THE ADVERSE HEALTH IMPACTS OF AIRPORT EXPANSION WITH PARTICULAR REFERENCE TO SEA-TAC INTERNATIONAL AIRPORT

From the Health Subcommittee of the Environmental Impact Committee of the Regional Coalition on Airport Affairs

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10/5/92

SUMMARY OF ADVERSE HEALTH EFFECTS OF AIRPORTS

Fiction:

Airport noise is a minor annoyance and people living near the airport should be "good sports" and learn to ignore it.

Fact:

Airport noise results in a significant increase in community use of tranquilizers and sleeping pills. Airport communities have an increased rate of alcoholism, and admissions to psychiatric hospitals. Airport-related noise can literally drive people mad.

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Fiction:

Communities near the airport offer affordable housing and would be suitable for young families.

Fact:

Infants born to mothers living under the flight path have lower birth weights and higher likelihood of prematurity. There is some experimental evidence to suggest that serious birth defects are more likely when the mother is exposed to high noise levels during pregnancy. Airport communities are unsafe for pregnant women and their children.

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Fiction:

Although it is annoying, airport noise will not affect your physical health.

Fact:

Excessive noise has been positively associated with the development of hypertension, high cholesterol, and high

blood sugar, all of which place people at increased risk of heart disease and stroke.

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Fiction:

Sea-Tac airport has become so quiet in recent years that it no longer impacts learning in our schools.

Fact:

Speech and communication are affected when noise levels exceed 60 decibels. Excessively noisy schools have been shown to adversely affect the ability to solve simple problems as well as to learn mathematics and reading. Actual noise measurements in several Highline Schools in 1992 exceeded 85 decibels in the class room and 100 decibels in the school yard. Since the beginning of jet traffic at Sea-Tac airport, standardized test scores in the Highline School District have fallen from among the highest in the state to the third from the bottom.

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Fiction:

Airport-related noise is merely an annoyance to neighboring citizens and has minimal impact on sleep patterns or sense of well-being.

Fact:

On a typical recent weeknight at Sea Tac Airport, at least 110 planes including more than 70 jets took off or landed between 10:00pm and 7:00am. The level of noise produced severely impacts thousands of people in South King County. Disturbance of sleep is one of the most significant sources of distress caused by airport noise. Airport noise causes difficulty in attaining deep sleep, shortened REM sleep, and

premature arousal from sleep. Both deep and REM sleep are thought to be physiologically important. Sleep deprivation leads to impaired reaction times, fatigue, lethargy, decreased efficiency, anxiety and desire to be left alone.

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Fiction:

Sea Tac Airport is only a minor contributor to regional air pollution.

Fact:

A 1991 State Department of Ecology study indicated that Sea Tac Airport operations generate up to 5% of all air pollution in King County. The bulk of this pollution occurs over a relatively very small area (less than 0.25% of the area of King County) leading to relatively high and potentially damaging concentrations of various pollutants and particulates.

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Fiction:

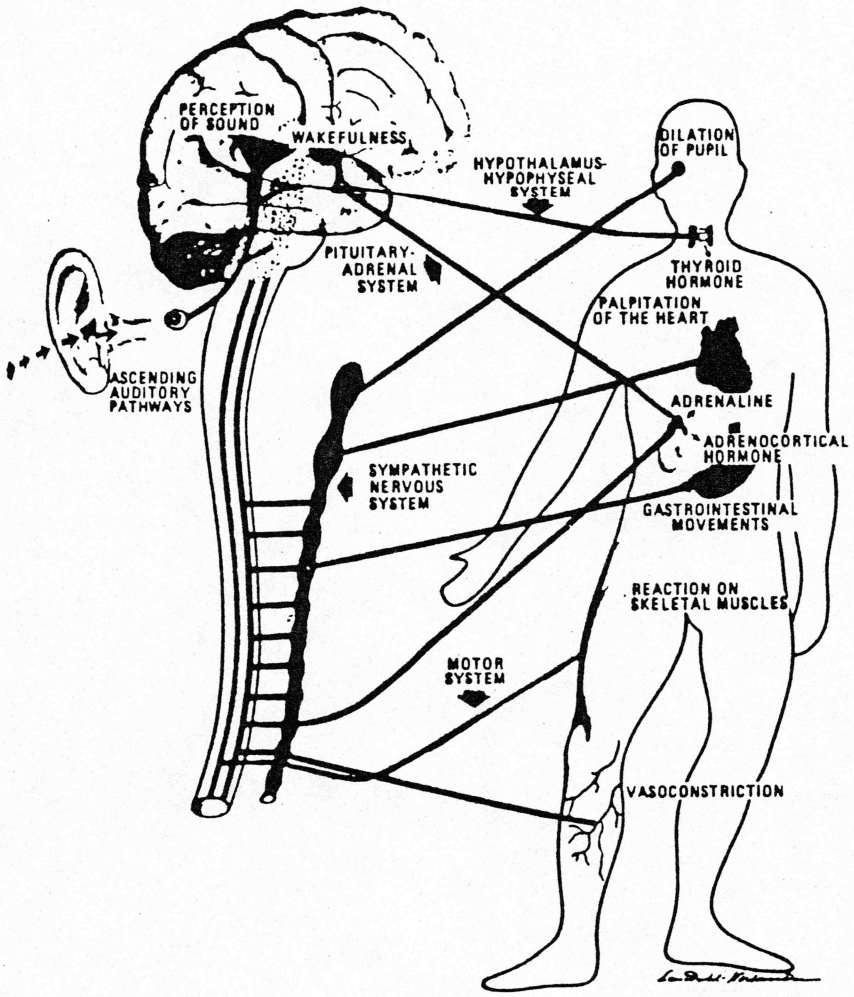
Detailed studies indicate no increased risk for development of cancer in communities nearest the airport.

Fact:

The study of cancer and its causes is highly complex. To date, no detailed comparative studies of actual cancer incidences have been performed to address this crucial question. 1990 U.S. Census Tract data programs necessary for beginning such studies will not be available to the Fred Hutchinson Cancer Research Center until early in 1993.

NOISE- GENERAL EFFECTS

Noise is considered to be a non-specific biologic stressor, eliciting a response that prepares the body for "fight or flight". The physiologic mechanism thought to be responsible for this reaction is the stimulation by noise of the brain's reticular activation system[1]. Neural impulses spread from the reticular system to the higher cortex and throughout the central nervous system. By means of the autonomic nervous system, noise can influence perceptual, motor, cognitive, behavioral, glandular, cardiovascular, and gastrointestinal function. "Noise promotes stress and anxiety, disrupts sleep and is a major threat to human health"[2].



(Figure 1)

Mental Health

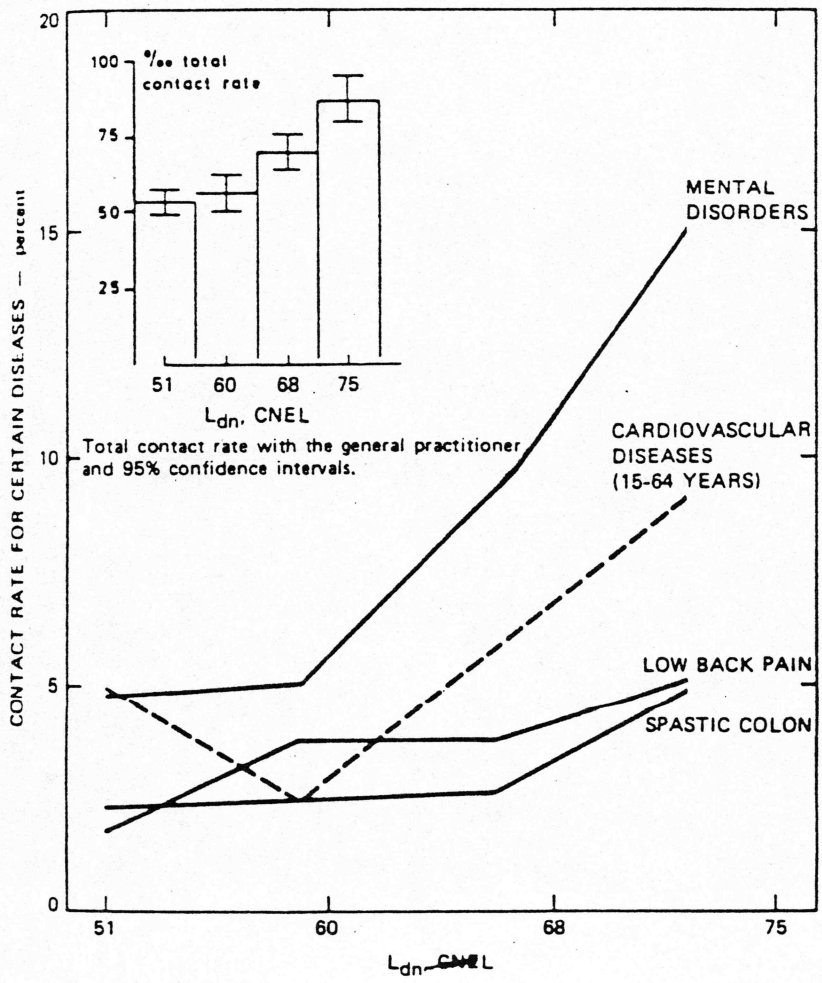
Over 60% of people in heavily noise-impacted areas complain of moderate to severe annoyance with airport noise. Chronic annoyance results in increased need for and use of sedative hypnotic medications and an increase in the frequency of nervous breakdowns. Studies have shown a marked increase in the use of tranquilizers and sedatives around jet airports [3,4], and an increase in the rate of alcoholism and its associated medical problems [5]. Experts have said that noise heightens aggressive behavior and dampens helpful impulses, which may in part explain an increased incidence of crime and domestic violence in airport communities[6]. Many studies have shown an increased number of psychiatric admissions from noise-impacted neighborhoods around jet airports [7,8,9,19,11]. More than simply being annoying, airport noise can have a measurable impact on mental health (see Figure 2).

Cardiovascular Disease

Cardiovascular disease is the number one cause of death in this country. Hypertension is second only to smoking as a cause of cardiovascular morbidity and mortality. Workplace noise of 85 to 95 dBA produces sustained hypertension in monkeys, even after the stimulus is withdrawn [12]. Systolic and diastolic hypertension has been produced experimentally in elderly people exposed to recorded aircraft noise [13]. Hypertension has also been demonstrated in school children under a jet flight path [14]. Prescriptions for antihypertensive medications gradually doubled in one airport community after the building of a new jet runway [15]. Similar observations have been made in other communities [16]. The result of excess hypertension in airport noise-impacted communities may well be an increase in heart disease and strokes. A study of 6000 noise-impacted people near the Amsterdam Airport found an increase in the use of

cardiovascular drugs, an increase in the medical treatment of heart disease, and an increase in pathological heart shape on x-ray in people exposed to aircraft noise[17]. One author has reported a 15% increase in the incidence of stroke near the L.A. International Airport compared to quieter communities[18]. Another study has failed to substantiate this finding [19].

In addition to raising blood pressure, noise can affect at least two other important risk factors for cardiovascular disease. A large epidemiologic study on road noise found that noise-exposed people had higher blood cholesterol levels, and higher blood glucose levels, both of which are associated with heart disease and stroke. The public health implications of these findings in a noise-exposed, urban population could be enormous[20]. Note the striking effects of increasing noise levels on mental and cardiovascular disease (Figure 2).



Pregnancy and Birth Defects

Heavily noise-impacted areas around jet airports are probably unsafe for pregnant women. Several studies have shown reduced birthweights and a higher rate of preterm labor and premature births in airport communities[21,22,23]. Studies have shown decreased fertility rates and increased birth defects when laboratory animals were exposed to loud noises during pregnancy [24]. One study has found an increase in the rates of neural tube defects (spina bifida and anencephaly) in children born to women living under the flight path of a large international airport [25]. Another study found a similar increase but felt it was statistically insignificant [26].

Gastrointestinal Disease

The effects of chronic noise exposure are not limited to the cardiovascular system. The Environmental Protection Agency (E.P.A.) has reported that people working in noisy areas have 5 times as many stomach and duodenal ulcers as the general population[27]. One study found that prescriptions for antacids, commonly used to treat ulcers and related acid peptic problems, nearly doubled in a community after the building of a new jet runway [28]. Another author found a 100% increase in the rate of cirrhosis of the liver related to alcoholism around a large international airport [29].

Immunology

Experts have also claimed that loud and disturbing noises trigger changes in circulating hormones and may lower resistance to disease and infection[30].

Learning Disabilities

Several Highline schools (up to 6000 students) are located in heavily noise-impacted areas. Sound measurements done in schools in the Highline district in 1992 recorded levels of 85 dBA in the classrooms[31]. Noise levels outside the schools reached 100 dBA. Noise begins to interfere with speech and learning when it exceeds 60 dBA. Although airport authorities would prefer to describe the noise as a day-night average (LDN) of 65 to 75 decibels, the actual effect in the classroom is similar to starting a gasoline lawn mower or running a food blender every 2 to 3 minutes. Studies have shown that students in noisy classrooms are more likely to read at least 1 year below grade level compared to students in quiet classrooms [32]. Another study found that children in schools exposed to airport noise were more likely to give up on a task, and less likely to succeed at simple problem solving compared to students in quiet schools. These effects were most marked in students who had been attending the noisy school the longest[33].

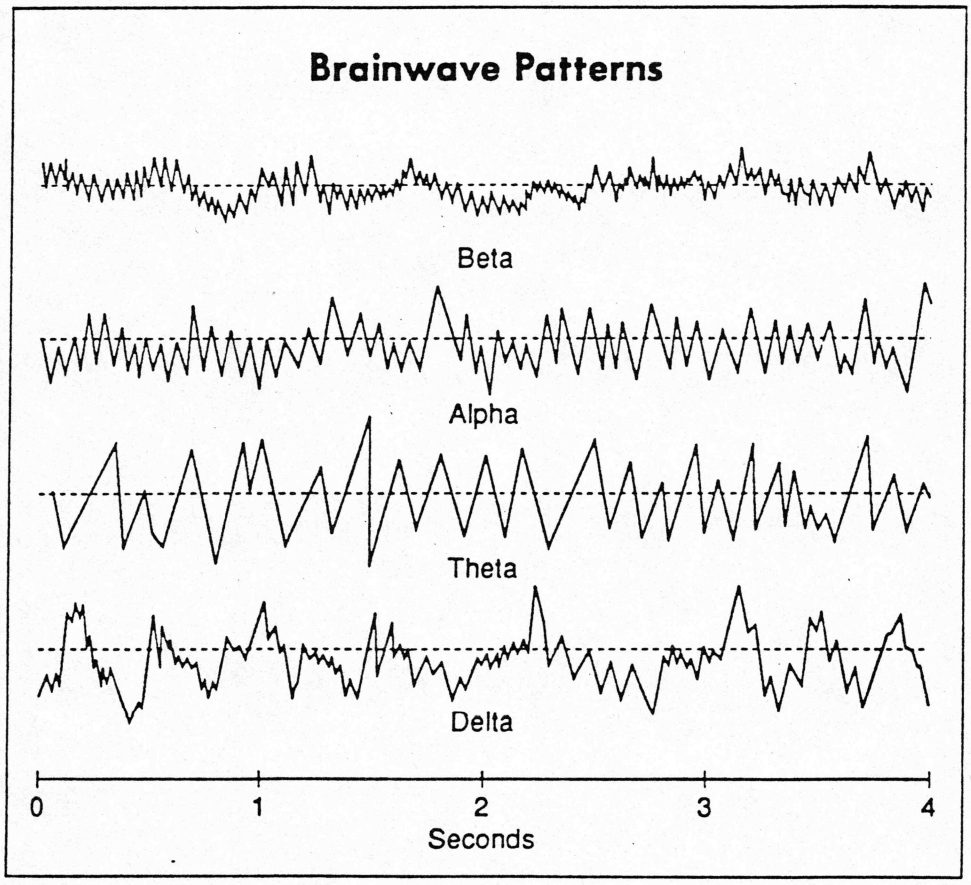
Mathematics testing was carried out in the Highline School District during the 1970's by Dr. Breysse of the University of Washington. He found that students in the noisiest schools did significantly worse on standard mathematics testing when compared to students studying in quieter schools in the same district. Highline School District M.A.T scores have fallen from among the best in the state to the 3rd lowest in the state concomitantly with the growth of jet aircraft traffic at Sea-Tac airport. For many students, the noise is not limited to the school environment. Many students live in homes impacted by aircraft noise. They arrive at school tired and inattentive from sleep disturbance and are expected to listen and concentrate in class rooms where noise levels significantly interfere with their education[31].

Sleep and Speech Disruption

Electrical brain activity as measured by the electroencephalogram (E.E.G.) indicates four states of consciousness according to certain brainwave patterns[34]:

BETA	>13 hz	Normal state of alertness, stress, anxiety
ALPHA	8-12 hz	State of light relaxation, super learning, positive thinking
THETA	4-7 hz	Deep relaxation, meditation, increased memory and focus
DELTA	1-3 hz	Deep sleep, lucid dreaming

(Figure 3)



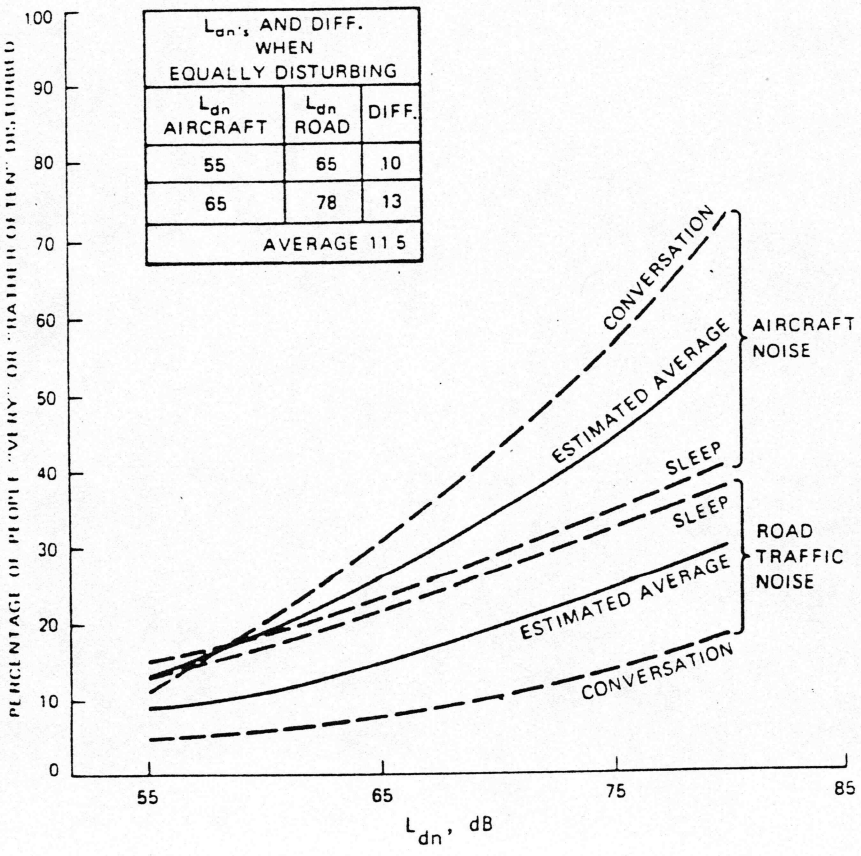
Sleep researchers described the drowsy period just preceding Stage 1 sleep as being characterized by a slowing of the alpha rhythm (8-12 hz) accompanied by slow rolling eye movements (SEM). As Stage 1 sleep is attained, the slowed alpha rhythm begins to break up and is replaced predominantly by an even slower, smaller amplitude (lower voltage) theta rhythm (4-7 hz) associated with unconsciousness. Deep sleep and lucid dreaming (Stages 3 and 4 Sleep) follow in association with rapid eye movements (REM) and a delta rhythm (1-3 hz)[34,35].

Disturbance of sleep is probably the most widespread source of distress caused by noise. Indoor threshold for falling asleep is 35 - 40 dBA. The indoor threshold for arousal from deep sleep is 70 dBA. Children are less susceptible and the elderly are more susceptible. Disruptions of sleep lead to symptoms of fatigue, lethargy, decreased efficiency, anxiety, and desire to be left alone [36].

According to one sleep study, 10% of people living 19 kilometers from Kennedy Airport reported difficulty sleeping compared with 60% of those within 6 kilometers of the airport. Falling asleep takes considerably longer with peak levels of 60 dBA and ambient levels of 50 dBA. Forty to 50 dBA are capable of changing the stage of sleep without producing complete awakening. The threshold for complete awakening is variable but violently fluctuating noise is the worst. Complete awakening can be seen with an increase of only 10 dBA over baseline. A study in a community in France done before and after the opening of a new noisy road found that noise levels of 40 +/- 3 dBA and peaks of only 55 +/-5 dBA caused people to take 16 minutes longer to fall asleep. Since deep and REM sleep are thought to be physiologically important, sleep impairment may well be damaging. ~~People~~

important, sleep impairment may well be damaging. People living in very noisy houses did worse in measurements of unprepared reaction time after noisy nights and showed improvement after simple sound insulation. This research supports the recommendation that night time noise levels not exceed 35 dBA[36].

Ldn 55 from aircraft noise is equivalent to 50 daily episodes of aircraft noise with a peak level of 81 dBA. Noise can interfere with sleep at or above 40 dBA and will interfere with speech communication at or above 50 dBA. Each disruption lasts for about 1 minute, and there are at least 25 million U.S. citizens exposed to Ldn 55 or higher. At Dallas Fort Worth airport, Ldn 55 is not reached until 6 miles from the end of the runway. Intermittent noise such as aircraft noise is much more annoying and disruptive than continuous noise such as noise generated from traffic. Aircraft noise at an Ldn of 55 could cause interference with sleep and communication whereas Ldn 55 automobile noise would be below the threshold levels capable of such interference[37]. (Figure 4)



Additional information regarding sleep disturbance and its impacts appeared in the 3/15/92 edition of the Seattle Times in Bob Ortega's article entitled "Life Beneath the Roar -- Escaping Jet Noise Means Sleeping in the Basement and Turning on the Radio" The following is a brief excerpt from "Life Beneath the Roar"[31]:

> "If you change the quality of sleep on a chronic basis, in the long run it will affect your health," says Peter Breysse, professor emeritus of environmental health at the University of Washington. Even when people aren't awakened, he said, noise can disrupt the dream and deep-sleep cycles.
>
> On a typical recent week night, at least 110 aircraft, including more than 70 jets, landed or took off from Sea-Tac between 10:00pm and 7:00am. According to Port records, among them were at least 24 Boeing 727s and other louder, older jets.
>
> Within two miles of the airport, consultants to the port have measured peak noise from older jets reaching 100 decibels - about as loud as a diesel locomotive trundling directly across the street.
>
> "People believe they get used to night-time noise," said Alice Suter, a Cincinnati-based research audiologist. But studies show that even after five years of exposure to aircraft noise, physical responses - higher blood pressure, higher stress levels - continue..."

AIR POLLUTION

The Seattle Tacoma International Airport Air Pollution Contribution Study of May, 1991 (generated by the Washington State Department of Ecology) identified the airport as being potentially a major contributor of air pollutants to South King County. The worst case scenarios produced estimates of carbon monoxide, fine particulates, nitrous oxide and benzene far in excess of recognized safe levels. According to the study, which utilized computer models, the airport probably contributes up to 5% of the total air pollutants in King County (including both the contributions of aircraft and motor vehicles going to and from the airport). Since the bulk of the emissions probably occurs on airport property or within its immediate vicinity, the concentration of various pollutants is expected to be far higher than in other parts of the county, since the area of the airport is less than 0.25% of the total area of King County (relative areas calculated by Don and Beth Williams, personal communication).

The health effects of releasing these pollutants and particulates in high concentration would be expected to lead to increased incidence of asthma and other respiratory diseases. Benzene is a known carcinogen, especially in settings of repeated exposures over a long period of time (see next section re cancer).

Gordon Baker, M.D. (allergist) has observed and has begun documenting an increased incidence of respiratory problems including bronchitis and asthma near the airport (personal communication). In a recent talk to Sea Tac area citizens on 9/11/92, Dr. Baker stated that many of his local patients complain of the same problems encountered in areas of high industrial air pollution or commonly seen during air thermal inversions. These problems include bronchitis,

asthma, decreased lung function and capacity, emphysema, sinusitis, rhinitis, sore throat, chest congestion, wheezing and runny eyes or ocular (eye) burning.

In spite of the significant concerns long-raised by local citizens and by the 1991 Department of Ecology Study, the Port of Seattle (P.O.S.) currently "has no data" regarding its emission levels (quoting P.O.S. representative Michael Feldmann during the Air Quality Study meeting of 8/24/92; see Appendix I). However, the Port is planning to perform "Pilot Studies" of "Air Quality" -- probably beginning in the near future (possibly in Fall, 1992).

At the recent planning meeting for the upcoming "Air Quality Studies", there seemed to be considerable initial differences of opinion between Port officials and the representatives from both the E.P.A. and the Puget Sound Air Pollution Control Agency over whether to use badge monitoring (passive diffusion) or the more expensive but more generally accepted evacuated canister sampling methods. Please refer to the report of that planning meeting included as Appendix I for further details.

CANCER

"Cancer" implies malignant neoplasm (new growth). Most cancers have the capability of killing their host either by direct spread from their site of origin or by metastasis to distant body sites via the blood or lymphatic systems. The study of cancer is highly complex in part because there are so many types of cancers for each human organ system. In addition, the causes of cancer seem to be multifactorial -- often involving multiple different physiologic insults working cooperatively through repeated exposures over a long period of time.

Among the known causes of cancer (carcinogens) are the following: ionizing radiation (X-rays, gamma-rays), viruses (Human papilloma virus with cervical cancer, Epstein Barr virus with nasopharyngeal cancer and with lymphoma, etc.), chemicals (benzene with leukemia, aniline dyes with bladder cancer, hydrocarbons in soot with scrotal cancer in chimney sweeps, etc.), ultraviolet light with various skin cancers, tobacco smoke with lung cancer, asbestos with malignant mesothelioma, etc.

Due to the long latency period between exposure to chemicals such as benzene and the development of disease, it may not be possible to detect an increased incidence of cancer in airport communities. The problem is compounded by the fact that thousands of people with previous lengthy exposures have left the Sea Tac area over the past 20 years. (1200 families were moved out of the immediate Sea Tac community north end between about 1973 - 1978 according to Ms. Rose Clark, (personal communication). None of these people will show in any current epidemiologic studies).

Dr. Lee Sanders has requested the Fred Hutchinson Cancer Research Center (F.H.C.R.C.) to conduct preliminary studies to determine the relative proportions of breast cancer, colorectal cancer, lung cancer, leukemia and lymphoma in the areas surrounding the airport. In these initial studies, there were no definite increases in the ratios of one cancer compared to another, suggesting that at least the relative <u>proportions</u> of these diseases are no different near the airport than in non-airport-impacted communities.

The study of proportional variations of various cancers is a useful but relatively crude screening tool. David B. Thomas, M.D., Dr. P.H., of the University of Washington Division of Public Health Sciences and head of the Epidemiology Program at the F.H.C.R.C. states that more

complete study would involve significant time and resources. In order to study possible relationships between airport pollution and cancer, the denominators (number of people by sex and age) in each census tract or an appropriate group of census tracts around Sea Tac Airport would need to be evaluated for various cancer types and then proper comparisons of actual incidences of each cancer type could be made to the incidences encountered in the surrounding 13 county area. The F.H.C.R.C. Epidemiology Department will not have the necessary 1990 census data programs to begin such a study until about February, 1993. Such studies should probably be provided by and funded by the Port of Seattle as part of any complete environmental impact statement, and ideally include an attempt to track the already-evacuated populace.

The potential inability to document increased cancer incidence does not necessarily mean that it does not exist. The estimated concentrations of benzene in some airport communities (although not measured) may at times exceed 24,000 parts per trillion. The acceptable source impact level for new sources proposed by WAC is 0.63 parts per trillion. Out of interest, Hartfield airport in Atlanta is in Clayton County. Clayton County had more than twice the national rate of lung cancer. A grand jury has been charged with conducting studies of the increased cancer risks[38].

CONCLUSION

This paper is not intended to be an exhaustive review of the literature regarding airport-related health issues. Many additional small studies can be cited supporting our conclusions and there are a few that do not. Small studies often lack the sensitivity required to demonstrate an effect (Beta or Type 2 statistical errors) and should not be used to refute a cause and effect relationship between airports

and public health. Even relatively small effects of airport noise and pollution on public health may be significant when large numbers of people are exposed. The weight of scientific evidence overwhelmingly supports the conclusion that airports are harmful to the health of people in surrounding communities. The health problems related to airport proximity are greatly compounded at Sea-Tac due to its relatively small size. Compared to most other airports with similar freight and passenger traffic, Sea-Tac has only one-fifth the land area, and there are a disproportionate number of schools and homes in heavily noise-impacted areas. Put simply, citizens around Sea-Tac are more likely to have airport-related health problems because the airport has an inadequate clear zone. Money earmarked for expansion of Sea-Tac would be better spent on alleviating the noise and pollution effects already felt by airport neighbors from existing operations. Cost estimates of further expansion of Sea-Tac must include more than the prices of fill dirt, concrete and construction. The additional numerous impacts of airport expansion on human health should be considered carefully before any decision is made to build. When these impacts and other community-borne costs are thoroughly considered along with the actual construction costs, expansion of Sea-Tac airport probably will not be financially feasible or ethically reasonable.

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Fig. 1. NASA Reference Publication 1115, 1984, p. 391

Fig. 2. NASA Reference Publication 1115, 1984 p. 495

Fig. 3. ref. 34 above

Fig. 4. NASA Reference Publication 1115, 1984, p. 553

APPENDIX I

Report on Planning by the Port of Seattle for Upcoming "Air Quality" Studies in and Around Sea Tac Airport

This reporter is a pathologist on the medical staff at Highline Community Hospital (HCH) and a member of the Health Subcommittee of the Environmental Committee regarding Sea Tac Airport expansion.

At the request of Mark Benedum (our subcommittee chairman) and at the invitation of the Port of Seattle (POS), I attended the "Airport Air Quality Working Group meeting" held at Sea Tac Airport on 8/24/92. The meeting was chaired by Michael Feldman (POS). As shown on the attached attendance list, multiple parties were represented including Department of Ecology (WA), EPA (Region 10), FAA, Puget Sound Air Pollution Control Agency (PSAPCA), U.W. Department of Environmental Health, Sea Tac Office Center, City of Sea Tac and, of course, POS. POS hopes that use of the air quality working group will lend credibility to any analysis performed. They profess to want real credibility and reliability of the studies.

Mr. Feldman stated that the meeting and pending studies had evolved because of multiple factors including (1) concerns raised from the 1991 Department of Ecology study using an "EDMS model" suggesting a significant potential impact of Sea Tac Airport on regional pollution (with particular reference to possible benzene "hot spots"), (2) A letter of concern written by the Medical Staff of HCH to PSATC, (3) Recent newspaper articles citing citizen concerns about possible relationships between Sea Tac Airport and cases of cancer in the adjacent neighborhoods, and (4) various comments made at the regional PSATC hearings regarding citizen concerns about air pollution and fuel dumping.

It was made clear that the POS wishes to perform "air quality" and emission studies to evaluate the situation and hopefully to allay various concerns or to enable the POS to mitigate problems which might exist. The clear reference was made by Mr. Feldman that if pollution problems are found, that a "more efficient" airport including a third runway might actually improve the situation (no mention being made of added motor vehicle traffic and 100,000 or more added flights per year!!). Mr. Feldman said that the POS has a 1992 budget of up to $50,000 for initial (pilot) studies. Multiple bids from several accredited local or regional testing laboratories had been obtained (ranging from about $35,000 to 55,000). The bids involving badge sampling (via passive diffusion) were favored by POS because that type of testing is about 25% less expensive than using evacuated canister sampling (or charcoal filter active sampling) followed by liquid or gas chromatography badge equipment would be less bulky and more easily and more safely placed in and around the airfield than would canister systems, according to Feldman.

A map of Sea Tac Airport was presented with about 10 sites proposed for testing on Airport property. The POS clearly wants to do a quick pilot study in 9/92 (using badges) to gather initial data. The implication was clear that if a decision is made to proceed with planning for a third Runway that more funds would be made available for more comprehensive and complete studies. September was felt to be a good month for sampling because of wind and weather conditions, and various committee members agreed.

Input from the group was welcomed by Mr. Feldman and included the following:

1. Dr. Sanders was concerned that the POS might only study one or two analytes including benzene and recommended

doing a comprehensive analysis including benzene, hydrocarbons, carbon monoxide, nitrous oxide, sulfur dioxide, particulates, formaldehyde, etc.. Mr. Feldman stated that more than just one or two compounds would be studied but cited high costs of studying a large number of pollutants.

2. Marsha Lee (EPA) was concerned that badge (passive diffusion) monitoring was not as accurate or sensitive or as established as using evacuated canisters or active sampling of known volumes of air over set periods of time. Canister methods can detect down to 1-2 parts per billion. Michael Morgan (an industrial hygienist from UW Department of Environmental Health disagreed in part and felt that badge testing was useful if accurately standardized. However, Ms. Lee stated that EPA has tried to avoid passive sampling in almost all of their previous studies. EPA recommends time-integrated active sampling methods. After much discussion and further input from Gerry Pade (PSAPCA), a consensus was reached that the gold standard for studies would be the very expensive use of on site gas chromatography. The next best method (next most established by previous studies and also acceptable to the EPA would be to use evacuated canister sampling or active sampling of known air volumes over charcoal filters). The <u>least preferred</u> or established method would be using badges (passive diffusion). Mr. Feldman will discuss these issues further with EPA. Mr. Pade felt that active canister samplers could be readily anchored on the field and that such methods would add credibility to the studies.

3. A final important suggestion made by Mr. Pade (PSAPCA) and seconded by Dr. Sanders was that the POS should also include some sampling at remote sites off airport property in order to provide some <u>comparative</u> data re: pollution levels. Sites suggested included U.W. Campus, Bellevue, etc.. POS representatives seemed interested in

doing some off site testing at some point but it wasn't clear if that would be part of a pilot study. POS said it might test at one of the Highline Schools, corner of 188th and Pacific Highway etc.. but timing was uncertain.

Conclusions and Recommendations:

Local citizens, RCAA and Rick Arambaru et. al. should monitor the pending studies and data very carefully. If the POS uses only badge monitoring without parallel canister/active monitoring, questions of validity could be raised, especially in view of the concerns raised by the EPA and PSAPC representatives. Also, if a significant number of types of pollutants from both motor vehicles and airplanes in and around Sea Tac Airport are not measured, the study would be less than thorough or comprehensive. Also, if enough off-site comparison locations are not studied, the needed comparative data would be missing or at least incomplete. Finally, we must be aware that if pollution problems (and/or fuel dumping problems) are identified by any of the pending studies, that POS will probably use those findings to support building a "more efficient" airport including a third runway as a means of reducing rather than increasing air pollution.