# Chapter Five
# NOISE ABATEMENT ALTERNATIVES

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# Noise Abatement Alternatives

The Department of Transportation (DOT)/Federal Aviation Administration (FAA) *Aviation Noise Abatement Policy of 1976*, the *Airport Safety and Noise Abatement Act of 1979*, and the *Airport Noise and Capacity Act of 1990* outline the framework for a coordinated approach to noise abatement and mitigation of noise impacts. Responsibilities are shared among federal, state, and local governments, airport proprietors, aircraft manufacturers, airport users, and residents of communities near the airport.

- The federal government has the authority and responsibility to control aircraft noise at the source, implement and enforce operational flight procedures, and manage the air traffic control system in ways that minimize noise impacts on populated areas.

- Local governments are responsible for land use planning, zoning, and building regulations to encourage development that is compatible with present and projected airport noise levels.

- Airport proprietors are responsible for planning and implementing airport development actions designed to reduce noise. These include noise abatement ground procedures and improvements in airport design. Proprietors may also enact restrictions on airport use that do not unjustly discriminate against any user, impede the federal interest in safety and management of the air navigation system, unreasonably interfere with interstate commerce, or otherwise conflict with federal law.

- Aircraft manufacturers are responsible for incorporating quiet engine technology into new aircraft designs to meet federal noise standards.

- Air carriers, all-cargo carriers, and commuter operators are responsible for retirement, replacement, or retrofitting of older aircraft to meet federal noise standards. They are also responsible for operating aircraft in ways that minimize the impact of noise on people.

- General aviation operators are responsible to use proper aircraft maintenance and flying techniques to minimize noise output.

- Air travelers and shippers generally should bear the cost of noise reduction, consistent with the established federal economic and environmental policy which states that the adverse environmental consequences of a service or product should be reflected in its price.

- Residents of areas surrounding airports should seek to understand the aircraft noise problem and what steps can and cannot be taken to minimize its effect on people.

- Prospective residents of areas impacted by aircraft noise should be aware of the affect of noise and make their locational decisions with that in mind.

An airport noise abatement program has three primary objectives:

1. To reduce the noise-impacted population in the study area, within practical cost and legal constraints.

2. To minimize, where practical, the exposure of the local population to very loud noise events. These loud single events can occur even outside the Day-Night-Level (DNL) contours. They can annoy airport neighbors and warrant attention.

3. To ensure maximum compatibility of existing and future land uses with aircraft noise at the airport.

This chapter discusses and analyzes measures which may potentially abate noise in the Georgetown Municipal Airport area. It begins by screening the full range of potential noise abatement measures for possible use at the airport. The screening criteria includes: the probable noise reduction over noise-sensitive areas, the potential for compromising safety margins, the ability of the airport to perform its intended functions, and the potential for implementation, considering the legal, political, and financial climate of the area. Measures which merit further consideration are analyzed in a following section where detailed noise analyses are presented. The last section summarizes the results of the analysis by comparing the various alternatives.

## *NOISE ABATEMENT ALTERNATIVE PREPARATION*

As part of the analysis leading to the preparation of this chapter, the consultant held a special technical conference to brainstorm potential noise abatement measures. This conference was held on December 7, 2001. Those attending the conference included aviation professionals responsible for the administration, control, and operation of aircraft and facilities at the airport and area airspace. They included professional pilots, representatives of companies using the airport, air traffic controllers, representatives of national aviation organizations, airport administration, the Texas Department of Transportation (TxDOT), and the Federal Aviation Administration (FAA).

In order to judge the effectiveness and appropriateness of a particular technique, it is important to consider the magnitude of the noise impacts around the Georgetown Municipal Airport. Chapter Four of the Noise Exposure Maps (NEM) document evaluated the impact of noise on the population around the airport. Based on the current conditions (2003), 18 persons are exposed to aircraft noise above 65 DNL. By 2008, the existing population exposed to aircraft noise above 65 DNL is expected to increase to 79. This is primarily due to a projected increase in aircraft operations. Growth in the number of people exposed to noise above 65 DNL could increase to as many as 93 persons by the year 2008 due to the potential for residential growth around the airport.

## ASSESSING THE IMPACTS OF NOISE

As a means to evaluate noise abatement recommendations, the FAA only considers the current and five-year noise contours. The FAA is most concerned with noise impacts at the 65 DNL level and higher in evaluating the acceptability of any proposed noise abatement measures. However, in 1990 the FAA issued a noise screening procedure for determining whether certain air traffic actions 3,000 feet above ground level (AGL) might increase DNL levels by 5 decibels or more (*FAA Notice 7210.360*, September 14, 1990). This procedure was developed in response to experience showing that increases of noise of this magnitude, even at cumulative levels well below 65 DNL, could be disturbing to people and become a source of controversy. In an *Environmental Impact Statement for the Expanded East Coast Plan* (FAA 1995, pages 5-14 through 5-42), the FAA evaluated noise down to the 45 DNL level for potential increases in DNL noise exposure of 5 decibels or more. Therefore, FAA concluded that increases of 5 DNL or greater between 45 and 60 DNL will be considered marginal impacts.

In 1992, the Federal Interagency Committee on Noise (FICON) advised that increases of 3 DNL down to 60 DNL should be considered in environmental studies. Increases in noise below 65 DNL were not necessarily to be considered as "significant impacts," but they were advised to be studied. For purposes of FAA environmental documents, increases of 3 DNL between 60 and 65 DNL are considered marginal impacts.

**Table 5A** depicts the FAA noise impact criteria.

**TABLE 5A**
**Criteria for Determining Impact Increases of Aircraft Noise**

| DNL Noise Exposure | Minimum Increase in DNL | Level of Impact |
|---|---|---|
| 65 dB or Above | + 1.5 dB | Significant |
| 60 to 65 dB | + 3.0 dB | Marginal |
| 45 to 60 dB | + 5.0 dB | Marginal |

Source: FAA Order 1050.1 and F.A.R. Part 150, Sec. 150.21(2)(d); FICON 1992; FAA Notice 7210.360.

## *POTENTIAL NOISE ABATEMENT MEASURES*

A comprehensive list of potential noise abatement measures is shown in **Exhibit 5A.** Federal Aviation Regulation (F.A.R.) Part 150 specifically requires most of these to be considered in noise compatibility studies for possible use at airports undertaking those studies. These techniques either (1) reduce the size of the noise contours or (2) move the noise to other areas where it is less disruptive.

To reduce the size of the noise contours, the total sound energy emitted by aircraft must be reduced. This can be done by modifying aircraft operating procedures or restricting the number or type of aircraft allowed to operate at the airport. Measures which can be used to shift the location of noise include runway use programs, special flight routes, and airport facility development. In general, potential noise abatement measures can be assigned to the following four categories:

- Runway Use and Flight Routes
- Facilities Development
- Aircraft Operational Procedures
- Airport Restrictions and Regulations

### RUNWAY USE AND FLIGHT ROUTES

The land use pattern around the airport provides clues to the design of arrival and departure corridors for noise abatement. By redirecting air traffic over compatible land uses, noise impacts may be significantly reduced in noncompatible areas.

Georgetown Municipal Airport is surrounded by residential and other

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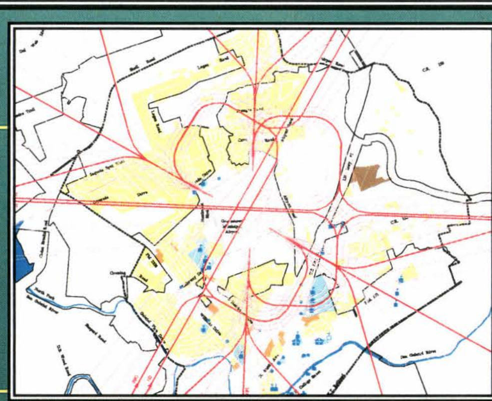
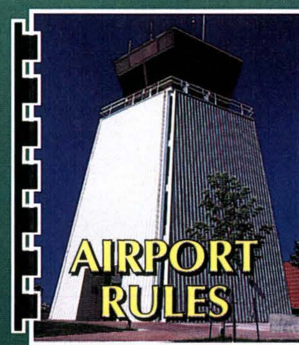
## RUNWAY USE AND FLIGHT ROUTES



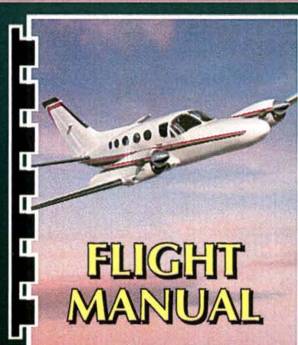
- Preferential Runway Use
- Departure Turns
- Visual Approach Procedures
- Instrument Approach Procedures
- Traffic Pattern Changes

## AIRPORT RESTRICTIONS AND REGULATIONS



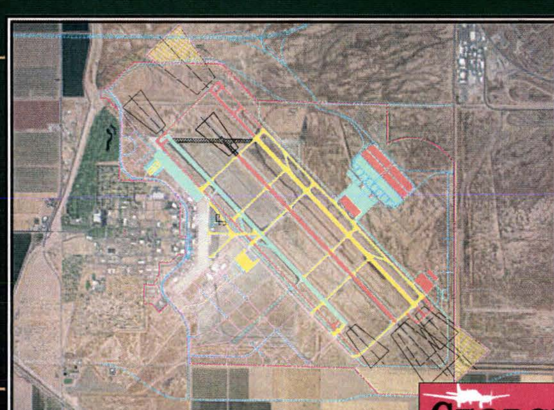

- Nighttime Curfews
- Variable Landing Fees Based on Noise Level or Time of Day
- Capacity Limitations (Operational Cap or Noise Budget)
- Aircraft Type Restrictions Based on Noise Level
- Ground Activity Restrictions
- Training Activity Restrictions

## AIRCRAFT OPERATING PROCEDURES




- Reduced Thrust Takeoffs
- Thrust Cutback Departures
- Minimum Approach Altitude
- Maximum Climb Departures
- Approach Flap Adjustments
- Two-Stage Descents
- Increased Approach Angle
- Limited Reverse Thrust

## FACILITIES DEVELOPMENT



- Runway Lengthening
- New Runways
- Displaced/Relocated Thresholds
- Approach Lighting
- Acoustical Shielding

GEORGETOWN MUNICIPAL AIRPORT

Exhibit 5A
POSSIBLE NOISE ABATEMENT TECHNIQUES

noise-sensitive development to the north, west, and south. The potential for additional residential and noise-sensitive development exists on nearly all sides of the airport. This includes significant in-fill development north, west, and south of the airport, and potential large scale development to the east.

**Runway Use Programs**

Runway use programs for noise abatement refer to the use of selected runways by aircraft. There are two types of runway use programs: rotational and preferential. Rotational runway use is intended to distribute aircraft noise equally off all runway ends. Preferential runway use programs are intended to direct as much aircraft noise as possible in one direction.

FAA Order 8400.9 describes national safety and operational criteria for establishing runway use programs. It defines two classes of programs: formal and informal. A formal program must be defined and acknowledged in a Letter of Understanding (LOU) between FAA's Flight Standards Division and Air Traffic Service, the airport proprietor, and the airport users. Once established, participation by aircraft operators is mandatory. Formal programs can be extremely difficult to establish, especially at airports with many different users.

An informal program is an approved runway use system which does not require the LOU. Informal programs are typically implemented through a Tower Order and/or publication of the procedure in the Airport/Facility Directory. Participation in the program is voluntary.

- EVALUATION

Currently, Georgetown Municipal Airport does not have an informal preferential or rotational runway use program. Although the only viable noise abatement corridor is southwest of the airport, many of the aircraft operating at Georgetown are confined to using Runway 18-36 due to the relatively short length of Runway 11-29 (4,100 feet). These aircraft include all business jet, turboprops, and some larger twin-engine piston-powered aircraft. Single-engine piston-powered aircraft utilize Runway 18-36 for the vast majority of the time, primarily a result of pilot preference.

In addition to runway length, wind conditions also contribute to runway use. This is especially fundamental when shorter runways are involved such as those at Georgetown Municipal Airport. The winds in the Georgetown area are predominately from the south-southeast making Runways 11 and 18 most often available to arriving and departing aircraft. However, during times of calm winds (under five knots) any runway could be utilized as this meets the specific aircraft's operating limitations.

Although larger aircraft are restricted to Runway 18-36, especially those weighing in excess of 12,500 pounds maximum certified takeoff weight, single-engine and small twin-engine aircraft could utilize Runway 11 for departures whenever wind and operating conditions allow. This is especially true during nighttime hours (10:00 p.m. to 7:00 a.m.) when aircraft departure noise is perceived as more intrusive over noise-sensitive areas. This would allow these aircraft to take advantage of a relatively undeveloped corridor located southeast of the airport.

- CONCLUSION

Based on the relatively short runway lengths and dominant wind condition at Georgetown Municipal Airport, aircraft in excess of 12,500 pounds (or those whose operating limitations require additional runway length) should continue to use Runway 18-36. Smaller aircraft such as single-engine and some twin-engine piston-powered aircraft could be encouraged to use Runway 11 during nighttime hours when traffic and wind conditions permit, including during periods of calm wind. This will allow these aircraft to take advantage of the relatively undeveloped corridor southeast of the airport during departure. The effectiveness of this preferential runway use program for Runway 11 should be considered for additional evaluation.

**Departure Turns**

A common noise abatement technique is to route departing aircraft over noise-compatible areas immediately after takeoff. In order to be fully effective, the compatible corridor must be relatively wide and closely aligned with the runway so that turns over the area are practical.

- EVALUATION

Due to the abundance of residential and other noise-sensitive land uses located north, west, and south of the airport, only one viable noise-compatible corridor exists for aircraft departing Georgetown Municipal Airport. This noise-compatible corridor is located off the extended centerline of Runway 11, as discussed as part of the informal preferential runway use program. This corridor is, however, only available to smaller aircraft weighing less than 12,500 pounds. Once aircraft departing Runway 11 have reached a safe altitude (usually 500 feet Above Ground Line [AGL]), they could turn north or south to follow the Interstate 35 corridor. Aircraft should follow this corridor until reaching a point beyond concentrations of noise-sensitive development before turning on-course. The prescribed departure turns for aircraft departing Runway 11 are depicted on **Exhibit 5B.**

Larger piston and turbine-powered aircraft do not have noise-compatible corridors available to them for departures on Runway 18-36. This is due to the existence of noise-sensitive land uses both north and south of the airport.

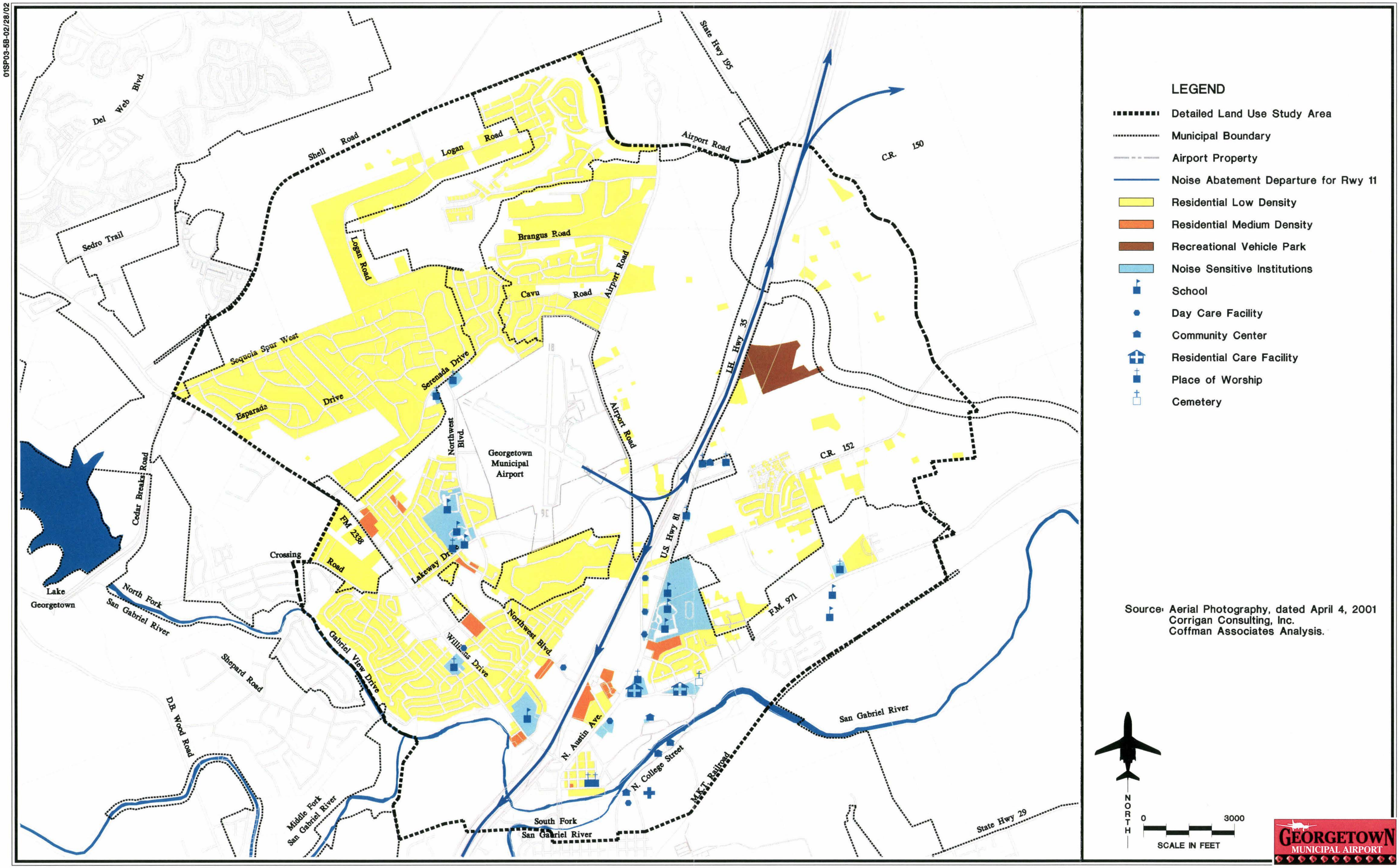



Exhibit 5B
NOISE ABATEMENT DEPARTURE TURN
RUNWAY 11

- CONCLUSION

The only existing noise-compatible corridor available at Georgetown Municipal Airport is located southeast of the airport, off the departure end of Runway 11. Aircraft with northern, southern, or western destinations could be encouraged to turn after departure to follow the Interstate 35 corridor in order to avoid overflights of noise-sensitive areas. Once aircraft have passed areas of noise-sensitive development, they could proceed on-course. The effects of the use of this corridor, in conjunction with departure turns along Interstate 35, will be analyzed in a later section.

### Visual And Offset Instrument Approaches

Approaches involving turns relatively close to the airport can sometimes be defined over noise-compatible corridors. These can be defined as either visual flight rule (VFR) approaches or non-precision instrument flight rule (IFR) approaches. A stabilized, straight-in final approach of at least one mile should be provided. If large aircraft are involved, a longer straight-in final approach of two to three miles is needed. In some instances, to be effective for noise abatement, an offset or "side-step" approach must be used by the loudest aircraft, primarily business jets, using the airport.

- EVALUATION

At Georgetown Municipal Airport, instrument approaches to the airport lack any viable noise-compatible corridors. Even with the advent of advanced navigational technology, the relative closeness of incompatible land uses to the airport prevents the avoidance of these areas when using an instrument approach.

Visual approaches offer a greater degree of flexibility regarding their final approach courses. Since these approaches follow a "see and avoid" methodology, pilots can visually avoid noise-sensitive areas. This allows for approaches that can be designed to avoid certain areas using visual ground references.

**Exhibit 5C** depicts several potential approaches to the airport as a means to minimize overflight of noise-sensitive areas. Aircraft approaching under VFR, for landing on Runway 18 from the north, would follow the Interstate 35 corridor and enter a right downwind leg for landing. Approaches from the south would follow the Interstate 35 corridor and join the left crosswind portion of the traffic pattern. Aircraft would then follow the standard traffic pattern for landing on Runway 18.

Aircraft approaching for landing on Runway 36 from the north would follow Interstate 35 to the intersection of State Highway 195. From here, the aircraft would enter a left base leg for landing. From the south, aircraft would follow the Interstate 35 corridor until reaching a position just beyond the intersection with Williams Drive, followed by a straight-in final approach. Approaches from the east and west, and approaches to Runway 11-29, would enter using a normal pattern.

Although it is unlikely that the noise benefits of these approach procedures will be reflected in an adjustment in the aircraft noise contours, it is likely that areas currently impacted north and south of the airport could realize fewer overflights.

- CONCLUSION

Due to the close proximity of noise-sensitive development both north and south of the primary runway at Georgetown Municipal Airport, adjusted or new instrument approach procedures would not provide noise reduction benefits. However, alterations to initial traffic pattern approaches on Runway 18-36 may offer area residents some relief from aircraft overflights. This alternative deserves further consideration and will be assessed in greater detail in a later section.

**Midfield Departures**

Midfield departures refer to aircraft beginning their engine spool-up and takeoff role from a point, usually a taxiway intersection (intersection takeoffs), near midfield. While these operations are usually undertaken to reduce taxi time, such operations can help centralize departure spool-up noise on the airfield.

Since aircraft are not departing from the runway end, the usable length of the runway is reduced. This can present great safety and operational concerns given parameters such as aircraft performance, weight, outside air temperature, and airport altitude. Midfield departures would pose a serious safety concern given the limited runway lengths available at Georgetown Municipal Airport.

An additional concern is that by beginning the takeoff roll at a position farther down the runway, the aircraft will not have gained as much altitude prior to leaving the airport. This may increase the level of aircraft noise realized by residents living off the departure end of the runway.

- EVALUATION

At Georgetown Municipal Airport, given the relatively short runway lengths, midfield departures would inhibit nearly all aircraft to safely depart the airport. These operations are further amplified by the warm and humid weather experienced in the region from late spring to early fall. In addition, residents located off the departure end of the airport would likely be impacted by greater levels of aircraft noise since aircraft would not have sufficient distance in which to gain altitude prior to leaving the airfield.

- CONCLUSION

While midfield takeoffs work well at some airports, factors such as shorter runways and seasonal climate conditions present serious safety implications for their use at Georgetown Municipal Airport. In addition, given that such procedures would likely increase noise impacts, their use at Georgetown Municipal Airport is not advised and will not be given additional consideration.

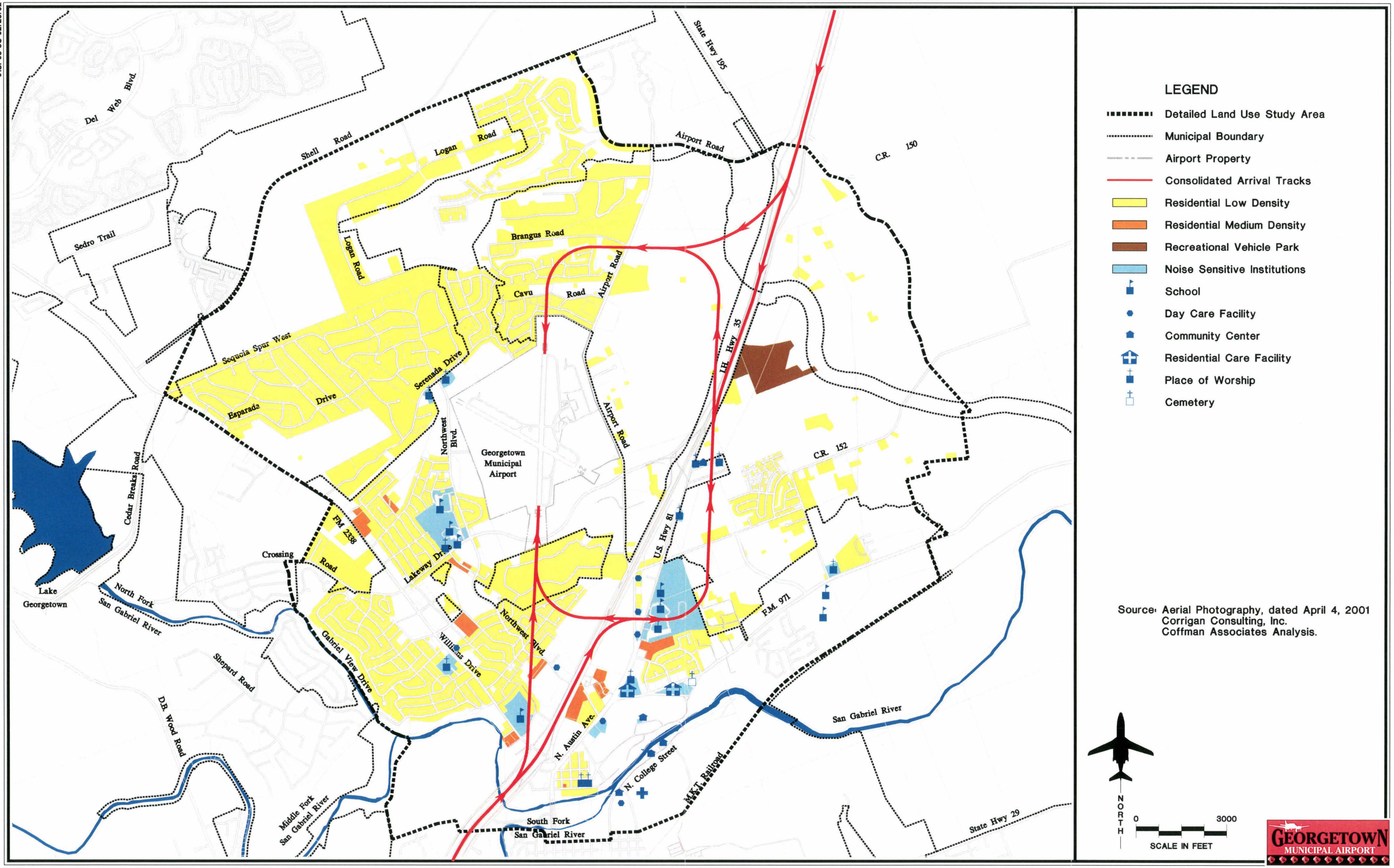



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Exhibit 5C
VISUAL ARRIVAL TRACKS

## FACILITIES DEVELOPMENT

In some cases, airport facilities can be developed to reduce airport noise in noise-sensitive areas. For example, runways can be built or lengthened to shift aircraft noise to compatible areas. Runway thresholds can be displaced or relocated to shift noise, and barriers can be built to shield noise-sensitive areas from aircraft noise on the ground at the airport.

### Runway Extensions And New Runways

New runways aligned with compatible land development or runway extensions shifting aircraft operations further away from residential areas are a proven means of noise abatement. New runways are most effective where there are large compatible areas near an airport, and existing runways are aligned with residential areas.

- EVALUATION

Again, at Georgetown Municipal Airport, the airport is surrounded by noise-sensitive development on three sides. This makes the prospect of constructing a new runway for noise abatement unlikely since this would simply shift noise from one noise-sensitive area to another. Given the surrounding noise-sensitive development, runway alignments are not feasible nor would they offer greater noise abatement benefits.

Runway extensions are usually beneficial where there is substantial residential development very close to one end of a runway and not the other. This is the case with Runway 11-29 that is relatively free from close-in development southeast of the airport; however; close-in noise-sensitive development exists off the northwest end of the runway. Therefore, lengthening Runway 11 would likely create additional impacts for these residents.

In 1991, Runway 18-36 was lengthened to the south by 900 feet for a total of 5,000 feet. As a precursor to this project, the Georgetown City Council enacted a limitation on the primary runway (18-36) that it not exceed 5,000 feet in length, restricting the airport to its current runway configuration. This action would prevent additional runway lengthening, including Runway 11-29.

- CONCLUSION

Given the existence of noise-sensitive development on three sides of the airport, new runway alignments would not be a viable noise abatement alternative since they would shift noise from one noise-sensitive area to another. As a means to maintain its role as a general aviation airport, the primary runway (18-36) was lengthened to 5,000 feet in 1991. Due to Georgetown City Council action, the airport is limited to a primary runway of this length. Therefore, no additional runway lengthening can be undertaken. In addition, lengthening Runway 11-29 would likely create additional noise impacts for residents northwest of the airport. These options, therefore, do not merit further consideration.

### Displaced And Relocated Thresholds

A displaced threshold involves the shifting of the touchdown zone for landings further down the runway. A relocated threshold involves shifting both the touchdown point and the takeoff initiation point. (In other words, the original runway end is completely relocated.) These techniques can promote noise abatement by effectively increasing the altitude of aircraft at any given point beneath the approach. The amount of noise reduction depends on the increased altitude which, in turn, depends on the length of the displacement. Another potential noise abatement benefit of runway displacement may be the increased distance between the aircraft and noise-sensitive uses adjacent to the runway, from the point at which reverse thrust is applied after touchdown.

The determination of the amount of threshold displacement must consider the runway length required for landing in addition to the amount of noise reduction provided by the displacement. A considerable displacement is needed to produce a significant reduction in noise. (For example, if a runway threshold is displaced 1,000 feet, the altitude of an aircraft along the approach path would increase by only 50 feet.)

Unlike threshold displacement, threshold relocation increases noise off the runway end opposite the relocation because of the shift in the point of the takeoff. Aircraft would be at lower altitudes at any given downrange location after takeoff than they would be without the relocation.

- EVALUATION

Displacing or relocating runway thresholds at Georgetown Municipal Airport would significantly reduce useful runway lengths. This would decrease safety margins for landing and departing aircraft given the airport's relatively short runway lengths. In addition, threshold relocation and displacement would do little for noise abatement.

- CONCLUSION

The significant aircraft operational safety issues generated by reducing the useful runway length at Georgetown Municipal Airport cannot warrant threshold adjustments. In addition, threshold displacement and relocation generally offer only small noise reduction benefits. Any reductions in arrival noise caused by threshold relocations would be offset by increases in departure noise off the opposite runway end. Threshold displacements would provide little, if any, benefit at Georgetown Municipal Airport. Additionally, any measure that would reduce runway lengths would reduce safety margins of aircraft currently operating at Georgetown Municipal Airport. Threshold adjustment will not receive additional consideration for analysis at Georgetown.

## Acoustical Barriers

Acoustical barriers such as noise walls or berms are intended to shield areas from the noise of aircraft powering up for takeoff and rolling down the runway. It is also possible to use the orientation of buildings on the airport to provide a noise barrier to protect nearby residential areas from noise. Noise walls act best over relatively short distances, and their benefits are greatly affected by surface topography and wind conditions. The effectiveness of a barrier is directly related to the distance of the noise source from the receiver and the distance of each from the barrier itself, as well as the angle between the ends of the berm and the receiver.

While noise walls and berms can attenuate noise, they sometimes are criticized by airport neighbors because they obstruct views. Another common complaint is that airport noise can become more alarming, particularly noise from unusual events, because people are unable to see the cause of the noise.

- EVALUATION

At Georgetown Municipal Airport, noise walls or berms could, in theory, provide noise attenuation benefits to the individuals residing near the departure end of Runway 18, on the north side of the airport. Such a structure would attenuate noise from aircraft pre-flight run-ups, thrust reverser noise from landing aircraft, and engine spool-up noise from aircraft departing to the south on Runway 18. However, the noise wall would have to be continuous without any gaps to be effective and would measure approximately 4,000 feet in length. In addition, approximately 14 homes would have to be purchased in order to keep the wall away from the Runway Safety Area (RSA) and from being an obstruction. Removal of this row of 14 homes would disrupt the cohesiveness of the neighborhood as well as potentially exposing the homes across the street to new noise. Such a barrier would also not be an effective method of attenuating noise once the aircraft is airborne.

- CONCLUSION

The construction of a noise wall or berm would likely attenuate ground noise impacts experienced by areas located adjacent to the northern portion of the airport. The benefits of using a noise wall, berm, or buildings for noise attenuation should receive additional consideration.

## Run-up Enclosures

An engine run-up enclosure is a special kind of noise barrier which can be appropriate at airports with aircraft engine maintenance operations. Engine run-ups are a necessary part of aircraft service and maintenance. They are necessary to diagnose problems and test the effectiveness of maintenance work. Run-up enclosures are designed so that aircraft can taxi or be towed into them. The structures are designed to absorb and deflect the noise from the run-up, thus reducing noise levels off the airport.

Run-up noise can be especially disturbing because it is so unpredictable. While the noise from takeoffs and landings is relatively brief and has a particular pattern to which a person can adjust, the noise from a run-up is completely unpredictable. The duration of the run-up can vary from 30 seconds up to 30 minutes, and the listener has no way of knowing how long any given run-up will be. If the run-up is at or near full power, the noise level can be extremely high.

- EVALUATION

There are several operators performing aircraft maintenance run-up operations at Georgetown Municipal Airport. These operations almost exclusively involve propeller-driven aircraft, lasting up to 30 minutes, four to six times per week. Depending on wind conditions (aircraft run-up operations are performed with aircraft facing the wind), maintenance run-ups are performed at two locations on the airfield. The first and primary location is on the connector taxiway, joining Taxiway C with Runway 18-36, on the southern portion of the airfield. Approximately 80 percent of aircraft maintenance run-up operations are performed at this location. All remaining run-ups are conducted on Taxiway B, adjacent to the windsock and segmented circle. Although these are located at the greatest distance from surrounding noise-sensitive land uses, such activities tend to be one of the primary causes of disturbance for individuals residing near the airport.

The airport was in the process of acquiring a run-up enclosure previously used at the now closed Austin Mueller Airport. Unfortunately, this structure is no longer available and is being used for storage on the former airport.

- CONCLUSION

The relatively close proximity of noise-sensitive land uses to the airport and the duration of maintenance run-up operations warrants consideration for a permanent run-up enclosure. The potential use of a run-up enclosure will be assessed in greater detail in a later section.

## AIRCRAFT OPERATIONAL PROCEDURES

Aircraft operational procedures which may reduce noise impacts include:

- Reduced thrust takeoffs.
- Thrust cutbacks after takeoff.
- Maximum climb departures.
- Minimum approach altitudes.
- Use of minimum flaps during approaches.
- Steeper approach angles.
- Limitations on use of reverse thrust during landings.
- Midfield departures.

### Reduced Thrust Takeoffs

A reduced thrust takeoff for jet aircraft involves takeoff with less than full thrust. A reduced power setting is used throughout both takeoff roll and climb. Use of the procedure depends on aircraft weight, weather and wind conditions, pavement conditions, and runway length. Since these conditions vary considerably, it is not possible to mandate safely the use of reduced thrust departures.

- EVALUATION

Business jet aircraft operating at Georgetown Municipal Airport must use standard departure thrust due to the relatively short runway lengths. Efforts to encourage the use of reduced thrust takeoffs would greatly reduce safety margins and are unlikely to be implemented by pilots and aircraft operators.

- CONCLUSION

The limited runway length at Georgetown Municipal Airport would greatly limit the ability of aircraft to operate within strict safety margins. Therefore, due to obvious safety implications, reduced thrust takeoffs should not be encouraged at Georgetown Municipal Airport.

**Thrust Cutbacks For Jets**

As a service to the general aviation industry, the National Business Aircraft Association (NBAA) prepared noise abatement takeoff and arrival procedures for business jets. Since that time, this program has virtually become an industry standard for operators of business jet aircraft. There are two types of departure procedures: the standard procedure and the close-in procedure. They are illustrated in **Exhibit 5D**.

The NBAA standard departure procedure calls for a thrust cutback at 1,000 AGL and a 1,000 feet per minute climb to 3,000 feet altitude during acceleration and flap retraction. The close-in procedure is similar except that it specifies a thrust cutback at 500 feet AGL. While both procedures are effective in reducing noise, the locations of the reduction vary with each. The standard procedure results in higher altitudes and lower noise levels over down-range locations, while the close-in procedure results in lower noise near the airport. Many aircraft manufacturers have developed their own thrust cutback procedures. Neither NBAA procedure is intended to supplant a procedure recommended by the manufacturer and published in the aircraft operating manual.

- EVALUATION

While some airports have defined special thrust cutback departure procedures, this is frowned upon by the aviation industry. Aircraft operators fear the consequences of a proliferation of airport-specific procedures. As the number of procedures increases, it would become more and more difficult for pilots to become proficient at all of them and still maintain comfortable safety margins. It would be similar to asking motorists to comply with a different set of braking and acceleration procedures at every intersection in the city. In any case, safety requires that the use of thrust cutbacks in any given situation must be left to the discretion of the pilot based on weather and the operational characteristics of the aircraft.

- CONCLUSION

Standard thrust cutback departure procedures are already used by many business jet operators. Efforts to mandate the use of these procedures, however, are not advised. As a critical flight operation, the use of thrust cutbacks in any given situation should be left to the discretion of the pilot to avoid eroding safety margins. The airport can, however, recommend that pilots use noise abatement departure techniques, such as those devised by NBAA or the aircraft manufacturer, whenever possible.

**Maximum Climb Departures**

Maximum climb departures can help reduce noise exposure over populated areas some distance from an airport. The procedure requires the use of maximum thrust with no cutback on departure. Consequently, the potential noise reductions in the outlying areas are at the expense of significant noise increases closer to the airport.

- EVALUATION

Given that large areas of noise-sensitive development are located close to the airport, the use of maximum climb departures would only serve to increase noise levels near the airport. In addition, many aircraft are likely already utilizing high thrust settings on departure in order to operate from Georgetown Municipal Airport's short runways. Fortunately, as aircraft engine technology advances, aircraft are able to climb faster, more quietly, and more efficiently.

- CONCLUSION

The use of more modern engine technology has enhanced aircraft performance and allowed aircraft to gain altitude more effectively. Currently, it is likely that nearly all turbojet aircraft operating at Georgetown Municipal Airport utilize some type of noise abatement departure procedure. Instituting maximum climb procedures may reduce noise for residents at some distance from the airport while significantly increasing noise levels for residents located near the airport. In addition, the noise benefit gained by needed additional altitude would be offset by the additional thrust needed to maintain the higher rate of climb. Therefore, the use of maximum climb procedures for noise abatement will not be addressed further.

**Minimum Approach Altitudes**

A minimum approach altitude procedure would entail an air traffic control requirement that all positively controlled aircraft approaches be conducted at a specified minimum altitude until the aircraft must begin its descent to land. This would affect only aircraft quite some distance from the

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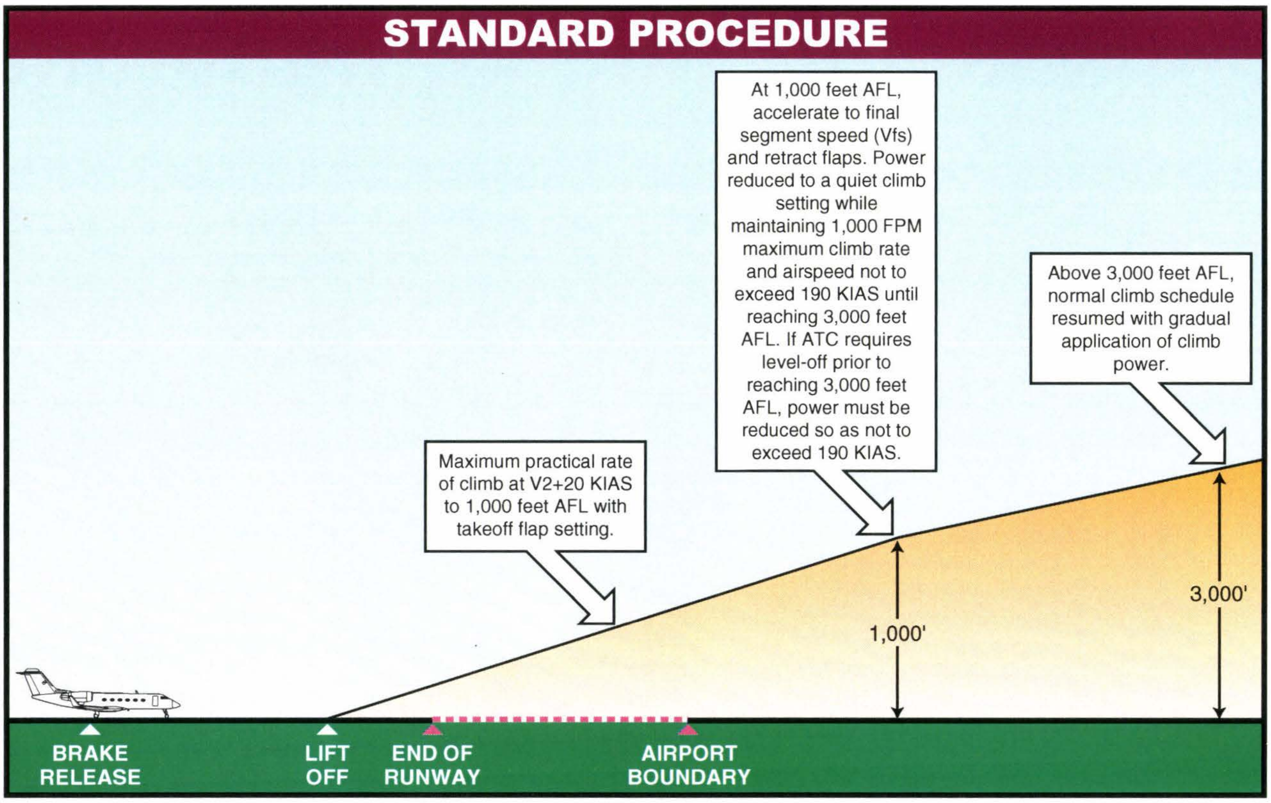


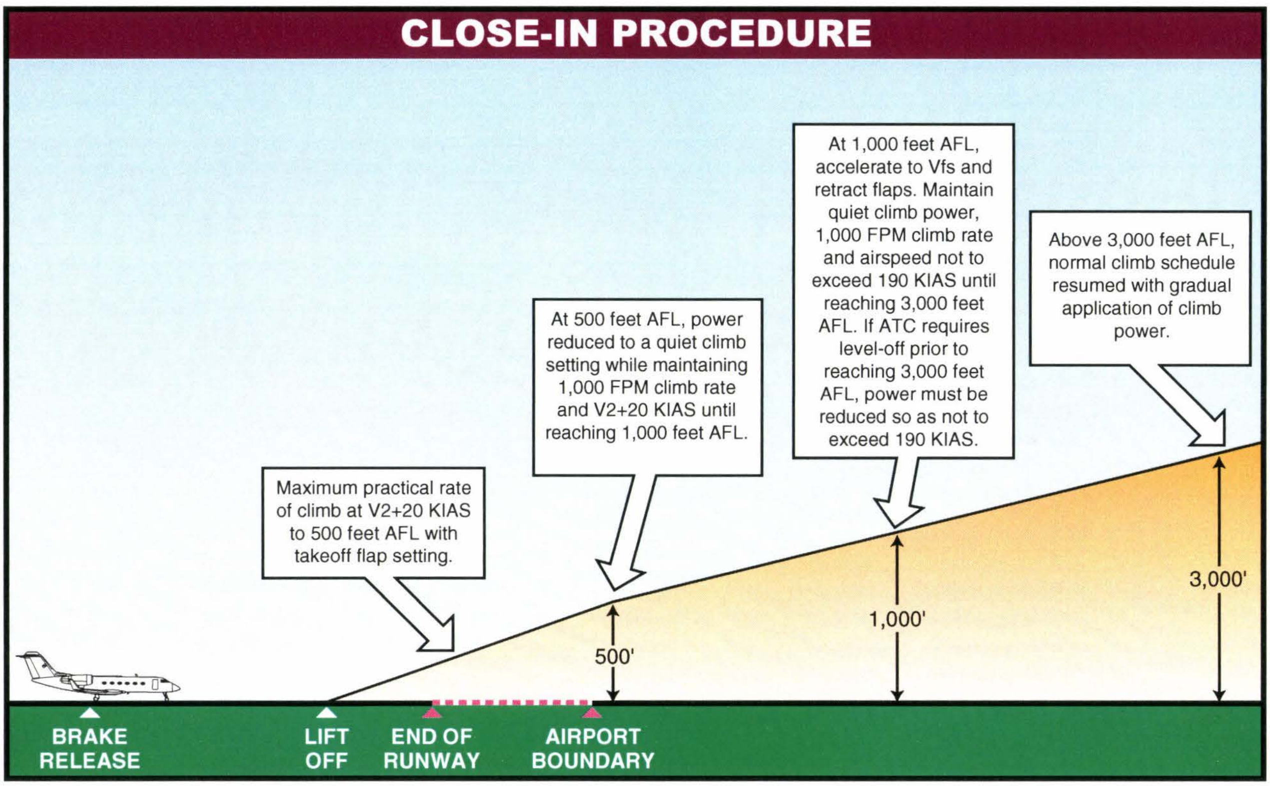


**KEY**

AFL - Above field elevation
ATC - Air traffic control
FPM - Feet per minute
KIAS - Knots, indicated airspeed

Note: It is recognized that aircraft performance will differ with aircraft type and takeoff conditions; therefore, the business aircraft operator must have the latitude to determine whether takeoff thrust should be reduced prior to, during, or after flap retraction.

Source: National Business Aircraft Association (NBAA), "NBAA Noise Abatement Program," January 1, 1993.

GEORGETOWN MUNICIPAL AIRPORT

Exhibit 5D
NBAA NOISE ABATEMENT DEPARTURE PROCEDURES

airport as well as outside the noise exposure contours. Since aircraft on approach are using little power, they tend to be relatively quiet. Accordingly, increases in approach altitudes result in only very small reductions in single event noise.

- EVALUATION

Currently, the pattern altitude at Georgetown Municipal Airport is 1,790 feet mean sea level (MSL), about 1,000 feet AGL. Minimum altitudes would apply to aircraft some distance from the airport, well outside the noise exposure contour area. Increases in approach altitude can yield only small reductions in noise. Even doubling of the altitude of aircraft within the traffic pattern or circling approach would achieve only a noise reduction of four to six decibels. Additionally, raising the pattern altitude would enlarge the pattern as aircraft would have to extend each leg of the traffic pattern to climb to, or descend from, the increased altitude.

- CONCLUSION

Raising approach altitudes into Georgetown Municipal Airport would produce only very small noise reductions well outside the 65 DNL noise contour. In addition, raising the traffic pattern altitude would potentially expose additional individuals to overflight noise due to an elongated traffic pattern. Therefore, these measures do not merit further consideration.

**Noise Abatement Approach Procedures**

Approach procedures to reduce noise impacts were attempted in the early days of noise abatement, but are no longer favorably received. The procedures include the minimal use of flaps in order to reduce power settings and airframe noise, the use of increased approach angles, and two-stage descent profiles.

- EVALUATION

All these techniques raise safety concerns because they are non-standard and require an aircraft to be operated outside its optimal safe operating configuration. Increased approach slope angles require aircraft to be landed at more than optimal approach speeds. The higher sink rates and faster speeds reduce pilot reaction time and erode safety margins. They also increase stopping distances on the runway and are especially inadvisable on relatively short runways, such as those at Georgetown Municipal Airport. Some of these procedures have actually been found to increase noise because of power applications needed to arrest high sink rates.

- CONCLUSION

Because these procedures erode safety margins and are of little practical noise abatement benefit, they do not deserve further consideration at Georgetown Municipal Airport.

### Reverse Thrust Restrictions

Thrust reversal is routinely used to slow jet aircraft immediately after touchdown. This is an important safety procedure which has the added benefit of reducing brake wear. Limits on the use of thrust reversal can reduce noise impacts off the sides of the runways, although they would not significantly reduce the size of the noise contours. Enforced restrictions on the use of reverse thrust, however, are not considered fully safe.

- EVALUATION

Given the location of noise-sensitive uses in the Georgetown Municipal Airport vicinity, a restriction on thrust reversal may produce some benefits. However, reverse thrust restrictions would significantly reduce landing safety margins on Georgetown's short runways, increase runway occupancy time, and increase brake wear on aircraft.

- CONCLUSION

Mandated limitations on the use of reverse thrust are inadvisable at Georgetown Municipal Airport because of reduced safety margins. As an operational flight procedure with a direct effect on safety, decisions about whether to use reverse thrust should be left to the discretion of pilots.

## AIRPORT REGULATIONS

F.A.R. Part 150 requires that, in developing Noise Compatibility Programs, airports study the possible implementation of airport use restrictions to abate aircraft noise. (See F.A.R. Part 150, B150.7[b][5].) The courts have recognized the rights of airport proprietors to reduce their liability for aircraft noise by imposing restrictions which are reasonable and do not violate contractual agreements with the FAA conditioning the receipt of federal aid. (These are known as "grant assurances.") In addition, constitutional prohibitions on unjust discrimination and the imposition of undue burdens on interstate commerce must be respected. The restrictions must also be crafted to avoid infringing on regulatory areas preempted by the federal government. Finally, the regulations must be evaluated under the requirements of F.A.R. Part 161.

Airport noise and access restrictions may be proposed by an airport operator in its F.A.R. Part 150 Noise Compatibility Program. The FAA has made it clear that the approval of a restriction in an F.A.R. Part 150 document would depend on the noise abatement benefit of the restriction at noise levels of 65 DNL or higher. Even if the FAA should accept a noise restriction as part of an F.A.R. Part 150 Noise Compatibility Program, the requirements of F.A.R. Part 161 would still need to be met before the measure could be implemented.

**F.A.R. Part 161**

In the *Airport Noise and Capacity Act* (ANCA) of 1990, Congress not only established a national phase-out policy for Stage 2 aircraft above 75,000 pounds, but it also established analytical and procedural requirements for airports desiring to establish noise or access restrictions on Stage 2 or Stage 3 aircraft. Regulations implementing these requirements are published in F.A.R. Part 161.

F.A.R. Part 161 requires the following actions to establish a local restriction on Stage 2 aircraft:

- An analysis of the costs and benefits of the proposed restriction and alternative measures.
- Publication of a notice of the proposed restriction in the Federal Register and an opportunity for comment on the analysis.

While implementation of a Stage 2 aircraft operating restriction does not require FAA approval, the FAA does determine whether adequate analysis has been done and all notification procedures have been followed.

For restrictions on Stage 3 aircraft, F.A.R. Part 161 requires a much more rigorous analysis as well as final FAA approval of the restriction. Before approving a local Stage 3 noise or access restriction, the FAA must make the following findings:

- The restriction is reasonable, non-arbitrary, and non-discriminatory.
- The restriction does not create an undue burden on interstate or foreign commerce.
- The restriction maintains safe and efficient use of navigable airspace.
- The restriction does not conflict with any existing federal statute or regulation.
- The applicant has provided adequate opportunity for public comment on the proposed restriction.
- The restriction does not create an undue burden on the national aviation system.

Based on FAA's interpretations of F.A.R. Part 161, the regulations do not apply to restrictions proposed only for aircraft under 12,500 pounds. Because these light aircraft, which include small, single-engine aircraft, are not classified under F.A.R. Part 36 as Stage 2 or 3, the FAA has concluded that the 1990 *Airport Noise and Capacity Act* was not intended to apply to them. (See *Airport Noise Report*, Vol. 6, No. 18, September 26, 1994, p. 142.)

Very few F.A.R. Part 161 studies have been undertaken since the enactment of ANCA. **Table 5B** summarizes the studies that have been done to date.

**Regulatory Options**

Regulatory options discussed in this section include the following:

- Nighttime curfews and operating restrictions.

**TABLE 5B**
**Summary of F.A.R. Part 161 Studies**

| Airport | Year Started | Year Ended | Cost | Proposal, Status |
|---|---|---|---|---|
| Aspen-Pitkin County Airport, Aspen, Colorado | N.A. | N.A. | N.A. | The study has not yet been submitted to FAA. |
| Kahului Airport, Kahului, Maui, Hawaii | 1991 | 1994 | $50,000 (est.) | Proposed nighttime prohibition of Stage 2 aircraft pursuant to court stipulation. Cost-benefit and statewide impact analysis found to be deficient by FAA. Airport never submitted a complete Part 161 Study. Suspended consideration of restriction. |
| Minneapolis-St. Paul International Airport, Minneapolis, Minnesota | 1992 | 1992 | N.A. | Proposed nighttime prohibition of Stage 2 aircraft. Cost-benefit analysis was deficient. Never submitted complete Part 161 study. Suspended consideration of restriction and entered into negotiations with carriers for voluntary cooperation. |
| Pease International Tradeport, Portsmouth, New Hampshire | 1995 | N.A. | N.A. | Have not yet submitted Part 161 study for FAA review. |
| San Francisco International Airport, San Francisco, California | 1998 | 1999 | $200,000 | Proposing extension of nighttime curfew on Stage 2 aircraft over 75,000 pounds. Started study in May 1998. Submitted to FAA in early 1999 and subsequently withdrawn. |
| San Jose International Airport, San Jose, California | 1994 | 1997 | Phase 1 - $400,000 Phase 2 - $5 to $10 million (est.) | Study undertaken as part of a legal settlement agreement. Studied a Stage 2 restriction. Suspended study after Phase 1 report showed costs to airlines at San Jose greater than benefits in San Jose. Never undertook Phase 2, systemwide analysis. Never submitted study for FAA review. |
| Burbank-Glendale-Pasadena Airport | 2000 | Ongoing | Phase 1 - $1 million (est.) | Proposed curfew restricting all aircraft operations from 10:00 p.m. to 7 a.m. |
| Naples Municipal Airport Naples, Florida | 2000 | 2000 | Currently $730,000<br><br>Expect an additional cost of $1.5 to $3.0 million in legal fees due to litigation. | Enactment of a total ban on Stage 2 general aviation jet aircraft under 75,000 pounds (the airport is currently restricted to aircraft under 75,000 pounds). Airport began enforcing the restriction on March 1, 2002. FAA has deemed the Part 161 Study complete; however, FAA has ruled that the restriction violated federal grant assurances. |

N.A. - Not available.

Sources: Telephone interviews with Federal Aviation Administration officials and staffs of various airports.

- Landing fees based on noise or time of arrival.
- Airport capacity limitations based on relative noisiness.
- Noise budgets.
- Restrictions based on aircraft noise levels.
- Restrictions on touch-and-go's or multiple approaches.
- Restrictions on engine maintenance run-ups.

## Nighttime Curfews And Operating Restrictions

Nighttime curfews and operating restrictions can often be effective methods for reducing aircraft noise exposure around an airport. Since noise is commonly assumed to be most annoying in the late evening and early morning hours, curfews are usually aimed at restricting nighttime operations. However, curfews have economic impacts on airport users, on those providing airport-related services, and on the community as a whole. Other communities also may be impacted through curtailment of service.

There are essentially three types of curfews or nighttime operating restrictions: (1) closure of the airport to all arrivals and departures (a full curfew); (2) closure to departures only; and (3) closure to arrivals and departures by aircraft exceeding specified noise levels.

- EVALUATION

The time during which nighttime restrictions could be applied varies. The DNL metric applies a 10-decibel penalty to noise occurring between 10:00 p.m. and 7:00 a.m. That period could be defined as a curfew period. A shorter period, corresponding to the very late night hours (midnight to 6:00 a.m.) could also be specified.

*Full Curfews*: While full curfews can totally resolve concerns about nighttime aircraft noise, they can be indiscriminately harsh. Not only would the loudest operations be prohibited, but quiet operations by light aircraft would also be banned by a full curfew. Full curfews also deprive the community of the services of some potentially important nighttime airport users.

Important economic reasons drive nighttime airport activity. Early morning departures are often attractive for business travelers who wish to reach their destinations with a large part of the workday ahead of them. Not only is this a personal convenience, but it can result in a significant savings in the cost of travel by reducing the need for overnight stays. Accordingly, early morning departures are often very popular. Similarly, late night arrivals are important in allowing travelers to return home without incurring the costs of another night away.

Different, but equally compelling, reasons encourage cargo carriers and courier companies to operate in the evening and at night. Cargo is collected during the business day. It is shipped to a hub facility in the evening or at night where it is sorted and, in the case of package express service, delivered to its destination the next business day. Bulk cargo companies work essentially the same way, although, where speed is not of paramount importance, the collection and delivery functions may involve more use of surface transportation. Modern air cargo service cannot operate without nighttime access to airports.

*Prohibition of Nighttime Departures:* The prohibition of nighttime departures would allow aircraft to return home but would prohibit departures, which are generally louder than arrivals. Although somewhat less restrictive, this would have similar impacts at Georgetown Municipal Airport as a full curfew. It would interfere with corporations in their attempts to schedule early morning departures for the business travel market.

As with a full curfew, a nighttime prohibition on departures would restrict access to the airport by Stage 3 aircraft. This would require a full F.A.R. Part 161 analysis and FAA approval of the restriction before it could be implemented.

*Nighttime Restrictions Based on Aircraft Noise Levels:* Nighttime operating restrictions can be designed to apply to only those aircraft which exceed specified noise levels. If it is to be effective in reducing the size of the DNL noise contours, the restricted noise level would have to be set to restrict the loudest, most commonly used aircraft at the airport. These restrictions would be subject to the special analysis procedures of F.A.R. Part 161. Any restrictions affecting Stage 3 aircraft would have to receive FAA approval.

- CONCLUSION

Curfews and nighttime operating restrictions can be an effective way to reduce the size of DNL noise contours around an airport. Because of the extra 10-decibel weight assigned to nighttime noise, removing a single nighttime operation is equivalent to eliminating 10 daytime operations. The effect on the noise contours can be significant.

A particularly troubling aspect of curfews and nighttime operating restrictions is their potential adverse effects on local air service and the region's economy. Additionally, implementation of nighttime restrictions can be costly, problematic, and require the completion and subsequent FAA approval of a F.A.R. Part 161 Study. Given the likelihood of FAA disapproval due to the limited impacts within the 65 DNL contour, curfews need not be considered further.

### Noise-Based Landing Fees

Differential landing fees based on either the noise level or the time of arrival have been used at some airports as incentives to use quieter aircraft or to operate at less sensitive times. A variable schedule of landing fees would be established based on the relative loudness of the aircraft, with arrivals by loud aircraft at night being charged the most and arrivals by quiet aircraft during the day being charged the least. To avoid being discriminatory, the fee must relate to both the time of day and certificated approach noise levels. Fees from such a program can finance noise abatement activities. This restriction does not provide a noise abatement benefit unless the fees are high enough to actually discourage use of the airport by the loudest aircraft.

- EVALUATION

Noise-based landing fees are considered airport noise restrictions under F.A.R. Part 161. A F.A.R. Part 161 analysis would be required before such a fee system could be implemented. Any fee structure that would place a noise surcharge on Stage 3 aircraft would require FAA approval prior to implementation.

- CONCLUSION

Georgetown Municipal Airport, like most general aviation airports, does not have landing fees. Such a program would be difficult to implement and would require subsequent FAA approval of a F.A.R. Part 161 Study. Given the likelihood of FAA disapproval of the F.A.R. Part 161 Study due to limited impacts within the 65 DNL contour, the development of a differential landing fee schedule does not warrant further consideration.

**Capacity Limitations**

Capacity limitations have been used by some severely impacted airports to control cumulative noise exposure. This kind of restriction is used to impose a cap on the number of scheduled operations. Unscheduled operations are very difficult to track and, therefore, a capacity limitation would be difficult to impose.

- EVALUATION

Due to the lack of scheduled air service at Georgetown Municipal Airport, a cap on operations could not be implemented. This type of restriction is only feasible at airports receiving scheduled aircraft operations.

- CONCLUSION

Airport capacity limitations are intended to control noise related to scheduled aircraft activity. Since all operations at Georgetown Municipal Airport are unscheduled, the airport could not enforce a capacity limit to control noise. For this reason, operational capacity limitations will not be discussed further.

**Noise Budgets**

In the late 1980s, noise budgets gained attention as a potential noise abatement tool. After enactment of ANCA and mandating the retirement of Stage 2 aircraft over 75,000 pounds, interest in noise budgets waned. Noise budgets are designed to limit airport noise and allocate noise among airport users. The intent is to encourage aircraft operators to convert to quieter aircraft or to shift operations to less noise-sensitive hours. Before ANCA, the intent was to encourage conversion to Stage 3 aircraft and to discourage the use of Stage 2 aircraft.

While noise budgets can be designed in many different ways, six basic steps are involved. First, the airport must set a target level of cumulative noise exposure, usually expressed in DNL, which it intends to achieve by a certain date. Second, it must determine how to express that overall noise level in a way that would permit allocation among airport users. Third, it must design the allocation system. Fourth is the design of a monitoring system to ensure that airport users are complying with the allocations. Fifth is the establishment of sanctions for aircraft operators that fail to operate within their allocations. Sixth, the system should be fine-tuned based on actual experience. The only simple step in this process is the first, setting a goal. From that point, it becomes increasingly complex.

- EVALUATION

Different approaches can be used to define noise in a way which permits allocation. It is possible to use the DNL metric, or a variant, for this purpose. This has some advantages in that the FAA's Integrated Noise Model (INM) can be easily used to derive DNL levels attributable to the average daily operations of the various airport operators. The INM database can be used to establish a basis for noise allocations based on aircraft type. An alternative is to use the effective perceived noise level (EPNL) metric. This is the metric used to certify aircraft noise levels for compliance with F.A.R. Part 36. Noise levels of various aircraft expressed in EPNL are published in FAA *Advisory Circulars 36-1E* and *36-2C*. EPNL values for the aircraft used by each operator on an average day could be summed to define the total noise attributable to the operator.

Two potential methods for allocating operational privileges is through an auction or lottery. However, with the lack of scheduled service at Georgetown, there is no way to effectively allocate operational privileges to an aircraft operator. It is also important that any allocation system include provisions for the entry of new carriers in order to have any chance of being legally permissible.

Another aspect involves monitoring compliance with the noise allocations. Any monitoring system will require extensive bookkeeping. The simplest method would involve the monitoring of aircraft schedules. Total noise contribution by each operator would be summed for the reporting period based on activity during that period. Noise levels for each flight would be based on the certificated noise level, or the INM data base noise level, for each aircraft. While this system would require large amounts of staff time to administer, it would be relatively simple to computerize and would have the advantage of enabling operators to plan their activities with a clear understanding of the noise implications of their decisions.

A theoretically more precise method of compliance monitoring, but a more expensive and complex method, would be to monitor actual aircraft noise levels. Actual noise from each aircraft operation could be recorded for each operator. The advantage of this approach is that it would be based on actual experience. A significant disadvantage, however, is that many variables influence the noise occurring from any particular aircraft operation, including the weather, pilot technique, and air traffic control instructions. In addition, Georgetown Municipal Airport would have to make a significant investment to purchase a monitoring and flight tracking system.

The final step is to establish a system of fines or other sanctions to levy against aircraft operators who fail to operate within their assigned noise allocations. To be effective, the sanctions should be severe enough to provide a strong incentive to cooperate with the program.

- CONCLUSION

Noise budgets are complex methods for promoting airport noise reduction. They are particularly vulnerable to attack on grounds of discrimination and interference with interstate commerce. Noise budgets are extremely difficult to design in a way that will be seen as fair by all airport users and are likely to be quite expensive to develop. Negotiations on noise budget design and noise allocations are likely to be long and contentious and would require the assistance of noise consultants and attorneys. The costs of administering the system also would be substantial. The bookkeeping requirements are complex and additional administrative staff would definitely be required.

At Georgetown Municipal Airport, a noise budget does not appear to be a practical option. The process would be long, expensive, and contentious. Its potential for delivering real and substantial improvements in the local airport noise environment is questionable; therefore, this alternative will not be discussed further.

**Restrictions Based On Aircraft Noise Levels**

Outright restrictions on the use of aircraft exceeding certain noise levels can reduce cumulative noise exposure at an airport. Aircraft producing noise above certain thresholds, as defined in F.A.R. Part 36, could be prohibited from operating at the airport at all or at certain times of the day. A variation is to impose a non-addition rule, prohibiting the addition of new flights by aircraft exceeding the threshold level at all or at certain times of the day. These restrictions would be subject to the special analysis procedures of F.A.R. Part 161. Any restrictions affecting Stage 3 aircraft would have to receive FAA approval.

Noise limits based on F.A.R. Part 36 certification levels have the virtue of being fixed national standards which are understood by all in the industry. They are average values, however, and do not consider variations in noise levels based on different methods of operating the aircraft. As an alternative, restrictions could be based on measured noise levels at the airport. This has the advantage of focusing on noise produced in a given situation and, in theory, gives aircraft operators increased flexibility to comply with the restrictions by designing special approach and departure procedures to minimize noise. It has the disadvantage of requiring extra administrative effort to design testing