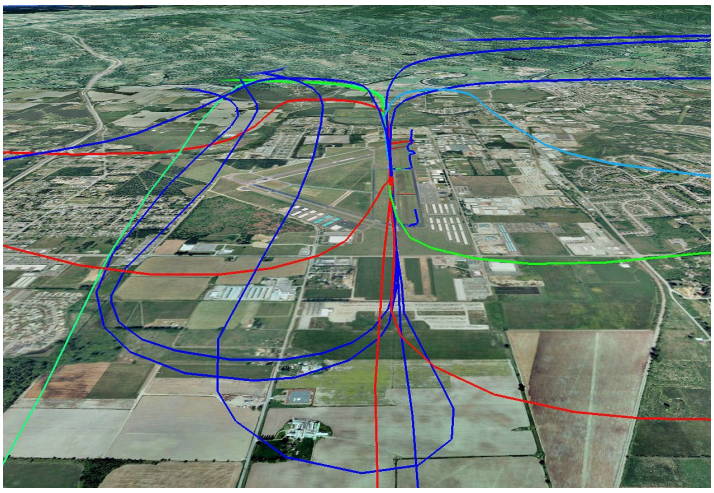
Flight Tracks

Flight track data generated by GPS equipped aircraft can be a useful tool in identifying the airspace used by aircraft, potential impacts, and communicating to decision makers the area necessary for land use compatibility planning. This gives planners and officials a more quantifiable decision making tool. The key to successfully conducting a flight track analysis is gathering an adequate sampling of aircraft operations. An adequate sampling should:

- Represent the airport's current fleet mix
- Record actual operations
- Identify special functions: Flight school, parachute, etc. activity, etc.
- Weather conditions



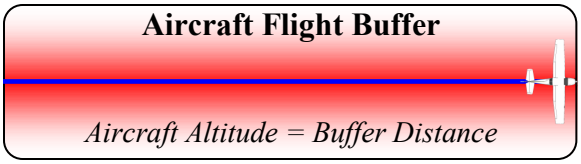
Flight track data is not a necessary component of the airport land use compatibility planning process, but can be an effective tool in educating decision makers and the public.

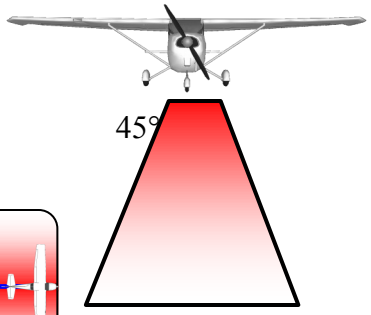
Why are GPS tracks good tools for planners?

- 3D visualization tool for decision makers.
- Precise spatial representation of aircraft: location, altitude.
- Makes visualizing complex concepts like the airport influence easier.

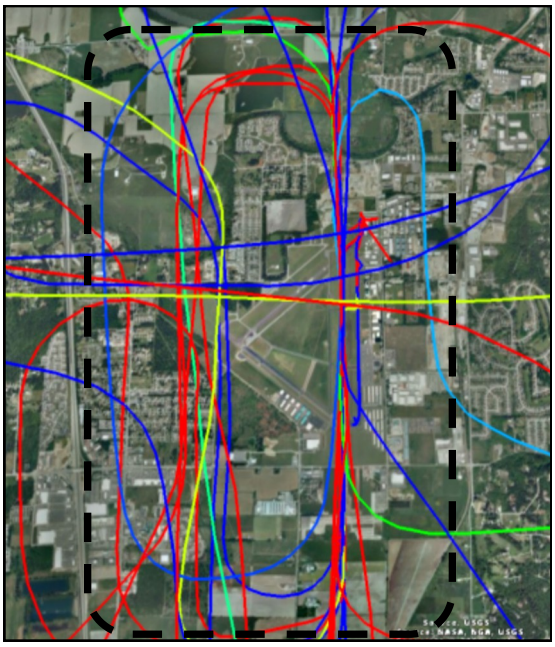
Remember to include a buffer beyond where the tracks are drawn

Aircraft flight impacts, such as nuisance noise, are not limited to just directly below the aircraft. Rather, they extend outward to encompass a corridor of land within which the aircraft can be heard and seen as they fly by (a good rule might be to extend the flight corridor laterally a distance equal to the altitude of the aircraft—that is, anything within a 45° angle downward from the aircraft).





The Airport Influence Area includes 80 to 85 percent of Aircraft Operations



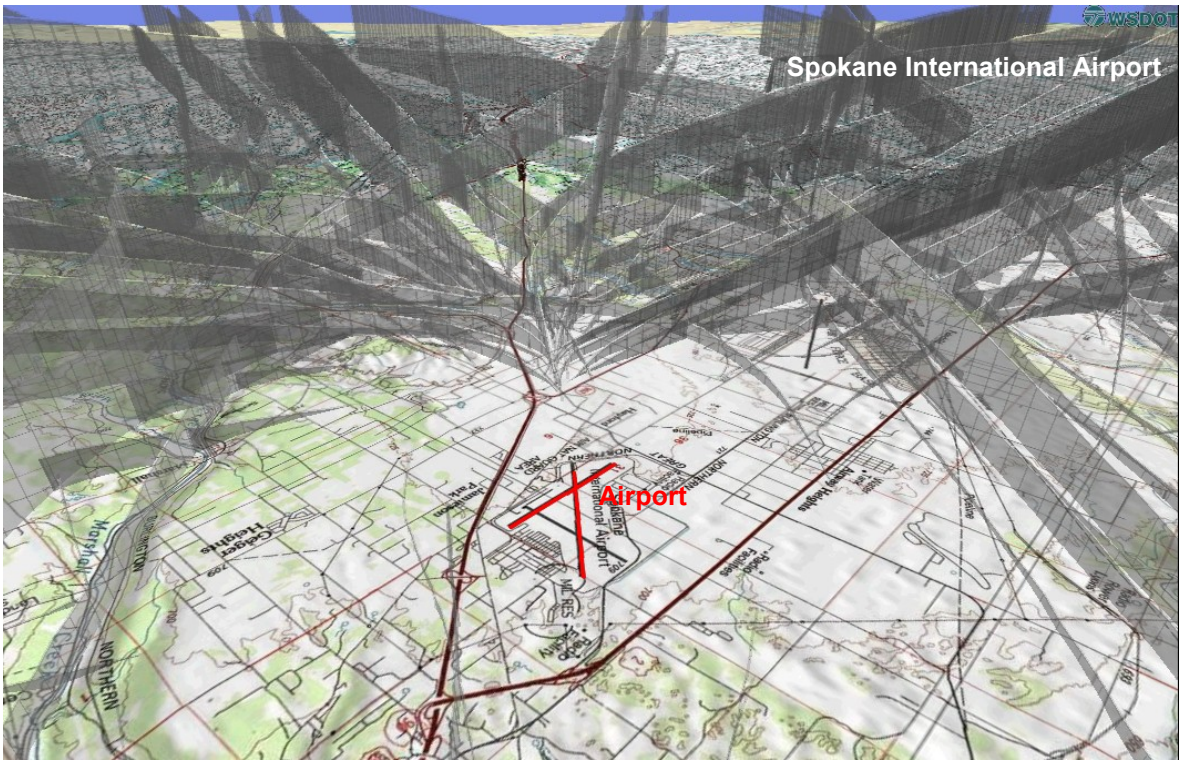
Flight Track Analysis

When drawing the airport influence area boundary, don't attempt to encompass every flight track, just the major ones—aim for about 80 percent. If you are defining the boundary based on information from pilots and others, you won't have 100 percent coverage in any case. However, even with radar data, you can omit the stray tracks that don't follow the typical routes. Some of these may just be aircraft passing through the area without landing. When considering complaints as one of the determinants of nuisance noise impacts, take into account the existing land uses. If the traffic patterns are over an area with few residences, then there will probably be few complaints. This status could dramatically change, however, if a new subdivision is built in the area. Also take consider the distribution of complaints. It is sometimes the case that one individual is responsible for the majority of complaints.

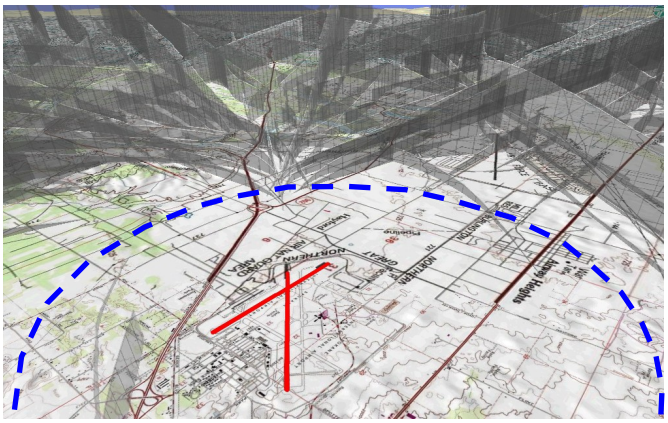
Radar Tracks

When available, radar tracks can be a helpful tool in identifying areas overflown by aircraft. Airport managers will be your best point of contact when requesting this data.

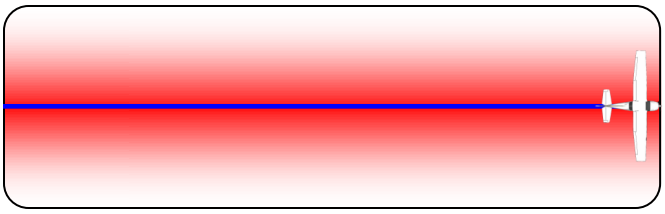
Radar track data is not a necessary component of the airport land use compatibility planning process, but like GPS tracks they can be an effective tool in educating decision makers and the public. The tracks take an abstract concept, like aircraft operations, and make it easy to understand.



Radar limitations
After aircraft descend in altitude radar contact is lost.



Remember to include a buffer beyond where the radar tracks are drawn
Aircraft impacts, such as nuisance noise, are not limited to just directly below the aircraft.



As in flight tracks, they extend outward to encompass a corridor of land within which the aircraft can be heard and seen as they fly by (a good rule might be to extend the flight corridor laterally a distance equal to the altitude of the aircraft—that is, anything within a 45° angle downward from the aircraft).

Appendix **C**

Airport Influence Area

Aircraft activity can be annoying, especially where ambient noise levels are low

Experience at many airports has shown that noise and other related concerns do not stop at the boundary of the outermost mapped DNL contours. Many people are sensitive to the frequent presence of aircraft overhead even when the aircraft produces relatively low levels of noise. These reactions are frequently expressed in the form of *annoyance*.

At many airports, particularly commercial service airports, complaints often come from locations beyond the defined noise contours. In fact, heavily used flight corridors to and from metropolitan areas are known to generate noise complaints 50 miles or more from the associated airport. The basis for such complaints may stem from the expectation that outside noise sources should not be intrusive. In some cases, people are disturbed if the noise is even distinctly audible—above the quiet, natural background noise level. Elsewhere, especially in locations beneath the traffic patterns of general aviation airports, a fear factor also contributes to some individuals' sensitivity to aircraft overflights. Also, light, vibration, fumes, and even just the sight of aircraft overhead can contribute to the annoyance, and aircraft may be considered an intrusion on the enjoyment of private property.

Nuisance Noise

Nuisance noise (noise under 65 DNL)

The Washington State Department of Transportation has recognized noise below 65 DNL as a compatibility factor. As such, noise below 65 DNL should be addressed during the local aviation land use compatibility planning process. Some within the FAA have also recognized the flaws with using 65 DNL as a compatibility threshold (Girvin). Research has shown a proliferation of complaints from areas outside the 65 DNL noise contour boundary (Girvin). Many complaints are the result of a single noise event. Factors contributing to annoyance include rapid changes in aircraft power settings, abnormally low-altitude flights, and actual or apparent aerobatic maneuvers.

Many jurisdictions have identified 55 decimals as the maximum permissible sound level for residential environments. Jurisdictions may wish to explore similar thresholds when analyzing the compatibility of uses within the airport influence area.

Aircraft nuisance noise is very similar to noise generated from common power tools. It is loud enough to be intrusive, disruptive and cause conflict between neighbors. Single event noise characteristics, modal bias and the high visibility of aircraft operations intensify the negative response many individuals experience.

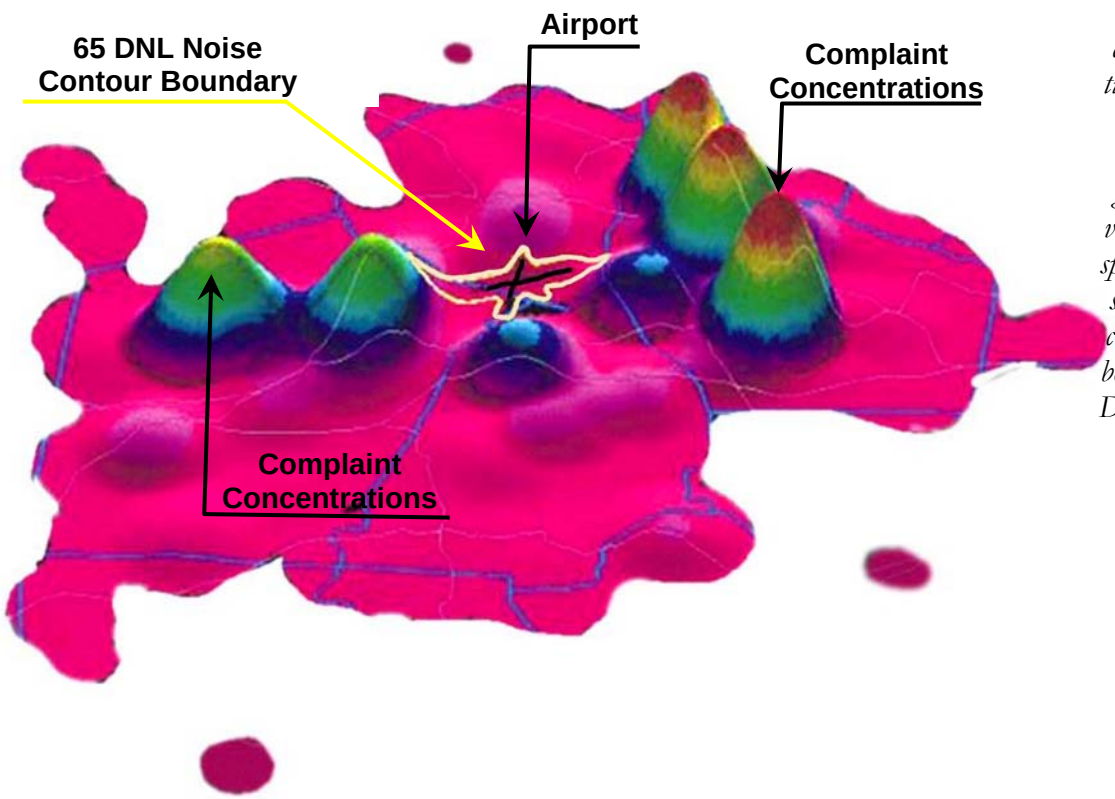
String Trimmer

Aircraft Operations

Chainsaw

Case Study: Naples Municipal Airport GIS Noise Analysis

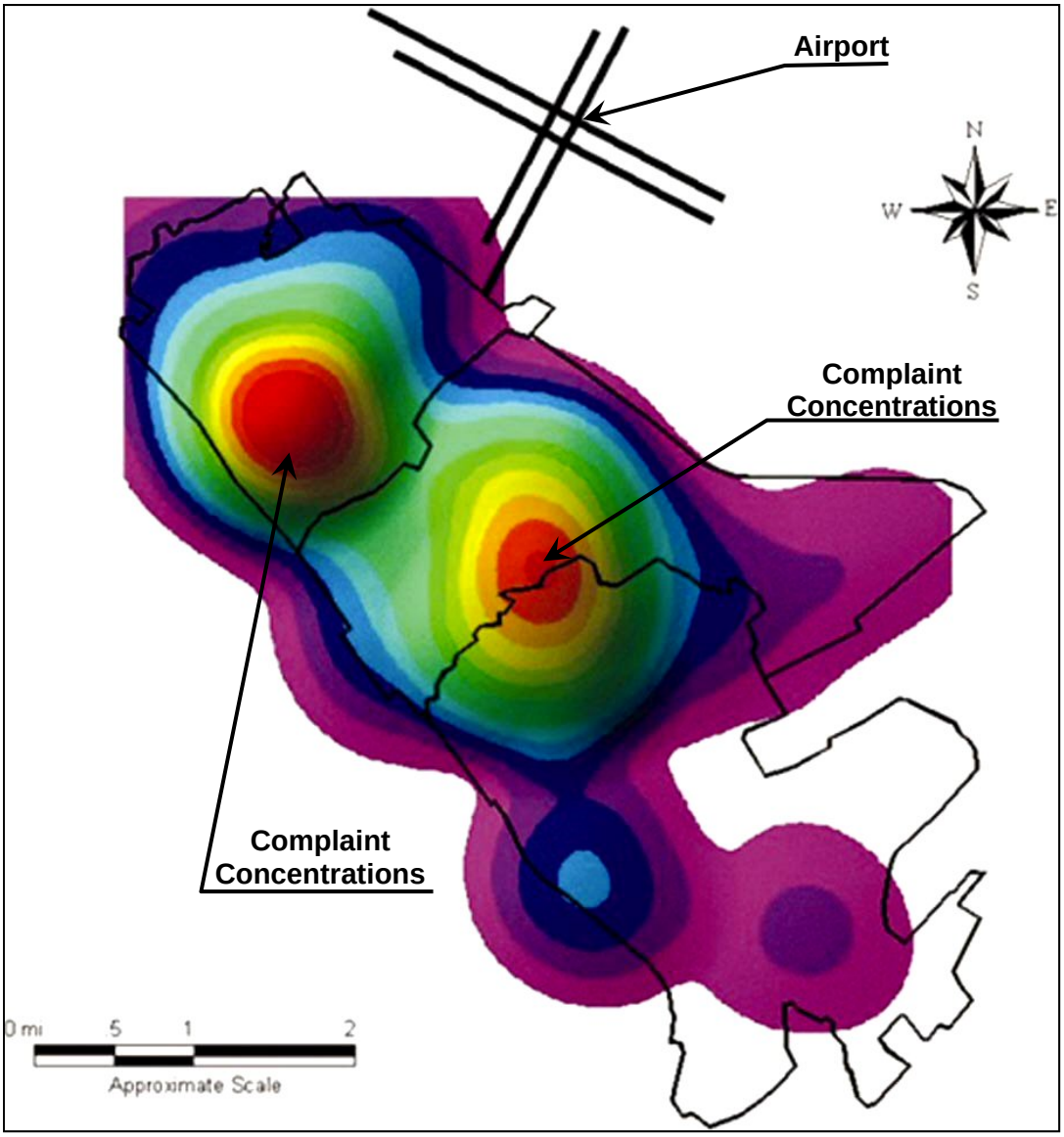
The argument that nuisance noise is a substantial compatibility factor is supported by research regarding the spatial distribution of noise complaints at Naples Municipal Airport. The research shows that most aircraft noise complaints are received from geographic areas outside the 65 DNL dB noise exposure contour. This fact demonstrates that noise complaints often have more to do with fleet mix, event times and operational characteristics than the 65 DNL noise contour. Cumulative noise exposure is itself a far from perfect predictor of annoyance (Fidell).



Complaints were geo-coded into street addresses and then spatially modeled in GIS. Complaints are represented by the graduated colors and vertical extrusion. The spatial analysis demonstrates that complaint concentrations are well beyond the airport's 65 DNL cumulative noise exposure contour.

~Complaints are represented by the graduated colors and vertical extrusion (exaggeration).
~65 DNL Noise Contour Line - yellow polygon
~Airport runways -black intersecting lines

Case Study: San Francisco International Airport



San Francisco International Airport conducted a six year analysis of noise complaints. The complaints were geo-coded into street addresses and then spatially modeled. The spatial analysis demonstrated that the 65 DNL contour is not where aircraft noise concerns end. Complaint concentrations are well beyond the airport's 65 DNL cumulative noise exposure contour.

Vibration

A vibration occurs when pressure waves or "sound-waves" travel from one object to another, transferring energy. Sound waves are moving energy that travel through the air as a pattern of changing or oscillating pressure waves. Because air is a gas, it presents less friction to a pressure wave than a solid. Thus an unobstructed pressure wave can travel a longer distance before all of its energy is lost as heat. A solid will quickly absorb the pressure wave, turning its energy into heat, and preventing it from travelling as far. These pressure waves impact an object and part of the energy is absorbed as it passes through. This can happen when a pressure wave strikes a wall of a home and part of the energy is transferred to the structure in the form of a vibration. This vibration in turn can create an annoyance for occupants of a structure. So when one tries to reduce vibration, in reality, it is often a problem of trying to reduce the pressure waves or "sound-waves". The number of times that a pressure wave vibrates in a second is called its frequency. Frequency is measured in cycles called hertz.

The most notable source of vibration associated with general aviation activity comes from helicopters. The rotating blade produces a phenomenon known as blade slap that varies in degree depending upon the speed and descent rate of the helicopter. The approach is the airport area most impacted by this phenomenon. Vibration can also be an issue in areas behind the start of takeoff roll for jet aircraft. Note that vibration can be a problem with light, piston driven aircraft. For example, experience shows us a pre-1970 Cessna 185 on departure with a prop speed between 2750 and 2800 RPMs can produce a significant noise signature and related vibration.

Light

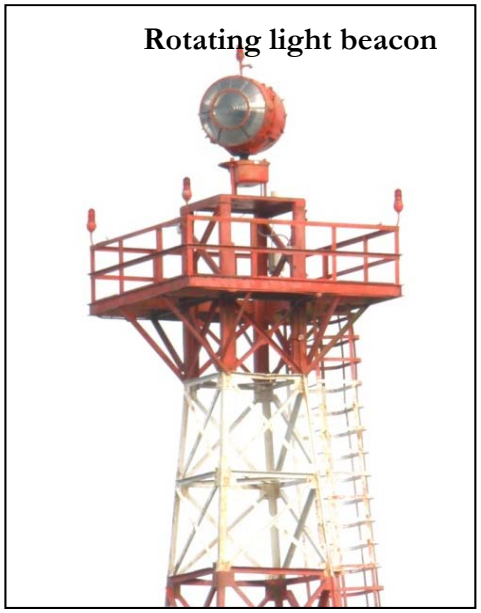
Although often overlooked as a compatibility factor, aviation related light can be a point of contention for airport neighbors. Light pollution, also known as photopollution or luminous pollution, is often defined as excessive or obtrusive artificial light. This industrial byproduct is most impactful in close proximity to the airport. Check with the airport manager to see if on airport light has been an issue in the past or could be an issue in the future.

Approach lighting system

On airport light

The primary sources of on airport light are: the Approach Light Systems (ALS), rotating light beacon, runway lights and general facility lighting.

- The Approach Light Systems (ALS) provides the basic means to transition from instrument flight to visual flight for landing. Operational requirements dictate the sophistication and configuration of the approach light system for a particular runway.
- A rotating light beacon indicates the airport's location to pilots at night. It is often mounted on top of a tall structure or control tower above other buildings on the airport. It produces flashes of light very similar to a lighthouse. The beacon may be an omnidirectional flashing strobe, or it may rotate at a constant speed, which produces the visual effect of flashes at regular intervals. Flashes may be of just a single color, or of two alternating colors, depending on airport configuration.


Rotating light beacon

- Runway lights come in a variety of intensities including High Intensity Runway Lights (HIRL), Medium Intensity Runway Lights (MIRL), and Low Intensity Runway Lights (LIRL). Most often, this form of light is confined to airport property and in an urban environment. Due to the nature of nighttime flight operations, aircraft landing lights are usually very high intensity. The area primarily impacted by aircraft light is the approach portion of the traffic pattern. Aircraft descending in altitude during the approach can impact adjacent property. In some cases, the landing lights of large aircraft can be seen for several miles. Another source of aviation related light is aircraft in the traffic pattern. Modern aircraft are equipped with red, green and white strobe lights to help identify which direction they are flying. In most cases, these lights don't present a compatibility issue.

Fumes

The impact of aviation fumes and waste particles on the quality of life we experience can often be hard to quantify. Aircraft operations can produce extremely small particles of carbon-based chemicals. These particles can be easily inhaled and, in some cases, promote respiratory inflammation. Exposure to these chemicals, which may be greater for people living near smaller airports, has also been associated with an increased risk of lung disease. Community development patterns and airport geography both play a role in population's exposure. Larger airports with commercial service typically have buffer areas isolating the airport from residential uses. These buffers often reduce the residents' exposure to pollution impacts. Small airports in heavily populated areas often don't have these buffers, so residents may be more directly exposed to aircraft emissions (HU, et al).

Fumes and unpleasant smells (often described as smelling like kerosene) are particularly noticeable from turbine-powered aircraft (jets, turbo-props, and some helicopters). On airport industrial activity can also be a source of offensive odors. Planners and decision makers should consult the airport manager about areas within the airport's environment exposed to the highest levels of fumes.

Low-flying Aircraft

The sight and sound of low flying aircraft in overflight areas of the traffic pattern may be perceived by some as a threat of danger, and as a result produce a negative emotional response. Fear and anxiety are two common emotional responses linked with perceived threats. Fear is often related to the specific event. Fear may be related to future events, such as worsening of a situation, or continuation of a situation that is unacceptable. Anxiety is often a result of ongoing or multiple threats, which are perceived to be uncontrollable or unavoidable. These emotional responses often increase stress and fuel opposition to normal airport operations.

Overflight and Environmental Justice

The subject of environmental justice is important, sensitive, difficult to measure and often not addressed as a part of airport land use compatibility planning. In the past, advocates have made a strong case that environmental justice communities (those with concentrations of low income and minority populations) bear more than their share of environmental burdens. Some have argued that these communities experience disproportionate exposure to chemicals, air pollutants, or facilities that emit smog and particulates. Housing choice plays a particularly strong role in this consideration. Housing choice is largely dependent on available housing types, cost considerations, and individual resources. It has been argued by some that living next to an airport is a choice and a variable of the market; however, for many members of our community, this free market solution to compatibility planning is not a viable option. Economic resources vary between different segments of the community, which often dictates social economic geography.

This fact may open up a large policy debate regarding environmental justice, social equity and the community's long-term vision and values. Some considerations a jurisdiction may wish to address may include:

- Does the community's policies and development regulations express its values regarding its objective of providing a high quality of life for all segments of the population?
- Will policies disproportionately affect low income or minority populations?
- Is it socially acceptable to place affordable housing in areas that experience a reduced quality of life?

While these impacts may be important community concerns, the question of importance here is whether any land use planning actions can be taken to avoid or mitigate the impacts or otherwise address the concerns. Commonly, when overflight impacts are under discussion in a community, the focus is on modification of the flight routes. Indeed, some might argue that overflight impacts should be addressed solely through the aviation side of the equation—not only flight route changes, but other modifications to where, when, and how aircraft are operated. Such changes are not always possible because of terrain, aircraft performance capabilities, FAA regulations, and other factors. These limitations notwithstanding, there are steps that local land use jurisdictions, often together with airport management, can and should take to help minimize overflight impacts.

Evaluating Impacts

The first step in evaluating aircraft impacts is knowing where aircraft fly in the vicinity of the airport. There are several possible sources for this data:

- **Airport Master Plan.** If possible, look first in the airport master plan. It may contain generalized flight track data that can be used as a starting place for assessing the traffic pattern location. Recognize, though, that aircraft do not fly the exact lines that are typically shown—the actual traffic pattern will typically be a wider band than the line shown on a flight track map.
- **Radar Data.** An excellent source, although not one that is available for most airports, is radar data. For airports where radar coverage is available at a low enough altitude to be useful—that is, at least down to the traffic pattern—this is the ideal source because it precisely shows where flights have occurred. Try contacting the airport staff or FAA regarding the radar data. It is not necessary to obtain data for an entire year, but be sure to get enough to be representative of all conditions. Make sure to have data for when each runway has been in use and for busy days when the traffic pattern may be busier than normal.

Tips

- Even if your airport does not have a radar antenna or even an air traffic control tower, it may still have radar coverage from a nearby major airport.

- **Airport Manager and Other Airport Personnel.** For most airports, especially general aviation airports, radar data is unavailable. Either the airport is too far from the nearest radar facility or intervening terrain prevents coverage at an altitude low enough to be useful. In these instances, anecdotal information from airport personnel who are familiar with the local aircraft traffic is usually the best alternative. Flight instructors are particularly good sources of information because they frequently fly. Once flight track location data has been obtained, the question is how large to show the aviation catchment area for land use compatibility planning purposes. In general, the objective should be to encompass locations where aircraft regularly fly as they approach, depart, or engage in flight training at an airport. By "regular," we suggest trying to include approximately 80 percent of these flights. There will always be some random flights associated with an airport that do not follow the pattern; typically it is not cost-effective to control land uses in these areas.

Addressing Annoyance

To avoid creating opportunities for annoyance, the preferred land use compatibility strategy is to keep residential development and other noise sensitive uses away from where aircraft regularly fly. Impacts within the airport influence area should be considered whenever drawing or redrawing of urban growth boundaries is contemplated. For airports located well outside urban areas, preventing extensive new residential development may not be difficult and having a few scattered rural residences is seldom a major compatibility concern.

Tips

- Be cautious that allowing a few residences doesn't become a precedent for many more.
- Be cautious about high intensities within the runway approach zones—see the discussion in Appendix E on safety.

Close to or inside the urban growth boundary, the challenge can be much greater, but there are still several strategies that can minimize overflight annoyance.

- **Plan for Uses with Low Noise Sensitivity.** As described in Chapter 3, most commercial and industrial land uses do not involve outdoor activities that would be disrupted by noise. As much as possible, these are the types of uses that should be planned for beneath the airport traffic pattern.

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- **High Residential Density.** Though seemingly illogical, higher residential densities can be better than low density when it comes to nuisance noise annoyance. High-density residential development, particularly multi-family uses, typically generates more noise of its own. Higher ambient noise makes aircraft and other transportation noise sources less intrusive (the amount of time that the noise is above the background noise level is less). Additionally, multi-family dwellings each have fewer external walls than a single-family house and the amount of outdoor living space is usually less. High density residential development is not compatible with some areas near airports, particularly in the approach and departure paths.

Tips

- A caveat to this approach, of course, is that it is only practical in locations where safety is not a major concern.

- **Buyer Awareness.** The third approach takes advantage of the fact that some people are more annoyed by aircraft noise than others. Establishing mechanisms to alert prospective residents to the proximity of a nearby airport and the impacts it creates can thus reduce the overall level of annoyance in the community. A real estate transaction disclosure statement prepared at the time that a property is offered for sale is one such mechanism and has the advantage of working both for new dwellings and ones that are being resold. For new development, another possible option is for the local jurisdiction to require that, as a condition for approval of the development, an airport-proximity disclosure statement be recorded as part of the property deed. In this manner the statement would automatically be passed forward to subsequent owners of the property rather than relying on th*e sellers and their agents to do so. See Chapter 3 for more discussion of these tools.*