- Levels of air toxics were within a range exhibited in other similarly sized urban areas such as St. Louis, Houston and Boston.

- The monitored air toxic pollutant profiles were indicative of automobile exhaust and not due to aircraft exhaust.

The Final EIS also indicated that formaldehyde was above the annual ASIL and acrolein was above the 24-hour ASIL. However, these compounds were not listed in the aforementioned Table 14.

The 1993 monitoring also sampled for CO and found that levels were below the 8-hour AAQS. Because of the limited sampling period, small number of samples, and relatively few sampling stations and their locations, the data is of limited use. It certainly should not be used as a baseline, but should be used as part of a long-term monitoring program.

In January 1994, in response to area resident's concerns, PSAPCA collected and analyzed three samples of residue (black speckles) for analysis. The results indicated that the residues were not similar to unburned jet aircraft fuel and consisted of fungal materials with associated green algae and minerals.

As a follow-up to this sampling, the Port of Seattle conducted another study of the black residues at three separate residences in January 1995. AM Test Labs analyzed these samples as well as a residue sample from the exhaust outlet of a jet aircraft for polynuclear aromatic (PNAs) hydrocarbons and heavy metals. In addition, a microscopic examination was conducted.

The results of this residue sampling indicated that the residue consisted of a variety of substances including fungus, insect particles, minerals/soil and soot. The soot was identified as more typical of motor vehicles or wood burning. Overall the results indicated that the residues are not due to jet fuel-related products. However, comments from the public questioned these results for the following main reasons:

- The quality control procedures followed during sampling were not fully explained.

- The use of the 100 cm swab to collect samples was not related to an overall unit of measurement for surfaces sampled and residue components.

- The soot was not analyzed for specific constituents and therefore the comment in the EIS that residues were not due to jet fuel-related products could not be supported.

As indicated previously, the air toxic analysis primarily discussed cancer effects. The results were not related to other potential health problems such as heart and respiratory disease, which also may be linked to other pollutants such as CO and PM_{10}. This should be discussed in more detail for both existing and future conditions.

Evidence of some of these other health impacts was discussed in, "A Survey and Critique of Epidemiologic Evidence of Adverse Health Effects Attributable Airport-Related Exposure" (Levy, 15 September 1995).

- **Construction Vehicle Air Quality Analysis** - The results of the construction vehicle air quality analysis is presented primarily in Chapter IV, Section 23 and Appendix D. The analysis focused on CO and PM_{10} concentrations and concluded:

  - The maximum CO concentrations along each of the haul routes is expected to be below the CO AAQS.

  - The Alternative 3 concentrations of CO will be equal to or slightly higher that the "Do-Nothing" condition.

  - Without mitigation the PM_{10} concentrations along the haul routes discussed in the EIS are modeled to exceed both the 24-hour and annual AAQS.

  - The Alternative 3-PM_{10} concentrations would be considerably greater than the "Do-Nothing" concentrations.

  The construction vehicle air quality analysis was based on particulate information from a more arid area than the Puget Sound Region, due to the lack of region-specific particulate data. Thus, the PM_{10} results are probably worst case. The lack of particulate data for the Region points out the need to monitor for this information as part of a long-term monitoring effort in the Airport area and Region.

  The CO and PM_{10} construction impact information in the EIS is adequate for the haul routes studied in the immediate vicinity of the Airport. As the Master Plan Update is implemented, source fill areas and haul routes are identified, the construction air quality impacts should be re-evaluated. This evaluation should extend further than the immediate area around the Airport.

- **Clean Air Act Conformity** - Chapter IV Section 9 of the EIS includes a discussion on the need for the Master Plan Update implementation to show that the project will not:

  - Cause or contribute to any new violations of any of the AAQS in the project or metropolitan area.

  - Increase the frequency or severity of any existing violations of AAQS.

  - Delay timely attainment of the AAQS or any required emission reduction in the project area.

  In the EIS, a brief conformity analysis was presented. According to the EPA (6 June 1996), the conformity analysis is only considered a draft and the final analysis should include the following:

"1. Creation of an emissions inventory that includes: (a) all reasonably foreseeable direct and indirect emissions for the pollutants of concern for the year of peak construction emissions prior to 2000 and 2020 [Because conformity requirements for "worse case analysis" differ from NEPA requirements, analysis of emissions during the year of highest impact is required."]; (b) emissions from sources such as construction and haul vehicles, associated increased congestion; and (c) mobile emissions associated with the use of regular gasoline."

"2. An air quality analysis that compares the "no project" and "with project" air quality impacts for the years stated in item one above."

"3. Appropriate mitigation measures - if the "with project" scenario results in an increase in either the frequency or severity of exceedances above the levels in the "no project" scenario, measures should be developed to mitigate these impacts."

"4. Commitments from appropriate governmental entities to conduct adequate, specific and enforceable mitigation measures that will prevent any increase in the severity or frequency of predicted exceedances of the National Ambient Air Quality Standards (NAAQS). Since the increased modeled exceedances occur at intersections outside of airport property, it may be necessary to obtain commitments to conduct these mitigation measures from other agencies or local authorities."

PSAPCA (6 June 1996) also commented on the Final EIS conformity determination for CO. They indicated that the Port of Seattle should ".... make more certain commitments regarding post-2010 project components before conformity to the SIP can be demonstrated." The PSAPCA then offered two options for SIP conformity as follows:

"1. One option would be for the Port to exclude post-2010 project elements from the conformity determination being made now and to make a clear commitment that post-2010 project elements modeled to create future air quality exceedances would not be pursued until additional field monitoring is conducted by other independent environmental agencies. The following would be recommended elements of such an approach:

- *Commit to revisit in future, via a full SEPA/NEPA environmental analysis, the CO air quality impacts and conformity-related mitigation needs of those master plan phases identified as causing post-2010 CO intersection exceedances, e.g., the North Passenger Terminal phase.*

- *Develop a protocol to govern the conduct of future Port-funded CO monitoring activities consistent with the normal monitoring protocols used by state, local and federal air quality agencies and agreed to by those agencies (Ecology, PSAPCA and EPA).*

- *Specify the schedule and technical approach to be relied upon for evaluating modeled vs. monitored data in the future in order to refine exceedance mitigation measures, coordinating with other state, local and federal air quality agencies as necessary.*

- *Institute a memorandum of agreement (MOA) signed by the Port, PSAPCA, Ecology and EPA laying out a funded program for monitoring CO air quality in the Sea-Tac Airport Master Plan project area, and interpreting the results for purposes of implementing conformity-related mitigation measures, ensuring future NEPA compliance and determining future CO monitoring needs. A specific Port commitment to contribute funding should be included in such an MOA."*

"2. A second optian would be for the Port to advance their current FEIS as published - and thus a positive conformity finding for all Master Plan elements - but commit now to actions affecting those post-2010 project phases for which CO air quality exceedances have been modeled, as follows:

- *Specify and commit to implementing a menu of intersection exceedance mitigation measures appropriate to the identified (modeled) CO air quality problems.*

- *Regardless of project phasing, demonstrate quantitatively that the identified modeled air quality problems can be resolved by reliance on all or part of this mitigation menu.*

- *Commit to revisit in future, via a full SEPA/NEPA environmental analysis, the CO air quality impacts and conformity-related mitigation needs of those master plan phases identified as causing post-2010 intersection exceedances, e.g., North Passenger Terminal phase.*

- *Develop a protocol to govern the conduct of future Port-funded CO monitoring activities consistent with the normal monitoring protocols used by state, local and federal air quality agencies and agreed to by those agencies (Ecology; PSAPCA and EPA).*

- *Specify the schedule and technical approach to be relied upon for evaluating modeled vs. monitored data in the future in order to refine exceedance mitigation measures, coordinating with other State, local and Federal air quality agencies as necessary.*

- *Institute a memorandum of agreement (MOA) signed by the Port, PSAPCA, Ecology and EPA laying out a funded program for monitoring CO air quality in the Sea-Tac Airport Master Plan project area, and interpreting the results for purposes of implementing conformity-related mitigation measures, ensuring future NEPA compliance and determining future CO monitoring needs. A specific Port commitment to contribute funding should be included in such an MOA."*

Based on these comments, it is obvious that the EIS Clean Air Act conformity discussion is incomplete. As the Master Plan Update is implemented, the public should be kept abreast of issues and status of the analysis.

- **Certification of Compliance With Air Quality Standards** - The EIS indicates that the Washington State's Governor's Office must issue a certification indicating that implementation of the Master Plan Update will comply with all applicable AAQS. The Governor's Air Quality Certificate is expected to be issued before completion of the Federal Aviation Administration Record of Decision.

Cumulative Impacts

The EIS did not adequately address air quality cumulative impacts associated with Master Plan Update implementation and other major proposed projects in the area. This also was commented upon by EPA (6 June 1996).

This issue needs to be addressed and would most likely include some revision to several areas of the air quality analysis, in particular, those associated with modeling air emissions and the construction vehicles air quality analysis. The EPA (6 June 1996) specifically indicated that cumulative impacts discussion should include the extension of SR 509; South Aviation Support Area aircraft maintenance facilities; Des Moines Creek Business Park; SeaTac Hotel; the proposed Cell Therapeutics Inc. (CTI) campus; and the 28th/24th Avenue South arterial project.

The EPA also mentioned the new Federal Detention Center immediately south of the Airport and the improvements to 3 miles of International Boulevard near the Airport. Both of these projects are currently ongoing.

Other projects which the EIS briefly describes in Chapter III Affected Environment are: regional transit authority high capacity, light rail system; and the aviation business center. The CTI campus development is included as part of a larger program, the Des Moines Creek Technology Campus.

The issue of cumulative impacts also was inadequately addressed for noise, water resources, and aesthetics and visual environmental issues. Thus, cumulative impacts need to be seriously evaluated, not just alluded to in a brief discussion.

Mitigation Measures

Mitigation for potential air quality impacts from Master Plan Update implementation are addressed for the following general topics:

- Construction impacts in particular for fugitive dust emissions.
- Mitigation at International Boulevard and South 170th Street and South 160th Street.
- Incentives or other regulatory requirements for reducing emissions.

Construction mitigation measures focus on excavation and wind erosion of soils; vehicle traffic on paved and unpaved roads; and cement and aggregate handling. Potential impacts from construction will be mitigated by implementing a Construction and Earthwork Management Plan which will designate haul routes, dust control techniques, etc.

Mitigation for the International Boulevard intersections of concern in the EIS include primarily construction of additional turn lanes. These improvements would occur by 2010 with other improvements by 2020. Other proposed mitigation measures include the Port of Seattle's support of the seasonal use of oxygenated fuels (which will be ended); wood burning stove curtailment initiative; and the vehicle inspection/ maintenance program.

The EIS also briefly discusses ongoing Airport activities to reduce emissions and additional actions which could further reduce air emissions.

These ongoing and proposed mitigation measures will be discussed in more detail in the Mitigation Plan. The EIS proposed mitigation measures are generally appropriate. Additional measures and issues which need to be addressed in the Construction and Earthwork Management Plan are discussed further in Section 7.

2.07 - WATER RESOURCES

In the EIS water resource issues are evaluated in terms of water quality and hydrology; wetlands; and floodplains. These areas include the Task 5 Environmental Analysis Scope of Services areas of concern which are: floodplains; storm drainage and surface runoff; and wetlands. These areas are incorporated in the discussion which follows.

Water Quality and Hydrology

Water quality and hydrology issues in the EIS are discussed in Chapter IV, Sections 10 and 23, Chapter V, Appendices F, G, P, Q-A, Q-B and part of Appendix R. These issues focus on potential impacts on surface water and ground water resulting from construction and operation of the proposed Master Plan Update implementation.

- **Methodology** - Surface water and ground water resources were evaluated by reviewing existing information and modeling hydrologic conditions of the Airport, Miller Creek and Des Moines Creek using the HSP-F Version 10 continuous simulation model. Also, average sediment production caused by erosion was estimated using the Revised Universal Soil Loss Equation (RUSLE).

  The baseline data used for the hydrological analysis for both the present and Master Plan Update conditions included the following:

- 47-year records of hourly precipitation from the Sea-Tac International Airport weather stations.
- 5-year flow records at the Miller Creek and Des Moines Creek stream gauging stations.
- Watershed data such as river basin drainage areas, land use status, and area soil types and classifications.
- Limited surface water and ground water quality information.

The key parameters/assumptions used in the HSP-F hydrological modeling analysis appear reasonable and engineering sound. These parameters include the runoff coefficient for different land surfaces, and the permeability and infiltration rates for the various soil formations. As part of the modeling assumptions, it is stated that:

> *"The Industrial Waste System (IWS) has a hydraulic capacity of between the 10- and 25-year storm events and overflows to the SDS during large storm events."*

This implies that the Airport SDS could receive untreated runoff from the IWS and requires a better explanation. However, the Washington DOE indicat that the IWS does not overflow to the SDS. Evidently, the IWS may backup onto the tarmac and cause local flooding. Also, in an extreme event, the third lagoon could overflow to Des Moines Creek, although this has never been known to have happened. The Port of Seattle is currently sealing manhole lids to surcharge the system in order to prevent localized flooding.

The RUSLE is an appropriate method of estimating average sediment production from erosion. The HSP-F model also is an appropriate way to assess the effects of the overall land use changes to derive stormwater detention capacity required to meet offsite discharge limitations. However, since a detailed presentation of proposed stormwater facilities (i.e., catch basins, conveyance pipes, stormwater ponds and pond outlet works, etc.) was not incorporated into the HSP-F model, the effect of these facilities on the determination of detention capacity was excluded. To complete the effort, a separate hydraulic analysis with computer program (WATERWORKS), modeling the proposed airport expansion Storm Drain System (SDS) within the Sea-Tac International Airport is being done. This will determine if the SDS would have a significant impact on the results so far obtained from the HSP-F modeling. At the time of the Final EIS only preliminary WATERWORKS model files were available. Therefore, the results of the stormwater system modeling analysis using WATERWORKS needs to be evaluated.

The baseline data used for the limited water quality and hydrology studies is based on available historical information from various agencies and publications. Thus, it is believed to be reliable and of acceptable quality. With the respect to surface water and ground water quality, there is a paucity of data which is typically included in an EIS. The surface water quality information in Table IV.10-3 only addressed 15 parameters and does not include some routinely monitored parameters such as flow and specific conductance.

For some parameters such as dissolved oxygen and temperature there is limited information. If a baseline is to be established to measure both potential construction and operational changes in surface water quality from the Master Plan Update implementation, additional more detailed surface water quality studies need to be conducted. They should be initiated before construction activities begin; seasonal sampling should be conducted (e.g., February, May, August and November); the parameters sampled should include a number of metals and organics (e.g., aviation fuel constituents, and ethylene and propylene glycol) which are based, in part, on the parameters for which water quality standards have been set; and the parameters should include those for which the Port of Seattle monitors for on the Airport such as in stormwater discharges. A recent study of the latter included information on 23 parameters (Port of Seattle, 30 June 1995).

There is essentially no groundwater quality information in the EIS. This information should be developed for parameters similar to those sampled for in surface water plus static surface water level. Also, a seasonal sampling regime should be developed.

A number of surface water sampling stations should be established on Miller Creek, Walker Creek and Des Moines Creek, starting at the headwaters. Ground water sampling stations also should be established in the various aquifers. These stations should take advantage of existing water supply wells including those of the Seattle Water Department and the Highline Water District.

Currently, the Port of Seattle is conducting a Receiving Water Monitoring Study which will contain updated water quality information for Miller Creek and Des Moines Creek. This study is due to be submitted to the Washington DOE on 30 June 1997. The study should be reviewed to ensure that adequate water quality information is provided.

When determining the extent of the groundwater monitoring program, the numerous cleanup studies which have been conducted at Sea-Tac International Airport should be considered. These studies include information on the hydrological conditions at the Airport and groundwater data from the Airport monitoring wells. With respect to monitoring wells, the Washington DOE has indicated that wells should not be drilled into deep drinking water aquifers in areas with known and unknown shallow soil and perched groundwater contamination at the near surface (in particular free product). This is because surficial contamination might spread through the monitoring wells to these aquifers.

According to the South King County Water Advisory Committee, et.al. (April 1991), long-term water level declines of 1 foot/year have been observed in the Des Moines Area. It was speculated that the water level declines may be due to urbanization and associated reductions in recharge. Thus, it was recommended that a comprehensive monitoring program including well water levels and pumpage, stream flows, lake levels and water quality should be implemented. It also was indicated that particular emphasis should be placed on hydrologic monitoring of aquifers in the Des Moines and Federal Way areas.

The South King County Water Advisory Committee, et.al. (April 1991) also made the following observations:

- The Seattle Water District's monitoring well network and the stream gauging on Miller Creek should be adequate for monitoring ground water in this area of the Des Moines Upland.

- Activities along Miller Creek need to be closely monitored and evaluated because of its sensitive recharge characteristics.

- In the Federal Way Upland, surface water monitoring sites should be maintained in order to ascertain impacts to the surface water system.

- Groundwater quality monitoring along International Boulevard should be closely evaluated to ensure that contamination from various activities is not occurring.

- The Sea-Tac International Airport area because of its significant industrial and commercial activities with numerous underground storage tank and fueling operations is a sensitive area and should be closely monitored.

• **Existing Conditions** - The hydrology analysis includes baseline information on the following for Miller Creek and Des Moines Creek Watersheds (Basins):

- Flood frequencies.
- Average seasonal flow rates.
- Annual runoff volumes.

The descriptions of the existing hydrology conditions for Miller Creek Watershed are deemed adequate and form a good baseline from which to monitor future conditions. The information on the approximate 75% of the Des Moines Creek Watershed which was modeled are also adequate. However, consideration should be given to modeling the entire Des Moines Creek Watershed, not just from the headwaters to South 208th Street. It is not completely clear why all of this watershed was not modeled. The hydrology description of the Miller Creek and Des Moines Creek Watersheds was based on the following information (Table 2.07).

Table 2.07
Watershed Hydrology

Watershed	Total Area	Total Impervious Area	Airport Impervious Area
Miller Creek	5,183 acres	1,224 acres	60 acres
Des Moines Creek	3,585 acres	1,202 acres	369 acres

(Source: US Department of Transportation, Federal Aviation Administration, and Port of Seattle, February 1996)

The primary land uses in the watersheds are residential and commercial with only 4% and 27% of the land devoted to Airport use in the Miller Creek and Des Moines Creek Watersheds, respectively. Thus, the urbanized watersheds exhibit stream flow characteristics associated with developed watersheds or basins. This includes rapid flow rate increases before and decreases after precipitation events.

Creek flow rates are typically highest from October through April and lowest between May and September. The existing flood frequencies are described as follows based on three and two locations along Miller Creek and Des Moines Creek, respectively:

Table 2.08
Flood Frequencies

	Existing Condition Return Period (Years) / Flow Rate (cfs)			
Watershed	**1.11**	**2**	**10**	**100**
Miller Creek	47-104	80-173	125-293	171-468
Des Moines Creek	74-76	103-112	154-178	232-280

(Source: US Department of Transportation, Federal Aviation Administration, and Port of Seattle, February 1996)

As one would expect the higher flow rates are experienced at downcreek locations. The probability of the flow rate return periods are: 1.11 year, 90%; 2 year, 50%; 10 year, 10% and 100 year, 1%.

Miller Creek and Des Moines Creek and their tributaries are classified as Class AA (extraordinary) waters by the Washington DOE. Although the creeks occasionally violate the Class AA water quality standards for pH, dissolved oxygen and ammonia. These violations are due primarily to pollutants found in urban and Airport stormwater runoff such as nutrients; oil and grease; metals; fecal coliforms; and suspended solids.

Information on estimated pollutant loadings from the Airport and other sources for each watershed are presented for total suspended solids; biochemical oxygen demand; total phosphorus, copper, lead and zinc; and oil and grease. Overall water quality for select sampling locations along Miller Creek and Des Moines Creek are presented for only fifteen parameters.

Four zones of ground water are described in the EIS with the following general characteristics:

- *Perched Zone* - No known use for drinking water; quality unknown, assumed to be good. The Washington DOE has indicated that there is a 30 to 50-foot blanket of glacial till at the Airport which contains numerous perched zones of groundwater. The perched zones are small, discontinuous, have various flow directions, and are often seasonal. Perched groundwater is the most contaminated at Sea-Tac International Airport and in many instances perched groundwater has trapped contamination and prevented it from reaching the deeper QVA aquifer.

- *Upper or Shallow Aquifer (QVA, Vashon Advance Outwash)* - Not used for domestic water supply; localized contamination from leaking jet fuel and rental car fuel distribution systems at the Airport.

- *Intermediate or Highline Aquifer (Qc(3), Third Coarse Grained Deposit)* - Seattle Water Department has three operating potable water supply wells and Highline Water District has two wells; 80 to 200 feet beneath the ground surface; no indication of ground water contamination; wellhead protection plans to protect wells from pollution within at least the 10 year time of travel zone or about 1/2 mile radius around each well.

- *Deep Aquifer (Qc(4), Fourth Coarse Grained Deposit)* - Excellent water quality.

As indicated above, there is inadequate surface water and ground water quality information. Before implementation of the proposed Master Plan Update activities, this data should be developed. It should include both available literature information and seasonal sampling data. In addition, there should be a surface water and ground water sampling plan in case there are spills on Airport property that reach the Miller and Des Moines Creek drainages. The information developed from this sampling should be compared with applicable standards and remedial actions taken, if necessary. The ground water information is particularly important to help determine potential future impacts on aquifers. It should be noted that since June 1995, the Port of Seattle had a *Spill Prevention, Control and Countermeasure (SPCC) Plan* which included a sampling plan in case of spills. The SPCC Plan should be reviewed and any additional surface and groundwater sampling should be consistent and coordinated with the SPCC Plan.

The EIS indicates that the Highline Aquifer is protected from existing contamination by overlying aquitards and various hydrologic characteristics. However, there is evidence that when wells are pumping water from this aquifer, drawdown can be observed in shallower aquifers (Greg Wingard, 22 July 1996, personal communication; Wingard and Smith, 19 June 1995). This is indicative of interconnection between the aquifers and a potential path for contaminated ground water to the Highline Aquifer. Therefore, ground water movement in the Airport area needs to be better defined. According to the EIS, these additional studies are being conducted and the Washington DOE has indicated that modeling will assume that there is a connection between the upper and lower aquifers. When available, the studies should be reviewed for potential ground water contamination impacts on the Highline Aquifer and other area aquifers.

Parts of the existing Airport's aircraft fuel handling system are known to have leaks and to have contaminated ground water. This is due, in part, to an aging fuel handling system, in particular the Northwest Airline's facilities. The Port of Seattle has recognized the need to upgrade and modernize the Airport's fuel handling facilities. This aspect of Airport operations should be done as part of Master Plan Update implementation.

In the EIS it is indicated that the Port of Seattle was to have conducted a monitoring study of Miller and Des Moines Creeks the winter of 1995 to 1996, both upstream and downstream of Airport stormwater discharges. The purpose of this study is to help determine the toxicity of Airport stormwater runoff and surface water quality. The results of this study need to be evaluated.

- **Future Conditions** - It is estimated that implementation of EIS preferred Alternative 3 would result in the following:

  - *Miller Creek* - 97 acres (new impervious surface area), 264 acres (drainage from fill area).
  - *Des Moines Creek* - 95 acres (new impervious surface area), 282 acres (drainage from fill area).

This is approximately 7% to 11% of the total watershed areas based on 5,183 and 3,585 acres in the Miller Creek and Des Moines Creek Watersheds, respectively. The increases in impervious areas are approximately 8% to 24% with existing impervious areas of 1,224 and 1,202 acres in the Miller Creek and Des Moines Creek Watersheds, respectively.

To minimize the potential impacts of the new impervious areas and drainage areas, new stormwater detention facilities are planned. If the preferred alternative is implemented the hydrologic analysis and stormwater management facilities should be re-evaluated to support final design. This is particularly true since the EIS indicates that the stormwater management facilities and discharge locations are conceptual layout. The re-evaluated hydrologic analysis should then be used as part of the baseline to monitor potential Alternative 3 impacts. During large storm events, the effect of possible overflow from the IWS on the receiving waters also should be addressed.

Limited details on both the construction and operation of the wet vaults and biofiltration swales was provided in the EIS. There was a more lengthy explanation of the constructed aquifer, which the EIS indicates has not been used before to manage stormwater. More detailed design and operating information needs to be provided on the wet vaults and biofiltration swales. If additional consideration is given to the constructed aquifer, its potential use must be more strongly justified. The Sea-Tac International Airport area may not be the most suitable place to try this technology out; especially considering the controversy over disturbing the headwaters of the two watersheds. The King County Surface Water Management Division has suggested that surface water retention facilities are more innovative and effective. Therefore, they should be considered further before the use of wet vaults and/or the constructed aquifer. The surface water facilities potentially could include modifying the Lake Reba facility for better water storage capacity and water quality treatment.

The Washington DOE also believes that if a constructed aquifer is proposed, additional analysis should be provided since it might not be appropriate for the Airport site. However, the Washington DOE has indicated that the constructed aquifer has the potential to provide a better mechanism for groundwater recharge to Miller Creek.

Future Miller Creek and Des Moines Creek flow rates were described for the same locations as the existing conditions. They are summarized in Table 2.09.

Table 2.09
Future Flood Frequencies

	Future Condition Return Period (Years) / Flow Rate (cfs)			
Watershed	**1.11**	**2**	**10**	**100**
Miller Creek	46-103	76-170	119-285	166-454
Des Moines Creek	68-74	96-108	149-173	232-280

(Source: US Department of Transportation, Federal Aviation Administration, and Port of Seattle, February 1996)

As can be seen from comparing the future condition flow rates with the previously mentioned existing condition flow rates, the flow rates are very similar. However, the EIS indicates that the annual runoff volumes will increase 6% to 11% at various locations in Miller Creek and 1% to 2% in Des Moines Creek. Most of the volume increase (97% to 99% would occur at flow rates less than the 2-year return period flow rate.

Construction impacts on Miller Creek and Des Moines Creek hydrology are really not discussed in the EIS; the emphasis is more on construction water quality issues and post-construction hydrology. If the mitigation procedures discussed in Appendix P, Natural Resource Mitigation Plan, are not adequately coordinated with the embankment fill activities, there could be problems with surface water runoff from precipitation events. The Construction Stormwater Pollution Prevention Plan referenced in the EIS should help control surface runoff quantity and quality. However, the details of this plan need to be developed and evaluated.

Construction impacts on burrow source site ground water hydrology would involve altering geology and changing ground water recharge, movement and discharge patterns. In general, glacial till areas may be removed which will expose more permeable areas. This could result in reductions in perched ground water and increases in upper aquifer recharge depending on the geology at the burrow sites and should be monitored. Construction in the area of the Third Runway would reduce upper aquifer recharge because of the impervious area. However, depending on the locations of the burrow source sites, this loss could be compensated for by the increased recharge at the burrow sites.

Once the Third Runway is in operation, aquifer recharge would be expected through the relocated Miller Creek and Des Moines Creek channels and other stormwater management facilities. Although the amount and success of this recharge cannot be accurately predicted and should be monitored.

There also would be potential surface water and ground water quality changes during both construction and operation. However, potential future impacts deal mainly with total suspended solids (TSS) and spills of materials such as fuels, lubricants and other materials. Based on the more detailed surface water and ground water quality information which should be collected, the future conditions discussion should include more than TSS and spilled materials. Although TSS is probably the most important parameter, in particular during construction and before the fill and burrow areas have adequate vegetation.

In EIS Chapter IV, Section 19 Earth, it is indicated that fill material will be "... placed in layers using common construction techniques." It is assumed that this includes compacting the fill to obtain appropriate densities, which may require large quantities of water. The source of water will have to be identified to ensure that it is from an acceptable source.

In some areas where fill has been placed, there have been reports of ground water levels rising in the fill. This needs to be evaluated with respect to the proposed Airport fill operations, including verification of this observation.

- **Cumulative Impacts** - In the EIS cumulative impacts of Airport Master Plan Update implementation and the relationship to other projects is discussed generically. A more detailed evaluation should be made. Master Plan Update implementation might have water quality and hydrology impacts which can be mitigated to minimize impacts; but, in combination with other projects, could have significant impacts.

- **Mitigation** - Relatively extensive water quality and management facilities are proposed, primarily to control stormwater. The mitigation measures will be expanded upon in the project's stormwater management plans. Overall the mitigation plans presented in the EIS are appropriate. However, additional comments will be provided in the mitigation plan task of the scope of services.

  If the proposed stormwater management facilities are built, they should be closely monitored to ensure that they work according to their design. This should include monitoring operation of the underground vaults such as collecting water samples before and after the vaults.

  As the Natural Resource Mitigation Plan is implemented, the plan also should be evaluated for conformance with the various City Comprehensive Plan and Stormwater and/or Surface Water Management Plans. For example, in the City of Burien's stormwater plan there are comments concerning the following with respect to the headwaters of Miller Creek:

- There is the possibility of building a major stormwater detention system on the Vacca Farm property which encompasses an area in the City of SeaTac of approximately 25 acres.

- If this development were to be operated in conjunction with Lake Laura and Lake Reba, stormwater could be better controlled for this area of Miller Creek.

Also, the Greater Des Moines Comprehensive Plan discusses some issues and mitigation measures associated with streams, ground water, water quality, stormwater and wetlands.

As part of mitigating potential impacts on Miller Creek, the upper reaches will be relocated. In the early 1970's there was litigation concerning development activities in the Miller Creek Basin. Under the settlement agreements, King County agreed that it would "... not in the future attempt the channelization of Miller Creek except in limited amounts in connection with retention facilities." The relationship between this stipulation and the proposed relocation of part of Miller Creek will have to be resolved as construction associated with Master Plan Update implementation proceeds.

2.08 - WETLANDS

The EIS discussion of project area wetlands is included primarily in Chapter IV, Sections 11 and 23, Chapter V and Appendices H-A, H-B, P and part of Appendix R. Raytheon's comments on wetlands follows.

Methodology

The evaluation and identification of wetlands in an area is always a sensitive issue. Wetlands play an important part in an ecosystem and they should be protected.

The wetlands in the area around the Airport were identified by accepted and appropriate methods. This included a review of literature information, discussions with appropriate staffs of various agencies, and ground-truthing. This resulted in wetlands being identified based on the soil and vegetation characteristics, and hydrologic regime.

Although accepted methodologies were used, these methodologies were not related enough to the wetland provisions of King County's Sensitive Areas Ordinance (King County Ordinance 9614, Sections 97 through 105). Thus, the EIS should have included a better discussion on at least the following key provisions of King County's wetland provisions:

- Wetland rating: unique/outstanding; significant; and low concern.

- Buffers/setbacks: establishes buffers by wetland rating; provisions for increasing the buffer width; and minimum building setbacks.

- Mitigation, restoration, enhancement and replacement.

Existing Conditions

Fifty-five individual wetlands, or approximately 144 acres, were identified in the study area. Based on the information available to Raytheon, it appears as if a good job was done at identifying the wetlands. In fact, one person in the State of Washington, Department of Ecology, believes that some wetland areas to the west of the Airport were over delineated. However, the wetland information in the EIS is a good basis for predicting future impacts.

Future Conditions

Of the 55 wetlands, 34 could be impacted by Master Plan Update implementation of Alternative 3 and construction of the 8,500-foot runway. This would result in approximately 10.4 acres of wetlands being destroyed during construction; there would be no additional disturbance of wetlands during operations unless there is some sort of spill at the Airport which reaches the watersheds or the planned mitigation measures for the hydrologic regime do not work. The latter could result in additional wetlands losses, from areas drying-up.

The wetlands which would be destroyed as part of Alternative 3 include 7.07 acres of forested wetlands, 2.88 acres of emergent wetlands, and 0.39 acres of shrub-scrub wetlands. According to the EIS, forested and shrub-scrub wetlands are usually considered to provide greater flood energy dissipation and wildlife nesting habitat than that provided by emergent wetlands: whereas emergent wetlands are generally considered to provide greater water quality improvement functions and wildlife feeding opportunities. The EIS also indicated in Appendix H-A that:

> *"Removal or alteration of wetlands as a result of the proposed project and other projects in the area, may limit the ability of remaining wetlands to perform the lost or diminished functions. This may be particularly true of stormwater storage functions of wetlands in the project vicinity. Increased impervious surfaces associated with development activities at the Airport may increase both the depth and duration of stormwater in remaining wetlands. This could result in increased floodwater elevations for longer periods of time in the watershed."*

Also, it was indicated that most wetlands in the area provide wildlife habitat, although they are fragmented and small, and:

> *"...their overall wildlife habitat function should not be overemphasized."*

Cumulative Impacts

The discussion of cumulative impacts to wetlands of Master Plan Update implementation and other proposed projects, was cursory. Cumulative impacts should be re-evaluated based on the other known proposed projects as listed in Chapter III Affected Environment. Although the projects listed are located primarily to the east and south of the Airport.

Mitigation

The Port of Seattle believes that it is not possible to mitigate in the Miller Creek Watershed for wetlands which will be lost as part of the Master Plan Update implementation. Thus, the wetland mitigation site is proposed for the lower Green River Valley (City of Auburn) in another watershed. It is a Washington State policy to mitigate for wetlands in the impacted watershed, if possible. But, projects are dealt with on a case-by-case basis and if necessary wetlands can be mitigated in another watershed.

The Port of Seattle has investigated over 100 parcels in the Airport area. Despite this effort, there are many citizens and some government personnel who believe that the loss of the wetlands in the Miller Creek Watershed should still be mitigated in this watershed. Thus, the Port of Seattle should have to continue to justify its wetlands mitigation plan and should be open about the process it is going through. This is particularly true with permitting with the US Army Corps of Engineers and discussions with the City of Auburn.

2.09 - FLOODPLAINS

Floodplains were discussed primarily in the EIS in Chapters IV, Section 12 and V, Appendix P and part of Appendix R. An evaluation of these parts of the EIS follows.

Methodology

Proposed Master Plan Update area flooding and 100-year floodplain information was obtained from existing information, in particular the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps. Potential impacts on flooding and floodplains were then determined by evaluating construction impacts and modeling post-construction flows. This methodology is acceptable and routinely used in evaluating at least 100-year floodplains.

The methodology did not include a discussion on the 500-year floodplain, which is relevant because of recent storms. There should be some discussion about the 500-year floodplain since this information is available in literature such as the FEMA maps.

Existing Conditions

Miller Creek has more extensive 100-year floodplains than does Des Moines Creek. Miller Creek essentially has floodplains along its entire length in depressions and relatively flat areas with little topographic relief. Des Moines Creek only has a 100-year floodplain below South 216th Street. These existing floodplains were adequately described in the EIS.

If the Master Plan Update implementation proceeds, the floodplain information should be updated as new data is available. This particularly includes revision of the FEMA maps. This will then allow a better comparison with future impacts.

Future Conditions

As indicated in the EIS, development requirements prohibit significant floodplain encroachment and reduction of flood storage capacity. As discussed in the EIS, without mitigation the proposed Master Plan Update could result in the following:

- Significant floodplain encroachment.
- Reduced flood storage capacity.
- Increased flow rates and volumes.

This could result in flooding in downstream areas adjacent to Miller Creek and Des Moines Creek.

For Alternative 3, the 8,500-foot runway could result in the loss of approximately 7.2 acres of 100-year floodplain in the vicinity of Lake Lora at the headwaters of Miller Creek. This loss of floodplain results in loss of flood storage capacity and possibly increases in flood heights in downstream areas. These impacts would depend on the amount of flood storage lost; stormwater runoff detention facility storage volume and release rates; and the timing of peak release rates with respect to other areas in the watershed or basin.

The amount of new impervious area also will potentially impact the amount of stormwater runoff and resultant flood impacts. The proposed 8,500-foot runway would have approximately 73 acres of impervious area of the approximate 192 acres of total impervious area.

The EIS evaluation of potential future impacts on floodplains was good. It forms a basis to evaluate actual changes as the Master Plan Update is implemented.

Cumulative Impacts

As with the other water resources related cumulative impacts discussions, this aspect of the floodplains evaluation is cursory and inadequate. Proposed new projects should have minimal, if any, potential impacts on the Miller Creek Watershed. However, there could be negative impacts on the Des Moines Creek Watershed floodplains.

Because of these potential impacts in combination with implementation of the Master Plan Update, there should be a more lengthy discussion of cumulative impacts. If enough information is available on these other projects, the evaluation should include incorporation of this information in the hydrology modeling. The resultant data could then be used for the cumulative impacts discussion associated with all water resources.

Mitigation

Floodplain mitigation would include adherence to floodplain development standards and floodway management requirements of the FAA and the Washington DOE. The development standards prohibit any reduction in the 100-year floodplain or base flood storage volume. State law requires compensatory mitigation for any proposed filling of 100-year floodplain so that there is no net loss in flood storage capacity. Also, the mitigation is to prevent an increased risk of loss of human life on property damage.

According to the Washington DOE, the primary mitigation goal is to replace the basic characteristics of Miller Creek and its tributaries. The mitigation objectives require that Miller Creek and its tributaries must continue to provide baseflow conveyance functions, accommodate the 100-year flow with no net 100-year storage loss, and the new tributary must provide an open channel of equivalent length as the existing tributary. This, mitigation must maintain the natural characteristics and functions of Miller Creek.

For the Master Plan Update compensatory mitigation primarily involves the following:

- Relocating approximately 1,080 feet of the main channel of Miller Creek approximately 200 feet west.
- Enhancing the habitat features of the relocated channel.
- Replace three intermittent tributaries of Miller Creek that will be in fill by constructing tributary mitigation channels.
- Relocating part of Des Moines Creek, which depends on development of the South Aviation Support Area.

The Washington DOE observed that the proposed mitigation plan would create 5,070 cubic yards of floodplain storage to offset 5,030 cubic yards of storage that would be lost in the proposed fill area. In addition, consideration is being given to modifying the operating procedures at the Lake Reba Regional Detention facility. This is supported by the King County Surface Water Management Division, in particular if the facility can be modified for additional water storage and water quality treatment.

In order to determine the effectiveness of the creek relocations and tributary replacement, a monitoring plan is proposed. The monitoring includes hydrology and hydraulics inspections and maintenance, and a contingency plan. The latter would involve primarily channel modifications to meet required flow rates and stream hydrology.

The proposed mitigation plan for Miller Creek and Des Moines Creek addresses floodplains, and water quality and hydrology. If implemented correctly, the plan should minimize the potential impacts of Master Plan Update implementation. However, with respect to floodplains, the EIS indicates that:

> *"Implementation of these mitigation requirements would be expected to prevent significant floodplain or flooding impacts from the proposed Master Plan Update alternatives."*

The plan does not guarantee that the mitigation measures will work. Therefore, monitoring of the mitigation measures construction and operation is extremely important.

2.10 - AESTHETICS AND VISUAL

Chapter IV, Section 24 and Appendix N of the Sea-Tac International Airport EIS deals with aesthetics and urban design.

Eighteen view-sites around the Airport's perimeter were used to describe the existing visual character of the Airport and to assess impacts of Master Plan Update implementation. Existing conditions were based on black and white photographs from the different viewpoints; three dimensional representations of the Master Plan Update alternatives were overlain on the photographs to show the expected changes or impacts.

The methodology used is routine for visual impact studies. However, the number of viewpoints was inadequate, in particular to the west of the Airport. Additional viewpoints should be included in the study, in particular on high ground. Two examples are in the City of Burien at 153rd and 4th Streets, and 160th between 9th and 10th Streets.

The use of black and white photographs makes it difficult to see existing and Master plan Update conditions. Color photographs should be used to more clearly show the Airport facilities. In addition, different stages of construction such as site clearing, earthwork and final design with/without landscaping should be shown.

Existing Conditions

The initial black and white photographs were used to show the context in which the Airport is located. However, the majority of view sites are located relatively close to the Airport. There are only a few view sites located further away and these are primarily to the northwest and south of the Airport.

As indicated above, more view sites and color photographs should be used to better describe the existing visual conditions of the Airport. The existing conditions description also should include a discussion of the ground shadow which is cast on the surrounding area from the existing embankment.

Additional view sites to the west, northwest and southwest of the Airport are particularly important because construction of the Third Runway will bring the runway activities approximately 1/2 mile closer to these areas.

The larger fill area also will be closer and will eliminate some of the view sites shown on Exhibit IV.24-1 in the EIS.

The existing condition view sites to the west, northwest and southwest also should more clearly show aircraft on the existing runways and possibly landing and taking-off. The view sites now show primarily trees and the embankment area and it would have been helpful to show airplanes, where possible.

Future Conditions

The treatment of future visual conditions is inadequate because the conditions are mainly described in the immediate area around the Airport. More view sites should be evaluated, in particular on high topographic relief points to the west of the Airport. The ground shadow which will be cast by the new embankment for the Third Runway also should be discussed in more detail than indicating that it will be about 15 minutes longer than the current shade.

Like the existing conditions, aircraft operations on the proposed Third Runway on the ground should be more clearly shown. This would be particularly helpful for the additional view sites to the west, northwest and southwest of the Sea-Tac International Airport.

Construction of the Third Runway will bring aircraft activities on the ground and in the air approximately 1/2 mile closer to the area west of the airport, in particular during landings and takeoffs. Therefore, the impact of aircraft in the air during landings and takeoffs should be shown and discussed in comparison to the existing conditions.

Cumulative Impacts

It is indicated that cumulative visual impacts could vary depending on what other developments are implemented. These potential developments should be described in relation to the proposed Master Plan Update improvements. If the visual impacts of these developments and the Airport improvements are deemed significant, visual representations should be presented.

Mitigation

As part of evaluating additional view sites, consideration needs to be given to developing short-range, medium-range and long-range views. For example, to the west of the Airport the viewpoints might be as follows: short-range, 1/2 mile or less from the Third Runway; medium-range, 1/2 to 1 mile from the Third Runway; and long-range, 1 to 1 1/2 miles or more from the Third Runway. The different viewpoints and their distance from the Third Runway area will depend, in part, on the topography.

Visual impact mitigation alludes to adherence to applicable design and landscape codes. It is assumed that this refers to the City of SeaTac Chapter 15.14 Development Standards: Tree Retention and Landscaping. These standards should be used taking into consideration the use of native vegetation of different age class that will minimize maintenance. Vegetation plantings should be used to minimize visual impacts on the Third Runway's embankment and off-site at sensitive viewpoints such as along 153rd and 4th Streets. Mitigation is discussed in more detail in Section 7.

SECTION 3

EIS TRANSPORTATION ANALYSIS

SECTION 3
EIS TRANSPORTATION ANALYSIS

3.01 - INTRODUCTION

Section 3 provides analysis regarding the traffic and transportation impacts due to construction of the proposed Third Runway at Sea-Tac International Airport. Section 8 addresses the potential traffic and transportation impacts and mitigation of implementation of the full Airport Master Plan.

The EIS forecasts were used in the analysis to assess traffic and transportation impacts and in development of the Mitigation Plan to address those impacts. This approach was taken due to the fundamental decision made early in the study to base the impact analysis on the data presented in the *Final Environmental Impact Statement, Proposed Master Plan Update to the Seattle-Tacoma International Airport.* The EIS contained traffic forecasts and projections for the following years:

- Year 1994 - Base condition
- Year 2000 - Completion of Third Runway
- Year 2020 - Completion of Master Plan improvements

3.02 - APPROACH

The overall approach in the EIS Transportation Analysis involved four basic steps:

- Determine the existing operating conditions on the highway system in the communities surrounding the Airport using the traditional level of service (LOS) criteria. This traditional LOS criteria was also used by the Port of Seattle in the EIS. The base year was 1994.

- Determine the traffic impacts on this network during the construction of the Third Runway. This analysis focused on the heavy truck traffic generated by hauling the fill material. Impacts of alternate haul methods and other activities of the contractor and suppliers during the construction of the Third Runway also were assessed. The analysis period was 1994 to 2000.

- Determine the traffic impacts after construction of the Third Runway and during implementation of the full Master Plan. This analysis period was 2000 to 2020.

- Develop a staged mitigation plan that addresses the impacts of the proposed full Master Plan Update for each of the following three project phases:

  - Mitigation of existing traffic impacts created by current operations of Sea-Tac International Airport.
  - Mitigation of impacts during construction of the Third Runway.
  - Mitigation of impacts after construction of the Third Runway on a continuing basis through implementation of the full Master Plan Update.

A key element of this phased mitigation plan for traffic and transportation impacts will be Interlocal Agreements which will form the basis for a continued involvement as the full Master Plan Update is implemented.

Table 3.01 shows the EIS chapters which were evaluated as part of the transportation analysis.

Table 3.01
EIS Chapters Reviewed for Transportation Issues

Chapter	Section	Title
--	--	Executive Summary
I	--	Project Background and Purpose and Need
II	--	Alternatives
III	--	Affected Environment
IV	15	Surface Transportation
IV	23	Construction Impacts
V	--	Probable, Unavoidable, Adverse Environmental Impacts and Mitigation Measures
Appendix J	--	Surface Transportation Construction Impacts Report
Appendix O-A	--	Surface Transportation Report
Appendix O-B	--	Revised Surface Transportation Report
Appendix O-C	--	On-Airport Surface Transportation Report

(Source: US Department of Transportation, Federal Aviation Administration, and Port of Seattle, February 1996)

3.03 - STUDY AREA

The study area for the traffic impact analysis included the jurisdictional boundaries of the cities of Burien, Des Moines, Federal Way, Normandy Park, and Tukwila. The study area also included the facilities operated by the Highline School District and the Highline Community Hospital District.

While this study area represents the limitations of the impact analysis, the Sea-Tac International Airport has an influence on the transportation systems within the Puget Sound Region and the State of Washington. This influence can be seen in an analysis of trip origins to the airport and will be felt on a regional level during the construction of the Third Runway since the truck haul route impacts extend along the entire route from the Airport to the borrow source.

An analysis of the origin destination information provided in the EIS as well as the 1991 study data provided by the Evans-McDonough Company for the Port of Seattle:

- Approximately 73% of trips to Sea-Tac International Airport are local and the remaining 27% are made by visitors.

- Of the local trips; 30% are from Seattle, 8% from Tacoma, 8% from Bellevue, 5% from King County outside the study area and the balance of 44% are from the remaining Puget Sound region.

- Of the visitor trips; 50% are from Seattle, 35% are from the City of SeaTac and the balance of 15% are from the remaining region.

It becomes readily apparent that the visitor trips are focused on the City of Seattle and City of SeaTac (where the hotels are) and the local trips are very diverse throughout the region.

It was also discovered that less than 6% of the total trips to the Airport are from the five cities within the study area; however, the traffic impacts tend to be concentrated in these five cities which is near the trip-end. The sole exception is the City of SeaTac which bears the heaviest traffic burden (but is not part of the study area).

3.04 - KEY CONCERNS

During this study, many issues were raised by agencies, organizations, groups and individual citizens regarding the impacts of the Airport Master Plan implementation on the highway system. These issues can be grouped into four categories of concern:

- Potential congestion on local streets expressed in reduced levels of service, increased accidents, parking and pedestrian problems, impacts on school bus operations and crossings, impacts on the efficient operations of police, fire and safety equipment and an increase in delay on transit operations.

- There is a general concern for potential physical damage to the highway system, not only on the local street network, but also on the State network due to increased volume of heavy truck traffic, the resultant lowering of legal bridge load limits and increased maintenance expenditures.

- There is a major concern regarding potential impacts on the highway system during construction of the Third Runway particularly along the main truck haul routes. As heavy truck volumes increase on the main haul routes, which are expected to be the freeways, there is a concern regarding diversion of traffic off the freeways to the local street system. A parallel major concern are the alternate haul methods being considered by the Port of Seattle; such as the Des Moines Creek barge and conveyor system. Construction work-force activity by the contractor and concurrent construction projects are also of concern.

- There is a concern regarding the potential lingering impacts caused by construction of the Third Runway and the ultimate implementation of the full Master Plan expressed in additional traffic on the local street network due to increased operations at the Airport and an increase in the operation and maintenance costs on the local streets.

3.05 - EXISTING TRAFFIC CONDITIONS

The first step in developing the mitigation measures discussed further in Section 8 was to assess the existing conditions and mitigate those existing impacts. This then becomes the base condition where existing impacts have been addressed thus allowing a wide range of future alternatives to be assessed and effectively mitigated without base condition influences.

The base year in the Sea-Tac International Airport EIS was 1994. This is also the base year chosen for the mitigation plan. The Sea-Tac International Airport EIS contained very limited traffic data which would allow a local network assessment of the impacts. The data collected and the analysis performed in the EIS was well done for 12 major intersections which surround the Airport and form the Airport's entry points or "driveways".

An analysis was not performed in the EIS on any segments of highway connecting these major intersections; however of more consequence, there was no data collected or analysis made of existing traffic impacts on the local network on outside this initial investigation of the entry points.

Traffic volumes into the Airport in 1994 are reported in the EIS as 75,000 AADT (average annual daily traffic) which is projected to increase to 130,000 AADT by the Year 2020 - an increase of over 70%. The local street system will be impacted by this increase; however, an analysis of that impact in sufficient detail has not been made. The Port of Seattle's analysis at the 12 entry points surrounding the Airport show that the intersections that were failing in 1994 (Level of Service "F") are also LOS "F" in 2020. However, the 70% increase in traffic must be absorbed by the State and local street system in the surrounding communities, since only so much traffic can pass these "failed" intersections in a given amount of time. The impact of this 70% increase in traffic on the surrounding street system has not been done, but must be completed as part of mitigation planning.

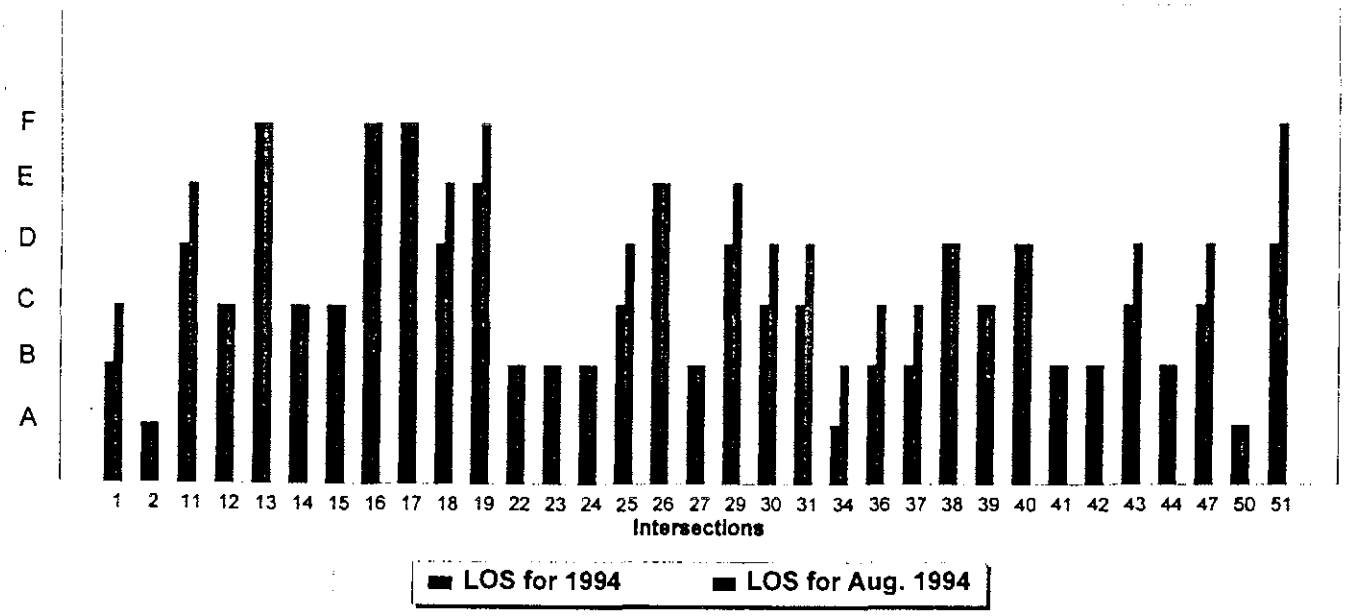
The 12 entry points/intersections evaluated in the EIS included 51 legs of these intersections. The EIS concluded that 20% of these intersection legs were currently failing, LOS "E" to "F" and another 30% were currently at capacity (LOS "C" to "D"), and could not handle more traffic without failing (see Table 3.02 and Figure 3.01). As expected, the failing intersections are on the east side of the Airport (City of SeaTac). The remaining 50% are currently operating at acceptable levels of service (LOS "A" to "B") and are on the west side of the Airport.

Table 3.02
1994 AADT/August Weekday Condition

Intersection Number and Name	1994 AADT Conditions			1994 August Weekday Conditions		
	Critical V/C	Average Delay (sec./veh.)	Level of Service	Critical V/C	Average Delay (sec./veh.)	Level of Service
1) SB SR 509 ramps at SR 518	0.764	10.7	B	0.846	15.0	C
2) NB SR and ramps at SR 518	0.614	1.8	A	0.713	2.3	A
11) SR 99 and South 154th	0.817	34.8	D	0.943	48.5	E
12) SR 99 and South 160th	0.586	21.1	C	0.667	22.6	C
13) SR 99 and South 170th	0.923	60.8	F	1.080	105.6	F
14) SR 99 and South 176th	0.496	18.8	C	0.572	19.5	C
15) SR 99 and South 180th	0.636	15.9	C	0.772	20.0	C
16) SR 99 and South 188th	1.154	247.4	F	1.326	406.8	F
17) SR 99 and South 192nd	---	---	F	---	---	F
18) SR 99 and South 200th	0.788	37.7	D	0.908	48.5	E
19) SR 99 and SR 516	0.687	49.4	E	0.802	70.3	F
22) 24th Ave. South and South 154th/156th	0.627	8.1	B	0.778	10.5	B
23) Des Moines Mem. Dr. and South 156th	0.563	7.6	B	0.710	6.9	B
24) Des Moines Mem. Dr. and South 160th	0.381	6.8	B	0.443	7.0	B
25) NB SR 509 ramps at South 160th	---	---	C	---	---	D
26) SB SR 509 ramps at South 160th	---	---	E	---	---	E
27) Air Cargo Rd. and South 160th	0.464	5.1	B	0.534	6.5	B
29) Air Cargo Rd. at SB Airport Exp. ramps	---	---	D	---	---	E
30) Air Cargo Rd. and South 170th	0.759	15.8	C	0.873	24.3	D
31) NB Airport Exp. and South 170th	---	---	C	---	---	D
34) SB SR 509 and South 188th	---	---	A	---	---	B
36) Des Moines Mem. Dr. and South 188th	0.661	12.6	B	0.755	15.0	C
37) 28th Avenue South and South 188th	0.783	12.6	B	0.840	15.9	C
38) Military Road and South 188th	0.749	27.9	D	0.857	36.2	D
39) SB IH-5 ramps and South 188th	0.546	15.0	C	0.624	16.2	C
40) NB IH-5 ramps and South 188th	0.704	28.1	D	0.812	35.7	D
41) Des Moines Mem. Dr. and South 200th	0.866	9.1	B	0.873	13.7	B
42) Des Moines Mem. Dr. and Marine View	0.447	8.3	B	0.510	8.6	B
43) 28th Avenue South and South 200th	---	---	C	---	---	D
44) Military Road and South 200th	0.562	8.2	B	0.710	9.4	B
47) Military Road and NB IH-5 ramps	---	---	C	---	---	D
50) 28th Avenue South and South 192nd	0.536	3.6	A	0.615	4.4	A
51) SB IH-5 ramps and SR 516	0.915	27.6	D	1.020	75.7	F

(Source: US Department of Transportation, Federal Aviation Administration and Port of Seattle, February 1996)

Figure 3.01
Level of Service Analysis by Intersection Number



Over time, as the Third Runway is constructed through the Year 2000 and the full Master Plan is implemented through the Year 2020, those intersections west of the Airport also will decline in level of service.

Existing trips (1994) to the Airport are generally oriented in north-south flow with 70% of the trips coming from the north 20% coming from the south and the balance 10% spread among the communities on the east and west. This strong orientation of trip-making makes the development of an effective Mitigation Plan much easier once traffic forecasts are extended beyond the 12 entry points surrounding the Airport.

There is a potential for increased vehicle accidents during the construction phase. The large number of heavy haul trucks will impact the current mix of vehicles on the roadway which will tend to increase the severity of the accidents and could also increase the frequency if the haul trucks were uncontrolled along the route.

Washington DOT accident data was made available for the SR 509/SR 518 interchange providing statistics on 548 accidents over the past 16 years which averages three accidents per month. This is the interchange which the haul trucks currently use for construction of the apron extension at the south end of the Airport. Over these 16 years, there has been no fatal accidents primarily because this interchange area is signalized and vehicle speeds are low at the time of the accidents. As one would expect, 75% of these accidents were angle-type (vehicles turning into each other), and the balance are predominately rear-end collisions.

3.06 - CONSTRUCTION IMPACTS

The EIS estimates that it will take three years to complete the embankment (fill) for construction of the Third Runway which will be completed in 2000. Over this three-year period, the EIS estimates 20 million cubic yards (MCY) of fill will be transported to the site. An additional 3 MCY will be needed to complete the full Master Plan improvements; although, that haul will be over the 2000 to 2020 time frame and should not become an issue on the highway system unless the haul is focused into a single construction season. However, the hauling of this additional 3 MCY should be part of any Mitigation Plan Agreement.

Eighteen borrow sites were identified in the EIS as potential sources of fill material. It is possible and likely that material will be transported from multiple sites depending on the contracting procedures of the Port of Seattle and market conditions at the time of contract bidding. Since it is not possible to either predict or control the borrow sources site(s), a Mitigation Plan Agreement must be developed to address impacts which arise from all potential sites. Of these 18 sites, 15 are south of the Airport, 2 are north and 1 is east. There also have been reports of borrow sites that would use Puget Sound as a transport route enabling borrow sites west of the Airport and in Vancouver to become economically feasible.

Hauling of 20 MCY by truck is a concern of the potentially impacted communities regarding safety, congestion and physical damage to their street network. This hauling operation would average 109 single bed trucks per hour in each direction or approximately 2,336 trucks per average day. By contrast, the current apron expansion contract moves 0.45 MCY or approximately 3% of the fill to be moved for construction of the Third Runway. The apron contract uses 10 trucks per hour, 6 days per week for 22 weeks, and is a source of controversy within the surrounding cities, including the City of SeaTac.

Due to the large volume of fill material to be hauled for construction of the Third Runway, double-bed and larger trucks are certain to be in the mix of general traffic. While the number of these larger trucks will be less, (109 singles - equivalent to 55 doubles or 36 triples) the operational characteristics and additional weight of these larger trucks are not directly proportional to the impact they will have on traffic operations and physical damage to the highway system. The Mitigation Plan must consider the impacts caused by the maximum permit weights allowed by Washington DOT and local ordinances.

Due primarily to economic factors as opposed to community opposition, alternate methods have been, and are being, explored by the Port of Seattle to haul 20 MCY to the site. One of the most discussed is a barge and conveyor system that would transport fill material by barge on Puget Sound to a newly constructed off-load facility at the mouth of the Des Moines creek and transfer material to an above ground conveyor belt that would run along the Des Moines creek sewer right-of-way three miles to the Airport property where on-site equipment would transport it to the construction site. Such a concept has been proposed to the Port of Seattle by the Westco Company. The primary advantage of this barge/conveyor system is that it will complete the haul in 18 months - a 50% time-savings over truck hauling.

There are other non-traffic alternatives being considered, such as barge transport along the Duwamish Waterway and transfer to a four-mile conveyor running along SR 509 and rail transport to the former long-acres site in Tukwila and transfer to a three-mile conveyor along IH-405/SR 518 with a tunnel under IH-5. In October 1996, the Port of Seattle released a Draft report entitled *Fill Material Alternative Delivery Method Study for the Third Runway* which considers the economic feasibility of these and other haul alternatives. This particular study ranks the alternatives as follows:

1) Barge to the Duwamish Waterway and truck along SR 509 to the Airport.
2) Trucking only.
3) Barge to Des Moines Creek and conveyor to the Airport.

Before the actual construction begins, there will be additional alternatives proposed with varying impacts to the communities. While the market conditions will influence the final decision, the impacted communities must have a Mitigation Plan Agreement in place prior to the haul that will address the impacts of that particular alternative, participate in the discussions and issue the necessary local permits. The Mitigation Plan must not only address the impacts of the truck and non-truck methods, but also be flexible enough to address changes proposed by the contractor during construction.

3.07 - POST-CONSTRUCTION IMPACTS

While the impacts during the construction phase would be mitigated through 2000, there will be additional impacts created by implementation of the full Master Plan between 2000 and 2020, including construction of the north unit terminal, cargo warehouse, the Runway 34R extension, gate expansions and expansion of the parking garage. Airport traffic is projected by the EIS to increase from 75,000 AADT in 1994 to 84,000 AADT in 2000, a 12% increase and to 130,000 AADT in 2020 a 55% increase over 2000. This 55% increase in traffic will be the focus of the Post Construction Impact Mitigation Plan. In the EIS analysis, the level of service decreased on 20 of the 51 intersection legs (40%) evaluated by the Year 2000. The impact of this reduction in level of service should be addressed in the Construction Phase Mitigation Plan, to be developed by either the Port of Seattle or its contractor. By the Year 2020, 80% of the legs have decreased levels of service which should be addressed in a Post-Construction Mitigation Plan.

Currently, parking for Airport operations is concentrated on Airport property and along SR 99 in the City of SeaTac. The Master Plan provides for additional required parking to be on Airport property or on the eastside of the Airport. Parking operations and impacts are therefore not part of the current Mitigation Plan; however if parking issues become apparent in the future, the Mitigation Plan Agreement will provide the mechanism to address them.

There would be associated increased operation and maintenance costs to the surrounding communities on the local street system. These would be assessed as part of Mitigation Plan in all three phases - base condition, construction and post construction.

3.08 - FINDINGS

In the EIS, the Port of Seattle made efforts to consider other proposed improvements to the Regional Transportation system within their planning for implementation of the full Master Plan. This is the appropriate approach. The regional projects considered in the EIS were as follows:

- Completion of the proposed regional transit authority (RTA) system.
- Completion of the proposed high-occupancy vehicle (HOV) system.
- Completion of the proposed SR 509 extension.
- Completion of the proposed Southern Airport Expressway.

Each of these regional transportation projects will move forward with varying schedules. The effect of including these four regional projects in the Year 2020 traffic forecast is to underestimate the impacts on the local street systems. Because it cannot be determined at this time which of these regional projects will be implemented and when, a Year 2020 forecast should be made without these projects to assess the worse case impacts on the local street system.

While the intersection analysis performed in the EIS was well done, the number of intersections studied was limited to the access "driveways" or entry points surrounding the Airport. Currently the heavy traffic impacts are east of the Airport (City of SeaTac); however, over time those heavy impacts will be felt throughout the surrounding area. There was minimal analysis performed in the impacted communities. A comprehensive area-wide traffic study needs to be prepared in order to assess potential impacts to the local street system in a comprehensive manner. This need is further indicated by the forecast of a 70% increase in Airport traffic and accompanying 80% decrease in traffic level of service by the Year 2020.

Based upon the EIS forecast of the fill requirements of the Third Runway, a convoy of haul trucks will be necessary in the peak periods of one truck every 30 seconds, 500 yards behind each other for three years. This a staggering statistic. For this reason doubles, triples and maximum weight carriers will be employed to contain the costs of transporting the fill material. The only highway type capable of handling this volume of heavy trucks is the regional freeway system with the Interstate Highways being the best prepared to handle this demand. If the fill material is transported by truck, the haul trucks must remain on the freeway system, be subject to operational restrictions by the DOT and access the construction site via a direct connection between the freeway system and the site. The area along SR 518 and the northern Airport boundary offers such an opportunity for this direct connection which could operate as a temporary construction entrance and be dismantled after completion of the contract.

There has been no analysis made of potential physical damage to the highway system, particularly the bridge decks, of this heavy truck volume in the EIS. This includes both the State and local highway systems.

While the context of this impact analysis is the communities immediately surrounding the Airport (excluding the City of SeaTac). The analysis of potential physical damage should be conducted along the entire fill haul route(s).

From the potential burrow sites to the Airport, the barge/conveyor system alternate avoids the physical damage and congestion on the highway system and would physically complete the haul in less time than the trucking alternate; however, there are potentially severe environmental impacts associated with this system along Des Moines Creek. There is the potential for spillage of material into Puget Sound along the route and at the transfer pier, above ground conveyor noise and visual impacts, loss of recreational use of the corridor during construction, safety issues with people, and the restoration of the entire corridor upon completion of the operation.

While traffic volumes in the areas surrounding the Airport is forecast to increase by 70% with corresponding decrease in highway level of service of 80%; not all of this increase/decrease is due to construction of the Third Runway or other Master Plan projects. Also included in this traffic are local trips, regional trips, shopping trips, work trips, recreation trips, etc. The approach that must be taken in the Mitigation Plan is to determine the actions necessary to mitigate the entire impact, determine the costs associated with mitigation the particular impact and finally, to the best extent possible, allocate these costs among the various parties in a responsible and equitable manner. This equitable distribution or *pro-rata* share has not yet been determined but should be a key element of the Mitigation Plan. Preliminary indicators in the EIS traffic figures point to a pattern of 33% of traffic on SR 518 is Airport traffic, 50% of all southbound traffic on SR 99 volume is Airport traffic and 25% of northbound SR 99 volume is Airport traffic. This is, of course, not reliable enough to base a cost allocation model upon; however, such a model must be prepared. This effort also would include an updated origin-destination study and a select link/screen line analysis along the principal arterials on an area-wide basis surrounding the Airport. The 1984 O-D study by the Port of Seattle is not adequate to develop this cost allocation model.

SECTION 4

EIS SOCIO-ECONOMIC ANALYSIS

SECTION 4
EIS SOCIO-ECONOMIC ANALYSIS

4.01 - INTRODUCTION

The impacts of an airport on a region's socio-economic environment manifest themselves through indirect and induced effects - unlike an airport's physical and biological impacts which impress themselves directly on the natural environment. This is true both for an airport's beneficial and adverse impacts.

In terms of an airport's beneficial impacts, the FAA defines the benefits to a community of an airport as including direct benefits, indirect benefits and induced benefits. In Butler and Kiernan (September 1996), the FAA states:

> *"The primary [transportation] benefits of an airport are usually the time saved and cost avoided by travelers who use it over the next best alternative"*; . . . . and the resulting *"economic activities [measured in terms of employment and income] that would not have occurred in the absence of the airport."*

In these definitions of airport beneficial impacts, it is not the Airport itself but the social and economic consequences of the Airport, measured in time savings and business activity, that generate the impacts. Specifically, there are three types of benefits - Direct, Indirect, and Induced:

- **Direct Benefits** - Defined as the time and cost saving to travelers compared with alternative modes of transportation and the jobs, income and business activity generated at the airport.

- **Indirect Benefits** - Defined as the jobs, income and business activity generated by companies that are not at the Airport but are users of, or closely linked to, aviation transportation services.

- **Induced Benefits** - Defined as the jobs, income and business activity generated by multiplier effects from inter-industry linkages to direct and indirect impact companies.

In line with the FAA's analysis of how airports generate beneficial impacts, the 1994 report, *The Local and Regional Economic Impacts of the Port of Seattle* (Martin O'Connell Associates, 31 May 1996) measures 4 types of impacts - jobs, personal earnings, business revenue and taxes paid. It estimates the direct job benefits to be 38% of the total. Equivalent measurement techniques have been used to estimate similar airport beneficial impacts both elsewhere in Washington State (Thomas/Lane & Associates, June 1991) and throughout the country (Hewings, et.al. 1995).

Similar to beneficial impacts, an airport's adverse impacts have a direct component but are primarily the result of indirect and induced effects. This Section defines and discusses the different types of adverse impacts produced by airports, and the significance of these impacts for the communities that lie within Sea-Tac International Airport's adverse impact area.

4.02 - DIRECT ADVERSE SOCIO-ECONOMIC IMPACTS

Direct adverse impacts of commercial airports on surrounding communities are measured by the decline in residential property values compared to what they would have been if the Airport were located elsewhere in the metropolitan area.

Airports generate noise, visual blight, surface traffic congestion, air pollution and other effects which cause most households to consider the areas immediately surrounding them to be less desirable places to live. Some households may have a primary wage earner employed at (or near) the Airport and consider the reduction in commuting time a more than off-setting factor to the Airport's direct adverse impacts. For others, there may be neighborhood or individual house characteristics that off-set the Airport's direct adverse impacts. But for most households, close proximity to an airport reduces a property's residential desirability. (Crowley, 1973). As a result, a residential housing unit located close to an airport will normally have a market value less than it would have had if located elsewhere in the region, other things (such as lot size and view) being the same.

Most studies of direct adverse impacts of airports have concentrated on measuring the noise impacts on property values (Newman and Beattie, 1985; Frankel, 1991; and Mieszkowski and Samper, 1978). A recent report by Booz-Allen & Hamilton, Inc. (September 1994), prepared for the FAA, reported:

> *"Impacts on property values of airport noise varies from negligible [$627 for lower priced housing units around Baltimore International Airport] to significant [$60,873 for moderately priced housing units around Los Angeles International Airport] and appears to be more pronounced in higher priced neighborhoods."*

A *Sea-Tac Airport Vicinity Land Use Inventory Project* report prepared for the Port of Seattle in 1994 looked at the noise issue by comparing the assessed values of 32 residences located within Sea-Tac International Airport's "Noise Remedy Area Boundary - 16 residences were within both the Airport's 65 LDN and Noise Remedy Area boundaries and 16 residences were outside the Airport's 65 LDN boundary but within the its Noise Remedy Area boundary (Shapiro and Associates, April 1994). For a variety of methodological and research procedure issues (the most notable being the lack of comparison between houses near to the Airport with comparable units in other parts of the central Puget Sound region), the report concludes (page 55):

"Given the limitation of this study, neither the existence nor the magnitude of any general effect on rates of appreciation of property values from airport noise is demonstrated."

The Airport's direct impacts primarily result in private costs, which are measured as the decline (or reduction in the rate of growth) of privately owned residential property. This cost is borne by the property owner at the time the Airport is created or at the time the Airport undergoes a significant increase in the magnitude of its adverse impacts - such as occurred when jet airplanes came into wide spread commercial use.

Direct public costs are measured by the decline in the local tax base that results from the reduced (or more slower growing) property values of residences in close proximity to the Airport.

4.03 - INDIRECT ADVERSE SOCIO-ECONOMIC IMPACTS

Indirect adverse impacts of commercial airports on surrounding communities are measured by the change in residential and business land uses that result from the decline in property values (or the decline in the rate of increase of property values) caused by the airport's direct impacts. The importance of indirect effects is that they are the intermediary through which direct impacts lead to induced impacts - and as will be discussed below, there are significant costs associated with induced impacts. Indirect impacts occur only at the community level and generally there are no private indirect costs.

An individual household or business that observes a relative decline in the value of land directly impacted by Sea-Tac International Airport will make a decision about changing land use to maximize its household welfare. From the perspective of the community however, the result of these individual welfare maximizing decisions is:

- An increase in single family residential rentals and the development of multi-family rental properties;
- A shift in a community's population from primarily home owners to a mix of stable home owners and more transient renters;
- The growth of business activity whose market is the more transient rental population; and,
- Resistance by impact area residents to pass levies needed for city and school district operations.

The net effect of such indirect effects is to produce significant induced adverse impacts in the 5 cities immediately surrounding Sea-Tac International Airport that are the focus of this study.

4.04 - INDUCED ADVERSE SOCIO-ECONOMIC IMPACTS

Induced adverse impacts of commercial airports on surrounding communities are measured by both:

- Costs associated with community service requirements such as community centers, schools, nuisance abatement, child care, and public safety; and,

- Declines in a community's property tax base produced by altered demographic and business profiles that result from the airport's indirect (land use) impacts.

The manner in which Sea-Tac International Airport's induced impacts can result in a fiscal squeeze (increased service requirement costs and reduced property tax revenues) on local jurisdictions is illustrated by the Highline School District. Sea-Tac International Airport's direct and indirect impacts produced lower relative land values, increased rental properties and a change in the District's population profile to include more transient (i.e.: renter) households with lower incomes. The close association between higher/lower income households and owner/renter occupancy status has been documented in a report entitled *Washington Housing Needs* Study (1986, prepared for the State of Washington Department of Community Development by Thomas/Lane & Associates, Phillips Associates, and Raj Joshi Associates).

The children of the lower income renter households, on average, require a higher level of service from the district's schools to achieve the same outcome - whether outcomes are measured in Washington's uniform test scores, percent of high school graduates continuing on to higher education, SAT scores of high school seniors, or any other generally recognized measure of academic performance (Ward and Krueger, 1996). At the same time the District experiences these increased service requirements and incurs the cost increases of providing additional service to achieve constant school outcomes, its tax base is reduced because of the decline in relative land values caused by the Airport.

A similar pattern of causality exists between Sea-Tac International Airport's direct and indirect impacts and its induced impacts (as measured by their costs) on public safety, child care, senior centers and other types of community services.

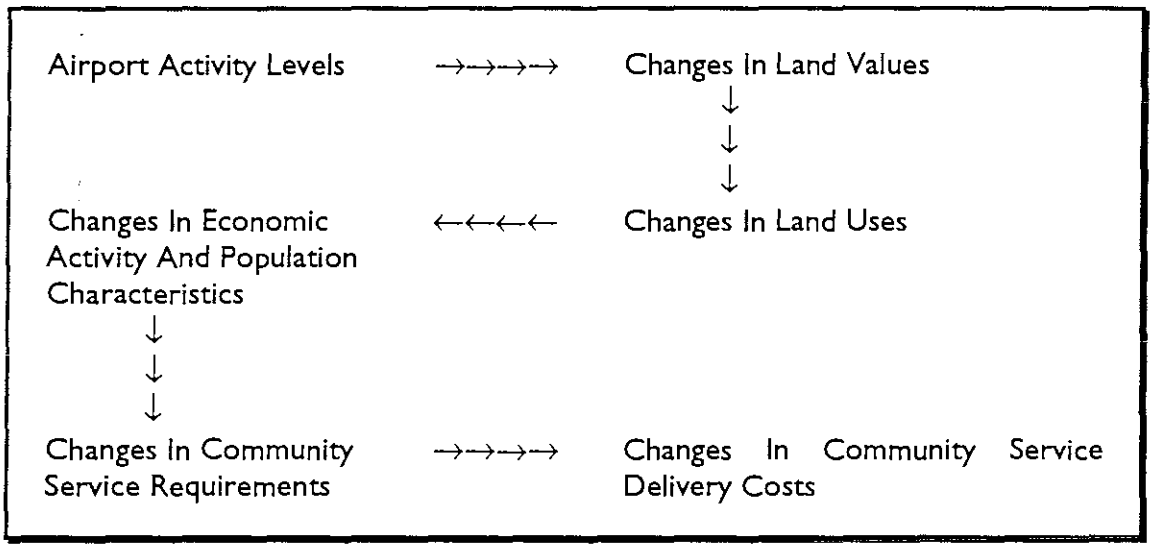
4.05 - TOTAL SOCIO-ECONOMIC ADVERSE IMPACTS

Sea-Tac International Airport's total socio-economic impacts are the sum of it direct, indirect and induced socio-economic impacts. This is true equally for the Airport's beneficial and adverse impacts. The requirement for mitigation of adverse socio-economic impacts occurs when the Airport's adverse impacts are greater than its beneficial impacts. In a global context, the relationship between Sea-Tac International Airport's total socio-economic beneficial impacts and adverse impacts is theoretically analogous to a socio-economic benefit/cost analysis.

Analyzing socio-economic mitigation requirements however, involves an analysis that is community specific. Sea-Tac International Airport's total benefits may exceed its total costs, but (as discussed in Appendix A) its benefits are widely distributed over the multi-county central Puget Sound region while its adverse impacts are concentrated in communities immediately surrounding the Airport. From the perspective of these communities, the Sea-Tac International Airport's adverse impacts far exceed its benefits; and the difference between the two represents the appropriate level of required socio-economic mitigation.

The sequence of causally linked steps that generate adverse socio-economic impacts for a community is illustrated in Figure 4.01.

Figure 4.01
Adverse Socio-Economic Causality



The relationship between direct, indirect and induced socio-economic beneficial and adverse impacts is shown in Table 4.01.

Table 4.01
Definition and Measurement of Airport Master Plan Update Impacts

Type of Impact	Adverse Impact		Beneficial Impact	
	Definition	Measurement	Definition	Measurement
Direct	Blighting of land values In the five cities in immediate proximity of Sea-Tac's approach/departure flight tracks	Decreases in value of residential land in the five cities immediately surrounding the airport over what it would have been if there was no airport	Economic activity occurring at Sea-Tac that would not occur in the absence of the airport's expansion and the time saving to travelers who use the new facilities	Number of jobs and amount of business and worker income generated at Sea-Tac as a result of the airport's expanded facilities
Indirect	Changes in land uses in the five cities immediately surrounding Sea-Tac	Down scaling of socio-economic characteristics of both businesses and population groups in the five impacted cities immediately surrounding Sea-Tac	Off-airport economic activity among companies that are users of, or closely linked to, aviation services that would not occur in the absence of the airport's expansion	Number of new jobs and amount of new business and worker income generated by companies that are users of or are closely linked to aviation transportation
Induced	Increase in community services (public safety, schools, nuisance abatement, community centers) needed to maintain constant quality of life in the five impacted cities immediately surrounding Sea-Tac	Cost of delivering the community services (public safety, schools, nuisance abatement, community centers) required to maintain constant quality of life in the five impacted cities immediately surrounding Sea-Tac	The multiplier affects of Sea-Tac's direct plus indirect impacts - i.e., increases in employment and income (over and above the combined direct plus indirect impacts) created by successive rounds of spending	Number of additional jobs and amount of additional business and worker income generated by multiplier affects from inter-industry linkages of directly and indirectly impacted companies and households

(Source: FAA Document DOT/FAA/PP-92-6)

4.06 - BALANCING SOCIO-ECONOMIC COSTS AND BENEFITS

It is widely recognized that airports generate a range of socio-economic impacts. For example, FAA Advisory Circular AC 150/5020-1, *Noise Control & Compatibility Planning for Airports*, states on page 6 that:

> *"Many [environmental assessments] contain analysis of airport noise, compatible land use, social impacts, and induced socioeconomic impacts."*

In Section 6 - Analysis of Costs and Benefits and Selection of an Alternative (page 42), the FAA Advisory Circular states:

> *"Evaluation of the social costs and benefits of the alternatives is of equal importance with those of economics and the environment."*

Some costs adversely impact the quality of life in communities - primarily communities immediately surrounding the Airport which suffer the air pollution, visual pollution, noise pollution and surface traffic congestion produced by Airport operations. Others beneficially impact the quality of life of communities in the region - primarily communities where jobs, income and business activity are created and where local residents frequently use air transportation services.

Among researchers who have studied the decline of urban environments, the growth of airports is considered, along with facilities such as toxic waste dumps, an environmental hazard.

A recently published study by Rutgers University professors Michael Greenberg and Dana Schneider reports:

> *"Airports are associated with traffic jams, airplane crashes, and extraordinarily high levels of noise. When present, low-flying aircraft are an even more distressing source of noise than motor vehicles on highways. Jets, especially jumbo jets that cannot rise quickly, create an extremely high decibel level and a whining sound upon takeoff. Unlike a highway where the noise is relatively continuous and can often be masked by sound barriers and air conditioning, airport noise is discontinuous and is virtually impossible to mask. In addition to task interference and uncontrollable physiological changes observed in people living near highways, those residing near airports suffer from feelings of helplessness and lack of control."*

A modern growing economy appears to require the services of an international airport, but the provision of air transportation services produces adverse as well as beneficial impacts. As is true with all airports, Sea-Tac International Airport's socio-economic impacts are not distributed uniformly over the region, nor are its benefits and costs distributed proportionately among communities. An analysis of appropriate mitigation consequently requires a community by community assessment of the Airport's net socio-economic impacts.

4.07 - ANALYSIS OF EIS'S "NO ACTION" ASSUMPTION AND THE IDENTIFICATION OF AIRPORT ACTIVITY LEVELS LIKELY TO RESULT IN FUTURE LAND VALUE CHANGES

The *Airport Master Plan Update for Seattle-Tacoma International Airport* was completed in 1996 (P&D Aviation, January 1996) and its findings and forecasts are the basis for Sea-Tac International Airport's proposed expansion, including construction of the Third Runway. The *Airport Master Plan Update* forecasts are also the basis upon which the Airport's *Environmental Impact Statement* (EIS) estimated the impact of Sea-Tac International Airport's Third Runway and related improvements.

The *Airport Master Plan Update* forecasts were:

> *"Prepared as an element of the Airport Master Plan Update to be used to develop airport facilities requirements and to estimate the time frames when future improvements are needed."* (P&D Aviation, 20 August 1994)

The objective of the *Master Plan Update* forecasts was:

> *"To develop updated master plan forecasts which can account for a range of potential future airport scenarios and provide a sound basis for guiding the development of future facility improvements at the airport. Accordingly, the forecasts ... are planning level estimates and are not intended to be exact predictions."* (P&D Aviation, 20 August 1994)

The approach to, and purpose of, forecasting contained in the *Master Plan Update* is consistent with FAA guidelines, which state:

> *"The purpose of aviation forecasts is to indicate the relative timing for airport investments in a manner that minimizes forecast error costs. The idea is to forecast the different elements of aviation demand, compare that demand over time with the* ***capacity*** *[emphasis added] of an airport's various facilities, and to identify the time when new or expanded airport facilities may be necessary."* (Advisory Circular No. 150/5070-6A. US Department of Transportation, Federal Aviation Administration)

However, when using the *Airport Master Plan Update* forecasts that were the basis for recommended facilities expansions at the Airport, the Sea-Tac International Airport Master Plan Update Final EIS states in Volume 4, Appendix R (page R-5):

> *"If the proposed new runway and other* ***facility improvements*** *[emphasis added] are not constructed, the growth in demand for air travel would continue to occur as would the number of aircraft operations, because it is expected that the Region will continue to experience growth in population and income " ... and that it is reasonable to* ***assume for purposes of this environmental analysis*** *[emphasis added] that the same number of operations would occur with and without the proposed new runway."*

A disjunction exists consequently between the objective for which the Sea-Tac International Airport forecast was made and purpose to which it was put in the EIS.

The *Master Plan Update* generated a forecast, compared it with Sea-Tac International Airport's existing facilities and determined the Airport's facilities needed expansion. **The EIS used the same forecast and assumed it would occur without any facilities being expanded** at the Airport. The result of the EIS's assumption is that the Third Runway causes almost no socio-economic impacts since the same level of passenger enplanements, aircraft operations and cargo movements occurs whether or not facilities at the Airport are expanded.

As a result of this assumption, the *Sea-Tac Master Plan Update Final EIS* considers socio-economic impacts only from the perspective of residences and businesses that will be displaced by the Airport's expansion. The Final EIS (Section 6 - Social Impacts) reports that:

- 388 single family housing units, 260 condominiums/apartments, and 105 businesses will be displaced and will need to be acquired (assuming a 8,500-foot long Third Runway is built)

- All of the displaced housing units and businesses are located in the City of SeaTac, in the immediate periphery of the existing Airport.

- The Cities of Des Moines, Federal Way, Kent, SeaTac and other nearby communities contain adequate comparable housing, or developable land, to absorb the demand created by the housing displacements; although finding all of the replacement housing within the City of SeaTac is likely not possible.

- The Port of Seattle proposes to purchase avigation easements from commercial properties located within the Third Runway's runway protection zone (RPZ), unless they conflict with the FAA's RPZ safety guidelines - in which case they will be displaced and their properties acquired.

- Acquisition and displacement of existing residences would cause some disruption of community character, with disruption being greatest in the west City of SeaTac neighborhood between 12th Avenue South and SR 509,

- No minority, age, or income group will be disproportionately affected, and the intent of Executive Order 12898, "Environmental Justice" is therefore met,

- About 71% of the housing units and 91% of the apartments/condominiums to be acquired would be "affordable housing".

- And identified social impacts will be mitigated only by acquisition of properties at fair market value and payment of relocation benefits, as specified in the federal Uniform Relocation Assistance Act (US DOT, 49 CFR, Part 24).

The Final EIS (Section 8 - Induced Socio-Economic Effects) considers the impact of property acquisitions and displacements on employment, payroll, business expenditures, and the tax receipts of affected cities. It reports the following findings:

- The total assessed value of the property to be acquired is $75.4 million, of which $54.1 million is residential property and $21.3 million is commercial property.

- As a result of property acquisitions, total annual reductions in property tax receipts would be $227,600 - $45,900 per year in the City of Burien and $181,700 per year in the City of SeaTac.

- As a result of business displacements, the total annual loss in taxabale retail sales would be $2.2 million - $0.6 million in the City of Burien and $1.6 million in the City of SeaTac [the Final EIS did not calculate or report the actual loss of retail sales tax receipts].

- Businesses located on properties to be acquired employ a total of 627 workers - 40 in the City of Burien and 587 workers in the City of SeaTac.

- Identified impacts will be mitigated only by acquisition of properties at fair market value and payment of relocation benefits, as specified in the Federal Uniform Relocation Assistance Act (US DOT, 49 CFR, Part 24).

EIS Section 8 also evaluates the reasonableness of the Final EIS's assumption that passenger enplanements, aircraft operations and cargo movements at Sea-Tac will be unaffected by whether or not any facilities - including the Third Runway - are expanded/constructed over the 25-year period, 1995 and 2020. It also evaluates the reasonableness of the Final EIS's description of the socio-economic impacts that will be caused by the proposed expansion of Sea-Tac. Finally, it proposes a more likely scenario of the relationship between facilities expansion and aviation activity at the Airport.

4.08 - THE MASTER PLAN UPDATE FORECAST

The final Sea-Tac *Airport Master Plan Update* forecast report (Volume 5) projects the demand for aircraft operations (landings and take-offs) to grow as shown in Table 4.02. The *Airport Master Plan Update* report also forecasts the mix of aircraft flying into Sea-Tac will contain larger aircraft than are in use today, as shown in Table 4.03.

The demand forecast for carrier/commuter operations and for the use of larger aircraft results from the following forecast of passenger enplanement demand, 96% of which comes from persons enplaning domestic air carriers flying in and out of Sea-Tac (Table 4.04).

Table 4.02
Aircraft Operations Forecast

Operation	1993 (actual)	2000	2010	2020	Change 1993-2020
Air Carriers	188,000	223,000	255,000	287,000	+99,000
Air Taxis/Commuters	127,000	127,000	118,000	117,000	-10,000
All-Cargo Carriers	16,000	20,000	23,000	27,000	+11,000
GA & Military	8,000	9,000	10,000	11,000	+3,000
Total	**339**	**379**	**406**	**442**	**103**

(Source: US Department of Transportation, Federal Aviation Administration, and Port of Seattle, February 1996, Volume 5, Table 5-15)

Table 4.03
Forecast of Aircraft Mix Flying Into Sea-Tac

Operation	1993 (actual)	2000	2010	2020	Change 1993-2020
Average Seats Per Air Carrier Aircraft	155	169	189	209	+54
Average Seats Per Air Taxi/ Commuter Aircraft	28	31	36	36	+8
% of All-Cargo Carriers Over 60,000 Pounds	64%	69%	75%	80%	+16%

(Source: US Department of Transportation, Federal Aviation Administration, and Port of Seattle, February 1996, Volume 5, Table 5-18)

Table 4.04
Forecast of Enplaning Passengers

Enplanement	1993 (actual)	2000	2010	2020	Change 1993-2020
Domestic Air Carriers	8,100,000	10,100,000	13,000,000	16,300,000	+8,200,000
Domestic Air Taxis/Commuters	600,000	700,000	800,000	900,000	+300,000
Enplanements to Canada	400,000	600,000	900,000	1,100,000	+700,000
Other International Enplanement	300,000	500,000	600,000	800,000	+500,000
Total	**9,400,000**	**11,900,000**	**15,300,000**	**19,100,000**	**+9,700,000**

(Source: US Department of Transportation, Federal Aviation Administration, and Port of Seattle, February 1996, Volume 5, Table 5-8)

Based on these forecasts, the *Airport Master Plan Update* report proposes numerous facilities improvements, including the following:

- A new 8,500 foot runway (the so-called Third Runway, or runway 16X-34X).
- A mid-field overnight parking apron between runways 16R-34L and 16X-34X.
- Limited expansion of 4 to 6 gates on Concourse A and the Main Terminal, including expansion of the Central Parking Garage.
- Development of a new north unit terminal.
- Development of a cargo warehouse.
- Construction of a new Air Traffic Control Tower and TRACON (terminal radar control area).
- Installation of a CAT III ILS (category 3 instrument landing system) on runway 16L.
- Extension of duel parallel Taxiways A and B the full length of runway 16L-34R and a taxiway bridge over 188th Avenue South.
- Extension of runway 34R by 600 feet and relocation of the glideslope.

The *Airport Master Plan Update* report finds operations levels will reach the Airport's capacity about the Year 2000, and therefore recommends that the Third Runway and the expansion of the Main Terminal at Concourse A be completed between the Years 2001 and 2005, with additional facilities expansions occurring between 2005 and 2020.

4.09 - OTHER AVIATION FORECASTS OF SEA-TAC'S CAPACITY

A report titled, *Air Transportation Demand, Aviation Industry Trends, and Air Capacity in Washington Through 2020* (TRA Consulting, October 1992), was prepared for the Washington State Air Transportation Commission (AIRTRACT). It calculated the service capacity or annual service volume (ASV) of Washington airports and reported:

> *"With 1991 operations at 365,000, Sea-Tac is close to capacity. According to the base forecasts, the ASV calculation of 380,000 operations will be reached between 1992 and 1993."*

The Final Report of the Puget Sound Council of Government's (jointly with the Port of Seattle) Puget Sound Air Transportation Committee (January 1995) also placed Sea-Tac's annual operating capacity at 380,000 operations.

A study titled, *Phase I Forecasts: Flight Plan Study*, conducted by KPMG/Peat Marwick (July 1990) for the Port of Seattle and the Puget Sound Conference of Governments in 1990 found that its forecast of 427,000 operations for the Year 2000, assuming no changes in Sea-Tac's runways and facilities would mean that:

> *"Annual average aircraft delays would approximate 10 minutes per aircraft operation. Average delays on the order of 10 minutes are experienced at the most congested airports in the United States, such as Chicago O'Hare International Airport, LaGuardia Airport, and Washington National Airport."*

O'Hare, LaGuardia, and Washington National are referred to as "slot controlled" airports where the FAA limits any increase in total operations during each airport's peak hours.

On 19 May 1992, P&D Aviation (the same consulting organization that prepared the *Airport Master Plan Update* for Sea-Tac) wrote a "Working Paper" for the Port of Seattle titled, *Analysis of Maximum Passenger Limits at* Sea-Tac *Airport Under the No New Runway Alternative*. The report estimated that the maximum acceptable delay would be an average of 22 minutes per aircraft operation, and it analyzed both non-structural methods by which the Airport could increase capacity and the likely airline response to increased delays. It concluded that the Airport would reach capacity somewhere between 2010 and 2012, but also concluded:

> *"Obviously an average delay of 22 minutes per operation would be a significant increase in delay and would have a large impact on Airport operations as well as overall passenger service."*

The Civil Tiltrotor Development Advisory Committee's *Report to Congress* (delivered in December 1995) contains a map reference to the FAA's Office of Policy and Plans which shows airports actually congested in 1993 and which are expected to be congested by the Year 2000. Sea-Tac International Airport is shown on the map as actually congested in 1993.

Finally, the *Final EIS for the Proposed Master Plan Development Actions* discusses Port of Seattle studies about Sea-Tac's capacity limits and reports that:

> *"The inability of existing airfield facilities to accommodate traffic into the 21st century was first recognized in the mid-1980s when the Port completed the Comprehensive Planning Review & Airspace Update Study. The purpose of the study was to assess the validity of previous plans developed for Sea-Tac in light of air travel growth and other changing conditions at the Airport. While previous plans had not indicated a need for new runway capacity, this new study showed that the existing runway system would not be capable of serving the increased demand past the Year 2000."*

All past studies, including the *Master Plan Update* study, conclude Sea-Tac's existing facilities cannot accommodate the operations, enplanements and cargo demands forecast for the Year 2020. Construction of the Third Runway, and related Airport improvements, are a necessary condition for expansion of Airport activity to the 2020 forecast levels.

In the absence of the Third Runway, and related Airport improvements, the number of annual operations contained in the forecast will not be reached. Airlines will raise fares for flights originating/departing Sea-Tac, shift flights to other airports in the region, discontinue short haul commuter operations and concentrate on long haul flights into/out-of Sea-Tac, or take other actions compatible with delay reduction and higher profit margins. If the average time delay per arriving flight forecast without the Third Runway and related Airport improvements occurs, there will be some reduction in use initiated by airlines flying into Sea-Tac, passengers using the Airport, or both.

While a full, detailed investigation of the relationship between Airport expansions and the growth of Airport activity is beyond the scope of the current work effort, a review of available data on major airports in the United States indicates that there are no cases of a major airport more than doubling its number of operations and enplanements and growing continuously over a period of 45 years without having major expansions in its "airside" and "landside" facilities. With Sea-Tac's last major facility expansion completed in 1975, this is the scenario assumed in the EIS.

Additionally, the forecast equations contained in P&D's *Final Forecast Report* are not compatible with the assumptions made in the EIS. P&D's primary domestic forecast equation says that Sea-Tac's domestic enplanements are positively related to personal income in the Puget Sound Region and negatively related to domestic airfares (page 5-6, *Final Forecast Report*). When personal income in the region goes up, domestic enplanements rise; when domestic fares go up (in constant value dollars), domestic enplanements fall. P&D's primary international forecast equation says Sea-Tac's international enplanements are positively related to gross state product in the 3-state area–also in constant value dollars (page 5-11). When the 3-states' gross state product rises, international enplanements rise. The importance of these equations is that the two variables positively related to enplanements at Sea-Tac are also measures of economic growth and business activity in the Puget Sound Region and the 3-state Pacific Northwest area. Hence the P&D forecasting equations state that when business activity declines, activity at the Airport falls.

There is widespread agreement that Sea-Tac is an important contributor to economic and business growth in the Puget Sound Region and the Pacific Northwest. The implication of this position however is that if the Third Runway (and related facilities) are not built, future economic growth and business activity will be adversely affected; gross state products and regional personal income will decline; and enplanements and operations at Sea-Tac will fall.

The problem with the EIS is that it assumes that even if the Airport is not expanded, there will be no fall in Airport activity. Since the EIS is based on P&D's *Master Plan Update Study*, it has to accept the equations on which the study's forecast is predicated. The EIS consequently assumes implicitly that expansion of the Airport has no influence on future economic conditions in the Puget Sound Region or the Pacific Northwest.

Again, the EIS's assumption is difficult to maintain. First, there is a professional/technical consensus that the growth/expansion of major airports is associated with the economic health of metropolitan regions, and this is true whether one argues that airports are causal or responsive to economic activity. Second, if the expansion of the Airport has no relationship to business activity - as reflected in either personal income or gross state product - what is the rationale for undertaking the major costs and disruptions that will be required. If the behavior of the business community does not change and the non-business traveling public flies the same amount with or without the Third Runway, as the EIS also assumes, why build it? The answer, clearly, is that the business community will be adversely affected, and that airlines may be forced to raise fares at Sea-Tac if they are confronted with the delays indicated in the P&D forecast and analysis; and that both of these consequences will cause enplanements and operations at Sea-Tac to decline. Which is to say, the EIS's assumption is methodologically flawed. As a result it is not compatible with either public statements made by the Port that link Sea-Tac to the region's and area's economic growth or the analysis of socio-economic impacts developed as part of the Sea-Tac Impact Mitigation Study.

The EIS says one thing while the *Update* study equations say another. The socio-economic analysis contained in the Sea-Tac Impact Mitigation Study takes the position that the forecasting equations contained in the P&D analysis are appropriate and the Airport is positively associated with the rate of economic growth in the Puget Sound Region and Pacific Northwest. This leads to the conclusion that if the Third Runway is not built, business activity will be adversely affected, personal income and gross state product will not grow as fast as otherwise, and enplanements and operations will be consequently reduced.

Whether looked at analytically or empirically, consequently, the probability that there will be no reduction in Sea-Tac activity levels whether or not the Third Runway, and related facilities, are built is so low that it cannot be taken seriously.

4.10 - SEA-TAC'S LIKELY CAPACITY LIMITS

Airport capacity and airport delay are closely related concepts. As discussed by the FAA in Advisory Circular 150/5060-5 (23 September 1983), *Airport Capacity and Delay*:

> *"As demand approaches capacity, individual aircraft delay is increased. Successive hourly demands exceeding the hourly capacity result in unacceptable delays. When the hourly demand is less than the hourly capacity, aircraft delays will still occur if the demand within a portion of the time interval exceeds the capacity during that interval. Because the magnitude and scheduling of user demand is relatively unconstrained, reductions in aircraft delay can best be achieved through airport improvements which increase capacity."*

The concept of Airport Capacity is usually defined in technical literature to be the maximum number of aircraft operations that can be accommodated at an airport in an hour.

An airport's Annual Service Volume (ASV) is an estimate of the number of operations the airport can accommodate in a year. At any airport, the ASV is a function of the runway-use configuration, percent arrivals, percent touch-and-go's, taxiways, airspace limitations, runway instrumentation, and weather conditions. Most of the analyses referred to earlier in this chapter use standard, FAA recommended modeling procedures to estimate Sea-Tac's ASV at approximately 380,000 operations.

Annual operation levels will be effected by year-to-year weather fluctuation, changes in air traffic control (ATC) procedures that affect airspace limitations, and other factors. As the ASV level after which airport improvements are required if future demand levels are to be accommodated, 380,000 operations is Sea-Tac's consensus threshold. As shown in Table 4.05, Sea-Tac is forecast to reach 379,200 operations in the Year 2000, effectively bumping up against its threshold ASV of 380,000 operations.

As shown in Table 4.05, Sea-Tac is forecast to increase aircraft operations by 62,400 (16.5%) after the Year 2000. Passenger enplanements are forecast to increase by 7,700,000 (67.5%) after the Year 2000. Cargo movements are forecast to increase by 370.0 metric tons (72.5%) after the Year 2000. These increases occur after Sea-Tac reaches its current ASV, and they occur because the Airport accommodates its forecasted demand levels by building the Third Runway, and related airport improvements. These activity levels will not occur at Sea-Tac without construction of the Third Runway, and related improvements. The consequences of the growth of operations, enplanements and cargo movements after Sea-Tac reaches its threshold ASV of 380,000 in the Year 2020, are the socio-economic impacts that require mitigation.

Table 4.05
Forecast of Operations, Enplanements and Cargo

Operation	1993 (actual)	2000	2010	2020
Aircraft Operations	**339,500**	**379,200**	**405,800**	**441,600**
Change in Aircraft Operations	---	+39,700	+26,600	+35,800
Cumulative Change	---	+39,700	+66,300	+102,100
Cumulative Change after 2000	---	---	+26,600	+62,400
Enplaned Passengers	**9,400,000**	**11,400,000**	**15,300,000**	**19,100,000**
Change in Enplaned Passengers	---	+2,000,000	+3,900,000	+3,800,000
Cumulative Change	---	+2,000,000	+5,900,000	+9,700,000
Cumulative Change after 2000	---	---	+3,900,000	+7,700,000
Air Cargo Tons (metric tons)	**381,000**	**510,000**	**680,000**	**880,000**
Change in Air Cargo Tons	---	+129,000	+170,000	+200,000
Cumulative Change	---	+129,000	+299,000	+499,000
Cumulative Change after 2000	---	---	+170,000	+370,000

(Source: P&D Aviation, 20 August 1994, Tables 5-8, 5-11 and 5-15)

SECTION 5

AIRPORT MITIGATION CASE STUDIES

SECTION 5
AIRPORT MITIGATION CASE STUDIES

5.01 - AIRPORTS WITHIN THE UNITED STATES

Airports across the United States have found it necessary to reduce or mitigate the impacts of their aircraft operations on surrounding residents and businesses. Airport mitigation is generally accomplished under the requirements of Federal Aviation Regulations (FAR) Advisory Circular Part 150 (commonly referred to as Part 150).

In order to determine the type of mitigation measures typically used, the mitigation programs of six US airports were analyzed studied. These airports were selected because of similarities with Sea-Tac International Airport's proposed project or as examples of the most recent mitigation programs. These selected case studies represent airports of varying size, location, and operations. All airports contacted had developed (or were developing) mitigation and remediation programs as a result of airport expansion projects. Telephone and in-person interviews were conducted with representatives of the following airports:

- **Colorado Springs International Airport (Colorado Springs, Colorado)** - Colorado Springs has experienced rapid recent growth as a result of the new Denver International Airport (DIA). Some of this growth at Colorado Springs has been attributed to higher landing fees at DIA. Also, it is now a longer trip to DIA (north of Denver) than it was to Denver's former international airport (Stapleton), so the Colorado Springs airport (south of Denver) has become more "geographically attractive". At the time of the telephone interview, Colorado Springs was in the process of developing a mitigation plan in support of a new runway project to meet this increasing demand.

- **Dallas/Fort Worth International Airport (Dallas, Texas)** - One of the largest and busiest airports in the world, DFW began operation in 1974. The land occupied by DFW is located between the cities of Dallas and Fort Worth. At the time DFW was initially designed, it was presumed that this site would be large enough to contain the ultimate airport build-out plan and all the accompanying impacts. As DFW continued to grow over the years, so too did the area surrounding the airport property. Today, DFW is surrounded by development. In the late 1980s, DFW began the process of developing a plan to add two new runways. Due to the amount of surrounding development, DFW had to develop a mitigation program for its four neighboring communities.

- **Lambert Field/St. Louis International Airport (St. Louis, Missouri)** - Lambert Field is an older urban airport which serves the St. Louis metropolitan area. It has an on-going mitigation and remediation program for its established neighboring communities, including Bridgeton (a low-income community).

- **Minneapolis/St. Paul International Airport (Minneapolis, Minnesota)** - Rather than build a new airport away from the city, the Minneapolis/St. Paul Airport is planning for the expansion of its existing facility. The Airport is located between the two cities (southeast of Minneapolis) and is surrounded by established communities, such as Richfield and Bloomington.

- **San Diego International Airport (San Diego, California)** - San Diego Airport is located in downtown San Diego along the shoreline of San Diego Bay. At 474 acres and with a single runway, it is the smallest airport that was studied. The area surrounding the airport is mostly non-residential and the arrival and departure paths bring aircraft at low altitudes over downtown and some residential areas. The cost of real estate and the expansion of the San Diego metropolitan area make siting a new airport impractical. According to Airport staff, the best option is to acquire approximately 500 acres adjacent to the Airport which is currently owned by the US Navy.

- **San Francisco International Airport (San Francisco, California)** - San Francisco Airport is an older facility, but it is located in San Francisco County and adjacent to San Francisco Bay. Consequently, much of the arrivals and departures are made over water. The area surrounding the Airport has developed with mostly industrial uses, with some residential areas located to the north and west. Because of the expense associated with a new airport and due to the fact that land in the San Francisco area is not available, improvements are being made to the existing facility.

Table 5.01 summarizes the general information on the airports studied.

Table 5.01
General Information on Case Study Airports

Information	Airport					
	Colorado Springs	**Dallas/ Fort Worth**	**San Diego**	**Saint Louis**	**Minneapolis/ St. Paul**	**San Francisco**
Size	7,200 acres	18,000 acres	474 acres	2,100 acres	3,100 acres	(a)
Annual Enplanements	2,500,000	57,000,000	13,000,000	(a)	27,000,000	(a)
Annual Operations	54,750	876,000	230,000	(a)	465,000	300,000
Airport Administered By	City of Colorado Springs	Dallas/ Fort Worth Airport Board	San Diego Unified Port District	City of St. Louis	Minnesota Airport Commission	Consolidated City/County of San Francisco
Cost of Mitigation Program	(a)	$150 million	$11 million (schools) $15 million (Phase 1)	(a)	(a)	(a)

(a) Information not available at time of survey

(Source: 1996 Airport Case Study Survey)

5.02 - AIRPORT/AIRCRAFT NOISE

Noise is the most common impact that is mitigated by US airports. However, how the noise impacts are measured and assessed are at the heart of an ongoing debate between airports and airport communities. Noise is typically generated by the following airport activities::

- By aircraft on either arrival or departure (departures are much louder than arrivals).
- By aircraft on the ground when backing away from the gate under their own power ("power-backs").
- By aircraft on the ground when performing engine maintenance tests which require powering up the engines to almost full thrust ("maintenance run-ups").

Noise is considered to be both an aviation and an environmental impact, so both the FAA and the United States Environmental Protection Agency (USEPA) define the means by which noise is measured. The standard noise descriptor mandated by these Federal agencies is the Day-Night Average Sound Level (LDN).

LDN provides a numerical description of the weighted 24-hour cumulative noise energy level using the A-weighted decibel scale over one year, with nighttime aircraft operations being weighted heavier than daytime operations. The LDN formula weighs aircraft operations during "daytime" operations (7:00 AM to 7:00 PM) at a 1-to-1 ratio. "Nighttime" operations (7:00 PM to 7:00 AM) are weighted at a 10-to-1 ratio.

Because LDN is often referred to as an "average" noise level, it is not an accurate representation of individual noise events for a specific location. This is the core of an ongoing debate between airport-area communities and airports regarding this method of noise measurement. Airport-area communities feel that Single-Event Noise Levels (SELs) are the more accurate representation of noise associated with airports. As of January 1997, neither FAA nor USEPA recognize SELs as the accepted means to measure airport noise.

Aircraft are classified by "stages" which has a direct correlation to their noise output:

- Old Stage 1 aircraft are no longer allowed to operate in the United States.
- Operation of Stage 2 aircraft will be prohibited in the United States by the Year 2000.
- Stage 3 aircraft will be allowed to operate in the United States beyond the Year 2000. Stage 2 aircraft that have been retrofitted with new engines - "hush kits" - which meet Stage 3 standards also will be allowed to operate.
- Establishment of a new Stage 4 standard is being considered, but it is anticipated that it will result in a minimal additional noise reduction (approximately 3 dBA).

US airports rely on FAR Part 150 to define how noise will be measured and mitigated. Part 150 is also the basis for FAA funding for noise mitigation programs. Airports that exceed the Part 150 requirements may be eligible for additional FAA funding (on a case-by-case basis) or may fund the mitigation programs from other sources.

5.03 - NOISE MITIGATION - PURCHASE/RELOCATION

Residential, business, school, church, and other properties that are identified to be within excessive noise areas are purchased outright by the airport. Residents and businesses are also eligible for relocation payments under the Uniform Relocation Assistance Act (US Department of Transportation, 49 CFR, Part 24). In these cases, the purchased area usually becomes part of the airport property and is restricted from future development/redevelopment.

A variation on the purchase/relocation program is some form of sales assistance. The airport will either act as a broker or as a third-party agent to foster the sale of a property where the airport will not take title. Assistance programs that maintain residential neighborhoods do not remove the area's incompatibility potential. In some cases, assistance programs can be used to assemble land to replat and redevelop former residential areas as airport-oriented non-residential uses.

DFW International Airport has developed the most comprehensive airport purchase program. Not only are homes within the 65 LDN contour purchased, but the purchase area is extended to encompass entire neighborhood areas, sometimes extending as far as the 62 LDN contour.

St. Louis has only purchased homes to the 70 LDN contour. The Minneapolis/St. Paul program is currently being developed, but will also likely purchase only to the 70 LDN contour.

The least comprehensive program is in San Francisco, where no homes are purchased. Residential areas are subjected to 70 and 75 LDN contours. Similarly, the areas surrounding San Diego's airport are non-residential and are not offered mitigation.

At the time of this report, Colorado Springs was evaluating the need for off-site noise mitigation, but no information was available from the airport.

5.04 - NOISE MITIGATION - SOUND INSULATION

Residential, business, school, church, and other properties that are identified - by the airport's interpretation - to be within noise areas that are not excessive enough to warrant purchase, are usually offered sound insulation programs.

These vary from airport to airport, but generally involve added attic insulation, triple-paned windows, and in some cases, central air conditioning. Sound insulation, however, does not adequately address mitigation of outdoor activities associated with homes, schools and parks.

In some cases, sound insulation of older, deteriorating homes can exceed that structure's value. When air conditioning is added, some residents, businesses, schools, or churches cannot afford the additional electric utility costs associated with keeping the system running.

Sound insulation is offered by all airports studied, but with variations in each program. For instance, DFW offered sound insulation to homes outside the 65 LDN "neighborhood" contour, in concert with an avigation easement (as discussed in Section 5.05).

St. Louis offers sound insulation as an option for homeowners in the 65 to 70 LDN contour (the other options being sales assistance or an avigation easement). In the poorer neighborhoods that surround St. Louis airport, the value of sound insulation exceeds the value of the structure. The airport considers sound insulation to be adequate compensation for the homeowner in these cases. San Francisco and Minneapolis have similar insulation programs for homes, businesses, schools and churches.

Title 21 of the California Noise Standards requires areas 65 CNEL and higher to be mitigated. CNEL (Community Noise Equivalent Levels) contours are very similar to LDN contours, except in the way aircraft operations are weighted (the LDN weighting approach described previously). The CNEL approach weighs operations in the following manner:

- 7:00 AM to 7:00 PM - 1-to-1 ratio.
- 7:00 PM to 10:00 PM - 3-to-1 ratio.
- 10:00 PM to 7:00 AM - 10-to-1 ratio.

The area surrounding San Diego's airport is mostly non-residential, but the airport has identified upwards of 750 homes that may require sound insulation under a Phase 1 mitigation program (still being developed). The airport has also almost completed an $11 million sound insulation of 6 schools.

Minneapolis offered sound insulation to area schools, but also required that the facilities stay in service for a specific period of time (20 years), so that improvements would not be made to an obsolete facility.

5.05 - NOISE MITIGATION - AVIGATION EASEMENTS

Residential, business, school, church, and other properties that are identified - by the airport's interpretation - to be impacted by aircraft activity also may be offered an "avigation easement". This instrument is similar to other property easements, except that it is permits passage through a property's air space, not on the ground like a utility easement.

Avigation easements are usually offered to property owners in exchange for a one-time payment and become a permanent attachment to the property deed. Payment may be a portion of the value of the property (sometimes as high as 25%) or may be offered in combination with a sound insulation program.

DFW once again had the most comprehensive avigation easement program. Easements were offered to homeowners in the 60 LDN contour at 25% of the fair market value of the home. However, DFW also learned that homeowners perceived the 25% payment as a beginning point for negotiation. Many turned down the easement in the hopes that a higher price would be offered (which was not).

DFW also acknowledged that the 25% payment was approximately equal to the reduction in property value as a result of aircraft activity. In theory, the avigation easement would give the owner of a $100,000 home a one-time cash payment of $25,000. The homeowner could then sell his/her home for as low as $75,000 and walk away from the transaction with no financial impact. The buyer would get a $100,000 home for a reasonable price and would be aware of the avigation easement at the time of purchase.

In other airports, the avigation easement was a requirement of accepting the sound insulation improvements. No cash payment was offered for the easement.

5.06 - PERMANENT NOISE MONITORING

All the airports studied had some form of permanent noise monitoring program in place. San Francisco conducts quarterly noise monitoring tests, while others monitor it continuously. The number and location of the monitors varies with each airport. St. Louis, for instance, has 13 permanent and 10 temporary noise monitoring stations. Minneapolis has 24 permanent noise monitoring stations and integrates the data with their geographic information system (GIS) data. San Diego has been providing permanent noise monitoring since 1974, and now has 24 permanent monitoring stations, also integrated with their GIS system.

5.07 - TRAFFIC/TRANSPORTATION MITIGATION

When an airport's capacity is enhanced, the number of enplanements and operations also increases. This has an associated increase in ground traffic headed to and from the airport. Most airports contacted do not offer any mitigation for off-site access and circulation. The exceptions were DFW and San Diego.

DFW has been working with the Texas Department of Transportation to construct and east/west connector highway which links two regional freeways (SH 161 and SH 360) with the airport's south entrance. San Diego will be building a new $28 million access roadway to improve airport access, but the new roadway will still connect with surface streets, rather than regional freeways.

5.08 - CONSTRUCTION MITIGATION

Except for the mitigation required as part of obtaining various permit approvals,. none of the airports contacted offered a mitigation program during project construction,. DFW was able to utilize dirt removed for construction of an adjacent freeway (SH 161) to build the new east runway. The remaining construction spoils were contained totally on-site. Given DFW's size (18,000 acres), construction traffic and staging was contained totally within airport property. DFW is also accessible from several major regional freeways, so there was no traffic impacts on the few local streets adjacent to the airport.

San Francisco, too, relies on regional freeways for its primary airport access. While these freeways are also heavily traveled by non-airport traffic, there is no capacity-enhancing project currently underway at the airport.

Minneapolis representatives stated that they had not yet assessed the potential construction impacts. They projected that most impacts would be traffic related (construction vehicles) and that the system of regional freeways accessing the airport would be satisfactory to handle the increase in traffic.

5.09 - COMMUNITY MITIGATION

Of the airports contacted, none offered any mitigation measures to reduce the impact on neighboring community facilities and services. Beyond sound insulation of structures, no measures were developed to mitigate impacts to parks, public safety services, the tax base, or other community facilities and services.

Absence of these measures, however, does not diminish their need. The St. Louis airport does have close-in residential and is experiencing compatibility problems which are yet to be resolved. (The other airports studied are not located in as urbanized a setting as Sea-Tac is. Airports in Colorado Springs, Dallas/Fort Worth, and San Franscisco are located away from population centers. San Diego's airport, while close to downtown, is surrounded by industrial and non-residential uses.)

5.10 - NOISE ABATEMENT PROCEDURES

All of the airports contacted have in place some formal noise abatement program which regulates the operation of aircraft on the ground and aloft during certain hours. Airports near lakes, bays, or other bodies of water commonly require a "water approach" for arrivals and departures.

Others restrict the use of Stage 2 aircraft during certain hours, or require those aircraft to follow arrival/departure corridors which fly over non-residential areas. The most restrictive nighttime procedures are at San Diego, which prohibits all departures, except for emergencies, between the hours of 11:30 PM and 6:30 AM. This includes cargo and passenger service.

5.11 - MAINTENANCE RUN-UPS

It is common to restrict or prohibit maintenance run-ups in the evening and early morning hours. St. Louis allows no more than a 2-minute run-up at 90% power. San Francisco minimizes, but does not prohibit run-ups. Minneapolis restricts aircraft operations between 11:00 PM and 6:00 AM to Stage 3 aircraft whenever possible, and prohibits maintenance run-up during these hours. San Diego will be phasing out Stage 2 aircraft by 1999 (one year earlier than required) and prohibits maintenance run-ups between the hours of 11:30 PM and 6:30 AM, with a restriction on departures also during that time.

5.12 - POWER BACKS

The way aircraft back away from the gate also can create noise. Aircraft can either back away from the gate under their own power - called "power backs" - or be pushed back using an airplane tug ("push backs"). Most airports now use push backs as a standard procedure. St. Louis even designed their aprons to slope slightly away from the gate to facilitate push backs.

San Diego and Minneapolis have no formal policy on power backs, but both say that push backs are more common.

5.13 - CASE STUDY SUMMARY

The airports contacted represent a cross-section of American airports in urbanized and urbanizing areas. They appear to "go by the book" when it comes to FAA-funded mitigation. Mitigation and remediation programs seem to be confined to noise abatement - through property acquisition, sales assistance, sound attenuation/insulation, avigation easements, and airport abatement procedures.

Most neighboring communities feel that the airports do not do enough to adequately compensate them for the "privilege" of having the airport as their neighbor. They routinely cite the inadequacy of LDN as a true measurement of noise impact, and promote the use of SEL contours instead.

Airport communities also have to live with reductions in the tax base, diminishing residential property values, increased traffic, and other community impacts, without any compensation or assistance from airports, the states, the FAA, the USEPA, or any other agency.

In summary, aside from noise, no other impacts were routinely mitigated at the case study airports.

Section 6

Washington State Mitigation case Studies

SECTION 6
WASHINGTON STATE MITIGATION CASE STUDIES

6.01 - WASHINGTON STATE EXPERIENCE

The State of Washington has demonstrated its desire to go beyond "traditional" mitigation measures as defined by Federally-funded programs. Several members of the consulting team, as well as staff from the City of Burien, have been involved in some of these projects.

For the purposes of comparison, the following case studies have been summarized:

- Puyallup Indian Tribe Land Claim
- Boeing/Everett Facility Expansion
- Satsop Power Plant Site Mitigation Plan
- IH-90 Freeway Improvement Project

Each case study exhibits mitigation that exceeds traditional physical remediation to include socio-economic and cultural mitigation.

6.02 - PUYALLUP INDIAN TRIBE LAND CLAIM

The Federal Government, the State of Washington, and various Pierce County local governments reached an agreement with the Puyallup Indian Tribe in August 1988 to relinquish tribal claims to land, tidelands, mineral claims, submerged lands, non-fisheries, and water rights. In return, the Tribe received 899 acres of land valued at $37.46 million, given on an "on-reservation" status.

The Tribe was also paid $24 million which was placed in an annuity fund. Each enrolled Tribe member 21 years old and older received a $20,000 cash payment. For remaining Tribe members under 21, a similar cash payment will be made upon their twenty-first birthday (by August 2009). Mitigation measures also included a $22 million trust fund to be used for housing, education and cultural preservation, supplemental health care, elderly care and day care centers, substance abuse, burial and cemetery maintenance. This trust fund would exist in perpetuity along with the Tribe.

The State and the Port of Tacoma jointly agreed to fund a $9.235 million fisheries enhancement program. The mitigation agreement required that the Tribe agree to specific projects to reduce conflicts between tribal fishing and commercial shipping. Job training was offered to 265 Tribe members, with 115 jobs offered in the private sector (valued at $2.5 million).

The agreement also granted $9.5 million to the Tribe for economic development of existing tribal lands, $2.0 million in business development funds for enterprises by Tribe members, and $2.5 million (the latter to be paid over a 20-year period) for the Tribe's participation in the Blair waterway project (widening and deepening of the channel to open it to foreign trade). In exchange, the Tribe agreed not to assert their taxation power for "non-trust" lands and to not exercise their authority over these lands and over "non-Indians" to protect the fisheries.

6.03 - BOEING/EVERETT FACILITY EXPANSION

This agreement involved the City of Everett, Washington and the Boeing Company which allows Boeing to expand their airplane manufacturing facility. The agreement was reached in September 1991, pursuant to the Washington State Environmental Protection Agency (SEPA) review and approval of the project.

The agreement lists specific Federal, State, and local requirements which Boeing must meet in order to mitigate identified impacts, including air, earth, surface water, plants, animals, wetlands, hazardous materials, and transportation. The Boeing expansion project would be denied if these conditions are not met. The agreement identified both on-site and off-site mitigation requirements.

On-site, Boeing must submit a revised site plan to the City of Everett which reflects the SEPA "decision document" and specifies construction requirements. Boeing must manage on-site environmentally-sensitive areas, landscaping, surface water, and transportation. The expansion project site was divided into five areas, with specific impacts and mitigation measures identified for each area.

Off-site, Boeing would provide $46.1 million for transportation mitigation, including purchasing 10 buses and 80 vans for ride-sharing purposes, and funding transportation system improvements and demand management strategies. Boeing would also fund a program ($3.9 million) to address company-related traffic through residential neighborhoods.

The project EIS projected that the expanded facility would attract 54,000 new workers to the area. Boeing agreed to invest $2.0 million in the "Local Initiative Support Coalition", seek new employees from the local impact area, and coordinate with local community colleges to develop vocational training in skills areas needed by Boeing. Boeing would also fund the necessary additions to the City's public safety personnel. At 1.9 firefighters and 1.4 security officers per 1,000 employees, that resulted in 102 new firefighters and 76 new security officers.

6.04 - SATSOP POWER PLANT SITE MITIGATION PLAN

This agreement involved the Washington Public Power Supply System (WPPSS) and the Washington State Department of Wildlife. involving proposed additions to the nuclear power plants operated by WPPSS. In return for project approval, WPPSS would replace and/or compensate for any fish and wildlife damage or loss resulting from the project. WPPSS also agreed to the State's measures to protect wildlife.

The agreement first required a habitat evaluation preservation analysis of the Satsop site, which determined the need for mitigation. The agreement ensured compliance, along with a site certification process.

Different areas on or near the construction site were identified which would require mitigation. In some cases, mitigation only consisted of preservation of the existing habitat. In other areas, mitigation involved limits to vehicular access, limits to thinning and tree removal, eliminating root rot, enhancing brush areas, maintenance of foraging fields, and preservation of ponds. The agreement also identified preservation zones in which no land management or wildlife enhancement activities would be conducted.

6.05 - IH-90 FREEWAY IMPROVEMENT PROJECT

An agreement between the Washington State Highway Commission ("Commission"), Metro, King County, and the cities of Seattle, Mercer Island and Bellevue was reached regarding proposed IH-90 improvements (between IH-405 and IH-5).

The Commission's design for IH-90 would incorporate all of the provisions for community amenities and for the reduction of adverse environmental impacts. The Commission agreed to participate with the City of Seattle in a planning study which addressed redevelopment of areas adjacent to the project. Additionally, the Commission would transfer fee title of all State-purchased lands (outside the project right-of-way) to the local jurisdictions at the lowest cost possible. IH-90 would be operated in a manner that encourages growth and development in King County's urban areas, but not in undeveloped areas. A review team was established to monitor the project and advise the Commission on the development of IH-90. The Commission would also become responsible for the design and construction of the portion of IH-90 that can be funded with Federal interstate funds, as well as the other parties responsible for the design and construction of the remaining facilities.

This agreement ended more than 20 years of dispute between the local cities and the Commission.

SECTION 7

POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION

SECTION 7
POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION

7.01 - INTRODUCTION

In evaluating the potential environmental impacts of the proposed Third Runway project, measures that were utilized in other airport and/or public facility projects have been employed for the five impacted communities being studied. The following impact measures were utilized in this study and are discussed in more detail below:

- **Noise and Vibration**
  - LDN (average day/night noise level)
  - SEL (single-event noise level)
  - Threshold analysis
  - Vibration

- **Air Quality**
  - Air emissions (aircraft)
  - Carbon monoxide air emissions (vehicles)
  - Hydrocarbon air emissions (vehicles)
  - Air toxics
  - Fugitive emissions (dust)
  - Point sources

- **Surface Water Quality and Hydrology**
  - Runoff volume
  - Erosion and sediment
  - Spills

- **Ground Water Quality and Hydrology**
  - Aquifer recharge
  - Contamination

- **Wetlands**
  - Wetland destruction

- **Floodplains**
  - Encroachment
  - Reduced flood storage capacity
  - Increased flow rates and volumes

- **Aesthetics and Visual**
  - Ground shadow
  - Visibility of aircraft
  - Visibility of fill

- **Other Environmental Mitigation**
  - Special status species and habitats
  - Cultural resources
  - Coastal zones
  - DOT Section 4(f) resources

Table 7.01
EIS Chapters Reviewed for Environmental Issues Mitigation Measures

Chapter	Section	Title
--	--	Executive Summary
III	--	Affected Environment
IV	2	Land Use
IV	7	Human Health
IV	9	Air Quality
IV	10	Water Quality and Hydrology
IV	11	Wetlands
IV	12	Floodplains
IV	19	Earth
IV	20	Solid Waste
IV	21	Hazardous Substances
IV	23	Construction Impacts
IV	24	Aesthetics and Urban Design
V	--	Probable, Unavoidable, Adverse Environmental Impacts and Mitigation Measures
Appendix C	--	Noise Impacts
Appendix D	--	Air Pollutant Methodology
Appendix N	--	Aesthetic Views and Photos
Appendix P	--	Natural Resource Mitigation Plan
Appendix Q	--	Water Studies
Appendix Q-A	--	Baseline Groundwater Study
Appendix Q-B	--	Preliminary Water Conservation Plan
Appendix Q-C	--	Concepts for Using a Constructed Aquifer to Manage Airport Stormwater
Appendix R	--	Responses to Public Comments

(Source: US Department of Transportation, Federal Aviation Administration, and Port of Seattle, February 1996)

The discussion of mitigation measures for the environmental issues includes construction and operation (post-construction) of the facilities associated with Master Plan Update implementation. The discussion follows the same format of the topics discussed in the Environmental Issues evaluation. Although some topics may not be impacted by construction or operation of the proposed facilities.

The mitigation measures evaluation includes some discussion of the proposed mitigation measures in the Final EIS for the Sea-Tac International Airport Master Plan Update. These mitigation measures were discussed in the EIS Chapters shown in Table 7.01.

7.02 - NOISE AND VIBRATION - LDN MITIGATION

As part of the EIS, aircraft noise effects were evaluated for the existing conditions. Master Plan Update implementation during construction will not impact aircraft noise levels which are a part of Airport operations. However, there may be an interaction between aircraft noise and construction activities. This area of concern was not addressed in the EIS. Therefore, as part of the mitigation measures for noise, this evaluation should be conducted by the Port of Seattle to determine potential impacts on the areas to the northwest, west and the southwest of the Airport during construction. This evaluation should be done using an appropriate computer model, taking into consideration the models that were used in the EIS.

Average noise contours (LDN) are computer-generated by a software program (the Integrated Noise Model) to represent the impact of air traffic at various years and/or service levels. Figure 7.01 shows the projected noise contours for the Airport's "preferred alternative" in the Year 2020 as included in the Airport's EIS.

Previous research by FAA has determined that exposure to certain noise contours is incompatible with certain types of land uses. Recent airport noise mitigation programs - such as the program in place at Dallas/Fort Worth International Airport developed by Landrum & Brown, Inc. - have shown the importance of mitigating entire residential neighborhoods, rather than individual structures. In the Dallas/Fort Worth program, entire neighborhoods were mitigated which fell within the 65 LDN contour. This resulted in mitigation of individual structures which were below the projected 65 LDN contour line.

Two types of mitigation measures were projected to address LDN noise impacts.

Acquisition and Redevelopment

For the area surrounding Sea-Tac International Airport, neighborhoods which were impacted by the Airport's projected 65 LDN contour were considered to be exposed to excessive noise impacts which result in the reduction of property values, quality of life, and stability of the neighborhood.

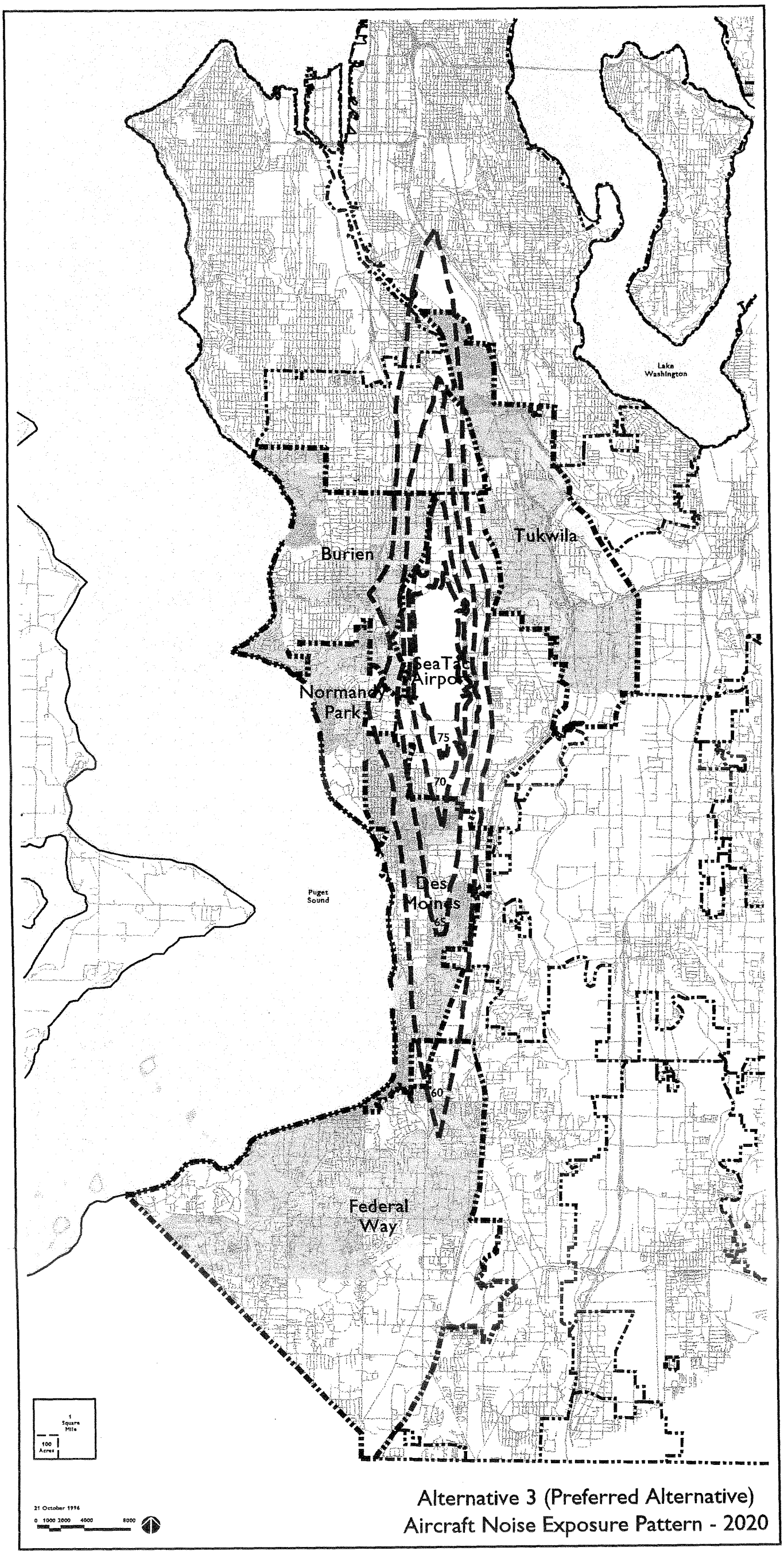
(A neighborhood which was one-third or more within the 65 LDN contour was considered to be impacted.) In those cases, this study recommends that these neighborhoods be considered candidates for redevelopment as non-residential uses. Costs involved with acquiring and redeveloping a neighborhood will involve residential and business acquisition and relocation costs in accordance with the Uniform Relocation Assistance Act (US DOT, 49 CFR, Part 24). Also included is the removal of structures, improvement of the utility infrastructure, and packaging and marketing the land for redevelopment. It is estimated that these costs will average $760,000 per acre, exclusive of additional on-site improvements.

Table 7.02 details the neighborhoods, Highline schools, and Highline Community Hospital facilities that have been identified as candidates for acquisition and redevelopment.

Table 7.02
Neighborhoods Identified for Acquisition and Redevelopment

City	Area	Amount
Burien	**Neighborhoods (1)**	
	Northeast neighborhood	$537.0 million
	Schools (3)	
	Cedarhurst Elementary School	$ to be determined
	Sunnydale Elementary School	$ to be determined
	Marine Tech Lab School	$ to be determined
Des Moines	**Neighborhoods (4)**	
	West Central neighborhood	$364.0 million
	North Central neighborhood	$183.2 million
	East Central neighborhood	$475.8 million
	South Des Moines neighborhood	$373.9 million
	Subtotal - Neighborhoods	**$1,396.9 million**
	Schools (3)	
	Midway Elementary School	$ to be determined
	Pacific Middle School	$ to be determined
	Mount Rainier High School	$ to be determined
Federal Way	No neighborhoods in Federal Way have been identified for acquisition and redevelopment.	
Normandy Park	No neighborhoods in Normandy Park have been identified for acquisition and redevelopment.	
Tukwila	No neighborhoods in Tukwila have been identified for acquisition and redevelopment.	
Other Highline School District Schools	**City of Seattle**	
	Southern Heights Elementary School	$ to be determined
	Unincorporated King County	
	Beverly Park Elementary School	$ to be determined
	Satellite Alternate High School	$ to be determined
Total Study Area		**$1,933.9 million (plus costs to be determined)**

Figure 7.01
LDN Noise Contours



While acquisition and redevelopment is the most far-reaching mitigation measure, this study acknowledges that it is also the most invasive of the mitigation measures studied. While it fully addresses land use incompatibility, it also has several serious repercussions:

- Acquisition and redevelopment removes existing neighborhoods and tax base.
- Viable redevelopment of acquisition areas may take several years.
- Acquisition and redevelopment is the most costly mitigation measure. A detailed land use inventory of each neighborhood need to be completed in order to develop more focused cost-estimates and projections.
- Acquisition and redevelopment is not in accordance with each City's comprehensive plan. Plans will have to be modified and revised if this mitigation measure is pursued.
- Acquisition and redevelopment as described above is based upon neighborhood boundaries identified by City representatives. Further study is required to determine if these are the most acceptable boundaries, or if "sub-neighborhoods" can be identified to minimize the need for complete redevelopment as shown.

It is recommended that the neighborhoods and schools identified in Table 7.02 be considered as "potential candidates" for acquisition and redevelopment. However, before any acquisition or redevelopment is initiated, a study should be conducted to further consider each neighborhood and school to determine if there are other less disruptive alternatives to acquisition and redevelopment. This study should be completed prior to construction of the Third Runway.

Sound Insulation and Avigation Easements

Neighborhoods where one-third or more of the area falls within the 60 to 65 LDN contour are subject to noise impacts that impact residents' ability to fully enjoy their properties, but does not threaten the stability of the neighborhood.

In these cases, this study recommends that these neighborhoods be considered candidates for sound abatement insulation and avigation easements. Costs will include attic and wall insulation, triple-glazed window systems, and air conditioning for older structures.

Avigation easements should be a function of property value. For example, Dallas/Fort Worth International Airport has offered avigation easements in the amount of 25% of the property value (value is figured as a comparable value unaffected by an airport).

It is estimated that these costs will average $37,500 per acre, and should vary according to density and age of development.

Table 7.03 details the neighborhoods, Highline schools, and Highline Community Hospital facilities that have been identified as candidates for acquisition and redevelopment.

Table 7.03
Neighborhoods Identified for LDN
Sound Insulation and Avigation Easements

City	Area	Amount
Burien	**Neighborhoods (4)**	
	East Central neighborhood	$23.4 million
	Southeast neighborhood	$10.0 million
	Gregory Heights neighborhood	$21.5 million
	Downtown neighborhood	$12.0 million
	Subtotal - Neighborhoods	**$66.9 million**
	Schools (7)	
	Gregory Heights Elementary School	$ to be determined
	Hazel Valley Elementary School	$ to be determined
	Salmon Creek Elementary School	$ to be determined
	Seahurst Elementary School	$ to be determined
	Shorewood Elementary School	$ to be determined
	Sylvester Middle School	$ to be determined
	Highline High School	$ to be determined
	Hospitals (1)	
	Highline Community Hospital	$ to be determined
Des Moines	**Neighborhoods (4)**	
	North Hill neighborhood	$23.4 million
	Zenith neighborhood	$20.6 million
	West Woodmont neighborhood	$16.1 million
	East Woodmont neighborhood	$11.5 million
	Subtotal - Neighborhoods	**$71.6 million**
	Schools (4)	
	Des Moines Elementary School	$ to be determined
	North Hill Elementary School	$ to be determined
	Olympic Elementary School	$ to be determined
	Parkside Elementary School	$ to be determined
Federal Way	**Neighborhoods (2)**	
	Star Lake neighborhood	$19.5 million
	Wildwood neighborhood	$20.7 million
	Subtotal - Neighborhoods	**$40.2 million**
Normandy Park	**Neighborhoods (1)**	
	East Central neighborhood	$3.4 million
	Schools (1)	
	Marvista Elementary School	$ to be determined
Tukwila	**Neighborhoods (1)**	
	M.I.C. neighborhood	$40.6 million

Table 7.03 (continued)

City	Area	Amount
Other Highline School District Schools	**City of SeaTac (7)**	
	Bow Lake Elementary School	$ to be determined
	Madrona Elementary School	$ to be determined
	McMicken Heights Elementary School	$ to be determined
	Valley View Elementary School	$ to be determined
	Chinook Middle School	$ to be determined
	Tyee High School	$ to be determined
	SeaTac Occupational Skills School	$ to be determined
	City of Seattle (5)	
	Hilltop Elementary School	$ to be determined
	Mount View Elementary School	$ to be determined
	Riverton Heights Elementary School	$ to be determined
	Cascade Middle School	$ to be determined
	Evergreen High School	$ to be determined
	Unincorporated King County (1)	
	White Center Heights Elem. School	$ to be determined
Total Study Area		**$222.7 million (plus costs to be determined)**

While insulation and avigation easements are less disruptive than acquisition and redevelopment, there is still the potential to change the character of the neighborhood.

It is recommended that the neighborhoods and schools identified in Table 7.03 be further studied to determine the full extent of the proposed insulation and easement program. This study should be completed prior to construction of the Third Runway.

7.03 - NOISE AND VIBRATION - SEL MITIGATION

Single-event noise levels (SEL's) are those associated with an individual aircraft, either on the ground or aloft. Airport neighbors across the country argue that this is a more appropriate measure of noise impact. Airports, the FAA, and USEPA counter with the fact that LDN is the only acceptable measure of noise. Rather than attempt to resolve this philosophical disagreement, this study will identify areas that are subject to SEL impacts and recommend mitigation measures that may or may not be implemented. In the Sea-Tac area, neighborhoods that are within the 400-foot topographic line and within 5 miles of the Airport are likely to experience SEL noise associated with ground and flight operations.

For these areas, the same sound abatement insulation and avigation easement program would be an appropriate response. In some cases, these neighborhoods will also be within 60, 65, or higher LDN contours, thus being eligible for other programs.

Table 7.04 identifies the neighborhoods and schools impacted by SEL noise.

Table 7.04
Neighborhoods Identified for SEL
Sound Insulation and Avigation Easements

City	Area	Amount
Burien	**Neighborhoods (2)**	
	North Central neighborhood	$18.3 million
	Central neighborhood	$5.8 million
	Total - Burien	**$24.1 million**
Des Moines	**Neighborhoods (2)**	
	Redondo neighborhood	$7.9 million
	Downtown neighborhood	$4.1 million
	Total - Des Moines	**$12.0 million**
Federal Way	No neighborhoods in Federal Way have been identified for SEL insulation and easements.	**$0.0 million**
Normandy Park	**Neighborhoods (2)**	
	Bonniewood neighborhood	$1.5 million
	North neighborhood	$13.0 million
	Total - Normandy Park	**$14.5 million**
Tukwila	**Neighborhoods (5)**	
	Allentown neighborhood	$13.0 million
	Cascade View neighborhood	$11.4 million
	Foster neighborhood	$18.2 million
	Thorndyke neighborhood	$15.7 million
	Riverton neighborhood	$10.3 million
	Total - Tukwila	**$68.6 million**
(No Highline School District or Highline Community Hospital facilities have been identified for SEL insulation and easements.)		
Total Study Area		**$119.2 million**

While insulation and avigation easements are less disruptive than acquisition and redevelopment, there is still the potential to change the character of the neighborhood.

It is recommended that the neighborhoods identified in Table 7.04 be further studied to determine the full extent of the proposed insulation and easement program. This study should be completed prior to construction of the Third Runway.

7.04 - NOISE AND VIBRATION - OVERFLIGHT MITIGATION

Neighborhoods that are subjected to direct overflights of arriving and departing aircraft often experience psycho-acoustic noise impacts (aircraft noise appears louder because the aircraft is visible). Departure operations are approximately three times as loud as arriving operations (depending on the specific aircraft), due to the different power requirements associated with climb-out. Figure 7.02 shows the projected arrival and departure flight-tracks that were included in the Airport's EIS.

Some neighborhoods impacted by overflights may already be mitigated by programs associated with LDN and SEL remediation. For those that are outside these areas, it is recommended that further sound abatement insulation and avigation easements be offered to the neighborhoods in question. An alternative method for mitigating these areas is for the flight tracks and arrival/departure procedures to be modified to avoid direct overflights of populated areas.

Table 7.05
Neighborhoods Identified for Overflight
Sound Insulation and Avigation Easements

City	Area	Amount
Burien	**Neighborhoods (1)**	
	Shorewood neighborhood	$22.5 million
	Total - Burien	**$22.5 million**
Des Moines	No neighborhoods in Des Moines have been identified for overflight insulation and easements.	**$0.0 million**

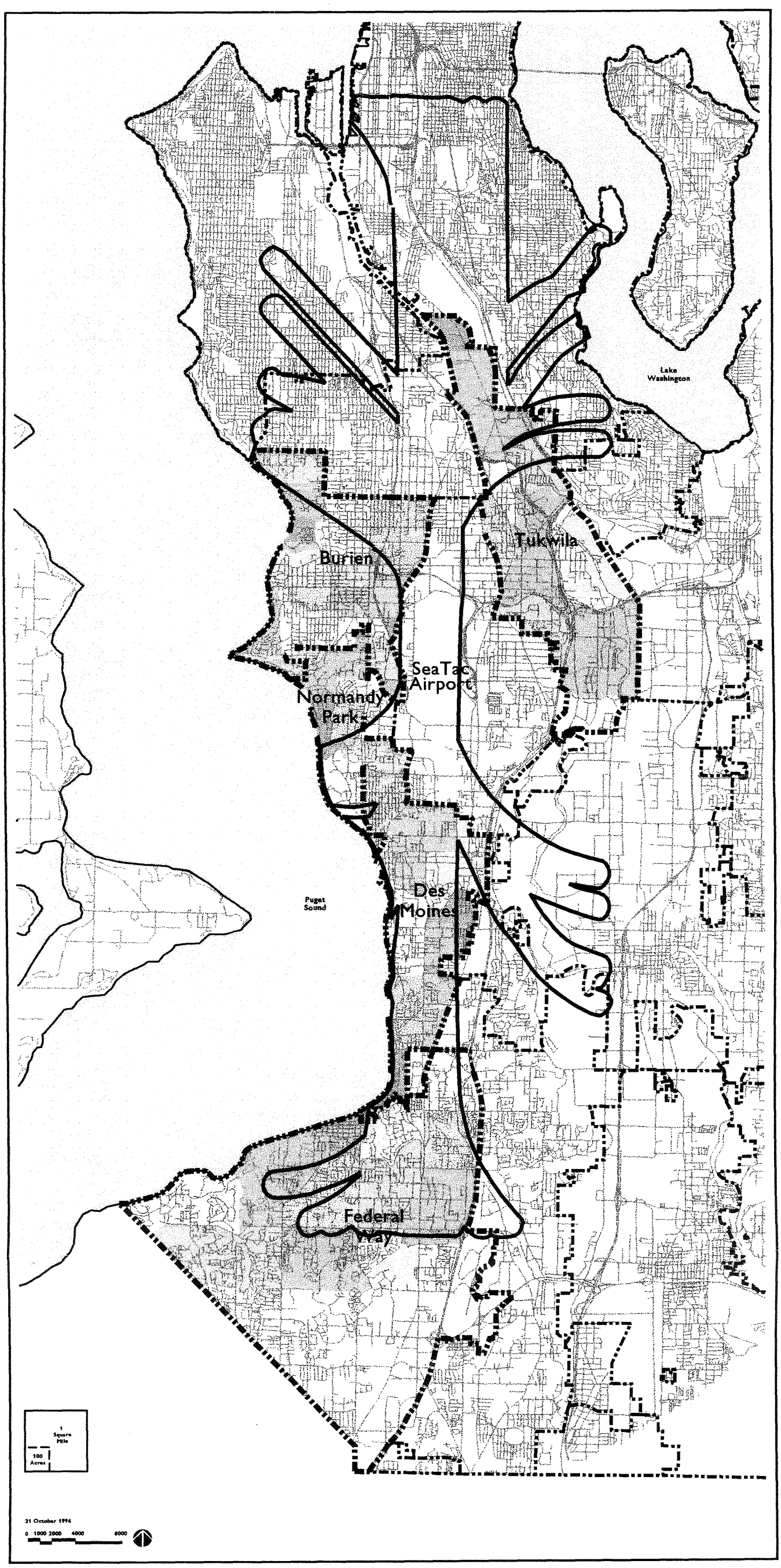
Table 7.05 (continued)

City	Area	Amount
Federal Way	**Neighborhoods (12)**	
	Marine Hills neighborhood	$19.8 million
	Easter Lake neighborhood	$27.3 million
	Steel Lake neighborhood	$13.0 million
	First Avenue neighborhood	$20.5 million
	Kitts Corner North neighborhood	$11.2 million
	City Center neighborhood	$16.1 million
	Mar-Cheri neighborhood	$0
	Dash Point neighborhood	$0
	Lakota neighborhood	$0
	Mirror Lake neighborhood	$0
	Twin Lakes neighborhood	$0
	West Campus neighborhood	$0
	Total - Federal Way	**$107.9 million**
Normandy Park	**Neighborhoods (5)**	
	Riviera neighborhood	$9.0 million
	East Central neighborhood	$9.3 million
	Normandy Province neighborhood	$1.5 million
	Arrow Lake neighborhood	$1.1 million
	South neighborhood	$17.0 million
	Total - Normandy Park	**$37.9 million**
Tukwila	**Neighborhoods (1)**	
	Ryan neighborhood	$4.3 million
	Total - Tukwila	**$4.3 million**
(No Highline School District or Highline Community Hospital facilities have been identified for overflight insulation and easements.)		
Total Study Area		**$172.6 million**

Table 7.05 identifies the neighborhoods and schools that are projected to be impacted by overflight noise as a result of the projected new flight tracks. Neighborhoods identified with a "$0" cost of mitigation are areas that will only require flight track modifications (not insulation and easements).

It is recommended that the neighborhoods identified in Table 7.05 be completely insulated and granted avigation easements as noted prior to operation of the Third Runway.

Figure 7.02
Future Flight Tracks



7.05 - NOISE AND VIBRATION - VIBRATION IMPACTS

In addition to noise, low frequency vibration can affect both individuals and structures. The EIS did not adequately address the projected impacts of noise-induced vibration on the neighborhoods within the study area. Further measurement and modeling will be necessary to adequately address vibration impacts. For neighborhoods that are within the 60 LDN, 65 LDN or higher, other mitigation programs will address vibration impacts. Neighborhoods identified as candidates for acquisition/redevelopment or insulation/easement will also be simultaneously be mitigated for vibration impacts.

The EIS did not provide information on potential impacts of vibration from construction activities. This may be particularly relevant for residences in the vicinity of the earthwork activities. This information should be provided by the Port of Seattle prior to the start of construction of activities associated with Master Plan Update implementation.

7.06 - NOISE AND VIBRATION - ADDITIONAL MITIGATION

Cumulative Construction Noise and Vibration Impacts

A number of other projects are proposed for the Sea-Tac International Airport area. These projects may occur at the same time as Master Plan Update implementation. The EIS had a cursory evaluation of potential construction noise cumulative impacts. A more detailed noise cumulative impacts discussion should be provided by the Port of Seattle prior to the start of construction associated with Master Plan Update implementation. The discussion should include all known proposed projects for the Airport area and projects which could interact with the fill haul routes. Also, this should include appropriate modeling.

Aircraft Noise and Vibration Impacts (Operation)

- **Run Latest Version of INM** - Version 5.1 of the INM was released in late 1996. This is a Windows '95-based version and will has at least the following enhancements: ability to plot noise contours on a street map; and an expanded data base of aircraft including the Boeing 777 and MD90. At the time the EIS was done, noise data for a Boeing 767-200 with JJ-9-D was substituted for the Boeing 777 aircraft.

Because of at least the greater accuracy of the INM, Version 5.1; the ability to plot noise contours on a street map; and the expanded base of aircraft information, the noise model should be rerun by the Port of Seattle using this new version. This will allow confirmation of the data from INM, Version 4.11 and the most up-to-date information available on the newer aircraft noise characteristics.

- **SEL Data** - The EIS noise study did not have an extensive evaluation of sound exposure level (SEL). The INM was used to show the SEL contours for one approach to Runway 16R and one departure from Runway 16L for five aircraft types which dominate the current and future fleet mixes at the Airport. This information should be developed by the Port of Seattle prior to Master Plan Update implementation and should include the SEL contours relationship to health problems, in particular, sleep and speech interference. Thus, this should be done concurrent with re-evaluating the noise data using INM, Version 5.1.

- **55 LDN Contour** - The EIS for the Flight Plan Project (Puget Sound Regional Council and Port of Seattle, October 1992), included noise assessment information associated with the 55 LDN level and a SEL of 80 dBA. This SEL was selected because it is often used to supplement the LDN analysis and 80 dBA corresponds to the level at which sleep disturbance and speech interference start to occur. Similar information should be developed prior to Master Plan Update implementation by the Port of Seattle.

- **Permanent Noise Monitoring** - Currently there are eleven noise monitoring stations. The Port of Seattle is upgrading the noise monitoring system to approximately twenty-five stations. Some of these monitoring stations should be located along the EIS predicted noise contours and consideration should be given to the need for additional stations if the twenty-five stations are deemed inadequate.

- **Arrivals Only** - The need for the proposed Third Runway is based on flight delays during inclement weather for arrivals. Therefore, the Third Runway should be used only for landings. This will help control noise levels associated with departures.

- **Runway Use Restriction** - There should be no arrivals on the Third Runway, except for emergencies, between 9:00 PM and 7:00 AM.

- **Additional Reviews** - As part of all FAR Part 150 reviews, a working group/oversight commission should be allowed to participate with the FAA and other parties. Near-term reviews should include at least the following:

  - An evaluation of the actions needed to apply, monitor and enforce the North Flow Daytime Departure Duwamish/Elliott Bay Noise Abatement Procedures specified in the 1990 Noise Mediation Agreement. Investigate, and if possible, implement the use of this corridor during periods of lighter activity such as midmorning and mid-afternoon.

  - An evaluation of the feasibility of extending the "nighttime" hours of use for the North Flow Nighttime Departure Noise Abatement Procedures from 10:00 PM to 6:00 AM to the evening "shoulder" of 8:00 PM to 10:00 PM, and to the early morning "shoulder" of 6:00 AM to 7:00 AM.

- A re-evaluation of the use of "minimum population exposure" flight tracks, in light of the increase in flight operations and the shift in the overall importance of arrival noise as Stage 2 aircraft are phased out.

- An evaluation of the potential net benefits of preferential runway use during "low activity" periods (e.g., would more use of the east runway result in reduced overall population noise exposure?), coupled with an expanded residential insulation and acquisition program, as needed.

- An evaluation of types of land uses and their compatibility with Airport operations in all areas affected by noise should be conducted based on noise contours at the 55, 60, 65, 70 and 75 LDN.

• **Additional Threshold Data** - The EIS also did not provide detailed information about the threshold above (TA) noise metric with respect to sensitive noise receptors such as schools, hospitals, etc. This information should be developed by the Port of Seattle as part of the re-evaluation of the noise data using the INM, Version 5.1.

• **Engine Run-Ups** - Permanent and/or portable "hush houses" should be used in conjunction with engine maintenance activities, in particular run-ups.

• **Noise Abatement** - The Port of Seattle should continue the following aircraft noise reduction/abatement programs including:

- *Noise Budget Program* - The Airport will move toward an all Stage 3 aircraft fleet by limiting the amount of noise airlines are allowed to make each year; the goal agreed to in the Noise Mediation Agreement (Port of Seattle and Mestre Greve Associates, 31 March 1990) is to reduce noise by the Year 2001.

- *Nighttime Limitations Program* - This program involves phasing out Stage 2 aircraft during nighttime hours; effective 1 October 1995, Stage 2 jet aircraft may not operate between 10:00 PM and 7:00 AM unless granted an exemption or variance (e.g., delays due to weather, air traffic control delays, etc.).

- *Ground Noise Control Program* - Aircraft are not allowed to back away from gates using engine power, instead they must be pushed away by "tugs". Run-ups during the daytime are allowed only at designated locations on the north and south ends of the Airport (aircraft must face into the wind so that jet blast is directed back across the airfield); between 10:00 PM and 7:00 AM. Run-ups are allowed only under special circumstances such as for a departure.

- *Overflight Noise Abatement Procedures* - Initial "straight-out" departure corridors are in a narrow flight path; Duwamish/Elliott Bay corridor for arriving and departing flights keep aircraft over water and industrial areas as much as possible; nighttime procedures to keep flights over Puget Sound waters as much as possible.

- *Flight Path Monitoring* - The Airport's Noise Abatement Office monitors jet flights in the noise abatement corridors.

- *Noise Monitoring* - Eleven station permanent noise monitoring system to record noise exposure levels in the Airport area should be used until the system has been expanded to at least 25 stations.

- *24-Hour Noise Information Line* - Provides information on noise issues or accepts noise complaints.

- **Nighttime Noise Budget** - In Appendix R of the EIS, it is indicated that the nighttime noise budget and limitations program is designed to address noise issues associated with aircraft categorized as having FAR Part 36 Stage 2 noise levels. Therefore, the program will expire with the completion of the scheduled phase out of these aircraft between 2000 and 2003. These two components are an integral part of the aircraft noise reduction/abatement programs and the Port of Seattle should continue the implementation of the nighttime limitations program beyond the Stage 2 phase out schedule. Depending on the status of the nighttime noise budget program in relation to Stage 3 aircraft, this program also should be continually evaluated and updated based on the different stages of aircraft.

- **Re-Run INM for Run-Ups** - INM Version 4.11 has the capability to compute noise levels due to airplane engine run-up operations. This is particularly useful for noise information around airplane maintenance facilities. Because concern has been expressed about noise levels associated with existing run-up and maintenance operations, and the proposed south aviation support area activities, a discussion of this feature and data for the Sea-Tac International Airport should be provided by the Port of Seattle for both the existing and uture conditions.

- **INM Parameters** - A number of assumptions must be made which can affect the outcome of the INM. Sensitivity tests can be used to evaluate how much change in a key input value or assumption might affect the outcome. A similar approach would be useful in evaluating the assumptions used in the future noise modeling and the resultant data in the EIS. Thus, sensitivity tests should be conducted and evaluated by the Port of Seattle.

  Also, if possible, information on the range and standard deviations of the LDN and other data in the EIS should be presented. The range and standard deviations of the data could provide an indication of potential impacts beyond the noise contours shown in the EIS.

- **Noise Mediation Agreement** - The noise mediation agreement (Port of Seattle and Mestre Greve Associates, 31 March 1990) indicates that as technology with noise barriers develops, the Port of Seattle will evaluate their use. It is not clear if during the future conditions evaluation the use of noise barriers was included. This may be particularly useful in the vicinity of any new maintenance facilities in addition to the use of "hushing" equipment. Appendix R of the EIS also mentions the use of vegetation to help reduce noise. The EIS indicates in Chapter 1 that as part of the Master Plan Update objectives, Airport noise is to be attenuated through the use of berms and barriers (Port of Seattle, May 1994).

The Port of Seattle should provide information on the status of using noise barriers at Sea-Tac International Airport and if this was included in the EIS noise modeling.

- **Amend the Four-Post Plan** - The Port of Seattle should provide information on amending the FAA Four-Post Plan in order to minimize low-altitude overflights of residential areas as discussed in the Flight Plan Project EIS (Puget Sound Regional Council and Port of Seattle, October 1992).

- **New Technologies** - The Port of Seattle should provide information on the status of implementing new technologies such as Microwave Landing System (MLS) and Global Positioning Satellite System (GPS) as part of potentially reducing noise impacts to areas around the Airport.

- **Aircraft Operations** - Appendix C Noise impacts in the EIS indicates that existing aircraft operations were based on average daily operations. It is not completely clear how many operations per hour this equates to. The air quality analysis used an aircraft peak hour activity level of about 88 operations (43.9 arrivals and 43.9 departures). The relationship, if any, between the noise and air quality aircraft operations or activity levels should be explained better by the Port of Seattle taking into consideration the noise and air quality analyses used the August and June 1994 Official Airline Guide (OAG), respectively. Also, the discussion should include comments on the Airport being able to accommodate 60 arrivals per hour which was recently mentioned by the Port of Seattle (26 March 1996; 1 August 1996).

- **Reduced Noise Levels** - The Port of Seattle should provide information on the ability to maintain the Airport's reduced noise level goals. This discussion is particularly relevant because of the recent concerns about the Port not sufficiently reducing on-the-ground noise impacts by 1 April 1996 (Puget Sound Regional Council, 27 March 1996).

- **Low Frequency Noise and Vibration** - The Port of Seattle should investigate methods and provide a report for mitigating low frequency noise and vibration.

Run-Up, Departure Roll, Thrust Reverse, Taxi, Idle and Auxiliary Power Noise

Sea-Tac International Airport's Ground Noise Study Phase II (Mestre Greve Associates, 20 February 1994) provided information on findings concerning noise impacts from aircraft engine run-up, departure roll, thrust reverse, taxi, idle and auxiliary power. In addition, recommendations on these areas were made. However, more information should be provided by the Port of Seattle on the below listed recommendations in order to evaluate their status and the need for additional studies/measures to help reduce Airport noise impacts.

- **Run-Up Mitigation** - The use of monitoring data to identify aircraft run-up noise including placing monitoring stations near run-up locations and sending the noise data to the noise office for recording. Documentation of the number and type of run-ups and what role they play in the total ground noise impact. Information on technological advances in run-up noise control facilities and their implementation at the Airport.

- **Departure Roll Noise Mitigation** - Information on the status of limiting operations of Stage 2 aircraft and their complete elimination during nighttime operations. Documentation that the noise insulation program takes into consideration mitigation of noise at lower frequencies to account for the lower frequency of Stage 3 aircraft.

- **Thrust Reverser Noise Mitigation** - Results of a taxiway use study; the development of a new taxiway system at the Airport; and a nighttime taxiway use plan to help reduce thrust reverser noise. Results of the Port of Seattle working with airlines to implement procedures that take advantage of the additional stopping distance to minimize the use of thrust reversers during the nighttime hours.

- **Taxi and Idle Noise Mitigation** - Measures to minimize the number of aircraft queuing at the runway ends during peak activity time periods (e.g., gate hold procedures and capacity enhancement measures). Use of a location at the north/south ends of the Airport for conducting pre-departure engine run-up so that noise is directed towards the buy-out areas, in particular at night. Study of various runway and taxiway designs on aircraft queuing and the resulting taxi and idle noise. Feasibility of constructing a noise berm at the west boundary of the Airport near the runway ends in order to help mitigate taxi and idle noise at the runway ends.

- **Auxiliary Power Noise Mitigation** - Steps to install fixed power at gates, etc., to minimize the use of auxiliary power, in particular during the nighttime hours. Installation of fixed power systems that include preconditioned air. Identification of the source of long duration steady state noise in the north cargo area and its mitigation.

On-The-Ground Reduction of Nighttime Noise Impacts

- **North Flow Noise Abatement** - The Port of Seattle and Federal Aviation Administration should more aggressively enforce compliance with the North Flow Nighttime Departure Noise Abatement Procedures and provide evidence of this enforcement (e.g., copies of notices of violations to airlines).

- **Nighttime Restrictions** - The Port of Seattle should provide evidence of the continuing effort to minimize flights between 10:00 PM and 6:00 AM.

- **Limit Nighttime Variances** - The Port of Seattle should provide evidence of its efforts to minimize the number of variances issued for the Nighttime Limitations Program.

- **Stage 2 Aircraft** - The Port of Seattle should provide evidence of its working with owners/operators of Stage 2 aircraft (including those under 75,000 pounds) which are currently exempt from the Nighttime Limitations Program, to obtain their cooperation in minimizing or eliminating the use of these aircraft between 9:00 PM and 7:00 AM.

- **Stage 3 Aircraft** - The Port of Seattle should provide evidence of its efforts to ensure the use of Stage 3 aircraft by airlines, in particular foreign airlines.

- **Engine Run-Ups** - The Port of Seattle should provide evidence of its continuing to work with airlines to minimize nighttime engine run-up. This should include the use of hush houses.

Vibration

The EIS vibration analysis should be expanded by the Port of Seattle to include qualitative and quantitative information on at least the following items for residences, schools and hospitals in the Airport area - human whole body vibration, annoyance and interference to humans caused by building vibration, and building structural damage.

With respect to humans, the evaluation should look at impacts on working efficiency, health, safety and comfort. The evaluation should incorporate the information and methodology discussed by the International Organization for Standardization (ISO; International Organization for Standardization, 1985a and b; 1989).

Cumulative Impacts

Other area projects which may be in operation concurrent with Master Plan Update implementation were only briefly discussed in the EIS noise analysis. In order to more adequately address the relationship between these projects and the activities associated with Master Plan Update implementation, the cumulative impacts discussion should be re-evaluated by the Port of Seattle. This should include appropriate modeling. The evaluation also should include all known proposed projects in the Airport area.

7.07 - AIR QUALITY - AIRCRAFT EMISSIONS MITIGATION

Increased air emissions as a result of increased aircraft activity have not been adequately addressed in the Airport's EIS. The EIS showed air sample data from monitors located 5 miles away from the Airport. With prevailing winds and aircraft altitude, aircraft emissions pose a regional problem. **Indeed, the potential for air quality impacts exists in every neighborhood in the five impacted communities**.

To mitigate the impacts of aircraft emissions, a runway utilization program should be developed by the Airport to minimize on-ground operations and queuing for departures and for arrival gates. Acceleration of the introduction of Stage 3 aircraft (which are more fuel efficient and less polluting) will also positively effect air emissions.

Acceleration of Stage 3 aircraft is already being initiated by many airlines. This mitigation measure, therefore, has no costs associated with it that are attributable to the Port of Seattle or any public agency.

7.08 - AIR QUALITY - VEHICULAR CARBON MONOXIDE MITIGATION

Increased activity at Sea-Tac will result in increased vehicle-trips. This increased traffic has the potential to overload existing road-ways and intersections. Additional traffic demand studies will be necessary to allocate traffic to specific "magnets" (such as the Airport).

Intersection improvements may run $500,000 per intersection, plus $100,000 per city for traffic improvement studies. However, additional improvements to be made to reduce traffic noise (see Section 8) will also positively impact intersections and traffic-flow.

Therefore, to avoid "double-counting", all intersections identified in Section 8 for improvements associated with traffic noise improvements will simultaneously improve carbon monoxide "hot spots".

7.09 - AIR QUALITY - VEHICULAR HYDROCARBON MITIGATION

Increased activity at Sea-Tac will result in increased vehicle-trips. This increased traffic has the potential to increase hydrocarbon emissions, associated with high-volume, high-speed traffic. Additional traffic demand studies will be necessary to allocate traffic to specific "magnets" (such as the Airport). However, many traffic-related problems may be already resolved by improvements designed to address traffic noise/LEQ impacts (see Section 8). Therefore, to prevent "double-counting", all intersections identified in Section 8 for improvements associated with traffic noise improvements will simultaneously improve traffic-flow and hydrocarbon impacts.

7.10 - AIR QUALITY - AIR TOXICS MITIGATION

Neighborhoods located under or near flight tracks (Figure 7.02) may also experience pollution by air toxics associated with aircraft. With the exception of neighborhoods that are redeveloped, most of these areas cannot be protected from these impacts. The modification of flight tracks and acceleration of Stage 3 aircraft use will help to reduce the potential for these impacts.

As stated in Section 7.07, the introduction of newer, cleaner Stage 3 aircraft, combined with flight track modifications, will have the most positive impact in the study area. These improvements are either currently being made (as in the case of acquisition of new aircraft by airlines) or can be accommodated for virtually no cost (flight track modifications). However, this study also recommends a long-term investigation into the effects of air toxics on human health.

7.11 - AIR QUALITY - FUGITIVE EMISSIONS MITIGATION

Dust associated with the construction of the Third Runway will impact neighborhoods that are adjacent to the north, south, and west sides of the Airport., specifically:

- **Burien** - North East, East Central, and South East neighborhoods.
- **Des Moines** - North Hill, West Central, North Central, and East Central neighborhoods.

It is recommended that a Dust Control Plan be included in the contractor's permit to address these impacts. Measures should include wetting down of the construction area, wetting down and covering stockpiled fill material, and covering of haul trucks on and off-site. The requirement of a Dust Control Plan should be satisfied prior to construction of the Third Runway.

7.12 - AIR QUALITY - POINT SOURCE MITIGATION

On-Airport pollution associated with both the construction and operation of the Third Runway will impact neighborhoods that are adjacent to the north, south, and west sides of the Airport., specifically:

- **Burien** - North East, East Central, and South East neighborhoods.
- **Des Moines** - North Hill, West Central, North Central, and East Central neighborhoods.

Individual on-Airport sites may contribute to air pollution and has the potential to impact neighborhoods that are north, south, and west of the Airport. Fueling operations associated with aircraft, rental cars, and other motor pools should include vapor recovery systems and the use of oxygenated or alternative fuels (as appropriate). On-Airport pollution control equipment and air quality monitors should be installed as part of the rebuilding of Sea-Tac Airport.

7.13 - AIR QUALITY - ADDITIONAL MITIGATION

Re-Analysis

Once the sources of fill material are known and the haul routes have been identified and approved, the construction vehicle air quality analysis should be re-evaluated and the dispersion analysis should be re-done in order to better predict potential air quality impacts prior to the start of construction. The analysis should extend from the Airport area to the fill source areas.

Particulate Matter

As part of the re-evaluation of the construction vehicle air quality analysis, the Port of Seattle should work with appropriate regulatory agencies to obtain PM_{10} data which is more representative of the Puget Sound Region. This should entail the establishment of additional air quality monitoring stations, in particular in the vicinity of the Airport.

Air Quality Monitoring

As part of construction activities, PM_{10} and CO should be monitored in the vicinity of the fill sources, along the haul routes and in the Airport construction area.

Fugitive Dust

During construction at least the following measures should be used to reduce fugitive dust emissions:

- Appropriate materials should be applied at the source fill areas and Airport construction areas to control fugitive dust emissions; if chemicals are used, Material Safety Data Sheets (MSDS) should be provided which show that the materials have a low adverse risk to humans and the environment.

- To reduce soil deposits on roads and subsequent fugitive dust, the Port of Seattle should implement procedures for minimizing tracking of soil on area roads at all construction areas including the source fill areas.

- The Port of Seattle should use gravel, paving and revegetation as appropriate to control fugitive emissions during construction.

Other Construction Requirements

- <u>Covered Trucks</u> - The Port of Seattle should ensure that all trucks hauling fill material should be covered to control fugitive dust emissions.

- **Emissions Control Devices** - All construction equipment should have appropriate emissions control devices and should comply with the vehicle inspection program.

- **Vehicle Maintenance** - All construction equipment should be well maintained to reduce emissions.

- **Vehicle Idling** - All construction vehicles should avoid prolonged periods of vehicle idling.

- **Batch Plants** - If concrete batch plants are used during construction, the Port of Seattle should provide documentation of their compliance with appropriate regulatory requirements.

- **Additional Study** - The Port of Seattle should provide a more detailed evaluation of cumulative impacts on air quality of construction associated with Master Plan Update implementation and other known proposed projects in the Airport area.

Air Quality Mitigation (Operation)

- **Clean Air Act Conformity** - The Port of Seattle should provide information on Master Plan Update implementation Clean Air Act Conformity. This should include at least the following - a copy of draft analysis/plan for review and comment; a copy of draft final analysis/plan for review and comment; and copies of the EPA, PSAPCA, DOE and any other approvals for the conformity analysis/plan.

- **Certification of Compliance with Air Quality Standards** - The Port of Seattle should provide at least the following information on the State of Washington's Certification of Compliance with Air Quality Standards - copy for review of documentation submitted to the Governor's Office and a copy of Governor's Air Quality Certificate.

- **Additional Air Monitoring** - The closest DOE and PSAPCA monitoring sites are approximately 5 miles from the Airport; there are no monitoring sites west, northwest and southwest of the Airport; CO and PM_{10}, are the most frequently monitored parameters; in order to make monitoring information such as this more useful; permanent monitoring stations should be established in and around the Airport area. Parameters monitored should include the AAQS parameters as well as toxic pollutants of concern such as 1,3 - butadiene, formaldehyde and benzene; quarterly monitoring reports should be provided which discusses the monitoring data with respect to AAQS and State of Washington ASILs.

- **Location of Air Monitors** - Air quality monitoring stations should be located in areas which have historically had complaints, even though the EIS screening analysis did not show violations of AAQS.

- **Area Dispersion Analysis** - After one year of baseline data has been collected at the new air quality monitoring sites, the area dispersion analysis should be re-evaluated by the Port of Seattle for both the existing and future conditions.

- **Mobile Sources** - The Port of Seattle should re-evaluate the existing and future roadway intersection analysis to confirm the accuracy of the evaluation in the EIS and to correct for the following inconsistencies discussed by EPA (6 June 1996):

  "The modeling results for air quality in the Sea-Tac International Airport Final EIS conflict with those from the draft EIS for the SR 509/South Access Road Corridor Project at two intersections (both EISs used the same models). The two EIS's model conflicting results for existing conditions and future action alternatives at South 188th and International Boulevard, and South 200th and International Boulevard for the average CO concentrations indicated on page 4-7 in the SR 509 EIS, as compared with the same analyses on page IV.9-11H in the Sea-Tac International Airport Final EIS. Both analyses model CO violations for existing conditions, but for future action alternatives the Sea-Tac International Airport analysis shows modeled CO violations where the SR 509 analysis does not."

  "Modeled air quality impacts at South 200th and International Boulevard are shown in the South Aviation Support Area Final EIS (pages 4-106 to 109 and 112), the 28/24th Street Arterial Final EIS (page 3.22) and the CTI Final EIS (page 4-7, 8). The results vary for each project ranging from 5.0 to 13.3 parts per million CO."

- **Port Vehicles** - All Port of Seattle and vehicles associated with Airport operations should comply with required vehicle emissions inspections and maintenance programs.

- **Air Toxics** - The Port of Seattle should provide information on the following or conduct the indicated studies related to air toxics:

  - Long-term air toxics data should be collected in the Airport area throughout different months of the year.

  - The Port of Seattle should conduct an evaluation of health problems in addition to cancer, in the Airport area; the study should include schools, hospitals, nursing homes and residences.

  - The Port of Seattle should conduct a study to determine the nature and extent of fuel odor problems in the Airport area; the study should include an evaluation of increased odors during inclement weather.

  - The Port of Seattle should collect appropriate data in order for a cancer risk assessment to be conducted in the Airport area.

  - The Port of Seattle should provide information on vapor recovery and regulatory compliance for all facilities associated with Airport operations including rental car and airline operations.

- **Queuing and Taxiing** - The Port of Seattle should conduct a study to determine if it is possible to reduce aircraft emissions by improving Airport operations associated with queuing and taxiing.

- **Master Plan Update** - As Master Plan Update implementation proceeds, the air dispersion and roadway traffic analysis should be re-evaluated by the Port of Seattle in order to accurately monitor potential impacts.

Cumulative Impacts

The EIS contained a brief discussion of cumulative impacts associated with air quality issues. The Port of Seattle should provide a more detailed evaluation of cumulative impacts on air quality and should include the known projects planned for the Airport area during operation of the Master Plan Update activities.

7.14 - SURFACE WATER QUALITY AND HYDROLOGY - RUNOFF VOLUME MITIGATION

Upstream development will decrease the amount of permeable surface available to absorb stormwater runoff, thus increasing the runoff coefficient. A stormwater management plan will be necessary to avoid inundating downstream properties (retention or detention ponds may be a component of such a plan). Neighborhoods that have a stream, creek or river that conveys water from or through the Airport may be affected by the Third Runway.

Additional runoff volume may result from a decrease in permeable surface within the drainage-shed. Further studies should be conducted to determine the specific "floodprone" areas. Figure 7.03 shows the streams and creeks in the study area. Table 7.06 identifies the neighborhoods which are prone to stormwater runoff impacts.

Table 7.06
Neighborhoods Identified for Stormwater Runoff Mitigation

City	Area	Amount
Burien	**Neighborhoods (4)**	
	North East neighborhood	$ to be determined
	East Central neighborhood	$ to be determined
	Gregory Heights neighborhood	$ to be determined
	South East neighborhood	$ to be determined
Des Moines	**Neighborhoods (3)**	
	North Hill neighborhood	$ to be determined
	West Central neighborhood	$ to be determined
	Downtown neighborhood	$ to be determined
Federal Way	No neighborhoods in Federal Way have been identified for stormwater runoff mitigation.	$0.0 million
Normandy Park	**Neighborhoods (5)**	
	Bonniewood neighborhood	$ to be determined
	Highlands neighborhood	$ to be determined
	North neighborhood	$ to be determined
	Riviera neighborhood	$ to be determined
	South neighborhood	$ to be determined
Tukwila	No neighborhoods in Tukwila have been identified for stormwater runoff mitigation.	$0.0 million
(No Highline School District or Highline Community Hospital facilities have been identified for stormwater runoff mitigation.)		
Total Study Area		**$ to be determined**

7.15 - SURFACE WATER QUALITY AND HYDROLOGY - EROSION AND SEDIMENT MITIGATION

Neighborhoods that have a stream, creek or river that conveys water from or through the Airport may be affected increased erosion and sediment as a result of the Third Runway project. As above, a stormwater management plan should address the impacts. Table 7.07 identifies the neighborhoods which are prone to stormwater runoff impacts.

Figure 7.03
Streams and Waterways

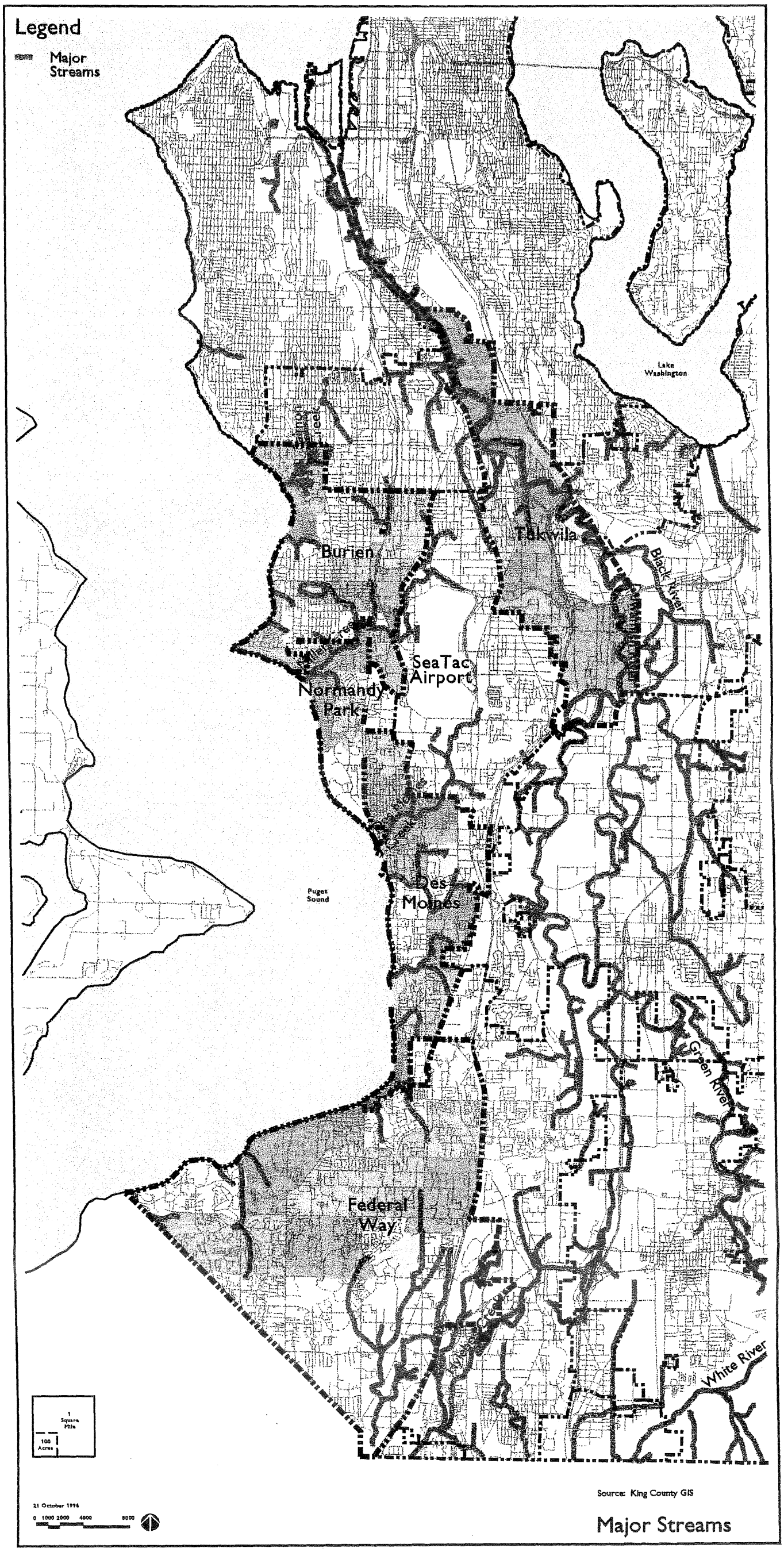


Figure 7.04
Wetlands

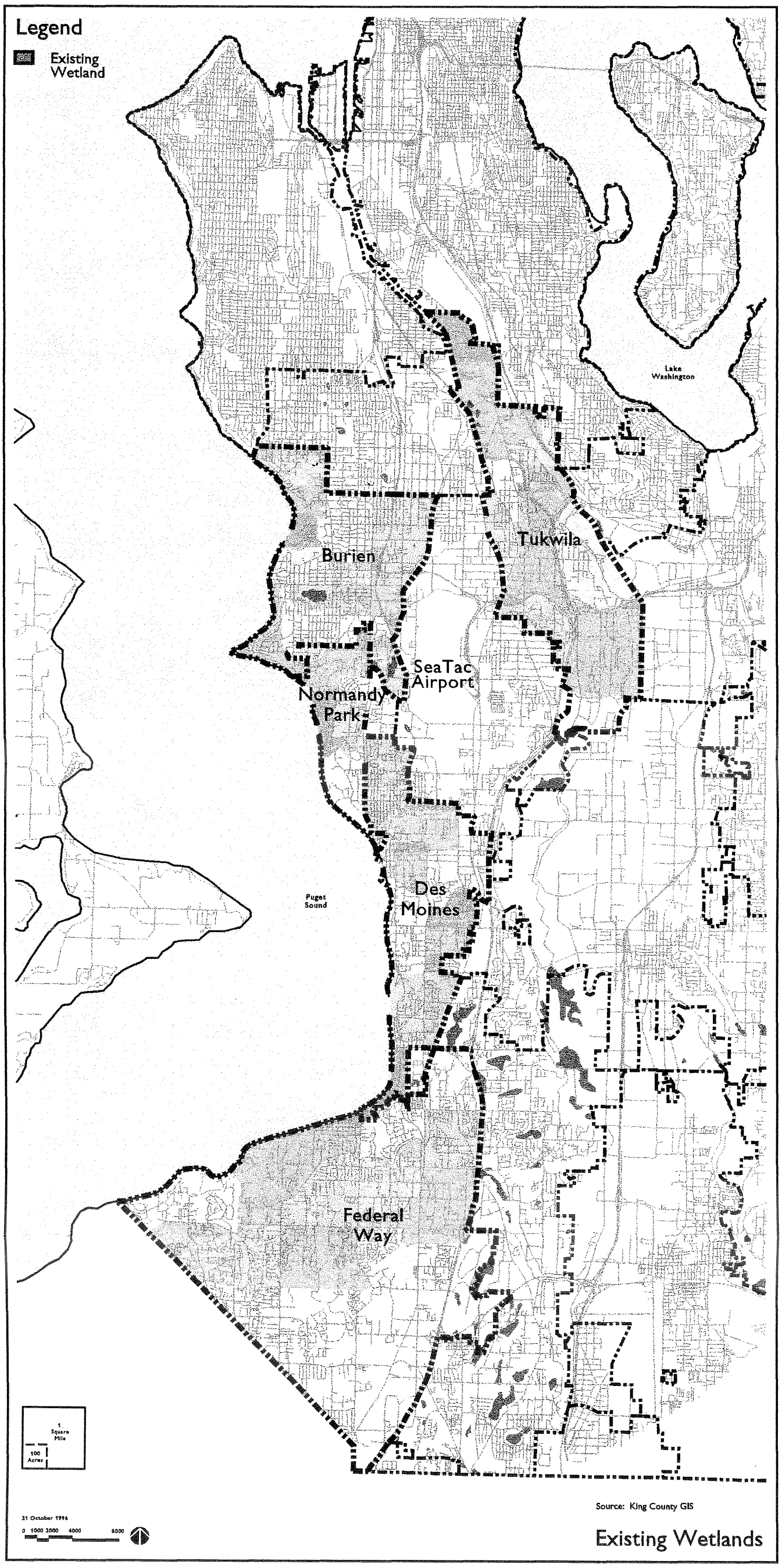


Figure 7.05
100-Year Floodplains

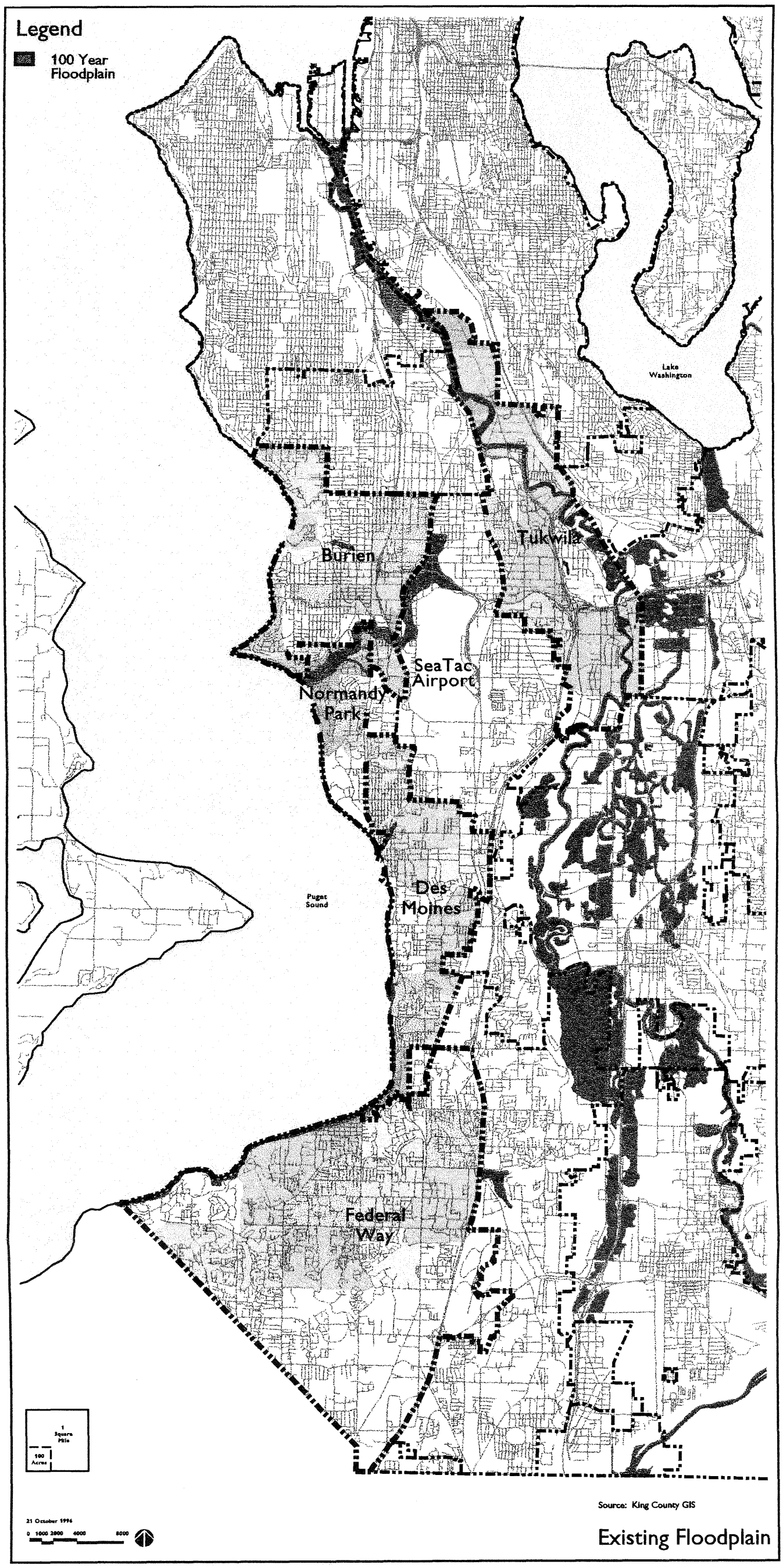


Table 7.07
Neighborhoods Identified for Erosion and Sediment Mitigation

City	Area	Amount
Burien	**Neighborhoods (4)**	
	North East neighborhood	$ to be determined
	East Central neighborhood	$ to be determined
	Gregory Heights neighborhood	$ to be determined
	South East neighborhood	$ to be determined
Des Moines	**Neighborhoods (3)**	
	North Hill neighborhood	$ to be determined
	West Central neighborhood	$ to be determined
	Downtown neighborhood	$ to be determined
Federal Way	No neighborhoods in Federal Way have been identified for erosion and sediment mitigation.	$0.0 million
Normandy Park	**Neighborhoods (5)**	
	Bonniewood neighborhood	$ to be determined
	Highlands neighborhood	$ to be determined
	North neighborhood	$ to be determined
	Riviera neighborhood	$ to be determined
	South neighborhood	$ to be determined
Tukwila	No neighborhoods in Tukwila have been identified for erosion and sediment mitigation.	$0.0 million
(No Highline School District or Highline Community Hospital facilities have been identified for erosion and sediment mitigation.)		
Total Study Area		**$ to be determined**

7.16 - SURFACE WATER QUALITY AND HYDROLOGY - SPILL MITIGATION

Neighborhoods that have a stream, creek or river that conveys water from or through the Airport may be affected by the Third Runway. These waterways may convey pollutants that are spilled on Airport property. The Airport should design an on-site containment system as part of the Third Runway to assure that all on-site spills are contained within the Airport. Additionally, operational controls for maintenance and fixed-base operators (FBOs) should be considered to further diminish the potential for contamination. Table 7.08 identifies the neighborhoods which could be impacted by on-Airport spills.

Table 7.08
Neighborhoods Identified for On-Airport Spill Mitigation

City	Area	Amount
Burien	**Neighborhoods (4)**	
	North East neighborhood	$ to be determined
	East Central neighborhood	$ to be determined
	Gregory Heights neighborhood	$ to be determined
	South East neighborhood	$ to be determined
Des Moines	**Neighborhoods (3)**	
	North Hill neighborhood	$ to be determined
	West Central neighborhood	$ to be determined
	Downtown neighborhood	$ to be determined
Federal Way	No neighborhoods in Federal Way have been identified for spill mitigation.	$0.0 million
Normandy Park	**Neighborhoods (5)**	
	Bonniewood neighborhood	$ to be determined
	Highlands neighborhood	$ to be determined
	North neighborhood	$ to be determined
	Riviera neighborhood	$ to be determined
	South neighborhood	$ to be determined
Tukwila	No neighborhoods in Tukwila have been identified for spill mitigation.	$0.0 million
(No Highline School District or Highline Community Hospital facilities have been identified for spill mitigation.)		
Total Study Area		**$ to be determined**

7.17 - GROUND WATER QUALITY AND HYDROLOGY - AQUIFER RECHARGE ZONE IMPACTS

The Airport's EIS addressed the Highline Aquifer and other aquifers, but did not delineate their total known limits. Additional studies should be undertaken to assure that the total recharge zone for these aquifers is protected. Any areas that are affected should be replaced. The previously-recommended stormwater management plan also will help control ground water pollution.

Table 7.09 identifies the neighborhoods which could be impacted by reduction of the Highline Aquifer recharge zone.

Table 7.09
Neighborhoods Identified for Highline Aquifer Mitigation

City	Area	Amount
Burien	**Neighborhoods (12)**	
	Shorewood neighborhood	$ to be determined
	North Central neighborhood	$ to be determined
	North East neighborhood	$ to be determined
	Seahurst Park neighborhood	$ to be determined
	Seahurst neighborhood	$ to be determined
	Central neighborhood	$ to be determined
	Lake Burien neighborhood	$ to be determined
	East Central neighborhood	$ to be determined
	South West neighborhood	$ to be determined
	Gregory Heights neighborhood	$ to be determined
	South East neighborhood	$ to be determined
	Downtown neighborhood	$ to be determined
Des Moines	**Neighborhoods (10)**	
	North Hill neighborhood	$ to be determined
	West Central neighborhood	$ to be determined
	North Central neighborhood	$ to be determined
	East Central neighborhood	$ to be determined
	Zenith neighborhood	$ to be determined
	South Des Moines neighborhood	$ to be determined
	West Woodmont neighborhood	$ to be determined
	East Woodmont neighborhood	$ to be determined
	Redondo neighborhood	$ to be determined
	Downtown neighborhood	$ to be determined
Federal Way	No neighborhoods in Federal Way have been identified for Highline Aquifer mitigation.	$0.0 million
Normandy Park	**Neighborhoods (9)**	
	Bonniewood neighborhood	$ to be determined
	Highlands neighborhood	$ to be determined
	North neighborhood	$ to be determined
	Riviera neighborhood	$ to be determined
	Manhattan neighborhood	$ to be determined
	East Central neighborhood	$ to be determined
	Normandy Province neighborhood	$ to be determined
	Arrow Lake neighborhood	$ to be determined
	South neighborhood	$ to be determined
Tukwila	No neighborhoods in Tukwila have been identified for Highline Aquifer mitigation.	$0.0 million
(No Highline School District or Highline Community Hospital facilities have been identified for Highline Aquifer mitigation.)		
Total Study Area		**$ to be determined**

7.18 - GROUND WATER QUALITY AND HYDROLOGY - AQUIFER CONTAMINATION MITIGATION

As in Section 7.17, neighborhoods that rely upon the Highline Aquifer may experience an increased potential for contamination of the water supply. The pollution control measures outlined above would also serve to minimize or eliminate this potential hazard. The same neighborhoods identified in Table 7.08 may be at risk for contamination to the Highline Aquifer.

7.19 - ADDITIONAL SURFACE/GROUND WATER MITIGATION MEASURES

Geotechnical Engineer

The Port of Seattle should hire for the duration of construction of the Third Runway a geotechnical engineer to ensure that fill is placed appropriately including compaction and to help detect and remove seismically unstable soils, such as in fill sources.

Toxic-Free Fill

The Port of Seattle should provide evidence including appropriate certifications that all fill material is free of harmful levels of toxic and hazardous materials as defined by the then-current Federal and State regulations.

Plans for Review

At least 2 months prior to construction, the Port of Seattle should provide for review and approval the following:

- Construction Stormwater Pollution Prevention Plan and Erosion/Sediment Control Plan.
- Spill Prevention, Control and Countermeasure (SPCC) Plan.
- Construction Management Plan.
- Construction Waste Management Plan.
- Geotechnical report.
- Reclamation plan for proposed fill sources.
- Earthwork specifications and drawings, in particular for the Third Runway.
- A copy of the State of Washington Governor's Water Quality Certificate which indicates that there is reasonable assurance that the project will be designed, constructed and operated in compliance with applicable water quality standards.

Monitoring Program

Limited baseline surface and ground water data was provided in the EIS. Therefore, prior to the start of construction the Port of Seattle should establish permanent, long term surface and groundwater monitoring stations in the Airport area. The locations and number of these stations should be approved by a working group/oversight commission.

The locations of the sampling stations should take into consideration previous or on-going water quality studies in the area. This should include at least studies by King County Surface Water Management Division and the Ground Water Management Program (various studies associated with groundwater contamination at Sea-Tac International Airport and the Port of Seattle's Receiving Water Monitoring Study). The report on the latter study will be submitted to the Washington DOE on 30 June 1997. Washington DOE has indicated (Washington DOE, 27 November 1996) that in selecting groundwater monitoring well locations:

> *"It would not be environmentally prudent to drill wells into deep, drinking water aquifers below an area like Sea-Tac Airport with known and unknown areas of shallow soil and perched groundwater contamination at the near surface (particularly free product). Best drilling technology cannot always preclude the spread of surficial contamination to the aquifers at depth through the monitoring wells (sampling stations) themselves."*

The DOE further indicated that a better location for the wells might be at the outer boundaries of the wellhead protection zones. Once the stations have been established, quarterly sampling should be initiated during the months of February, May, August and November. The parameters sampled should include metals and organics such as those associated with Airport operations. The parameters sampled should be selected based upon discussions with appropriate State of Washington and King County regulatory agencies and a working group/oversight commission. Potential parameters to be considered for sampling are shown in Table 7.10 for surface and groundwater.

Highline Aquifer

There is evidence that when wells are pumping from the Highline Aquifer, drawdown can be observer in shallower aquifers (Greg Wingard, 22 July 1996, personal communications; Wingard and Smith, 19 June 1995). This is indicative of interconnection between the aquifers and a potential path for contaminated ground water to the Highline Aquifer. Therefore, ground water movement in the Airport area should be better defined prior to the start of construction by the Port of Seattle. According to the EIS, these additional studies are being conducted. When available, the studies should be reviewed for potential ground water contamination impacts on the Highline Aquifer and other area aquifers.

Table 7.10
Potential Water Sampling Parameters

General		Indicators of Airport, Industrial and Municipal Contaminants	
Surface Water	**Groundwater**	**Surface Water**	**Groundwater**
Water temperature[a]	Depth to groundwater	BOD, 5-day	Chloride
Specific conductance[a]	Water temperature	COD	Oil and grease
pH[a]	Specific conductance	Chloride	Sulfide
Dissolved oxygen[a]	pH	Cyanide	Coliform, total per 100 ml
Flow[a]	Dissolved oxygen	Oil and grease	Coliform, fecal per 100 ml
Acidity	Acidity	Sulfide	Aviation fuel contaminants
Alkalinity	Alkalinity	Coliform, total per 100 ml	Ethylene glycol
Bicarbonate	Bicarbonate	Coliform, fecal per 100 ml	Propylene glycol
Carbonate	Carbonate	Aviation fuel constituents	Gasoline
Calcium	Calcium	Ethylene glycol	
Hardness	Hardness	Propylene glycol	
Color	Color		
Turbidity	Dissolved solids (total)		
Dissolved solids (total)	Suspended solids (total)		
Suspended solids (total)	Fluoride		
Fluoride	Magnesium		
Magnesium	Potassium		
Potassium	Silica		
Silica	Sodium		
Sodium	Sulfate		
Sulfate			
Nutrients		**Trace Elements**	
Surface Water	**Groundwater**	**Surface Water**	**Groundwater**
Ammonia	Ammonia	Aluminum	Aluminum
Kjeldahl nitrogen	Kjeldahl nitrogen	Arsenic	Arsenic
Nitrate	Nitrate	Cadmium	Cadmium
Nitrite	Nitrite	Chromium (total)	Chromium (total)
Phosphorus (total)	Phosphorus (total)	Chromium (hexavalent)	Chromium (hexavalent)
Ortho-phosphorus	Ortho-phosphorus	Copper	Copper
		Iron	Iron
		Lead	Lead
		Manganese	Manganese
		Mercury	Mercury
		Silver	Silver
		Zinc	Zinc

a - In-situ field measurements.

Miller/Des Moines Creek Monitoring Studies

In the EIS it is indicated that the Port of Seattle was to have conducted a monitoring study of Miller and Des Moines Creeks the winter of 1995 to 1996, both upstream and downstream of Airport stormwater discharges. The purpose of this study is to help determine the toxicity of Airport stormwater runoff and surface water quality.

The results of this study should be provided by the Port of Seattle and reviewed by a working group/oversight commission prior to the start of construction.

Stormwater Detention

To minimize the potential impacts of the new impervious areas and drainage areas, new stormwater detention facilities are planned. If the preferred alternative is implemented the hydrologic analysis and stormwater management facilities should be re-evaluated to support final design by the Port of Seattle prior to the start of construction. This is required because the EIS indicates that the stormwater management facilities and discharge locations are conceptual layout. The re-evaluated hydrologic analysis should then be used as part of the baseline to monitor potential Alternative 3 impacts. During large storm events, the effect of possible overflow from the IWS on the receiving waters also should be addressed. The hydrologic analysis and stormwater information should be provided by the Port of Seattle to a working group/oversight commission for review at least 2 months prior to the start of construction.

Wet Vaults/Biofiltration Swales

Limited details on both the construction and operation of the wet vaults and biofiltration swales was provided in the EIS. There was a more lengthy explanation of the constructed aquifer, which the EIS indicates has not been used before to manage stormwater. More detailed design and operating information should be provided on the wet vaults and biofiltration swales by the Port of Seattle at least 2 months prior to the start of construction.

If additional consideration is given to the constructed aquifer, its potential use must be more strongly justified. The Sea-Tac International Airport area may not be the most suitable place to try this technology out; especially considering the controversy over disturbing the headwaters of the two watersheds. The King County Surface Water Management Division has suggested that surface water retention facilities are more innovative and effective. Therefore, they should be considered further before the use of wet vaults and/or the constructed aquifer. The surface water facilities to be considered for modification should include the Lake Reba facility.

Construction Fence

The Port of Seattle must place a construction fence at the outside limits of the construction area.

Fill Material Source

Prior to the start of construction, when the borrow source areas have been identified, the Port of Seattle should conduct baseline studies of any area surface waters and the ground water. This information should be used to describe the existing conditions and to help monitor potential changes after the earthwork activities are complete. Parameters which should be considered for evaluation should be the same as those listed in Table 7.10.

Miller Creek Relocation

Prior to the start of relocating any part of Miller Creek, the Port of Seattle should provide information on the potential impact on the relocation of litigation concerning King County agreeing not to channelize the Creek except in limited amounts in connection with retention facilities.

Water Quality and Hydrology

- **Expansion Storm Drain System Report** - At the time the EIS was issued, a hydraulic analysis with computer program (WATERWORKS) was modeling the proposed Airport expansion storm drain system. The Port of Seattle should provide a copy of the final report for review and comment.

- **Surface/Groundwater Monitoring** - The Port of Seattle should continue the surface and groundwater monitoring which was initiated prior to the start of construction as discussed previously. The need to sample on a quarterly basis should be discussed and adjusted if it is deemed appropriate. Other aspects of the monitoring program which should be discussed should include the parameters being monitored and the number and locations of the monitoring stations. The discussion of the monitoring program components should be a continuous process in order to take advantage of the monitoring data and in order to reflect Airport operations/issues.

- **Borrow Site Hydrology** - The borrow site hydrology monitoring should be continued by the Port of Seattle until adequate information is obtained for comparison with the EIS existing or baseline conditions.

- **Operations Erosion and Sediment Control Plan** - At least 2 months prior to the completion of construction on the Third Runway, the Port of Seattle should provide an operations erosion and sediment control plan, and a stormwater pollution prevention plan.

- **Fuel Handling System** - The existing Airport aircraft fuel handling system has experienced some leaks, in particular in older parts of the system. As part of the Master Plan Update implementation, the Port of Seattle should upgrade and modernize the fuel handling system.

7.20 - WETLAND MITIGATION

Impacts from the proposed project may remove, pollute, reduce, or destroy wetlands. Figure 7.04 shows the wetlands as delineated in the EIS. A plan for the replacement of the wetlands within the same watershed should be completed to keep these natural areas within each City. The only neighborhoods in the study area known to be impacted are within the City of Burien (North East, East Central, and South East neighborhoods).

At least 2 months before the start of construction the Port of Seattle should provide additional justification for wetlands mitigation in the Green River Valley and not the Miller Creek Watershed. This should include evidence of further discussions concerning mitigation in the Miller Creek Watershed with State of Washington and King County regulatory agencies and an approved wetlands mitigation plan from appropriate regulatory agencies.

At least 2 months before the start of construction the Port of Seattle should provide more detailed information on what wetlands will be destroyed as part of Master Plan Update implementation and how other Airport area wetlands will be protected from construction activities.

The Port of Seattle should also initiate a wetlands monitoring program to provide at least yearly reports on the success of the wetlands mitigation plan.

7.21 - FLOODPLAINS - ENCROACHMENT MITIGATION

Neighborhoods within 100-year floodplains may experience a potential for increased flooding and increased contamination following construction of the Third Runway. Figure 7.05 shows the 100-year floodplains in the study area as delineated by the Federal Emergency Management Agency (FEMA). A stormwater retention/detention system will aid in flood control and pollution abatement that may be due to the Third Runway project. Table 7.11 identifies neighborhoods that may experience floodplain encroachment.

Table 7.11
Neighborhoods Identified for Floodplain Encroachment Mitigation

City	Area	Amount
Burien	**Neighborhoods (4)**	
	North East neighborhood	$ to be determined
	East Central neighborhood	$ to be determined
	Gregory Heights neighborhood	$ to be determined
	South East neighborhood	$ to be determined
Des Moines	**Neighborhoods (3)**	
	North Hill neighborhood	$ to be determined
	West Central neighborhood	$ to be determined
	Downtown neighborhood	$ to be determined
Federal Way	No neighborhoods in Federal Way have been identified for floodplain encroachment mitigation.	$0.0 million
Normandy Park	**Neighborhoods (5)**	
	Bonniewood neighborhood	$ to be determined
	Highlands neighborhood	$ to be determined
	North neighborhood	$ to be determined
	Riviera neighborhood	$ to be determined
	South neighborhood	$ to be determined
Tukwila	No neighborhoods in Tukwila have been identified for floodplain encroachment mitigation.	$0.0 million
(No Highline School District or Highline Community Hospital facilities have been identified for floodplain encroachment mitigation.)		
Total Study Area		**$ to be determined**

7.22 - FLOODPLAINS - REDUCED FLOOD STORAGE CAPACITY MITIGATION

Neighborhoods within 100-year floodplains may experience an increase in downstream runoff due to a decrease in upstream permeable surfaces, resulting in inadequate downstream storage capacity. The same neighborhoods identified in Table 7.11 above may experience reduced flood storage capacity as a result of the Third Runway project. A stormwater management plan will improve flood control due to increases in runoff.

7.23 - FLOODPLAINS - INCREASED FLOW RATE/VOLUME MITIGATION

Neighborhoods within a 100-year floodplain may be impacted by increased upstream runoff from the Airport. The same neighborhoods identified in Table 7.10 above may experience increased stormwater flow rates and volumes as a result of the Third Runway project. The same stormwater management plan previously mentioned would address these impacts.

7.24 - FLOODPLAINS - ADDITIONAL MITIGATION MEASURES

At least 2 months before the start of construction, the Port of Seattle should provide the following:

- Information on the relationship between the 100 and 500-year floodplains, recent storms in the Puget Sound region and the Master Plan Update implementation EIS analysis.
- A copy of the final monitoring plan for evaluating the effectiveness of the Miller Creek and Des Moines Creek relocations.
- Final design information for the Miller Creek and Des Moines Creek relocations including specifications and drawings.

Cumulative Impacts

In the EIS cumulative impacts on water resources during construction associated with Master Plan Update implementation and other projects are not discussed in detail. At least 2 months prior to the start of construction the Port of Seattle should provide for review/approval a more comprehensive cumulative impacts discussion.

7.25 - AESTHETICS AND VISUAL - GROUND SHADOW MITIGATION

Neighborhoods adjacent to the northern, southern, and western edges of the Airport property will be subjected to increased shadows as a result of the 20 MCY of fill material necessary for construction of the Third Runway. These neighborhoods include the East Central and South East neighborhoods (both within the City of Burien). Neighborhoods that are redeveloped also will be mitigated for this impact. Other neighborhoods may require additional remodeling to reduce these aesthetic impacts. A "visual inventory" should be conducted to fully project the extent of these impacts.

7.26 - AESTHETICS AND VISUAL - VISIBILITY OF AIRCRAFT

Neighborhoods underneath or adjacent to flight tracks will view arriving and departing aircraft. To mitigate these impacts, the Airport may modify flight tracks to re-route aircraft over non-residential areas. The measures associated with overflight mitigation and ground shadow mitigation will simultaneously mitigate these areas as well. No further mitigation measures are suggested for these areas.

7.27 - AESTHETICS AND VISUAL - VISIBILITY OF FILL

Neighborhoods adjacent to the western edge of the Airport property will be in the line-of-sight of the 20 MCY of fill material necessary for construction of the Third Runway. Table 7.12 identifies these neighborhoods within the study area.

Table 7.12
Neighborhoods Identified for Fill Visibility Mitigation

City	Area	Amount
Burien	**Neighborhoods (7)**	
	North Central neighborhood	$ to be determined
	North East neighborhood	$ to be determined
	Central neighborhood	$ to be determined
	East Central neighborhood	$ to be determined
	Gregory Heights neighborhood	$ to be determined
	South East neighborhood	$ to be determined
	Downtown neighborhood	$ to be determined
Des Moines	**Neighborhoods (3)**	
	North Hill neighborhood	$ to be determined
	West Central neighborhood	$ to be determined
	North Central neighborhood	$ to be determined
Federal Way	No neighborhoods in Federal Way have been identified for fill visibility mitigation.	$0.0 million
Normandy Park	**Neighborhoods (2)**	
	Bonniewood neighborhood	$ to be determined
	North neighborhood	$ to be determined
Tukwila	No neighborhoods in Tukwila have been identified for fill visibility mitigation.	$0.0 million
(No Highline School District or Highline Community Hospital facilities have been identified for fill visibility mitigation.)		
Total Study Area		**$ to be determined**

Neighborhoods that are redeveloped also will be mitigated for the aesthetics and visual impact. Other neighborhoods may require additional measures to reduce these aesthetic impacts, including reforestation/re-landscaping or improvements to the Airport Landscape Plan.

7.28 - AESTHETICS AND VISUAL - ADDITIONAL MITIGATION MEASURES

Prior to the start of construction, the Port of Seattle should provide the following concerning aesthetic and visual resources.

Color Photographs

Color photographs of pictures taken from the EIS viewpoints and additional viewpoints which show the existing and future conditions. The additional viewpoints should be selected based on discussions with a working group/oversight commission. The selection of viewpoints should consider short-range, medium-range and long-range views. For example, to the west of the Airport the viewpoints might be as follows: short-range, 1/2 mile or less from the Third Runway; medium-range, 1/2 to 1 mile from the Third Runway; and long-range, 1 to 1.5 miles or more from the Third Runway.

Landscape Plans

Landscape plans for the borrow source areas and the Third Runway fill area. These plans should take into consideration the following:

- The City of SeaTac and other appropriate landscape requirements.
- Planting temporary vegetation or a cover crop as construction in various areas is completed or proceeds in order to minimize short term impacts, in particular from erosion and sedimentation.
- The final landscaping should include the use of a variety of native vegetation which require low maintenance; and has a mixture of seedlings and more mature plants in order to avoid a monoculture.

Other Visual Impacts

A cumulative impacts discussion and color photographs, if appropriate, of facilities associated with Master Plan Update implementation and other known proposed projects in the Airport area.

Following construction of the facilities associated with Master Plan Update implementation, the Port of Seattle should provide a landscape maintenance plan. The plan should include a description of the proposed uses of any pesticides such as herbicides and insecticides.

7.29 - OTHER ENVIRONMENTAL IMPACTS

Special Status Species/Habitat Mitigation

Neighborhoods with EIS-identified habitats should be further studied to determine the Third Runway's impact on endangered or threatened species. A preservation and protection plan should be developed for the neighborhoods identified in Table 7.13

Table 7.13
Neighborhoods Identified for Special Status Species/Habitat Mitigation

City	Area	Amount
Burien	**Neighborhoods (5)**	
	Shorewood neighborhood	$ to be determined
	Seahurst Park neighborhood	$ to be determined
	Seahurst neighborhood	$ to be determined
	Lake Burien neighborhood	$ to be determined
	South West neighborhood	$ to be determined
Des Moines	No neighborhoods in Des Moines have been identified for special status species/habitat mitigation.	$0.0 million
Federal Way	No neighborhoods in Federal Way have been identified for special status species/habitat mitigation.	$0.0 million
Normandy Park	No neighborhoods in Normandy Park have been identified for special status species/habitat mitigation.	$0.0 million
Tukwila	**Neighborhoods (1)**	
	Allentown neighborhood	$ to be determined
(No Highline School District or Highline Community Hospital facilities have been identified for special status species/habitat mitigation.)		
Total Study Area		**$ to be determined**

Cultural Resource Mitigation

Neighborhoods with significant cultural resources (architectural, religious, ethnic, etc.) should be further studied to determine the Third Runway's potential impact on these resources. A preservation and protection plan should be developed for the neighborhoods identified in Table 7.14.

Table 7.14
Neighborhoods Identified for Cultural Resource Mitigation

City	Area	Amount
Burien	**Neighborhoods (7)**	
	North East neighborhood	$ to be determined
	Lake Burien neighborhood	$ to be determined
	East Central neighborhood	$ to be determined
	South West neighborhood	$ to be determined
	Gregory Heights neighborhood	$ to be determined
	South East neighborhood	$ to be determined
	Downtown neighborhood	$ to be determined
Des Moines	**Neighborhoods (3)**	
	West Central neighborhood	$ to be determined
	Redondo neighborhood	$ to be determined
	Downtown neighborhood	$ to be determined
Federal Way	No neighborhoods in Federal Way have been identified for cultural resource mitigation.	$0.0 million
Normandy Park	No neighborhoods in Normandy Park have been identified for cultural resource mitigation.	$0.0 million
Tukwila	No neighborhoods in Tukwila have been identified for cultural resource mitigation.	$0.0 million
(No Highline School District or Highline Community Hospital facilities have been identified for cultural resource mitigation.)		
Total Study Area		**$ to be determined**

Coastal Zone Mitigation

Neighborhoods adjacent to Puget Sound may be impacted by coastal pollution associated with polluted stormwater runoff or increased sedimentation and erosion associated with the proposed barge/conveyor system. Potential point sources for pollutants should be identified and a pollution control management plan developed for the neighborhoods identified in Table 7.15.

Table 7.15
Neighborhoods Identified for Coastal Zone Mitigation

City	Area	Amount
Burien	**Neighborhoods (4)**	
	Shorewood neighborhood	$ to be determined
	Seahurst Park neighborhood	$ to be determined
	Seahurst neighborhood	$ to be determined
	South West neighborhood	$ to be determined
Des Moines	**Neighborhoods (4)**	
	Zenith neighborhood	$ to be determined
	West Woodmont neighborhood	$ to be determined
	Redondo neighborhood	$ to be determined
	Downtown neighborhood	$ to be determined
Federal Way	No neighborhoods in Federal Way have been identified for coastal zone mitigation.	$0.0 million
Normandy Park	**Neighborhoods (3)**	
	North neighborhood	$ to be determined
	Riviera neighborhood	$ to be determined
	South neighborhood	$ to be determined
Tukwila	No neighborhoods in Tukwila have been identified for coastal zone mitigation.	$0.0 million
(No Highline School District or Highline Community Hospital facilities have been identified for coastal zone mitigation.)		
Total Study Area		**$ to be determined**

DOT Section 4(F) Resource Mitigation

Neighborhoods with significant open spaces, parks, and recreational areas may be impacted by increased traffic and congestion associated with increased demand at the Airport. These resources should be preserved and protected from potential impacts, or should be relocated and replaced if possible. Table 7.16 identifies the neighborhoods in the study with these resources.

Table 7.16
Neighborhoods Identified for Section 4(f) Mitigation

City	Area	Amount
Burien	**Neighborhoods (5)**	
	Shorewood neighborhood	$ to be determined
	North Central neighborhood	$ to be determined
	East Central neighborhood	$ to be determined
	South West neighborhood	$ to be determined
	Gregory Heights neighborhood	$ to be determined
Des Moines	**Neighborhoods (7)**	
	West Central neighborhood	$ to be determined
	North Central neighborhood	$ to be determined
	Zenith neighborhood	$ to be determined
	South Des Moines neighborhood	$ to be determined
	West Woodmont neighborhood	$ to be determined
	Redondo neighborhood	$ to be determined
	Downtown neighborhood	$ to be determined
Federal Way	**Neighborhoods (3)**	
	Wildwood neighborhood	$ to be determined
	Easter Lake neighborhood	$ to be determined
	Steel Lake neighborhood	$ to be determined
Normandy Park	**Neighborhoods (5)**	
	North neighborhood	$ to be determined
	Riviera neighborhood	$ to be determined
	East Central neighborhood	$ to be determined
	Arrow Lake neighborhood	$ to be determined
	South neighborhood	$ to be determined
Tukwila	**Neighborhoods (2)**	
	Foster neighborhood	$ to be determined
	McMicken neighborhood	$ to be determined
(No Highline School District or Highline Community Hospital facilities have been identified for Section 4(f) mitigation.)		
Total Study Area		**$ to be determined**

7.30 - OVERSIGHT COMMISSION

Previous references in this Section have mentioned a "working group" or oversight commission" which play a critical role in the mitigation process. Because of the extent of the mitigation measures discussed, a working group or oversight commission should be assembled to interact with the Port of Seattle during Master Plan Update implementation. The group should have permanent staff with technical expertise in airport construction and operation and should be supported by representatives of the various cities around the Airport and citizen groups.

The permanent staff positions should be funded as part of the mitigation agreement and should be separate from Port of Seattle staff.

The working group/oversight commission should be provided documentation related to the mitigation measures discussed here. The group will then evaluate this information, provide the Port of Seattle comments and finally approve the proposed mitigation measures. In order to avoid delays with the proposed activities associated with Master Plan Update implementation, the information should be provided for review at least 30 to 60 days before proceeding with the various activities. Work on the proposed activities cannot proceed without the group's approval of the mitigation measures and related information.

As part of the mitigation measures for the EIS environmental disciplines, the Port of Seattle should provide the working group/oversight commission prior to Master Plan Update implementation, a table of all of the engineering and environmental permits/approvals which are required for construction and operation. In addition, a schedule for obtaining these permits/approvals should be provided. Then, throughout the construction period and until all operating permits/approvals are obtained, monthly permits/approvals status reports will be provided. The mitigation measures specified here should not take the place of the measures discussed in the EIS. They should be used in conjunction with and should supplement the mitigation measures discussed in the EIS.

7.31 - ENVIRONMENTAL IMPACT SUMMARIES

Plates 7.1 through 7.6 summarize the potential environmental impacts for each of the five impacted communities, plus the Highline School District and Highline Community Hospital. The impact, mitigation measure, and costs are identified for each neighborhood. The following conventions should be noted when reviewing these Plates:

- **"- - -"** - Indicates that there is no impact identified for this neighborhood.
- **"$ TBD"** - Indicates that the mitigation costs are yet to be determined. Not enough information was available during this study to determine these costs.
- **"$0.0 M"** - Indicates that there are no mitigation costs for this neighborhood.
- **"Mitigated by . . . measures"** - Indicates that other mitigation measures simultaneously mitigate this neighborhood for multiple impact types.
- **"See . . . matrix"** - (Appears only in the Public Facility matrix) Indicates that these impacts are addressed by measures delineated in another City/neighborhood matrix.
- **"Outside Study Area"** - (Appears only in the Public Facility matrix) Indicates that only impacts to the school/hospital building are delineated. Analysis of other impacts are outside the scope of this study.

ENVIRONMENTAL IMPACT MATRIX - CITY OF BURIEN

Neighborhood		Noise & Vibration				Air Quality						Surface Water Quality/Hydrology			Ground Water Quality/Hydrology		Wetlands	Floodplains			Aesthetics and Visual			Other			
Name	Measures	LDN	SEL	Over-Flights (TA)	Vibration	Air emissions (aircraft)	CO emissions (vehicles)	HC emissions (vehicles)	Air toxics	Fugitive emissions	Point source	Runoff volume	Erosion & sediment	Spills	Aquifer recharge	Contam-ination	Destruc-tion	Encroach-ment	Reduced flood storage capacity	Increased flow rate & volume	Ground shadow	Visibility (aircraft)	Visibility (fill)	Special status species/ hab.	Cult-ural res's.	Coast. zone	DOT Sec. 4(f) res.
Shorewood	*Impact*	---	---	Sound exposure	---	Air pollution	---	Mitigated	Air pollution	---	---	---	---	---	Contam./ destruc.	Pollution	---	---	---	---	---	Mitigated	---	E/T loss	---	Pollu-tion	Park loss
	Mitigation	---	---	Insulation/ easement	---	Op's and equipment	---	by LOS	Op's and equip.	---	---	---	---	---	Manage-ment plan	Manage-ment plan	---	---	---	---	---	by TA	---	Preser-vation	---	Control source	Avoid/ replace
(601 acres)	*Cost*	---	---	$22.5 M	---	$0.0 M	---	measures	$0.0 M	---	---	---	---	---	$ TBD	$ TBD	---	---	---	---	---	measures	---	$ TBD	---	$ TBD	$ TBD
North Central	*Impact*	---	Topo. 400' w/in 5 mi.	Mitigated	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	Contam./ destruc.	Pollution	---	---	---	---	---	Mitigated	Views of fill	---	---	---	Park loss
	Mitigation	---	Insulation/ easement	by SEL	by SEL	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	Manage-ment plan	Manage-ment plan	---	---	---	---	---	by TA	Screening/ landscap.	---	---	---	Avoid/ replace
(488 acres)	*Cost*	---	$18.3 M	measures	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	$ TBD	$ TBD	---	---	---	---	---	measures	$ TBD	---	---	---	$ TBD
North East	*Impact*	65 contour	Mitigated	Mitigated	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	Dust	Pollution	Flooding	Slides	Spills	Contam./ destruc.	Pollution	Loss of wetlands	Flooding	Flooding	Flooding	---	Mitigated	Views of fill	---	Loss	---	---
	Mitigation	Acquire/ redevelop	by LDN	by LDN	by LDN	Op's and equipment	by LOS	by LOS	Op's and equip	Control plan	FBO control	Manage-ment plan	Manage-ment plan	On-site contain.	Manage-ment plan	Manage-ment plan	Relocate/ replace	Manage-ment plan	Manage-ment plan	Manage-ment plan	---	by TA	Screening/ landscap.	---	Avoid/ replace	---	---
(707 acres)	*Cost*	$537.0 M	measures	measures	measures	$0.0 M	measures	measures	$0.0 M	$0.0 M	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	---	measures	$ TBD	---	$ TBD	---	---
Seahurst Park	*Impact*	---	---	---	---	Air pollution	---	---	---	---	---	---	---	---	Contam./ destruc.	Pollution	---	---	---	---	---	---	---	E/T loss	---	Pollu-tion	---
	Mitigation	---	---	---	---	Op's and equipment	---	---	---	---	---	---	---	---	Manage-ment plan	Manage-ment plan	---	---	---	---	---	---	---	Preser-vation	---	Control source	---
(166 acres)	*Cost*	---	---	---	---	$0.0 M	---	---	---	---	---	---	---	---	$ TBD	$ TBD	---	---	---	---	---	---	---	$ TBD	---	$ TBD	---
Seahurst	*Impact*	---	---	---	---	Air pollution	Mitigated	---	---	---	---	---	---	---	Contam./ destruc.	Pollution	---	---	---	---	---	---	---	E/T loss	---	Pollu-tion	---
	Mitigation	---	---	---	---	Op's and equipment	by LOS	---	---	---	---	---	---	---	Manage-ment plan	Manage-ment plan	---	---	---	---	---	---	---	Preser-vation	---	Control source	---
(393 acres)	*Cost*	---	---	---	---	$0.0 M	measures	---	---	---	---	---	---	---	$ TBD	$ TBD	---	---	---	---	---	---	---	$ TBD	---	$ TBD	---
Central	*Impact*	---	Topo. 400' w/in 5 mi.	---	Mitigated	Air pollution	Mitigated	Mitigated	---	---	---	---	---	---	Contam./ destruc.	Pollution	---	---	---	---	---	Mitigated	Views of fill	---	---	---	---
	Mitigation	---	Insulation/ easement	---	by SEL	Op's and equipment	by LOS	by LOS	---	---	---	---	---	---	Manage-ment plan	Manage-ment plan	---	---	---	---	---	by TA	Screening/ landscap.	---	---	---	---
(156 acres)	*Cost*	---	$5.8 M	---	measures	$0.0 M	measures	measures	---	---	---	---	---	---	$ TBD	$ TBD	---	---	---	---	---	measures	$ TBD	---	---	---	---
Lake Burien	*Impact*	---	---	---	---	Air pollution	---	---	---	---	---	---	---	---	Contam./ destruc.	Pollution	---	---	---	---	---	---	---	E/T loss	Loss	---	---
	Mitigation	---	---	---	---	Op's and equipment	---	---	---	---	---	---	---	---	Manage-ment plan	Manage-ment plan	---	---	---	---	---	---	---	Preser-vation	Avoid/ replace	---	---
(162 acres)	*Cost*	---	---	---	---	$0.0 M	---	---	---	---	---	---	---	---	$ TBD	$ TBD	---	---	---	---	---	---	---	$ TBD	$ TBD	---	---
East Central	*Impact*	60 contour	Mitigated	Mitigated	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	Dust	Pollution	Flooding	Slides	Spills	Contam./ destruc.	Pollution	Loss of wetlands	Flooding	Flooding	Flooding	Fill shadow	Mitigated	Mitigated	---	Loss	---	Park loss
	Mitigation	Insulation/ easement	by LDN	by LDN	by LDN	Op's and equipment	by LOS	by LOS	Op's and equip.	Control plan	FBO control	Manage-ment plan	Manage-ment plan	On-site contain.	Manage-ment plan	Manage-ment plan	Relocate/ replace	Manage-ment plan	Manage-ment plan	Manage-ment plan	Screening/ landscap.	by TA	by Ground Shadow measures	---	Avoid/ replace	---	Avoid/ replace
(254 acres)	*Cost*	$9.5 M	measures	measures	measures	$0.0 M	measures	measures	$0.0 M	$0.0 M	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	measures		---	$ TBD	---	$ TBD
South West	*Impact*	---	---	---	---	Air pollution	---	---	---	---	---	---	---	---	Contam./ destruc.	Pollution	---	---	---	---	---	---	---	E/T loss	Loss	Pollu-tion	Park loss
	Mitigation	---	---	---	---	Op's and equipment	---	---	---	---	---	---	---	---	Manage-ment plan	Manage-ment plan	---	---	---	---	---	---	---	Preser-vation	Avoid/ replace	Control source	Avoid/ replace
(365 acres)	*Cost*	---	---	---	---	$0.0 M	---	---	---	---	---	---	---	---	$ TBD	$ TBD	---	---	---	---	---	---	---	$ TBD	$ TBD	$ TBD	$ TBD
Gregory Heights	*Impact*	---	Topo. 400' w/in 5 mi.	---	Mitigated	Air pollution	---	---	---	---	---	Flooding	Slides	Spills	Contam./ destruc.	Pollution	---	Flooding	Flooding	Flooding	---	Mitigated	Views of fill	---	Loss	---	Park loss
	Mitigation	---	Insulation/ easement	---	by SEL	Op's and equipment	---	---	---	---	---	Manage-ment plan	Manage-ment plan	On-site contain.	Manage-ment plan	Manage-ment plan	---	Manage-ment plan	Manage-ment plan	Manage-ment plan	---	by TA	Screening/ landscap.	---	Avoid/ replace	---	Avoid/ replace
(574 acres)	*Cost*	---	$21.5 M	---	measures	$0.0 M	---	---	---	---	---	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	---	$ TBD	$ TBD	$ TBD	---	measures	$ TBD	---	$ TBD	---	$ TBD
South East	*Impact*	60 contour	Mitigated	Mitigated	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	Dust	Pollution	Flooding	Slides	Spills	Contam./ destruc.	Pollution	Loss of wetlands	Flooding	Flooding	Flooding	Fill shadow	Mitigated	Mitigated	---	Loss	---	---
	Mitigation	Insulation/ easement	by LDN	by LDN	by LDN	Op's and equipment	by LOS	by LOS	Op's and equip.	Control plan	FBO control	Manage-ment plan	Manage-ment plan	On-site contain.	Manage-ment plan	Manage-ment plan	Relocate/ replace	Manage-ment plan	Manage-ment plan	Manage-ment plan	Screening/ landscap.	by TA	by Ground Shadow measures	---	Avoid/ replace	---	---
(268 acres)	*Cost*	$10.0 M	measures	measures	measures	$0.0 M	measures	measures	$0.0 M	$0.0 M	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	measures		---	$ TBD	---	---
Downtown	*Impact*	60 contour	Mitigated	---	Mitigated	Air pollution	Mitigated	Mitigated	---	---	---	---	---	---	Contam./ destruc.	Pollution	---	---	---	---	---	Mitigated	Views of fill	---	Loss	---	---
	Mitigation	Insulation/ easement	by LDN	---	by LDN	Op's and equipment	by LOS	by LOS	---	---	---	---	---	---	Manage-ment plan	Manage-ment plan	---	---	---	---	---	by TA	Screening/ landscap.	---	Avoid/ replace	---	---
(308 acres)	*Cost*	$12.0 M	measures	---	measures	$0.0 M	measures	measures	---	---	---	---	---	---	$ TBD	$ TBD	---	---	---	---	---	measures	$ TBD	---	$ TBD	---	---
Total (4,442 ac.)	$636.6 M plus TBD	$568.5 M	$45.6 M	$22.5 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$0.0 M	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD

ENVIRONMENTAL IMPACT MATRIX - CITY OF DES MOINES

Neighborhood		Noise & Vibration				Air Quality						Surface Water Quality/Hydrology			Ground Water Quality/Hydrology		Wetlands	Floodplains			Aesthetics and Visual			Other			
Name	Measures	LDN	SEL	Over-Flights (TA)	Vibration	Air emissions (aircraft)	CO emissions (vehicles)	HC emissions (vehicles)	Air toxics	Fugitive emissions	Point source	Runoff volume	Erosion & sediment	Spills	Aquifer recharge	Contam-ination	Destruc-tion	Encroach-ment	Reduced flood storage capacity	Increased flow rate & volume	Ground shadow	Visibility (aircraft)	Visibility (fill)	Special status species/ hab.	Cult-ural res's.	Coast. zone	DOT Sec. 4(f) res.
North Hill	*Impact*	60 contour	Mitigated	Mitigated	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	Dust	Pollution	Flooding	Slides	Spills	Contam./ destruc.	Pollution	---	Flooding	Flooding	Flooding	---	Mitigated	Views of fill	---	---	---	---
	Mitigation	Insulation/ easement	by LDN	by LDN	by LDN	Op's and equipment	by LOS	by LOS	Op's and equip.	Dust con-trol plan	FBO controls	Manage-ment plan	Manage-ment plan	On-site contain.	Manage-ment plan	Manage-ment plan	---	Manage-ment plan	Manage-ment plan	Manage-ment plan	---	by TA	Screening/ landscap.	---	---	---	---
(623 acres)	*Cost*	$23.4 M	measures	measures	measures	$0.0 M	measures	measures	$0.0 M	$0.0 M	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	---	$ TBD	$ TBD	$ TBD	---	measures	$ TBD	---	---	---	---
West Central	*Impact*	65 contour	Mitigated	Mitigated	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	Dust	Pollution	Flooding	Slides	Spills	Contam./ destruc.	Pollution	---	Flooding	Flooding	Flooding	---	Mitigated	Views of fill	---	Loss	---	Park loss
	Mitigation	Acquire/ redevelop	by LDN	by LDN	by LDN	Op's and equipment	by LOS	by LOS	Op's and equip.	Dust con-trol plan	FBO controls	Manage-ment plan	Manage-ment plan	On-site contain.	Manage-ment plan	Manage-ment plan	---	Manage-ment plan	Manage-ment plan	Manage-ment plan	---	by TA	Screening/ landscap.	---	Avoid/ replace	---	Avoid/ replace
(479 acres)	*Cost*	$364.9 M	measures	measures	measures	$0.0 M	measures	measures	$0.0 M	$0.0 M	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	---	$ TBD	$ TBD	$ TBD	---	measures	$ TBD	---	$ TBD	---	$ TBD
North Central	*Impact*	65 contour	Mitigated	Mitigated	Mitigated	Air pollution	---	Mitigated	Air pollution	Dust	Pollution	---	Slides	Spills	Contam./ destruc.	Pollution	---	---	---	---	---	Mitigated	Views of fill	---	---	---	Park loss
	Mitigation	Acquire/ redevelop	by LDN	by LDN	by LDN	Op's and equipment	---	by LOS	Op's and equip.	Dust con-trol plan	FBO controls	---	Manage-ment plan	On-site contain.	Manage-ment plan	Manage-ment plan	---	---	---	---	---	by TA	Screening/ landscap.	---	---	---	Avoid/ replace
(241 acres)	*Cost*	$183.2 M	measures	measures	measures	$0.0 M	---	measures	$0.0 M	$0.0 M	$ TBD	---	$ TBD	$ TBD	$ TBD	$ TBD	---	---	---	---	---	measures	$ TBD	---	---	---	$ TBD
East Central	*Impact*	65 contour	Mitigated	Mitigated	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	Dust	Pollution	---	---	---	Contam./ destruc.	Pollution	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	Acquire/ redevelop	by LDN	by LDN	by LDN	Op's and equipment	by LOS	by LOS	Op's and equip.	Dust con-trol plan	FBO controls	---	---	---	Manage-ment plan	Manage-ment plan	---	---	---	---	---	by TA	---	---	---	---	---
(626 acres)	*Cost*	$475.8 M	measures	measures	measures	$0.0 M	measures	measures	$0.0 M	$0.0 M	$ TBD	---	---	---	$ TBD	$ TBD	---	---	---	---	---	measures	---	---	---	---	---
Zenith	*Impact*	60 contour	Mitigated	Mitigated	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	Contam./ destruc.	Pollution	---	---	---	---	---	Mitigated	---	---	---	Pollu-tion	Park loss
	Mitigation	Insulation/ easement	by LDN	by LDN	by LDN	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	Manage-ment plan	Manage-ment plan	---	---	---	---	---	by TA	---	---	---	Source control	Avoid/ replace
(550 acres)	*Cost*	$20.6 M	measures	measures	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	$ TBD	$ TBD	---	---	---	---	---	measures	---	---	---	$ TBD	$ TBD
South Des Moines	*Impact*	65 contour	Mitigated	Mitigated	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	Contam./ destruc.	Pollution	---	---	---	---	---	Mitigated	---	---	---	---	Park loss
	Mitigation	Acquire/ redevelop	by LDN	by LDN	by LDN	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	Manage-ment plan	Manage-ment plan	---	---	---	---	---	by TA	---	---	---	---	Avoid/ replace
(492 acres)	*Cost*	$373.9 M	measures	measures	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	$ TBD	$ TBD	---	---	---	---	---	measures	---	---	---	---	$ TBD
West Woodmont	*Impact*	60 contour	Mitigated	Mitigated	Mitigated	Air pollution	---	Mitigated	Air pollution	---	---	---	---	---	Contam./ destruc.	Pollution	---	---	---	---	---	Mitigated	---	---	---	Pollu-tion	Park loss
	Mitigation	Insulation/ easement	by LDN	by LDN	by LDN	Op's and equipment	---	by LOS	Op's and equip.	---	---	---	---	---	Manage-ment plan	Manage-ment plan	---	---	---	---	---	by TA	---	---	---	Source control	Avoid/ replace
(430 acres)	*Cost*	$16.1 M	measures	measures	measures	$0.0 M	---	measures	$0.0 M	---	---	---	---	---	$ TBD	$ TBD	---	---	---	---	---	measures	---	---	---	$ TBD	$ TBD
East Woodmont	*Impact*	60 contour	Mitigated	Mitigated	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	Contam./ destruc.	Pollution	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	Insulation/ easement	by LDN	by LDN	by LDN	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	Manage-ment plan	Manage-ment plan	---	---	---	---	---	by TA	---	---	---	---	---
(306 acres)	*Cost*	$11.5 M	measures	measures	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	$ TBD	$ TBD	---	---	---	---	---	measures	---	---	---	---	---
Redondo	*Impact*	---	Topo. 400' w/in 4 mi.	Mitigated	Mitigated	Air pollution	---	---	Air pollution	---	---	---	---	---	Contam./ destruc.	Pollution	---	---	---	---	---	Mitigated	---	---	Loss	Pollu-tion	Park loss
	Mitigation	---	Insulation/ easement	by SEL	by SEL	Op's and equipment	---	---	Op's and equip.	---	---	---	---	---	Manage-ment plan	Manage-ment plan	---	---	---	---	---	by TA	---	---	Avoid/ replace	Source control	Avoid/ replace
(212 acres)	*Cost*	---	$7.9 M	measures	measures	$0.0 M	---	---	$0.0 M	---	---	---	---	---	$ TBD	$ TBD	---	---	---	---	---	measures	---	---	$ TBD	$ TBD	$ TBD
Downtown	*Impact*	---	Topo. 400' w/in 5 mi.	Mitigated	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	Dust	Pollution	Flooding	Slides	Spills	Contam./ destruc.	Pollution	---	---	---	---	---	Mitigated	---	---	Loss	Pollu-tion	Park loss
	Mitigation	---	Insulation/ easement	by SEL	by SEL	Op's and equipment	by LOS	by LOS	Op's and equip.	Dust con-trol plan	FBO controls	Manage-ment plan	Manage-ment plan	On-site contain.	Manage-ment plan	Manage-ment plan	---	---	---	---	---	by TA	---	---	Avoid/ replace	Source control	Avoid/ replace
(108 acres)	*Cost*	---	$4.1 M	measures	measures	$0.0 M	measures	measures	$0.0 M	$0.0 M	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	---	---	---	---	---	measures	---	---	$ TBD	$ TBD	$ TBD
Total (4,067 ac.)	$1,481.4 M plus TBD	$1,469.4 M	$12.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$ TBD	$ TBD	$ TBD	$ TBD	$TBD	$TBD	$0.0 M	$ TBD	$ TBD	$ TBD	$ TBD	$0.0 M	$ TBD	$ 0.0 M	$ TBD	$ TBD	$ TBD

ENVIRONMENTAL IMPACT MATRIX - CITY OF FEDERAL WAY

Neighborhood		Noise & Vibration				Air Quality						Surface Water Quality/Hydrology			Ground Water Quality/Hydrology		Wetlands	Floodplains			Aesthetics and Visual			Other			
Name	Measures	LDN	SEL	Over-Flights (TA)	Vibration	Air emissions (aircraft)	CO emissions (vehicles)	HC emissions (vehicles)	Air toxics	Fugitive emissions	Point source	Runoff volume	Erosion & sediment	Spills	Aquifer recharge	Contam-ination	Destruc-tion	Encroach-ment	Reduced flood storage capacity	Increased flow rate & volume	Ground shadow	Visibility (aircraft)	Visibility (fill)	Special status species/ hab.	Cult-ural res's.	Coast. zone	DOT Sec. 4(f) res.
Star Lake	*Impact*	60 contour	Mitigated	Mitigated	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	Insulation/ easement	by LDN	by LDN	by LDN	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	---
(531 acres)	*Cost*	$19.5 M	measures	measures	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	---
Wildwood	*Impact*	60 contour	Mitigated	Mitigated	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	Park loss
	Mitigation	Insulation/ easement	by LDN	by LDN	by LDN	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	Avoid/ replace
(553 acres)	*Cost*	$20.7 M	measures	measures	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	$ TBD
Marine Hills	*Impact*	---	---	Sound exposure	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	---	---	Insulation/ easement	by TA	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	---
(529 acres)	*Cost*	---	---	$19.8 M	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	---
Mar-Cheri	*Impact*	---	---	Overflight exposure	Mitigated	Air pollution	---	---	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	---	---	Modify flight track	by TA	Op's and equipment	---	---	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	---
(311 acres)	*Cost*	---	---	$0.0 M	measures	$0.0 M	---	---	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	---
Dash Point	*Impact*	---	---	Overflight exposure	Mitigated	Air pollution	---	---	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	---	---	Modify flight track	by TA	Op's and equipment	---	---	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	---
(826 acres)	*Cost*	---	---	$ 0.0 M	measures	$0.0 M	---	---	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	---
Lakota	*Impact*	---	---	Overflight exposure	Mitigated	Air pollution	Mitigated	---	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	---	---	Modify flight track	by TA	Op's and equipment	by LOS	---	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	---
(949 acres)	*Cost*	---	---	$0.0 M	measures	$0.0 M	measures	---	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	---
Mirror Lake	*Impact*	---	---	Overflight exposure	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	---	---	Modify flight track	by TA	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	---
(713 acres)	*Cost*	---	---	$0.0 M	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	---
Easter Lake	*Impact*	---	---	Overflight exposure	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	Park loss
	Mitigation	---	---	Modify flight track	by TA	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	Avoid/ replace
(729 acres)	*Cost*	---	---	$0.0 M	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	$ TBD
Steel Lake	*Impact*	---	---	Sound exposure	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	Park loss
	Mitigation	---	---	Insulation/ easement	by TA	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	Avoid/ replace
(347 acres)	*Cost*	---	---	$13.0 M	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	$ TBD
Twin Lakes	*Impact*	---	---	Overflight exposure	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	---	---	Modify flight track	by TA	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	---
(1,118 acres)	*Cost*	---	---	$0.0 M	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	---

ENVIRONMENTAL IMPACT MATRIX - CITY OF FEDERAL WAY (continued)

Neighborhood		Noise & Vibration				Air Quality						Surface Water Quality/Hydrology			Ground Water Quality/Hydrology		Wetlands	Floodplains			Aesthetics and Visual			Other			
Name	Measures	LDN	SEL	Over-Flights (TA)	Vibration	Air emissions (aircraft)	CO emissions (vehicles)	HC emissions (vehicles)	Air toxics	Fugitive emissions	Point source	Runoff volume	Erosion & sediment	Spills	Aquifer recharge	Contam-ination	Destruc-tion	Encroach-ment	Reduced flood storage capacity	Increased flow rate & volume	Ground shadow	Visibility (aircraft)	Visibility (fill)	Special status species/ hab.	Cult-ural res's.	Coast. zone	DOT Sec. 4(f) res.
West Campus	*Impact*	---	---	Overflight exposures	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	---	---	Modify flight track	by TA	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	---
(848 acres)	*Cost*	---	---	$0.0 M	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	---
First Avenue	*Impact*	---	---	Sound exposure	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	---	---	Insulation/ easement	by TA	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	---
(546 acres)	*Cost*	---	---	$20.5 M	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	---
Kitts Corner North	*Impact*	---	---	Sound exposure	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	---	---	Insulation/ easement	by TA	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	---
(299 acres)	*Cost*	---	---	$11.2 M	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	---
City Center	*Impact*	---	---	Sound exposure	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	---	---	Insulation/ easement	by TA	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	---
(430 acres)	*Cost*	---	---	$16.1M	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	---
Total (8,719 ac.)	$148.1 M plus TBD	$40.2 M	$0.0 M	$107.9 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$ 0.0 M	$ 0.0 M	$0.0 M	$0.0 M	$0.0 M	$ TBD	$ TBD	$ TBD	$ TBD	$0.0 M	$ TBD	$ 0.0 M	$0.0 M	$0.0 M	$ TBD

ENVIRONMENTAL IMPACT MATRIX - CITY OF TUKWILA

Neighborhood		Noise & Vibration				Air Quality						Surface Water Quality/Hydrology			Ground Water Quality/Hydrology		Wetlands	Floodplains			Aesthetics and Visual			Other			
Name	Measures	LDN	SEL	Over-Flights (TA)	Vibration	Air emissions (aircraft)	CO emissions (vehicles)	HC emissions (vehicles)	Air toxics	Fugitive emissions	Point source	Runoff volume	Erosion & sediment	Spills	Aquifer recharge	Contam-ination	Destruc-tion	Encroach-ment	Reduced flood storage capacity	Increased flow rate & volume	Ground shadow	Visibility (aircraft)	Visibility (fill)	Special status species/ hab.	Cult-ural res's.	Coast. zone	DOT Sec. 4(f) res.
Ryan	*Impact*	---	---	Sound exposure	Mitigated	Air pollution	---	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	---	---	Insulation/ easement	by TA	Op's and equipment	---	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	---
(114 acres)	*Cost*	---	---	$4.3 M	measures	$0.0 M	---	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	---
Allentown	*Impact*	---	Topo. 400' w/in 5 mi.	Mitigated	Mitigated	Air pollution	---	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	E/T loss	---	---	---
	Mitigation	---	Insulation/ easement	by SEL	by SEL	Op's and equipment	---	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	Preser-vation	---	---	---
(346 acres)	*Cost*	---	$13.0 M	measures	measures	$0.0 M	---	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	$ TBD	---	---	---
Cascade View	*Impact*	---	Topo. 400' w/in 5 mi.	---	Mitigated	Air pollution	---	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Mitigation	---	Insulation/ easement	---	by SEL	Op's and equipment	---	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
(303 acres)	*Cost*	---	$11.4 M	---	measures	$0.0 M	---	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Foster	*Impact*	---	Topo. 400' w/in 5 mi.	---	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Park loss
	Mitigation	---	Insulation/ easement	---	by SEL	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Avoid/ replace
(485 acres)	*Cost*	---	$18.2 M	---	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	$ TBD
Thorndyke	*Impact*	---	Topo. 400' w/in 5 mi.	---	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Mitigation	---	Insulation/ easement	---	by SEL	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
(420 acres)	*Cost*	---	$15.7 M	---	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Tukwila Hill	*Impact*	---	---	---	---	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Mitigation	---	---	---	---	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
(857 acres)	*Cost*	---	---	---	---	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
McMicken	*Impact*	---	---	---	---	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Park loss
	Mitigation	---	---	---	---	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Avoid/ replace
(461 acres)	*Cost*	---	---	---	---	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	$ TBD
M.I.C.	*Impact*	60 contour	Mitigated	Mitigated	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	Insulation/ easement	by LDN	by LDN	by LDN	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	---
(1,083 ac.)	*Cost*	$40.6 M	measures	measures	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	---
Riverton	*Impact*	---	Topo. 400' w/in 5 mi.	Mitigated	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	---	Insulation/ easement	by SEL	by SEL	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	---
(276 acres)	*Cost*	---	$10.3 M	measures	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	---
CBD	*Impact*	---	---	---	---	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Mitigation	---	---	---	---	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
(1,095 ac.)	*Cost*	---	---	---	---	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Tukwila Valley South	*Impact*	---	---	---	---	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Park loss
	Mitigation	---	---	---	---	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Avoid/ replace
(367 acres)	*Cost*	---	---	---	---	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	$ TBD
Total (5,807 ac.)	$113.5 M plus TBD	$40.6 M	$68.6 M	$4.3 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$ TBD	$0.0 M	$0.0 M	$ TBD

ENVIRONMENTAL IMPACT MATRIX - CITY OF TUKWILA

Neighborhood		Noise & Vibration				Air Quality						Surface Water Quality/Hydrology			Ground Water Quality/Hydrology		Wetlands	Floodplains			Aesthetics and Visual			Other			
Name	Measures	LDN	SEL	Over-Flights (TA)	Vibration	Air emissions (aircraft)	CO emissions (vehicles)	HC emissions (vehicles)	Air toxics	Fugitive emissions	Point source	Runoff volume	Erosion & sediment	Spills	Aquifer recharge	Contam-ination	Destruc-tion	Encroach-ment	Reduced flood storage capacity	Increased flow rate & volume	Ground shadow	Visibility (aircraft)	Visibility (fill)	Special status species/ hab.	Cult-ural res's.	Coast. zone	DOT Sec. 4(f) res.
Ryan	*Impact*	---	---	Sound exposure	Mitigated	Air pollution	---	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	---	---	Insulation/ easement	by TA	Op's and equipment	---	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	---
(114 acres)	*Cost*	---	---	$4.3 M	measures	$0.0 M	---	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	---
Allentown	*Impact*	---	Topo. 400' w/in 5 mi.	Mitigated	Mitigated	Air pollution	---	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	E/T loss	---	---	---
	Mitigation	---	Insulation/ easement	by SEL	by SEL	Op's and equipment	---	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	Preser-vation	---	---	---
(346 acres)	*Cost*	---	$13.0 M	measures	measures	$0.0 M	---	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	$ TBD	---	---	---
Cascade View	*Impact*	---	Topo. 400' w/in 5 mi.	---	Mitigated	Air pollution	---	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Mitigation	---	Insulation/ easement	---	by SEL	Op's and equipment	---	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
(303 acres)	*Cost*	---	$11.4 M	---	measures	$0.0 M	---	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Foster	*Impact*	---	Topo. 400' w/in 5 mi.	---	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Park loss
	Mitigation	---	Insulation/ easement	---	by SEL	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Avoid/ replace
(485 acres)	*Cost*	---	$18.2 M	---	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	$ TBD
Thorndyke	*Impact*	---	Topo. 400' w/in 5 mi.	---	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Mitigation	---	Insulation/ easement	---	by SEL	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
(420 acres)	*Cost*	---	$15.7 M	---	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Tukwila Hill	*Impact*	---	---	---	---	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Mitigation	---	---	---	---	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
(857 acres)	*Cost*	---	---	---	---	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
McMicken	*Impact*	---	---	---	---	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Park loss
	Mitigation	---	---	---	---	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Avoid/ replace
(461 acres)	*Cost*	---	---	---	---	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	$ TBD
M.I.C.	*Impact*	60 contour	Mitigated	Mitigated	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	Insulation/ easement	by LDN	by LDN	by LDN	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	---
(1,083 ac.)	*Cost*	$40.6 M	measures	measures	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	---
Riverton	*Impact*	---	Topo. 400' w/in 5 mi.	Mitigated	Mitigated	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	---	Insulation/ easement	by SEL	by SEL	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	by TA	---	---	---	---	---
(276 acres)	*Cost*	---	$10.3 M	measures	measures	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	measures	---	---	---	---	---
CBD	*Impact*	---	---	---	---	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Mitigation	---	---	---	---	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
(1,095 ac.)	*Cost*	---	---	---	---	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Tukwila Valley South	*Impact*	---	---	---	---	Air pollution	Mitigated	Mitigated	Air pollution	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Park loss
	Mitigation	---	---	---	---	Op's and equipment	by LOS	by LOS	Op's and equip.	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Avoid/ replace
(367 acres)	*Cost*	---	---	---	---	$0.0 M	measures	measures	$0.0 M	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	$ TBD
Total (5,807 ac.)	$113.5 M plus TBD	$40.6 M	$68.6 M	$4.3 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$ TBD	$0.0 M	$0.0 M	$ TBD

ENVIRONMENTAL IMPACT MATRIX - CITY OF NORMANDY PARK

Neighborhood		Noise & Vibration				Air Quality						Surface Water Quality/Hydrology			Ground Water Quality/Hydrology		Wetlands	Floodplains			Aesthetics and Visual			Other			
Name	Measures	LDN	SEL	Over-Flights (TA)	Vibration	Air emissions (aircraft)	CO emissions (vehicles)	HC emissions (vehicles)	Air toxics	Fugitive emissions	Point source	Runoff volume	Erosion & sediment	Spills	Aquifer recharge	Contam-ination	Destruc-tion	Encroach-ment	Reduced flood storage capacity	Increased flow rate & volume	Ground shadow	Visibility (aircraft)	Visibility (fill)	Special status species/ hab.	Cult-ural res's.	Coast. zone	DOT Sec. 4(f) res.
Bonniewood	*Impact*	---	Topo. 400' w/in 5 mi.	---	Mitigated	Air pollution	---	Mitigated	---	---	---	Flooding	Slides	Spills	Contam./ destruc.	Pollution	---	Flooding	Flooding	Flooding	---	---	Views of fill	---	---	---	---
	Mitigation	---	Insulation/ easement	---	by SEL	Op's and equipment	---	by LOS	---	---	---	Manage-ment plan	Manage-ment plan	On-site contain.	Manage-ment plan	Manage-ment plan	---	Manage-ment plan	Manage-ment plan	Manage-ment plan	---	---	Screening/ landscap.	---	---	---	---
(41 acres)	*Cost*	---	$1.5 M	---	measures	$0.0 M	---	measures	---	---	---	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	---	$ TBD	$ TBD	$ TBD	---	---	$ TBD	---	---	---	---
Highlands	*Impact*	---	---	---	---	Air pollution	---	---	---	---	---	Flooding	Slides	Spills	Contam./ destruc.	Pollution	---	Flooding	Flooding	Flooding	---	---	---	---	---	---	---
	Mitigation	---	---	---	---	Op's and equipment	---	---	---	---	---	Manage-ment plan	Manage-ment plan	On-site contain.	Manage-ment plan	Manage-ment plan	---	Manage-ment plan	Manage-ment plan	Manage-ment plan	---	---	---	---	---	---	---
(81 acres)	*Cost*	---	---	---	---	$0.0 M	---	---	---	---	---	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	---	$ TBD	$ TBD	$ TBD	---	---	---	---	---	---	---
North	*Impact*	---	Topo. 400' w/in 5 mi.	---	Mitigated	Air pollution	---	Mitigated	---	---	---	Flooding	Slides	Spills	Contam./ destruc.	Pollution	---	Flooding	Flooding	Flooding	---	---	Views of fill	---	---	Pollu-tion	Park loss
	Mitigation	---	Insulation/ easement	---	by SEL	Op's and equipment	---	by LOS	---	---	---	Manage-ment plan	Manage-ment plan	On-site contain.	Manage-ment plan	Manage-ment plan	---	Manage-ment plan	Manage-ment plan	Manage-ment plan	---	---	Screening/ landscap.	---	---	Control source	Avoid/ replace
(348 acres)	*Cost*	---	$13.0 M	---	measures	$0.0 M	---	measures	---	---	---	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	---	$ TBD	$ TBD	$ TBD	---	---	$ TBD	---	---	$ TBD	$ TBD
Riviera	*Impact*	---	---	Sound exposure	Mitigated	Air pollution	---	Mitigated	Air pollution	---	---	Flooding	Slides	Spills	Contam./ destruc.	Pollution	---	Flooding	Flooding	Flooding	---	Mitigated	---	---	---	Pollu-tion	Park loss
	Mitigation	---	---	Insulation/ easement	by TA	Op's and equipment	---	by LOS	Op's and equip.	---	---	Manage-ment plan	Manage-ment plan	On-site contain.	Manage-ment plan	Manage-ment plan	---	Manage-ment plan	Manage-ment plan	Manage-ment plan	---	by TA	---	---	---	Control source	Avoid/ replace
(240 acres)	*Cost*	---	---	$9.0 M	measures	$0.0 M	---	measures	$0.0 M	---	---	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	---	$ TBD	$ TBD	$ TBD	---	measures	---	---	---	$ TBD	$ TBD
Manhattan	*Impact*	60 contour	---	Mitigated	Mitigated	Air pollution	---	Mitigated	Air pollution	---	---	---	---	---	Contam./ destruc.	Pollution	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	Insulation/ easement	---	by LDN	by LDN	Op's and equipment	---	by LOS	Op's and equip.	---	---	---	---	---	Manage-ment plan	Manage-ment plan	---	---	---	---	---	by TA	---	---	---	---	---
(90 acres)	*Cost*	$3.4 M	---	mesures	measures	$0.0 M	---	measures	$0.0 M	---	---	---	---	---	$ TBD	$ TBD	---	---	---	---	---	measures	---	---	---	---	---
East Central	*Impact*	---	---	Sound exposure	Mitigated	Air pollution	---	Mitigated	Air pollution	---	---	---	---	---	Contam./ destruc.	Pollution	---	---	---	---	---	Mitigated	---	---	---	---	Park loss
	Mitigation	---	---	Insulation/ easement	by TA	Op's and equipment	---	by LOS	Op's and equip.	---	---	---	---	---	Manage-ment plan	Manage-ment plan	---	---	---	---	---	by TA	---	---	---	---	Avoid/ replace
(248 acres)	*Cost*	---	---	$9.3 M	measures	$0.0 M	---	measures	$0.0 M	---	---	---	---	---	$ TBD	$ TBD	---	---	---	---	---	measures	---	---	---	---	$ TBD
Normandy Province	*Impact*	---	---	Sound exposure	Mitigated	Air pollution	---	Mitigated	Air pollution	---	---	---	---	---	Contam./ destruc.	Pollution	---	---	---	---	---	Mitigated	---	---	---	---	---
	Mitigation	---	---	Insulation/ easement	by TA	Op's and equipment	---	by LOS	Op's and equip.	---	---	---	---	---	Manage-ment plan	Manage-ment plan	---	---	---	---	---	by TA	---	---	---	---	---
(39 acres)	*Cost*	---	---	$1.5 M	measures	$0.0 M	---	measures	$0.0 M	---	---	---	---	---	$ TBD	$ TBD	---	---	---	---	---	measures	---	---	---	---	---
Arrow Lake	*Impact*	---	---	Sound exposure	Mitigated	Air pollution	---	Mitigated	Air pollution	---	---	---	---	---	Contam./ destruc.	Pollution	---	---	---	---	---	Mitigated	---	---	---	---	Park loss
	Mitigation	---	---	Insulation/ easement	by TA	Op's and equipment	---	by LOS	Op's and equip.	---	---	---	---	---	Manage-ment plan	Manage-ment plan	---	---	---	---	---	by TA	---	---	---	---	Avoid/ replace
(29 acres)	*Cost*	---	---	$1.1 M	measures	$0.0 M	---	measures	$0.0 M	---	---	---	---	---	$ TBD	$ TBD	---	---	---	---	---	measures	---	---	---	---	$ TBD
South	*Impact*	---	---	Sound exposure	Mitigated	Air pollution	---	Mitigated	Air pollution	---	---	Flooding	Slides	Spills	Contam./ destruc.	Pollution	---	Flooding	Flooding	Flooding	---	Mitigated	---	E/T loss	Loss	Pollu-tion	Park loss
	Mitigation	---	---	Insulation/ easement	by TA	Op's and equipment	---	by LOS	Op's and equip.	---	---	Manage-ment plan	Manage-ment plan	On-site contain.	Manage-ment plan	Manage-ment plan	---	Manage-ment plan	Manage-ment plan	Manage-ment plan	---	by TA	---	Preser-vation	Avoid/ replace	Control source	Avoid/ replace
(454 acres)	*Cost*	---	---	$17.0 M	measures	$0.0 M	---	measures	$0.0 M	---	---	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	---	$ TBD	$ TBD	$ TBD	---	measures	---	$ TBD	$ TBD	$ TBD	$ TBD
Total (1,570 ac.)	$55.8 M plus TBD	$3.4 M	$14.5 M	$37.9 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$0.0 M	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD

ENVIRONMENTAL IMPACT MATRIX - PUBLIC FACILITIES

Public Facility		Noise & Vibration				Air Quality						Surface Water Quality/Hydrology			Ground Water Quality/Hydrology		Wetlands	Floodplains			Aesthetics and Visual			Other			
Name	Measures	LDN	SEL	Over-Flights (TA)	Vibration	Air Emissions (Aircraft)	CO Emissions (Vehicles)	HC Emissions (Vehicles)	Air Toxics	Fugitive Emissions	Point Source	Runoff Volume	Erosion & Sediment	Spills	Aquifer Recharge	Contam-ination	Destruc-tion	Encroach-ment	Reduced Flood Storage Capacity	Increased Flow Rate & Volume	Ground Shadow	Visibility (Aircraft)	Visibility (Fill)	Special Status Species/ Hab.	Cult-ural Res's.	Coast. Zone	DOT Sec. 4(f) Res.
Highline School/Hospital Facilities in City of Burien																											
Highline Community Hospital (Gregory Heights)	Impact	55 to 60 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	See Gregory Heights (Plate 7.1)	---	---	---	---	---	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	---	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	---	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	---	See Greg. Heights (Plate 7.1)	---	See Greg. Heights (Plate 7.1)
	Mitigation	Insulation/ easement					---	---	---	---	---						---				---			---		---	
	Cost	$ TBD					---	---	---	---	---						---				---			---		---	
Gregory Heights Elementary School (Gregory Heights)	Impact	55 to 60 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	See Gregory Heights (Plate 7.1)	---	---	---	---	---	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	---	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	---	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	---	See Greg. Heights (Plate 7.1)	---	See Greg. Heights (Plate 7.1)
	Mitigation	Insulation/ easement					---	---	---	---	---						---				---			---		---	
	Cost	$ TBD					---	---	---	---	---						---				---			---		---	
Sylvester Middle School (Gregory Heights)	Impact	55 to 60 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	See Gregory Heights (Plate 7.1)	---	---	---	---	---	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	---	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	See Greg. Heights (Plate 7.1)	---	See Gregory Heights (Plate 7.1)	See Gregory Heights (Plate 7.1)	---	See Greg. Heights (Plate 7.1)	---	See Greg. Heights (Plate 7.1)
	Mitigation	Insulation/ easement					---	---	---	---	---						---				---			---		---	
	Cost	$ TBD					---	---	---	---	---						---				---			---		---	
Hazel Valley Elementary School (Downtown)	Impact	55 to 60 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	See Down-town (Plate 7.1)	See Down-town (Plate 7.1)	See Down-town (Plate 7.1)	---	---	---	---	---	---	See Down-town (Plate 7.1)	See Down-town (Plate 7.1)	---	---	---	---	---	See Down-town (Plate 7.1)	See Down-town (Plate 7.1)	---	See Down-town (Plate 7.1)	---	---
	Mitigation	Insulation/ easement							---	---	---	---	---	---			---	---	---	---	---			---		---	
	Cost	$ TBD							---	---	---	---	---	---			---	---	---	---	---			---		---	
Salmon Creek Elementary School (North Central)	Impact	55 to 60 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	See North Central (Plate 7.1)	See North Central (Plate 7.1)	See North Central (Plate 7.1)	See North Central (Plate 7.1)	---	---	---	---	---	See North Central (Plate 7.1)	See North Central (Plate 7.1)	---	---	---	---	---	See North Central (Plate 7.1)	See North Central (Plate 7.1)	---	---	---	See North Central (Plate 7.1)
	Mitigation	Insulation/ easement								---	---	---	---	---			---	---	---	---	---			---		---	
	Cost	$ TBD								---	---	---	---	---			---	---	---	---	---			---		---	
Seahurst Elementary School (Seahurst)	Impact	55 to 60 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	See Seahurst (Plate 7.1)	See Seahurst (Plate 7.1)	---	---	---	---	---	---	---	See Seahurst (Plate 7.1)	See Seahurst (Plate 7.1)	---	---	---	---	---	---	---	---	See Sea-hurst (Plate 7.1)	---	See Sea-hurst (Plate 7.1)
	Mitigation	Insulation/ easement						---	---	---	---	---	---	---			---	---	---	---	---			---		---	
	Cost	$ TBD						---	---	---	---	---	---	---			---	---	---	---	---			---		---	
Shorewood Elementary School (Shore-wood)	Impact	55 to 60 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	See Shore-wood (Plate 7.1)	---	See Shore-wood (Plate 7.1)	See Shore-wood (Plate 7.1)	---	---	---	---	---	See Shore-wood (Plate 7.1)	See Shore-wood (Plate 7.1)	---	---	---	---	---	See Shore-wood (Plate 7.1)	---	See Shore-wood (Plate 7.1)	---	See Shore-wood (Plate 7.1)	See Shore-wood (Plate 7.1)
	Mitigation	Insulation/ easement					---			---	---	---	---	---			---	---	---	---	---			---			
	Cost	$ TBD					---			---	---	---	---	---			---	---	---	---	---			---			
Marine Tech Lab. (Shore-wood)	Impact	55 to 60 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	See Shore-wood (Plate 7.1)	---	See Shore-wood (Plate 7.1)	See Shore-wood (Plate 7.1)	---	---	---	---	---	See Shore-wood (Plate 7.1)	See Shore-wood (Plate 7.1)	---	---	---	---	---	See Shore-wood (Plate 7.1)	---	See Shore-wood (Plate 7.1)	---	See Shore-wood (Plate 7.1)	See Shore-wood (Plate 7.1)
	Mitigation	Insulation/ easement					---			---	---	---	---	---			---	---	---	---	---			---			
	Cost	$ TBD					---			---	---	---	---	---			---	---	---	---	---			---			
Cedarhurst Elementary School (North East)	Impact	65 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	See North East (Plate 7.1)	See North East (Plate 7.1)	See North East (Plate 7.1)	See North East (Plate 7.1)	See North East (Plate 7.1)	See North East (Plate 7.1)	See North East (Plate 7.1)	See North East (Plate 7.1)	See North East (Plate 7.1)	See North East (Plate 7.1)	See North East (Plate 7.1)	See North East (Plate 7.1)	See North East (Plate 7.1)	See North East (Plate 7.1)	See North East (Plate 7.1)	---	See North East (Plate 7.1)	See North East (Plate 7.1)	---	See North East (Plate 7.1)	---	---
	Mitigation	Replace/ relocate																			---			---		---	---
	Cost	$ TBD																			---			---		---	---
Sunnydale Elementary School (East Central)	Impact	70 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	---	See East Central (Plate 7.1)	---	See East Central (Plate 7.1)
	Mitigation	Replace/ relocate																						---		---	
	Cost	$ TBD																						---		---	
Highline High School (East Central)	Impact	60 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	See East Central (Plate 7.1)	---	See East Central (Plate 7.1)	---	See East Central (Plate 7.1)
	Mitigation	Insulation/ easement																						---		---	
	Cost	$ TBD																						---		---	
Highline School/Hospital Facilities in City of Des Moines																											
Des Moines Elementary School (West Central)	Impact	60 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	---	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	---	See West Central (Plate 7.2)	See West Central (Plate 7.2)	---	See West Central (Plate 7.2)	---	See West Central (Plate 7.2)
	Mitigation	Insulation/ easement															---				---			---		---	
	Cost	$ TBD															---				---			---		---	

ENVIRONMENTAL IMPACT MATRIX - PUBLIC FACILITIES (continued)

Public Facility		Noise & Vibration				Air Quality						Surface Water Quality/Hydrology			Ground Water Quality/Hydrology		Wetlands	Floodplains			Aesthetics and Visual			Other			
Name	Measures	LDN	SEL	Over-Flights (TA)	Vibration	Air Emissions (Aircraft)	CO Emissions (Vehicles)	HC Emissions (Vehicles)	Air Toxics	Fugitive Emissions	Point Source	Runoff Volume	Erosion & Sediment	Spills	Aquifer Recharge	Contam-ination	Destruc-tion	Encroach-ment	Reduced Flood Storage Capacity	Increased Flow Rate & Volume	Ground Shadow	Visibility (Aircraft)	Visibility (Fill)	Special Status Species/ Hab.	Cult-ural Res's.	Coast. Zone	DOT Sec. 4(f) Res.
Highline School/Hospital Facilities in City of Des Moines (continued)																											
Olympic Elementary School	*Impact*	60 contour	Mitigated	Mitigated	Mitigated	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	---	See West Central (Plate 7.2)	See West Central (Plate 7.2)	See West Central (Plate 7.2)	---	See West Central (Plate 7.2)	See West Central (Plate 7.2)	---	See West Central (Plate 7.2)	---	See West Central (Plate 7.2)
	Mitigation	Insulation/ easement	by LDN	by LDN	by LDN												---				---			---		---	
(West Central)	*Cost*	$ TBD	measures	measures	measures												---				---			---		---	
Midway Elementary School	*Impact*	65 contour	Mitigated	Mitigated	Mitigated	See East Central (Plate 7.2)	See East Central (Plate 7.2)	See East Central (Plate 7.2)	See East Central (Plate 7.2)	See East Central (Plate 7.2)	See East Central (Plate 7.2)	---	---	---	See East Central (Plate 7.2)	See East Central (Plate 7.2)	---	---	---	---	---	See East Central (Plate 7.2)	---	---	---	---	---
	Mitigation	Replace/ relocate	by LDN	by LDN	by LDN							---	---	---			---	---	---	---	---		---	---	---	---	---
(East Central)	*Cost*	$ TBD	measures	measures	measures							---	---	---			---	---	---	---	---		---	---	---	---	---
Pacific Middle School	*Impact*	65 contour	Mitigated	Mitigated	Mitigated	See East Central (Plate 7.2)	See East Central (Plate 7.2)	See East Central (Plate 7.2)	See East Central (Plate 7.2)	See East Central (Plate 7.2)	See East Central (Plate 7.2)	---	---	---	See East Central (Plate 7.2)	See East Central (Plate 7.2)	---	---	---	---	---	See East Central (Plate 7.2)	---	---	---	---	---
	Mitigation	Replace/ relocate	by LDN	by LDN	by LDN							---	---	---			---	---	---	---	---		---	---	---	---	---
(East Central)	*Cost*	$ TBD	measures	measures	measures							---	---	---			---	---	---	---	---		---	---	---	---	---
Mount Rainier High School	*Impact*	65 contour	Mitigated	Mitigated	Mitigated	See East Central (Plate 7.2)	See East Central (Plate 7.2)	See East Central (Plate 7.2)	See East Central (Plate 7.2)	See East Central (Plate 7.2)	See East Central (Plate 7.2)	---	---	---	See East Central (Plate 7.2)	See East Central (Plate 7.2)	---	---	---	---	---	See East Central (Plate 7.2)	---	---	---	---	---
	Mitigation	Replace/ relocate	by LDN	by LDN	by LDN							---	---	---			---	---	---	---	---		---	---	---	---	---
(East Central)	*Cost*	$ TBD	measures	measures	measures							---	---	---			---	---	---	---	---		---	---	---	---	---
North Hill Elementary School	*Impact*	60 contour	See North Hill (Plate 7.2)	See North Hill (Plate 7.2)	See North Hill (Plate 7.2)	See North Hill (Plate 7.2)	See North Hill (Plate 7.2)	See North Hill (Plate 7.2)	See North Hill (Plate 7.2)	See North Hill (Plate 7.2)	See North Hill (Plate 7.2)	See North Hill (Plate 7.2)	See North Hill (Plate 7.2)	See North Hill (Plate 7.2)	See North Hill (Plate 7.2)	See North Hill (Plate 7.2)	---	See North Hill (Plate 7.2)	See North Hill (Plate 7.2)	See North Hill (Plate 7.2)	---	See North Hill (Plate 7.2)	See North Hill (Plate 7.2)	---	---	---	---
	Mitigation	Insulation/ easement															---				---			---	---	---	---
(North Hill)	*Cost*	$ TBD															---				---			---	---	---	---
Parkside Elementary School	*Impact*	60 contour	Mitigated	Mitigated	Mitigated	See South Des Moines (Plate 7.2)	See South Des Moines (Plate 7.2)	See South Des Moines (Plate 7.2)	See South D M (Plate 7.2)	---	---	---	---	---	See South Des Moines (Plate 7.2)	See South Des Moines (Plate 7.2)	---	---	---	---	---	See South Des Moines (Plate 7.2)	---	---	---	---	See South D M (Plate 7.2)
	Mitigation	Insulation/ easement	by LDN	by LDN	by LDN					---	---	---	---	---			---	---	---	---	---		---	---	---	---	
(South Des Moines)	*Cost*	$ TBD	measures	measures	measures					---	---	---	---	---			---	---	---	---	---		---	---	---	---	
Highline School/Hospital Facilities in City of Normandy Park																											
Marvista Elementary School	*Impact*	55 to 60 contour	Mitigated	Mitigated	Mitigated	See South	---	See South	See South	---	---	See South	See South	See South	See South	See South	---	See South	See South	See South	---	See South	---	See South	See South	See South	See South
	Mitigation	Insulation/ easement	by LDN	by LDN	by LDN		---			---	---						---				---		---				
(South)	*Cost*	$ TBD	measures	measures	measures	(Plate 7.4)	---	(Plate 7.4)	(Plate 7.4)	---	---	(Plate 7.4)	(Plate 7.4)	(Plate 7.4)	(Plate 7.4)	(Plate 7.4)	---	(Plate 7.4)	(Plate 7.4)	(Plate 7.4)	---	(Plate 7.4)	---	(Plate 7.4)	(Plate 7.4)	(Plate 7.4)	(Plate 7.4)
Highline School/Hospital Facilities in City of SeaTac (outside study area)																											
Bow Lake Elementary School	*Impact*	60 contour	Mitigated	Mitigated	Mitigated	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation	Insulation/ easement	by LDN	by LDN	by LDN																						
(SeaTac)	*Cost*	$ TBD	measures	measures	measures																						
Madrona Elementary School	*Impact*	60 contour	Mitigated	Mitigated	Mitigated	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation	Insulation/ easement	by LDN	by LDN	by LDN																						
(SeaTac)	*Cost*	$ TBD	measures	measures	measures																						
McMicken Heights Elementary School	*Impact*	55 to 60 contour	Mitigated	Mitigated	Mitigated	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation	Insulation/ easement	by LDN	by LDN	by LDN																						
(SeaTac)	*Cost*	$ TBD	measures	measures	measures																						
Valley View Elementary School	*Impact*	55 to 60 contour	Mitigated	Mitigated	Mitigated	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation	Insulation/ easement	by LDN	by LDN	by LDN																						
(SeaTac)	*Cost*	$ TBD	measures	measures	measures																						
Chinook Middle School	*Impact*	55 to 60 contour	Mitigated	Mitigated	Mitigated	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation	Insulation/ easement	by LDN	by LDN	by LDN																						
(SeaTac)	*Cost*	$ TBD	measures	measures	measures																						

ENVIRONMENTAL IMPACT MATRIX - PUBLIC FACILITIES (continued)

Public Facility		Noise & Vibration				Air Quality						Surface Water Quality/Hydrology			Ground Water Quality/Hydrology		Wetlands	Floodplains			Aesthetics and Visual			Other			
Name	Measures	LDN	SEL	Over-Flights (TA)	Vibration	Air Emissions (Aircraft)	CO Emissions (Vehicles)	HC Emissions (Vehicles)	Air Toxics	Fugitive Emissions	Point Source	Runoff Volume	Erosion & Sediment	Spills	Aquifer Recharge	Contam-ination	Destruc-tion	Encroach-ment	Reduced Flood Storage Capacity	Increased Flow Rate & Volume	Ground Shadow	Visibility (Aircraft)	Visibility (Fill)	Special Status Species/ Hab.	Cult-ural Res's.	Coast. Zone	DOT Sec. 4(F) Res.
Highline School/Hospital Facilities in City of SeaTac (continued)																											
Tyee High School (SeaTac)	Impact	55 to 60 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation	Insulation/ easement																									
	Cost	$ TBD																									
Sea-Tac Occupa-tional Skill (SeaTac)	Impact	55 to 60 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation	Insulation/ easement																									
	Cost	$ TBD																									
Highline School/Hospital Facilities in City of Seattle (outside study area)																											
Hilltop Elementary School (Seattle)	Impact	60 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation	Insulation/ easement																									
	Cost	$ TBD																									
Mount View Elementary School (Seattle)	Impact	55 to 60 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation	Insulation/ easement																									
	Cost	$ TBD																									
Riverton Heights Elementary School (Seattle)	Impact	60 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation	Insulation/ easement																									
	Cost	$ TBD																									
Southern Heights Elementary School (Seattle)	Impact	65 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation	Replace/ relocate																									
	Cost	$ TBD																									
Cascade Middle School (Seattle)	Impact	55 to 60 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation	Insulation/ easement																									
	Cost	$ TBD																									
Evergreen High School (Seattle)	Impact	55 to 60 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation	Insulation/ easement																									
	Cost	$ TBD																									
Highline School/Hospital Facilities in Unincorporated King County (outside study area)																											
Beverly Park Elementary School (County)	Impact	65 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation	Replace/ relocate																									
	Cost	$ TBD																									
White Center Elementary School (County)	Impact	55 to 60 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation	Insulation/ easement																									
	Cost	$ TBD																									
Satellite Alternate High School (County)	Impact	65 contour	Mitigated by LDN measures	Mitigated by LDN measures	Mitigated by LDN measures	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation	Replace/ relocate																									
	Cost	$ TBD																									
Total	$ TBD	$ TBD	$0.0 M	$0.0 M	$0.0 M																						

SECTION 8

POTENTIAL TRANSPORTATION IMPACTS AND MITIGATION

SECTION 8
POTENTIAL TRANSPORTATION IMPACTS AND MITIGATION

8.01 - INTRODUCTION

As a result of construction of the Third Runway, there are two general areas of impact to the existing roadway network in the study area:

- Congestion on the network; and,
- Physical damage to the network.

These will occur over two periods of time:

- During construction of the Third Runway, projected in the EIS to be from 1997 to 2000; and,

- After construction of the Third Runway in the period from 2000 to 2020 when the full proposed Master Plan is implemented.

The transportation impacts and mitigation approach taken was to initially determine and list those measurable factors that would enable an impact analysis based upon a reasonable set of data as opposed to a qualitative approach which would be exposed to more opinion rather than reasonableness.

The second step was to assess each measurable factor against an established roadway network in the study area comprised of the freeways, principal arterials, and minor arterials. This functional system will carry the bulk of the Airport-related traffic and is shown in Figure 8.01.

The next step taken was to make a reasoned attempt to identify "types" of improvements to this network that would address the impact factors identified, but which could be implemented in a corridor or areawide approach that would address many impacts with a minimum of cost. The key component was the development of a unit-cost approach for each type of improvement that could be applied on a corridor basis.

Finally, the type of improvement needed to mitigate the identified impacts was determined, the unit-cost for the improvement was applied to the impacted network, and mitigation costs were summarized by City and neighborhood.

Of course, the full cost of mitigation of traffic and transportation impacts is not attributable to construction of the Third Runway or overall Airport operations. The equitable distribution or *pro rata* share of these costs has not yet been determined. A cost-allocation model must be developed to determine the *pro rata* share and should be based upon a comprehensive origin-destination study.

Since the EIS evaluated only those intersections immediately surrounding the Airport, it became necessary to establish a roadway network that potentially would be impacted within the study area. This network was developed using a functional system of roadways that would reasonably carry the bulk of the traffic during and after construction. These roadways were defined as the freeways and principal arterials. However, during the construction phase, if the "trucking only" alternative is selected for the haul of 20 MCY of fill material, significant diversion off the freeway system to the principal arterials is expected. Because these principal arterials are currently operating with high traffic volumes, further diversion to the local minor arterials is projected. therefore, the selected roadway network consists of the following functional classifications:

- Freeways;
- Principal arterials; and,
- Minor arterials.

The adopted Comprehensive Plans for the five impacted communities in the study area were referenced and the study area roadway network was proposed. This network was also previously shown on Figure 8.01. Table 8.01 describes this network by City and jurisdiction.

Table 8.01
Study Area Thoroughfare Network

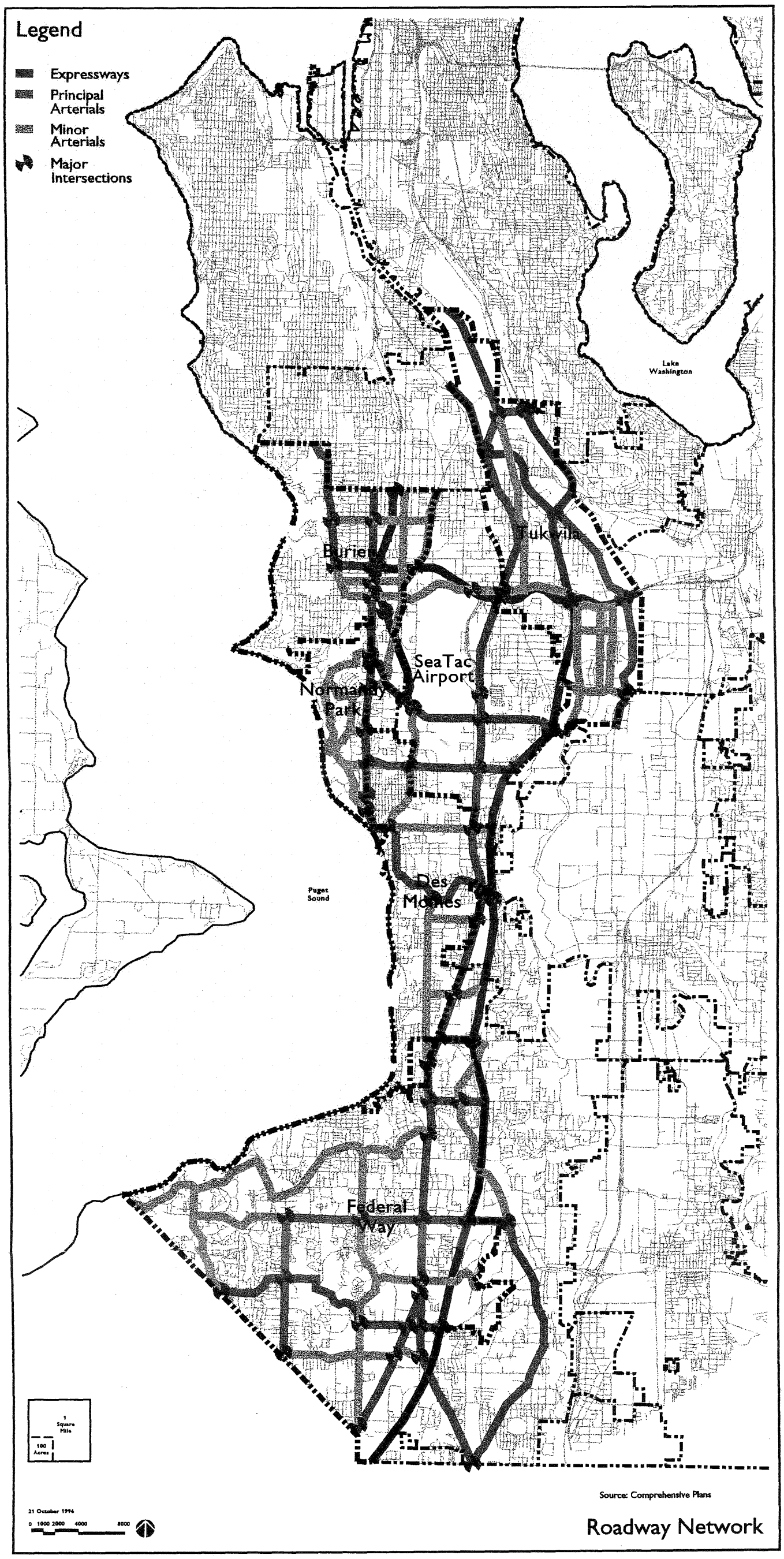
Functional Classification	Local					State
	Burien	Des Moines	Federal Way	Normandy Park	Tukwila	
State						
Freeways	- - -	- - -	- - -	- - -	- - -	31 miles
Principal arterials	- - -	- - -	- - -	- - -	- - -	6 miles
Local						
Principal arterials	5 miles	7 miles	19 miles	0 miles	9 miles	- - -
Minor arterials	9 miles	7 miles	21 miles	7 miles	11 miles	- - -
Number of major intersections	10	9	20	5	10	- - -

(Source: Draft and Adopted Comprehensive Plans for the Cities of Burien, Des Moines, Federal Way, Normandy Park, and Tukwila)

The measurable factors (measures) for the following four areas of analysis used were:

- **Congestion**
  - Level of service
  - Accidents
  - School bus operations
  - Transit operations
  - Police and emergency operations
  - Parking and pedestrian circulation
  - Traffic noise (LEQ)

Figure 8.01
Thoroughfare Network



- **Physical Damage**
  - Local street system
  - State street system
  - Bridge ratings and pavement condition
  - Increased maintenance and reconstruction

- **Construction Impacts**
  - Truck haul routes
  - Barge/rail/conveyor systems
  - Traffic diversion
  - Traffic control
  - Construction staging and phasing
  - Work-force traffic
  - Concurrent construction projects

- **Post-Construction Impacts**
  - Additional traffic
  - Increased operation and maintenance costs
  - Master plan implementation

8.02 - TYPES OF IMPROVEMENTS

Reliable and current traffic data and a uniform set of forecasts for the Years 2000 and 2020 for the network of freeways, principal arterials and minor arterials surrounding the Airport was not available. Thus, an approach was taken in an attempt to quantify a level of mitigation for traffic and transportation impacts that would have the following attributes:

- Clear, reasonable and not overstated.

- Cost-effective in that a single mitigation item would address multiple impacts.

- Corridor-based and not spot-based improvements to enable an economy of scale and a comprehensive approach.

- Average unit-cost approach based upon actual program costs within the impacted communities.

- Program-based versus-project-based to enable the development of the project list when the detailed traffic study becomes available.

Two general types of improvements were developed into a mitigation program to address the issues of increased congestion and physical damage to the infrastructure - Increased Efficiency and Damage Reconstruction. These improvements are discussed below.

Increased Efficiency

The program of improvements developed to address congestion impacts are intended to be the minor Transportation System Management (TSM), or Congestion Management System (CMS), types of improvements applied on a corridor basis. They are not intended to be the heavy capital investment types of improvements. This approach was taken because it is recognized that not every roadway on the entire network is, or will be, in need of TSM/CMS type improvements as a result of the implementation of the Airport Master Plan. However, it is also recognized that there will be one major capital intensive project that will be identified as needed for mitigation. The objection is that the program "budget" for mitigation established on a TSM/CMS basis for the entire network will cover the actual expenditures when one route is not improved at all and another route needs a much greater investment than estimated using the unit cost approach. While the actual mitigation costs will not be fully known until contractor bids are opened, this approach appears to be the best basis of accuracy and reasonableness with the data available.

The type of TSM/CMS improvements considered include:

- Traffic signal interconnects.
- Re-timing of existing traffic signals.
- Upgrade signal controllers.
- New signal heads, masts, etc.
- New signalized intersections.
- Left/right turn lanes.
- Minor lane widening at intersections.
- Lane restriping
- Signage.
- Speed limitations
- Parking restrictions.
- Pedestrian signals and crosswalks.
- Sidewalks.
- Emergency vehicle signal pre-emption.

This program of TSM/CMS improvements does not provide any increases in the capacity of the existing network. It is intended to improve the flow of traffic with a minimum investment. If an increase in capacity of a particular route is identified as needed for mitigation, the TSM/CMS based program budgets should include the costs.

Damage Reconstruction

The second type of improvement investigated was directed at addressing the physical damage to the roadway network, primarily due to the "trucking-only" alternative for the haul of fill material during construction of the Third Runway, but also due to normal "wear and tear" on the system attributable to increased traffic. Normal deterioration is traditionally addressed by annualized resurfacing programs; however, a targeted mitigation program will be necessary to prevent excessive damage during the construction phase.

The primary focus during a truck-haul construction phases is damage to pavement and bridge decks caused by repeated heavy loads. This impact will be felt mostly on the State freeway network during the construction phase.

A major goal of this mitigation plan is to keep the haul trucks on the freeway network and construct a temporary connection from the freeway network directly into the Airport property and/or construction site without passing through the SR 509/SR 518 interchange which is reported to be the highest accident location in the region.

The first level of bridge repair is replacement of the deck, followed by rehabilitation of the bridge and in the most severe circumstance, replacement of the bridge at a very high cost. The mitigation program is based upon replacement of all the bridge decks within the study area, recognizing that not all decks will need to be replaced. The analysis further recognized that seismic retrofit of bridges in the study area may become a necessary element and added cost.

Aside from damage to the bridge decks, there is also the potential for damage to the pavement by the repeated heavy truck loads, particularly in areas where the pavement base may be weakened due to freeze-thaw activity or settlement around cross-pipes. The universally recognized pothole will become a constant maintenance issue during the haul activity.

The potential damage to the freeway pavement is focused on the heavy trucks during construction, while potential damage to the principal and minor arterials is primarily focused on increased general traffic loads which should be addressed by normal annualized resurfacing programs on the local streets. However, the frequency of scheduled repairs may increase due to increased traffic caused by the Airport Master Plan implementation.

The two types of improvements identified to mitigate physical damage impacts to the pavements on the State and local network is resurfacing, followed by the more expensive pavement reconstruction. Widening of roadways to increase capacity is not considered in the cost analysis.

The mitigation program for pavements is based upon a resurfacing (only) of the entire system every 5 years. This approach recognizes that not all routes need to be resurfaced every 5 years; however, some routes may need to be reconstructed once over the 25-year time-span of this analysis at three times the cost of a resurfacing.

Unit Costs

The unit costs developed for the mitigation of congestion and physical damage impacts were based upon the following sources:

- City of Burien Comprehensive Plan - GMA Transportation Element (The Transpo Group, Inc., 18 December 1995).

- City of Des Moines, Transportation Recommended Roadway Improvements (The Transpo Group, Inc., 18 October 1995).

- City of Federal Way Comprehensive Plan, Transportation Improvement Program (November 1995).

- City of SeaTac, 1997-2006 Transportation Improvement Program (7 June 1996).

- Puget Sound Regional Council, 1996-1998 Regional Transportation Improvement Program, King County Projects (28 September 1995).

- Washington State Department of Transportation, 1997-2016 State Highway System Plan, Northwest Region (March 1996).

The resultant average unit costs for the various types of mitigation obtained from the referenced transportation improvement programs were as follows:

• Signals and turn lanes	$500,000 per mile
• Corridor improvements	$1,400,000 per mile
• Bridge decks	$500,000 each
• Bridge rehabilitation	$600,000 each
• Bridge replacement	$1,800,000 each
• Bridge seismic retrofits	$1,000,000 each
• Roadway resurfacing	$400,000 per mile
• Roadway reconstruction	$1,300,000 per mile

These average unit costs were then applied to the roadway network as described previously for corridor-based congestion and physical damage impact mitigation program development. Within the study area the total network includes:

- 31 miles of freeways
- 36 miles of principal arterials
- 55 miles of minor arterials
- 54 major intersections

Bridges impacted were only on the State freeway system.

The resultant corridor-based, cost-effective program of TSM/CMS improvements, bridge repairs and resurfacing programs follows in Sections 8.03 through 8.25.

- City of Des Moines, Transportation Recommended Roadway Improvements (The Transpo Group, Inc., 18 October 1995).

- City of Federal Way Comprehensive Plan, Transportation Improvement Program (November 1995).

- City of SeaTac, 1997-2006 Transportation Improvement Program (7 June 1996).

- Puget Sound Regional Council, 1996-1998 Regional Transportation Improvement Program, King County Projects (28 September 1995).

- Washington State Department of Transportation, 1997-2016 State Highway System Plan, Northwest Region (March 1996).

The resultant average unit costs for the various types of mitigation obtained from the referenced transportation improvement programs were as follows:

• Signal interconnect	$200,000 per mile
• Signals and turn lanes	$500,000 per mile
• Corridor improvements	$1,400,000 per mile
• Bridge decks	$500,000 each
• Bridge rehabilitation	$600,000 each
• Bridge replacement	$1,800,000 each
• Bridge seismic retrofits	$1,000,000 each
• Roadway resurfacing	$400,000 per mile
• Roadway reconstruction	$1,300,000 per mile

These average unit costs were then applied to the roadway network as described previously for corridor-based congestion and physical damage impact mitigation program development. Within the study area the total network includes:

- 31 miles of freeways
- 36 miles of principal arterials
- 55 miles of minor arterials
- 54 major intersections

Bridges impacted were only on the State freeway system.

The resultant corridor-based, cost-effective program of TSM/CMS improvements, bridge repairs and resurfacing programs follows in Sections 8.03 through 8.25.

8.03 - CONGESTION - LEVEL OF SERVICE MITIGATION

Table 8.02 shows the acceptable Level of Service (LOS) established by each of the five impacted communities for its local streets. In most cases, the threshold is LOS "E". As traffic increases, local LOS may deteriorate, necessitating capital improvements to improve traffic flow. Further traffic studies will be necessary to determine where additional improvements are necessary to bring the LOS back up to "E".

Table 8.02
Acceptable LOS Levels in the Five Impacted Communities and King County

Area	LOS Criteria
Burien	Comprehensive Plan in development
Des Moines	D - residential E - commercial F - SR 99 corridor
Federal Way	E
Normandy Park	C
Tukwila	D - residential E - commercial
King County	E

An increase in traffic volumes will concurrently decrease the LOS of area thoroughfares. Each city has established acceptable performance levels - the average minimum LOS for each city is LOS "E". Table 8.03 projects study area neighborhoods in which the LOS deteriorates as a result of increased airport traffic. These LOS deteriorations may be addressed by the implementation of traffic system management projects which improve operations. An origin-destination survey, screen line analysis, or select-link analysis will be necessary to determine the amount of traffic impacts attributable to the proposed project.

It is recommended that the areas identified in Table 8.03 be mitigated prior to construction of the Third Runway. An origin-destination survey and a cost-allocation model should also be developed to determine the amount of impacts attributable to Airport traffic (see Section 8.24).

Table 8.03
Neighborhoods Identified for Level of Service Mitigation

City	Area	Amount
Burien	Shorewood neighborhood	$1.2 million
	North Central neighborhood	$1.6 million
	North East neighborhood	$9.8 million
	Central neighborhood	$1.3 million
	East Central neighborhood	$9.8 million
	Downtown neighborhood	$2.7 million
	Total - Burien	**$26.4 million**
Des Moines	North Hill neighborhood	$3.5 million
	West Central neighborhood	$1.6 million
	East Central neighborhood	$5.2 million
	Zenith neighborhood	$1.2 million
	South Des Moines neighborhood	$2.3 million
	East Woodmont neighborhood	$2.3 million
	West Woodmont neighborhood	$0.8 million
	Total - Des Moines	**$16.9 million**
Federal Way	Star Lake neighborhood	$4.0 million
	Wildwood neighborhood	$4.6 million
	Easter Lake neighborhood	$2.0 million
	Steel Lake neighborhood	$3.3 million
	First Avenue neighborhood	$1.7 million
	Kitts Corner North neighborhood	$2.1 million
	City Center neighborhood	$3.1 million
	Total - Federal Way	**$20.8 million**
Normandy Park	Bonniewood neighborhood	$0.2 million
	North neighborhood	$1.3 million
	Manhattan neighborhood	$1.0 million
	East Central neighborhood	$1.7 million
	Normandy Province neighborhood	$0.2 million
	Arrow Lake neighborhood	$0.6 million
	South neighborhood	$4.8 million
	Total - Normandy Park	**$9.8 million**
Tukwila	Ryan neighborhood	$0.8 million
	Allentown neighborhood	$4.0 million
	Cascade View neighborhood	$1.1 million
	Foster neighborhood	$1.5 million
	Thorndyke neighborhood	$4.3 million
	Tukwila Hill neighborhood	$4.9 million
	McMicken neighborhood	$1.0 million
	M.I.C. neighborhood	$8.6 million
	Riverton neighborhood	$3.8 million
	CBD neighborhood	$11.1 million
	Tukwila Valley South neighborhood	$2.6 million
	Total - Tukwila	**$43.7 million**
Total Study Area		**$117.6 million**

8.04 - CONGESTION - ACCIDENT MITIGATION

Neighborhoods with major intersections may experience an increase in accidents as traffic increases. Intersection improvements will be necessary to reduce this potential.

An increase in traffic volumes will concurrently increase the potential for accidents. However, the improvements made in association with TSM and CMS with concurrently reduce the potential for accidents on these same roadways. Therefore, neighborhoods that are projected to experience an increase in vehicular accidents associated with the proposed project will be concurrently mitigated by intersection improvements (see Table 8.03 above).

Preliminary estimation of mitigation costs for transportation impacts within the City of Federal Way will be deferred until the Areawide Traffic Study has been completed. Therefore, cost estimates for mitigation of accident impacts are not shown at this time within the City of Federal Way.

8.05 - CONGESTION - SCHOOL BUS OPERATION MITIGATION

Neighborhoods with school bus routes may experience increases in delays and schedule adjustments due to increased local and diversion traffic during project construction and operation. The Highline School District may need to develop alternate routes to prevent lengthening of travel time and to minimize the impacts of traffic congestion. In the study area, only the cities of Burien, Des Moines, and Normandy Park are served by the Highline School District (Federal Way and Tukwila are served by other districts which were not part of this study.) The Highline School District also serves neighborhoods within the Cities of SeaTac and Seattle. In these instances, the school impacts were part of the study scope, but remaining other neighborhood impacts were not included.

An increase in traffic volumes will increase potential delays for school buses. Additional equipment, drivers, and alternate routes may be necessary to address these delays. An origin-destination survey, screen line analysis, or select-link analysis will be necessary to determine the number of bus routes affected by increased traffic associated with the proposed project. However, neighborhoods that are projected to experience an increase in school bus delays should be concurrently mitigated by intersection improvements (see Table 8.03 above). Additional equipment and alternative routes also may be necessary for these neighborhoods, plus additional neighborhoods in the Cities of SeaTac and Seattle which are served by the Highline School District. (As indicated above, preliminary estimation of mitigation costs for transportation impacts within the City of Federal Way will be deferred until the Areawide Traffic Study has been completed. Therefore, cost estimates for mitigation of school bus impacts are not shown at this time within the City of Federal Way.)

It is recommended that any additional mitigation for Highline School District school bus impacts be assessed and completed prior to commencement of construction of the Third Runway. Highline School District school bus mitigation may include re-routing/rescheduling, relocation of bus-stops, and/or additional buses and drivers.

8.06 - CONGESTION - TRANSIT BUS OPERATION MITIGATION

Neighborhoods with regularly-scheduled public transit service may experience decreases in service due to increased local and diversion traffic during project construction and operation. The Regional Transit Authority (RTA) may need to develop alternate routes to prevent lengthening of travel time and to minimize the impacts of traffic congestion and cost of operations.

An increase in traffic volumes will increase potential delays for transit buses. Additional equipment, drivers, and alternate routes may be necessary to address these delays. An origin-destination survey, screen line analysis, or select-link analysis will be necessary to determine the number of bus routes affected by increased traffic associated with the proposed project. However, neighborhoods that are projected to experience an increase in transit bus delays should be concurrently mitigated by intersection improvements (see Table 8.03 above). Additional equipment and alternative routes may also be necessary for these neighborhoods. (Preliminary estimation of mitigation costs for transportation impacts within the City of Federal Way will be deferred until the Areawide Traffic Study has been completed. Therefore, cost estimates for mitigation of transit bus impacts are not shown at this time within the City of Federal Way.)

It is recommended that any additional transit impact mitigation be assessed and completed prior to commencement of construction of the Third Runway. Transit mitigation may include re-routing/rescheduling, relocation of bus-stops, and/or additional buses and drivers.

8.07 - CONGESTION - POLICE AND EMERGENCY VEHICLE OPERATION MITIGATION

Increased local and diversion traffic during project construction and operation may hamper the ability of emergency vehicles to access all neighborhood areas. Additional equipment and personnel may be required to address the reduced response time. Additional public safety stations may be necessary to address response time problems.

An increase in traffic volumes will result in a decrease in the response time by emergency service personnel (police, fire, ambulance, etc.). Additional equipment, drivers, and new public safety sub-stations may be necessary to address these delays. An origin-destination survey, screen line analysis, or select-link analysis will be necessary to determine the number of emergency services affected by increased traffic associated with the proposed project. The neighborhoods that are projected to experience an decrease in response times should be concurrently mitigated by intersection improvements (see Table 8.03 above). Additional equipment, personnel, and station locations may eventually be necessary to address response time delays for these communities. (Preliminary estimation of mitigation costs for transportation impacts within the City of Federal Way will be deferred until the Areawide Traffic Study has been completed. Therefore, cost estimates for mitigation of emergency vehicle access impacts are not shown at this time within the City of Federal Way.)

It is recommended that public safety response times in the five impacted communities be continually monitored during the construction phase of the Third Runway. Reductions in response times should be addressed by additional equipment, personnel, or new station locations. The origin-destination survey and cost-allocation model (Section 8.24) should be used to determine the amount of response time decrease attributable to Airport traffic.

8.08 - CONGESTION - PARKING AND PEDESTRIAN ACCESS MITIGATION

Increased local and diversion traffic during project construction and operation may negatively impact parking access to local businesses, schools, churches, and stores. Increased traffic may also conflict with pedestrian circulation. Additional parking, circulation, and pedestrian linkage studies are necessary to further determine these impacts.

An increase in traffic volumes will result in potential conflicts with pedestrian and parking circulation patterns. Intersection improvements associated with level of service improvements will simultaneously address these impacts (see Table 8.03). Preliminary estimation of mitigation costs for transportation impacts within the City of Federal Way will be deferred until the Areawide Traffic Study has been completed. Therefore, cost estimates for mitigation of parking and pedestrian access impacts are not shown at this time within the City of Federal Way.

8.09 - CONGESTION - TRAFFIC NOISE MITIGATION

Neighborhoods adjacent to high-volume roadways (including freeways and principal and minor arterials) will experience an accompanying increase in traffic noise as traffic increases. Improvements to the traffic management system will address both traffic flow and noise.

An increase in traffic volumes will concurrently increase associated traffic noise. Traffic noise may be addressed by the installation of sound abatement wall systems along grade-separated highways and by constructing intersection improvements to smooth out traffic flow. An origin-destination survey, screen line analysis, or select-link analysis will be necessary to determine the amount of traffic impacts attributable to the proposed project. Intersection improvements associated with level of service improvements will simultaneously address traffic noise impacts (see Table 8.03). Preliminary estimation of mitigation costs for transportation impacts within the City of Federal Way will be deferred until the Areawide Traffic Study has been completed. Therefore, cost estimates for mitigation of traffic noise impacts are not shown at this time within the City of Federal Way.

8.10 - PHYSICAL DAMAGE - LOCAL STREET SYSTEM MITIGATION

Neighborhoods that are subjected to increased traffic may experience decreases in the serviceability index (SI) of the roadways. Reconstruction of the local arterials will be necessary to improve the thoroughfares as the SI decreases. An origin-destination survey will be necessary to determine the extent to which this increase in traffic is attributable to the Airport. Table 8.04 delineates the neighborhoods projected to require mitigation for physical damage to the local street system.

It is recommended that the areas identified in Table 8.04 for local street mitigation be continually monitored for serviceability index decreases. Roadways where the SI decrease should be reconstructed as soon as possible. The cost-allocation model (Section 8.24) should determine the amount of damage attributable to Airport traffic.

Table 8.04
Neighborhoods Identified for Physical Damage Mitigation (Local System)

City	Area	Amount
Burien	Shorewood neighborhood	$1.2 million
	North Central neighborhood	$1.6 million
	North East neighborhood	$4.6 million
	Seahurst neighborhood	$0.7 million
	Central neighborhood	$1.3 million
	East Central neighborhood	$3.5 million
	Gregory Heights neighborhood	$0.6 million
	South East neighborhood	$2.0 million
	Downtown neighborhood	$1.4 million
	Total - Burien	**$16.9 million**
Des Moines	North Hill neighborhood	$1.4 million
	West Central neighborhood	$2.1 million
	North Central neighborhood	$2.1 million
	East Central neighborhood	$2.1 million
	Zenith neighborhood	$2.1 million
	South Des Moines neighborhood	$2.1 million
	West Woodmont neighborhood	$0.8 million
	East Woodmont neighborhood	$0.5 million
	Downtown neighborhood	$0.6 million
	Total - Des Moines	**$13.8 million**
Federal Way	Star Lake neighborhood	$1.4 million
	Wildwood neighborhood	$2.1 million
	Mirror Lake neighborhood	$0.8 million
	Easter Lake neighborhood	$0.5 million
	First Avenue neighborhood	$0.5 million
	City Center neighborhood	$1.1 million
	Total - Federal Way	**$6.4 million**
Normandy Park	Bonniewood neighborhood	$0.2 million
	North neighborhood	$1.3 million
	Riviera neighborhood	$1.9 million
	Manhattan neighborhood	$1.0 million
	East Central neighborhood	$1.7 million
	Normandy Province neighborhood	$0.2 million
	Arrow Lake neighborhood	$0.6 million
	South neighborhood	$4.8 million
	Total - Normandy Park	**$11.7 million**
Tukwila	Cascade View neighborhood	$1.1 million
	Foster neighborhood	$1.7 million
	Thorndyke neighborhood	$3.0 million
	Tukwila Hill neighborhood	$2.1 million
	McMicken neighborhood	$0.3 million
	M.I.C. neighborhood	$5.1 million
	Riverton neighborhood	$1.9 million
	CBD neighborhood	$10.0 million
	Tukwila Valley South neighborhood	$2.0 million
	Total - Tukwila	**$27.2 million**
Total Study Area		**$103.2 million**

8.11 - PHYSICAL DAMAGE - STATE STREET SYSTEM MITIGATION

Neighborhoods that are subjected to increased traffic may experience decreases in the SI of the State-jurisdiction roadways. Resurfacing and reconstruction of the State roads will be necessary to improve the highways as the SI decreases. An origin-destination survey will be necessary to determine the extent to which this increase in traffic is attributable to the Airport. Table 8.05 delineates the neighborhoods projected to require mitigation for physical damage to the State street system.

It is recommended that the areas identified in Table 8.05 for State street mitigation be continually monitored for serviceability index decreases. Roadways where the SI decrease should be reconstructed as soon as possible. The cost-allocation model (Section 8.24) should determine the amount of damage attributable to Airport traffic.

8.12 - PHYSICAL DAMAGE - BRIDGE RATINGS AND PAVEMENT CONDITION MITIGATION

Neighborhoods with bridges may experience a decrease in the load rating of the State-maintained bridge due to heavy truck loadings. Eventually, the bridge rating will decrease to the point that trucks may be diverted and reconstruction of the bridge will be required. An origin-destination survey will be necessary to determine the extent to which this loss in rating is attributable to the Airport. Table 8.06 indicates the neighborhoods which may become eligible for bridge deck replacement and mitigation.

Due to the high potential for damage to the State freeway system due to repeated heavy loads of maximum weight limit vehicles over an extended three-year period, an immediate survey of the conditions of the bridge decks and pavement condition is necessary to establish the baseline against which any damage claims can be assessed. Existing bridge ratings and pavement condition indices should be reviewed and updated and a continuous monitoring system established.

It is recommended that the Washington State Department of Transportation should establish the baseline conditions of the bridges and pavement on the freeway routes most likely to be used from the borrow pit locations to the construction site and establish a system of monitoring prior to any truck movements. The monitoring system should include weigh-in-motion, bridge deck instrumentation, mobile pavement condition survey vehicle(s), and selected closed-circuit television/video monitoring.

Table 8.05
Neighborhoods Identified for Physical Damage Mitigation (State System)

City	Area	Amount
Burien	North East neighborhood	$1.9 million
	East Central neighborhood	$1.2 million
	South East neighborhood	$0.9 million
	Total - Burien	**$4.0 million**
Des Moines	East Central neighborhood	$2.3 million
	South Des Moines neighborhood	$0.5 million
	East Woodmont neighborhood	$0.8 million
	Total - Des Moines	**$3.6 million**
Federal Way	Star Lake neighborhood	$2.0 million
	Wildwood neighborhood	$1.3 million
	Marine Hills neighborhood	$0.5 million
	Easter Lake neighborhood	$0.6 million
	Steel Lake neighborhood	$1.5 million
	First Avenue neighborhood	$0.5 million
	Kitts Corner North neighborhood	$1.1 million
	City Center neighborhood	$1.3 million
	Total - Federal Way	**$8.8 million**
Normandy Park	No neighborhoods in Normandy Park have been identified for physical damage mitigation (State system).	**$0.0 million**
Tukwila	Ryan neighborhood	$0.3 million
	Allentown neighborhood	$1.2 million
	Foster neighborhood	$1.3 million
	Thorndyke neighborhood	$1.5 million
	Tukwila Hill neighborhood	$2.0 million
	McMicken neighborhood	$1.5 million
	M.I.C. neighborhood	$1.5 million
	Riverton neighborhood	$0.7 million
	CBD neighborhood	$1.3 million
	Tukwila Valley South neighborhood	$0.3 million
	Total - Tukwila	**$11.6 million**
Total Study Area		**$28.0 million**

Table 8.06
Neighborhoods Identified for Bridge Mitigation

City	Area	Amount
Burien	North East neighborhood	$8.5 million
	East Central neighborhood	$10.2 million
	South East neighborhood	$5.1 million
	Total - Burien	**$23.8 million**
Des Moines	East Central neighborhood	$1.7 million
	Total - Des Moines	**$1.7 million**
Federal Way	Star Lake neighborhood	$1.7 million
	Wildwood neighborhood	$1.7 million
	Steel Lake neighborhood	$1.7 million
	Kitts Corner North neighborhood	$1.7 million
	Total - Federal Way	**$6.8 million**
Normandy Park	North neighborhood	$1.7 million
	Total - Normandy Park	**$1.7 million**
Tukwila	Foster neighborhood	$6.8 million
	Thorndyke neighborhood	$3.4 million
	Tukwila Hill neighborhood	$3.4 million
	M.I.C. neighborhood	$1.7 million
	CBD neighborhood	$3.4 million
	Tukwila Valley South neighborhood	$1.7 million
	Total - Tukwila	**$20.4 million**
Total Study Area		**$54.4 million**

8.13 - PHYSICAL DAMAGE - INCREASED MAINTENANCE AND RECONSTRUCTION MITIGATION

Neighborhoods in which the SI and maintenance cycle decreases due to increased traffic may experience increased frequency of resurfacing and maintenance due to the increased traffic volume. An origin-destination survey will be necessary to determine the extent to which this increase in traffic is attributable to the Airport. Table 8.07 indicates the neighborhoods which may be eligible for increased maintenance and reconstruction mitigation.

It is recommended that the areas identified in Table 8.07 for increased maintenance and reconstruction mitigation be continually monitored for serviceability index decreases. Roadways where the SI decrease should be reconstructed as soon as possible. The cost-allocation model (Section 8.24) should determine the amount of damage attributable to Airport traffic.

Table 8.07
Neighborhoods Identified for Maintenance/Reconstruction Mitigation

City	Area	Amount
Burien	Shorewood neighborhood	$0.5 million
	North Central neighborhood	$0.5 million
	North East neighborhood	$1.3 million
	Seahurst neighborhood	$0.2 million
	Central neighborhood	$0.4 million
	East Central neighborhood	$1.0 million
	Gregory Heights neighborhood	$0.2 million
	South East neighborhood	$0.6 million
	Downtown neighborhood	$0.4 million
	Total - Burien	**$5.1 million**
Des Moines	North Hill neighborhood	$1.0 million
	West Central neighborhood	$0.5 million
	East Central neighborhood	$0.5 million
	Zenith neighborhood	$0.3 million
	South Des Moines neighborhood	$0.8 million
	East Woodmont neighborhood	$0.4 million
	Downtown neighborhood	$0.1 million
	Total - Des Moines	**$3.6 million**
Federal Way	Star Lake neighborhood	$0.5 million
	Wildwood neighborhood	$0.5 million
	Marine Hills neighborhood	$0.3 million
	Mirror Lake neighborhood	$0.8 million
	Easter Lake neighborhood	$0.6 million
	Steel Lake neighborhood	$0.1 million
	First Avenue neighborhood	$0.6 million
	Kitts Corner North neighborhood	$0.1 million
	City Center neighborhood	$0.4 million
	Total - Federal Way	**$3.9 million**

Table 8.07 (continued)

City	Area	Amount
Normandy Park	Bonniewood neighborhood	$0.1 million
	North neighborhood	$0.5 million
	Riviera neighborhood	$0.7 million
	Manhattan neighborhood	$0.4 million
	East Central neighborhood	$0.6 million
	Normandy Province neighborhood	$0.1 million
	Arrow Lake neighborhood	$0.2 million
	South neighborhood	$1.7 million
	Total - Normandy Park	**$4.3 million**
Tukwila	Ryan neighborhood	$0.1 million
	Allentown neighborhood	$0.3 million
	Cascade View neighborhood	$0.3 million
	Foster neighborhood	$0.9 million
	Thorndyke neighborhood	$1.3 million
	Tukwila Hill neighborhood	$1.2 million
	McMicken neighborhood	$0.5 million
	M.I.C. neighborhood	$1.9 million
	Riverton neighborhood	$0.8 million
	CBD neighborhood	$3.2 million
	Tukwila Valley South neighborhood	$0.7 million
	Total - Tukwila	**$11.2 million**
Total Study Area		**$28.1 million**

8.14 - CONSTRUCTION IMPACTS - TRUCK HAUL ROUTES MITIGATION

Neighborhoods with principal and minor arterials may experience increased construction truck traffic. The EIS identifies 20 MCY of fill material that will be necessary for construction of the Third Runway. If this fill material is hauled by truck, it should be confined to State freeways. Traffic that would normally use these highways may divert to local roads to avoid the trucks. Individual cities may need to implement truck traffic controls and assign a traffic officer to control traffic and enforce truck haul routes. Table 8.08 indicates neighborhoods where traffic control officers may be necessary to address truck traffic associated with construction of the Third Runway.

Table 8.08
Neighborhoods Identified for Truck Haul Mitigation

City	Area	Amount
Burien	Shorewood neighborhood	$50,000/year/location
	North Central neighborhood	$50,000/year/location
	North East neighborhood	$50,000/year/location
	Seahurst neighborhood	$50,000/year/location
	Central neighborhood	$50,000/year/location
	East Central neighborhood	$50,000/year/location
	Gregory Heights neighborhood	$50,000/year/location
	South East neighborhood	$50,000/year/location
	Downtown neighborhood	$50,000/year/location
Des Moines	East Central neighborhood	$50,000/year/location
	South Des Moines neighborhood	$50,000/year/location
	East Woodmont neighborhood	$50,000/year/location
Federal Way	Star Lake neighborhood	$50,000/year/location
	Wildwood neighborhood	$50,000/year/location
	Easter Lake neighborhood	$50,000/year/location
	Kitts Corner North neighborhood	$50,000/year/location
	City Center neighborhood	$50,000/year/location
Normandy Park	No neighborhoods in Normandy Park have been identified for truck haul mitigation.	
Tukwila	Allentown neighborhood	$50,000/year/location
	Foster neighborhood	$50,000/year/location
	Thorndyke neighborhood	$50,000/year/location
	Tukwila Hill neighborhood	$50,000/year/location
	McMicken neighborhood	$50,000/year/location
	M.I.C. neighborhood	$50,000/year/location
	Riverton neighborhood	$50,000/year/location
	CBD neighborhood	$50,000/year/location
	Tukwila Valley South neighborhood	$50,000/year/location

Two general methods have been proposed to bring in the fill material - either by conventional truck or by barge on Puget Sound to a conveyor system. Each alternative has its "pros" and "cons". A separate study by HNTB, Inc., evaluated several alternatives and gave the barge/conveyor system a high rank. As of this study, it has not yet been determined which alternative will be selected.

The truck haul alternative requires more time to bring in the fill material and would impact area freeways with additional truck traffic, mostly dual-trailer dump trucks ("doubles") which will impact other vehicular traffic.

The barge/conveyor system will bring in the same amount of fill in approximately half the time, but has the potential to significantly impact the creek corridor and the barge/conveyor transfer point along the Puget Sound coast.

It is recommended that the Port of Seattle establish contingency plans for the various alternatives for bringing in the fill material. If the truck haul alternative is selected, the Port of Seattle should require the contractor to establish a truck haul route system that keeps haul traffic on State highways or intestates only. Haul traffic should not be allowed on local streets. Haul traffic should also have restricted hours of operation. The Port or its contractor should be financially responsible or provide traffic control officers at needed locations. The haul traffic should also have its own dedicated construction exit/entrance on the appropriate State or interstate highways.

It is further recommended that prior to the start of construction of any work associated with Master Plan Update implementation, the Port of Seattle should identify all borrow source areas and haul routes. Then, the Port of Seattle should re-evaluate the roadway noise analysis to reflect the actual haul routes.

8.15 - CONSTRUCTION IMPACTS - BARGE/RAIL/CONVEYOR SYSTEMS MITIGATION

An alternate to trucking is the use of a series of barges to bring the fill material in to a delivery point where it can be off-loaded onto a conveyor system. While physically twice as fast as the truck haul alternative, it may result in significant environmental damage to the chosen corridor and the nearby coastal areas. An environmental impact study of the barge/conveyor system seems warranted to assure the integrity of the chosen corridor. The plan should also include operational mitigation and corridor restoration upon completion. Table 8.09 indicates neighborhoods where mitigation of the barge/conveyor alternative may be required, if it is assumed that the conveyor is installed along Des Moines Creek.

It is recommended that the Port of Seattle establish contingency plans for the various alternatives for bringing in the fill material. If the barge/conveyor alternative is selected, an environmental assessment should be conducted of the delivery/transfer point, the selected creek corridor, and the coastal zone north and south of the delivery/transfer point to establish its baseline condition. After the material is delivered, these areas will then be restored to their baseline condition or better. The Port or its contractor should also prepare a plan that keeps non-authorized personnel out of the conveyor system, that minimizes noise impacts on adjacent residents, and that contains an emergency contingency plan that addresses pollution, spills, sedimentation, erosion, and other system failures.

Table 8.09
Neighborhoods Identified for Barge/Conveyor Mitigation

City	Area	Amount
Burien	South East neighborhood	$ to be determined
	Total - Burien	**$ to be determined**
Des Moines	West Central neighborhood	$ to be determined
	North Central neighborhood	$ to be determined
	Downtown neighborhood	$ to be determined
	Total - Des Moines	**$ to be determined**
Federal Way	No neighborhoods in Federal Way have been identified for barge/conveyor mitigation.	
Normandy Park	South neighborhood	$ to be determined
	Total - Normandy Park	**$ to be determined**
Tukwila	No neighborhoods in Tukwila have been identified for barge/conveyor mitigation.	
Total Study Area		**$ to be determined**

8.16 - CONSTRUCTION IMPACTS - TRAFFIC DIVERSION MITIGATION

An increase in traffic volumes on the freeways will divert a portion of the traffic onto local streets which are not designed for such volumes. This has a ripple effect where the traffic on the freeways divert to the principal arterials which divert to the minor arterials. Improvement to minor arterials may be necessary to accommodate this increase in traffic. An origin-destination survey will be necessary to determine the extent to which this increase in traffic is attributable to the Airport. However, neighborhoods that are projected to experience an increase in diverted traffic will be simultaneously mitigated by level of service improvements (see Table 8.03).

A computer model should be developed to project the amount of traffic diversion for various operations of heavy trucks on the freeways as well as congestion diversions due to the full Airport Master Plan implementation.

It is recommended that a diversion model be prepared for the project which includes the network as shown in Figure 8.01. Improvements to the arterial system as a result of diversion should be implemented prior to the start of the hauling activity on the freeways. An arterial improvement program should be implemented prior to the construction of the Third Runway.

8.17 - CONSTRUCTION IMPACTS - TRAFFIC CONTROL MITIGATION

Neighborhoods adjacent to the Airport that also have major intersections may experience increases in traffic congestion. Existing traffic signals should be modified or modernized as necessary. In some cases, uncontrolled intersections may require signalization. However, neighborhoods that are projected to experience an increase need for traffic control will be simultaneously mitigated by level of service improvements (see Table 8.03).

8.18 - CONSTRUCTION IMPACTS - CONSTRUCTION STAGING AND PHASING MITIGATION

Neighborhoods adjacent to the construction site may experience impacts as result of construction operations and traffic. Traffic management improvement implemented in the congestion measures should automatically address these concerns. All other staging and phasing issues should be limited to on-Airport locations. However, neighborhoods that are projected to experience an increase need for traffic control will be simultaneously mitigated by level of service improvements (see Table 8.03).

8.19 - CONSTRUCTION IMPACTS - WORK-FORCE TRAFFIC MITIGATION

The Port of Seattle estimates approximately 2,000 construction workers will be employed during construction of the proposed project. There may be some localized traffic congestion at staging and other areas. In these cases, it is projected that this traffic will be mitigated by improvements made to address level of service problems (see Table 8.03).

8.20 - CONSTRUCTION IMPACTS - CONCURRENT CONSTRUCTION PROJECTS MITIGATION

There is the potential for other major projects to be simultaneously under construction in southern and central King County at the same time the Third Runway is being built, including:

- Regional Transit Authority (RTA) improvements for light-rail and bus-lanes.
- Construction of the new Mariners Ballpark stadium.
- Relocation or reconstruction of the Kingdome.
- Improvements to IH-5.
- Construction of the SR 509 extension.
- Improvements to SR 518.
- Improvements to SH 99/International Boulevard.

Overlapping construction phases of these projects (and others) combined with construction of the Third Runway could have significant impacts on the region's ability to meet traffic demand.

If these projects are not managed concurrently, there is the potential to impact **every neighborhood in every city in the study area**. Therefore, it is urged that the various implementing agencies establish a dialogue as soon as possible to prevent this overlapping from occurring, or at least to minimize impacts associated with phases that must overlap.

All neighborhoods in all impacted communities are projected to be impacted by overlapping concurrent projects. Each City should estimate the need for another 25% to its average annual transportation budget to address the need for short-term projects and studies.

8.21 - POST-CONSTRUCTION IMPACTS - ADDITIONAL TRAFFIC MITIGATION

An increase in traffic is expected to occur after construction is completed and the Third Runway is operational, requiring additional improvements to intersections, signalization, and roadway capacity. Neighborhoods with principal arterials that are adjacent to the Airport may experience increased traffic as a result of increased Airport demand. Additional transportation improvement projects may be necessary to address this increase in traffic. As stated above, an origin-destination survey will be necessary to determine the extent to which traffic is attributable to the Airport. Table 8.10 lists those neighborhoods that may require additional traffic mitigation.

It is recommended that the areas identified in Table 8.10 be monitored for additional traffic impacts after the Third Runway is operational. If traffic impacts exceed EIS projections, the cost-allocation model (Section 8.24) should be used to determine the amount of mitigation required due to Airport-related traffic impacts.

Preliminary estimation of mitigation costs for transportation impacts within the City of Federal Way will be deferred until the Areawide Traffic Study has been completed. Therefore, cost estimates for mitigation of additional traffic impacts are not shown at this time within the City of Federal Way.

Table 8.10
Neighborhoods Identified for Additional Traffic Mitigation

City	Area	Amount
Burien	Shorewood neighborhood	$2.4 million
	North Central neighborhood	$3.2 million
	North East neighborhood	$12.0 million
	Seahurst neighborhood	$2.6 million
	Central neighborhood	$2.6 million
	East Central neighborhood	$9.2 million
	South East neighborhood	$3.2 million
	Downtown neighborhood	$5.4 million
	Total - Burien	**$40.6 million**
Des Moines	North Hill neighborhood	$7.0 million
	West Central neighborhood	$3.2 million
	East Central neighborhood	$10.4 million
	Zenith neighborhood	$2.4 million
	South Des Moines neighborhood	$4.6 million
	East Woodmont neighborhood	$4.6 million
	Downtown neighborhood	$1.0 million
	Total - Des Moines	**$33.2 million**
Federal Way	No neighborhoods in Federal Way have been identified for mitigation of additional traffic.	**$0.0 million**
Normandy Park	Bonniewood neighborhood	$0.4 million
	North neighborhood	$2.6 million
	Riviera neighborhood	$3.8 million
	Manhattan neighborhood	$2.0 million
	East Central neighborhood	$3.4 million
	Normandy Province neighborhood	$0.4 million
	Arrow Lake neighborhood	$1.2 million
	South neighborhood	$9.6 million
	Total - Normandy Park	**$23.4 million**
Tukwila	Ryan neighborhood	$0.6 million
	Allentown neighborhood	$2.4 million
	Cascade View neighborhood	$2.2 million
	Foster neighborhood	$6.0 million
	Thorndyke neighborhood	$9.0 million
	Tukwila Hill neighborhood	$8.2 million
	McMicken neighborhood	$3.6 million
	M.I.C. neighborhood	$13.2 million
	Riverton neighborhood	$5.2 million
	CBD neighborhood	$22.6 million
	Tukwila Valley South neighborhood	$4.6 million
	Total - Tukwila	**$90.8 million**
Total Study Area		**$188.0 million**

8.22 - POST-CONSTRUCTION IMPACTS - INCREASED OPERATION AND MAINTENANCE COSTS MITIGATION

Neighborhoods with principal arterials that are adjacent to the Airport may experience increased maintenance costs as a result of increased Airport demand. Additional maintenance improvement projects may be necessary to address this increase in maintenance frequency. As stated above, an origin-destination survey will be necessary to determine the extent to which traffic is attributable to the Airport. However, improvements made to address level of service improvements (see Table 8.03) should also simultaneously address the needs for increased operation and maintenance costs.

8.23 - POST-CONSTRUCTION IMPACTS - MASTER PLAN IMPLEMENTATION MITIGATION

As the Airport's Master Plan is implemented, additional traffic may be experienced as a result of more employees, more airline personnel, more travelers, and more support services. Additional transportation improvement projects may be necessary to address this increase in traffic. As stated above, an origin-destination survey will be necessary to determine the extent to which traffic is attributable to the Airport. However, improvements made to address level of service improvements (see Table 8.03) should also simultaneously address the additional demands as a result of the full Master Plan Update implementation.

Like the existing conditions analysis, the future analysis should be evaluated again by the Port of Seattle in order to reflect more accurately the information available prior to the start of construction for Master Plan Update implementation. This, is in part, to reflect actual Airport area traffic information due to growth, changes in any traffic patterns, etc. The re-evaluation would benefit from the following:

- More accurate information on construction activities, in particular haul routes, so that construction traffic can be included in the roadway noise re-evaluation.
- More accurate information on vehicle classification and their use of the various roadways.
- The additional monitoring data obtained from the roadway noise monitoring sites.

8.24 - OTHER TRANSPORTATION MITIGATION MEASURES

Section 3 of this report analyzed the Airport's EIS and raised several concerns regarding the information presented on transportation issues. As a result, many of the projected transportation impacts and mitigation costs presented in this Section must be considered preliminary, at best, until the necessary studies are completed.

This study recommends that supplemental transportation studies be conducted **prior to Federal and State approval to proceed with the project.** While the Port of Seattle is the project sponsor, responsibility for these studies is expected to be the responsibility of various agencies and may involve at least the PSRC, the State of Washington Department of Transportation, the City of Seattle, King County, and the Port of Seattle.

The following supplemental transportation studies are suggested to be conducted prior to project approval.

Areawide Traffic Study

While the EIS performed an acceptable analysis of traffic at the 12 major intersections surrounding the Airport property, many issues regarding increased congestion and damage to streets will continue to be raised until hard data is available within the entire study area.

An areawide traffic study should be undertaken for the South King County area, including the Cities of Burien, Des Moines, Federal Way, Normandy Park and Tukwila, to establish existing baseline conditions and forecast levels of service on the roadway network as shown in Figure 8.01. This study should, as best possible, forecast traffic for the following time-frames:

- 1994 - EIS baseline.
- 1997 - Current.
- 2000 - EIS completion of Third Runway.
- 2020 - EIS full Airport Master Plan implementation.

This study should:

- Build upon the existing transportation plans of the above cities.
- Establish common level of service criteria for mitigation of Airport impacts.
- Address the issue of concurrent construction projects in the forecasts.
- Be conducted on a corridor-basis.
- Provide for monitoring and updating.
- Determine the current and projected levels of service on the network and major intersections.

It is recommended that as the project sponsor, the Port of Seattle should expand the EIS traffic analysis to the entire network as shown in Figure 8.01.

Origin-Destination (O-D) Survey

One of the key questions raised in Section 3 of this report was the affect of increased traffic on the local and State thoroughfare networks. According to Airport projections, future demand will roughly double whether or not the Airport expands its facilities. During this same time-frame, it is logical to project that there will be **some** increase in regional traffic unrelated to Sea-Tac International Airport. But it has not yet been determined what percentage of future traffic will be attributable to the Airport and what percentage is attributable to non-Airport regional growth.

Development of an origin-destination survey (or select link analysis or screen-line analysis) will project these percentages on major local and State roadways. The O-D survey should be the basis for assigning financial responsibility for transportation improvements which benefit various land uses, including the Airport.

It is recommended that in its capacity as the region's metropolitan transportation planning agency, the Puget Sound Regional Council should conduct an origin-destination (O-D) survey to determine the amount of regional traffic attributable to Sea-Tac International Airport. This survey should use the most recent data available and may necessitate extensive data collection and sampling of motorists. The percentage of traffic attributable to the Airport should be projected to the year 2020 in 5-year increments and be used for projecting cost-sharing of various transportation projects that serve and benefit Sea-Tac International Airport. These projects include, but are not limited to:

- **Thoroughfare projects to reduce traffic noise and accidents and to improve level of service.**
- **Thoroughfare projects to improve school bus, transit bus, and emergency service operations.**
- **Thoroughfare projects to improve parking and pedestrian circulation.**
- **Repair/reconstruction/replacement of local streets and State roads and bridges.**
- **Increased frequency of maintenance and reconstruction of local and State roadways.**
- **Traffic control measures to manage construction and diverted traffic.**
- **Traffic control measures to manage future traffic of the full Airport Master Plan build-out.**

Cost Allocation Model

After completion of an updated O-D study, the calculation of a *pro rata* share of transportation impact costs attributable to construction of the Third Runway and implementation of the full Airport Master Plan becomes possible. This allocation model should be based upon the O-D results, negotiated with the impacted communities and **be part of an interlocal agreement before construction of the Third Runway begins.**

It is recommended that the estimated mitigation costs calculated in Section 8 of this report should be recalculated taking into consideration the O-D information recommended above. Costs for mitigation projects should be assigned to the Port of Seattle only if those impacts are attributable to traffic as a result of the Third Runway. Other transportation projects would be implemented by the appropriate local, county, State, and/or Federal agencies. Costs to be recalculated include:

- **Traffic noise abatement projects.**
- **Local/State street reconstruction and bridge replacement projects.**
- **Increased maintenance and reconstruction projects.**
- **Construction traffic control projects.**
- **Additional traffic impacts (for full Airport Master Plan build-out).**

Projects that have not been estimated in this study but will eventually require calculation include:

- **Level of service improvements.**
- **School bus and transit bus routes, scheduling, equipment, and staffing improvements.**
- **Police and emergency service routes, equipment, staffing, and response time improvements.**
- **Parking access and pedestrian circulation improvements.**

Incident Management Plan

With the expected increase of heavy haul trucks on the freeways during the construction phase of the Third Runway, there is a high likelihood that the type, frequency and severity of accidents currently experienced will change; possibly dramatically. To prepare for this haul period, a Freeway Incident Management Plan should be prepared prior to any hauling permits being issued and should include:

- Detection systems.
- Emergency services protocols.
- Control of the accident scene.
- Fast transport of injured.
- Traffic diversion points.
- Diversion/detour routes.
- Roles and responsibilities identified.
- Accident investigation sites.

This system would also respond to spills and should be based upon state-of-the-art telecommunications techniques.

It is recommended that the Washington Department of Transportation develop a Freeway Incident Management Plan for the construction phase and also impose operational restrictions on the heavy trucks involved with the haul and consider:

- **Haul truck climbing lanes.**
- **Lane restrictions.**
- **Time-of-day restrictions.**
- **Weight/length restrictions.**
- **Permitting/fines system.**

Surface Transportation Noise Mitigation

- **Regulatory Compliance** - The Port of Seattle should comply with all appropriate Federal, State and local noise regulatory requirements for surface transportation of fill and other materials associated with Master Plan Update implementation.

- **Construction Time-Limits** - All construction operations, including heavy equipment and trucks hauling fill, should only operate between the hours of 7:00 AM and 9:00 PM Monday through Friday and 9:00 AM to 9:00 PM on Saturdays. No operations should be allowed on Sundays or holidays.

- **Noise Control Devices** - All construction equipment, including trucks hauling fill, should be equipped with noise control devices which should be at least as effective as those devices provided with the original equipment.

- **Complaint-Driven Requirements** - If noise complaints are received during construction, the Port of Seattle should at least implement one or more of the following:

  - Locate stationary construction equipment as far from nearby noise sensitive properties as possible.

  - Shut off idling equipment.

  - Re-schedule construction operations to avoid periods of noise annoyance.

  - Notify nearby residents whenever extremely noisy work will be occurring.

  - Install temporary or portable acoustic barriers around stationary construction noise sources.

  - Place material stockpiles between crushing or screening operations and the affected dwelling(s).

- **Remodeling** - Depending on when the Master Plan Update implementation is started, existing surface transportation noise should be remodeled by the Port of Seattle with the then-current version of STAMINA or the most accepted program. This will allow a comparison with the 1994 existing baseline conditions and the actual conditions at the start of construction. In order to plan for this re-evaluation, the following should be done:

  - Specific roadway noise monitoring sites should be established at key locations, possibly some of the sites identified as being noise impacted by the Federal Highway Administration noise sensitivity criterion; the locations of these sites should be coordinated with the establishment of additional aircraft noise monitoring sites; data collection from these noise monitoring sites should begin as soon as possible in order to provide up-to-date baseline information before Master Plan Update implementation construction starts.

  - More accurate traffic information should be obtained for the roads in the Airport area (e.g., vehicle categories and road use); the EIS indicates that relevant data was available only on I-5 and International Boulevard for surveys conducted on 3 August 1987; 8 July 1991; and 25 February 1992.

- **Clarify INM and Surface Traffic Noise** - The INM incorporated aircraft ground noise in its analysis. However, it was not clear if this included construction and other surface traffic, in particular traffic associated with hauling fill. This should be clarified by the Port of Seattle and if necessary the interaction between surface transportation and aircraft noise levels should be evaluated including the construction traffic.

8.25 - TRANSPORTATION IMPACT SUMMARIES

Plates 8.1 through 8.6 summarize the environmental impacts for each of the five impacted communities, plus the Highline School District and Highline Community Hospital. The impact, mitigation measure, and cost is identified for each neighborhood. The following conventions should be noted when reviewing these Plates:

- **"- - -"** - Indicates that there is no impact identified for this neighborhood.
- **"$ TBD"** - Indicates that the mitigation costs are yet to be determined. Not enough information was available during this study to determine these costs.
- **"$0.0 M"** - Indicates that there are no mitigation costs for this neighborhood.
- **"Mitigated by . . . measures"** - Indicates that other mitigation measures simultaneously mitigate this neighborhood for multiple impact types.
- **"See . . . matrix"** - (Appears only in the Public Facility matrix) Indicates that these impacts are addressed by measures delineated in another City/neighborhood matrix.
- **"Outside Study Area"** - (Appears only in the Public Facility matrix) Indicates that only impacts to the school/hospital building are delineated. Analysis of other impacts are outside the scope of the study.

TRANSPORTATION IMPACT MATRIX - CITY OF BURIEN

Neighborhood		Congestion							Physical Damage				Construction Impacts							Post-Construction Impacts		
Name	Measures	Level of service (LOS)	Accidents	School bus operations	Transit bus operations	Police & emergency vehicle operations	Parking & Pedestrian Access	Traffic Noise (LEQ)	Local streets	State roads	State bridges	Increased maintenance/ reconstruc.	Truck haul routes	Barge/rail conveyor system	Traffic diversion	Traffic control	Construct. staging/ phasing	Work-force traffic	Concurrent construct. projects	Additional traffic	Increased operation/ maintenance costs	Master plan update
Shorewood	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	---	---	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	---	---	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(601 acres)	*Cost*	$1.2 M	measures	measures	measures	measures	measures	measures	$1.2 M	---	---	$0.5 M	$50,000 /year per location	---	measures	measures	measures	measures	$ TBD	$2.4 M	measures	measures
North Central	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	---	---	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	---	---	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(488 acres)	*Cost*	$1.6 M	measures	measures	measures	measures	measures	measures	$1.6 M	---	---	$0.5 M	$50,000 /year per location	---	measures	measures	measures	measures	$ TBD	$3.2 M	measures	measures
North East	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	Road damage	Bridge damage	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	Reconstruct roads	Replace bridges	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(707 acres)	*Cost*	$9.8 M	measures	measures	measures	measures	measures	measures	$4.6 M	$1.9 M	$8.5 M	$1.3 M	$50,000 /year per location	---	measures	measures	measures	measures	$ TBD	$12.0 M	measures	measures
Seahurst Park	*Impact*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Regional traffic	---	---	---
	Mitigation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Transp. manage. plan	---	---	---
(166 acres)	*Cost*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	$ TBD	---	---	---
Seahurst	*Impact*	---	---	---	---	---	---	---	Road damage	---	---	Pavement damage	Increased truck traffic	---	---	---	---	---	Regional traffic	Additional traffic	---	---
	Mitigation	---	---	---	---	---	---	---	Reconstruct roads	---	---	Increase maint.	Traffic control	---	---	---	---	---	Transp. manage. plan	Corridor improve's.	---	---
(393 acres)	*Cost*	---	---	---	---	---	---	---	$0.7 M	---	---	$0.2 M	$50,000 /year per location	---	---	---	---	---	$ TBD	$2.6 M	---	---
Central	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	---	---	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	---	---	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(156 acres)	*Cost*	$1.3 M	measures	measures	measures	measures	measures	measures	$1.3 M	---	---	$0.4 M	$50,000 /year per location	---	measures	measures	measures	measures	$ TBD	$2.6 M	measures	measures
Lake Burien	*Impact*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Regional traffic	---	---	---
	Mitigation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Transp. manage. plan	---	---	---
(162 acres)	*Cost*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	$ TBD	---	---	---
East Central	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	Road damage	Bridge damage	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	Reconstruct roads	Replace bridges	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(254 acres)	*Cost*	$9.8 M	measures	measures	measures	measures	measures	measures	$3.5 M	$1.2 M	$10.2 M	$1.0 M	$50,000 /year per location	---	measures	measures	measures	measures	$ TBD	$9.2 M	measures	measures
South West	*Impact*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Regional traffic	---	---	---
	Mitigation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Transp. manage. plan	---	---	---
(365 acres)	*Cost*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	$ TBD	---	---	---
Gregory Heights	*Impact*	---	---	---	---	---	---	---	Road damage	---	---	Pavement Damage	Increased truck traffic	---	---	---	---	---	Regional traffic	---	---	---
	Mitigation	---	---	---	---	---	---	---	Reconstruct roads	---	---	Increase maint.	Traffic control	---	---	---	---	---	Transp. manage. plan	---	---	---
(574 acres)	*Cost*	---	---	---	---	---	---	---	$0.6 M	---	---	$0.2 M	$50,000 /year per location	---	---	---	---	---	$ TBD	---	---	---
South East	*Impact*	---	---	---	---	---	---	---	Road damage	Road damage	Bridge damage	Pavement damage	Increased truck traffic	Corridor damage	---	---	---	---	Regional traffic	Additional traffic	---	---
	Mitigation	---	---	---	---	---	---	---	Reconstruct roads	Reconstruct roads	Replace bridges	Increase maint.	Traffic control	Reconstruct corridor	---	---	---	---	Transp. manage. plan	Corridor improve's.	---	---
(268 acres)	*Cost*	---	---	---	---	---	---	---	$2.0 M	$0.9 M	$5.1	$0.6 M	$50,000 /year per location	$ TBD	---	---	---	---	$ TBD	$3.2 M	---	---
Downtown	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	---	---	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	---	---	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(308 acres)	*Cost*	$9.8 M	measures	measures	measures	measures	measures	measures	$1.4 M	---	---	$0.4 M	$50,000 /year per location	---	measures	measures	measures	measures	$ TBD	$5.4 M	measures	measures
Total (4,442 ac.)	$116.8 M plus TBD	$26.4 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$16.9 M	$4.0 M	$23.8 M	$5.1 M	$50,000 /year per location	$ TBD	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$ TBD	$40.6 M	$0.0 M	$0.0 M

TRANSPORTATION IMPACT MATRIX - CITY OF DES MOINES

Neighborhood		Congestion							Physical Damage				Construction Impacts							Post-Construction Impacts		
Name	Measures	Level of service (LOS)	Accidents	School bus operations	Transit bus operations	Police & emergency vehicle access	Parking & pedestrian access	Traffic noise (LEQ)	Local streets	State roads	State bridges	Increased mainten./ reconstruc.	Truck haul routes	Barge/rail conveyor system	Traffic diversion	Traffic control	Construct. staging/ phasing	Work-force traffic	Concurrent construc. projects	Additional traffic	Increased operation/ maintenance costs	Master plan update
North Hill	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	---	---	Pavement damage	---	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	---	---	Increase maint.	---	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(623 acres)	*Cost*	$3.5 M	measures	measures	measures	measures	measures	measures	$1.4 M	---	---	$1.0 M	---	---	measures	measures	measures	measures	$ TBD	$7.0 M	measures	measures
West Central	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	---	---	Pavement damage	---	Corridor damage	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	---	---	Increase maint.	---	Reconstruct corridor	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(479 acres)	*Cost*	$1.6 M	measures	measures	measures	measures	measures	measures	$2.1 M	---	---	$0.5 M	---	$ TBD	measures	measures	measures	measures	$ TBD	$3.2 M	measures	measures
North Central	*Impact*	---	---	---	---	---	---	---	Road damage	---	---	---	---	Corridor damage	---	---	---	---	Regional traffic	---	---	---
	Mitigation	---	---	---	---	---	---	---	Reconstruct roads	---	---	---	---	Reconstruct corridor	---	---	---	---	Transp. manage. plan	---	---	---
(241 acres)	*Cost*	---	---	---	---	---	---	---	$2.1 M	---	---	---	---	$ TBD	---	---	---	---	$ TBD	---	---	---
East Central	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	Road damage	Bridge damage	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	Reconstruct roads	Replace bridges	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(626 acres)	*Cost*	$5.2 M	measures	measures	measures	measures	measures	measures	$2.1 M	$2.3 M	$1.7 M	$0.5 M	$50,000/year per location	---	measures	measures	measures	measures	$ TBD	$10.4 M	measures	measures
Zenith	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	---	---	Pavement damage	---	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	---	---	Increase maint.	---	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(550 acres)	*Cost*	$1.2 M	measures	measures	measures	measures	measures	measures	$2.1 M	---	---	$0.3 M	---	---	measures	measures	measures	measures	$ TBD	$2.4 M	measures	measures
South Des Moines	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	Road damage	---	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	Reconstruct roads	---	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(492 acres)	*Cost*	$2.3 M	measures	measures	measures	measures	measures	measures	$2.1 M	$0.5 M	---	$0.8 M	$50,000/year per location	---	measures	measures	measures	measures	$ TBD	$4.6 M	measures	measures
West Woodmont	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	---	---	---	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	---	Mitigated	Mitigated
	Mitigation	Insulation/ easement	by LOS	by LDN	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	---	---	---	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	---	by LOS	by LOS
(430 acres)	*Cost*	$2.3 M	measures	measures	measures	measures	measures	measures	$0.8 M	---	---	---	$50,000/year per location	---	measures	measures	measures	measures	$ TBD	---	measures	measures
East Woodmont	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	Road damage	---	Pavement damage	---	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Insulation/ easement	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	Reconstruct roads	---	Increase maint.	---	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(306 acres)	*Cost*	$0.8 M	measures	measures	measures	measures	measures	measures	$0.5 M	$0.8 M	---	$0.4 M	---	---	measures	measures	measures	measures	$ TBD	$4.6 M	measures	measures
Redondo	*Impact*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Regional traffic	---	---	---
	Mitigation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Transp. manage. plan	---	---	---
(212 acres)	*Cost*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	$ TBD	---	---	---
Downtown	*Impact*	---	---	---	---	---	---	---	Road damage	---	---	Pavement damage	---	Corridor damage	---	---	---	---	Regional traffic	Additional traffic	---	---
	Mitigation	---	---	---	---	---	---	---	Reconstruct roads	---	---	Increase maint.	---	Reconstruct corridor	---	---	---	---	Transp. manage. plan	Corridor improve's.	---	---
(108 acres)	*Cost*	---	---	---	---	---	---	---	$0.6 M	---	---	$0.1 M	---	$ TBD	---	---	---	---	$ TBD	$1.0 M	---	---
Total (4,067 ac.)	$72.8 M plus TBD	$16.9 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$13.8 M	$3.6 M	$1.7 M	$3.6 M	$50,000/year per location	$ TBD	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$ TBD	$33.2 M	$0.0 M	$0.0 M

TRANSPORTATION IMPACT MATRIX - CITY OF FEDERAL WAY

Neighborhood		Congestion							Physical Damage				Construction Impacts							Post-Construction Impacts		
Name	Measures	Level of service (LOS)	Accidents	School bus operations	Transit bus operations	Police & emergency vehicle access	Parking & pedestrian access	Traffic noise (LEQ)	Local streets	State roads	State bridges	Increased mainten./ reconstruc.	Truck haul routes	Barge/rail conveyor system	Traffic diversion	Traffic control	Construct. staging/ phasing	Work-force traffic	Concurrent construc. projects	Additional traffic	Increased operation/ maintenance costs	Master plan update
Star Lake	*Impact*	Traffic congestion	---	---	---	---	---	---	Road damage	Road damage	Bridge damage	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	---	Mitigated	Mitigated
	Mitigation	Corridor improve's.	---	---	---	---	---	---	Reconstruct roads	Reconstruct roads	Replace bridges	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	---	by LOS	by LOS
(531 acres)	*Cost*	$4.0 M	---	---	---	---	---	---	$1.4 M	$2.0 M	$1.7 M	$0.5 M	$50,000/year per location	---	measures	measures	measures	measures	$ TBD	---	measures	measures
Wildwood	*Impact*	Traffic congestion	---	---	---	---	---	---	Road damage	Road damage	Bridge damage	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	---	Mitigated	Mitigated
	Mitigation	Corridor improve's.	---	---	---	---	---	---	Reconstruct roads	Reconstruct roads	Replace bridges	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	---	by LOS	by LOS
(553 acres)	*Cost*	$4.6 M	---	---	---	---	---	---	$2.1 M	$1.3 M	$1.7 M	$0.5 M	$50,000/year per location	---	measures	measures	measures	measures	$ TBD	---	measures	measures
Marine Hills	*Impact*	---	---	---	---	---	---	---	---	Road damage	---	Pavement damage	---	---	---	---	---	---	Regional traffic	---	---	---
	Mitigation	---	---	---	---	---	---	---	---	Reconstruct roads	---	Increase maint.	---	---	---	---	---	---	Transp. manage. plan	---	---	---
(529 acres)	*Cost*	---	---	---	---	---	---	---	---	$0.5 M	---	$0.3 M	--	---	---	---	---	---	$ TBD	---	---	---
Mar-Cheri	*Impact*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Regional traffic	---	---	---
	Mitigation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Transp. manage. plan	---	---	---
(311 acres)	*Cost*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	$ TBD	---	---	---
Dash Point	*Impact*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Regional traffic	---	---	---
	Mitigation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Transp. manage. plan	---	---	---
(826 acres)	*Cost*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	$ TBD	---	---	---
Lakota	*Impact*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Regional traffic	---	---	---
	Mitigation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Transp. manage. plan	---	---	---
(949 acres)	*Cost*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	$ TBD	---	---	---
Mirror Lake	*Impact*	---	---	---	---	---	---	---	Road damage	---	---	Pavement damage	---	---	---	---	---	---	Regional traffic	---	---	---
	Mitigation	---	---	---	---	---	---	---	Reconstruct roads	---	---	Increase maint.	---	---	---	---	---	---	Transp. manage. plan	---	---	---
(713 acres)	*Cost*	---	---	---	---	---	---	---	$0.8 M	---	---	$0.8 M	---	---	---	---	---	---	$ TBD	---	---	---
Easter Lake	*Impact*	Traffic congestion	---	---	---	---	---	---	Road damage	Road damage	---	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	---	Mitigated	Mitigated
	Mitigation	Corridor improve's.	---	---	---	---	---	---	Reconstruct roads	Reconstruct roads	---	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	---	by LOS	by LOS
(729 acres)	*Cost*	$2.0 M	---	---	---	---	---	---	$0.5 M	$0.6 M	---	$0.6 M	$50,000/year per location	---	measures	measures	measures	measures	$ TBD	---	measures	measures
Steel Lake	*Impact*	Traffic congestion	---	---	---	---	---	---	---	Road damage	Bridge damage	Pavement damage	---	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	---	Mitigated	Mitigated
	Mitigation	Corridor improve's.	---	---	---	---	---	---	---	Reconstruct roads	Replace bridges	Increase maint.	---	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	---	by LOS	by LOS
(347 acres)	*Cost*	$3.3 M	---	---	---	---	---	---	---	$1.5 M	$1.7 M	$0.1 M	---	---	measures	measures	measures	measures	$ TBD	---	measures	measures
Twin Lakes	*Impact*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Regional traffic	---	---	---
	Mitigation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Transp. manage. plan	---	---	---
(1,118 acres)	*Cost*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	$ TBD	---	---	---

TRANSPORTATION IMPACT MATRIX - CITY OF FEDERAL WAY (continued)

Neighborhood		Congestion							Physical Damage				Construction Impacts							Post-Construction Impacts		
Name	Measures	Level of service (LOS)	Accidents	School bus operations	Transit bus operations	Police & emergency vehicle access	Parking & pedestrian access	Traffic noise (LEQ)	Local streets	State roads	State bridges	Increased maintenance/ reconstruc.	Truck haul routes	Barge/rail conveyor system	Traffic diversion	Traffic control	Construct. staging/ phasing	Work-force traffic	Concurrent construc. projects	Additional traffic	Increased operation/ maintenance costs	Master plan update
West Campus	*Impact*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Regional traffic	---	---	---
	Mitigation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Transp. manage. plan	---	---	---
(848 acres)	*Cost*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	$ TBD	---	---	---
First Avenue	*Impact*	Traffic congestion	---	---	---	---	---	---	Road damage	Road damage	---	Pavement damage	---	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	---	Mitigated	Mitigated
	Mitigation	Corridor improve's	---	---	---	---	---	---	Reconstruct roads	Reconstruct roads	---	Increase maint.	---	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	---	by LOS	by LOS
(546 acres)	*Cost*	$1.7 M	---	---	---	---	---	---	$0.5 M	$0.5 M	---	$0.6 M	---	---	measures	measures	measures	measures	$ TBD	---	measures	measures
Kitts Corner North	*Impact*	Traffic congestion	---	---	---	---	---	---	---	Road damage	Bridge damage	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	---	Mitigated	Mitigated
	Mitigation	Corridor improve's	---	---	---	---	---	---	---	Reconstruct roads	Replace bridges	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	---	by LOS	by LOS
(299 acres)	*Cost*	$2.1 M	---	---	---	---	---	---	---	$1.1 M	$1.7 M	$0.1 M	$50,000/year per location	---	measures	measures	measures	measures	$ TBD	---	measures	measures
City Center	*Impact*	Traffic congestion	---	---	---	---	---	---	Road damage	Road damage	---	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	---	Mitigated	Mitigated
	Mitigation	Corridor improve's	---	---	---	---	---	---	Reconstruct roads	Reconstruct roads	---	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	---	by LOS	by LOS
(430 acres)	*Cost*	$3.1 M	---	---	---	---	---	---	$1.1 M	$1.3 M	---	$0.1 M	$50,000/year per location	---	measures	measures	measures	measures	$ TBD	---	measures	measures
Total (8,719 ac.)	$46.7 M plus TBD	$20.8 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$6.4 M	$8.8 M	$6.8 M	$3.9 M	$50,000/year per location	$ 0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$ TBD	$0.0 M	$0.0 M	$0.0 M

TRANSPORTATION IMPACT MATRIX - CITY OF NORMANDY PARK

Neighborhood		Congestion							Physical Damage				Construction Impacts							Post-Construction Impacts		
Name	Measures	Level of service (LOS)	Accidents	School bus operations	Transit bus operations	Police & emergency vehicle access	Parking & pedestrian access	Traffic noise (LEQ)	Local streets	State roads	State bridges	Increased mainten./ reconstruc.	Truck haul routes	Barge/rail conveyor system	Traffic diversion	Traffic control	Construct. staging/ phasing	Work-force traffic	Concurrent construc. projects	Additional traffic	Increased operation/ maintenance costs	Master plan update
Bonniewood	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	---	---	Pavement damage	---	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	---	---	Increase maint.	---	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(41 acres)	*Cost*	$0.2 M	measures	measures	measures	measures	measures	measures	$0.2 M	---	---	$0.1 M	---	---	measures	measures	measures	measures	$ TBD	$0.4 M	measures	measures
Highlands	*Impact*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Regional traffic	---	---	---
	Mitigation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Transp. manage. plan	---	---	---
(81 acres)	*Cost*	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	$ TBD	---	---	---
North	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	---	Bridge damage	Pavement damage	---	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	---	Replace bridges	Increase maint.	---	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(348 acres)	*Cost*	$1.2 M	measures	measures	measures	measures	measures	measures	$1.3 M	---	$1.7 M	$0.5 M	---	---	measures	measures	measures	measures	$ TBD	$2.6 M	measures	measures
Riviera	*Impact*	---	---	---	---	---	---	---	Road damage	---	---	Pavement damage	---	---	---	---	---	---	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	---	---	---	---	---	---	---	Reconstruct roads	---	---	Increase maint.	---	---	---	---	---	---	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(240 acres)	*Cost*	---	---	---	---	---	---	---	$1.9 M	---	---	$0.7 M	---	---	---	---	---	---	$ TBD	$3.8 M	measures	measures
Manhattan	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	---	---	Pavement damage	---	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	---	---	Increase maint.	---	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(90 acres)	*Cost*	$1.0 M	measures	measures	measures	measures	measures	measures	$1.0 M	---	---	$0.4 M	---	---	measures	measures	measures	measures	$ TBD	$2.0 M	measures	measures
East Central	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	---	---	Pavement damage	---	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	---	---	Increase maint.	---	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(248 acres)	*Cost*	$1.7 M	measures	measures	measures	measures	measures	measures	$1.7 M	---	---	$0.6 M	---	---	measures	measures	measures	measures	$ TBD	$3.4 M	measures	measures
Normandy Province	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	---	---	Pavement damage	---	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	---	---	Increase maint.	---	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(39 acres)	*Cost*	$0.2 M	measures	measures	measures	measures	measures	measures	$0.2 M	---	---	$0.1 M	---	---	measures	measures	measures	measures	$ TBD	$0.4 M	measures	measures
Arrow Lake	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	---	---	Pavement damage	---	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	---	---	Increase maint.	---	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(29 acres)	*Cost*	$0.6 M	measures	measures	measures	measures	measures	measures	$0.6 M	---	---	$0.2 M	---	---	measures	measures	measures	measures	$ TBD	$1.2 M	measures	measures
South	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	---	---	Pavement damage	---	Corridor damage	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	---	---	Increase maint.	---	Reconstruct corridor	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(454 acres)	*Cost*	$4.8 M	measures	measures	measures	measures	measures	measures	$4.8 M	---	---	$1.7 M	---	$ TBD	measures	measures	measures	measures	$ TBD	$9.6 M	measures	measures
Total (1,570 ac.)	$50.9 M plus TBD	$9.8 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$11.7 M	$0.0 M	$1.7 M	$4.3 M	$0.0 M	$ TBD	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$ TBD	$23.4 M	$0.0 M	$0.0 M

TRANSPORTATION IMPACT MATRIX - CITY OF TUKWILA

Neighborhood		Congestion							Physical Damage				Construction Impacts							Post-Construction Impacts		
Name	Measures	Level of service (LOS)	Accidents	School bus operations	Transit bus operations	Police & emergency vehicle access	Parking & pedestrian access	Traffic noise	Local streets	State roads	State bridges	Increased maintenance/ reconstruc.	Truck haul routes	Barge/rail conveyor system	Traffic diversion	Traffic control	Construct. staging/ phasing	Work-force traffic	Concurrent construc. projects	Additional traffic	Increased operation/ maintenance costs	Master plan update
Ryan	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	---	Road damage	---	Pavement damage	---	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	---	Reconstruct roads	---	Increase maint.	---	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(114 acres)	*Cost*	$0.8 M	measures	measures	measures	measures	measures	measures	---	$0.3 M	---	$0.1 M	---	---	measures	measures	measures	measures	$ TBD	$0.6 M	measures	measures
Allentown	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	---	Road damage	---	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	---	Reconstruct roads	---	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(346 acres)	*Cost*	$4.0 M	measures	measures	measures	measures	measures	measures	---	$1.2 M	---	$0.3 M	$50,000/year per location	---	measures	measures	measures	measures	$ TBD	$2.4 M	measures	measures
Cascade View	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	---	---	Pavement damage	---	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	---	---	Increase maint.	---	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(303 acres)	*Cost*	$1.1 M	measures	measures	measures	measures	measures	measures	$1.1 M	---	---	$0.3 M	---	---	measures	measures	measures	measures	$ TBD	$2.2 M	measures	measures
Foster	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	Road damage	Bridge damage	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	Reconstruct roads	Replace bridges	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(485 acres)	*Cost*	$1.5 M	measures	measures	measures	measures	measures	measures	$1.7 M	$1.3 M	$6.8 M	$0.9 M	$50,000/year per location	---	measures	measures	measures	measures	$ TBD	$6.0 M	measures	measures
Thorndyke	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	Road damage	Bridge damage	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	Reconstruct roads	Replace bridges	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(420 acres)	*Cost*	$4.3 M	measures	measures	measures	measures	measures	measures	$3.0 M	$1.5 M	$3.4 M	$1.3 M	$50,000/year per location	---	measures	measures	measures	measures	$ TBD	$9.0 M	measures	measures
Tukwila Hill	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	Road damage	Bridge damage	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	Reconstruct roads	Replace bridges	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(857 acres)	*Cost*	$4.9 M	measures	measures	measures	measures	measures	measures	$2.1 M	$2.0 M	$3.4 M	$1.2 M	$50,000/year per location	---	measures	measures	measures	measures	$ TBD	$8.2 M	measures	measures
McMicken	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	Road damage	---	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	Reconstruct roads	---	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(461 acres)	*Cost*	$1.0 M	measures	measures	measures	measures	measures	measures	$0.3 M	$1.5 M	---	$0.5 M	$50,000/year per location	---	measures	measures	measures	measures	$ TBD	$3.6 M	measures	measures
M.I.C.	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	Road damage	Bridge damage	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	Reconstruct roads	Replace bridges	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(1,083 ac.)	*Cost*	$8.6 M	measures	measures	measures	measures	measures	measures	$5.1 M	$1.5 M	$1.7 M	$1.9 M	$50,000/year per location	---	measures	measures	measures	measures	$ TBD	$13.2 M	measures	measures
Riverton	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	Road damage	---	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	Reconstruct roads	---	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(276 acres)	*Cost*	$3.8 M	measures	measures	measures	measures	measures	measures	$1.9 M	$0.7 M	---	$0.8 M	$50,000/year per location	---	measures	measures	measures	measures	$ TBD	$5.2 M	measures	measures
CBD	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	Road damage	Bridge damage	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	Reconstruct roads	Replace bridges	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(1,095 ac.)	*Cost*	$11.1 M	measures	measures	measures	measures	measures	measures	$10.1 M	$1.3 M	$3.4 M	$3.2 M	$50,000/year per location	---	measures	measures	measures	measures	$ TBD	$22.6 M	measures	measures
Tukwila Valley South	*Impact*	Traffic congestion	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Road damage	Road damage	Bridge damage	Pavement damage	Increased truck traffic	---	Mitigated	Mitigated	Mitigated	Mitigated	Regional traffic	Additional traffic	Mitigated	Mitigated
	Mitigation	Corridor improve's.	by LOS	by LOS	by LOS	by LOS	by LOS	by LOS	Reconstruct roads	Reconstruct roads	Replace bridges	Increase maint.	Traffic control	---	by LOS	by LOS	by LOS	by LOS	Transp. manage. plan	Corridor improve's.	by LOS	by LOS
(367 acres)	*Cost*	$2.6 M	measures	measures	measures	measures	measures	measures	$2.0 M	$0.3 M	$1.7 M	$0.7 M	$50,000/year per location	---	measures	measures	measures	measures	$ TBD	$4.6 M	measures	measures
Total (5,807 ac.)	$191.7 M plus TBD	$43.7 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$27.2 M	$11.6 M	$20.4 M	$11.2 M	$50,000/year per location	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$77.6 M	$0.0 M	$0.0 M

TRANSPORTATION IMPACT MATRIX - PUBLIC FACILITIES

School/Hospital (Neighborhood)		Congestion							Physical Damage				Construction Impacts							Post-Construction Impacts		
Name	Measures	Level of Service (LOS)	Accidents	School Bus Operations	Transit Bus Operations	Police & Emergency Vehicle Access	Parking & Pedestrian Access	Traffic Noise (LEQ)	Local Streets	State Roads	State Bridges	Increased Mainten./ Reconstruc.	Truck Haul Routes	Barge/Rail Conveyor System	Traffic Diversion	Traffic Control	Construct. Staging/ Phasing	Work-Force Traffic	Concurrent Construc. Projects	Additional Traffic	Increased Operation/ Maintenance Costs	Master Plan Update
Highline School/Hospital Facilities in City of Burien																						
Highline Community Hospital (Gregory Heights)	Impact	---	---	---	---	---	---	---	See Gregory Heights (Plate 8.1)	---	---	See Gregory Heights (Plate 8.1)	See Gregory Heights (Plate 8.1)	---	---	---	---	---	See Gregory Heights (Plate 8.1)	---	---	---
	Mitigation	---	---	---	---	---	---	---		---	---			---	---	---	---	---		---	---	---
	Cost	---	---	---	---	---	---	---		---	---			---	---	---	---	---		---	---	---
Gregory Heights Elementary School (Gregory Heights)	Impact	---	---	---	---	---	---	---	See Gregory Heights (Plate 8.1)	---	---	See Gregory Heights (Plate 8.1)	See Gregory Heights (Plate 8.1)	---	---	---	---	---	See Gregory Heights (Plate 8.1)	---	---	---
	Mitigation	---	---	---	---	---	---	---		---	---			---	---	---	---	---		---	---	---
	Cost	---	---	---	---	---	---	---		---	---			---	---	---	---	---		---	---	---
Sylvester Middle School (Gregory Heights)	Impact	---	---	---	---	---	---	---	See Gregory Heights (Plate 8.1)	---	---	See Gregory Heights (Plate 8.1)	See Gregory Heights (Plate 8.1)	---	---	---	---	---	See Gregory Heights (Plate 8.1)	---	---	---
	Mitigation	---	---	---	---	---	---	---		---	---			---	---	---	---	---		---	---	---
	Cost	---	---	---	---	---	---	---		---	---			---	---	---	---	---		---	---	---
Hazel Valley Elementary School (Downtown)	Impact	See Downtown (Plate 8.1)	See Downtown (Plate 8.1)	See Downtown (Plate 8.1)	See Downtown (Plate 8.1)	See Downtown (Plate 8.1)	See Downtown (Plate 8.1)	See Downtown (Plate 8.1)	See Downtown (Plate 8.1)	---	---	See Downtown (Plate 8.1)	See Downtown (Plate 8.1)	---	See Downtown (Plate 8.1)	See Downtown (Plate 8.1)	See Downtown (Plate 8.1)	See Downtown (Plate 8.1)	See Downtown (Plate 8.1)	See Downtown (Plate 8.1)	See Downtown (Plate 8.1)	See Downtown (Plate 8.1)
	Mitigation									---	---			---								
	Cost									---	---			---								
Salmon Creek Elementary School (North Central)	Impact	See North Central (Plate 8.1)	See North Central (Plate 8.1)	See North Central (Plate 8.1)	See North Central (Plate 8.1)	See North Central (Plate 8.1)	See North Central (Plate 8.1)	See North Central (Plate 8.1)	See North Central (Plate 8.1)	---	---	See North Central (Plate 8.1)	See North Central (Plate 8.1)	---	See North Central (Plate 8.1)	See North Central (Plate 8.1)	See North Central (Plate 8.1)	See North Central (Plate 8.1)	See North Central (Plate 8.1)	See North Central (Plate 8.1)	See North Central (Plate 8.1)	See North Central (Plate 8.1)
	Mitigation									---	---			---								
	Cost									---	---			---								
Seahurst Elementary School (Seahurst)	Impact	---	---	---	---	---	---	---	See Seahurst (Plate 8.1)	---	---	See Seahurst (Plate 8.1)	See Seahurst (Plate 8.1)	---	---	---	---	---	See Seahurst (Plate 8.1)	See Seahurst (Plate 8.1)	---	---
	Mitigation	---	---	---	---	---	---	---		---	---			---	---	---	---	---			---	---
	Cost	---	---	---	---	---	---	---		---	---			---	---	---	---	---			---	---
Shorewood Elementary School (Shorewood)	Impact	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	---	---	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	---	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)
	Mitigation									---	---			---								
	Cost									---	---			---								
Marine Tech Lab. (Shorewood)	Impact	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	---	---	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	---	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)	See Shorewood (Plate 8.1)
	Mitigation									---	---			---								
	Cost									---	---			---								
Cedarhurst Elementary School	Impact	See North East (Plate 8.1)	See North East (Plate 8.1)	See North East (Plate 8.1)	See North East (Plate 8.1)	See North East (Plate 8.1)	See North East (Plate 8.1)	See North East (Plate 8.1)	See North East (Plate 8.1)	See North East (Plate 8.1)	See North East (Plate 8.1)	See North East (Plate 8.1)	See North East (Plate 8.1)	---	See North East (Plate 8.1)	See North East (Plate 8.1)	See North East (Plate 8.1)	See North East (Plate 8.1)	See North East (Plate 8.1)	See North East (Plate 8.1)	See North East (Plate 8.1)	See North East (Plate 8.1)
	Mitigation													---								
	Cost													---								
Sunnydale Elementary School (East Central)	Impact	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	---	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)
	Mitigation													---								
	Cost													---								
Highline High School (East Central)	Impact	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	---	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)	See East Central (Plate 8.1)
	Mitigation													---								
	Cost													---								
Highline School/Hospital Facilities in City of Des Moines																						
Des Moines Elementary School (West Central)	Impact	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	---	---	See West Central (Plate 8.2)	---	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)
	Mitigation									---	---		---									
	Cost									---	---		---									

TRANSPORTATION IMPACT MATRIX - PUBLIC FACILITIES (continued)

School/Hospital (Neighborhood)		Congestion							Physical Damage				Construction Impacts							Post-Construction Impacts		
Name	Measures	Level of Service (LOS)	Accidents	School Bus Operations	Transit Bus Operations	Police & Emergency Vehicle Access	Parking & Pedestrian Access	Traffic Noise (LEQ)	Local Streets	State Roads	State Bridges	Increased Mainten./ Reconstruc.	Truck Haul Routes	Barge/Rail Conveyor System	Traffic Diversion	Traffic Control	Construct. Staging/ Phasing	Work-Force Traffic	Concurrent Construc. Projects	Additional Traffic	Increased Operation/ Maintenance Costs	Master Plan Update
Highline School/Hospital Facilities in City of Des Moines (continued)																						
Olympic Elementary School (West Central)	Impact	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	---	---	See West Central (Plate 8.2)	---	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)	See West Central (Plate 8.2)
	Mitigation									---	---		---									
	Cost									---	---		---									
Midway Elementary School (East Central)	Impact	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	---	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)
	Mitigation												---									
	Cost												---									
Pacific Middle School (East Central)	Impact	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	---	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)
	Mitigation												---									
	Cost												---									
Mount Rainier High School (East Central)	Impact	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	---	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)	See East Central (Plate 8.2)
	Mitigation												---									
	Cost												---									
North Hill Elementary School (North Hill)	Impact	See North Hill (Plate 8.2)	See North Hill (Plate 8.2)	See North Hill (Plate 8.2)	See North Hill (Plate 8.2)	See North Hill (Plate 8.2)	See North Hill (Plate 8.2)	See North Hill (Plate 8.2)	See North Hill (Plate 8.2)	---	---	See North Hill (Plate 8.2)	See North Hill (Plate 8.2)	---	---	See North Hill (Plate 8.2)	See North Hill (Plate 8.2)	See North Hill (Plate 8.2)	See North Hill (Plate 8.2)	See North Hill (Plate 8.2)	See North Hill (Plate 8.2)	See North Hill (Plate 8.2)
	Mitigation									---	---		---	---	---							
	Cost									---	---		---	---	---							
Parkside Elementary School (South Des Moines)	Impact	See South Des Moines (Plate 8.2)	See South Des Moines (Plate 8.2)	See South Des Moines (Plate 8.2)	See South Des Moines (Plate 8.2)	See South Des Moines (Plate 8.2)	See South Des Moines (Plate 8.2)	See South Des Moines (Plate 8.2)	See South Des Moines (Plate 8.2)	See South Des Moines (Plate 8.2)	---	See South Des Moines (Plate 8.2)	See South Des Moines (Plate 8.2)	---	See South Des Moines (Plate 8.2)	See South Des Moines (Plate 8.2)	See South Des Moines (Plate 8.2)	See South Des Moines (Plate 8.2)	See South Des Moines (Plate 8.2)	See South Des Moines (Plate 8.2)	See South Des Moines (Plate 8.2)	See South Des Moines (Plate 8.2)
	Mitigation										---			---								
	Cost										---			---								
Highline School/Hospital Facilities in City of Normandy Park																						
Marvista Elementary School (South)	Impact	See South (Plate 8.4)	See South (Plate 8.4)	See South (Plate 8.4)	See South (Plate 8.4)	See South (Plate 8.4)	See South (Plate 8.4)	See South (Plate 8.4)	See South (Plate 8.4)	---	---	See South (Plate 8.4)	---	See South (Plate 8.4)	See South (Plate 8.4)	See South (Plate 8.4)	See South (Plate 8.4)	See South (Plate 8.4)	See South (Plate 8.4)	See South (Plate 8.4)	See South (Plate 8.4)	See South (Plate 8.4)
	Mitigation									---	---		---									
	Cost									---	---		---									
Highline School/Hospital Facilities in City of SeaTac (outside study area)																						
Bow Lake Elementary School (SeaTac)	Impact	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation																					
	Cost																					
Madrona Elementary School (SeaTac)	Impact	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation																					
	Cost																					
McMicken Heights Elementary School (SeaTac)	Impact	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation																					
	Cost																					
Valley View Elementary School (SeaTac)	Impact	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation																					
	Cost																					
Chinook Middle School (SeaTac)	Impact	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
	Mitigation																					
	Cost																					

TRANSPORTATION IMPACT MATRIX - PUBLIC FACILITIES (continued)

School/Hospital (Neighborhood)		Congestion							Physical Damage				Construction Impacts							Post-Construction Impacts		
Name	Measures	Level of service (LOS)	Accidents	School bus operations	Transit bus operations	Police & emergency vehicle access	Parking & pedestrian access	Traffic Noise (LEQ)	Local streets	State roads	State bridges	Increased mainten./ reconstruc.	Truck haul routes	Barge/rail conveyor system	Traffic diversion	Traffic control	Construct. staging/ phasing	Work-force traffic	Concurrent construc. projects	Additional traffic	Increased operation/ maintenance costs	Master plan update
Highline School/Hospital Facilities in City of SeaTac (continued)																						
Tyee High School (SeaTac)	Impact / Mitigation / Cost	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
Sea-Tac Occupa-tional Skill (SeaTac)	Impact / Mitigation / Cost	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
Highline School/Hospital Facilities in City of Seattle (outside study area)																						
Hilltop Elementary School (Seattle)	Impact / Mitigation / Cost	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
Mount View Elementary School (Seattle)	Impact / Mitigation / Cost	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
Riverton Heights Elementary School (Seattle)	Impact / Mitigation / Cost	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
Southern Heights Elementary School (Seattle)	Impact / Mitigation / Cost	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
Cascade Middle School (Seattle)	Impact / Mitigation / Cost	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
Evergreen High School (Seattle)	Impact / Mitigation / Cost	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
Highline School/Hospital Facilities in Unincorporated King County (outside study area)																						
Beverly Park Elementary School (County)	Impact / Mitigation / Cost	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
White Center Elementary School (County)	Impact / Mitigation / Cost	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
Satellite Alternate High School (County)	Impact / Mitigation / Cost	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area	Outside Study Area
Total																						

APPENDIX C
PROJECT CONTACTS

City Council Members/Staff
City of Burien, Washington
City of Des Moines, Washington
City of Federal Way, Washington
City of Normandy Park, Washington
City of SeaTac, Washington
City of Tukwila, Washington

Colorado Springs International Airport
Bob Allison, Assistant Director of Aviation

Dallas/Fort Worth International Airport
Karen Robertson, Noise Abatement Officer
Dana Ryan, Senior Airport Planner

King County Ground Water Management Program
Mark Isaacson
Paul Shallow

King County Surface Water Management Division
David Masters

Lambert Field/St. Louis International Airport
Jerry Tinnea, Noise Abatement Officer

Miller Creek Management Coalition
Clark Dodge

Minneapolis/St. Paul International Airport
Nigel Finney, Deputy Executive Director/Planning & Environment

Normandy Park Community Club
Shawn McEvoy

Port of Seattle
Marsha Holbrook
Bob Wells

Puget Sound Air Pollution Control Agency
David Kircher
Dennis McLerran
Brian Sullivan

San Diego International Airport
Nile Marmion, Airport Noise Specialist
Jeanette Lake, Director of Noise Information

San Francisco International Airport
Marvin Ellis, Noise Abatement Officer

Seattle Water Department
Sean Aronow
Laurie Arima

State of Washington, Department of Community, Trade and Economic Development
Steve Wells, Director
Sandra L. Benbrook, PHD, Assistant Director

State of Washington, Department of Ecology
Doug Brown
Paul Carr
Erik Stockdale

State of Washington, Department of Fish and Wildlife
Ted Muller

State of Washington, Department of Transportation
Bill Dues
Robert Josephson
David McCormick
Renee Montgelas
Craig Stone
Samuel Teitzel

Synergy Consultants, Inc.
Mary Vigilante, President

Trout Unlimited
Al Miller

US Department of Transportation
John D'Aprile
Gregg Fleming

Waste Action Project
Greg Wingard

Other
Airport Impact Assistance Executive Committee
City of Burien Planning Commission
Highline School District
Regional Council on Airport Affairs

SECTION 9

POTENTIAL SOCIO-ECONOMIC IMPACTS AND MITIGATION

SECTION 9
POTENTIAL SOCIO-ECONOMIC IMPACTS AND MITIGATION

9.01 - EXPECTED CHANGES IN LAND VALUES, LAND USES, HOME OWNERSHIP TENURE, LOCAL GOVERNMENT REVENUE AND SOCIAL SERVICE NEEDS RESULTING FROM CONSTRUCTION OF THE THIRD RUNWAY AND RELATED FACILITIES

Aircraft operations at Sea-Tac International Airport impact the value of close-by properties in two ways.

First, the Airport's operations depress property values below the level that real estate markets would produce if the Airport did not exist. If a single-family residential house located in, for example, Burien could be physically transported to an identical location on an identical lot in another part of King County, its value would be increased, and the amount of its increase is the depression in value caused by proximity to the Airport. Section 9.02 estimates the average loss in value of real estate locate in close proximity to Sea-Tac International Airport by comparing a large sample of comparable single-family housing units in Northwest and Southwest King County holding constant the non-Airport factors that also influence real estate values.

A second way in which Sea-Tac International Airport operations impact the value of real estate is in the variation in value among properties caused by their proximity to the flight paths of arriving and departing aircraft. Such changes are the "shadow" affects (noise pollution, visual pollution, possible air quality pollution, and a generally degraded environment for human habitat) caused by living under low-flying aircraft. Section 9.03 uses a statistical technique known as regression analysis to estimate Sea-Tac International Airport's shadow affects by measuring the difference in value of a property, holding other things the same, when it is located at different distances from directly under one of Sea-Tac International Airport's arrival/departure flight paths.

The remaining subsections provide information on the changes in land use produced by Airport-induced depressions in adjacent land values, and the alteration in the demographic profile of persons living in jurisdictions where depressed land values result in altered land uses.

It is important to remember that the following analysis addresses the issue of depressed but not declining land values. All parts of the Puget Sound Region have experienced population growth in the recent past, and the entire Puget Sound Region is expected to experience rates of population growth above the national average in the foreseeable future. This means that the Puget Sound Region is expected to have significant net in-migration. As a result, average real estate values in the region will undoubtedly rise. Real estate located in close proximity to the Airport will participate in these growth trends and will also experience rising land values.

Because of the Airport, however, the rate of appreciation in the value of close-by real estate is expected to be less than it otherwise would have been. The correct measure of the Airport-induced depression in land values, consequently, is the price difference between comparable properties located close too and distant from the Airport. Neither a simple calculation of whether or not property values have increased nor a comparison of properties inside or outside any specific LDN contour line provides an appropriate basis for comparison.

9.02 - AIRPORT IMPACTS ON AVERAGE PROPERTY VALUES

The impact of proximity to the Airport was evaluated using average property values for comparable housing units in ten Census Tracts in Southwest King County immediately around Sea-Tac International Airport and ten Census Tracts in Northwest King County - the area that generally conforms to the City of Shoreline.

Northwest King County was chosen for comparison based on the following criteria:

- The Census Tracts are all located in King County and are equally affected by County and State land use and development policies.
- The Census Tracts are all bordered by Puget Sound to the west and Lake Washington to the east.
- Both clusters of Census Tracts contain commercial areas bordering Highway 99, and both have a mix of residential areas ranging from low/moderate income to high/ upper income.
- Both clusters of Census Tracts contain racially and ethnically diverse populations.

The cluster of ten Census Tracts around the Airport contained 17,046 housing units in 1990, of which 11,526 (67.6%) were single-family. The cluster of ten Census Tracts in Northwest King County contained 19,523 housing units in 1990, of which 12,683 (65.0%) were single-family.

The following parameters were used to screen housing units in the two clusters of Census Tracts for comparability:

- Only units rated as being in "Very Good" condition by the King County Assessors office were included.
- All units with a "View" were excluded.
- All units were in "Single-Family ' zoned areas and were classified as single-family land uses.
- All units had an above ground structure of 1,000 square feet or more.

- All units were located on lots of between 10,000 and 14,999 square feet.
- All units had three or more bedrooms.
- All units had two or more bathrooms.

These screening criteria excluded the top and the bottom of the distribution of housing units in both areas and resulted in a total of 739 of the 11, 526 single-family properties (6.4%) in the ten Census Tracts around the Airport (Southwest King County) and 760 of the 12,683 single-family properties (6.0%) in ten Census Tracts in Northwest King County being used for comparison of real estate values. Summary statistics from the King County Assessors Office for these units are contained in Table 9.01.

Table 9.01
Comparison of Housing Units in Northwest and Southwest King County - 1993

	SW mean value	NW mean value	Difference (SW-NW)	Percent Difference
Size				
Lot size	11,914 sq. ft.	11,522 sq. ft.	+392 sq. ft.	3.3%
Above ground structure size	1,538 sq. ft.	1,507 sq. ft.	-31 sq. ft.	-2.0%
Rooms				
Number of bedrooms	3.6	3.6	0	-1.4%
Number of bathrooms	2.0	2.0	0	0.6%
Value				
Assessed value of land	$52,734	$60,181	-$7,447	-14.1%
Assessed value of structure	$88,703	$95,550	-$6,847	-7.7%
Total assessed value	$141,438	$155,731	-$14,294	-10.1%

(Source: King County Assessors Office)

The two groups of properties compared closely in terms of their physical attributes. The difference in average lot size between the Southwest and Northwest King County properties was 3.3%. The difference in size of structure was 2.0%, in number of bedrooms 1.4%, and in number of baths 0.6%. In terms of property values however the differences were more pronounced. Average assessed value of land was 14.1% higher in Northwest King County than it was in areas immediately surrounding the Airport, and assessed value of structures was 7.7% higher. The assessed value of land and structures combined was 10.1% higher.

Standardized for view, condition of structure, size of structure, lot size, number of bedrooms, number of baths, zoning, land use, county/state development policies, and similarity of neighborhoods, a housing unit selling for $141,400 in the immediate vicinity of the Airport would sell for $155,700, or $14,300 (10. l%) more, if it were located elsewhere.

The average difference of 10.1% in the assessed value of real estate (property plus structure) when all other factors are adjusted for is attributable to the impact of low flying aircraft in the immediate vicinity of Sea-Tac International Airport. The resulting depression of property values as of 1993, taking account of community differences is shown in Table 9.02.

Table 9.02
Estimated Average Depression in Single-Family Residential Property Values, by Community - 1993

Community	Actual Average Assessed Value of Housing Unit	Estimated Assessed Value Without Airport	Difference
Burien	$129,900	$143,000	-$13,100
Des Moines	$136,100	$149,800	-$13,700
Federal Way	$142,900	$157,300	-$14,400
Normandy Park	$173,600	$191,100	-$17,500
Tukwila	$122,400	$134,800	-$12,400

Between 1993 and the Year 2000, operations at Sea-Tac International Airport are forecast to increase by 39,700, or 11.7%. Between the Years 2000 and 2020, operations are forecast to increase by an additional 62,400, or 16.5%. Applying these same rates of change to the estimated 1993 difference in single-family residential property values caused by aircraft operation at Sea-Tac International Airport produces the depressed values shown in Table 9.03. The next to the last column of Table 9.03 contains the expected reduction of value for the average single-family residential housing unit between the Years 2000 and 2020. The last column shows the average difference in value experienced over the entire 20-year period 2000 through 2020.

There will be no reduction in property value attributable to the Sea-Tac International Airport expansion until the Year 2000. The decline will be small the first year since there will be few operations over the Airport's annual service volume (ASV). As operations over the ASV threshold increase, the relative decline in property value will increase, reaching, in the case of Burien, $36,356 in the Year 2020. Averaged over the entire 20-year period, the yearly decline is $13,179, as shown in the last column of Table 9.03.

This loss of value occurs after Sea-Tac International Airport would have reached its ASV capacity limit had the Third Runway and related facility improvements not been built.

Table 9.03
Forecast of Average Depression in Single-Family Residential Property Values Caused by Aircraft Operations at Sea-Tac

Community	1993	2000	2020	Change 2000 - 2020	Average Yearly Difference 2000-2020
Burien	-$13,100	-$29,831	-$56,187	-$26,356	-$13,179
Des Moines	-$13,700	-$31,227	-$58,835	-$27,609	-$13,804
Federal Way	-$14,400	-$32,804	-$61,795	-$28,891	-$14,496
Normandy Park	-$17,500	-$39,859	-$75,079	-$35,221	-$17,610
Tukwila	-$12,400	-$28,172	-$53,016	-$24,844	-$12,422

9.03 - FLIGHT TRACK IMPACTS ON AVERAGE PROPERTY VALUES

The impact on a parcel's value of its location under, or in close proximity to, the approach/ departure flight track of aircraft operating at Sea-Tac International Airport was estimated using the linear regression model:

$$y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10}$$

where:

Y = assessed value of land and structures
X_1 = lot size (sq. ft.)
X_2 = structure size (sq. ft.)
X_3 = number of bedrooms
X_4 = number of baths
X_5 = distance from center of a jet flight track (east of runway 16/34R or west of runway 16/34L), measured in tenths of a mile.
X_6 = a binary variable representing the City of Des Moines
X_7 = a binary variable representing the City of Normandy Park
X_8 = a binary variable representing the City of SeaTac
X_9 = a binary variable representing Unincorporated King County
X_{10} = a binary variable representing the City of Tukwila

The model's parameters were estimated from Assessors data on 3,026 properties in ten Census Tracts in the immediate vicinity of the Airport. The regression coefficient (adjusted R^2) was 0.65.

The model initially contained variables for the Cities of Federal Way and Kent, but these places had too few cases to be meaningful and were dropped from the final model, The distance from each parcel to the center of the Airport was also initially used as a variable but its coefficient was not statistically significant and it was also dropped from the final model. The following housing units were excluded in estimating the regression model - units with fewer than three bedrooms; units whose condition was less than "good" or "very good"; units with a view; and units not in single-family residential zoned areas. The ratio of the regression's standard error to the standard deviation of the dependent variable was 0.59. The log likelihood ratio was -35,379, and the F-statistic was 566. The Durbin-Watson statistic was 1.44.

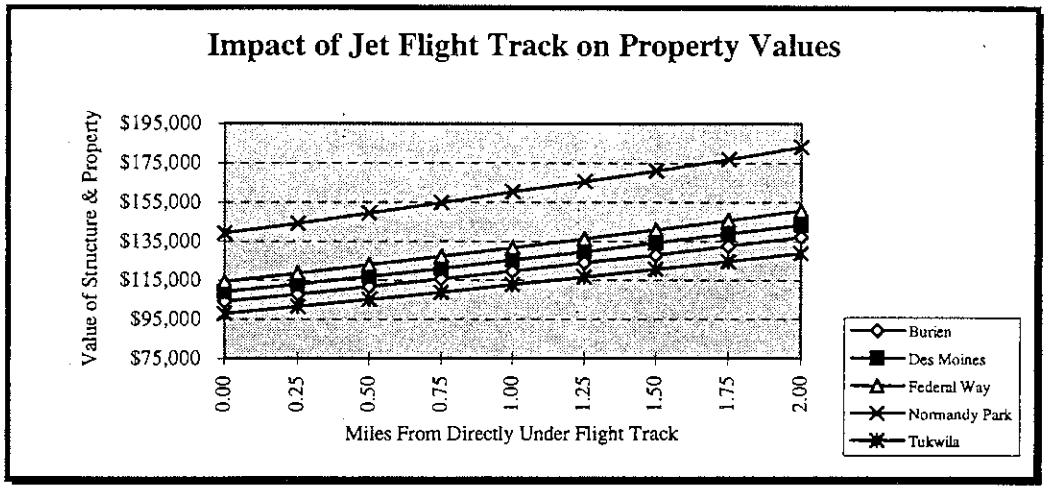
All of the independent variables in the model were statistically significant at the 90% level and seven were statistically significant at the 99% level. The variable measuring a property's distance from a flight track was significant at the 99% level.

The coefficient on the variable for distance from a jet aircraft flight track was 17,784, meaning that. all other things remaining equal, the value of a house and lot increases by about 3.4% ($4,450 on the average valued house of $129,900) for every quarter of a mile the house is farther away from being directly underneath the flight track of departing/approaching jet aircraft. This relationship is shown in Table 9.04 and illustrated in Figure 9.01.

Table 9.04
Model Estimated Impact of Jet Flight Track on Average Property Values

Miles from flight track	Average Value Structure & Property, By Community				
	Burien	Des Moines	Federal Way	Normandy Park	Tukwila
0.00	$104,151	$109,122	$114,574	$139,189	$98,138
0.25	$107,843	$112,990	$118,636	$144,123	$101,617
0.50	$111,666	$116,996	$122,841	$149,232	$105,210
0.75	$115,625	$121,143	$127,196	$154,522	$108,949
1.00	$119,724	$125,438	$131,705	$160,000	$112,811
1.25	$123,822	$129,732	$136,214	$165,478	$116,673
1.50	$128,062	$134,174	$140,878	$171,143	$120,668
1.75	$132,446	$138,767	$145,701	$177,002	$124,799
2.00	$136,980	$143,518	$150,689	$183,062	$129,072

Figure 9.01



9.04 - OPERATIONS IMPACTS ON RESIDENTIAL PROPERTY TAX REVENUES

The *Sea-Tac Master Plan Update Final EIS*'s estimate of reduced residential property tax revenues caused by construction of the Third Runway and related facility improvements is shown in Table 9.05.

The only cause of reduced revenues identified in the Final EIS is the acquisition of property now on the tax tolls of the Cities of Burien and SeaTac. The EIS assumes there will be no impact on land located in the immediate vicinity of the Airport or under the flight track of the Airport's increased traffic volumes. In other words, the Final EIS assumes that unless land is acquired it will not be affected.

Table 9.05
EIS Estimate of Third Runway Induced Decline in Residential Property Tax Revenues

Jurisdiction	Property Tax Rate Per $1,000 Assessed Value	Reduction in Residential Property Tax Revenues
City of Burien	$3.00838	$45,867
City of SeaTac	$3.02811	$181,687
Total		**$227,554**

(Source: US Department of Transportation, Federal Aviation Administration, and Port of Seattle, February 1996, Final EIS, page IV.8-12)

As discussed earlier, construction of the Third Runway and related facilities improvements will allow aircraft operations at the Airport to increase after the Year 2000 - when it reaches its ASV capacity limit - by 62,400, or over 16%. A statistical analysis of comparable properties in King County demonstrates that these increased operations will:

- On average, depress all property values around the Airport below levels they would have had if the aircraft didn't expand; and,

- Specifically, cause a depression of value for properties directly under, and up to two miles on either side of, jet aircraft approach/departures tracks.

The depression of property values below the market levels that would otherwise occur also depresses the flow of property tax revenues to local, county, special purpose, and state governments.

The methodology used to estimate the reduction in single-family residential property tax revenues resulting from Airport impacts that depress property values is as follows. The number of single-family residential housing units in each impacted community was multiplied by the average loss (depression) of value per unit for each community between the Years 2000 and 2020 to estimate the aggregate loss of property value. Each city's total levy rate (regular and fire) was multiplied by its aggregate loss of property value to estimate the loss of single-family residential property taxes. The number of single-family housing units in each city was obtained from the Office of Financial Management's Forecasting Division. The average yearly increase in each city's single-family residential housing units between 1990 and 1995 was used to trend forward its stock of single-family housing.

Levy rates for each city were obtained from the King County Assessors Office's Accounting Division. The estimated property value loss by community for the Years 2000, 2010 and 2020 and the cumulative property losses between 2000 and 2020 are shown in Table 9.06.

In the Year 2000, after which the increase in aircraft operations at Sea-Tac International Airport will be the result of construction of the Third Runway and related facilities improvements, the five impacted cities will experience depressed property values for single-family residential housing units estimated of approximately $1.7 million. As Sea-Tac International Airport operations increase, the depression of property values in the impacted communities will grow each year, reaching $2.2 million in the Year 2020. Over the 20-year period, 2000 through 2020, the cumulative loss of property tax revenues in the five impacted cities is estimated at approximately $38.8 million (expressed in constant value 1995 dollars), distributed among the cities as follows:

- Burien $14.2 million
- Des Moines $6.4 million
- Federal Way $11.6 million
- Normandy Park $2.8 million
- Tukwila $3.7 million

Table 9.06
Single-Family Residential Property Tax Revenue Losses by Housing Units in Five Impacted Cities in Immediate Proximity of the Airport

Community	Forecast Year 2000	2010	2020
Burien			
Number of impacted housing units	15,890 DU	17,890 DU	19,890 DU
Average loss of value per DU	-$13,179	-$13,179	-$13,179
Estimated total loss of value	-$209,411,749	-$235,769,426	-$262,127,104
City property tax levy rate	0.00300969	0.00300969	0.00300969
Yearly revenue loss	-$630,264	-$709,593	-$788,921
Cumulative revenue loss	-$630,264	-$6,699,287	-$14,191,858
Des Moines			
Number of impacted housing units	5,179 DU	6,179 DU	7,179 DU
Average loss of value per DU	-$13,804	-$13,804	-$13,804
Estimated total loss of value	-$71,492,950	-$85,297,343	-$99,101,736
City property tax levy rate	0.00374534	0.00374534	0.00374534
Yearly revenue loss	-$267,765	-$319,468	-$371,170
Cumulative revenue loss	-$267,765	-$2,936,165	-$6,389,351
Federal Way			
Number of impacted housing units	10,992 DU	12,392 DU	13,792 DU
Average loss of value per DU	-$14,496	-$14,496	-$14,496
Estimated total loss of value	-$159,334,980	-$179,628,737	-$199,922,493
City property tax levy rate	0.00323195	0.00323195	0.00323194
Yearly revenue loss	-$514,963	-$580,551	-$646,138
Cumulative revenue loss	-$514,963	$5,477,569	-$11,611,022
Normandy Park			
Number of impacted housing units	2,417 DU	2,577 DU	2,737 DU
Average loss of value per DU	-$17,610	-$17,610	-$17,610
Estimated total loss of value	-$42,564,077	-$45,381,724	-$48,199,371
City property tax levy rate	0.00310000	0.00310000	0.00310000
Yearly revenue loss	-$131,949	-$140,683	-$149,418
Cumulative revenue loss	-$131,949	-$1,363,160	-$2,813,667
Tukwila			
Number of impacted housing units	3,666 DU	4,866 DU	6,066 DU
Average loss of value per DU	-$12,422	-$12,422	-$12,422
Estimated total loss of value	-$45,539,453	-$60,445,984	-$75,352,516
City property tax levy rate	0.00310000	0.00310000	0.00310000
Yearly revenue loss	-$141,172	-$187,383	-$233,593
Cumulative revenue loss	-$141,172	-$1,642,774	-$3,747,651
Yearly Revenue Loss All Cities	**-$1,686,113**	**-$1,937,677**	**-$2,189,239**
Cumulative Revenue Loss All Cities	**-$1,686,113**	**-$18,118,955**	**-$38,753,549**

(Source: Office of Financial Management, King County Assessor's Office.)

9.05 - FLIGHT TRACK IMPACTS ON RESIDENTIAL PROPERTY TAX REVENUES

In addition to the loss of value resulting from aircraft operations that will affect all single housing units in immediate proximity to the Airport, single-family housing units that will be under the flight tack of approaching/departing aircraft using the proposed Third Runway will suffer additional value losses from having low flying aircraft pass directly overhead. The magnitude of these types of impacts were described and analyzed in Section 9.03, above. The methodology used to estimate the flight track impacts on the property tax revenues of the affected cities was as follows.

Approaches/departures using the Third Runway will create a flight track approximately half a mile to the west of the flight track on existing runway 16/34L. A new set of single-family housing units will lie directly under the flight track (defined as 1/8th of a mile on either side) and a new set of units will fall within the quarter mile and half mile bands to the west of the Third Runway s new flight track. To the south, the affected single-family housing units will be in Des Moines Federal Way and Normandy Park (only the half mile band will impact Normandy Park). To the North, the new Third Runway flight track will pass over the City of Burien. The City of Tukwila lies entirely to the east of the Airport and will not be impacted by the flight track generated by the Third Runway.

The linear north-south distance of the new flight track for the Third Runway was calculated for each of the impacted cities. Each flight track "impact band" used in the regression model (Section 9.03) was a quarter-mile wide.

The linear distance of the Third Runway's flight track over each impacted city multiplied by a quarter mile therefore generated an estimate of the area of each impact band within each city. The average lot size of single-family residential housing units used to calibrate the regression model was 12,950 square feet. Using this average lot size produces an estimate of 538 single-family housing units for each linear mile of the new flight track.

Multiplying this estimate by the dollar value of the average annual depression in single-family housing units for each city produced the estimated total value reduction in single-family residential housing units as a result of the Third Runway's value loss gradient. Multiplying the loss of value by each city's property tax levy rate produced the estimate of annual property tax revenue loss for each city. The results are summarized in Table 9.07

In the five impacted cities combined, tax collections from single-family residential units lying directly under or close to the Third Runway's jet flight tracks will be reduced by $294,260 a year, or $5.89 million (expressed in constant value 1995 dollars) over the 20-year period 2000 to 2020 as a result of depressed property values. The distribution of these cumulative 20-year revenue losses by city are as follows:

- Burien $0.97 million
- Des Moines $2.73 million
- Federal Way $1.78 million
- Normandy Park $0.41 million
- Tukwila $0.00 million

Table 9.07
Average Annual Single-Family Property Tax Revenue Losses Resulting from the Third Runway's Flight Track Gradient

	Burien	Des Moines	Federal Way	Normandy Park	Tukwila
Track Miles by Noise Gradient					
0.00 miles	1.28	2.77	1.99	0.00	0.00
0.25 miles	1.28	2.77	1.99	0.00	0.00
0.50 miles	1.28	2.77	1.99	1.14	0.00
SF DUs/Track Mile	538	538	538	538	538
New Noise Gradient Affected DU					
0.00 miles	688	1,491	1,070	---	---
0.25 miles	688	1,491	1,070	---	---
0.50 miles	688	1,491	1,070	612	---
Average Property Value Loss per DU					
0.00 miles	-$7,551	-$7,874	-$8,267	-$10,043	-$7,081
0.25 miles	-$7,782	-$8,153	-$8,560	-$10,399	-$7,332
0.50 miles	-$8,057	-$8,442	-$8,864	-$10,768	-$7,592
Total Value Loss from Gradient					
0.00 miles	-$5,170,645	-$11,737,775	-$8,848,167	---	---
0.25 miles	-$5,353,943	-$12,153,876	-$9,161,832	---	---
0.50 miles	-$5,543,738	-$12,584,727	-$9,486,616	-$6,585,531	---
Total	-$16,068,326	-$36,476,378	-$27,496,615	- S6,585,531	---
Property tax levy rate	0.00300969	0.00225795	-0.00155887	0.0017	0.00321043
Annual Loss of Property Tax Revenues					
0.00 miles	-$15,562	-$43,962	-$28,597	$0	$0
0.25 miles	-$16,114	-$45,520	-$29,611	$0	$0
0.50 miles	-$16,685	-$47,134	-$30,660	-$20,415	$0
Total	-$48,361	-$136,616	-$88,868	-$11,195	$0

9.06 - SUMMARY OF IMPACTS ON SINGLE FAMILY RESIDENTIAL PROPERTY TAX REVENUES

The total cumulative reduction in single-family property tax revenues during the Years 2000 through 2020 caused by construction and operation of the proposed Third Runway and related Airport facilities in the five impacted cities is shown in Table 9.08. In this table, the flight track-induced relative land value losses are deducted from the operations-induced relative land value losses to prevent double-counting.

Over the 20-year period 2000 through 2020, the five impacted communities will suffer a reduction in property tax revenues from single-family residential units of $39.9 million (expressed in constant value 1995 dollars) as a result of construction of the Third Runway and related Airport improvements. The average annual revenue reduction will be almost $2.0 million.

Table 9.08
Total Loss of Single-Family Residential Housing Property Tax Revenue Caused by Construction and Operation of the Third Runway, Years 2000 through 2020

Community	Total Revenue Losses	Land Acquisition-Induced Losses	Aircraft Operations-Induced Losses	Flight Track Gradient-Induced Losses
Burien	-$15,338,533	-$1,146,675	-$13,224,644	-$967,214
Des Moines	-$6,389,351	$0	-$3,657,022	-$2,732,329
Federal Way	-$11,611,022	$0	-$9,833,668	-$1,777,354
Normandy Park	-$2,813,667	$0	-$2,405,364	-$408,303
Tukwila	-$3,747,651	$0	-$3,747,651	$0
Combined Total Losses	**-$39,900,224**	**-$1,146,675**	**-$32,868,349**	**-$5,885,196**

The largest source of property tax losses (82.3%) will be depressions in property values caused by the increase in Sea-Tac International Airport's aircraft operations after the Year 2000, and made possible by construction of the Third Runway and related Airport improvements. A loss of $32.9 million in local government revenues (expressed in constant value 1995 dollars) over the 20-year period will result. The second largest source of property tax losses (14.8%) will come from the decline in single-family residential property values of units beneath the flight track of aircraft using the proposed Third Runway. These property value reductions will cause a loss of an additional $5.9 million in local government revenues over the 20-year period (again expressed in constant value 1995 dollars).

The smallest cause of local government property tax revenue losses will result from the acquisition of properties required for expansion of the Airport. These reduction (which are the only ones discussed in the Final EIS) will cause a cumulative loss of $1.1 million. The acquisition of properties as part of the Airport's Third Runway related expansion will begin in 1996. Cumulative revenue losses are for a 25-year period 1996 through 2020, inclusive. Looked at in terms of the impacted communities, Table 9.09 contains the percentage distribution of total property tax revenue losses among the impacted cities.

Table 9.09
Distribution of Property Tax Revenue Losses Among Impacted Cities

Community	Cumulative Loss of Property Tax Revenues	Percent of Total
Burien	-$15,338,533	38.4%
Des Moines	-$6,389,351	16.0%
Federal Way	-$11,611,022	29.1%
Normandy Park	-$2,813,667	7.1%
Tukwila	-$3,747,651	9.4%
5-City Combined Total	**-$39,900,224**	**100.0%**

9.07 - IMPACTS ON OWNERSHIP OF SINGLE-FAMILY RESIDENTIAL HOUSING UNITS

Economic theory argues that the relative change (reduction) in single-family residential land values discussed above will lead to tenure changes in the affected single-family housing units. The major expected tenure change is a shift from owner occupied to renter occupied housing as relative housing prices fall. Table 9.10 compares housing tenure in the Sea-Tac International Airport impacted communities with housing tenure in the comparison Census Tracts in Northwest King County.

Table 9.10
Owner and Renter Occupied Single-Family Housing Units
Sea-Tac Impacted and Northwest King County Comparison Communities

	Number	Percent
NW King County Comparison Communities		
Total single-family housing units	12,683	100.0%
Owner occupied units	12,254	96.6%
Renter-occupied units	429	3.4%
Sea-Tac Impacted Communities		
Total single-family housing units	11,526	100.0%
Owner occupied units	9,618	83.4%
Renter-occupied units	1,908	16.6%

(Source: 1990 Census, STF-3)

As the data show, the expectations from economic theory hold true. Renter occupied units in areas immediately surrounding the Airport were 16.6% of total single-family housing. In the comparison areas in Northwest King County, they were only 3.4%. If past trends continue, the percent of single-family housing units in the impacted communities occupied by renters will rise to 20.6% in the Year 2020. About two-thirds of the increase in renter's housing tenure percentage will occur after the Year 2000, and is attributable to construction of the proposed Third Runway and related facilities improvement's at Sea-Tac International Airport.

9.08 - IMPACTS ON COMMUNITY DEMOGRAPHIC PROFILES

In *Washington State Housing Needs and Market Trends: An Overview* (Joshi, et.al., 1989) it was stated that (page 44):

> *"Most low income households are renters...Sixty percent of all Washington households with annual incomes below [75% of state median income] were renters....The average renter is generally younger, more mobile, and has an income half that of the average homeowner."*

Table 9.11 compares the income distribution of owner and renter households.

Table 9.11
Income Distribution of Household Owners and Renters - Washington State

Household Income Status	Total	Owner	Renter
Below 50% State median income	26.3%	17.9%	42.4%
50% to 100% State median income	28.4%	25.1%	34.6%
100% to 165% State median income	23.5%	27.6%	15.7%
Over 165% State median Income	21.8%	29.4%	7.3%
Total	**100.0%**	**100.0%**	**100.0%**

(Source: Washington State Housing Needs and Market Trends)

Among households that own their own home, 43% are below state median income and 18% are below half of the state's median income. Among households that rent their home, 76% are below state median income and 42% are below half the state's median income. Looked at from another perspective, renter households make up 66% of all households in the state but they account for only 17% of households with incomes below the State median.

A regression model developed by the consultant team that relates Washington State Department of Social and Health Services' (DSHS) "county use rates" by county to per capita personal income levels in 1994 indicates that the relationship between income levels and need for public services is statistically significant and has a negative sign - meaning that the need for public services goes up as household incomes (and hence, the percent of owners) fall.

"Use rates" are derived by dividing a county's total DSHS clients, for all types of DSHS services, by the county's total population. Counties where a high percentage of seasonal or transient residents receive DSHS services will have overstated use rates. (Washington State Department of Social and Human Services, Office of Research and Data Analysis, April 1996). The regression models adjusted R^2 was 0.15785, the T-statistic for the per capita personal income variable was 2.6335, the regression's F-statistic was 6.9361.

Although a detailed analysis of the relationship between different types of public service needs and the growth of aircraft operations at Sea-Tac International Airport is beyond the work scope of the current socio-economic analysis, it appears from preliminary analysis of available data that such a relationship exists; and that it is statistically meaningful.

9.09 - THE THIRD RUNWAY'S IMPACT UPON COMMUNITY FACILITIES AND SERVICES

The Third Runway and related Airport facilities, will affect the need for community facilities and services by impacting community demographic profiles in the areas immediately surrounding Sea-Tac International Airport. Many of these communities already have a higher need for community services than other communities in King County - reflecting, in part, past impacts of the Airport. One way to compare community service needs is by using "service use rates" calculated by the Washington State DSHS for ninety-nine largest cities in the state, including 18 cities located (at least in part) in King County.

DSHS provides a variety of services and grants to individuals and families with one or more of the following difficulties:

- Child neglect
- Dependent elderly status
- Alcohol/substance abuse
- Developmental disabilities
- Other long-lasting physical/mental disabilities
- Poverty
- Recent refugee status
- Juvenile criminal offenses

DSHS also provides the services in the following administrative categories to individuals and families having these difficulties:

- Aging & Adult Services Administration (AASA)
- Division of Alcohol & Substance Abuse (DASA)
- Division of Children & Family Services (DCFS)
- Division of Developmental Disabilities (DDD)
- Division of Vocational Rehabilitation (DVR)
- Economic Services Administration (ESA)
- Juvenile Rehabilitation Administration (JRA)
- Medical Assistance Administration (MSA)
- Mental Health Division (MHD)

Each fiscal year, DSHS calculates for each city for which it reports the number of clients served in each of its administrative service categories divided by the city's population. It calls these calculations "service use rates" The most recent rates calculated were for 1994 (Washington State Department of Social and Health Services, Office of Research and Data Analysis, May 1996). The total use rate and the programmatic rates for DCFS, DASA, JRA and ESA are presented in Figures 9.02- 9.06.

In terms of DSHS's rate for its total array of services, Normandy Park and Federal Way were below the average use rate for all DSHS cities in King County. The DSHS use rate for Burien, Des Moines and Tukwila was above the average.

Although Renton was below the county average and Lake Forest Part was above it, the general pattern was for cities in the south county to have rates above the average and cities in the north county to have use rates below the average Figure 9.02. In part, this likely reflects past impacts of the Airport on the quality of life, property values, and the resulting land uses and demographics of south King County communities.

Figure 9.02
DSHS Total Service Use Rate

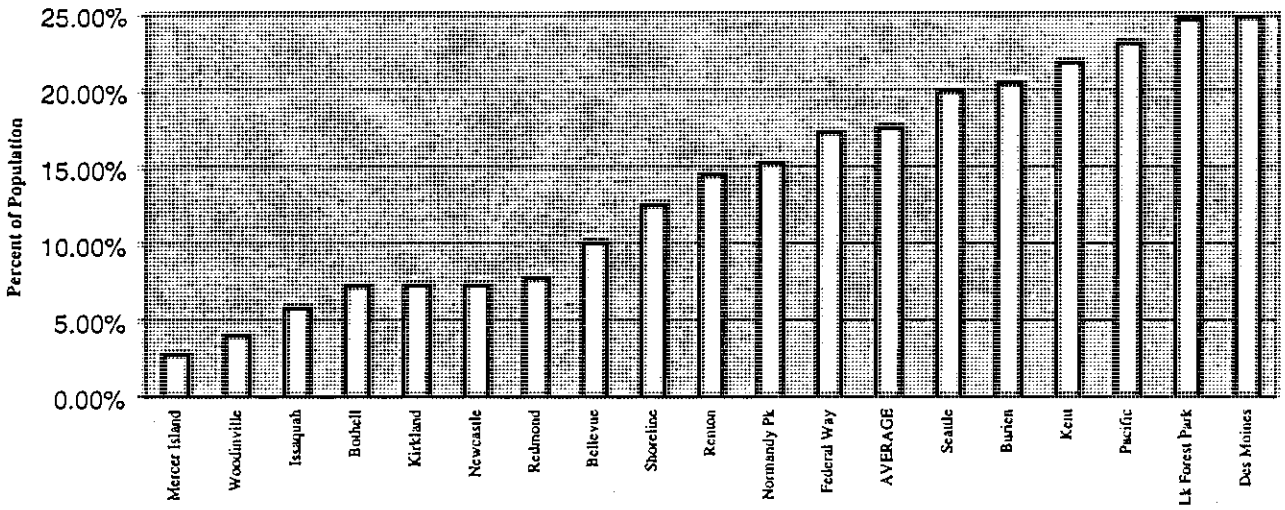
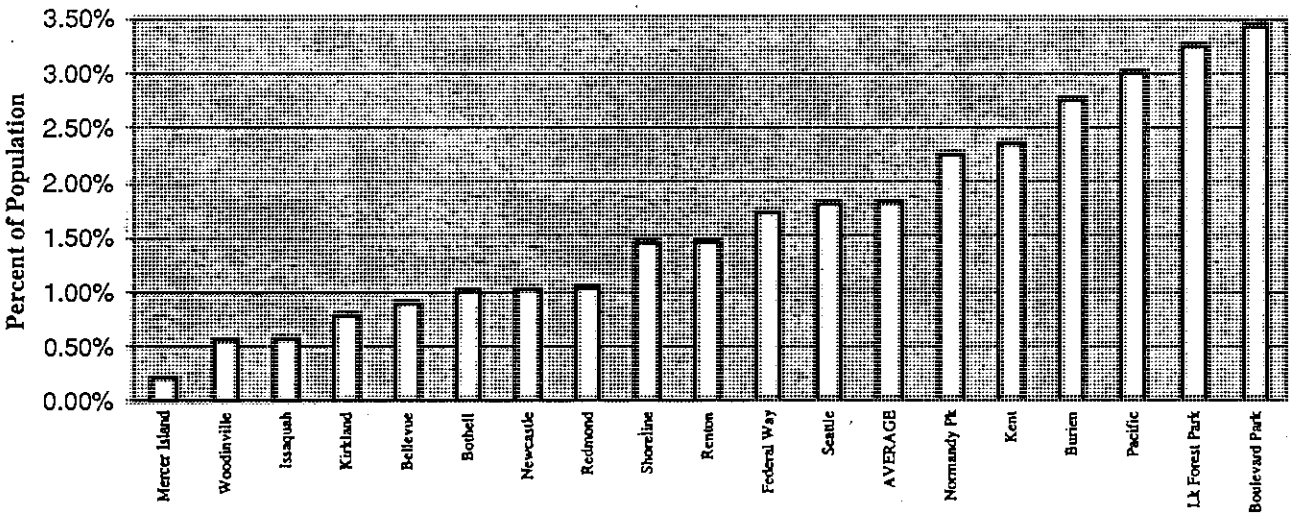


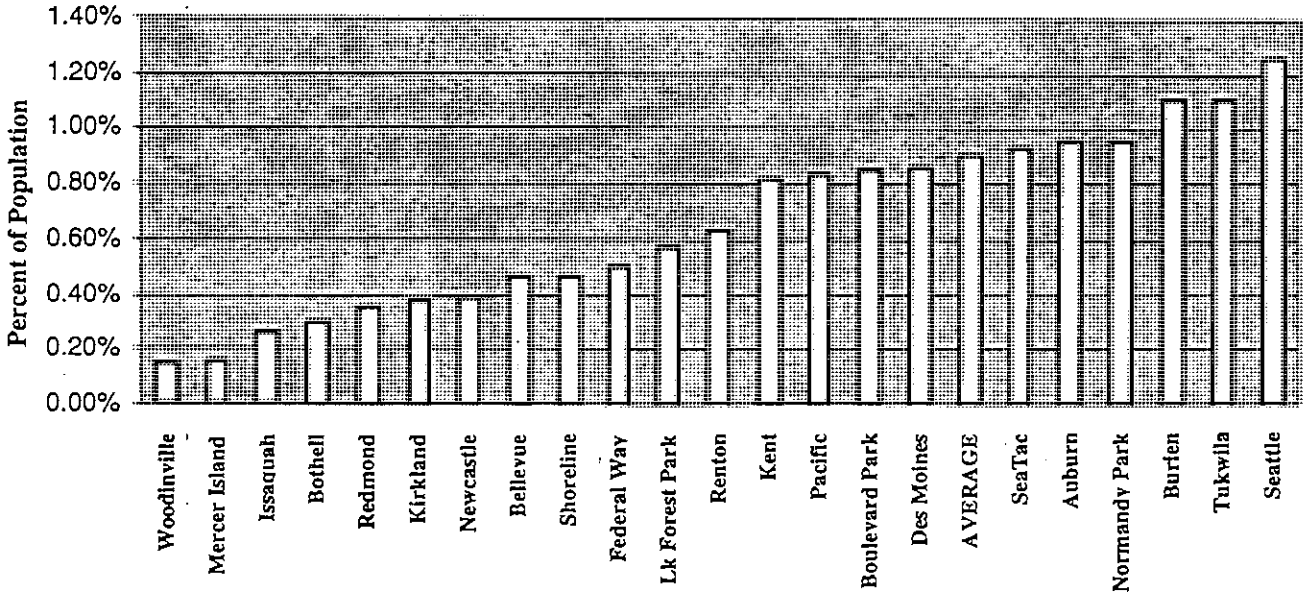
Figure 9.03 shows the use rate for children and family services among King County cities. Federal Way falls below the county average, while Burien, Des Moines, Normandy Park and Tukwila fall above the county's average use rate. Tukwila has the highest DCFS use rate in King County at 3.8%. (The county average was calculated by weighting each city by its population. The weighted total use rate average, for example, was 17.64% while the unweighted average was 16.19%.)

Figure 9.03
DSHS Child & Family Services Use Rates



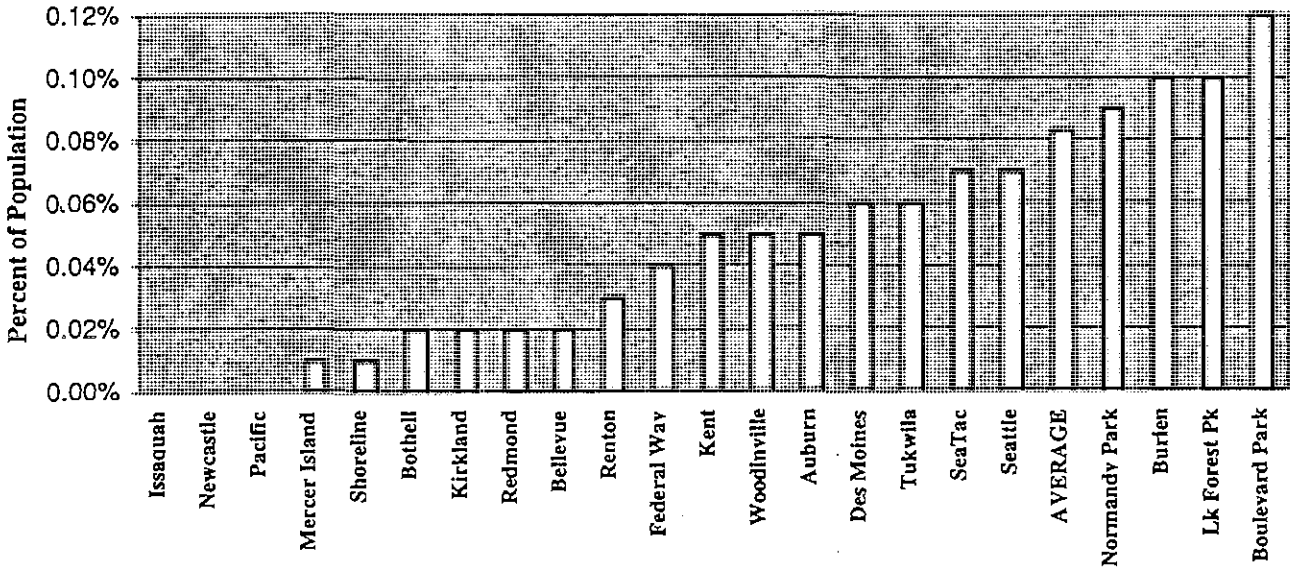
The city alcohol and substance abuse rates are shown in Figure 9.04. Federal Way and Des Moines have rates below the King County average, and Burien, Normandy Park and Tukwila have rates above the county average. To some extent, the DASA use rates reflect the location of alcohol and substance abuse rehabilitation facilities - which probably accounts for Seattle having the highest DASA rate in the county.

Figure 9.04
DSHS Alcohol & Substance Abuse Use Rates



The juvenile rehabilitation rate for King County cities is shown in Figure 9.05. Federal Way, Des Moines and Tukwila are all below the county average while Normandy Park and Burien are above it.

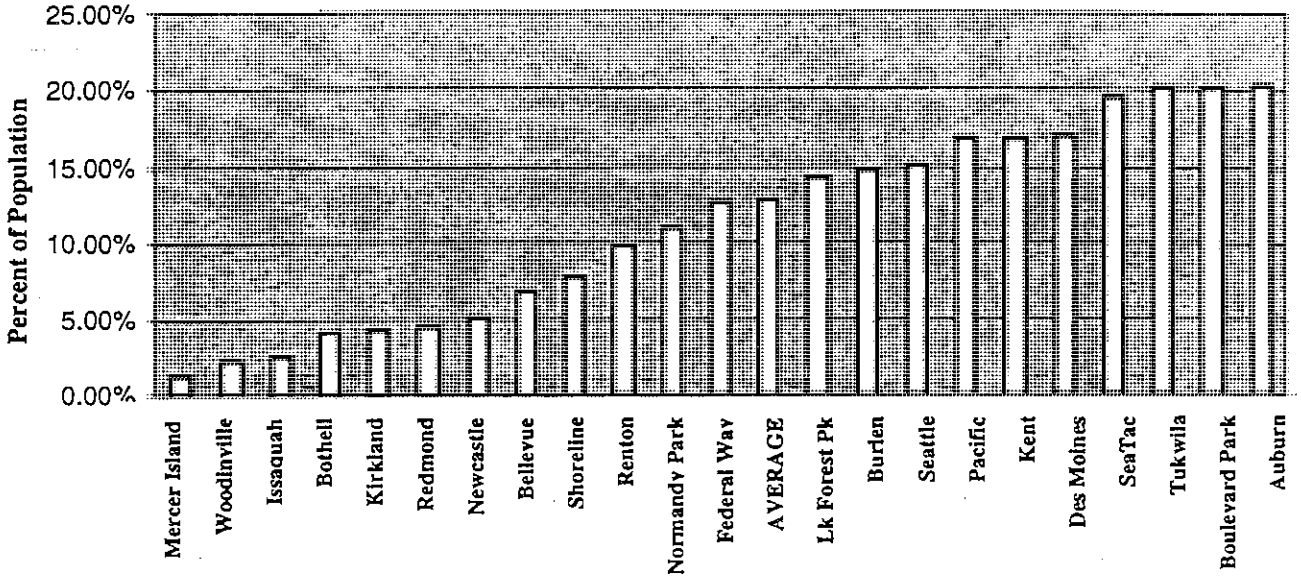
Figure 9.05
DSHS Juvenile Rehabilitation Service Use Rates



The economic security services use rate for county cities is shown in Figure 9.06. Normandy Park and Federal way have rates below the county average, and Burien, Des Moines and Tukwila have rates below the county average.

Overall, Normandy Park and Federal Way have the lowest use rates among the five cities covered by the Sea-Tac International Airport Impact Mitigation Study. This may reflect Federal Way's relatively greater distance from the Airport and both Federal Way's and Normandy Park's locations to the west of the Airport's flight tracks. Since the Third Runway will locate a flight tract to the west, these communities will likely have a greater impact from the Third Runway than they did from Sea-Tac International Airport's first or second runways. The highest social service use rates currently are in Tukwila and Des Moines.

Figure 9.06
DSHS Economic Sercurity Services Use Rates



The Third Runway and related Airport facilities will impact community services and facilities in numerous ways. Environmental and transportation impacts during construction will include the movement of construction vehicles over the road system contained within the District, and will likely affect the movement along, and possibly safety, of public streets and parking places. After construction, environmental impacts will mainly be generated by noise from the growth of aircraft operations from the Third Runway and related Airport facilities will allow Sea-Tac International Airport to exceed its ASV of 380,000 operations after the Year 2000. The impacts of noise on the ability of churches, hospitals, nursing homes, community centers and libraries to function normally is analyzed in the environmental impact sections of this Sea-Tac International Airport Impact Mitigation Study.

As discussed previously, the growth of operations at Sea-Tac International Airport after its 380,000 ASV capacity has been reached around the Year 2000, will mean that the value of residential properties surrounding the Airport will not appreciate as fast as they otherwise would have. The market adjustment to such a relative decline in residential property values will be an alteration in land uses away from owner occupied homes toward renter occupied homes. Since renters have a profile that is younger, more mobile and lower income than owners, communities experiencing the impacts of the Third Runway will have to offer expanded social services if they are to maintain the quality of life achieved in the past.

9.10 - COMMUNITY FACILITIES IMPACTED BY THE THIRD RUNWAY'S FLIGHT TRACK

Employing the DSHS use rates discussed earlier as a guide to the types of impacts the Third Runway and related Airport facilities development will have, the most likely impacts will be generated by the changes in the demographic profile of the population living to the west of the current Sea-Tac International Airport flight tracks. The proportion of renter occupied housing units will likely rise after the Year 2000, and will result in a population needing more child care services, community social services, counseling services and employment assistance services than is either true today or would be true if the Airport were not expanded. Existing facilities at local churches, community centers, schools and libraries will most likely be inadequate to cope with these increased needs and will have to be expanded.

Additional facilities required by Sea-Tac International Airport's Third Runway impacts can be calculated by applying current service use rates per 1,000 of the population, for specific services, to the forecast populations for the impacted cities and subtracting the derived service levels from service requirement levels independently forecast based on the cities' expected demographic shifts. This type of analysis should be reviewed for "reasonableness" by working professionals in both the functional service areas and the agencies/organizations now providing the services in the impacted cities.

The most likely communities to suffer major facility impacts from the Third Runway and related Airport facilities development will be Burien, Des Moines, Normandy Park and Federal Way. Tukwila appears to have suffered the community facility and service need impacts from Sea-Tac International Airport's existing approach/departure flight tracks, but it is to the east of Sea-Tac International Airport and will likely not face the same magnitude of impacts from the approach/departure tracks of the proposed Third Runway. The growth of surface traffic on Pacific Highway South (SH 99) however could easily generate a business environment that gives rise to anti-social and criminal behavior and will require an expansion of Tukwila's public safety personnel and facilities.

No analysis of the community facility requirements was contained in the EIS for the Third Runway and related Airport facilities. The resources and time available under this Sea-Tac International Airport Master Impact Mitigation Study were not sufficient to allow such an analysis to be made using quantifiable research techniques. It is recommended that such a research based analysis be conducted.

Affects of the Third Runway's Flight Track

Community services and facilities in the five impacted communities will be affected by the Third Runway and related Airport facilities in different ways. These include demographic factors, economic factors and psychological factors. None of these factors was considered in the Port of Seattle's Master Plan Update EIS, as a result the information available about these factors only allows for informed speculation and analysis - based on judgments about likely impacts. Additional research should be conducted on each of these factors to determine its statistical significance and magnitude.

- **Demographic Factors** - These factors have already been discussed as an outcome of the land use changes resulting from the growth of operations after the Year 2000 when the Third Runway and related Airport facilities become operational. The increased proportion of rental housing units in the area will produce a resident population that is younger, more mobile and lower income than today's. Given the established correlation between income and the need for community services and facilities, it is likely that future populations in the impacted communities will require higher service levels per capita and more facilities per capita than does the current population.

- **Economic Factors** - The factors adversely impacting the impacted communities will primarily be the reduction in residential property values that will reduce city tax revenues below what they otherwise would have been.

  The decline in relative residential property values between 1995 and the Year 2000 due to the Airport is attributed to a growth of enplanements within the Airport's ASV capacity limit. But the relative property value declines that will reduce revenues after the Year 2000 are attributed to construction of the Third Runway and related Airport facilities.

  In addition to the revenue losses to the impacted communities, local home owners will face a relative decline in the value of their property. At the same time that the cities would be faced with a need to increase expenditures per thousand persons residing in the cities in order to maintain its quality life, it would face growing voter resistance to raising local tax rates. The resulting financial squeeze will be a major economic impact on the cities, and it will rival in importance the impact on home owners of the relative decline in the value of their properties.

  The calculation of quantitatively probable, rather than illustrative, economic impacts on the impacted communities requires a research effort not possible within the resources available under the current Sea-Tac International Airport Impact Mitigation Study. The entire topic of economic impacts of the Third Runway and related Airport facilities on the community facilities and services (a topic which was not addressed at all in the EIS) needs additional research.

- **Psychological Factors** - The factors impacting the cities' needs for community services and facilities as a result of the Third Runway could come from several sources. The interruption of normal family functioning at home by aircraft noise could increase stress on affected families. Also, parents and children unable to engage in normal outdoor activities such as playing games or sports, enjoying park lands, or having outdoor barbecues may suffer the psychological stress associated with the disruption of normal neighborhood-based activities. Additional psychological impacts may be the consequence of living in neighborhoods where household turnover is high and interpersonal relationships are unstable; or from living in households with only one parent and/or which is under severe economic and financial pressure.

The current study was not able to quantitatively investigate psychological factors, but the association of such factors with the types of demographic shifts that will be accentuated by construction of the Third Runway and related Airport facilities is highly probable and warrants further research and analysis.

Need for Additional Community Services/Facilities

The noise impacts on community facilities to the west of Sea-Tac International Airport caused by the increase in approaching/ departing aircraft after the Year 2000, and which are attributable to the Third Runway, related Airport facilities, and expansion of the Airport's ASV capacity, may require remodeling, rebuilding, or other structural alterations. The mitigation of these Third Runway impacts relate to the need to attenuate noise at existing facilities. These requirements are analyzed and their mitigation requirements presented in the environmental part of the Sea-Tac International Airport Impact Mitigation Study.

The impact of the increase in approaching/departing aircraft after the Year 2000 attributable to the Third Runway, related Airport facilities, and expansion of the Airport's ASV capacity on the value of residential properties surrounding the Airport - and as a result, the cities' needs to increase expenditures for community services and facilities - is addressed later in this Section where the mitigation of individual property value losses and community property tax reductions are discussed. Any action that mitigates property losses to individual homeowners or reduces the loss of property tax revenues to communities will also increase the city and School District tax base.

The optimum methods of providing community services as a way to mitigate the demographic shifts that will be caused by the increase in approaching/departing aircraft after the Year 2000 attributable to the Third Runway, related Airport facilities, and expansion of the Airport's ASV capacity will require additional analysis. First, quantitative research needs to be conducted on the affects of the population's shifting demographic profile on the community service needs of affected families. After which, appropriate mitigation policies need to be formulated by community service professionals within each of the impacted cities. Some of these policies will likely include increased community centers, increased child care, expanded levels of police and fire services, and creation of additional community facilities.

Regardless of which or how many of these types mitigation actions will be determined as both needed and appropriate, it is evident that the impacted cities will require additional resources to mitigate the socio-economic impacts of the Third Runway and related Airport facilities.

9.11 - THE IMPACT OF SEA-TAC'S EXPANSION ON PUBLIC SCHOOLS

The Third Runway and related Airport facilities will impact Highline School District's public schools in numerous ways. Environmental and transportation impacts during construction will include the movement of construction vehicles over the road system contained within the District, and will likely affect the movement, scheduling and possibly safety of school busses. After construction, environmental impacts will mainly be generated by noise from the growth of aircraft operations associated with the Third Runway and related Airport facilities which allow Sea-Tac International Airport to exceed its ASV of 380,000 operations.

The impacts of noise on the ability of teachers to teach and students to learn is documented in a variety of ways. A Highline School District study of noise impacts on classroom performance was conducted at Sunset Junior High School, located about six blocks from the end of one of Sea-Tac International Airport's runways, in 1973 (*Aircraft Noise Study: Remedial Construction/Schools*, Highline School District, 1973). Four classrooms were selected, two adjacent rooms on the junior high school's first floor and two on its second floor, where each of the classrooms was estimated to experience five or more minutes of high level aircraft noise per 50-minute classroom period.. One of the first floor rooms and one of the second floor rooms was insulated while the other two rooms were not. Students in all four classrooms were given a math test which evaluated their "concentration and attention-to-task." As shown in Table 9.12, the test scores of students in the insulated classrooms where aircraft noise had been attenuated appear to be significantly higher than the scores of students in the non-insulated classrooms. (The measured statistical significance of the difference in test scores between the insulated and non-insulated classrooms was not reported.)

Table 9.12
Math Test Scores of Students in Insulated and Non-Insulated Classrooms

Classrooms	Sound Proofed Rooms	Non-Sound Proofed Rooms
First-floor classrooms	75.6	64.2
Second-floor classrooms	75.9	57.6

Additional information on the importance of attenuating aircraft noise for learning comes from the experience of classroom teachers. The *Highline News* recently reported a teacher at Cedarhurst Elementary School as follows (Steffens, "No Peace for Students", 23 October 1996):

> *"I just stop class completely when there's a plane going over. Students just stop themselves and look at me and wait until the [aircraft] noise is gone."*

A *Seattle Times* supplement designed to be "a comprehensive guide to public and private high schools in the greater Seattle area" contained the following statement as part of its evaluation of the Highline School District ("Guide to High Schools", 20 November 1996):

> *"A perennial challenge to the District has been its proximity to Seattle-Tacoma International Airport. Some classrooms lie directly beneath the flight path of roaring jets, which disrupts classes, assemblies and outdoor physical education. ... Now, with plans for the Third Runway in the works, school officials worry about the problems worsening."*

As discussed previously, the growth of operations at Sea-Tac International Airport after its 380,000 ASV capacity has been reached around the Year 2000, will mean that the value of residential properties surrounding the Airport will not appreciate as fast as they otherwise would have. The market adjustment to such a relative decline in residential property values will be an alteration in land uses away from owner occupied homes toward renter occupied homes. Since renters have a profile that is younger, more mobile and lower income than owners, a higher proportion of students attending District schools will require enhanced educational services if the District is to maintain the educational outputs (graduation levels, Comprehensive Test of Basic Skills (CTBS) scores, SAT scores, college admission rates) that it achieved in the past.

Whether measured by student test score, educational attainment, or post-school earnings, a wide spread professional consensus exists that the educational attainment of parents, the existence of single parent-headed households, female labor force participation, child poverty, and low household income are important influences on the quality of student outcome (Hanushek, 1996). Consequently, if the District is to maintain its historic quality of educational; outcomes, it will have to compensate for the demographic changes associated with increased renter-occupied housing by providing additional resources per student.

At the same time, the Highline School District will find itself under increased financial pressure as a result of construction of the Third Runway and related Airport facilities. Under Washington State law, State resources are distributed through funding formulas that, when combined with local and Federal resources, equalize educational opportunities throughout the State. Local property tax levies to support schools are determined by local School District needs and the resulting tax rates are submitted for approved to local District voters. The relative reduction in residential property values caused by the Third Runway and related Airport facilities will mean that higher tax rates will be required to generate the same level of resources; and the higher the rates, the more difficulty the District will have in obtaining voter approval.

Thus, at the same time the District's shifting demographic profile will require additional resources to prevent education outcomes from falling, declining relative property values will make it increasingly difficult to obtain voter approval for needed revenues. Both sides of the interaction between District needs for additional resources and voter resistance to approving school levies are traceable to the expansion of aircraft operations at Sea-Tac International Airport made possible by the Third Runway and related Airport facilities, and constitute the socio-economic impacts investigated in this Section.

Impacts on School Age Children Living Under the Third Runway's Approach/Departure Flight Tract

The Third Runway will be to the west of Sea-Tac International Airport's existing 16R/34L runway. The school children most affected consequently will live in areas served by the following elementary schools:

- Beverly Park at Glendale
- Cedarhurst
- Des Moines
- North Hill
- Olympic
- Southern Heights
- Sunnydale

The characteristics of students attending these schools are shown in Table 9.13. All of the Third Runway impacted elementary schools had a higher percentage of non-white students in 1993 than the District average, but they had few other similarities. Three of the seven schools (North Hill, Southern Heights, and Olympic) had a higher percentage of students enrolled in special education classes/programs. Three (Beverly Park, North Hill and Olympic) had a larger percentage enrolled in ESL classes. Four (Beverly Park, Sunnydale, Cedarhurst and Olympic) had a larger percentage than the District average receiving free/reduced cost lunches; but only two (Cedarhurst and Beverly Hills) were below the District average percent of students living in two-parent households.

In terms of their fourth grade Comprehensive Test of Basic Skills (CTBS) test scores compared to the entire District, the six impacted schools were mixed in their relative standings. (North Hill Elementary only has grades K through 3, and consequently does not report CTBS scores.) Beverly Park and Cedarhurst both had scores below the District average in all three test components: reading, math and language. Des Moines had test scores above the District average in all three test components. The remaining three elementary schools were above the District average in at least one of the components and below it in at least another.

In summary, children living in the elementary school service areas to the immediately west of Sea-Tac International Airport's existing boundaries will be the group most directly impacted by the westerly shift of the Airport's approach/departure flight tracks that results from construction of the Third Runway and related Airport facilities. As property values in these areas exhibit a relative decline caused by the growth of Airport operations and an increasing number of single-family residences shift from owner occupancy to renter occupancy, the number of students arriving at school with educational deficits will likely rise. To maintain the quality of educational outcome in the District, classrooms and curriculum will have to be enriched.

Highline High School lies immediately to the west of Sea-Tac International Airport's existing boundaries and it also will be significantly impacted by the Third Runway.

Table 9.13
Student Characteristics at Third Runway Impacted Elementary Schools

		Percent of Total Enrollment				
		Non-White Students	Special Education /Program Students	ESL Students	Free/ Reduced Lunch Students	Living With Two Parents Students
District Average	1990/1991	N/A	N/A	N/A	27.0%	65.0%
	1993	21.3%	8.9%	4,.1%	35.0%	57.0%
Cedarhurst	1990/1991	27.4%	8.0%	9.0%	21.0%	70.0%
	1993	37.3%	7.0%	10.0%	39.0%	56.0%
Beverly Park at Glendale	1990/1991	18.1%	10.0%	0.0%	28.0%	53.0%
	1993	26.4%	8.0%	0.0%	44.0%	51.0%
Des Moines	1990/1991	24.6%	5.0%	8.0%	23.0%	69.0%
	1993	24.5%	2.0%	0.0%	24.0%	58.0%
North Hill	1990/1991	23.4%	9.0%	16.0%	27.0%	70.0%
	1993	23.1%	10.0%	12.0%	34.0%	68.0%
Olympic	1990/1991	31.5%	14.0%	20.0%	40.0%	73.0%
	1993	28.4%	30.0%	16.0%	51.0%	64.0%
Southern Heights (1991)	1990	22.2%	7.0%	0.0%	27.0%	71.0%
	1993	24.4%	13.0%	0.0%	31.0%	63.0%
Sunnydale (1991)	1990	14.7%	3.0%	0.0%	19.0%	54.0%
	1993	33.5%	3.0%	0.0%	43.0%	61.0%

Notes:
1) 1990 data = percent non-white, percent with free/reduced lunch, percent living with two parents.
   1991 data = percent special education classes/programs, percent in ESL classes
2) North Hill has grades K-3 only; Olympic has grades 4-6.

(Source: Highline School District, 1993-94)

Table 9.14
Student Characteristics at Highline High School

Student Characteristic	Highline High School	District Average
Non-white students	25.8%	21.3%
Special education/program students	6.0%	8.9%
ESL students	6.0%	4.1%
Free/reduced lunch students	17.0%	35.0%
Living with two parents students	54.0%	57.0%

(Source: Highline School District, 1993-94)

Importance of Elementary School Impacted Children

The seven elementary schools which will be most impacted by the Third Runway had a combined enrollment in 1993 of 2,807 students, and represented almost one-third (29.5%) of the District's total elementary school enrolled children. Students from Des Moines and Olympic elementary schools matriculate to Pacific Middle School and go on to Rainier High School. Students at Sunnydale and Cedarhurst elementary schools matriculate to Sylvester Middle School and than go on to Highline High School. Students from Beverly Park and Southern Heights elementary schools matriculate to Cascade Middle School and than to Evergreen High School.

Thus, the socio-economic impact of the Third Runway on the demographic profile of enrolled students in elementary schools immediately to the west of the Airport's current boundary will be spread from the seven directly impacted schools to the entire District school system. (Only Chinook Middle School and Tyee High School, both located on the east side of the Airport, will likely not be affected by induced demographic shift attributable to the Third Runway and related Airport facilities.)

Affect of Increased Operations on School Children

The educational performance of children attending school in the Highline School District will be affected by the Third Runway and related Airport facilities in different ways. These include demographic factors, economic factors and psychological factors. None of these factors was considered in the Port of Seattle's Master Plan Update EIS, as a result the information available about these factors only allows for informed speculation and analysis-based judgments about likely impacts. Additional research should be conducted on each of these factors to determine its statistical significance and magnitude.

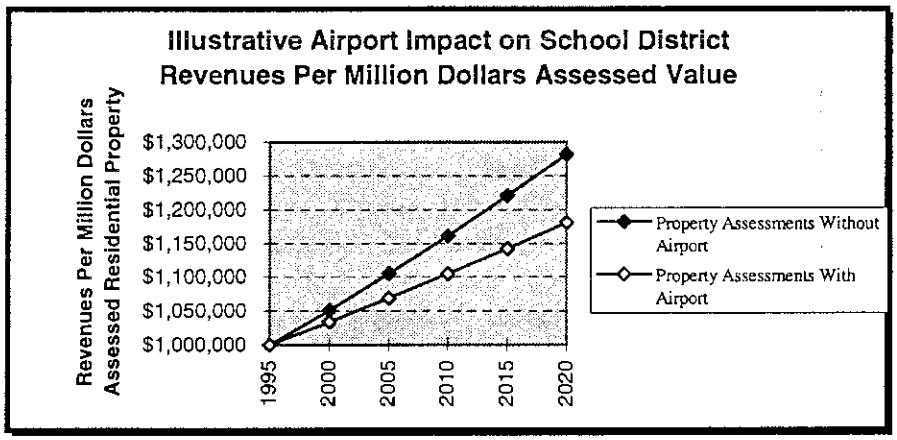
- **Demographic Factors** have already been discussed as an outcome of the land use changes resulting from the growth of operations after the Year 2000 when the Third Runway and related Airport facilities become operational. The increased proportion of rental housing units in the District will produce a resident population that is younger, more mobile and lower income than today's. Given the established correlation between income and educational attainment, it also is likely that the District's future population will have attained lower educational levels than today's population if the Third Runway and related Airport facilities are built.

- **Economic Factors** adversely impacting the Highline School District will primarily be the reduction in residential property values that will require higher special levy rates. For example, the District's most recent special levy rate was 3.015 cents per $1,000 of assessed value. Each million dollars of residential property therefore generates $3,015 of special levy revenue. Assume property values in equivalent areas in King County increase at a rate of 1% per year on average but as a result of increased Sea-Tac International Airport operation property values in the District's residential housing stock increase at only two-thirds of a percent per year. The results of this example are shown in Table 9.15 and Figure 9.07

Table 9.15
Illustrative Impact of Airport on Highline School District Revenues

Year	Property Assessments Without Airport (assumed 1.00% per year property value growth)	Property Assessments With Airport (assumed 0.67% per year property value growth)
1995	$1,000,000	$1,000,000
2000	$1,051,010	$1,033,781
2005	$1,104,622	$1,068,703
2010	$1,160,969	$1,104,804
2015	$1,220,190	$1,142,125
2020	$1,282,432	$1,180,707

Figure 9.07



In the above illustrative example, the decline in residential property values between 1995 and the Year 2000 are attributed to a growth of enplanements within the Airport's existing ASV capacity limit. The relative property value declines after the Year 2000, however, are attributed to construction of the Third Runway and related Airport facilities. In the illustrative example, the School District would have had to increase its levy rate in 2020 from $3.015 to $3.275 per $1,000 of assessed residential property value to equalize the two revenue streams.

Local home owners faced with a relative decline in the value of their property would be asked to approve higher special school levy rates than would otherwise be necessary, and the ability of the District to get voter approval would almost certainly become more difficult. At the same time, the District would be faced with a need to increase expenditures per student in order to maintain the quality of its educational outcomes, it would face growing voter resistance to raising levy rates.

The resulting financial squeeze will be a major economic impact on the School District that results from construction of the Third Runway and related Airport facilities.

The calculation of probable, rather than illustrative, economic impacts on the School District requires a research effort not possible within the resources available under the current Sea-Tac International Airport Impact Mitigation Study. The illustrative differential of one-third of a percent per year in the growth of residential property values with and without the Third Runway appears low on the basis of the property value finding reported previously, and the entire topic of economic impacts of the Third Runway and related Airport facilities on the School District (a topic which was not addressed at all in the EIS) needs additional research.

- **Psychological Factors** impacting the School District's children as a result of the Third Runway could come from several sources. The interruption of classroom teaching by aircraft noise could increase stress on students in affected classrooms. Also, student learning could be impaired in affected west-side elementary schools; and after matriculating to the middle schools in the District, these students may suffer the psychological stress associated with an inability to educationally perform with grade-level peers. Additional psychological impacts may be the consequence of living in neighborhoods where household turnover is high and interpersonal relationships are unstable; or from living in households with only one parent and/or which is under severe economic and financial pressure.

  The current study was not able to investigate the psychological factors, but the association of such factors with the types of demographic shifts that will be accentuated by construction of the Third Runway and related Airport facilities is highly probable and warrants further research and analysis.

The Need for Additional School Services/Facilities

The noise impacts on the seven elementary schools and high school immediately to the west of Sea-Tac International Airport caused by the increase in approaching/departing aircraft after the Year 2000, and which are attributable to the Third Runway, related Airport facilities, and expansion of the Airport's ASV capacity, will require remodeling, rebuilding, or other structural alterations.

The mitigation of the Third Runway impacts are over and above the structural requirements needed to attenuate noise at such schools as Hilltop, Riverton Heights, Midway and Parkside Elementary Schools, Pacific Middle School and Mount Rainier High School that were caused by the second runway and have still not been fully addressed (Highline School District, November, 1992; and Heigh, 24 August 1994). These noise induced structural impacts are analyzed and their mitigation requirements presented in the environmental part of this Sea-Tac International Airport Impact Mitigation Study.

The optimum methods of enriching the classroom learning experience as a way to mitigate the District's demographic shift caused by the increase in approaching/departing aircraft after the Year 2000 attributable to the Third Runway, related Airport facilities, and expansion of the Airport's ASV capacity will require additional analysis. Quantitative research needs to be conducted on the affects of the population's shifting demographic profile on students' classroom performance. After which, appropriate mitigation policies need to be formulated by educational professionals within the District. Some of these policies will likely include reduced student/teacher ratios, increased teacher support staff in classrooms, creation of enriched curricula, and use of additional teaching materials. Regardless of which or how many of these types of mitigated actions will be determined to be appropriate for maintaining the Highline School District's traditional quality of education outcomes, it is evident that the District will require additional resources to mitigate the socio-economic impacts of the Third Runway and related Airport facilities.

9.12 - MITIGATION OF SEA-TAC'S ADVERSE IMPACTS

The expansion of Sea-Tac International Airport will produce adverse socio-economic impacts on both households and communities in its immediate environment. Section 9.12 discusses appropriate mitigation measures for both types of impacts in three categories of mitigation: mitigation based on tax base change, mitigation based on service level changes, and mitigation based on other changes. Mitigation measures are divided into the following types:

- **Tax Base Changes**
  - Depressed Property Values
  - Reduced School Revenues
  - Reduced Local Government Revenues
  - Land Use Changes

- **Service Level Changes**
  - Public Safety
  - Community Cultural Services
  - Community Social Services
  - Educational Services
  - Health Services

- **Other Socio-Economic Impacts**
  - Environmental Justice
  - Quality of Life
  - Economic Development

9.13 - TAX BASE CHANGES

Depressed Property Values

The primary impact on households will be the decline in the relative value of residential property caused by Sea-Tac International Airport's expanded operations after the Year 2000 - as will result from construction of the Third Runway and related Airport facilities. Table 9.16 reports the average relative decline in housing values for each of the five impacted cities for the Years 2000 to 2020. (the data in Table 9.16 are derived from Table 9.03.)

Between the Years 2000 and 2020, the average residential housing unit (land plus structure) in Burien is expected to experience a relative decline of $26,356 (expressed in constant value 1995 dollars). For the City of Des Moines the comparable number is $27,609; for Federal Way it is $28,891; for Normandy Park it is $35,221; and for Tukwila it is $24,844.

To make residents of the five impacted cities whole, each household would receive the equivalent of a 20-year annuity where the sum of the annuity's payments equals the relative loss of the property value. In Burien, for example, each affected household would receive an annual payment such that the sum of the payments from the Year 2000 to 2020 discounted for real time preference would equal $26,356.

Having the Port of Seattle contribute an amount equal to the above described annual annuity payment toward the payment of a householder's annual property taxes would have the same effect as giving each householder an annuity. It would have the additional benefit of attaching the mitigating action to the property that's being impacted rather than to the householders residing on the property. Further, market forces should increase the value of the property by the discounted present value of the annuity's payment stream (the Port's contribution to the property's tax obligations), and this increase in property values will increase revenues to the five impacted cities - thus mitigating the cities' revenue shortfalls at the same time.

As mitigation for the loss of relative residential property values by homeowners, it is recommended that the Port of Seattle make a partial payment of property taxes for homeowners in the five impacted cities, the amount of the partial payment equal to an annuity the present value of whose payments equals the property's loss of relative value caused by expansion of the Airport.

Table 9.16
Average Housing Unit's Relative Decline in Value
Caused by Sea-Tac's Expansion

Year	Burien	Des Moines	Federal Way	Normandy Park	Tukwila
2000	---	---	---	---	---
2001	-$1,318	-$1,380	-$1,450	-$1,761	-$1,242
2002	-$2,636	-$2,761	-$2,899	-$3,522	-$2,484
2003	-$3,954	-$4,141	-$4,349	-$5,283	-$3,727
2004	-$5,271	-$5,522	-$5,798	-$7,044	-$4,969
2005	-$6,589	-$6,902	-$7,248	-$8,805	-$6,211
2006	-$7,907	-$8,283	-$8,697	-$10,566	-$7,453
2007	-$9,225	-$9,663	-$10,147	-$12,327	-$8,696
2008	-$10,543	-$11,044	-$11,596	-$14,088	-$9,938
2009	-$11,861	-$12,424	-$13,046	-$15,849	-$11,180
2010	-$13,179	-$13,804	-$14,496	-$17,610	-$12,422
2011	-$14,497	-$15,185	-$15,945	-$19,371	-$13,664
2012	-$15,815	-$16,565	-$17,395	-$21,132	-$14,907
2013	-$17,133	-$17,946	-$18,844	-$22,893	-$16,149
2014	-$18,450	-$19,326	-$20,294	-$24,654	-$17,391
2015	-$19,768	-$20,707	-$21,743	-$26,416	-$18,633
2016	-$21,086	-$22,087	-$23,193	-$28,177	-$19,875
2017	-$22,404	-$23,468	-$24,642	-$29,938	-$21,118
2018	-$23,722	-$24,848	-$26,092	-$31,699	-$22,360
2019	-$25,040	-$26,228	-$27,542	-$33,460	-$23,602
2020	-$26,356	-$27,609	-$28,891	-$35,221	-$24,844
Average	**-$13,179**	**-$13,804**	**-$14,496**	**-$17,610**	**-$12,422**

The approximate amount of such payments is show in Table 9.17, along with the estimated average annual cost to the Port. The numbers in Table 9.17 are a mitigation guideline and will have to be modified to account for differences between the average value of all housing units in a city and the actual value of specific properties and adjustment for inflation during the 20-year period between the Years 2000 and 2020. The table uses a real interest rate of 4% for its calculations. During 1995, the interest rate on a 30-year government bond was around 6.5% and the rate of inflation was around 2.5%, yielding a real rate of interest for long term assets of around 4%.

Table 9.17
Estimated Cost of Mitigating Residential Housing Unit Property Losses

Community	Contribution by Port to Average Residential Property's Tax Obligation	Average Number of Impacted Single-Family Housing Units	Total Cost to Port of Seattle
Burien	$885	17,890 DU	$15,832,650
Des Moines	$927	6,197 DU	$5,744,619
Federal Way	$973	12,392 DU	$12,057,416
Normandy Park	$1,182	2,577 DU	$3,046,014
Tukwila	$834	4,866 DU	$4,058,244
Total			**$40,738,943**

Reduced School Revenues

Reduced school revenues will result from the relative decline in residential property values caused by expansion of Sea-Tac International Airport after the Year 2000. If the Port of Seattle undertakes a program of making partial property tax payment for residential properties in the affected cities, market forces will bid up the price of these properties and off-set the relative declines that would otherwise occur. Consequently, there would be no reduction in school revenues (increases in levy rates) and no additional mitigation would be required.

If the Port of Seattle does not mitigate the relative decline in residential property values caused by the Third Runway and related Airport facilities, the Highline School District will experience revenue shortfalls, compared to what would have occurred had the Airport not expanded. The estimation of these revenue shortfalls is complex and needs to account for both the business personal property tax receipts generated by the Airport to the School District and Washington State's educational funding formulas. It was beyond the budget and scope of this study, but the full effects should be calculated.

It is recommended that a detailed analysis of the likely shortfall in Highline School District's property tax base that will result from construction of the *Third Runway and related Airport facilities be conducted.*

Reduced Local Government Revenues

Reduced local government revenues will result from the relative decline in residential property values caused by expansion of Sea-Tac International Airport after the Year 2000. If the Port of Seattle undertakes a program of making partial property tax payment for residential properties in the affected cities, market forces will bid up the price of these properties and off-set the relative declines that would otherwise occur. Consequently, there would be no reduction in local government revenues and no additional mitigation would be required.

If the Port of Seattle does not mitigate the relative decline in residential property values caused by the Third Runway and related Airport facilities, the city governments of Burien, Des Moines, Federal Way, Normandy Park and Tukwila will experience revenue shortfalls, compared to what would have occurred had the Airport not expanded. The cumulative revenue losses to all five impacted cities from all Third Runway related impacts will be $38.8 million (in constant value 1995 dollars), ranging from an annual revenue loss of $1.7 million during the first year after the Third Runway goes into operation to an annual revenue loss of $2.2 million in the Year 2020.

If the Port of Seattle does not take action to mitigate the decline in relative residential property values by making partial property tax payments to homeowners, it is recommended that the Port of Seattle make annual off-setting payments to each of the five impacted cities to compensate them for the relative declines in residential property values caused by construction of the Third Runway and related Airport facilities.

The magnitude of the off-setting payments should be determined by each city's revenue losses. Table 9.18 presents estimates of these revenue losses.

Table 9.18
Estimated Revenue Loss Off-Setting Mitigation Payments

Community	Total Revenue Losses from Relative Declines in Single-Family Property Values 2000-2020	Average Yearly Decline in Single-Family Property Values 2000-2020	Annual Tax Revenue Loss Off-Setting Mitigation Payments
Burien	-$14,191,858	-$709,592	$709,592
Des Moines	-$6,389,351	-$319,468	$319,468
Federal Way	-$11,611,022	-$580,551	$580,551
Normandy Park	-$2,813,667	-$140,683	$140,683
Tukwila	-$3,747,651	-$187,383	$187,383

Land Use Changes

Land use changes in the form of a shift from owner occupied to renter occupied residential properties will result from the relative decline in residential property values caused by expansion of Sea-Tac International Airport after the Year 2000. If the Port of Seattle undertakes a program of making partial property tax payments for residential properties in the affected cities, market forces will bid up the price of these properties and off-set the relative declines that would otherwise occur. Consequently, there would be no market pressure for shifts in land use patterns and no additional mitigation would be required.

If the Port of Seattle does not mitigate the relative decline in residential property values caused by the Third Runway and related Airport facilities, there will be a need to mitigate the affects of having more transient residents living in the five impacted cities.

It is recommended a revolving "Home Ownership Loan Fund" be established to facilitate the movement of persons living in Burien, Des Moines, Federal Way, Normandy Park and Tukwila from renter to owner housing tenure status.

Additional analysis will be required to determine the size of the loan fund, but a rough estimate of assistance provided to approximately 500 households a year in achieving home ownership status would indicate the size of the fund should be in the range of $15 million to $25 million. It is assumed that the home ownership program would operate through loan guarantees and the majority of the funding would be provided through private financial institutions.

9.14 - SERVICE LEVEL CHANGES

Expansion of Sea-Tac International Airport through construction of the Third Runway and related Airport facilities will increase the proportion of renters among residents of the five impacted cities. As a result, the cities will experience a shift in population toward younger, lower income and more mobile households. This shift will require an increase in community services if the cities are to retain the quality of life they had in the past.

Public Safety

Public safety requirements will increase for all five of the impacted cities. The Cities of Burien, Des Moines and Tukwila will have the greatest requirements for additional neighborhood patrolling by uniformed police officers. The growth of operations at Sea-Tac International Airport after the Year 2000 will particularly impact the City of Tukwila where Airport-induced neighborhood decline is already advanced on Pacific Highway South and will continue to worsen.

It is recommended that as part of the mitigation of the Third Runway and related Airport facilities at Sea-Tac International Airport there be a program whereby the Port of Seattle reimburses the Cities of Burien, Des Moines and Tukwila for the additional public safety requirements they will experience.

Community Cultural Services

Given the demographic shift expected to occur in the five impacted cities as a result of construction of the Third Runway and related Airport facilities, the continuance of their quality of life will require an enrichment of the cultural resources available to their residents. In particular, it will be important to expand the availability of central meeting places such as parks, libraries and community centers where new residents can meet their neighbors and become integrated into their communities. The greatest needs will occur in the Cities of Burien, Des Moines and Tukwila, although significant, but lesser, pressure for additional community cultural resources will be experienced in the cities of Federal Way and Normandy Park.

It is recommended that each of the five impacted cities draw-up a cultural resources enhancement plan specifically directed toward meeting the quality of life challenge that the Third Runway and related Airport facilities, will impose, and that the actions identified as needed in each city's cultural resources enhancement plan be funded as part of the mitigation of the construction of the Third Runway and related Airport improvements.

Community Social Services

Community social services such as day care and after school care, elderly centers, family counseling services, work training and job search counseling will all be required in the five impacted cities that were the focus of the Sea-Tac International Airport Mitigation Impact Study. Over and above the needs for such services that a growing population will require, the demographic shift caused by the increase in Sea-Tac International Airport operations that will be made possible by expansion of the Third Runway and related Airport facilities, will cause an expanded growth in demand for social services. If the impacted cities are only able to provide increased social services in proportion to their population growth, and are not able to provide for the additional social services made necessary by construction of the Third Runway and related Airport facilities, their quality of life will be progressively diminished after the Year 2000.

It is recommended that the five impacted communities develop a southwest King County integrated community social service resource and delivery plan and that the plan, once developed, be funded as part of the mitigation of the Third Runway's impacts.

Educational Services

There will be a need to enrich classroom learning experiences in order to mitigate demographic shift among the Highline School District students that will be caused by the Third Runway and related Airport facilities. To determine the best mitigation measures, quantitative research needs to be conducted on the affects of shifting demographic profiles on student classroom performance. After which, appropriate mitigation policies need to be formulated by educational professionals within the District. Some of these policies will likely include reduced student/teacher ratios, increased teacher support staff in classrooms, creation of enriched curricula, and use of additional teaching materials. Regardless of which or how many of these types of mitigation actions will be determined as appropriate for the task of maintaining the Highline School District's traditional quality of education outcomes, it is evident that the District will require additional resources to mitigate the socio-economic impacts of the Third Runway and related Airport facilities.

It is recommended that additional research be undertaken to develop quantitative estimates of the relationship between demographic shifts in the Highline School District's student population, levels of student performance and appropriate mitigation measures to maintain the District's traditional quality of education outcomes; and that such measures be funded as part of the mitigation of the Third Runway's impacts.

Health Services

High levels of concern have been expressed by citizens and community leaders from the five impacted cities about the deleterious affects the Airport now has on the health of families living in its immediate environment. If such concerns are demonstrated as warranted, they would apply forcefully to the expansion of Airport operations that will occur as a result of building the Third Runway and related Airport facilities. A public health evaluation and assessment of the Airport was outside the scope and budget of this study.

It is recommended that the School of Public Health at the University be funded to conduct an Airport health impact assessment, and that if the assessment finds a positive correlation between adverse health impacts and levels of Airport operation, appropriate measures to mitigate these affects be funded.

9.15 - OTHER SOCIO-ECONOMIC IMPACTS

Environmental Justice

Parts of the City of Burien that are the home of an ethnically diverse population will be impacted by Sea-Tac International Airport's expansion that construction of the Third Runway and related facilities will allow.

It is recommended that a monitoring system by established and operated in the area to the north of the Airport which will be under the approach/departure flight track for the Third Runway to insure that the intent of federal Executive Order 12898, "Environmental Justice" are met.

Quality of Life

Most of the issues surrounding the socio-economic impact of the Third Runway and related Airport facilities, on neighboring communities involves their quality of life and the manner in which expansion of operations at the Airport will cause it to be degraded. The quality of life issue is central to understanding the socio-economic impacts of the Third Runway and developing effective mitigation strategies. This issue needs to be approached in a straight forward manner, and the development of prototype quality of life indicator systems, both nationally and in the Puget Sound Region, should make this possible.

It is recommended that a quality of life indicator model be created for the five impacted cities and for areas in Northwest King County which are appropriate as a comparison area; the indicator model be estimated for data at least as far back as 1960 for both the impacted and comparison cities; that it be used to identify changes in the impacted cities' relative quality of life over time, the major quality of life indicators which contributed to the decline; and the quality of life indicator model become the basis for identifying needed socio-economic mitigation measures for the Third Runway and related Airport facilities.

Economic Development

Many of the adverse impacts of the Third Runway and related Airport facilities have to do with the direct, indirect or induced relative declines in property values that occur when Airport operations increase. One strategy for mitigating these property value impacts is to direct to the maximum extent, feasible airport economic functions into the five impacted cities. For example, if Sea-Tac International Airport's proposed new hotel were located in Burien or Des Moines instead of on Airport lands there would be a positive (mitigating) result. Equally, if the Airport were to construct a haul road for all air cargo movements which exited on the west side of the Airport, it is highly likely that new warehousing and distribution facilities would spring-up; and the increased value of economic activity thus resulting would mitigate the Third Runway's otherwise adverse impacts. In many ways, a mitigation strategy which depends, at least in part, on economic development enhancing actions is preferable to alternative types of mitigation since it uses market forces rather than government spending or regulation as its implementing force.

It is recommended that an economic and engineering assessment of Airport operations be conducted to determine Airport functions which would have positive economic development benefits and could be shifted to the five impacted cities.

SECTION 10

SUMMARY OF FINDINGS

SECTION 10
SUMMARY OF FINDINGS

10.01 - INTRODUCTION

The consultant team was charged with the task of reviewing and evaluating the impacts of the proposed Third Runway project at Sea-Tac International Airport. Given the study's schedule and budget, the consultant team was directed to utilize existing data in reviewing the proposed project. In accomplishing this task, the consultant team relied principally on data, studies, reports, and documents supplied by:

- The Port of Seattle.
- The Cities of Burien, Des Moines, Federal Way, Normandy Park, and Tukwila.
- The Puget Sound Regional Council.
- King County.
- The City of Seattle.
- Various regional departments and agencies.
- Various departments and agencies of the State of Washington.
- Various departments and agencies of the Federal government.

A technical reference bibliography appears in Appendix B of this report.

During 1996, various meetings were conducted in the study area and in the City of Olympia with representatives of the Port of Seattle, the five impacted communities, the general public, and various local, regional, State and Federal agencies. A list of project contacts made during this study appears in Appendix C of this report.

10.02 - EIS REVIEW

Sections 2 through 4 of this report presented an analysis of the Port of Seattle's Environmental Impact Statement and evaluated its findings with regards to potential general environmental impacts, transportation impacts and socio-economic impacts.

Environmental

Generally, the EIS did a good job of presenting potential environmental impacts. However, certain areas of improvement were noted, including but not limited to:

- Re-running the new Integrated Noise Model using the newest version and running the model to calculate the 55 LDN contour line.

- Addressing the issue of single-event noise levels and their associated impacts on surrounding residential and non-residential activity.

- Re-running the air quality model using re-sampled data which occurs within the study area rather than 5 miles away from the Airport.

- Further developing the visual impact analysis utilizing color photographs and additional viewing locations.

- Performing additional analyses on overflight and vibration impacts.

- Expanding the analysis of aquifer impacts to study all of the Highline Aquifer within the study area, as well as other aquifers.

These areas of concern - and others as identified in Section 2 - should be fully addressed prior to construction of the Third Runway.

Transportation

As above, the EIS did a good job of presenting potential transportation impacts. However, certain areas of improvement were noted, including but not limited to:

- Expanding the analysis area of transportation impacts to include the surrounding impacted communities, rather than just looking at the "driveways" to the Airport property.

- Expanding the analysis of the haul alternatives and preparing detailed operational procedures for the proposed alternative.

- Improving the analysis of the impacts to the local street system and the State roadway network.

- Improving the analysis of projected load impacts to bridges on the State network.

- Addressing the impacts of construction and post-construction traffic on local traffic diversion, school/transit routes, and emergency vehicle access.

These areas of concern - and others as identified in Section 3 - should be fully addressed prior to construction of the Third Runway.

Socio-Economic

The Port of Seattle's EIS does not present an adequate discussion, analysis and mitigation of the socio-economic impacts associated with the proposed project. The consultant team did not question the overall benefit of an expanded Sea-Tac International Airport. However, as the analysis in Sections 4 and 9 shows, while the Airport's benefits are distributed regionally and Statewide, the costs and impacts are disproportionally distributed among the five impacted communities.

The EIS does not address the socio-economic impacts of the proposed project on local social and community services, such as public safety and education. It also does not address the depression of local property values (with respect to other similar King County areas that are not impacted by an airport).

The socio-economic analyses recommended in Sections 4 and 9 should be completed by the Port of Seattle prior to construction of the Third Runway.

10.03 - MITIGATION CASE STUDIES

Sections 5 and 6 of this report presented a summary of various other mitigation experiences at other US airports (Section 5) and other major projects in Washington State (Section 6).

Other airport projects - notably the addition of two new runways at Dallas/Fort Worth International Airport - proposed a more comprehensive mitigation approach which addressed the effects on whole neighborhoods, rather than just individual structures. The Washington State examples clearly demonstrated the precedent in Washington to extend mitigation programs beyond "traditional" physical remediation to also include social and economic mitigation.

It also does not appear that the proposed project follows the requirements of the State of Washington's *Growth Management Act* (Washington Administrative Code 197-11-060, 197-11-442, and 197-11-443). The GMA fundamentally changed the process of planning in the State. It affects all local jurisdictions, but most significantly, those within the 29 counties planning under the Act. The GMA establishes 13 goals, requires the development of countywide planning policies (including mufti-county countywide planning policies for the central Puget Sound region), local general purpose governmental comprehensive plans with mandatory elements and implementing development regulations. these plans and their implementing agencies must be internally consistent. They must also be consistent with adjacent jurisdictions.

A specific requirement of plans is that they contain a capital facilities plan element identifying those facilities necessary to support the plan and including how these facilities will be financed. The requirements for transportation components are more detailed including the requirement for regional and State consistency. State agencies are required to act consistently with these plans and regulations. Special districts' plans and facilities must also be in conformity.

Each local government in the study area has adjusted their initial comprehensive plan with the exception of Burien, which is in the process of developing its initial comprehensive plan under GMA. Incorporated in 1992, Burien has adopted policies under GMA to guide planning and development in the interim period. Each jurisdiction has developed their plan to accommodate projected future growth as determined by the Washington State Office of Financial Management and distributed by the King County Countywide Planning Policies. What, if any, impacts the implementation of the updated Airport Master Plan Update will have on these jurisdictions was not analyzed nor incorporated in the development of these plans.

GMA requires that there be consistency in three important ways:

- Local jurisdictions' comprehensive plans must be internally and externally (with adjacent communities) consistent. How these jurisdictions change their plan to accommodate the anticipated impacts of the Third Runway will open a window for a State challenge by citizens, other local governments, or the State.

- The State transportation plan, the regional transportation plan and local jurisdictions' transportation elements within their comprehensive plans are required to be consistent. In an interesting balancing of interests, no single plan dominates nor can any one dictate what must be done in another plan. As currently practiced, all parties must negotiate until there is "consistency".

- State agencies are required to comply with adopted local comprehensive plans and implementing development regulations including the expenditure of operational, grant, and capital facility funding.

The GMA requires local jurisdictions to specifically identify in their comprehensive plans those capital facilities necessary to support future development. at specific levels of service. The comprehensive plan must specifically identify how these facilities will be financed. If financing is not feasible, the plans must be revised until feasibility is achieved.

The GMA places the primary responsibility for planning for future growth in the hands of local elected officials. The overall result should be coordinated, consistent local plans which are financially feasible and work together within the region to support a broad vision for the future. State and local agencies are bound to support these plans in their actions.

Failure to meet responsibilities leaves jurisdictions vulnerable to challenges through the Growth Management Hearings Board or superior court. In the former, jurisdictions found out of compliance are potentially subject to loss of revenues, loss of grant funds, and loss of revenue authority. It appears that the proposed Third Runway project does not comply with the requirements of the State's Growth Management Act.

10.04 - RECOMMENDED ENVIRONMENTAL MITIGATION

Section 7 of this report presented the recommend environmental mitigation program to address the projected impacts of the proposed Third Runway.

In summary, prior to construction of the Third Runway, the following mitigation measures should be accomplished:

- Establish a working group/oversight commission to participate with the FAA and other parties in overseeing the application of mitigation measures and programs.

- Run the latest version of the INM to further refine the projected LDN and SEL noise contours and include the 55 LDN contour.

- Based on the INM results, relocate all eligible residents, businesses, schools, churches, and other uses incompatible with extended periods of high-volume aircraft noise. Relocation should be based on neighborhood boundaries.

- Based on the INM results, insulate all eligible residential, business, school, church, and other structures generally incompatible with extended periods of high-volume aircraft noise. Owners of these structures also should be paid for an avigation easement which stays with the property in perpetuity. Insulation and easements should be offered based on neighborhood boundaries.

- Establish additional threshold data which provides detailed information about the threshold above (TA) noise metric with respect to sensitive noise receptors such as schools, hospitals, etc. This information should be developed by the Port of Seattle as part of the re-evaluation of the noise data using the INM, Version 5.1 (or most recent available version).

- Establish a permanent noise monitoring program which locates monitoring stations along predicted noise contours. Additional stations beyond the 25 proposed by the Port of Seattle may be required.

- Utilize permanent and/or portable "hush houses" in conjunction with engine maintenance activities, in particular run-ups.

- Continue or establish noise programs such as a Noise Budget, a Nighttime Limitations Program, a Ground Noise Control Program, Overflight Noise Abatement Procedures, Flight Path Monitoring, and a 24-Hour Noise Information Line.

- Establish a noise mediation agreement which specifies how the Port will deal with exceedances and violations of noise programs.

- Amend the Four-Post Plan to minimize overflights over population areas.

- Require a Dust Control Plan as part of the contractor's permit to construction fugitive dust impacts.

After the Third Runway is operational, the following mitigation measures should be accomplished:

- Utilize the Third Runway for arrivals only during inclement weather in order to help control noise levels associated with departures. There should be no arrivals on the Third Runway, except for emergencies, between 9:00 PM and 7:00 AM.

- Utilize new technologies such as Microwave Landing System (MLS) and Global Positioning Satellite System (GPS) as part of potentially reducing noise impacts to areas around the Airport.

- Conduct a study to determine if it is possible to reduce aircraft emissions by improving Airport operations associated with queuing and taxiing.

The complete listing of mitigation recommendations may be found in Section 7. Environmental mitigation associated with the impacts as delineated in Section 7 as shown in Table 10.01.

Table 10.01
Environmental Mitigation

Environmental Mitigation	Burien	Des Moines	Federal Way	Normandy Park	Tukwila	Total
		Community				
Noise and vibration	$636.6 M	$1,481.4 M	$148.1 M	$55.8 M	$113.5 M	$2,435.4 M
Air quality	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD
Surface water	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD
Ground water	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD
Wetlands	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD
Floodplains	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD
Aesthetic/visual	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD
Other	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD
Total	**$636.6 M plus TBD**	**$1,481.4 M plus TBD**	**$148.1 M plus TBD**	**$55.8 M plus TBD**	**$113.5 M plus TBD**	**$2,435.4 M plus TBD**

As can be easily seen, most of the environmental mitigation costs are not yet identified. This is due to the amount of additional study still required. Of the approximately $2.4 billion in identified mitigation costs, approximately $2.0 billion (84%) is associated with potential relocation and redevelopment of neighborhoods within Burien and Des Moines. Should this option not be selected, mitigation costs should be significantly lower. All TBD (to be determined) costs should be reconciled prior to construction of the Third Runway.

10.05 - RECOMMENDED TRANSPORTATION MITIGATION

Section 8 of this report presented the recommended transportation mitigation program to address the projected impacts of the proposed Third Runway.

In summary, prior to construction of the Third Runway, the following mitigation measures should be accomplished:

- Perform an Origin-Destination Survey and develop a Cost Allocation Model to determine the amount of impacts attributable to Airport traffic.
- Perform an Areawide Traffic Study to determine region-wide traffic demands on the network surrounding the Airport.
- Develop an Incident Management Plan to respond to emergencies in the study area during and after construction.
- Implement Surface Transportation Noise Mitigation measures to minimize the impacts of freeway noise in the study area.
- Establish baseline conditions for State roads and bridges to measure further deterioration attributable to increased heavy haul truck traffic.
- Select the method of transporting fill material to the construction site (either truck hauling or barge/conveyor/rail) and develop a separate environmental assessment and an emergency contingency plan for the selected transport method.
- Mitigate all identified neighborhoods for corridor congestion impacts.
- Further study the projected traffic impacts on transit and Highline School District bus routes and develop mitigation measures including re-routing/rescheduling, relocation of bus-stops, and/or additional buses and drivers.
- Further study the projected traffic impacts on police and emergency vehicle response time in the five impacted communities and develop mitigation measures including additional equipment, additional personnel, and/or new station locations.
- Conduct monitoring of the serviceability index of local and State roads, and the condition/load rating of State-jurisdiction bridges and rehabilitate or reconstruct these facilities as needed.

During and after construction of the Third Runway, the following mitigation measures should be accomplished:

- Mitigate all identified neighborhoods for corridor congestion impacts.

- Each City should develop a transportation management plan as part of its ongoing transportation planning functions.

Table 10.02
Transportation Mitigation

Transportation Mitigation	Burien	Des Moines	Federal Way	Normandy Park	Tukwila	Total
	Community					
Congestion	$26.4 M	$16.9 M	$20.8 M	$9.8 M	$43.7 M	$117.6 M
Physical damage	$49.8	$22.7 M	$25.9 M	$17.7 M	$70.4 M	$186.5 M
Construction	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD	$ TBD
Post-construction	$40.6 M	$33.2 M	$0.0 M	$23.4 M	$77.6 M	$174.8 M
Total	**$116.8 M plus TBD**	**$72.8 M plus TBD**	**$46.7 M plus TBD**	**$50.9 M plus TBD**	**$191.7 M plus TBD**	**$478.9 M plus TBD**

(Source: Section 8, SeaTac Impact Mitigation Study)

Of the nearly $500 million in transportation mitigation identified, approximately 39% is to address the effects of physical damage to the roadway network. About 40% of the total transportation mitigation costs occur within the City of Tukwila, principally because of the high number of State-jurisdiction roads and bridges. Burien and Des Moines account for another 40% of the total costs due to their close proximity to the Airport and project site.

It is significant that most of the costs associated with construction impacts are not yet known and **should be fully identified prior to construction**. Costs for transportation mitigation have not been assigned to any particular funding agency, but it is likely that the Cities, the State of Washington, the Federal Highway Administration/US DOT, and the Port of Seattle will all participate in project funding at various levels.

10.06 - RECOMMENDED SOCIO-ECONOMIC MITIGATION

Section 9 of this report presented the recommended socio-economic mitigation program to address the projected impacts of the proposed Third Runway.

In summary, prior to construction of the Third Runway, the following mitigation measures should be accomplished:

- As mitigation for the loss of relative residential property values by homeowners, it is recommended that the Port of Seattle make a partial payment of property taxes for homeowners in the five impacted cities, the amount of the partial payment equal to an annuity the present value of whose payments equals the property's loss of relative value caused by expansion of the Airport.

- A detailed analysis should be prepared of the likely shortfall in Highline School District's property tax base that will result from construction of the Third Runway and related Airport facilities.

- The Port of Seattle should make annual off-setting payments to each of the five impacted cities to compensate them for the for the additional public safety requirements they will experience as a result of the Third Runway and related Airport facilities.

- The Port of Seattle should make off-setting payments to each of the five impacted cities to compensate them for the relative declines in residential property values caused by construction of the Third Runway and related Airport facilities.

- A revolving "Home Ownership Loan Fund" should be established to facilitate the movement of persons living in Burien, Des Moines, Federal Way, Normandy Park and Tukwila from renter to owner housing tenure status.

- Each of the five impacted cities should develop a cultural resources enhancement plan specifically directed toward meeting the quality of life challenge that the Third Runway and related Airport facilities will impose, and that the actions identified as needed in each city's cultural resources enhancement plan be funded as part of the mitigation of the construction of the Third Runway and related facilities.

- Each of the five impacted communities should develop a Southwest King County integrated community social service resource and delivery plan and that the plan, once developed, be funded as part of the mitigation of the Third Runway's impacts.

- Additional research should be undertaken to develop quantitative estimates of the relationship between demographic shifts in the Highline School District's student population, levels of student performance and appropriate mitigation measures to maintain the District's traditional quality of education outcomes; and that such measures be funded as part of the mitigation of the Third Runway's impacts.

- The School of Public Health at the University of Washington should be funded to conduct an Airport Health Impact Assessment, and that if the assessment finds a positive correlation between adverse health impacts and levels of Airport operation, appropriate measures to mitigate these affects should also be funded.

- A monitoring system should be established and operated in the area to the north of the Airport which will be under the approach/departure flight track for the Third Runway to insure that the intent of Federal Executive Order 12898, "Environmental Justice" is met.

- A Quality Of Life Indicator Model should be created for the five impacted cities and for areas in Northwest King County which are appropriate as a comparison area, to be used to identify changes in the impacted cities' relative quality of life over time and become the basis for identifying needed socio-economic mitigation measures for the Third Runway and related Airport facilities.

- An economic and engineering assessment of Airport operations should be conducted to determine Airport functions which would have positive economic development benefits and could be shifted to the five impacted cities.

Table 10.03
Socio-Economic Mitigation - 2000 to 2020

Socio-Economic Mitigation	Community					Total
	Burien	Des Moines	Federal Way	Normandy Park	Tukwila	
Total	$14.2 M	$6.4 M	$11.6 M	$2.8 M	$3.7 M	$38.7 M

10.07 - SUMMARY

A total of $2.95 billion in mitigation costs have been identified for the five impacted communities in the areas of environmental, transportation, and socio-economic impacts (see Table 10.04).

Table 10.04
Total Identified Mitigation Costs for the Five Impacted Communities

Community	Mitigation Costs			
	Environ-mental	Transpor-tation	Socio-Economic	Total
Burien	$636.6 M	$116.8 M	$14.2 M	**$767.6 M**
Des Moines	$1,481.4 M	$72.8 M	$6.4 M	**$1,560.6 M**
Federal Way	$148.1 M	$46.7 M	$11.6 M	**$206.4 M**
Normandy Park	$55.8 M	$50.9 M	$2.8 M	**$109.5 M**
Tukwila	$113.5	$191.7 M	$3.7 M	**$308.9 M**
Total	**$2,435.4 M**	**$478.9 M**	**$38.7 M**	**$2,953.0 M**

It is not surprising that of the total **known** and **calculated** amount of $2.95 billion, approximately 79% ($2.3 billion) covers mitigation within the Cities of Burien and Des Moines. These are the two cities within the study area that immediately abut the project site. Most of the mitigation costs in Burien and Des Moines ($2.1 billion or approximately 72% of the total) account for the acquisition/relocation/redevelopment alternative described earlier.

As mentioned in this study, it is not recommended that these areas be totally acquired and redeveloped. This study has calculated a value of these areas at approximately $2.1 billion. Their future development should be further studied by Burien and Des Moines as part of each city's Comprehensive Plan and should be in conformance with the State's GMA requirements.

Tukwila's mitigation costs are third in line, primarily because of the extensive State roadway network within the City.

Federal Way's mitigation costs are primarily associated with sound in insulation and avigation easements for residences affected by SEL and overflight noise. Modification of the Four-Post Plan and the projected Third Runway flight tracks may also mitigate these areas for significantly lower costs. However, it has not yet been determined if there are available flight tracks which would not affect any resident in Southwest King County.

As the smallest community in size and population, Normandy Park's mitigation costs are the lowest of the five impacted communities. Mitigation in Normandy Park is almost evenly split between sound insulation/avigation easements and transportation impacts.

While it may appear to be a high figure, the $2.95 billion does <u>not</u> represent the total potential mitigation amount.

It is important to note that many costs have not yet been determined as part of this study. Primarily, the costs associated with relocating, insulating, and granting easements to select Highline School District facilities was not calculated. Also, costs associated with insulating the Highline Community Hospital were not calculated. Several additional significant environmental and transportation-related impacts should also be calculated <u>prior to</u> construction of the Third Runway.

It is the recommendation of this study that all known environmental, transportation, and socio-economic impacts as identified be mitigated prior to construction of the Third Runway. Multiple additional studies have been identified - mostly to be prepared by the Port of Seattle or its consultants - in order to further clarify the scope of various impacts. All of these studies should be completed prior to the Record of Decision being granted.

This study also recommends ongoing monitoring and mitigation to occur during and after construction, through at least the Year 2020. The five impacted communities should have a voice in this ongoing effort through the recommended "working group/oversight commission".

Finally, in accordance with the GMA, the development of a South King County Comprehensive Plan is strongly urged. This should also involve the City of SeaTac and should integrate all comprehensive planning for the cities, the County, and the Airport into a cohesive, sub-regional document.

APPENDICES

APPENDIX A

EQUITY ISSUES AND SOCIO-ECONOMIC IMPACTS

APPENDIX A
EQUITY ISSUES AND SOCIO-ECONOMIC IMPACTS

A.01 - INTRODUCTION

Equity issues related to the geographic distribution of Seattle-Tacoma International Airport's benefits and costs underpin the requirement for socio-economic impact mitigation. Although a source of contention, it is arguable that socio-economic benefits such as increased economic activity (jobs, income, and output) and social/cultural events (family visits, traveling performance companies and ease of recreational travel) generated by commercial aviation services taking place at Sea-Tac International Airport exceed the Airport's socio-economic costs (noise, traffic congestion, a degraded environment for human habitat, adversely affected educational and social services, and a reduced tax base). However, the benefits are distributed over western Washington and the Puget Sound Region while the costs are localized in a small number of communities immediately surrounding the Airport. Consequently, there is a need for mitigation that redirects some of the Airport's benefits back to the communities that disproportionately bare its costs.

Appendix A looks at the geographic area adversely affected by Sea-Tac International Airport's impacts and compares it to the places of origin of persons initiating commercial air service travel at Sea-Tac International Airport. It also analyses the Airport's economic benefits and how they affect the five impacted communities that are the focus of this study.

The data base for the origin of enplaning passengers at Sea-Tac International Airport comes from a 1991 Origin/ Destination (O/D) study conducted by the Evans-McDonough Company (EMC) for the Port of Seattle (Butler and Kiernan, September 1992). Population estimates used to calculate per capita trip generation rates were from the Washington State Office of Financial Management. Different estimates of the Airport's geographic impact area are derived from studies of Sea-Tac International Airport noise and related impacts conducted for the Port of Seattle during the past decade.

A.02 - GEOGRAPHIC AREA OF SEA-TAC'S ADVERSE IMPACTS

Numerous communities throughout the central Puget Sound region have perceived themselves adversely impacted by some factor (usually noise) connected with Sea-Tac International Airport activity levels, and there is considerable elasticity to the delineation of the geographic area primarily affected. It is widely acknowledged however that the Airport's primary adverse impacts occur in the communities immediately surrounding the Airport.

A Sea-Tac International Airport noise exposure (Part 150) study conducted for the Port of Seattle in 1989 defined the Airport's land use impact area as a rectangle extending approximately 6.2 miles north, 7.0 miles south, 1.2 miles west and 1.6 miles east of the ends of runway 16L/34R (Martin O'Connell Associates, 31 May 1994). The defined area includes all or parts of what are currently the Cities of Burien, Des Moines, Federal Way, Normandy Park, SeaTac and Tukwila plus parts of South Seattle and parts of unincorporated King County.

A 1994 "Public Building Sound Insulation Project" conducted by the Port of Seattle sent questionnaires to public buildings that might have been adversely impacted by Sea-Tac International Airport's noise. Questionnaires were sent to public buildings located in the Cities of Bellevue, Burien, Des Moines, Federal Way, Kent, SeaTac and Tukwila plus parts of South Seattle and unincorporated King County (Thomas/Lane & Associates, June 1991).

The Port of Seattle's *Final Environmental Impact Statement*, issued February, 1996, defines the "general Study area" for analyzing impacts as a rectangle approximately 7.8 miles north and south and 1.3 miles east and west of the ends of runway 16L/34R. The area includes all or part of the Cities of Burien, Des Moines, Federal Way, Kent, Normandy Park, SeaTac and Tukwila plus parts of South Seattle and unincorporated King County.

The Airport Communities Coalition (ACC) consists of general and special purpose local governments that have organized in opposition to the proposed Sea-Tac International Airport expansion, and they see themselves, collectively, as the primary area affected by the Airport's adverse impacts. ACC members include the Cities of Burien, Des Moines, Federal Way, Normandy Park and Tukwila plus the Highline School District.

The five Cities of Burien, Des Moines, Federal Way, Normandy Park and Tukwila covered by this SeaTac Impact Mitigation Study are clearly within the area most adversely impacted by SeaTac International Airport's operations, and they (together with the Highline School District) constitute the focus of this socio-economic analysis.

A.03 - GEOGRAPHIC DISTRIBUTION OF PASSENGERS ORIGINATING TRIPS AT SEA-TAC

The O/D study conducted by EMC is 1991 contains responses from 3,278 originating passengers (Butler and Kiernan, September 1992). Respondents were not required to answer all questions contained in the survey. There were 3,170 responses on the data disk obtained from the Port of Seattle with usable information about trip purposes and trip origins. Respondents were asked the ZIP Code of the place where they spent the prior night (the *place of origin* of the trip). The ZIP Code locations were converted to city and town locations using a US Post Office ZIP Code manual. Table A.01 shows the distribution of respondents originating their trips at home, at a hotel/motel or at a business office.

Table A.01
Trip Origins of Survey Respondents

Place of Trip Origin	Number	Percent
Home	1,856	58.5%
Hotel/motel	830	26.2%
Business office	484	15.3%
Total Respondents	**3,170**	**100.0%**

(Source: Evans-McDonough Company)

The Central Puget Sound region accounted for almost three quarters (71.9%) of all trip respondents in the survey.

Passengers Originating Trips At Home

The majority (58.5%) of persons originating the air portion of their trips at Sea-Tac International Airport went to the airport directly from home. Almost two-thirds (61.2%) of travelers going to the Airport directly from home were traveling for pleasure while the remaining one-third (38.8%) were traveling for business. Table A.02 presents the geographic distribution of passengers who went to the airport directly from home and who originated the air portion of their trip at Sea-Tac International Airport.

Table A.02
Counties of Home Originating Travelers

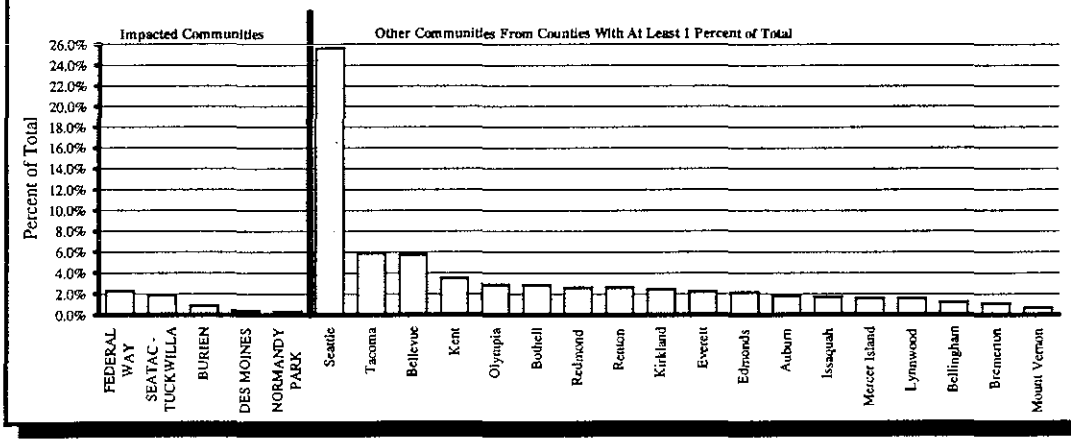
Area	Percent of Total Originating Enplanements
King County (excluding impacted communities)	57.2%
Pierce County	10.4%
Snohomish County	10.1%
Five Impacted Communities Combined	**5.9%**
Thurston County	3.1%
Kitsap County	3.1%
Rest of Washington State	10.2%

(Source: Evans-McDonough Company)

The five impacted cities immediately surrounding the airport that are the focus of this study accounted for 5.9% of these enplanements. King County (excluding the five impacted communities) accounted for 57.2%. Pierce County and Snohomish County accounted for 10.4% and 10.1%, respectively. In terms of large aggregates of places, King County (excluding the five impacted communities) plus Pierce, Snohomish, Thurston and Kitsap counties accounted for 83.9% of home originating enplanements; the rest of Washington State accounted for 10.2% and the five impacted communities combined accounted for 5.9%.

Figure A.01 compares the geographic distribution of home originating enplanements of the five impacted communities with other cities and towns located in Washington counties which generated at least 1.5% of total home originating enplanements. The Cities of Seattle (25.6%), Tacoma (5.9%), Bellevue (5.8%), Kent (3.5%), Olympia (2.9%), Bothell (2.9%), Redmond (2.6%), Renton (2.6%) and Kirkland (2.5%) all account for a larger percentage of total home originating enplanements than do *any* of the five impacted communities. Bellingham, located in Whatcom County and over 100 miles away from the airport generates a larger percentage of home originating enplanements than does Burien. Mount Vernon, located in Skagit County and approximately 75 miles from the Airport generates a larger proportion of home-based enplanements than do either Des Moines or Normandy Park.

Figure A.01
City Distribution of Home-Based Enplanements



Passengers Originating Trips At Hotels and Motels

Approximately a quarter (26.2%) of persons originating the air portion of their trips at Sea-Tac International Airport went to the Airport directly from a hotel or motel. Just over one-quarter (25.7%) of travelers going to the Airport directly from a hotel or motel were traveling for pleasure while three-quarters (74.3%) were traveling for businesses purposes.

Trip departures from hotels and motels are highly concentrated, reflecting the concentration of hotel and motel rooms in the region. King County (excluding the impacted communities) accounted for over half (55.9%) of all persons going to Sea-Tac International Airport directly from a hotel or motel. Within King County (excluding the five impacted communities), just over three-quarters (75.6%) of all trips originating at a hotel or motel were in the City of Seattle; and within Seattle, a single downtown ZIP Code (98101) accounted for almost half (49.0%) of the City's total hotel/motel originating trips.

The impacted communities immediately surrounding the airport accounted for an additional one-third (32.8%) of all persons going to Sea-Tac International Airport directly from a hotel or motel. Within the impacted communities, most of the trips to Sea-Tac International Airport (90.8%) originating at a hotel or motel came from the SeaTac/Tukwila area; and within the SeaTac-Tukwila area, a single ZIP code immediately to the east of the Airport along Pacific Highway South/International Boulevard (ZIP code 98188) accounted for almost three-quarters (72.5%) of the area's total hotel/motel originating trips.

Table A.03
Counties of Hotel and Motel Originating Travelers

Area	Percent of Total Originating Enplanements
King County (excluding impacted communities)	55.9%
Five Impacted Communities Combined	**32.8%**
Pierce County	2.9%
Snohomish County	2.5%
Kitsap County	1.1%
Thurston County	1.0%
Rest of Washington State	3.9%

(Source: Evans-McDonough Company)

Passengers Originating Trips At Business Offices

Almost one of six persons (15.3%) originating the air portion of their trip at Sea-Tac International Airport went to the Airport directly from a business office. Fewer than one in five travelers (17.5%) going to the Airport directly from a business office were traveling for pleasure while more than four of five (82.5%) were traveling for businesses purposes.

Enplanements originating at business offices are highly concentrated in King County (excluding the impacted communities), which accounts for just under two-thirds (66.1%) of the travelers. The impacted communities accounted for an additional 12.4%, and no other county accounted for over 10%.

Figure A.02
City Distribution of Hotel/Motel Based Enplanements

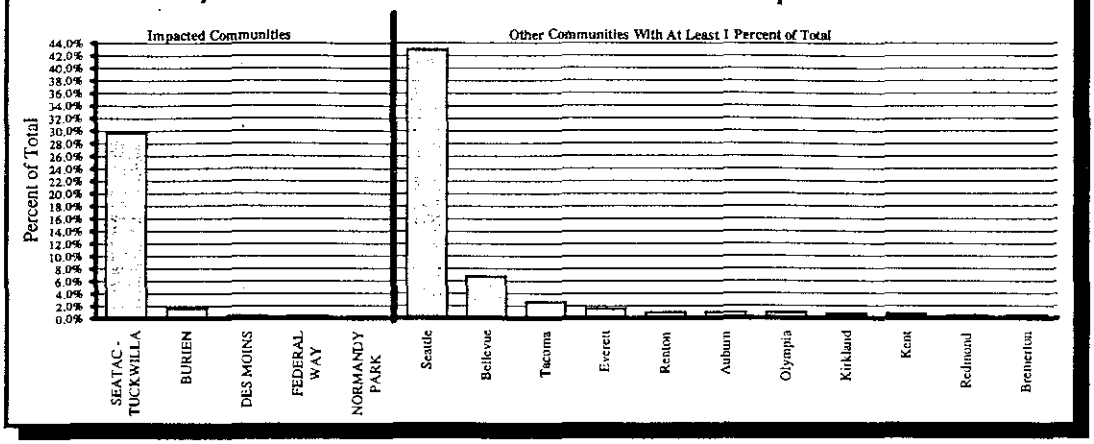
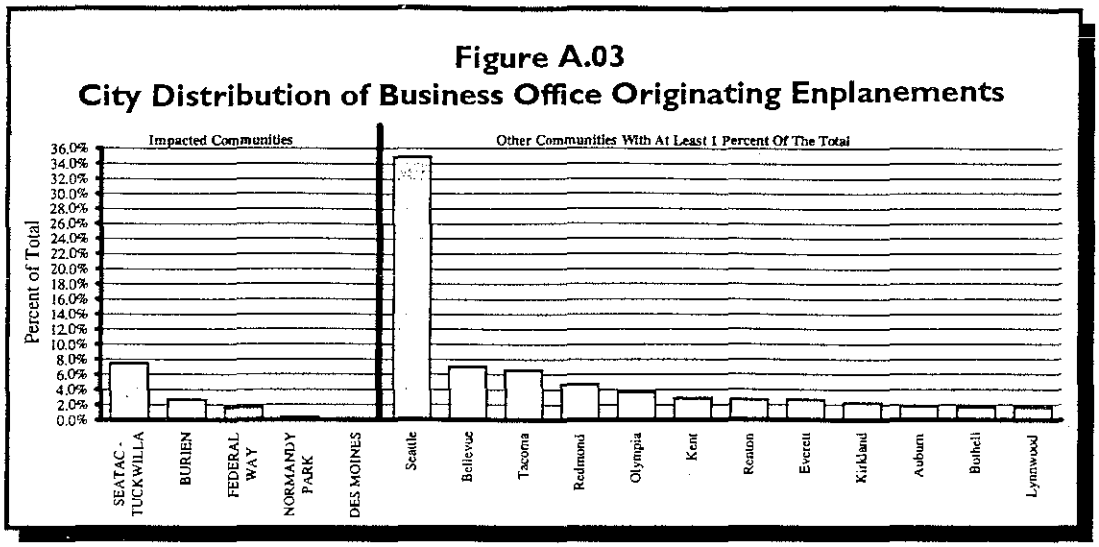


Table A.04
Counties of Business Office Originating Travelers

Area	Percent of Total Originating Enplanements
King County (excluding impacted communities)	66.1%
Five Impacted Communities Combined	**12.4%**
Pierce County	7.9%
Snohomish County	6.0%
Thurston County	3.7%
Kitsap County	0.6%
Rest of Washington State	3.3%

(Source: Evans-McDonough Company)

Within King County (excluding the impacted communities), the City of Seattle accounted for 58.0% of all enplanements originating at a business office, and a single downtown ZIP Code (98101) accounted for almost one-third (30.6%) of Seattle's business office originating enplanements. This pattern of concentrated business office originating enplanements was even more pronounced in the impacted communities. Over two-thirds (69.2%) of the business office originating enplanements generated within the impacted communities occurred in the SeaTac-Tukwila area, and a single ZIP Code (98188 - the same ZIP Code in which hotel/motel originating enplanements were concentrated) accounted for almost all (97.2%) of SeaTac-Tukwila's business office originating enplanements. The pattern of city concentration of business originating enplanements is shown in Figure A.03.



A.04 - GEOGRAPHIC DISTRIBUTION OF PER CAPITA ORIGINATING ENPLANEMENTS

Dividing the number of originating enplanements in a community by the community's population and multiplying by 10,000 gives the number of home-originating trips per 10,000 population by community. The 1991 survey of originating enplanement data were divided by the State of Washington's 1991 community population estimates for the analysis of per capita originating enplanements (Butler and Kiernan, September 1992).

Per Capital Home Originating Enplanements

King County (excluding the impacted communities) generated 7.7 originating enplanements per 10,000 population. The impacted communities (combined) generated 6.8 originating enplanements per 10,000 population. No other place in the state generated over 4.0 originating enplanements per 10,000 population.

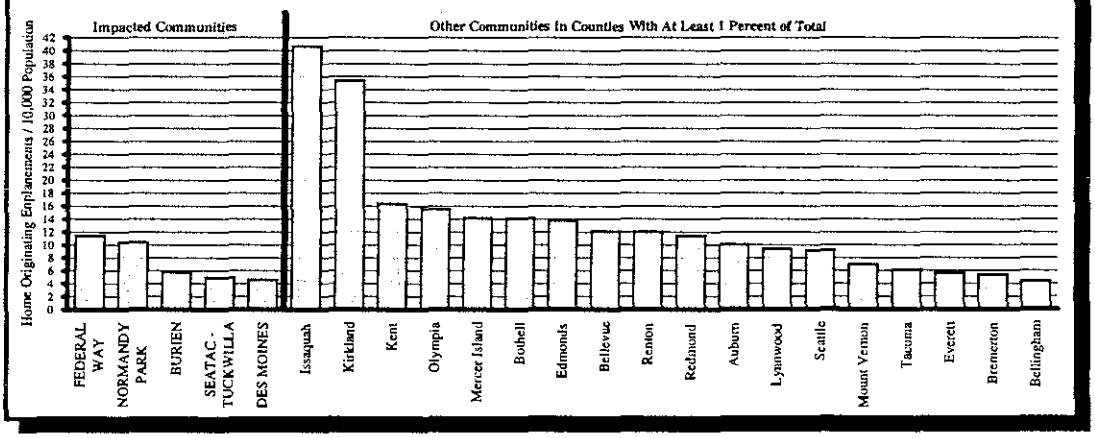
Figure A.03 shows the home trips per 10,000 population of cities and towns in counties which accounted for at least 1% of total statewide home originating enplanements. Among the impacted communities, the highest rate occurred in Federal Way at 11.5 home originating enplanements per 10,000 population. Higher rates occurred in Issaquah (40.7), Kirkland (35.4), Kent (16.4), Olympia (15.5), Mercer Island (14.2), Bothell (14.1), Edmonds (13.8), Bellevue (12.1) and Renton (12.1). The City of Mount Vernon, approximately 75 miles north of Sea-Tac International Airport, had a higher home originating enplanement rate per 10,000 population (6.9) than three of the five impacted communities.

Table A.05
Per Capita Home Originating Travelers

Area	Originating Enplanements Per 10,000 Population
King County (excluding five impacted communities)	7.7
Five Impacted Communities Combined	**6.8**
Snohomish County	3.9
Thurston County	3.5
Pierce County	3.2
Kitsap County	2.9

(Source: Evans-McDonough Company)

Figure A.04
City Distribution of Per Capita Home Originating Enplanements



A.05 - GEOGRAPHIC MISMATCH BETWEEN AIRPORT USER BENEFITS AND COSTS

Various delineation's of Sea-Tac International Airport's primary adverse impact area exist. However, they all identify the communities and unincorporated areas of southwest King County, immediately surrounding the Airport, as the one's which suffer the primary burden of Sea-Tac International Airport's adverse impacts. These communities are impacted by the Airport's non-market costs, such as noise pollution, visual degradation, surface traffic congestion and air quality decline.

Non-market costs refer to costs resulting from operation of the Airport which are not incorporated in the price Airport users have to pay for air transportation services. They represent a transfer of value *from* persons living in the immediate vicinity of the Airport *to* persons using the air transportation services provided at the Airport. If the same persons that suffer the Airport's primary non-market adverse impacts were either its primary users or the primary recipients of its non-market benefits, (Shapiro and Associates, April 1994), benefits and costs would be roughly in-line and no equity issue would exist.

However, an analysis of Airport users' residential and business locations reveals a "disconnect" between the Airport's benefits and costs. The five ACC communities plus the City of SeaTac, combined, account for only 5.9% of all Sea-Tac International Airport enplanements originating at the traveler's home. Cities such as Bellingham - located over 100 miles to the north of the Airport - generate a larger percentage of home originating enplanements than three of the impacted communities. The City of Seattle accounts for over four times the number of home originating enplanements than do all the impacted communities combined. In terms of per capita rates, the Cities of Issaquah, Kirkland, Kent, Olympia, Mercer Island, Bothell, Edmonds, Bellevue and Renton all generated more home originating enplanements per 10,000 population than did any of the impacted communities.

The City of Mount Vernon, approximately 75 miles to the north, had a higher home originating enplanement rate than three of the five impacted communities. The rate of home originating enplanements per 10,000 population for all the impacted communities combined was less than the rate for the rest of King County (6.8 compared to 7.7, respectively).

In terms of persons who live in the region, the impacted communities represent a small fraction of enplanements and they generate a lower rate of participation in flying than does the rest of King County.

Turning to business benefits reflected by enplanements originating from hotels, motels and business offices, the area directly east of Sea-Tac International Airport along Pacific Highway South/International Boulevard generates the second largest concentration of hotel/motel originating enplanements in the region - after downtown Seattle. Even a casual inspection of the area shows these hotel/motel originating enplanements to be concentrated directly across from Sea-Tac International Airport's terminal.

Enplanements originating from business offices are disproportionately concentrated in King County (excluding the impacted communities) which accounts for almost two-thirds (66.1%) of such enplanements. The combined impacted communities account for only 12.4% of these types of enplanements. Again, most of the business enplanements originating from the impacted communities come from the area directly east of Sea-Tac International Airport along Pacific Highway South/International Boulevard.

In terms of business activity related to the Airport, the distribution of originating enplanements shows that the City of SeaTac gets some significant business activity (particularly guests at its motels), but the Cities of Burien, Des Moines, Federal Way, Normandy Park and Tukwila receive little business related benefit from the Airport.

Overall, residents of the communities immediately surrounding the Airport get disproportionately small benefits (both in total and per capita terms) from their use of the Airport while suffering disproportionately large costs. Business activity generated by the Airport appear to produce significant benefit for the City of SeaTac but little benefit for the Cities of Burien, Des Moines, Federal Way, Normandy Park and Tukwila.

Comparing geographic areas which receive the major benefits of Sea-Tac International Airport's air transportation services with those that suffer the primary costs (adverse impacts) leads to the inescapable conclusion that a large discrepancy exists between the costs suffered and benefits received by residents of Burien, Des Moines, Federal Way, Normandy Park and Tukwila. The discrepancy results in a lack of equity between residents of the region who primarily benefit from the Airport and residents who primarily suffer its socio-economic costs. It causes an imbalance between populations that benefit and that suffer the cost of Sea-Tac International Airport as a major aviation center. It is an imbalance that necessitates socio-economic mitigation by the Port of Seattle to redress.

A.06 - GEOGRAPHIC MISMATCH BETWEEN OTHER AIRPORT BENEFITS AND COSTS

An additional benefit attributable to Sea-Tac International Airport is the jobs (and income) it creates. Table A.06 shows the number of direct jobs created at Sea-Tac International Airport held by residents of the five impacted cities, and the percent of all jobs held by residents of the five impacted cities that they account for. Table A.07 shows the same information but for the indirect jobs created by the Airport in the City of SeaTac.

Table A.06
Direct Jobs Created at Sea-Tac International Airport Held by Residents of the Five Impacted Cities

City	Total Work-Trips to Airport	Total Resident Workers	Airport Work-Trips As Percent of Resident Workers
Federal Way	911	40,001	2.28%
Des Moines	436	14,576	2.99%
Burien	341	17,312	1.97%
Normandy Park	154	2,688	5.73%
Tukwila	125	7,652	1.63%

(Source: Census Transportation Planning Package)

Table A.07
Indirect Jobs Created at City of SeaTac Held by Residents of the Five Impacted Cities

City	Total Work-Trips to City of SeaTac	Total Resident Workers	SeaTac Work-Trips As Percent of Resident Workers
Federal Way	1,299	40,001	3.25%
Des Moines	756	14,576	5.19%
Burien	582	17,312	3.36%
Tukwila	232	7,652	3.03%
Normandy Park	193	2,688	7.18%

(Source: Census Transportation Planning Package)

The analysis of Sea-Tac International Airport's direct and indirect job impacts was conducted on information provided by the Puget Sound Regional Council (PSRC) from two special data runs on the 1990 Census Transportation Planning Package (CTPP). One data run on the CTTP provided the number of work trips with origins in the Cities of Burien, Des Moines, Federal Way, Normandy Park and Tukwila that had destinations at Sea-Tac International Airport (Traffic Analysis Zone 355). The second run provided the same information for work trips that had destinations in the 13 Traffic Analysis Zones (TAZs) that lie within the City of SeaTac.

As can be seen from Table A.06, the percentage of resident workers in the five impacted communities covered by this study with direct jobs at the Airport is low - ranging from 1.63% in Tukwila to 5.73% in Normandy Park. For the five cities combined, the percent of resident workers with jobs directly at the Airport is 2.39%. The percent of City of SeaTac residents with jobs in the Airport's TAZ is 3.29%.

Table A.07 presents similar information, only for residents of the five impacted cities whose work trips have destinations in the City of SeaTac. The data in Table A.07 are presented because the City of SeaTac contains the second largest concentration of hotel/motel rooms in the region where air travelers stay immediately before departing on their trip; and might be a significant source of indirect Airport jobs for residents of the five impacted cities. As Table A.07 shows, however, this is not the case. Even if all residents of the five impacted cities working in the City of SeaTac held indirect Airport jobs, the percent of residents affected would vary from a high of 7.18% in Normandy Park to a low of 3.03% in Tukwila. For the five impacted cities combined, the maximum percent of residents with Airport jobs is 3.72%.

More likely, the proportion is between half to three-quarters. Using the upper end of this range (0.75%), the combined direct plus indirect jobs generated by the Airport equals 5.18% of the combined resident workers in the five impacted communities.

The final way in which Sea-Tac International Airport might generate benefits to the five impacted cities is through their collection of property, sales and business and occupation (B&O) taxes. For the City of SeaTac, such taxes may be a large contribution to the city's fiscal health since it contains numerous hotels, motels and office buildings which likely would not be there if not for the Airport. Additionally, the city collects taxes for automobiles that park at Sea-Tac International Airport's parking garage. The Highline School District collects business personal property taxes from the commercial airlines that operate out of Sea-Tac International Airport. The five impacted cities studied in this report plus the Highline School District all experience reduced residential property tax collections as a result of the Airport (as is discussed previously in this report) and with the few jobs and income produced by the Airport that go to residents of the five impacted cities, it is highly likely that the net effect of the Airport on tax revenue collections in the five affected cities is negative. The question of Airport-generated tax revenues in the affected cities can only be roughly estimated since the topic was not addressed in the Master Plan Update EIS and there are not any readily available sources for making estimates. Based on available data describing the travel industry, direct job and indirect job impacts generated by the Airport, it does not appear likely that Sea-Tac International Airport produces significant tax benefits for the five impacted cities.

A.07 - SUMMARY OF AIRPORT GENERATED BENEFITS AND COSTS

The working assumption of this Sea-Tac International Airport Impact Mitigation Study is that the total benefits which will result from expansion of the Airport are greater than the total costs that will be incurred. Viewed from the perspective of the entire Puget Sound region or the State of Washington, there is justification for Sea-Tac International Airport's expansion. The benefits of the Airport's expansion however are spread over the entire state and region. Relatively few of these benefits go to residents of the five Cities of Burien, Des Moines, Federal Way, Normandy Park and Tukwila. Whether benefits are measured in terms of time saving to the traveling public, direct and indirect jobs (and income) created, or tax revenues generated, the vast majority of benefits go to persons who do not reside in the five impacted cities that are the focus of this study.

On the other hand, there is evidence that the adverse socio-economic impacts (costs) of the Airport are concentrated in the five Cities of Burien, Des Moines, Federal Way, Normandy Park and Tukwila. From the perspective of these cities, the Airport's benefits are far less than its costs.

If Sea-Tac International Airport is to be expanded, consequently, equity demands that these cities be made whole by actions designed to mitigate the Airport's adverse socio-economic impacts and re-establish some balance between the benefits and costs which these cities will face. The fact that the Airport's total benefits exceed its total costs means that there is a margin available for such mitigation. What is required is public policy that both recognizes the magnitude of the equity issue and directs sufficient resources to restore a balance between benefits and costs facing the five impacted cities and the Highline School District.

APPENDIX B

TECHNICAL REFERENCES

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Appendix C

Project Contacts

APPENDIX C
PROJECT CONTACTS

City Council Members/Staff
City of Burien, Washington
City of Des Moines, Washington
City of Federal Way, Washington
City of Normandy Park, Washington
City of SeaTac, Washington
City of Tukwila, Washington

Colorado Springs International Airport
Bob Allison, Assistant Director of Aviation

Dallas/Fort Worth International Airport
Karen Robertson, Noise Abatement Officer
Dana Ryan, Senior Airport Planner

King County Ground Water Management Program
Mark Isaacson
Paul Shallow

King County Surface Water Management Division
David Masters

Lambert Field/St. Louis International Airport
Jerry Tinnea, Noise Abatement Officer

Miller Creek Management Coalition
Clark Dodge

Minneapolis/St. Paul International Airport
Nigel Finney, Deputy Executive Director/Planning & Environment

Normandy Park Community Club
Shawn McEvoy

Port of Seattle
Marsha Holbrook
Bob Wells

Puget Sound Air Pollution Control Agency
David Kircher
Dennis McLerran
Brian Sullivan

San Diego International Airport
Nile Marmion, Airport Noise Specialist
Jeanette Lake, Director of Noise Information

San Francisco International Airport
Marvin Ellis, Noise Abatement Officer

Seattle Water Department
Sean Aronow
Laurie Arima

State of Washington, Department of Community, Trade and Economic Development
Steve Wells, Director
Sandra L. Benbrook, PHD, Assistant Director

State of Washington, Department of Ecology
Doug Brown
Paul Carr
Erik Stockdale

State of Washington, Department of Fish and Wildlife
Ted Muller

State of Washington, Department of Transportation
Bill Dues
Robert Josephson
David McCormick
Renee Montgelas
Craig Stone
Samuel Teitzel

Synergy Consultants, Inc.
Mary Vigilante, President

Trout Unlimited
Al Miller

US Department of Transportation
John D'Aprile
Gregg Fleming

Waste Action Project
Greg Wingard

Other
Airport Impact Assistance Executive Committee
City of Burien Planning Commission
Highline School District
Regional Council on Airport Affairs

Appendix D

Glossary of Terms

APPENDIX D
GLOSSARY OF TERMS

A

AADT	Average annual daily traffic
AAQS	Ambient Air Quality Standards
AASA	Aging & Adult Services Administration
ACC	Airport Communities Coalition
AIRTRACT	Washington State Air Transportation Commission
ASIL	Acceptable Source Impact Level
ASV	Annual Service Volume
ATC	Air traffic control

B

(none)

C

CAA	Clean Air Act
CAL3QHC	Air quality computer model
CFR	Code of Federal Regulations
cfs	Cubic feet per second
cm	Centimeter
CMS	Congestion Management System
CNEL	Community Noise Equivalent Level
CO	Carbon monoxide
COE	United States Army Corps of Engineers
CPS	Cycles per second (same as "Hertz")
CTBS	Comprehensive Test of Basic Skills
CTED	Washington Department of Community, Trade, and Economic Development
CTI	Cell Therapeutics Inc. campus (proposed)
CTPP	Census Transportation Planning Package

D

DASA	Division of Alcohol & Substance Abuse
dB	Decibel
dBA	A-weight decibel
DCFS	Division of Children & Family Services
DDD	Division of Developmental Disabilities
DEIS	Draft Environmental Impact Statement
DFW	Dallas/Fort Worth International Airport
DIA	Denver International Airport
DOE	Washington Department of Ecology
DSHS	Washington Department of Social and Health Services
DU	Dwelling unit
DVR	Division of Vocational Rehabilitation

E

EDMS	Emissions and Dispersion Modeling System
EIS	Environmental Impact Statement
ESA	Economic Services Administration
ESL	English as a Second Language

F

FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Maps
FHWA	Federal Highway Administration

G

GA	General aviation
GIS	Geographic information system
GMA	Growth Management Act
GPS	Global Positioning Satellite System

H

HC	Hydrocarbon
HOV	High-occupancy vehicles
Hz	Hertz (or cycles per second)

I

IH	Interstate Highway
ILS	Instrument landing system
INM	Integrated Noise Model
ISO	International Organization for Standardization
IWS	Industrial Waste System

J

JRA	Juvenile Rehabilitation Administration

K

(none)

L

LDN	Average Day/Night Sound Level (generally associated with aviation activity)
LEQ	Average Daily Sound Level (generally associated with surface transportation activity)
LOS	Level of Service

M

$\mu g/m^3$	Micrograms per cubic meter
MCY	Million cubic yards
MHD	Mental Health Division
MLS	Microwave Landing System
MOA	Memorandum of Understanding
MOBILESA	Mobile source emission program from US EPA
MSA	Medical Assistance Administration

N

NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NO_2	Nitrogen dioxide
NOISEMAP	Aircraft noise model developed by the US Air Force
Northflow	Departure traffic to the north, arriving traffic from the south

O

O_3	Ozone
OAG	Official Airline Guide
O-D	Origin-destination survey
OFM	Office of Financial Management, King County Assessor's Office

P

$PM_{2.5}$	Particulate matter (2.5 microns or less)
PM_{10}	Particulate matter (10 microns or less)
PNA	Polynuclear aromatic
ppm	Parts per million
Port	Port of Seattle
POS	Port of Seattle
PSAPCA	Puget Sound Air Pollution Control Agency
PSRC	Puget Sound Regional Council

Q

(none)

R

ROD	Record of Decision
RPZ	Runway protection zone
RUSLE	Revised Universal Soil Loss Equation
RTA	Regional Transit Authority

S

Sea-Tac	Seattle-Tacoma International Airport
SEL	Single-Event Noise Levels
SEPA	Washington State Environmental Protection Agency and Washington State Environmental Policy Act
SASA	South Aviation Support Area
SAT	Scholastic Aptitude Test
STAMINA	Computer noise model for roadway noise
SDS	Storm Drain System
SH	State Highway
SI	Serviceability index
SIP	Statewide Implementation Program
SO_2	Sulfur dioxide
Southflow	Departure traffic to the south, arriving traffic from the north
SPCC	Spill Prevention, Control and Countermeasure Plan
SR	State Route

T

TA	Threshold Analysis (also referred to as Time Above)
TAZ	Traffic Analysis Zone
TRACON	Terminal radar control area
TRB	Transportation Research Board
TSM	Transportation System Management
TSS	Total suspended solids

U

URAA	Uniform Relocation Assistance Act
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency

V

V/C	Volume/capacity ratio
VOC	Volatile organic compound

W

WAC	Washington Administrative Code
WATERWORKS	Hydraulic analysis computer program
WISHA	Washington Industrial and Safety Health Act
WPPSS	Washington Public Power Supply System

X

(none)

Y

(none)

Z

(none)

NOTES