Introduction

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This Working Paper, Working Paper Four, presents the background information on potential noise abatement alternatives as well as an evaluation of several operational alternatives that may reduce the size of the noise contours. It is anticipated that the Committee will recommend additional alternatives to be evaluated. This working paper is the fourth in a series to be prepared for the General Mitchell International Airport FAR Part 150 Study. This Working Paper is intended for review and comment by the Committee, and should be considered a draft chapter of the final report.

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Introduction

The purpose of this Chapter is to:

- **Provide a foundation for understanding the roles and responsibilities of various parties in noise abatement and abatement planning.**
- **Identify the range of noise reduction/abatement measures that are either required to be considered in a Part 150 Study or are suggested by the Consultant or public for consideration during the study process.**
- **Provide an initial understanding of how each noise reduction measure might affect noise exposure conditions.**

The measures presented in this chapter are general in nature. This chapter provides a broad perspective of how each measure could address specific noise issues and identifies any known issues with implementation. It is expected that the Study Advisory Committee will assist the Airport and Consultants in identifying more specific noise abatement measures for consideration during this study.

This working paper identifies the following:

- Roles and responsibilities of the parties participating in the Part 150 Study;
- Measures available to the airport operator;
- Measures available to state and local agencies; and
- Measures dependent upon the federal government.

Roles and Responsibilities of the Parties

Before considering specific means of reducing aircraft noise and land use incompatibilities, the authority of various parties must be defined. The FAA's 1976 *Noise Abatement Policy* established the following policies regarding roles and responsibilities:

> "The **Federal Government** has the authority and responsibility to control aircraft noise by the regulation of source emissions, by flight operational procedures, and by management of the air traffic control system and navigable airspace in ways that minimize noise impact on residential areas, consistent with the highest standards of safety. The federal government also provides financial and technical assistance to airport proprietors for noise reduction planning and abatement activities and, working with the private sector, conducts continuing research into noise abatement technology."
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> "**Airport Proprietors** are primarily responsible for planning and implementing action designed to reduce the effect of noise on residents of the surrounding area. Such actions include optimal site location, improvements in airport design, noise abatement ground procedures, land acquisition, and 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, or unreasonably interfere with interstate or foreign commerce."
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> **State and Local Governments and Planning Agencies** are responsible for providing for land use planning and development, zoning, and housing regulation that will limit the uses of land near airports to purposes compatible with airport operations.
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> The **Air Carriers** are responsible for retirement, replacement, or retrofit of older jets that do not meet federal noise level standards, and for scheduling and flying airplanes in a way that minimizes the impact of noise on people.
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> **Residents and Prospective Residents** in areas surrounding airports should seek to understand the noise problem and what steps can be taken to minimize its effect on people. Individual and community responses to aircraft noise differ substantially and, for some individuals, a reduced level of noise may not eliminate the annoyance or irritation. Prospective residents of areas impacted by airport noise thus should be aware of the effect of noise on their quality of life and act accordingly.

As such, when considering various means of reducing aircraft noise exposure, these roles must be considered. In addition, a substantial history of airport noise reduction precedent has been set over the last few decades nationally and at General Mitchell International Airport (MKE) specifically. The following paragraphs briefly describe these activities and actions.

In the early 1980s, the FAA began issuing rules and regulations that control aircraft noise at the source, the aircraft engine. These aircraft noise standards, established by the federal government, must be met by the aircraft manufacturers through newly-designed engines and aircraft. The government established timetables in which the airlines must comply with noise standards, commonly known as Stage 1, Stage 2, Stage 3, and Stage 4. Full compliance with Stage 2 standards was established January 1, 1988 (FAR Part 36). Then Congress passed the Noise Act (The Airport Noise and Capacity Act of 1990 [ANCA], PL 101-508, 104 Stat. 1388), which established two broad directives for the FAA. The first directive established a method to review aircraft noise and airport use or access restrictions imposed by airport proprietors, and the second was to institute a program of phase-out of Stage 2 aircraft over 75,000 pounds by December 31, 1999. To implement ANCA, the FAA amended FAR Part 91 and issued a new FAR Part 161. Part 91 addresses the phase-out of large Stage 2 aircraft and the phase-in of Stage 3 aircraft. The airlines were responsible for meeting this deadline and they have all achieved full compliance.

After adoption of FAR Part 150, FAR Part 161 was implemented as a stringent review and approval process for initiating use or access restrictions by airport proprietors, such as curfews and caps on operations. This is in keeping with one of the major reasons for the Act, which was to discourage local restrictions more stringent than the Act's 1999 phase-out of Stage 2 aircraft. Part 161 makes it more difficult for the Airport or any others to implement use or access restrictions, especially those associated with Stage 3 aircraft. These difficulties are so significant that, to date, only one Part 161 plan has been approved by the FAA. This was approved for Naples Airport in Florida. Worth noting, airport/aircraft use restrictions in place at airports before the passage of ANCA were "grandfathered" and therefore allowed to remain in place as long as the airports did not modify the restrictions making them more stringent.

Airports and state and local governments are preempted from regulating the operations of aircraft, with one exception. They may exclude aircraft from an airport for noise reasons as long as the exclusion is reasonable and nondiscriminatory. In addition, it must comply with the provisions of the ANCA, through FAR Part 161, and it must not regulate military aircraft.

The outcome of a Part 150 Noise Compatibility Study is intended to define a balanced and cost-effective program for reducing existing and future noise exposure. The development of reasonable measures is the focus of the FAR Part 150 noise compatibility planning process. The objective is to explore a wide range of feasible measures of land use patterns, noise control actions and noise exposure patterns, seeking optimum accommodation of both airport users and airport neighbors within acceptable safety, economic and environmental parameters. Each measure should:

1) Have the potential of resolving the problem;
2) Be implementable within acceptable economic, environmental, and social costs; and,
3) Be implementable in compliance with federal, state, and local legislation, regulations, and ordinances.

This section contains a description of potential noise abatement and mitigation measures or actions that may be considered for General Mitchell International Airport. A general evaluation of each is made on the basis of the three factors listed above. In addition, FAR Part 150 identifies a number of measures that the FAA has determined must be considered in developing a Part 150 Noise Compatibility Plan. These required measures are:

- Acquisition of land or interest therein;
- Construction of barriers and acoustical shielding, including sound insulation of public buildings;
- Use of flight procedures (including modification of flight tracks) to control the operation of aircraft to reduce noise exposure to individuals;
- Implementation of any restriction on the use of airport by any type or class of aircraft based on the noise characteristics of those aircraft;
- Implementation of a preferential runway use system;
- Other actions or combination of actions which would have a beneficial noise control or abatement effect on the public; and
- Other actions as recommended by the FAA.

These measures are explained in greater detail in the following sections. Each measure is assigned to one of three categories identifying whether the airport operator, a state/local government, or the federal government is responsible for implementing the measure if it is included in the final Noise Compatibility Plan (NCP). The potential measures presented in the following paragraphs are general in nature. It is expected that the Study Advisory Committee will assist the Airport and Consultant in identifying more specific measures to evaluate for noise abatement or mitigation. As these more specific measures are identified, they will be evaluated and presented in subsequent Working Papers, Study Advisory Committee meetings, and public workshops.

Tables F1 and F2 list a range of noise abatement and land use compatibility measures that will be discussed, as well as specific noise issues these measures are designed to address.

General Measures Available to the Airport Proprietor

Denial of Use of Airport to Aircraft Not Meeting FAR Part 36 Standards

This measure might be implemented by limiting access to the Airport for aircraft that do not meet certain noise standards. Most turboprops and other large aircraft produced after 1964 were required to meet FAR Part 36 standards. Older, non-complying (Stage 1) turbojets over 75,000 pounds maximum gross takeoff weight, which have standard airworthiness certificates, were required to be retrofitted or cease operating in U. S. airspace as of January 1, 1985 (Part 91, Subpart E). Effective December 31, 1999, all aircraft weighing more than 75,000 lbs met Stage 3 noise levels. Therefore, all civilian aircraft today over 75,000 pounds are Stage 3 aircraft. Aircraft types weighting less than 75,000 lbs are not required to be Stage 3.

This measure is feasible where the majority of the aircraft fall within the parameters of FAR Part 36. However, to restrict Stage 3 or Stage 2 aircraft less than 75,000 pounds, the provisions of Part 161 must be complied with. This includes a cost/benefit analysis of the proposed restriction (with FAA approval of the methodology or results) and proper notice must be given, not only to the public, but to all affected parties.

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TABLE F1 - Operational and Facility Measures Studied in the Part 150 Process

	Measures For Consideration	Ground noise	Departure flight noise	Approach Flight Noise	Landing Roll Noise	Mainte-nance Activity Noise	Ground Equip. Noise	Sample Implementation Measure
Airport Layout Plan	Changes in Runway location, length or strength	◆	◆	◆	◆			New parallel runway. Runway extension. Pavement overlay.
	Displaced Thresholds[1]	◆		◆				Relocated existing runway threshold.
	High Speed Exit Taxiways	◆			◆			Examine locations of taxiway exits to reduce use of reverse thrust.
	Relocated Terminals	◆				◆	◆	Construct new terminal buildings and/or concourses.
	Isolating Maintenance Run-ups Use of Barriers	◆				◆	◆	Barriers. Hush House/Ground Run-up Enclosure.
Airport and Airspace Use	Preferential or Rotational Runway Use	◆	◆	◆	◆			Increased east flow or Increased west flow Balanced flow.
	Preferential Flight Tracks Use of Modification to Approach and Departure Procedures		◆	◆				Monitor compliance with existing corridors. Greater compliance with departure procedures. Develop "minimum" population flight tracks.
	Restrictions on Ground Movement of Aircraft	◆						Implement taxiway use restrictions.
	Restrictions on Engine Run-ups or Use of Ground Equipment					◆	◆	Minimize the number of nighttime run-ups.
	Limits on Number or Types of Operations or Types of Aircraft	◆	◆	◆	◆	◆	◆	Conduct a Part 161 Study.
	Use Restrictions	◆	◆	◆	◆		◆	Part 161 Studies.
	Raise Glide Slope Angle or Intercept			◆				Modify glide slope antennas
Aircraft Operation	Power and Flap Management		◆	◆				Identify appropriate departure climb profile to reduce noise.
	Limited use of Reverse Thrust				◆			Implement reverse thrust reduction procedures.
Noise Program Management	Noise-related Landing Fees	◆	◆	◆	◆			Conduct a Part 161 Study
	Noise Monitoring		◆	◆		◆		Noise Monitoring upgrades.
	Establish Citizen Complaint Mechanism	◆	◆	◆	◆	◆	◆	Establish a noise complaint hotline
	Establish Community Participation Program	◆	◆	◆	◆	◆	◆	Host quarterly public airport workshops

[1] Displaced Threshold describes a situation where the actual landing area on a runway is not at the physical end of the runway, but at some distance on the runway from the physical end.

Table F2 - Land Use Measures Studied in the Part 150 Process

	Measure For Consideration	Sample Implementation Measure	Noise Issue						
			Ground noise	Departure flight	Approach Flight	Landing Roll	Training Flights	Maint. Activity	Ground Equip.
Corrective	Acquisition	Acquisition of single family residences Acquisition of vacant residential land Acquisition of multi-family residential	◆	◆	◆	◆	◆	◆	
	Sound Insulation	Insulation of single family residential Insulation of multi-family residential Insulation of public buildings Insulation of schools	◆	◆	◆	◆	◆	◆	
	Mobile Homes	Relocate mobile homes to another location	◆	◆	◆	◆	◆	◆	
	Identify Noise Remedy Boundaries	Areas of Eligibility	◆	◆	◆	◆	◆	◆	◆
Preventative	Zoning		◆	◆	◆	◆	◆	◆	◆
	Building Code Modifications		◆	◆	◆	◆	◆	◆	◆
	Comprehensive Plans		◆	◆	◆	◆	◆		
	Noise Overlay Zone		◆	◆	◆	◆	◆	◆	◆

Capacity Limits Based on Defined Noise Levels

The following measures are required to be evaluated by FAR Part 150. However, they would require an FAR Part 161 Cost/Benefit Study prior to adoption. Prior to the approval of a Part 161 study, all non-restrictive measures must be evaluated to determine if they can achieve noise abatement or mitigation. Therefore, this Part 150 Study will evaluate and carry forward the non-restrictive measures available to an airport.

Restrictions on airport use or airport access might be based on the desire to keep noise below some specific level. However, such restrictions often have economic consequences and should only be considered after all other attempts at noise reduction have been exhausted. The implementation of this type of restriction might take three broad forms:

Restrictions Based on Cumulative Impact: With this measure, a maximum cumulative impact (such as the total area within the existing DNL 65, 70 or 75 contour) would be established as the baseline cumulative impact, and then, an airport's operations and/or fleet mix (mix of aircraft types) would be adjusted or limited so as not to exceed that maximum in the future. This could be accomplished through "capacity limitations," whereas either the aircraft types, based upon their relative "noisiness," or the numbers and mix of aircraft, would be limited or adjusted so as not to exceed the existing noise impact. One variation of this measure can be referred to as a "noise budget."

Restrictions Based on Certificated Single-Event Noise Levels: Most aircraft today have been certificated by the FAA, as part of the FAR Part 36 process described earlier. The certificated noise levels are published as part of the most recent update to *Noise Levels for US Certificated and Foreign Aircraft* contained in Advisory Circular 36. Based on the published noise levels, it might be possible to devise limitations that could prevent aircraft from exceeding those noise levels. This measure could be formulated so as to set a threshold noise level that cannot be exceeded at any time, or different noise levels can be implemented for either daytime or nighttime operations. An aircraft's compliance with this limit would be determined from the published FAA certification data. It should be noted that aircraft can be operated at less than certificated noise levels under certain operational conditions, which then becomes a means that air carriers continue to operate despite the noise level limit.

Restrictions Based on Measured Single-Event Noise Levels; Recognizing that aircraft noise levels vary widely, it might be possible to set limits based on actual, measured single-event noise levels. Aircraft exceeding this limit would be prohibited from using an airport. This does not mean that the airport, the community, or citizen groups can set up a microphone and noise-level limit and challenge the pilots to "beat the box." Compliance with the single-event level would be measured over an extended period of time for many single events, and violation would then be determined from repeated excess noise.

These are also the types of restrictions that are under the jurisdiction of Part 161 and are historically used in place of a general Stage 2 aircraft restriction. However, military aircraft are not subject to such restrictions.

Landing Fees Based on Noise

This measure is based on the premise that all or part of the landing fee for each aircraft would be focused on the noise emitted by that individual aircraft. This would apportion the "cost" of producing the noise to those aircraft that contribute the most to it. In theory, this measure would be designed to encourage the use of quieter aircraft and might actually generate additional revenue for the Airport. To avoid discrimination, the noise fee would need to be based upon a published standard for single-event noise levels, such as those contained in Advisory Circular 36. The opposite strategy also might be used. In other words, quieter aircraft would be apportioned a lesser fee than noisier aircraft, thus serving as an incentive for quieter aircraft. In this manner, operators reducing noise generated by their aircraft might be rewarded.

The cost of implementing this measure, in terms of manpower, finances and public relations, would not be offset by the revenue or benefit derived from it. The administrative cost involved in maintaining records of aircraft types and numbers, and billing statements, are not commensurate with the noise reduction achieved. In addition, this measure would not apply to military aircraft as they do not pay landing fees. The implementation of this measure would require a Part 161 Study.

Complete or Partial Curfews

Airport curfews can be an effective but costly means of controlling noise intrusion into areas adjacent or close to an airport. However, curfews can have a significant negative effect on both aviation interests and the community. In addition, other communities may also be impacted if flights are discontinued and passengers are unable to obtain the required air service. Thus, curfews can create an unreasonable burden to interstate or foreign commerce.

A curfew can take various forms: restrictions on some or all flights during certain times of the day or night, or restrictions based on certificated aircraft noise levels contained in AC 36-3H. Curfews are usually implemented to restrict operations during periods when people are most sensitive to noise intrusion. This most often occurs during the nighttime hours, particularly between the hours of 11:00 p.m. and 7:00 a.m.; these measures can be effective if there is a significant number of night flights and a notable amount of nighttime noise disturbance. Curfews have been upheld by a Federal District Court in California for a general aviation airport (Santa Monica Airport),[1] while at the same time, they have been denied by a Federal District Court in New York (Westchester County).[2] The implementation of a complete or partial curfew would require a Part 161 Study.

Ban All Jet Aircraft

This measure is sometimes proposed at airports to relieve noise impacts, but this is not legally possible. It not only puts an unreasonable burden on interstate commerce (which is an area of regulation reserved for the federal government), but also results in a discriminatory regulation that violates the tenets of the U.S. Constitution. This measure also violates the equal protection clause. An outright ban on all jet aircraft cannot be legally implemented, and therefore, is not recommended.

Acquisition of Land or Interest Therein

The most complete method of controlling and mitigating noise is to purchase the impacted property (referred to as acquisition in fee simple). However, this method is also the most costly since it removes the property from the tax base of the community. Certain land areas are more critical than others, and it may be appropriate to purchase land to mitigate severe noise impact where the purchase of full or partial interest may be the only means of achieving compatibility. This is especially true for residences within the 75 DNL noise contour. However, in the case of General Mitchell International Airport there are no residences within the existing or future Base Case 75 DNL noise contours.

Instead of acquiring property, airports sometimes purchase an easement from the property owner that effectively purchases the right to create noise or restrict development. An easement is sometimes preferred because it keeps property on the tax roll. There are three main types of easements associated with airports: 1) a clear zone

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1 Santa Monica Airport Assoc. v. City of Santa Monica, 659 F. 2d. 100, [9th Cir., 1981

2 Westchester County v. United States of America, 571 F. Supp. 786 [Southern District of New York, 1983

easement associated with the runway protection zone (PRZ); 2) a noise easement; 3) and an avigation easement that combines portions of both. Easements can be purchased, condemned or dedicated through the land use subdivision process. Easements also are acquired by airports when the airport provides sound insulation, discussed later.

Another method of keeping noise-affected residential property on the tax rolls is to purchase the property, then resell it for a compatible use or for residential use, but retain the rights to create noise (such as placing an easement on the property when it is sold). In other words, an airport operator could purchase a property, then resell it to the original homeowner or anyone else, but retain a covenant or easement which identifies the airport's right to fly over the property and create noise. This would result in the property owner giving up his/her right to initiate litigation against the airport due to the specified noise impact. In addition, this method would allow the market to set the price and value of the noise easement which would be retained by the airport. An airport could also develop or resell the property to another government agency for a compatible use (golf course, nature area, cemetery, etc.), or the agency could purchase the property outright for its own use. This would have to be coordinated with the airport staff and management to ensure redevelopment with a compatible use.

Instead of purchasing land, sound insulation (or attenuation) is often recommended for areas near airports. Sound insulation is the process of adding structural components, such as insulation, to a building to reduce the inside noise levels to a specific degree. Normally, a 25 to 30 dB(A) reduction from outside to inside noise levels is recommended. Such noise reductions are normally achieved by adding double-pane windows, installing solid core doors, installing special ventilation systems and sometimes employing certain wall treatments. Many residents prefer this measure because it reduces the inside noise levels and allows the homeowner to remain in his/her home. Sound insulation, when funded with public monies, often requires the granting of a noise easement in return. General Mitchell International Airport has had a successful sound insulation program for several years and the majority of the homes within the existing and future base case noise contour have been sound attenuated or offered sound insulation.

No matter what portion or right of land is purchased, if federal assistance is used, the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policy Act of 1970 (also known as the Uniform Act) must be followed.

Noise Barriers (Shielding, including earth berms and walls)

Noise generated from ground-level sources can result from engine run-up and maintenance operations, aircraft movement on the runways and taxiways, and aircraft engine reverse thrust on landing. Noise intrusion from these sources is usually only significant to those areas close to an airport. One method of mitigating this type of noise is through the use of noise barriers or earthen berms. These can protect adjacent areas from unwanted noise by blocking the path of noise. Another method is through the strategic and well-planned location of airport buildings and structures that can provide shielding to adjacent areas to block noise. Run-up and maintenance areas can be located away from noise-sensitive uses adjacent to an airport, and if necessary "hush houses" or “ground run-up enclosures” (GRE) can be constructed to absorb sound for specific run-up and maintenance operations. General Mitchell International Airport has constructed a ground run-up enclosure and it has significantly reduced engine run-up noise at the airport.

Construct a New Runway in a Different Orientation

Often the construction of a new runway with a different orientation will shift noise away from noise sensitive uses to either less populated areas or compatible areas (commercial lands, rivers etc). For instance, at airports that have a north-south runway orientation, perhaps an east-west orientation or slightly different angle, might be considered. The orientation of a runway is dependent upon many factors, including prevailing winds, topography, obstacles and other conditions. A new runway cannot be constructed if wind direction and topographic conditions are such that safety criteria cannot be met. In addition, both existing and future land uses must be considered so that the noise is not shifted to other populated areas. This is an expensive measure that must be beneficial to both the airport users and the surrounding community. Presently, there are no plans to construct additional runways at General Mitchell International Airport within the timeframe of this Part 150 Noise Compatibility Study.

Runway Extensions

Often a runway extension can reduce noise impacts to areas close to an airport. A runway extension can allow aircraft to gain altitude sooner and produce less noise exposure. In addition, a runway extension may enable aircraft to fly certain flight paths (such as making turns after departure) not possible with an existing runway length. However, there are tradeoffs with an extension that must be considered. With an extension, the area closest to the extended end can experience greater noise levels due to lower approach altitudes, and aircraft beginning departure roll closer to those areas. This sometimes can be corrected by establishing a displaced threshold so that aircraft land farther down the runway and maintain altitude over the area beyond the extension. Displaced thresholds generally are not recommended by the FAA due to safety considerations.

An additional factor to consider with a runway extension is that many times a longer runway will enable more or heavier, larger aircraft to use the runway. This may be desirable since many of the larger, heavier aircraft are new-generation aircraft and actually are quieter than smaller aircraft presently operating. Runway extensions also can be used as a noise abatement measure to help reduce the need for using reverse thrust upon landing, which can generate a considerable amount of ground-level noise. There are no plans to extend runways at General Mitchell International Airport within the time frame of this Part 150 Study.

Touch-and-Go Restrictions

Restrictions on training flights performing touch-and-go operations can mitigate noise impacts at airports where there are a significant number of training operations, especially jet training. Touch-and-go operations occur when the pilot approaches the runway as if landing, the aircraft touches down on the runway, then lifts up for departure in a series of practice runs. Restricting touch-and-go training is particularly effective if the operations occur during the nighttime and early morning hours, when such operations can be most intrusive. However, such restrictions may not be legal as they often are found to limit access or be a capacity restriction. Capacity restrictions are different from access restrictions based on noise (which may be possible subsequent to a Part 161 Study) as capacity restrictions are beyond the ability of an airport operator to implement. They are pre-empted by federal regulation. There are very few touch-and-go operations occurring at General Mitchell International Airport and this is not a viable measure for this study. In addition, military aircraft are not subject to touch and go restrictions.

High-Speed Exit Taxiways

High-speed taxiway exits can help reduce noise impacts by allowing aircraft to exit the runway at a higher rage of speed, thereby reducing the use of reverse thrust. Two types of taxiway exits typically are developed on an airport:

1) a high-speed exit that is usually angled; and,

2) a regular taxiway exit that is angled at 90 degrees (thereby requiring the aircraft to come to a near stop before turning).

This measure is viable only with runways of sufficient length to allow aircraft to slow down early enough to use high-speed exits, which usually are placed closer to the middle of the runway, nearer the terminal. High-speed taxiway exits do little good as an independent measure, and typically must be implemented along with other measures.

Noise Monitoring Program

Noise monitoring or sound-level measurement programs can enhance the effectiveness of noise abatement and compatibility programs at airports. These airports have used the systems to demonstrate changes in aircraft noise exposure and to identify noise levels associated with specific aircraft events. Noise monitoring often is used as a means of showing progress toward reducing the problem. Most systems have several remote microphone units that sample the weighted sound level once or twice per second, record the samples, and transmit the data to a minicomputer system with printouts. Any FAA-approved noise monitoring system would have the following minimum capabilities: continuous measurement of dBA at each site; hourly Leq data; daily Ldn data; and single-event; maximum A-weighted sound level data. General Mitchell International Airport has had a permanent noise monitoring system in place for several years. The system combines aircraft noise monitoring with flight track monitoring and provides valuable information concerning aircraft operations and associated aircraft noise levels. This system should be reviewed to assess effectiveness and identify potential areas of improvement.

Noise Complaint/Citizen Liaison Program

Many airports in the United States provide staff in a Noise Abatement Office to receive and respond to citizen complaints of aircraft noise. A comprehensive noise complaint system has many advantages, including identification of unusual conditions based on citizen complaints that lead to a notice sent to an aberrant pilot, public accessibility of information about the airport operation and noise conditions, data collection to identify sensitive areas, and positive public relations. At most airports, one person is designated to receive and address noise complaints from citizens. The complaint officer keeps a file on each complaint, noting the time, place, type of complaint, type of aircraft and N-number or other identifying characteristics of the aircraft, if known. This gives citizens a central office to lodge noise complaints and to obtain information concerning aircraft operations or changes in flight procedures. General Mitchell International Airport currently has such a system in place and is keeping records of noise complaints. This system will be reviewed and recommendations made for improvement, as necessary and appropriate.

Options Available to State or Local Governments

Land Use Controls

Federal guidelines contained in FAR Part 150 indicate that residential development, along with other noise sensitive uses such as schools, churches, hospitals, rest homes, etc., should not be located within areas exposed to 65 DNL or greater noise levels. These guidelines are recognized not only by the FAA but also by the Department of Housing and Urban Development, Department of Defense, and the Environmental Protection Agency, as well as numerous state and local agencies. Land use and development controls are one method of ensuring such noise sensitive uses will be restricted within the noise contours. It should be remembered that it is within the discretion and authority of the local unit of government to determine the types of lands that are incompatible with noise levels and to define their own threshold of sensitivity. In the case of the communities in the vicinity of General Mitchell International Airport, no local noise related controls have been established.

One of the primary tools used by local communities to guide development within the jurisdiction is a comprehensive planning process. Land use and development controls which are based on a well-defined and thoroughly documented comprehensive plan are among the easiest and most powerful tools available to the local unit of government to ensure land use compatibility. It is the responsibility of the local unit of government having land use jurisdiction to implement these controls to protect its residents from aircraft noise impacts and to protect the airport from encroachment of incompatible land uses. This is particularly important when more than one unit of government has land use control authority for the area outside an airport's boundary. It is extremely critical that the local unit of government accept the responsibility for ensuring land use compatibility in its planning and development actions. It also is important that the state government provide the necessary enabling legislation that will allow the local unit of government to institute land use controls. The most common forms of land use controls available to the local governments include: zoning, easements, transfer of development rights, building code modifications, capital improvement programs, subdivision regulations, and comprehensive planning. These forms of land use controls will only be briefly outlined in the following paragraphs.

Zoning. Zoning is the most common and traditional form of land use control in the United States today. It controls the type and placement of different land uses within designated areas. It is used to encourage land use compatibility while leaving property ownership in the hands of private individuals or business entities, thus leaving the land on the tax rolls. Zoning is not applied retroactively and is not necessarily permanent. It is most effective in areas that are not developed but could develop with compatible uses. As stated earlier, all jurisdictions have typical zoning ordinances in effect concerning the way land use districts are delineated between residential, commercial, industrial, public, and other uses.

Easements. An easement is a right held by one party to make use of the property of another for a limited purpose, as defined in the easement.

Transfer of Development Rights. The transfer of development rights involves separate ownership of the "bundle of rights" associated with property ownership. The concept involves the transfer of the right to develop a certain parcel of property to a certain density/intensity to another parcel of property under separate ownership. This would allow the property that obtains the added development rights to develop to an intensity/density that is beyond that which would normally be allowed. An airport operator could also purchase these rights from the landowner and retain them or sell them to another landowner. This concept can be used to retain property in compatible uses and still compensate the landowner for loss of development. The idea depends upon market conditions of the area and (there is some disagreement on this point) upon the availability of state enabling legislation authorizing the development of the concept at the local level.

Building Code Modifications. This measure is to modify existing or potential building codes to include specific sound insulation provisions for structures within areas affected by aircraft noise. Recommendations may be made to the various jurisdictions concerning sound insulation, as appropriate.

Capital Improvements Program. This is a document that establishes priorities and costs on the funding and development of public facilities (roads, streets, sewers, libraries, etc.). It can be used very successfully in concert with subdivision regulations and a comprehensive plan, to control not only the areas of development but also the timing of development, by controlling the timing and location of public facilities construction.

Subdivision Regulations. Subdivision regulations are used to control the design and placement of public and private facilities in the conversion of raw land to developed property. Many of the jurisdictions surrounding the Airport have adopted subdivision regulations.

Comprehensive Planning. Comprehensive future land use planning, when it is coordinated with the zoning ordinance, subdivision regulations and the capital improvements program, can reduce or avoid land use incompatibilities in the future. Many of the jurisdictions surrounding the Airport have adopted comprehensive plans for their areas of jurisdiction.

All of the land use controls mentioned above will be analyzed in greater depth as to their feasibility for implementation when the final noise contours are produced and a Future Noise Exposure Map is presented.

Options Dependent Upon the Federal Government Approval

Departure Thrust Cutback (Departure Climb Profile)

During initial takeoff, the power or thrust used by the aircraft to gain altitude is usually at its maximum. This measure would involve the application of thrust cutbacks at various stages of take-off. Because of system-wide needs, each operator has developed its own standardized take-off procedure. This measure is recommended when aircraft operators have the opportunity to use a different departure thrust setting and still be within safety limits as per the particular type of aircraft, given the characteristics of the particular airport. Often it is better for aircraft to climb faster and turn earlier than to fly over noise-sensitive areas at lower power. In addition, this measure cannot be implemented without the direct concurrence of the FAA, taking into account operational, safety and airspace considerations. The FAA's Advisory Circular (AC) 91-53A titled "Noise Abatement Departure Profile" defines two standard departure procedures for aircraft: a "close-in" departure and a "distant" departure. The close-in departure typically reduces noise near the airport, but may increase noise farther from an airport (such as 8 to 10 miles away). Conversely, the distant procedure concentrates noise closer to an airport (such as within 3 to 5 miles), but reduces noise farther away.

Flight Management (FMS)/Global Positioning System (GPS)/Required Navigation Procedures (RNP or RNAV)

Global positioning satellite (GPS) systems have enabled a wide range of new flight procedures at airports that effectively rely on computer technology to direct the flight of the aircraft. These systems use satellites to determine exact aircraft location, and with the addition of a ground unit, can very accurately determine altitude. Computers onboard the aircraft use this information to direct the flight. These types of systems are considered to be the precision instrument landing system of the future, and are less expensive to equip and maintain both onboard and at ground facilities. A precision instrument landing system is currently in place on both ends of the longest runway

(Runway 1L/19R with varying capabilities during different prevailing weather and visibility conditions) and on runway end 7R of Runway 7R/25L, the second longest runway. Runway end 25L has a non-precision approach. The use of GPS for approaches, coupled with FMS (Flight Management Systems) or Required Navigation (RNAV or RNP) for departures, will be explored as part of this study to assess whether flight tracks can more accurately be followed; thereby reducing noise levels over noise sensitive areas.

Designated Noise Abatement Take-off/Approach Paths (Flight Tracks)

This measure is very similar to that described previously, except that it concerns designated paths that aircraft follow on approach or takeoff to minimize the overflight of noise sensitive residential areas. Such take-off/approach flight tracks specify the location relative to the ground of aircraft at certain altitudes and during certain turning procedures. These procedures are dictated by the relative location of noise-sensitive land uses and considerations of aircraft operational safety and air traffic control procedures. Generally, air traffic control procedures can be managed to avoid specific areas; however, this may create unintended consequences that reduce airport and airspace capacity or increase noise to other areas not previously overflown. Turns during the last three (3) to four (4) miles of the final approach in good weather, and within the final six (6) to seven (7) miles during poor weather, are undesirable for safety reasons because they do not allow pilots of large commercial airliners to establish and maintain a stabilized approach. Aircraft bank angles near the ground need to be restricted to no more than 15 to 20 degrees and are not to be initiated when the aircraft is below 500 feet above ground level (AGL). These procedures cannot be implemented without the concurrence of the FAA, taking into account operational, safety and airspace considerations.

When evaluating noise abatement flight tracks, consideration should be given to the following measures which, when developed around specific community needs, could reduce aircraft noise impacts. The measures include:

- Equalizing or dispersing noise – this is often an approach when attempting to fairly distribute operations around an airport;
- Concentrating noise – this is the opposite of equalizing/dispersing noise. By concentrating noise, paths are established that result in consistent overflight of specific area(s) to concentrate noise over that area. This approach often provides the predictability of over flight patterns sought by residents. New technology, such as FMS, enables a greater ability to concentrate noise if desired. Concentrating noise typically enables land use compatibility actions (such as sound insulation) to remedy any residual incompatibilities.

- Concentrating noise close-in (within 3 to 4 miles), and dispersing noise farther away – this approach is a combination of the previous two and would result in concentration of noise primarily in the 65 DNL contour, but disperse noise outside the 65 DNL.

When considering flight paths, the Study Advisory Committee should indicate its desires relative to the above approaches.

Preferential Runway Use System

A preferential runway use system typically identifies the runway end(s) that for departures creates the least impact on the surrounding community and emphasizes the use of that runway(s). Such programs use these preferred runway end(s) the majority of the time, establishing operations in a certain direction, with operations occurring in the opposite direction held to a minimum. This measure is very closely related to wind direction and airspace safety considerations. The FAA has the responsibility to implement this measure through air traffic routing, with aircraft safety being the prime concern. This is available only for use during certain wind conditions and is recommended only when there is a severe noise compatibility problem directly off other ends of the runways. At General Mitchell International Airport, during an average day, about 50% of the jet departures are on Runway 19, 25% on Runway 7R, 13% on Runway 1L and about 12% on Runway 25L. Jet arrivals occur about 42% of the time on Runway 25L, about 25% on Runway 7R, about 20% on Runway 1L and about 13% on Runway 19R. This varies with the wind direction during any given day. The Airport currently has an informal nighttime preferential runway system in place, with Runway 19R being the preferred runway for all turbojet departures and Runway 1L for arrivals. This is a contra-flow operation which is only in effect between 10:00 pm and 6:00 am, and when weather and traffic conditions allow.

Power and Flap Settings

A variety of aircraft operating procedures are possible for implementation at an airport. These include minimum flap landings and delaying flap and gear deployment. On approach, an increasing level of noise is generated as flaps are applied to slow the aircraft. Similarly, noise levels typically increase when the landing gear is lowered. To help minimize fuel costs and flight time, most operators of large jet aircraft have adopted procedures for reduced flap settings and delaying flap and gear extension, consistent with safety and current aircraft and air crew capabilities. During VFR (good) weather conditions and low traffic conditions, large jet aircraft generally land with minimum flap settings.

Existing Actions

The Airport completed the previous FAR Part 150 Study in 1994, and the FAA issued its Record of Approval for that Study in March 1995. The FAA approved, and the Airport has implemented, several noise abatement/mitigation measures contained in that document. The Record of Approval can be found in the Appendix along with the Tower Order and Airport Operations Bulletin. The Airport implemented three new noise abatement measures along with continuing two existing noise abatement measures. Sixteen land use mitigation measures were approved by the FAA, of which eleven were outside the jurisdiction of the Airport to implement since the Airport has no land use control authority. The remaining five land use mitigation measures have all been implemented except for the Phase 2 avigation easement/sales assistance measure. The remaining seven continuing measures have all been implemented. These include publishing noise abatement procedures in the Airport Facility Directory, continued coordination with key agencies, maintaining complaint response system, monitoring aircraft activity and fleet conversion status, developing flight track and noise monitoring system, evaluating and update the Noise Compatibility Plan, and establishing noise abatement and mitigation staff.

Summary

The potential measures presented in this chapter are general in nature and provide a broad perspective of actions that could be recommended for further study and implementation. It is expected that the Study Advisory Committee will assist the Airport and Consultants in identifying more specific noise abatement or mitigation measures to evaluate using the guidelines and information provided. As these measures are identified, they will be reviewed and presented in subsequent Working Papers, Study Advisory Committee meetings, and public workshops.

Abatement Alternatives Evaluation (Part One)

Introduction

From the range of potential operational and facility alternatives presented in the previous chapter, and from suggestions made by the public, the following preliminarily operational alternatives have been determined to be appropriate for review when developing noise abatement measures for General Mitchell International Airport. It is recommended that these operational alternatives be evaluated for the contribution each would make to noise abatement. These "Part One" alternatives are the first set to be evaluated in the FAR Part 150 Noise Compatibility Study. As additional alternatives are developed, they will be evaluated in subsequent Working Papers.

After these Part One alternatives have been reviewed by and discussed with the Study Advisory Committee, it is anticipated that additional alternatives will be recommended by the Committee for further analysis and evaluation. The Part One alternatives are all similar in nature; as such, the methodology and analysis for these alternatives are similar. Additional alternatives for review will consist of suggestions from Airport staff and the Committee. The ground-based noise alternatives analysis incorporates additional noise monitoring data acquired during a supplemental noise monitoring survey. Land use and administrative alternatives will be evaluated after the operational and facility alternatives have been refined.

Listed below are the Part One Aircraft Operation Alternatives that have been selected for initial review and analysis. These alternatives consist of modifications to existing flight tracks, as well as an on-airport operational modification. The alternatives are not listed in terms of priority and are only to be considered as initial feasible alternatives that will be further refined and combined, which will result in final recommendations. It is anticipated and encouraged that additional alternatives be recommended by the Committee for evaluation. The term Flight Management System (FMS) will be used generically to include a wide variety of satellite based navigation systems.

Aircraft Operational Alternatives - Flight Track Changes

Alternative 1 Develop FMS departure procedures for Runway 19R (South departures).

Alternative 2 Develop FMS departure procedures for Runway 7R (East departures, no jet aircraft turns until reaching shore).

Alternative 3 Develop FMS departure procedures for Runway 1L (North departures).

Alternative 4 Develop FMS departure procedures for Runway 25L (West departures).

Alternative 5 Evaluate altitudes of turbo-prop departures.

Alternative 6 Develop procedures to reduce early turns on approach for turbo-prop aircraft.

Alternative 7 Evaluate close-in and distant departure procedures.

Aircraft Operational Alternatives - On-Airport Changes

Alternative 8 Evaluate intersection departures for south-bound aircraft at night.

Alternative 9 Develop ground-based noise alternatives.

Alternative 10 Provide additional high-speed taxiways to reduce use of reverse thrust on landing.

Noise Analysis Methodology

In order to evaluate and differentiate the noise abatement alternatives, multiple noise metrics are presented for each. These metrics include the FAA mandated DNL, as well as supplemental noise metrics to better understand the character of the noise and how that noise may change with the implementation of a specific alternative. The DNL metric information is presented in graphic and tabular format and the supplemental metrics are presented in tabular format. As discussed in previous Working Papers, all of the analysis is based upon year 2009 future conditions (five years in the future from existing base year conditions). The noise metrics analyzed within this study include:

DNL Noise Contour Analysis. DNL noise contours have been developed for selected alternatives to graphically depict areas exposed to specific DNL noise levels. The comparison of noise contours for various alternatives illustrates how the contour may change in size and area relative to each other. The DNL noise contours are presented in terms of the 65, 70, and 75 DNL noise value. These contours are the average annual DNL noise level.

Representative Receptor Analysis. This allows for a direct comparison of how noise levels may change in different neighborhoods. The Representative Receptor locations are a grid of points on the ground surrounding each quadrant around the Airport where noise levels may experience a change. The effectiveness of the alternatives is not always measurable by DNL standards; therefore, Time Above, Number of Events Above, and Single Event analysis are included for noise receptor locations around the Airport.

The representative receptor grid locations are presented in Figure G17 at the end of this Working Paper. The grid results tables are also at the end of this Working Paper in Tables G5 through G10. Grids were drawn on the four quadrants of the Airport covering areas where aircraft fly. Each alternative has an associated table that shows how the noise changes at each of the chosen grid points. Existing and future noise levels for any location can be approximated by plotting a location within the grid.

The following noise metrics will be determined at each grid point for each alternative under consideration:

DNL Analysis. Tables and graphics present the DNL, which is the annual average noise level, at the representative locations.

Time Above Analysis. Tables presenting the Time Above noise level depict the number of minutes per day that the noise is greater than 65 dBA at each of the representative locations.

Number of Events Above Analysis. Tables present the Number of Events Above noise level, which is the number of events per day that the noise is greater than 65 dBA at each of the representative locations.

Single Event Analysis. For Alternative 7, a table presenting the Single Event noise level (SEL) at the representative locations, using the departure of an MD83 aircraft as a representative loud aircraft.

Alternatives Analysis

The following sections of this Working Paper provide a detailed analysis for each Part One alternative. The analysis describes the noise goal of the alternative, a description of the alternative, how it varies from existing procedures, and what potential change in noise may result from implementation of the alternative.

Alternative 1
Develop Satellite Based Departure Procedures for Runway 19R
(South Flow Departures)

Goal:

The goal of this alternative is to provide for more precise flight paths for aircraft departing to the south on Runway 19R. There are two procedures under consideration in this alternative: one for south departures that turn to the east (Alternative 1A) and the second for south departures that turn to the west (Alternative 1B). This alternative is designed to reduce drift and early turns at lower altitudes. The intent of the alternative is to take advantage of compatible land uses and to concentrate aircraft close-in to the Airport over the compatible land use and then disperse them farther out from the Airport.

Description:

Alternatives 1A and 1B use FMS technology, which allows aircraft to fly a more precise path than is possible with current vectoring procedures. With FMS, flight paths are more concentrated and deviate less from the procedure. This allows aircraft flight paths close-in to the Airport to be concentrated and then fan out, or disperse, as they fly farther from the Airport.

An FMS procedure typically consists of a series of three guides: *way points, altitudes,* and *flight heading information*. Way points are known positions on the ground that provide references for aircraft flight. Two types of way points can be part of FMS-based procedures: fly-over and fly-by. The two procedures are described below:

- A fly-over way point is a point on the ground that the aircraft actually flies directly over.
- A fly-by way point is a point on the ground that the FMS computer onboard the aircraft uses as a reference in flying the aircraft through a turn. The aircraft typically flies an equal distance inside that point, both entering and exiting the turn. The turn is not equal for all aircraft and varies with speed.

Alternative 1A— Satellite Based Departure Procedure for Runway 19R, East Destinations.

Existing Procedure:

Commercial jet aircraft departing to the south on Runway 19R, heading to eastern or southeastern destinations, fly runway heading until roughly crossing the departure end of the runway. After the aircraft has passed the departure end of Runway 19R, south and east-bound aircraft are turned approximately 15 degrees to the left (east) of the extended centerline until reaching 3,000 feet above Mean Sea Level (MSL); eastern destinations then turn to the east, while southern destinations continue on this heading. With current navigation technology, aircraft will often turn early and some aircraft will drift more to the east due to weather or natural spread associated with existing navigation technology.

New Procedure:

The FMS computer would direct jet aircraft to fly runway heading until it reaches approximately one-half mile past the runway end. Then, the computer would change the aircraft heading to approximately 15 degrees left (east) of the extended runway centerline. The FMS flight path would have way points to guide the aircraft more precisely on the flight track. The FMS flight path would essentially be the same flight path that is flown today, but with new technology providing a more precise departure path with less spread and drift. Once the aircraft has cleared 3,000 feet above MSL, it would turn on course as is done today. Figure G1, *Alternatives 1A & 1B Runway 19R Jet Departure Flight Tracks*, shows the new FMS flight path overlaid on the existing flight tracks.

New Procedure Noise Analysis:

Figure G2, *Comparison of Alternative 1A, FMS South DNL Contour and 2009 Base Case DNL Contour*, shows the 65, 70, and 75 DNL noise contours associated with this alternative compared with the 2009 Base Case DNL noise contours. The Base Case contours are shown with a solid line; changes to the Base Case 2009 contour due to the alternative are shown as a dashed line. The land use and population changes associated with this alternative, compared to the future Base Case contour, are shown in Table G4, at the end of this chapter.

Alternative 1A could be used by 80 percent of the existing commercial jet aircraft fleet operating at General Mitchell International Airport. Military aircraft, older hush-kit aircraft, turbo-prop, and general aviation aircraft are not equipped to fly FMS procedures; as such, these aircraft would continue to fly their existing flight procedures. This alternative would reduce the eastern drift and the number of early turns by turbojet aircraft, thus reducing DNL noise levels by up to 2.9 DNL southeast of the Airport. The number of people in the 65 DNL that have not previously received sound insulation would be reduced by one. The Number of Events above 65 dBA metric would be reduced by 10.9 per day in the area southeast of the Airport and increased by 18.8 per day in the area directly south of the Airport. The Time Above 65 dBA would be decreased by 2.5 minutes per day in areas southeast of the Airport.

Alternative 1B— Satellite Based Departure Procedure for Runway 19R, West Destinations.

Existing Procedure:

Aircraft departing to the south on Runway 19R, heading to western or southwestern destinations, fly runway heading until roughly crossing the departure end of the runway. After the aircraft has passed the departure end of Runway 19R, it is turned approximately 15 degrees to the right (west) of the extended centerline until reaching 3,000 feet above MSL; northwest and west destinations then turn to the west at this point, while southwest destinations continue on this heading. With current navigation technology, aircraft often turn early. Additionally, some aircraft drift more to the west due to weather or natural spread associated with current navigation technology.

New Procedure:

The FMS flight path would be the same flight path that is flown today, but with new technology that provides for a more precise departure path. The FMS computer would direct the aircraft to fly runway heading until it reaches the runway end. Then, the computer would change the aircraft heading to approximately 15 degrees right (west) of the extended runway centerline. The FMS flight path would have way points to guide the aircraft more precisely on the flight track. The way points would be located at positions of change in direction so that they would not be too closely spaced. Figure G1, *Alternatives 1A and 1B Runway 19R Jet Departure Flight Tracks*, shows the new FMS flight path overlaid on the existing flight tracks.

New Procedure Noise Analysis:

Figure G3, *Comparison of Alternative 1B, FMS South DNL Contour and 2009 Base Case DNL Contours*, shows the 65, 70, and 75 DNL noise contours associated with this alternative compared with the 2009 Base Case DNL noise contours. The Base Case contours are shown with a solid line; changes to the Base Case 2009 contour due to the alternative are shown as a dashed line. The land use and population changes associated with this alternative, compared to the future Base Case contour, are shown in Table G4, at the end of this chapter.

Alternative 1B could be used by 80 percent of the existing commercial jet aircraft fleet operating at General Mitchell International Airport. Military aircraft, older hush-kit aircraft, turbo-prop, and general aviation aircraft are not equipped to fly FMS procedures; as such, these aircraft would continue to fly their existing flight procedures. This alternative would reduce the westerly drift and the number of early turns by turbojet aircraft, thereby reducing DNL noise levels by 1.5 DNL close to the Airport with a corresponding increase of 1.5 DNL farther from the Airport. Alternative 1B would not result in a change to the total number of housing units in the 65 DNL; however, this alternative would increase the number of non-compatible housing units in the 65 DNL by seven. Non-compatible housing units include those that have not been previously sound insulated because the houses were either outside the previous program boundaries or inside the previous program boundary and refused sound insulation. The Events Above 65 dBA is decreased by 2.3 events a day in the areas south of the Airport and increased by 9.9 events a day in the areas southwest of the Airport. The Time Above 65 dBA metric is increased by 3.1 minutes per day in the southwest and decreased by 1.6 minutes closer to the Airport.

Difference Compared to Base Case Contour:

Alternative 1A would result in the 65 DNL noise contour expanding south of the Airport, east of Clement Avenue, which is not within the 2009 Base Case 65 DNL noise contour. The 65 DNL associated with Alternative 1A is the same as the 2009 Base Case 65 DNL in all other areas. Alternative 1B would result in the 65 DNL noise contour expanding to just south of Rawson Avenue and east of Howell Avenue. The 65 DNL noise contour is essentially the same as the 65 DNL Base Case contour in all other areas.

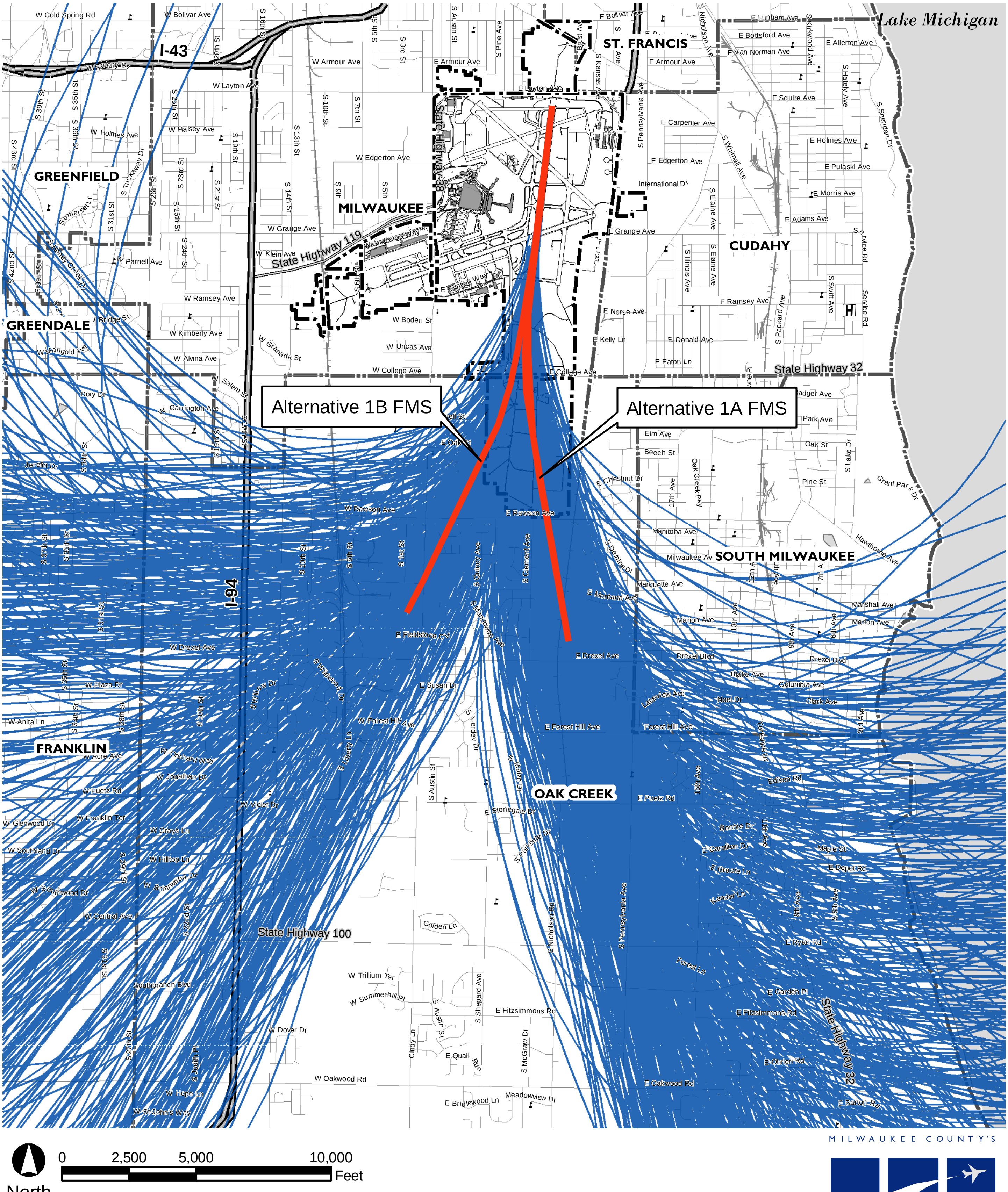


Figure G1 Alt 1A & 1B INM Jet Departure Flight Tracks
Overlaid on Existing Radar Jet Departure Flight Tracks for Runway 19R
(Representative sample of 1,100 jet departures during June 2003)

MILWAUKEE COUNTY'S
GENERAL
MITCHELL
INTERNATIONAL AIRPORT

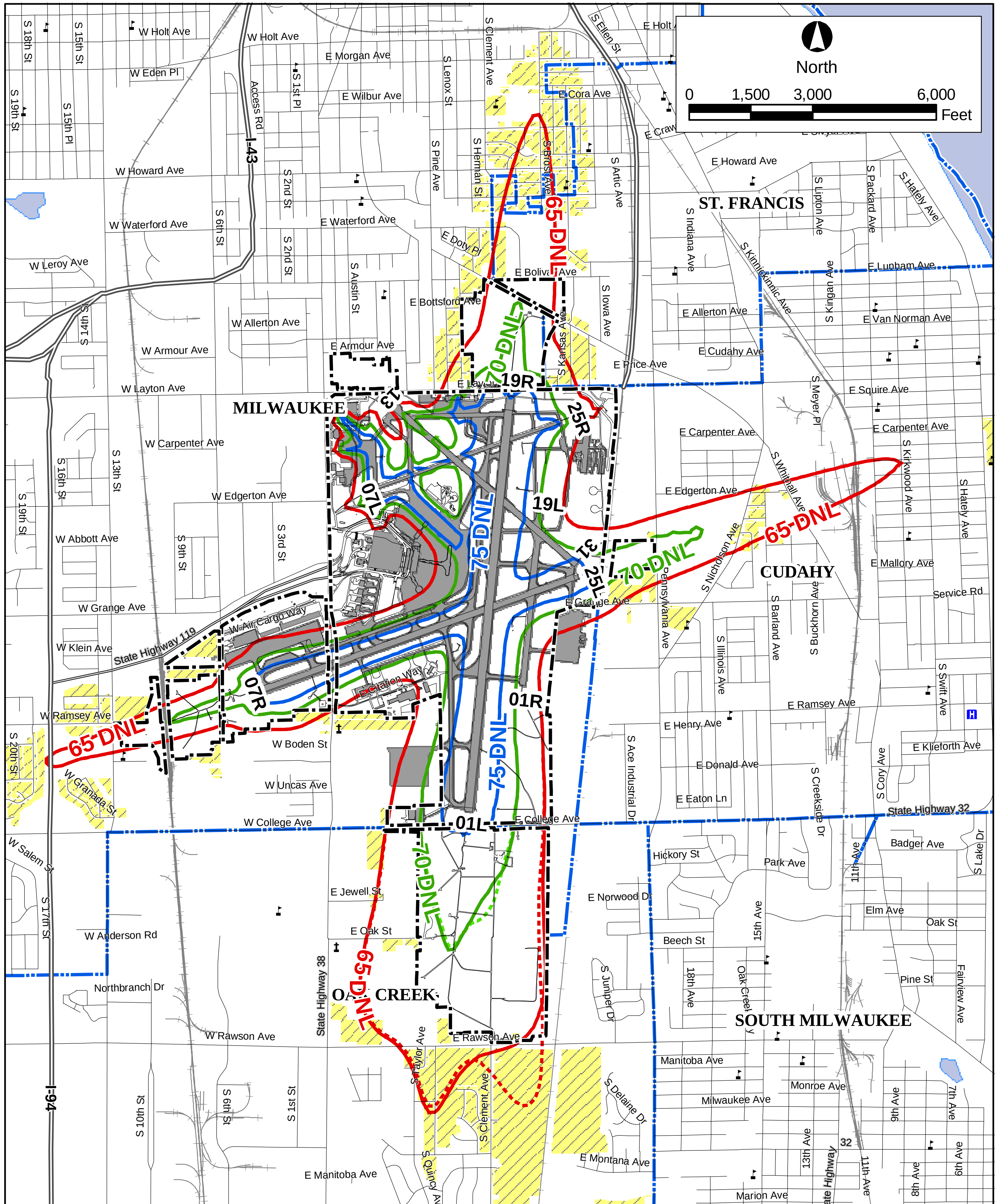


Figure G2
Comparison of
Alternative 1A FMS South DNL Contour &
2009 Base Case DNL Contour

Legend

2009 Base Case

- 65 DNL Contour
- 70 DNL Contour
- 75 DNL Contour

Alternative 1A

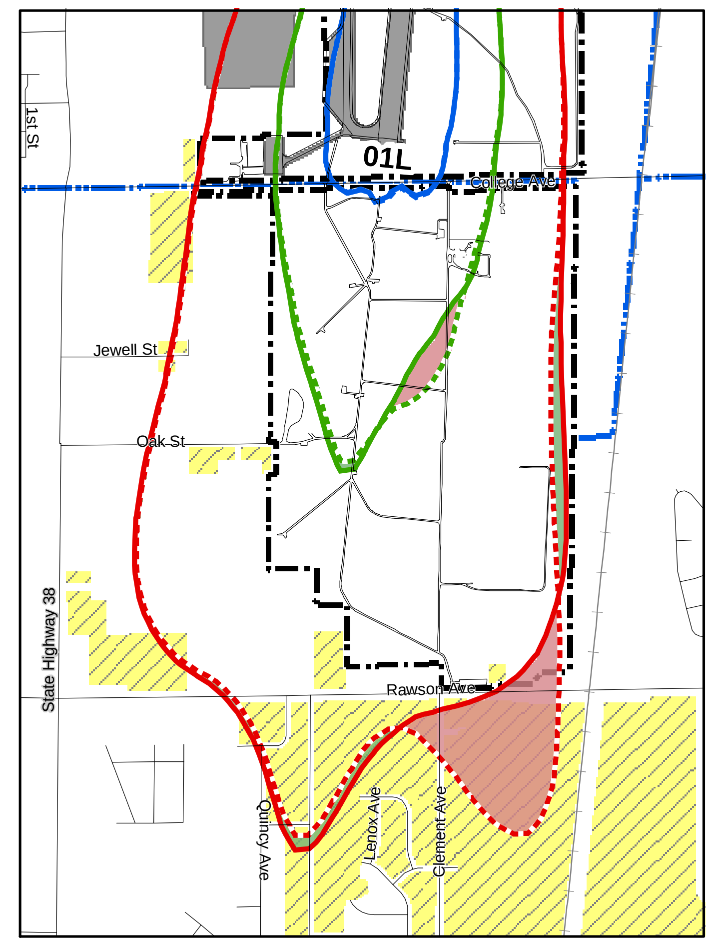
- 65 DNL Contour
- 70 DNL Contour
- 75 DNL Contour
- Phase 1 Program Boundries
- CORPORATE BOUNDARY
- AIRPORT BOUNDARY
- hospitals
- schools
- churches

Source: Milwaukee County, 2003

Comparative Analysis

Areas within the limits of this alternative but not within the limits of the 2009 Base Case are shown in red.
65 DNL - Approx. 40 Acres
70 DNL - Approx. 6 Acres

Areas within the limits of the 2009 Base Case but not within the limits this alternative are shown in green.
65 DNL - Approx. 18 Acres
70 DNL - Approx. 3 Acres



Runway End 01L Detail

North

0 1,000 2,000 4,000 Feet

Legend

- Newly affected
- No longer affected

MILWAUKEE COUNTY'S GENERAL MITCHELL INTERNATIONAL AIRPORT

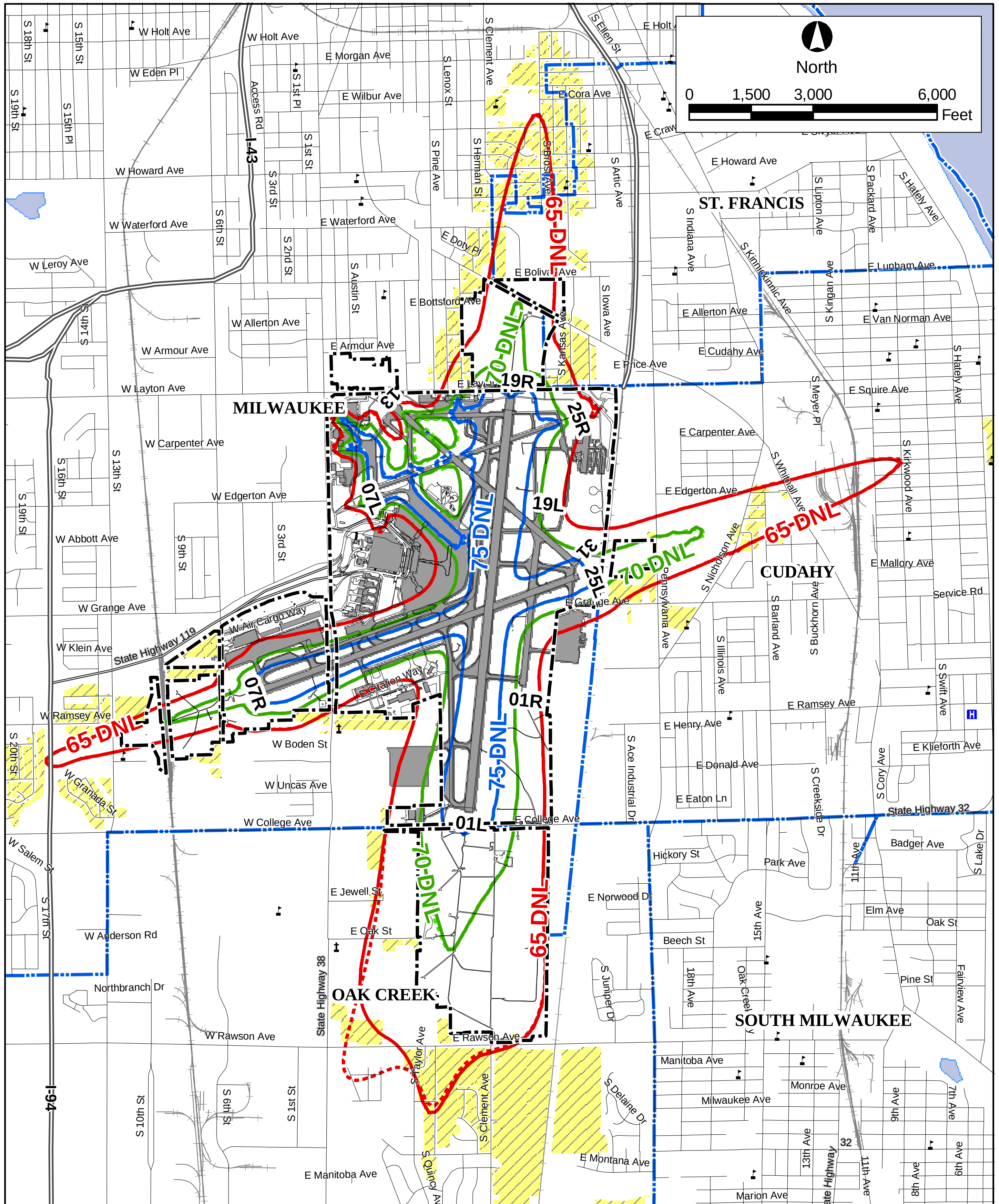


Figure G3

Comparison of
Alternative 1B FMS South DNL Contour &
2009 Base Case DNL Contour

Comparative Analysis

Areas within the limits of this alternative but not within the limits of the 2009 Base Case are shown in red.
65 DNL - Approx. 38 Acres
70 DNL - Approx. 2 Acres

Areas within the limits of the 2009 Base Case but not within the limits this alternative are shown in green.
65 DNL - Approx. 13 Acres

Legend

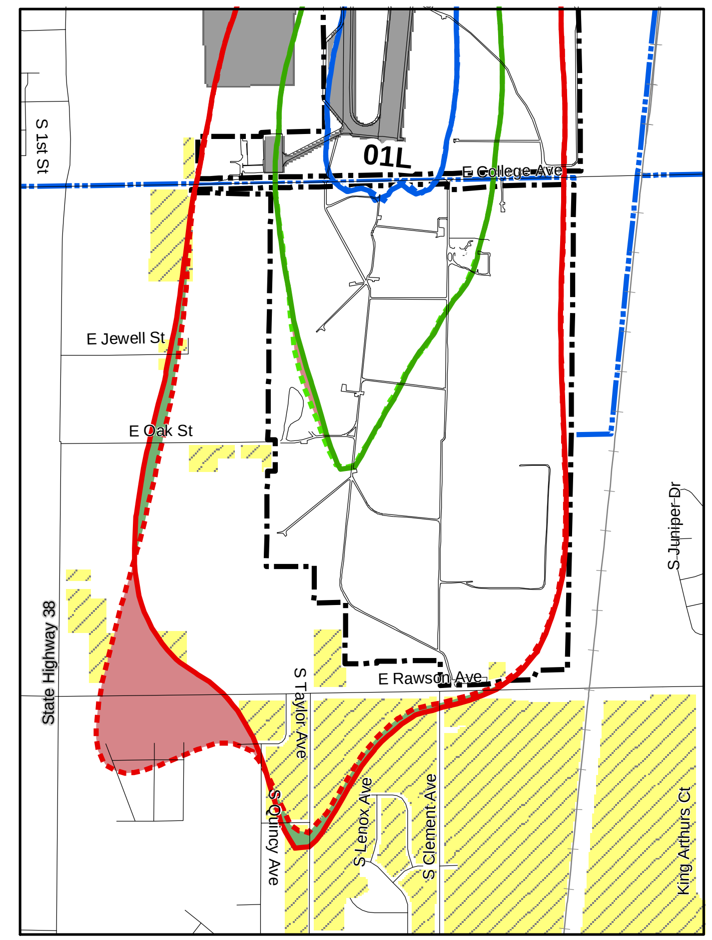
2009 Base Case

- CONTOUR_65-0
- CONTOUR_70-0
- CONTOUR_75-0
- Phase 1 Program Boundries

Alternative 1B

- 65 DNL Contour
- 70 DNL Contour
- 75 DNL Contour
- CORPORATE BOUNDARY
- AIRPORT BOUNDARY
- hospitals
- schools
- churches

Source: Milwaukee County, 2003



Runway End 01L Detail

North

0 1,000 2,000 4,000 Feet

Legend

- Newly affected
- No longer affected

MILWAUKEE COUNTY'S GENERAL MITCHELL INTERNATIONAL AIRPORT

THE BARNARD DUNKELBERG & COMPANY TEAM

Alternative 2
Develop Satellite Based Departure Procedures for Runway 7R
(East Departures, No Jet Aircraft Turns until Reaching Lake Michigan)

Goal:

This alternative was developed with the goal of reducing early departure turns by jet aircraft before reaching Lake Michigan. The goal of this alternative is to concentrate departures over a small area of compatible land use along the runway centerline, with no jet aircraft turning until reaching Lake Michigan.

Description:

This procedure would create a more defined and narrow flight path using FMS technology to concentrate aircraft flight tracks under the runway centerline. Aircraft would use the existing east-bound flight paths, but would utilize FMS technology to reduce dispersion over non-compatible use areas, such as residential.

Existing Procedures:

Aircraft depart Runway 7R and fly runway heading until reaching 2,000 feet above MSL. At this point, aircraft continue on course or turn left or right to the heading assigned by Air Traffic Control based upon destination.

New Procedure:

Aircraft would depart Runway 7R and fly runway heading using FMS way points until reaching the shoreline. After passing the shoreline, aircraft would continue on course or turn depending upon destination. With this procedure, aircraft would fly a narrower path than possible with the existing procedure. In addition, fewer jet aircraft would turn north or south before reaching the shoreline. Figure G4, *Alternative 2 Runway 7R Jet Departure Flight Tracks*, shows the new FMS flight path overlaid on the existing flight tracks.

New Procedure Noise Analysis:

Figure G5, *Comparison of Alternative 2, FMS East and 2009 Base Case DNL Contours*, shows the 65, 70, and 75 DNL noise contours associated with this alternative compared with the 2009 Base Case DNL noise contours. The Base Case contours are shown with a solid line; changes to the Base Case 2009 contour due to the alternative are shown as a dashed line. The land use and population changes associated with this alternative, compared to the future Base Case contour, are shown in Table G4, at the end of this chapter.

Alternative 2 could be used by 80 percent of the existing commercial jet aircraft fleet operating at General Mitchell International Airport. Military aircraft, older hush-kit aircraft, turbo-prop, and general aviation aircraft are not equipped to fly FMS procedures; as such, these aircraft would continue to fly their existing flight procedures. This alternative reduces the dispersion of the aircraft from the center flight path and reduces the number of early turns by turbojet aircraft. However, the alternative increases the size of the 65 DNL noise contour and the number of housing units and people in the 65 DNL noise contour. The Time Above 65 dBA metric is reduced by 2.4 minutes per day and the Number of Events above 65 dBA is reduced by 7.7 events per day east of the Airport.

Difference Compared to Base Case Contour:

Alternative 2 would result in the 65 DNL noise contour expanding to the east beyond Kirkwood Avenue to just about Somers Avenue, east of the Airport beyond the 2009 Base Case 65 DNL noise contour. The 65 DNL associated with Alternative 2 is the same as the 2009 Base Case 65 DNL in all other areas.

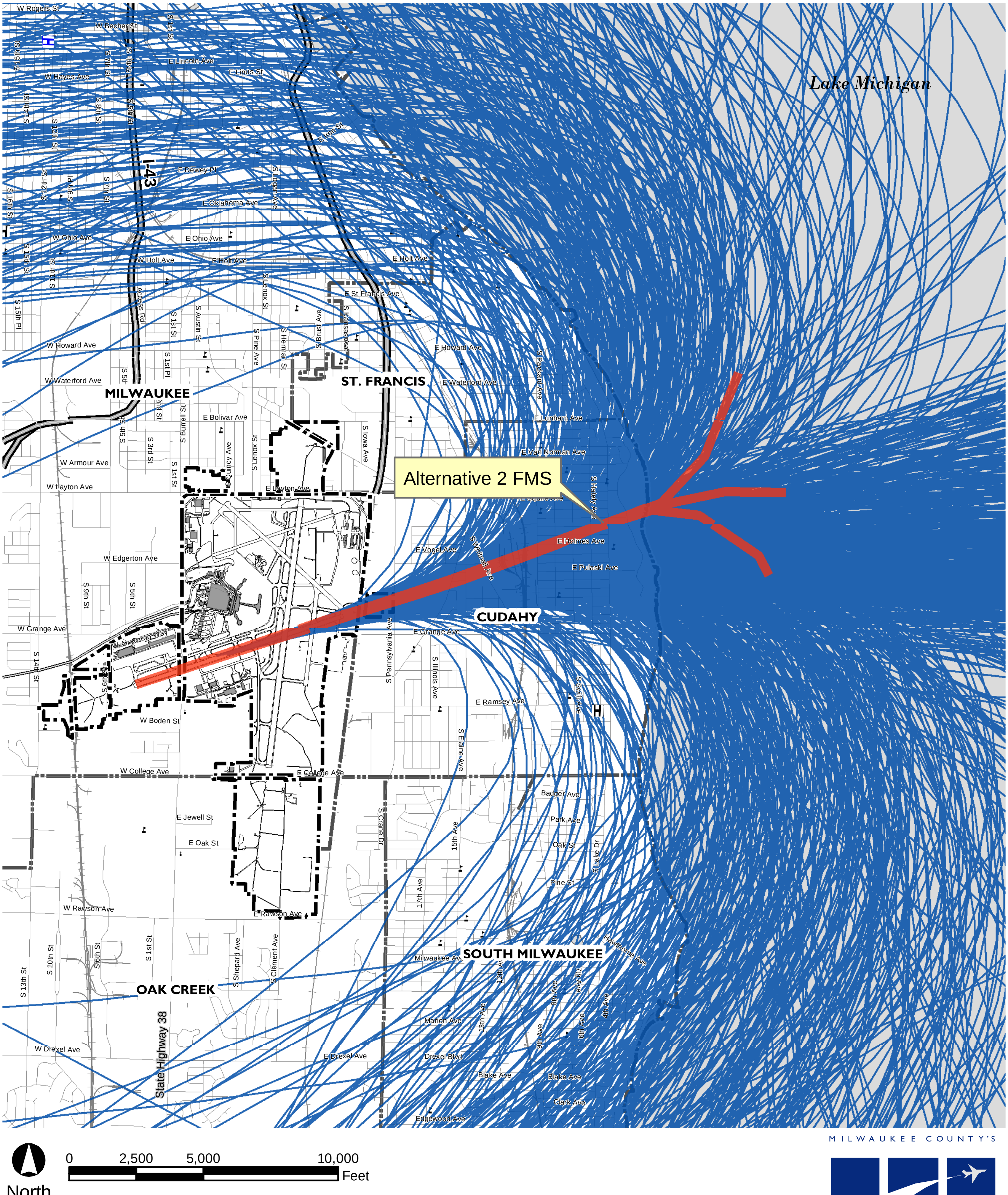


Figure G4 Alternative 2 INM Jet Departure Flight Tracks
Overlaid on Existing Runway 7R Radar Jet Departure Flight Tracks
(Representative sample of 1,200 jet departures during June 2003)

MILWAUKEE COUNTY'S GENERAL MITCHELL INTERNATIONAL AIRPORT

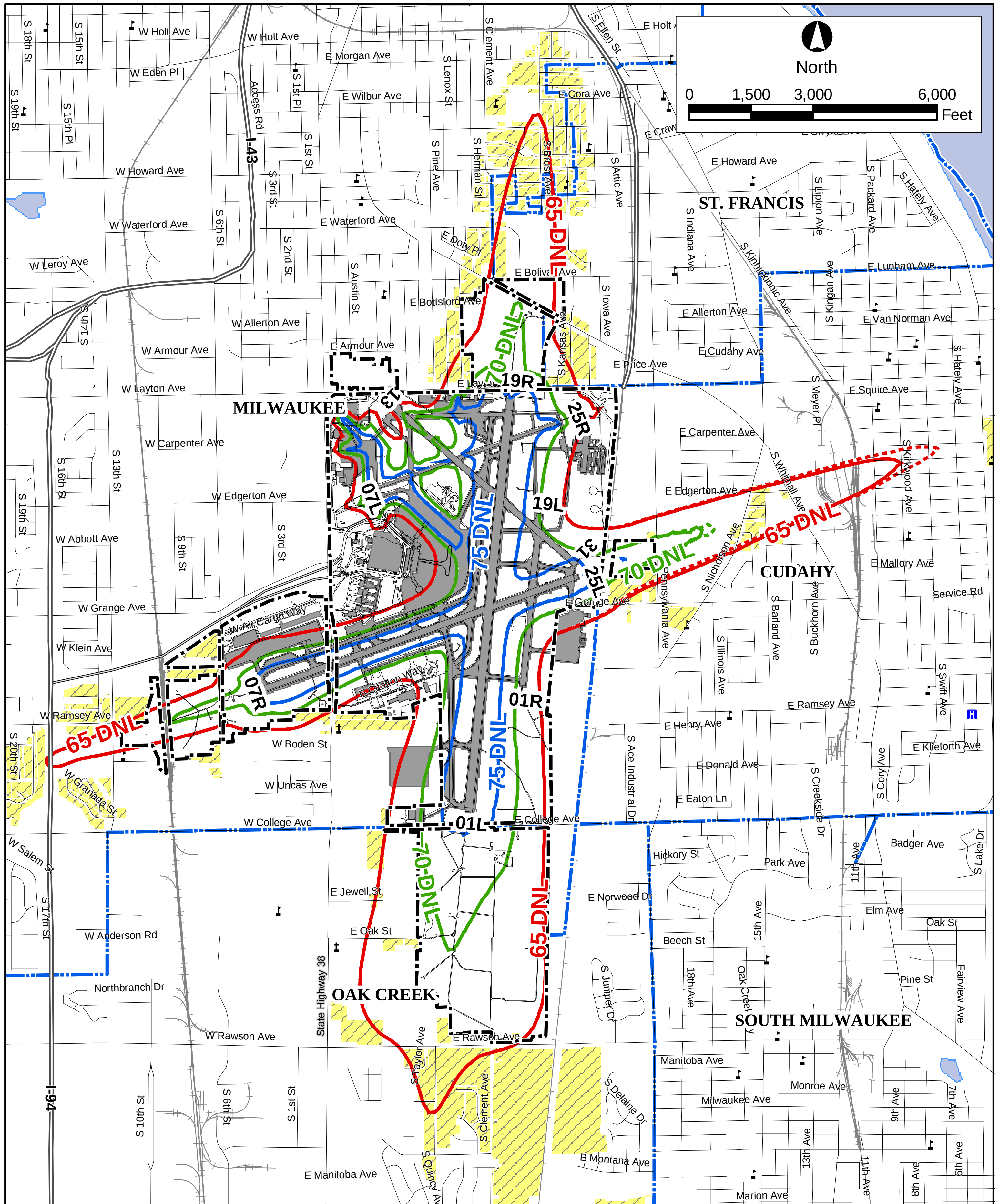


Figure G5
Comparison of
Alternative 2 FMS East DNL Contour &
2009 Base Case DNL Contour

Legend

2009 Base Case
- 65 DNL Contour
- 70 DNL Contour
- 75 DNL Contour

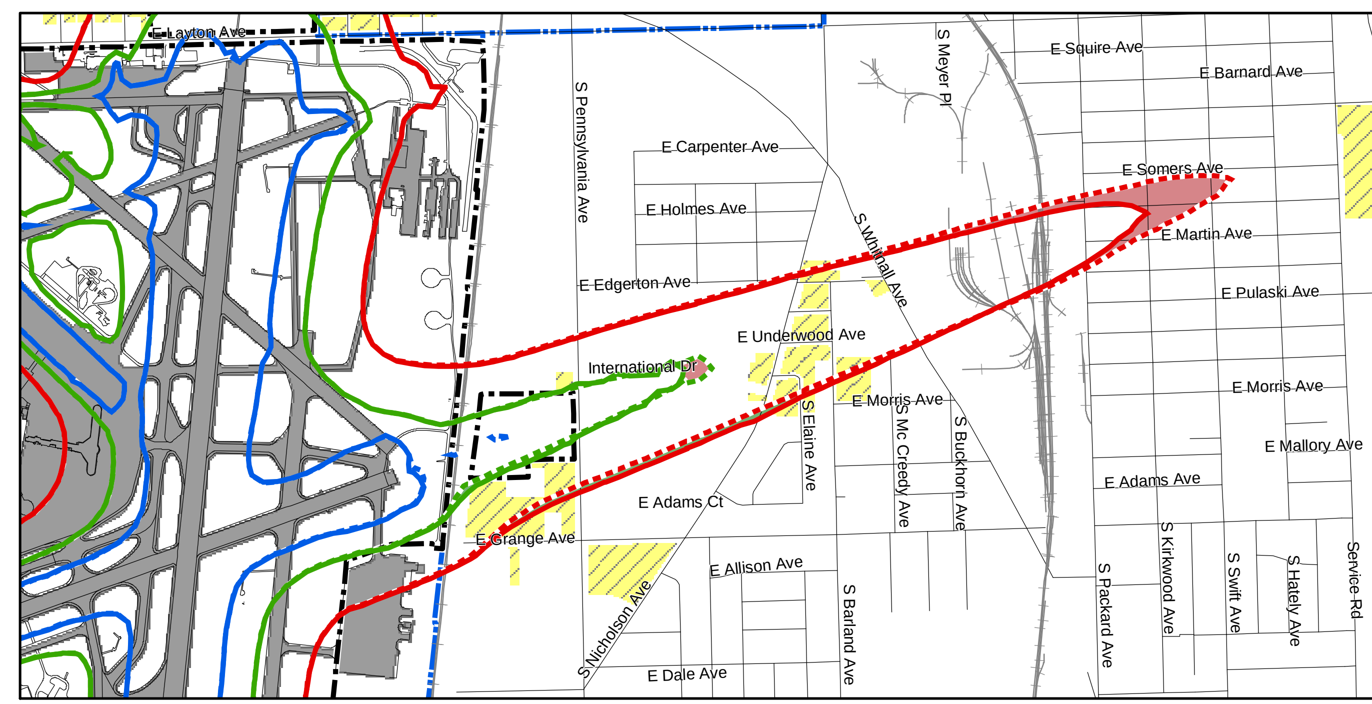
Alternative 2
- 65 DNL Contour
- 70 DNL Contour
- 75 DNL Contour
- Phase 1 Program Boundries
- CORPORATE BOUNDARY
- AIRPORT BOUNDARY
- hospitals
- schools
- churches

Source: Milwaukee County, 2003

Comparative Analysis

Areas within the limits of this alternative but not within the limits of the 2009 Base Case are shown in red.
65 DNL - Approx. 18 Acres
70 DNL - Approx. 4 Acres

Areas within the limits of the 2009 Base Case but not within the limits this alternative are shown in green.
65 DNL - Approx. 9 Acres
70 DNL - Approx. 3 Acres



Runway End 25 Detail

North

Legend
- Newly affected
- No longer affected

0 1,000 2,000 4,000 Feet

MILWAUKEE COUNTY'S GENERAL MITCHELL INTERNATIONAL AIRPORT

Alternative 3
Develop Satellite Based Departure Procedures for Runway 1L
(North Jet Departures)

Goal:

This alternative was developed with the goal to eliminate "drift" for aircraft departing initially to the north, but then turning east or west. The intent of the alternative is to take advantage of compatible land uses directly north of the Airport. The alternative would concentrate aircraft over the compatible land use close to the Airport and then disperse aircraft flight paths farther out from the Airport.

Description:

This procedure would create a more defined flight path using FMS technology to concentrate aircraft flight tracks over compatible land uses near the Airport. Aircraft would use the existing north-bound flight paths, but would use FMS technology to reduce dispersion over non-compatible use areas. Military aircraft, older hush-kit aircraft, smaller (non-commercial service) turbo-prop, and general aviation aircraft are not equipped with the necessary instruments to fly FMS procedures, and, as such, these aircraft would continue to fly their existing flight paths.

Existing Procedures:

Aircraft depart Runway 1L and fly runway heading until reaching 2,000 feet above MSL. At this point, aircraft continue on course or turn to the heading assigned by Air Traffic Control based upon destination.

New Procedure:

Aircraft would depart Runway 1L and fly runway heading using FMS technology until reaching 2,000 feet above MSL. At this point, aircraft would continue on course or turn left or right, depending upon destination. With this procedure, aircraft would fly a narrower path than what occurs with the existing procedure. In addition, fewer jet aircraft would turn east or west before reaching the minimum altitude goals. The minimum altitude goal before turning on course for the new procedure would be 2,000 feet above MSL. This is similar to the current procedure; but, with the new technology, there is less dispersion, and early turns at altitudes lower than 2,000 feet above MSL are minimized. Figure G6, *Alternative 3 Runway 1L Jet Departure Flight Tracks*, shows the new FMS flight path overlaid on the existing flight tracks.

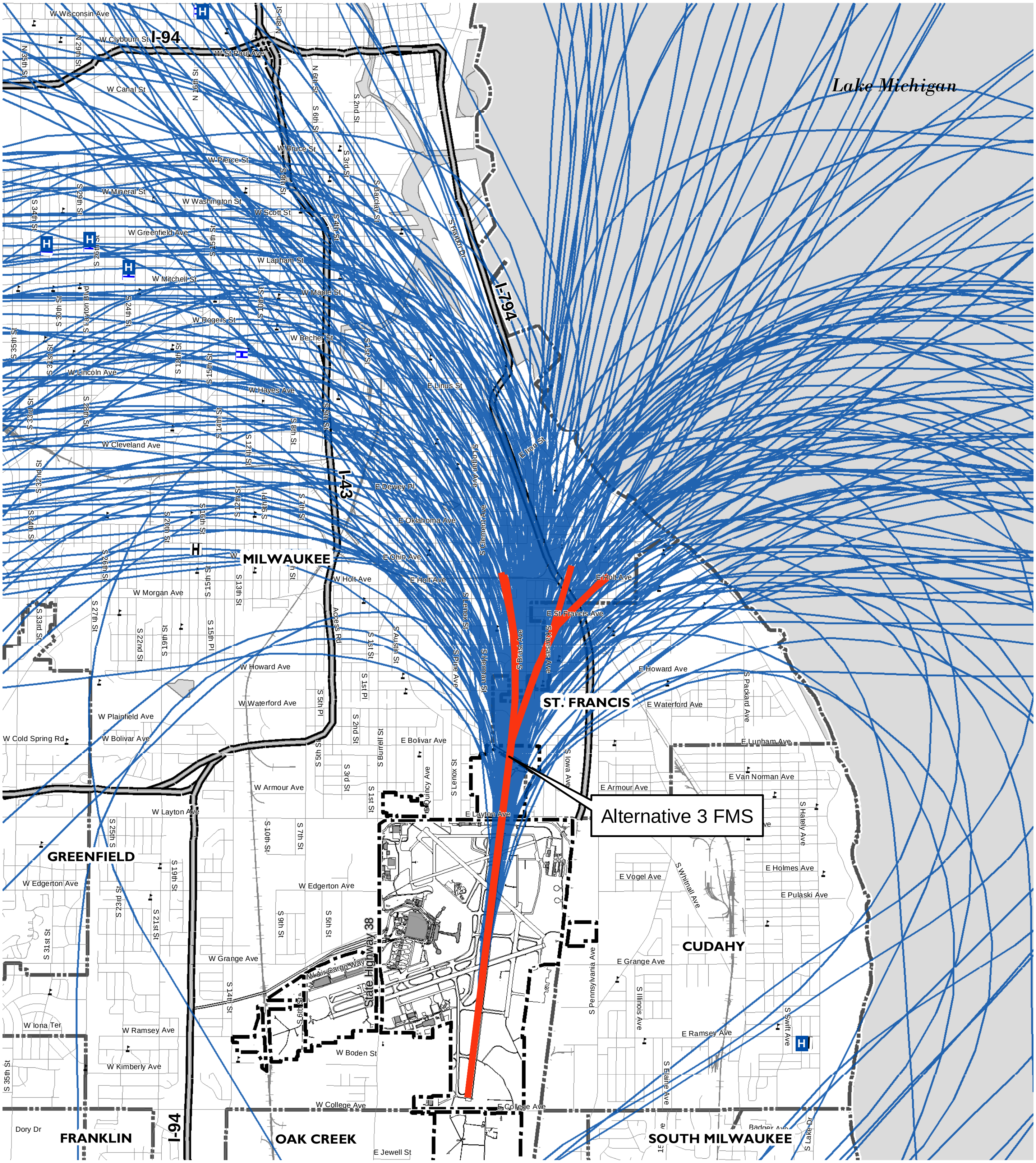
New Procedure Noise Analysis:

Figure G7, *Comparison of Alternative 3, FMS North DNL and 2009 Base Case DNL Contours*, shows the 65, 70, and 75 DNL noise contours associated with this alternative compared with the 2009 Base Case DNL noise contours. The Base Case contours are shown with a solid line; changes to the Base Case 2009 contour due to the alternative are shown as a dashed line. The land use and population changes associated with this alternative, compared to the future Base Case contour, are shown in Table G4, at the end of this chapter.

Alternative 3 could be used by 80 percent of the existing commercial jet aircraft fleet operating at General Mitchell International Airport. Military aircraft, older hush-kit aircraft, turbo-prop, and general aviation aircraft are not equipped to fly FMS procedures; as such, these aircraft would continue to fly their existing flight procedures. This alternative would increase the total number of housing units within the 65 DNL noise contour by 39 when compared to the 2009 Future Base Case contour; however, there would be no increase in non-compatible housing units (i.e. those that have not been sound attenuated). The Time Above metric increases by less than 1 minute per day; the Events Above 65 dBA metric shows an increase of 3.7 events per day northeast of the Airport and a decrease of 4.9 events per day northwest of the Airport.

Difference Compared to Base Case Contour:

Alternative 3 would result in the 65 DNL noise contour expanding north of the Airport beyond Saveland Avenue when compared against the 2009 Base Case 65 DNL noise contour. The 65 DNL associated with Alternative 3 is the same as the 2009 Base Case 65 DNL in all other areas.



North

0 2,500 5,000 10,000
Feet

Figure G6 Alternative 3 INM Jet Departure Flight Tracks
Overlaid on Existing Runway 1L Radar Jet Departure Flight Tracks
(Representative sample of 300 jet departures during June 2003)

MILWAUKEE COUNTY'S
GENERAL
MITCHELL
INTERNATIONAL AIRPORT

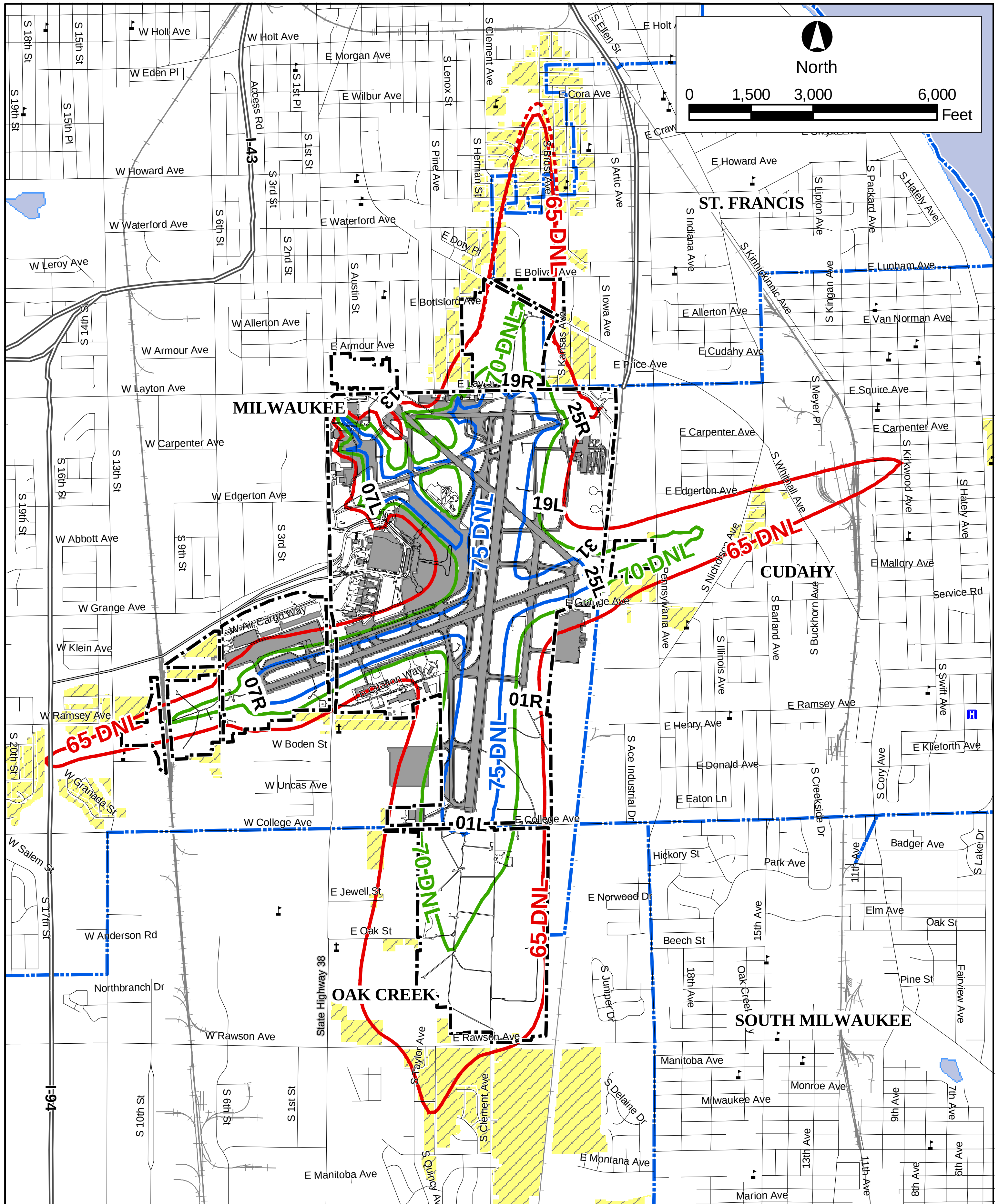
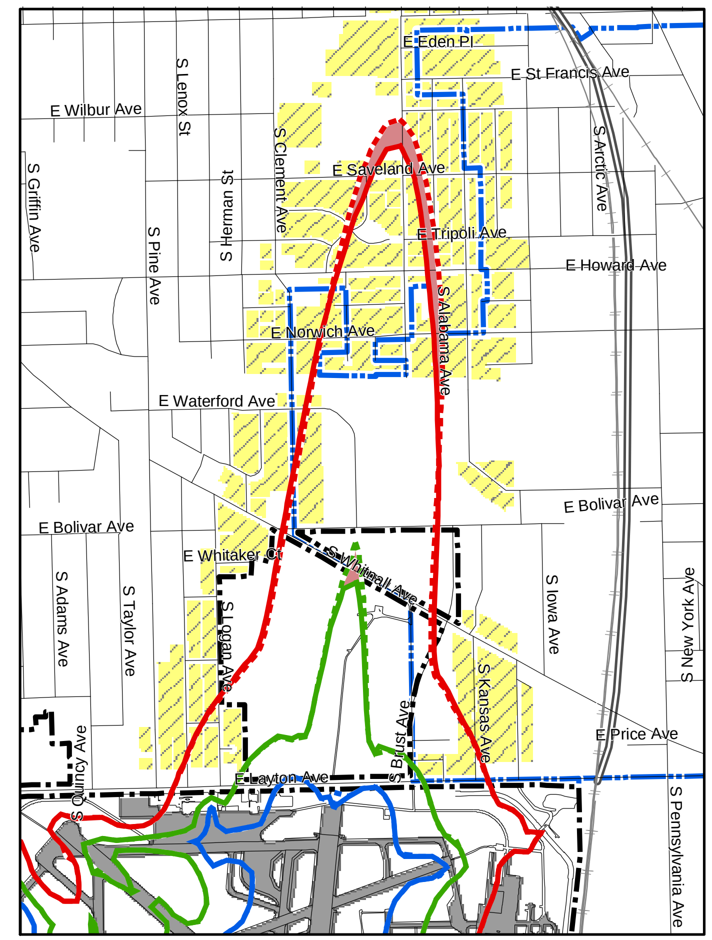


Figure G7
Comparison of Alternative 3 FMS North DNL Contour & 2009 Base Case DNL Contour

Comparative Analysis

Areas within the limits of this alternative but not within the limits of the 2009 Base Case are shown in red.
65 DNL - Approx. 11 Acres
70 DNL - Approx. 2 Acres

Areas within the limits of the 2009 Base Case but not within the limits this alternative are shown in green.
65 DNL - Approx. 4 Acres



Runway End 19R Detail

North

0 1,000 2,000 4,000 Feet

Legend
- Newly affected
- No longer affected

Legend

2009 Base Case
- 65 DNL Contour
- 70 DNL Contour
- 75 DNL Contour

Alternative 3
- 65 DNL Contour
- 70 DNL Contour
- 75 DNL Contour
- Phase 1 Program Boundries
- CORPORATE BOUNDARY
- AIRPORT BOUNDARY
- hospitals
- schools
- churches

Source: Milwaukee County, 2003

MILWAUKEE COUNTY'S GENERAL MITCHELL INTERNATIONAL AIRPORT

Alternative 4
Develop Satellite Based Departure Procedures for Runway 25L
(South Jet Departures)

Goal:

This alternative was developed with the goal to eliminate "drift" from jet departures on Runway 25L. The goal of this alternative is to concentrate turbojet aircraft over a small area along the runway centerline and other compatible land uses southwest of the Airport. The flight paths under consideration are west departures on Runway 25L that turn to the south. West departures that head west or turn north would not be modified, because no large compatible land use corridors are present.

Description:

This procedure would create a more defined and narrow flight path using FMS technology to concentrate aircraft flight tracks along the extended runway centerline and to the south. Aircraft would use the existing west departure and then turn southbound while using FMS technology to reduce dispersion over non-compatible use areas. Military aircraft, older hush-kit aircraft, turbo-prop, and general aviation aircraft are not equipped with the necessary instruments to fly FMS procedures; as such, these aircraft would continue to fly their existing flight paths. West departures not turning south would continue to use existing departure procedures after reaching 2,000 feet MSL.

Existing Procedures:

Aircraft depart Runway 25L and fly runway heading until reaching 2,000 feet MSL. At this point, aircraft continue on course or turn left or right to the heading assigned by Air Traffic Control based upon destination. A new procedure would be developed for those aircraft turning to the south.

New Procedure:

Aircraft would depart Runway 25L and fly runway heading using FMS way points. The flight procedure would be written such that aircraft flying to southern destinations would then turn southward using FMS way points at about 2 ½ miles from the start of takeoff, as shown in Figure G8. Aircraft turning south would fly a narrower path following a concentration of compatible land uses. Aircraft with a western or northern destination would continue to fly the existing departure procedure. Figure G8, *Alternative 4 Runway 25L Jet Departure Flight Tracks, South Turn*, shows the new FMS flight path overlaid on the existing flight tracks.

New Procedure Analysis:

Figure G9, *Comparison of Alternative 4, FMS West DNL Contour and 2009 Base Case DNL Contours*, shows the 65, 70, and 75 DNL noise contours associated with this alternative compared with the 2009 Base Case DNL noise contours. The Base Case contours are shown with a solid line; changes to the Base Case 2009 contour due to the alternative are shown as a dashed line. The land use and population changes associated with this alternative, compared to the future Base Case contour, are shown in Table G4, at the end of this chapter.

Alternative 4 could be used by 80 percent of the existing commercial jet aircraft fleet operating at General Mitchell International Airport; exceptions are the older hush-kit jet aircraft that do not have the necessary navigation instruments. This alternative would reduce the number of early turns by turbojet aircraft. The number of total housing units and people in the 65 DNL noise contour would be slightly reduced; however, the number of non-compatible housing units would remain the same. The Time Above metric ranges from an increase of 1.1 minutes per day above 65 dBA to a decrease of 0.4 minutes per day. The Number of Events metric ranges from an increase of 4.1 events per day and a decrease of 1.9 events per day.

Difference Compared to Base Case Contour:

Alternative 4 is essentially identical to the 2009 Base Case noise contour. There are no perceivable differences in the 65 DNL associated with either Alternative 4 or the 2009 Base Case noise contour.

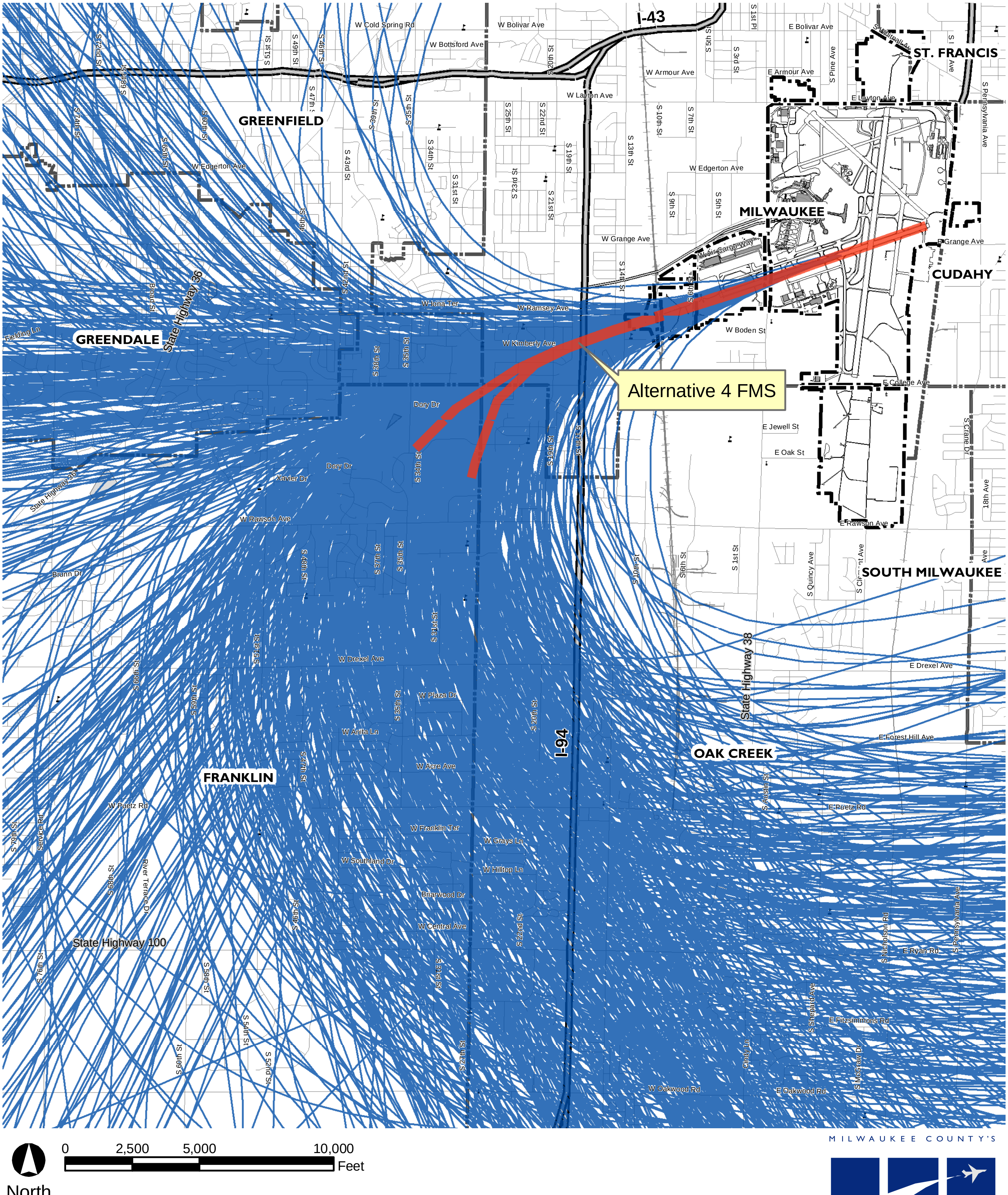
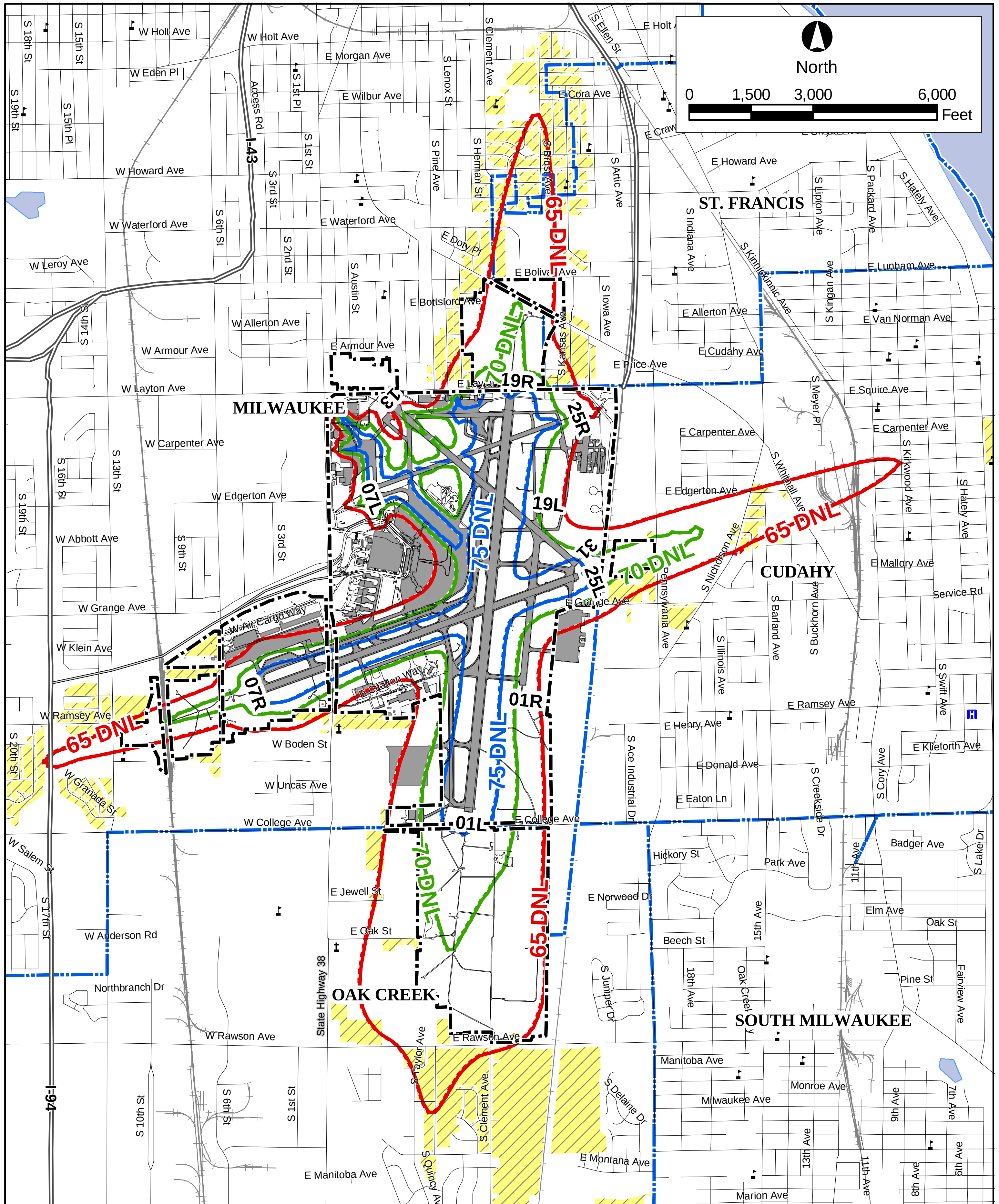
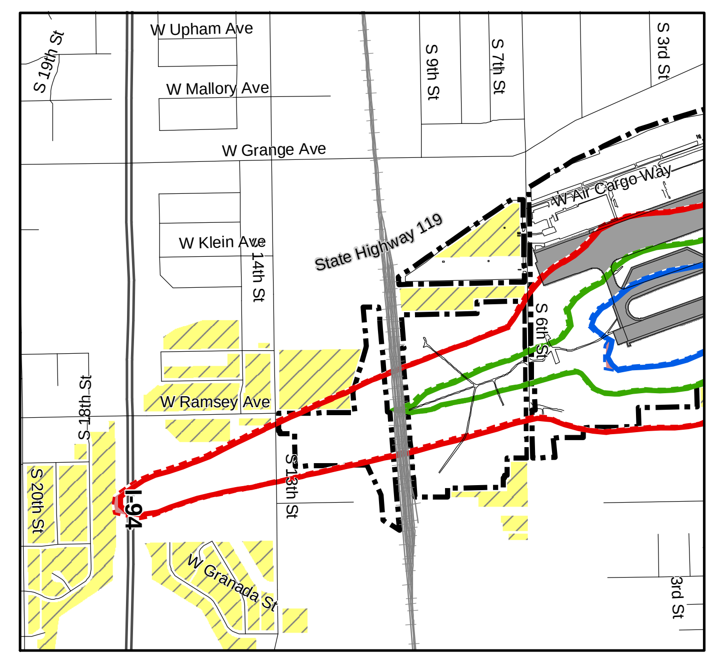


Figure G8 Alternative 4 Runway 25L INM Jet Departure Flight Tracks, South Turn Overlaid on Existing Radar Flight Tracks for Runway 25L Jet Departures (Representative sample of 1000 jet departures during June 2003)

MILWAUKEE COUNTY'S GENERAL MITCHELL INTERNATIONAL AIRPORT





Runway End 07R Detail

North

Legend

Newly affected

0 1,000 2,000 4,000 Feet

Figure G9
Comparison of
Alternative 4 FMS West DNL Contour &
2009 Base Case DNL Contour

Legend

2009 Base Case

- 65 DNL Contour
- 70 DNL Contour
- 75 DNL Contour

Alternative 4

- 65 DNL Contour
- 70 DNL Contour
- 75 DNL Contour
- Phase 1 Program Boundries
- CORPORATE BOUNDARY
- AIRPORT BOUNDARY
- hospitals
- schools
- churches

Source: Milwaukee County, 2003

Comparative Analysis

Areas within the limits of this alternative but not within the limits of the 2009 Base Case are shown in red.
65 DNL - Approx. 5 Acres
70 DNL - Approx. 3 Acres
75 DNL - Approx. 4 Acres

MILWAUKEE COUNTY'S GENERAL MITCHELL INTERNATIONAL AIRPORT

Alternative 5
Evaluate Altitude of Small Propeller Aircraft Departures

Goal:

The goal of this alternative is to increase the altitude over residential neighborhoods of small propeller aircraft departing from the Airport. Increasing the altitude would likely result in reduced single event sound exposure noise levels from these aircraft operations.

Description:

This alternative evaluates methods of how to increase the departure altitude of small propeller aircraft departing the Airport. While the majority of these aircraft are at, or above, 500 feet above field elevation (AFE), some slow-climbing aircraft turn before reaching this altitude. In addition to increasing the altitude at which these propeller aircraft turn, it would also reduce the early turns by defining a specific altitude where the turn should occur.

Existing Procedure:

Small propeller aircraft generally depart the Airport at various altitudes; however, at times, they execute early turns during slow climb outs over residential neighborhoods. Propeller aircraft, during busy times, do not always depart and fly runway heading until reaching 500 feet AFE. Figure G10, *Alternative 5 Existing Flight Tracks, Small Propeller Departures Runway 7L*, shows the dispersion of these aircraft on departure from Runway 7L.

New Procedure:

Small propeller aircraft would fly runway heading until reaching at least 500 feet AFE, or until reaching a designated landmark assigned through coordination with FAA air traffic control. At that point, the aircraft would turn towards its destination. This procedure would be used during periods of lower activity levels, for operations on the smaller runways during visual meteorological conditions, or when aircraft are able to make visual contact with the designated landmark. Since the majority of these operations are from aircraft operators that regularly fly in and out of General Mitchell International Airport, a pilot awareness brochure could be developed through a fly quiet program to work with the chief pilots to educate them on this noise issue.

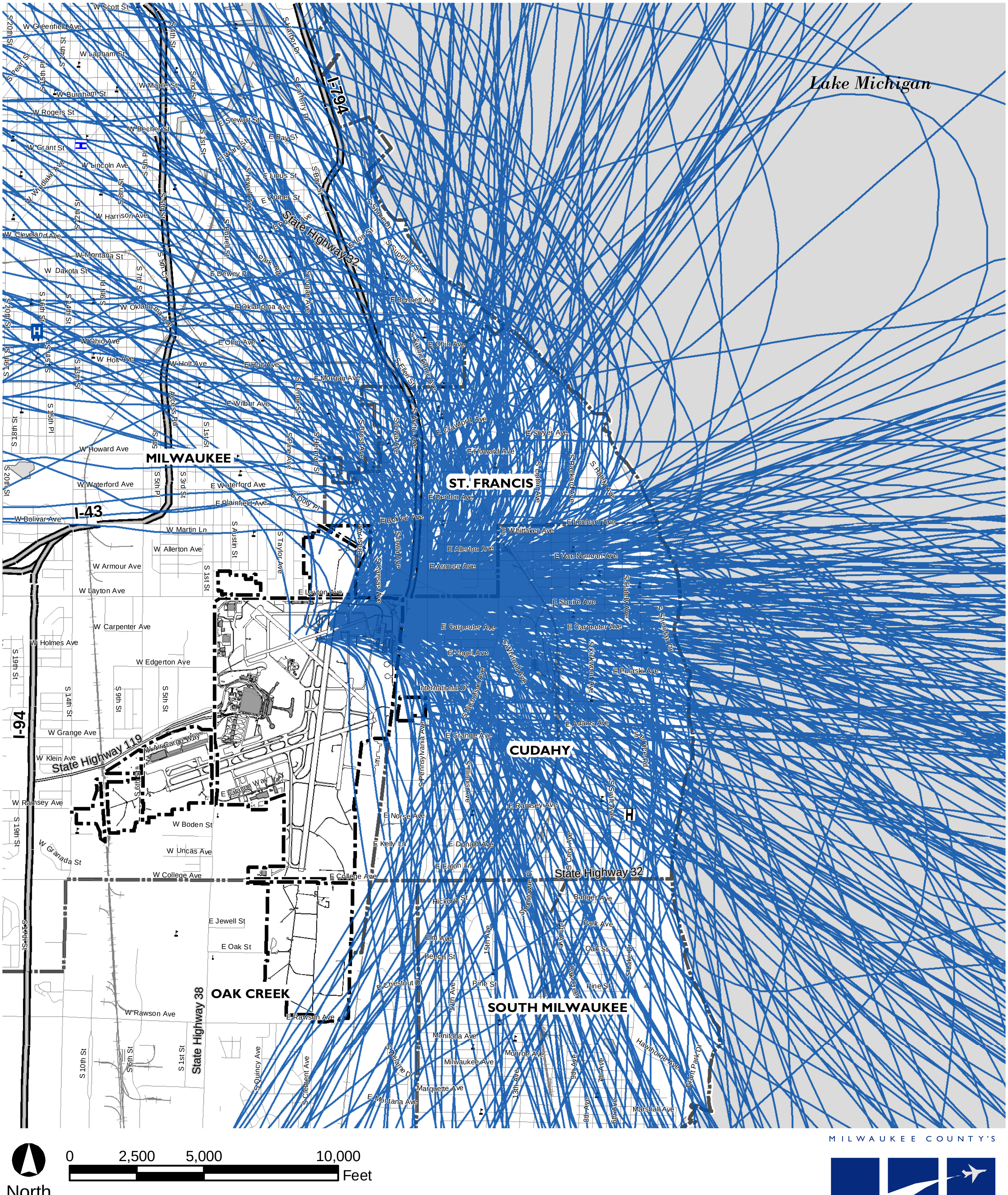
New Procedure Noise Analysis:

This alternative would not alter the DNL noise contours, but could have a beneficial effect by reducing annoyance from single event flyovers.

This alternative could potentially reduce the single event noise levels from 2 to 4 dBA. While many aircraft are already at, or above, 500 feet AFE, the alternative is designed to increase the altitude of the lowest aircraft. Typically, these aircraft generate the highest single event noise levels associated with these operations. Alternative 5 is dependent on Air Traffic Control workload and availability to have aircraft fly runway heading until 500 feet AFE. If an aircraft needs to expedite its departure, the aircraft might need to be turned early in order to keep them in the proper sequence.

Difference Compared to Base Case Contour:

No DNL contours were developed for this alternative.



MILWAUKEE COUNTY'S GENERAL MITCHELL INTERNATIONAL AIRPORT

Figure G10 Alternative 5 Existing Radar Flight Tracks, Small Propeller Departures Runway 7L

(Representative sample of 500 propeller aircraft departures during Second Quarter 2003)

Alternative 6
Develop Procedures to Reduce Early Turns on Approach for Small Propeller Aircraft.

Goal:

The goal of this alternative is to avoid flying over residential areas by reducing early turns by small propeller aircraft on approach. This occurs when propeller aircraft "cut the corner" for a short approach and fly low over non-compatible land uses. These early turns are done for a variety of reasons including weather minimums, pilot convenience, and to assist in the sequencing of landing aircraft during high activity periods.

Description:

This alternative evaluates procedures to reduce the number of early turns by small propeller aircraft on arrival. At times, these aircraft are flying level at 500 feet AFE for long periods to intercept the glide slope. This alternative is designed to minimize the time these aircraft are flying low when approaching to land.

Existing Procedures:

Small propeller aircraft fly at relatively low altitudes (500 to 1,000 feet AFE) when approaching the Airport so that they are easily sequenced in with landing jet or other high performance aircraft. Figure G11, *Alternative 6 Existing Flight Tracks, Small Propeller Arrivals Runway 25R*, shows the dispersion and occasional early turns of the small propeller aircraft arriving on Runway 25R.

New Procedure:

Aircraft would not begin a turn to the final approach leg until crossing a designated location (shoreline, way point, intersection, or landmark) at, or above, 500 feet AFE. When small propeller aircraft are approaching the Airport, they would not descend early to this altitude and over-fly for long distances at level altitude. Instead, these aircraft would fly the three (3) degree glide slope to descend at a constant rate. Since the majority of these operations are from aircraft operators that regularly fly in and out of General Mitchell International Airport, a pilot awareness brochure could be developed to work with the chief pilots to educate them regarding this specific measure.

New Procedure Noise Analysis:

This alternative would not alter the DNL noise contours, but could have beneficial effects by reducing annoyance from single event flyovers.

This alternative would potentially reduce the single event noise levels from 2 to 4 dBA. While many aircraft are already at, or above, this altitude, the alternative is designed to increase the altitude of the lowest aircraft. Typically, these aircraft generate the highest single event noise levels associated with these low-level operations. Alternative 6 is dependent on Air Traffic Control workload, and, if Air Traffic Control needs to expedite an arrival, the aircraft might need to be brought to a lower altitude in order to keep aircraft in the proper sequence.

Difference Compared to Base Case Contour:

No DNL contours were developed for this alternative.

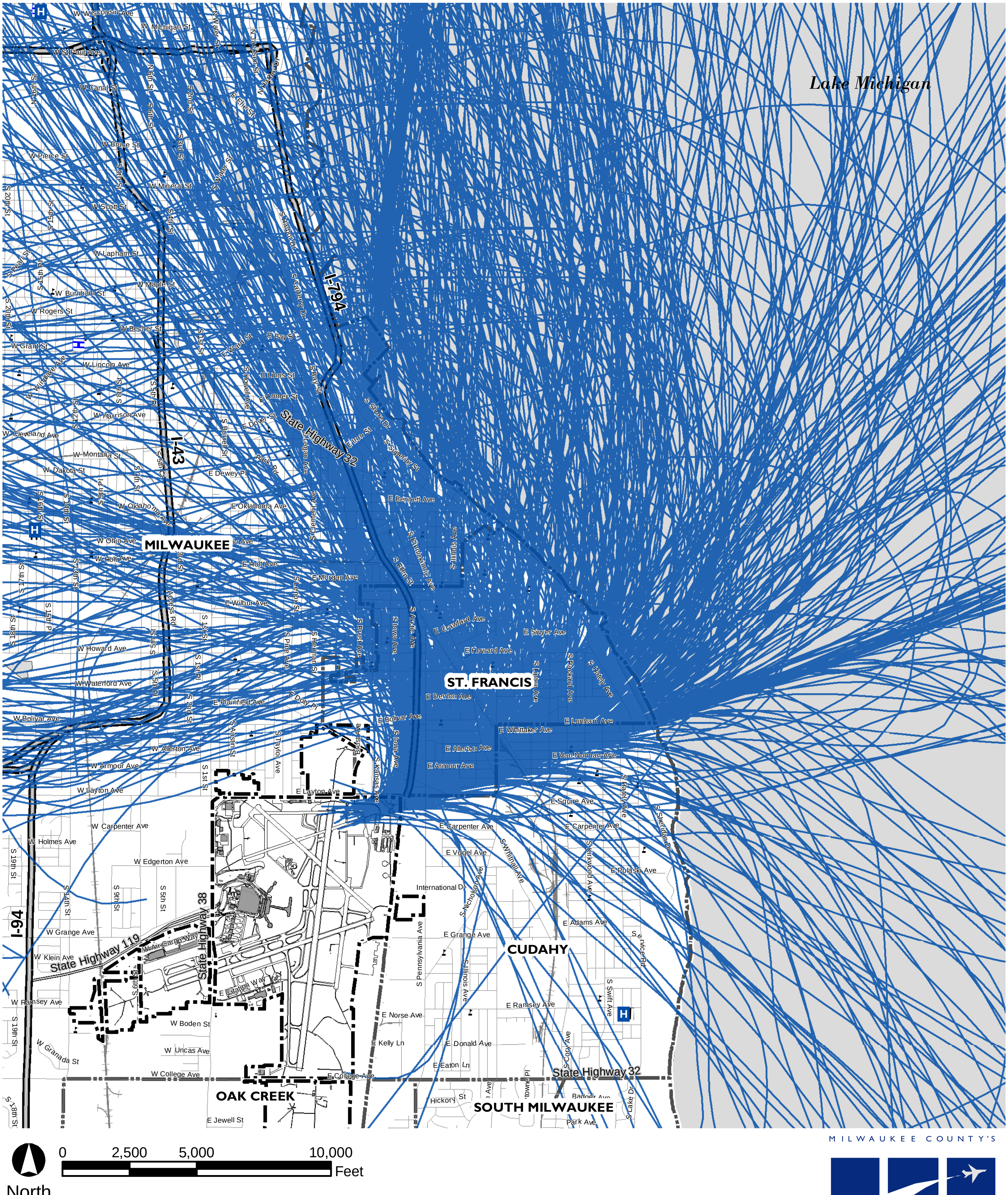


Figure G11 Alternative 6 Existing Radar Flight Tracks, Small Propeller Arrivals Runway 25R

(Representative sample of 800 propeller aircraft arrivals during Second Quarter 2003)

MILWAUKEE COUNTY'S GENERAL MITCHELL INTERNATIONAL AIRPORT

Alternative 7
Evaluate Close-in and Distant Departure Procedures

Goal:

The goal of this alternative is to reduce single event noise levels from commercial jet departures over residential land uses by utilizing the appropriate thrust cutback departure procedure, which would result in the lowest noise levels in the community. The departure procedure is based upon FAA Noise Abatement Departure Profile (NADP), as detailed in FAA Advisory Circular (AC) 91-53A.

Description:

In 1993, the Federal Aviation Administration revised AC 91-53 (1978) to describe two standard departure profiles for turbojet aircraft over 75,000 lbs. These departure profiles described as "close-in" and "distant" have the potential to minimize airplane noise impact on communities surrounding airports by modifying distance and altitude for application of full takeoff power, engine thrust cutback, and re-application of normal climb thrust.

The close-in departure typically reduces noise closer to an airport, but may increase noise farther from an airport (8 to 10 miles away). Conversely, the distant procedure concentrates noise closer to an airport (within 3 to 6 miles), but reduces noise farther away.

Existing Procedures:

Radar data obtained for General Mitchell International Airport indicates that aircraft thrust cutback typically occurs at 1,000 to 1,200 feet above field elevation (AFE). The current departure climb procedure is applicable to most commercial jet aircraft that operate at the Airport. Takeoff power (full power) is applied until reaching about 1,000 feet above airfield elevation (AFE), at which point the power is cut back to a reduced climb power. Regular climb power is re-applied when reaching an altitude of 3,000 feet AFE.

New Procedure:

Alternative 7 examines two departure scenarios, a close-in departure and a distant departure. The departure procedures would be determined for the Airport by each airline for every aircraft type operated, within the limits determined in the Advisory Circular.

FAA AC 91-53A specifies that normal climb power be re-applied at an altitude of 3,000 feet above field elevation (AFE), or above, or when the airplane has been fully transitioned to the en-route configuration (whichever occurs first). At General Mitchell International Airport, the re-application of normal climb thrust would occur in the vicinity of 3 to 6 statute miles from the beginning of takeoff. Locations where normal climb thrust is re-applied may experience an increase in noise above what would be experienced during a typical departure, due to lower aircraft altitude and the re-application of normal climb thrust.

Close-In Departure Procedure: Full power is applied until reaching an altitude of 800 feet, and then the thrust is cut back until reaching 3,000 feet, where climb power would be re-applied. Figure G12 shows the points where a typical MD83 reaches 800 feet AFE, and then 3,000 feet AFE when using the close-in procedure.

Distant Departure Procedure: The "distant" departure procedure is a variant on the current Airport departure - the difference being that the initial full power would remain until aircraft reach an altitude of 1,500 feet AFE before thrust cut back. Similar to the previous procedures, full power would again resume at an altitude of 3,000 feet AFE. Figure G12 shows the points where a typical MD83 reaches 1,500 feet, and then 3,000 feet AFE when flying this procedure.

Following is a summary of each Noise Abatement Departure Profile variant:

1. Current Airport Departure Procedure: At present, pilots apply takeoff power until reaching about 1,000 to 1,200 feet AFE, when they cut back power to reduce noise levels on the ground. Regular climb power is re-applied when reaching an altitude of 3,000 feet AFE.

2. Close-In Departure Procedure: Using this procedure, aircraft would apply full power until reaching an altitude of 800 feet AFE when they cut back and re-apply regular power at 3,000 feet AFE.

3. Distant Departure Procedure: This procedure is a variant on the current Airport departure - the only difference being that full power would remain until aircraft reach an altitude of 1,500 feet AFE before the cutting back. Regular power would again resume at an altitude of 3,000 feet AFE.

New Procedure Noise Analysis:

The noise analysis for Alternative 7 is conducted by comparing the single event noise levels for each procedure, and a determination of the population within the 85 SEL noise contour, shown in Table G1. The change in the single event noise levels, as expressed in SEL between the existing procedure and both the close-in and distant procedures, was determined. Annual DNL noise contours were not developed for this alternative because the potential changes in noise are best illustrated using a single event noise analysis. The analysis was based upon a heavy MD83 aircraft departing north on Runway 1L. Figure G12*, Alternative 7, Typical MD 83 Close-in and Distant Departure Procedure Points,* graphically depicts the close-in and distant points. The MD83 is one of the loudest aircraft operating at the Airport, and is also a relatively slow-climbing aircraft as compared to new-generation aircraft. Newer generation aircraft climb much quicker, and there is less difference between procedures.

Table G1
EXISTING, CLOSE-IN, AND DISTANT DEPARTURE PROCEDURES
POPULATION COUNT COMPARISONS
(MD83 Departure Northward on Runway 1L)
General Mitchell International Airport FAR Part 150 Noise Compatibility Study

Departure Procedure	Population within 85 SEL Contour	Population within 90 SEL Contour	Population within 95 SEL Contour	Population within 100 SEL contour	Population within 105 SEL contour
Existing	26,089	15,837	4,865	338	0
Close-In	24,949	15,393	6,123	227	0
Distant	28,024	16,806	4,971	428	0

The above population numbers are cumulative. In other words, the population within the 85 SEL contains the population in the 90, 95, 100, and 105 SEL contours.

For the close-in departure procedure, there is a noise decrease in the areas close to the Airport, where the SEL noise levels would decline by -0.1 to -1.4 dBA. The areas more distant to the Airport would experience an increase in the SEL noise of +0.0 to +0.8 dBA.

For the distant departure procedure, there is a noise decrease in the areas more distant from the Airport where the SEL noise levels would decline by -0.1 to -0.9 dBA. The areas close to the Airport would experience an increase in SEL noise of +0.1 to +2.1 dBA. These results are presented in Table G2 for the north Representative Grid Locations that are presented in Figure G17.

Table G2

CHANGE IN NOISE GRIDS (ALTERNATIVE 7)
EXISTING PROCEDURE SEL VS. CHANGE IN SEL WITH ALTERNATIVE PROCEDURES
(MD83 Departure Northward on Runway 1L)
General Mitchell International Airport FAR Part 150 Noise Compatibility Study

Grid ID	Existing Procedure SEL	Change in SEL with Close In Procedure	Change in SEL with Distant Procedure
N11	81.9	-0.1	0.0
N12	83.8	-1.0	0.2
N13	83.7	-0.8	2.1
N14	85.8	-0.5	0.9
N15	89.9	0.0	-0.1
N21	97.6	0.0	0.0
N22	95.9	-1.1	0.1
N23	94.2	-0.3	1.9
N24	95.7	0.5	-0.3
N25	95.0	0.8	-0.9
N31	91.8	0.0	-0.1
N32	94.0	-1.4	0.0
N33	91.8	-0.4	1.9
N34	88.9	-0.2	1.1
N35	85.1	-0.3	0.5
N41	80.2	-0.1	0.0
N42	82.2	-1.3	0.3
N43	81.1	-0.9	2.0
N44	79.5	-0.5	2.1
N45	77.5	-0.6	1.2

Difference Compared to Base Case Contour:

No DNL noise contours were developed for this alternative because the potential differences are best illustrated using SEL analysis described above.

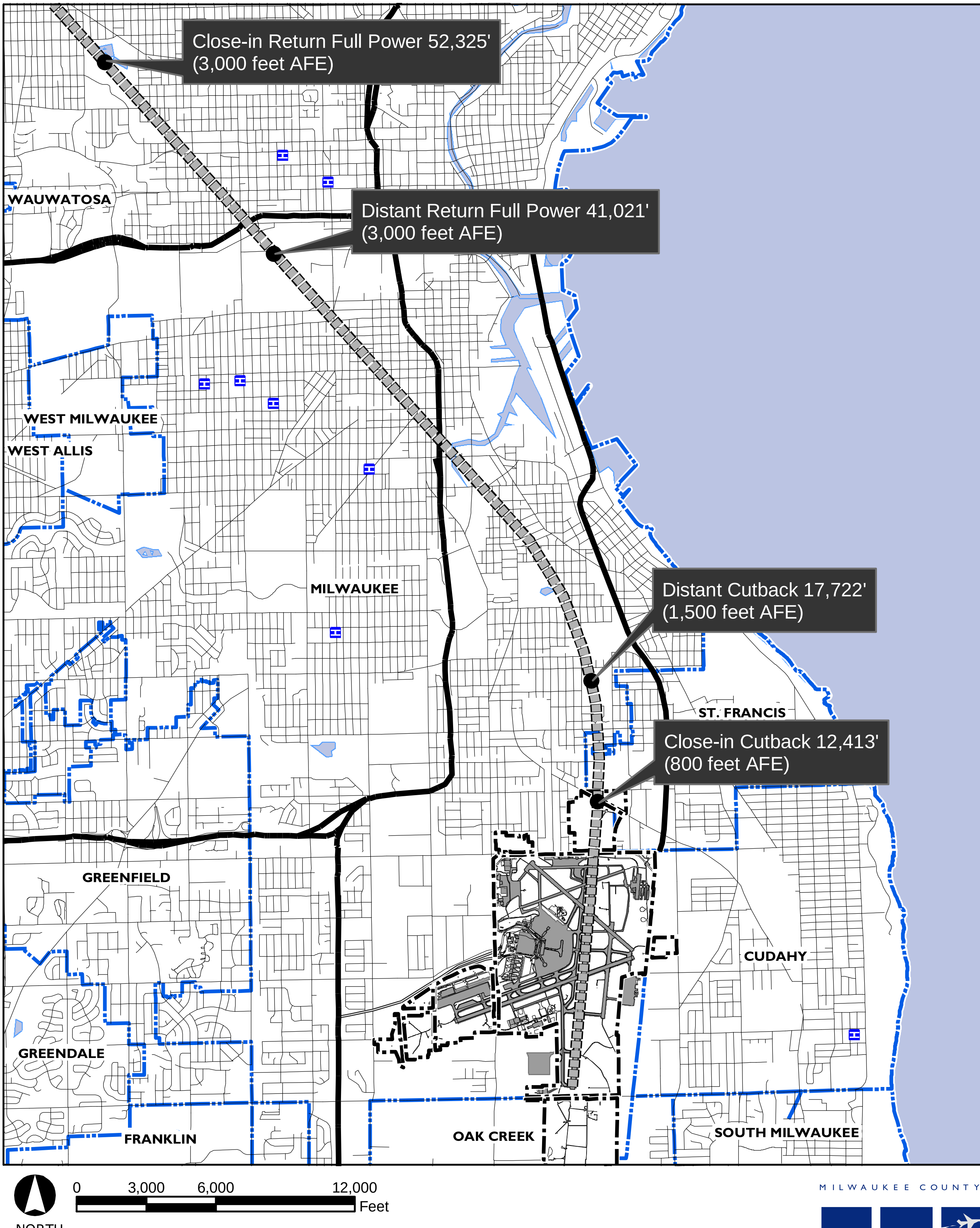


Figure G12
Alternative 7
Typical MD83 Close-in and Distant Departure Procedure Points (Departure 1L)

MILWAUKEE COUNTY'S GENERAL MITCHELL INTERNATIONAL AIRPORT

Alternative 8
Intersection Departures for South-Bound Departures at Night

Goal:

The goal of this alternative is to reduce jet takeoff and taxi noise in the neighborhood north of the Airport, especially during the night hours of 10 p.m. to 6 a.m., by having aircraft depart at the intersection of Runway 19R and taxiway Victor.

Description:

Airports can use intersection departures during hours of low activity as a noise abatement option. When weather and runway conditions are appropriate, some jets may be able to start their takeoff roll at a point south of the northern runway end, as opposed to the normal location at the north threshold of the runway.

Existing Procedure:

Aircraft that depart on Runway 19R typically depart at the end of Runway 19R, using the full length of the runway for the departure. Per FAA Order 7110.22T, there are no intersection departures permitted at General Mitchell International Airport by jet aircraft between the hours of 10 p.m. to 6 a.m. Intersection departures are allowed during the daytime hours to allow for use of Runway 7L/25R, which is restricted if the full length of Runway 01L/19R is used.

New Procedure:

Aircraft would start the departure roll at the taxiway Victor, or "V" intersection, approximately 1,090 feet south of the Runway 19R threshold. Figure G13*, Victor Departure Point,* presents an aerial photo that illustrates the runway end and the taxiway Victor departure point. This procedure would result in less aircraft noise in communities north of the Airport. This would apply only to aircraft that are able to depart on the resulting shorter runway. Aircraft using the intersection Victor departure would have 8,600 feet of useful runway for departures. It is estimated that 70 percent of the aircraft that operate at the Airport would be able to use the intersection departure procedure. While an aircraft is capable of executing an intersection departure, use of the procedure would depend on pilot discretion, as well as wind, weather conditions, and aircraft loading.

New Noise Procedure Analysis:

Figure G14, *Comparison of Alternative 8, Intersection Departures South DNL Contours and 2009 Base Case DNL Contour,* shows the 65 and greater DNL noise contours associated with this alternative. The land use and population changes associated with this alternative, compared to the future Base Case contour, are shown in Table G4, at the end of this Working Paper. Alternative 8 would not appreciably affect the 65 DNL; however, there is a slight reduction to the north area and a slight increase to the south. Alternative 8 results in one less non-compatible housing unit within the 65 DNL noise contour and 49 fewer total housing units within the contour when compared to the 2009 Future Base Case.

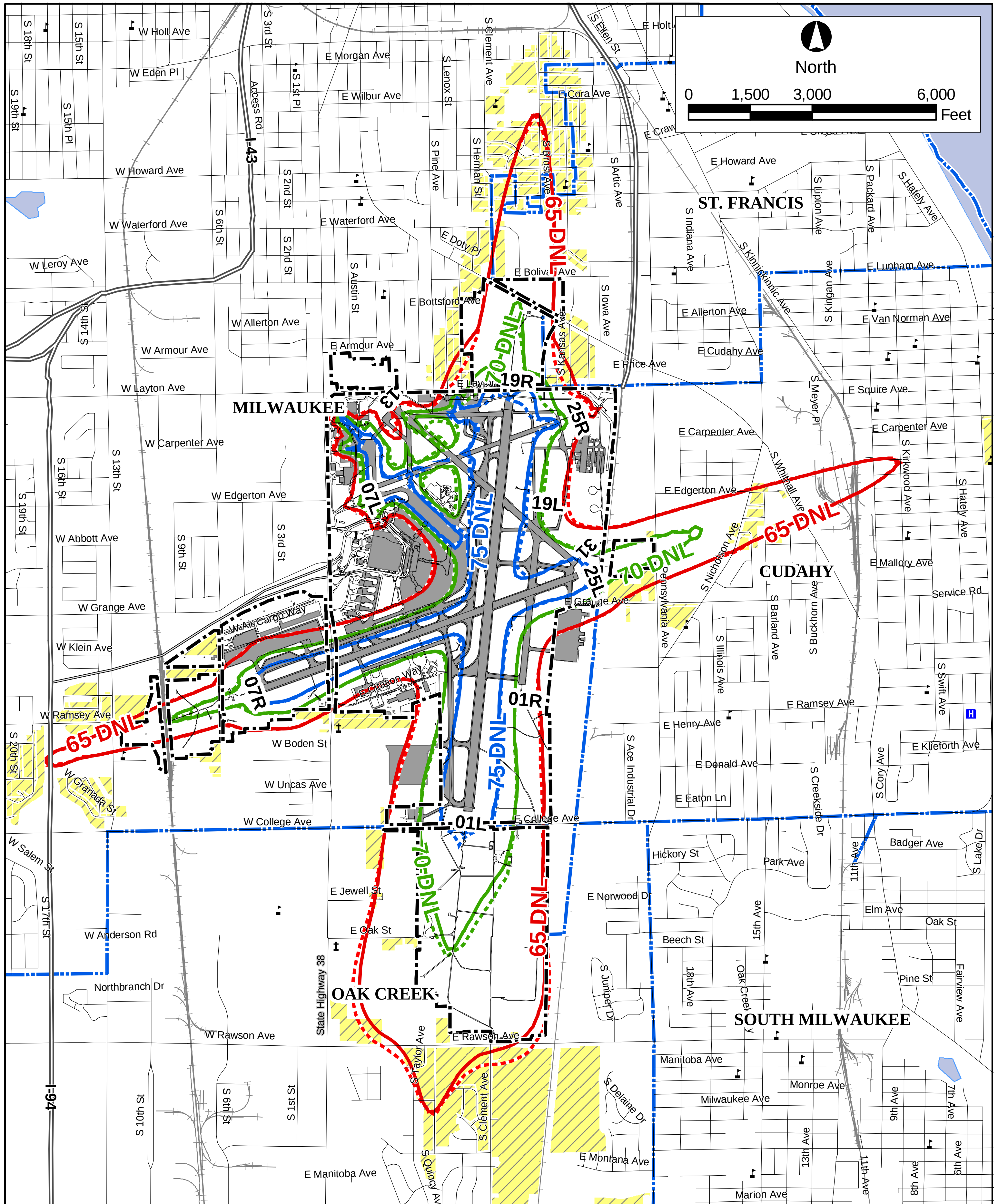
The back blast (low frequency) noise levels to the north would be reduced by more than 2.0 DNL when using the intersection departure rather than a full runway length departure. To the south, there is a corresponding 0.5 DNL increase. The Number of Events per day above 65 dBA decreases by 11 events north of the Airport with a corresponding increase of one event per day to the south.

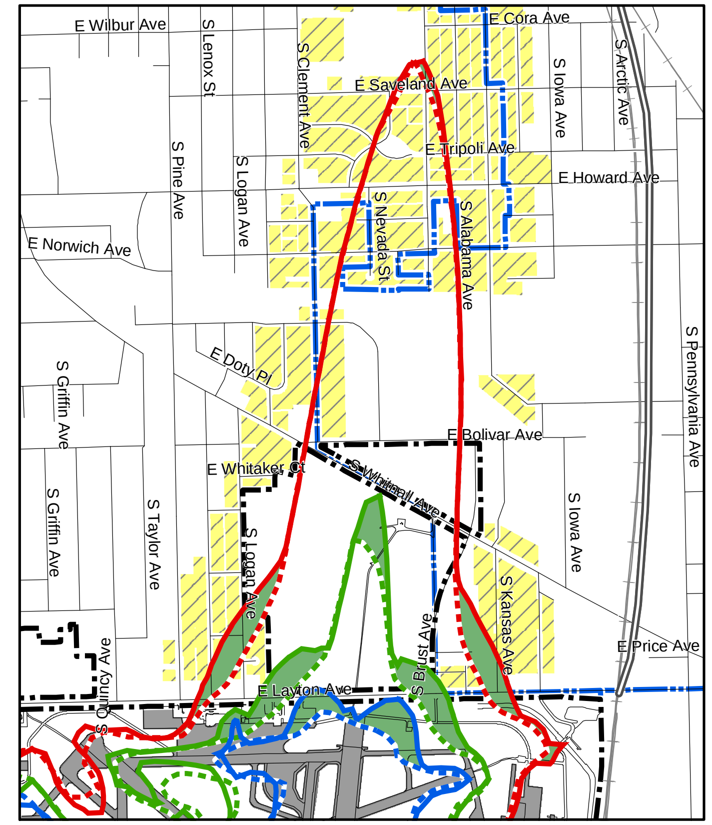
Difference Compared to Base Case Contour:

Alternative 8 would result in the 65 DNL noise contour generally changing in width. To the south, the contour would expand slightly to the east and west basically around Rawson Avenue. To the north, the 65 DNL noise contour associated with Alternative 8 would reduce in width just north of Layton Avenue. The 70 DNL would also reduce in width north of the Airport, when compared to the 2009 Base Case noise contours.

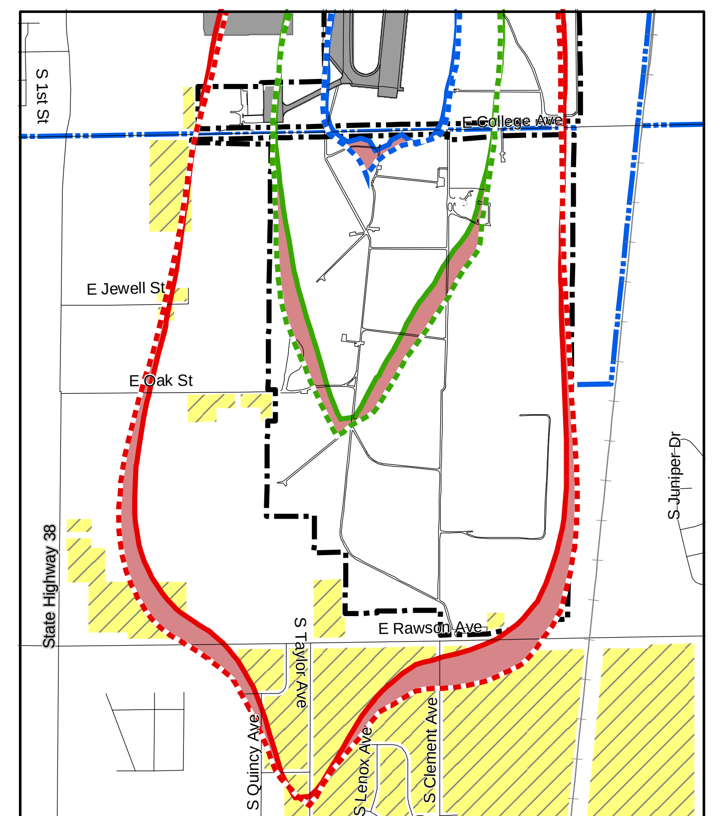
Figure G13, Aerial Photo of Victor intersection

Figure G14
Comparison of
Alternative 8 Intersection Departures to
South DNL Contour &
2009 Base Case DNL Contour





Runway End 19R Detail



Runway End 01L Detail

North
0 1,000 2,000 4,000
Feet

Legend
Newly affected
No longer affected

Legend

2009 Base Case

- 65 DNL Contour
- 70 DNL Contour
- 75 DNL Contour

Alternative 8

- 65 DNL Contour
- 70 DNL Contour
- 75 DNL Contour
- Phase 1 Program Boundries
- CORPORATE BOUNDARY
- AIRPORT BOUNDARY
- hospitals
- schools
- churches

Source: Milwaukee County, 2003

Comparative Analysis

Areas within the limits of this alternative but not within the limits of the 2009 Base Case are shown in red.
65 DNL - Approx. 45 Acres
70 DNL - Approx. 21 Acres
75 DNL - Approx. 4 Acres

Areas within the limits of the 2009 Base Case but not within the limits this alternative are shown in green.
65 DNL - Approx. 20 Acres
70 DNL - Approx. 19 Acres
75 DNL - Approx. 9 Acres

MILWAUKEE COUNTY'S GENERAL MITCHELL INTERNATIONAL AIRPORT

Alternative 9
Ground-Based Noise Alternatives

Goal:

The goal of this alternative is to reduce noise in surrounding communities resulting from aircraft operations on the ground at General Mitchell International Airport. This alternative was developed to explore available options that will minimize ground noise intrusion, especially in areas north of the Airport.

Description:

Alternative 9 addresses aircraft noise from ground operations, which is defined as all aircraft movement while an aircraft is on the ground, including operations on the taxiways, runways, apron areas, terminal area, and ground run-up enclosure. The term "remote facilities" is an umbrella term that encompasses all facilities away from the passenger terminal, including maintenance hangars, general aviation areas, military areas, and fixed based operators (FBO). Types of ground noise include the following:

- Run-up procedures by all aircraft categories at the remote facilities
- Taxi
    - To and from remote facilities
    - To and from terminal gates
- Idle
    - At the terminal gates
    - At the remote facilities
- Takeoff roll prior to lift off
- Engine start and auxiliary power unit (APU) use at remote facilities
- APU use at terminal gates

The following lists the type of general mitigation measures available for ground noise:

- Sound barriers such as sound walls, earthen berms, and any solid material that acts to shield the noise, including existing or proposed structures such as buildings and hangars.
- Parking plans to determine aircraft placement on aprons and at terminal gates that minimize the impact of the noise in the adjacent communities.
- Use of ground power for aircraft to minimize use of aircraft engines and auxiliary power units.
- Voluntary Airport Regulations for reducing aircraft ground noise.

Ground Mitigation Measures:

<u>Sound Barriers</u>

Ground noise irritation comes from the run-ups and taxiing of aircraft, especially at night. Sometimes, barriers can be effective in reducing ground noise exposure in adjoining neighborhoods. A noise barrier is an obstruction to the path of the sound transmission from ground-based aircraft operations. Once an aircraft becomes airborne, barriers have no further effect. Barriers include walls (those used along highways), earth mounds (berms), wall and berm combinations, or placement of buildings and landscaping. In the case of barriers, neighbors would be shielded from the noise source as long as the barrier is solid and sufficiently breaks the line-of-sight from the noise source to the listener. Barriers can potentially provide noise reduction benefits for communities near an airport from aircraft ground operations. The closer a barrier is to the noise source, the more effective it is (i.e. the reason the Ground Run-Up Enclosure works so well is the close proximity between the noise source and the barrier).

The placement of structures, barriers or berms is dictated by airport design guidelines and regulations, one of which is Federal Aviation Regulation (FAR) Part 77, which defines certain height restrictions at specified distances from runways. To ensure the safe operation of aircraft on the Airport, these restrictions should not be exceeded, thereby making berms unfeasible in specific locations.

Noise Barrier Design Overview

Noise barriers are structures designed to block the propagation of noise at the source. An overview of the acoustic principles behind noise barrier design is summarized below. An understanding of these acoustical principles is essential in the design of effective noise barriers. When there are no obstacles between the source and adjoining areas, sound travels by a direct path of "source" to "receiver." This straight line is referred to as the "line-of-sight."

Introducing a barrier between the source and the receiver, which interrupts the line of sight, redistributes the sound energy into several paths: a diffracted path over the top of the barrier; a transmitted path through the barrier; and a reflected path directed away from the receiver. The noise reflected off the sound barrier is usually directed away from the receiver, and can be ignored unless large buildings or other reflecting surfaces are present. Absorptive barriers are often used if there are receivers located on the other side of the noise source as well. The noise path of primary concern is the diffracted path.

All receivers located in the shadow zone (the area between the barrier and the diffracted noise path) will experience some sound attenuation; the amount of that attenuation is directly related to the degree that the sound must bend or diffract. That is, the barrier attenuation is a function of the geometrical relationship between the source, receiver, and barrier. (The closer the receiver is to the barrier, the more attenuation it will receive.)

The location of barriers is dependent on its distance from the noise source, the orientation of the noise source, FAR Part 77 surface requirements, and time of day. Noise propagation is louder in certain directions and during times of low ambient noise levels (generally nighttime hours). It is usually advantageous to locate a noise barrier as close to the noise source as possible; if this is not possible, aircraft should then be located as far away from non-compatible land uses as possible while still taking advantage of the noise barrier. In addition to locating an aircraft as far away as possible, the aircraft should be oriented so that noise will dissipate away from the sensitive land use. For example, an idling jet should be parked with its tail pointed towards the community, because noise from an idling jet is louder at the front of the aircraft due to noise from the engine fans.

Types of Barriers

- Earthen berm:
  Earthen berms are generally composed of dirt with a ground cover such as grass, low-profile plants, small bushes, or trees. The height of the berm is dependent on its location on the airfield, its intended use and proximity to airfield activities. Berms are generally located on airport property boundaries.

- Earthen berm and wall combination:
  Earthen berms can be combined with a wall to create a higher structure. Walls can be placed on top of an earthen berm to create a more aesthetically-pleasing noise barrier.

- Landscape:
  The placement of trees can be effective in breaking the line of sight between a noise source and the community. The density of the trees affects the dissipation of noise. At locations where aircraft noise levels are not substantially higher than the ambient neighborhood noise, landscaping can be a good alternative to reduce the line of sight. Landscaping is generally located on airport property boundaries.

- Building placement:
  Airports can take advantage of existing buildings to shield communities from aircraft noise. If ground noise is an issue at an airport, the siting of new buildings can take into account how they can be used for noise reduction.

- Hay bales:
  Hay bales (or other straw-like material) have been found to be an economical way to reduce ground noise propagation. Unlike standard construction materials, hay bales can be easily and quickly formed into the specific shape needed to mitigate noise.

- Blast fence:
  Blast fences are used to deflect noise from engine start-up, run-up, and taxi. Blast fences are located on apron areas, terminal areas, and airport property lines. Blast fences can vary in height and length depending on intended use.

Parking and Taxi Plan

As detailed in the *Inventory* Chapter, residential and other noise sensitive land uses border Airport property or are close to Airport facilities and the location and orientation of parked aircraft on the airfield can greatly influence noise levels in these adjoining areas. Similarly, the route aircraft taxi on the airfield can influence noise exposure in the vicinity. Typically aircraft taxi to and from either the terminal area or remote facilities and the runway ends.

Terminal Area

The use of terminal gates by commercial aircraft is determined by a combination of the following:

- Airline
- Aircraft size
- Schedule – aircraft arrival and departure
- Location relative to preferred runway
- Aircraft position relative to the surrounding community

Airlines lease gate space from the airport operator; depending on the level of activity at certain airports, more than one airline can use the same gate. The use of gates is generally covered by a gate usage plan monitored by the airport operator. Aircraft generally taxi to the terminal from the runways and hangars, if the aircraft was parked overnight or needed maintenance.

Remote Areas

Most airports have numerous aprons, ramp areas, and leased facilities that are used for aircraft parking, maintenance, and run-up. Each of these apron areas has unique characteristics that are analyzed independently of each other. As stated earlier, parking and taxiing of aircraft in remote areas in relation to a noise barrier are determined by distance from the noise barrier, orientation of the aircraft, time of day usage, and location of existing structures.

The use of parking aprons by commercial and general aviation aircraft is determined by a combination of the following:

- Apron load capabilities
- Aircraft size
- Schedule
- Location relative to sound barriers
- Orientation of aircraft

Electrification of Ground Power

Ground-based aircraft noise occurs when aircraft are operating on the airfield after arrival, before takeoff, or during maintenance operations. The majority of aircraft use auxiliary power units (APUs) to power the aircraft while parked, both at terminal gates and remote facilities. An APU is a small jet engine that powers the heating, air conditioning, and electrical units in the aircraft, and because APUs are jet engines, there are generally high noise levels associated with their use. A small number of aircraft do not have on-board APUs. In this case, the aircraft typically either use gas or diesel ground power unit (GPU), which also generates ground noise, or receive an engine start from the ground crew and operate the aircraft at idle engine power while on the ramp.

Airports have the capacity to electrify passenger boarding gates with the type of power that an aircraft needs to run the cooling and heating system and the onboard computer systems. Airports install 400Hz power, which can be converted for use by all aircraft types, both turbojet and turbo propeller, as is being done at General Mitchell International Airport. The same type of power could potentially be installed at remote areas such as fixed-base operators and parking aprons where electricity would be installed in the pavement based on typical parking patterns of aircraft.

General Mitchell Ground-Based Aircraft Noise:

Alternative 9 analyzes the above-ground noise issues by type of noise. There are three ground-based options as described above and five distinct areas on the airfield that have ground noise that are proposed for evaluation. The five areas of the airfield that are used for aircraft parking and taxiing are: the Signature Ramp, Skyway Ramp, West Ramp, Northeast Ramp, and Terminal Facilities. Table G3 provides a listing of the areas being studied as well as recommended noise abatement measures for each. Figure G15, *Alternative 9 Airfield Locations*, graphically shows each location.

Table G3
ALTERNATIVE 9 BY AIRFIELD LOCATION
General Mitchell International Airport FAR Part 150 Noise Compatibility Study

Area	Issue	Applicable Measure
Signature Ramp	Business jet and large corporate aircraft start up, taxi, and idle noise	Noise Barrier, Parking Plan, Electrification
Skyway Ramp	Turbo propeller aircraft start up, aircraft remaining overnight	Noise Barrier, Electrification, Parking Plan
West Ramp	Large Aircraft Parking, APU usage	Noise Barrier, Electrification
Northeast Ramp	Piston and turbo propeller aircraft run-up and taxi	Noise Barrier
Terminal Facilities	Turbojet aircraft APU use and parking orientation	Parking Plan, Electrification

Figure G15, Alternative 9 Airfield Locations

Signature Flight Support Ramp

Signature Flight Support (Signature) is a Fixed Base Operator (FBO) located on the north end of the Airport, north of Taxiway "F." Signature provides aviation services such as fuel, maintenance, crew support, and hangar facilities to business jets, narrow- and wide-body charter aircraft, as well as turboprop aircraft. Among the services offered is a large aircraft parking apron where corporate jets and narrow-body charter aircraft are parked. Because of Signature's location, it can expose nearby communities north of the Airport to aircraft noise from aircraft start up, APU use, and taxi.

Mitigation Options

For the Signature Ramp, a noise barrier on the Airport property line would be effective for the homes due north and directly across Layton Street. For the homes to the northwest, along East Armour Avenue, a barrier along the Airport property line would not have much of an effect due to the elevated terrain at these homes. A barrier located at the highest point on the ground between the noise source and receiver may be more effective in reducing the ground noise. The location and height of potential noise barriers will be evaluated.

In addition to noise barriers, noise reductions could be achieved by providing electrical connections in the ramp area in conjunction with an updated parking plan that takes advantage of the existing buildings, potential noise barriers, and the directional characteristics of the aircraft noise. As part of the supplemental noise monitoring that was completed in September 2005, ground noise monitoring was done in this area. Based upon this additional data, a recommend parking plan is being developed for this area.

Skyway Ramp

The Skyway Airlines Ramp is on the northwest side of the airfield. Activities on the Skyway Ramp include turbo-prop and regional jet maintenance, turbo-prop run-ups, APU use, and taxi. The apron area in front of the Skyway Ramp is used for parking of commercial aircraft that remain overnight. Typically, 4 to 12 aircraft will remain overnight. Aircraft are taxied to the apron area from the terminal at night and taxied back to the terminal when the aircraft is scheduled to depart the next day. The Skyway hanger serves as a barrier for local communities from much of the ground-based aircraft activity noise.

Mitigation Options

A noise barrier would be an effective option with the specific location, size, and material evaluated through ongoing analysis. The barrier would need to be located close to the Skyway building to effectively shield noise from the homes to the north that are at a higher elevation than the airfield. A noise barrier located at the highest point of ground elevation for the homes along East Armour (described for the Signature Ramp option) will also be evaluated.

The Skyway Ramp could also benefit from electrification of the ramp, a parking plan, and an agreement with the airlines on APU use. A parking plan can be effective in orienting aircraft so the majority of noise stays on the Airport. Aircraft currently park in an east-west orientation at the request of the noise abatement office. The parking plan and preferred aircraft parking orientation will be further evaluated to assess possible improvements.

West Ramp

Commercial aircraft are often parked on the West Ramp overnight (east of the Air Wisconsin hangar). These aircraft are parked on the ramp overnight and then taxied to the terminal gates early in the morning. While on the West Ramp, these aircraft use their APUs for startup before taxi to the terminal gates or during cleaning and minor maintenance during the night.

Mitigation Options

The West Ramp could benefit from electrification of the ramp.. Each of these options will be evaluated for the West Ramp.

Northeast Ramp

The Northeast Ramp is located in the northeast section of the Airport. Activities on the Northeast Ramp include turbo-prop maintenance, turbo-prop run-ups, APU use, and taxi. The orientation of the Northeast Ramp exposes local communities to the ground-based aircraft activity noise.

Mitigation Options

The Northeast Ramp can benefit from a noise barrier such as a blast fence, hay bales, or using the existing buildings for shielding. Initial review of the area indicates that a noise barrier could be effective if located next to the hanger area. If a noise barrier is found to be ineffective, the Airport could request that Northeast Ramp operators use the ground run-up enclosure. While the ground run-up enclosure is an effective noise mitigation tool, aircraft located on the Northeast Ramp must taxi across active runways to the ground run-up enclosure, which could result in decreased airfield capacity and increase Air Traffic Control Tower staff workload. This additional taxiing could also create new noise from the taxiing aircraft.

Terminal Facilities

The Terminal Facilities are comprised of the three concourses attached to the main terminal building and the International Arrivals Building (IAB) used for commercial aircraft operations. Activities at the terminal include aircraft parking, taxiing, and APU use. General Mitchell International Airport is currently in the process of providing electrification at each of the aircraft gates to reduce APU use and noise.

Mitigation Options

Because of the central location of the terminal facility relative to the airfield, ground noise from the terminal complex contributes a relatively small amount to community noise exposure. Nonetheless, the terminal facilities, including the International Arrivals Building, will be evaluated to assess possible aircraft noise reductions through electrification.

New Procedure Noise Analysis:

The mitigation measures presented in Alternative 9 will not affect the 65 DNL, but will affect single event noise levels. Additional noise monitoring for this study was conducted in September 2005. The results of the additional noise monitoring as applicable to this alternative will be presented in the subsequent working paper.

Alternative 10
Provide Additional High-Speed Taxiways to Reduce Use of Reverse Thrust on Landing

Goal:

The goal of this alternative is to reduce the noise from reverse thrust when aircraft land at the Airport. Thrust reversers redirect the flow of the jet engine thrust toward the front of the aircraft. Reversing the power in this way assists in slowing the aircraft when landing.

Description:

This alternative would minimize the use of reverse thrust as a means of reducing noise to residents in close proximity to the Airport through two specific possible actions:

1. Pilot awareness program concerning the impact of reverse thrust.
2. Installation of additional high-speed exits that would facilitate less use of reverse thrust.

The use of reverse thrust is at the pilot's control and is based on stability and safety. It is based on runway conditions, landing conditions, and weather conditions, once the aircraft are on the runway. This alternative evaluated how noise would be reduced by the installation of additional high-speed taxiway exits that could facilitate a decrease in the use of reverse thrust. A typical landing procedure involves the pilot deploying the thrust reversers shortly after the main landing gear has touched down. The appropriate placement of multiple-angled (high-speed) taxiways can also help reduce the need for applying reverse thrust, as the aircraft has more options for exiting the runway and does not necessarily have to slow down the same amount to turn off the runway. A standard perpendicular connecting taxiway requires the aircraft to slow to a greater extent than an angled taxiway.

Existing Procedure:

The Airport has appropriately placed high-speed taxiways, and additional taxiways would not contribute significantly to the reduction in the use of reverse thrust, unless new aircraft types are accommodated or additional landside facilities are programmed. The placement of such taxiway exits is dependent upon the aircraft's desired destination, such as a gate, apron, or landside facility. In future airfield planning efforts, it is appropriate to plan and design high-speed taxiways where appropriate and feasible. This alternative is dependent on the possible shift of the runway thresholds and runway safety area; thus, further study is recommended once the location of the thresholds is determined. Figure

G16, *Alternative 10, High-Speed Taxiway Locations*, shows the location of the high-speed taxiways.

New Procedure:

Alternative 10 would involve establishing a pilot education program, possibly coupled with new high-speed taxiway exits to reduce the use of reverse thrust. As part of the noise abatement programs at General Mitchell International Airport, it would educate pilots on the noise impact associated with the use of reverse thrust and encourage reduced use where safe and operationally feasible.

New Noise Procedure:

This procedure does not have a DNL noise contour to model. However, reduced use of reverse thrust should be part of the pilot awareness program and should continue to be evaluated. It is appropriate to include such an awareness program in the Fly Quiet Program.

Figure G16, Alternative 10, High-Speed Taxiway Locations

Contour Evaluation

Land Use Comparison

Population and housing units, along with other noise sensitive uses for each modeled alternative, are evaluated and compared to the Future Base Case noise contours in the following table. The evaluation compares the number of residents, housing units, and other noise sensitive uses within the 65 DNL and greater noise contour, which is the federally recognized contour for identifying land use compatibility. As seen, Alternatives 1A, 1B, 4 and 8 result in the same or slightly less total population within the 65 DNL noise contour as the 2009 Future Base Case contour. The other alternatives increase, although not dramatically in some cases, the number of non-compatible housing units and people within the 65 DNL noise contour compared to the 2009 Future Base Case.

Table G4

2009 DNL CONTOUR COMPARISON FOR EACH MODELED ALTERNATIVE

General Mitchell International Airport FAR Part 150 Noise Compatibility Study

	2009 Future Base Case		Alt 1A		Alt 1B		Alt 2		Alt 3		Alt 4		Alt 8	
	Total	Non-Compatible[1]	Total	Non-Compatible[1]	Total	Non-Compatible[1]	Total	Non-Compatible[1]	Total	Non-Compatible[1]	Total	Non-Compatible[1]	Total	Non-Compatible[1]
DNL 65														
Housing Units	463	77	460	76	463	84	529	147	502	77	462	77	414	76
Population	1,090	180	1,080	180	1,090	195	1,240	345	1,180	180	1,085	180	970	180
Schools	1	0	1	0	1	0	1	0	2	0	1	0	1	0
Churches	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DNL 70														
Housing Units	8	7	7	6	7	6	6	5	8	7	9	8	5	4
Population	20	15	15	15	15	15	15	10	20	15	20	20	10	10
Schools	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Churches	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DNL 75														
Housing Units	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Population	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Schools	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Churches	0	0	0	0	0	0	0	0	0	0	0	0	0	0

A1a **FMS Departure Procedure, Runway 19R, East Destinations**
A1b **FMS Departure Procedure, Runway 19R, West Destinations**
A2 **FMS Procedures for East Departures, No Turns until Reaching Lake Michigan, Runway 7R**
A3 **FMS Procedures, North-Bound Departures, Runway 1L**
A4 **FMS Procedures, South-Bound Departures, Runway 25L**
A8 **Intersection Departures for South-Bound Departures at Night.**

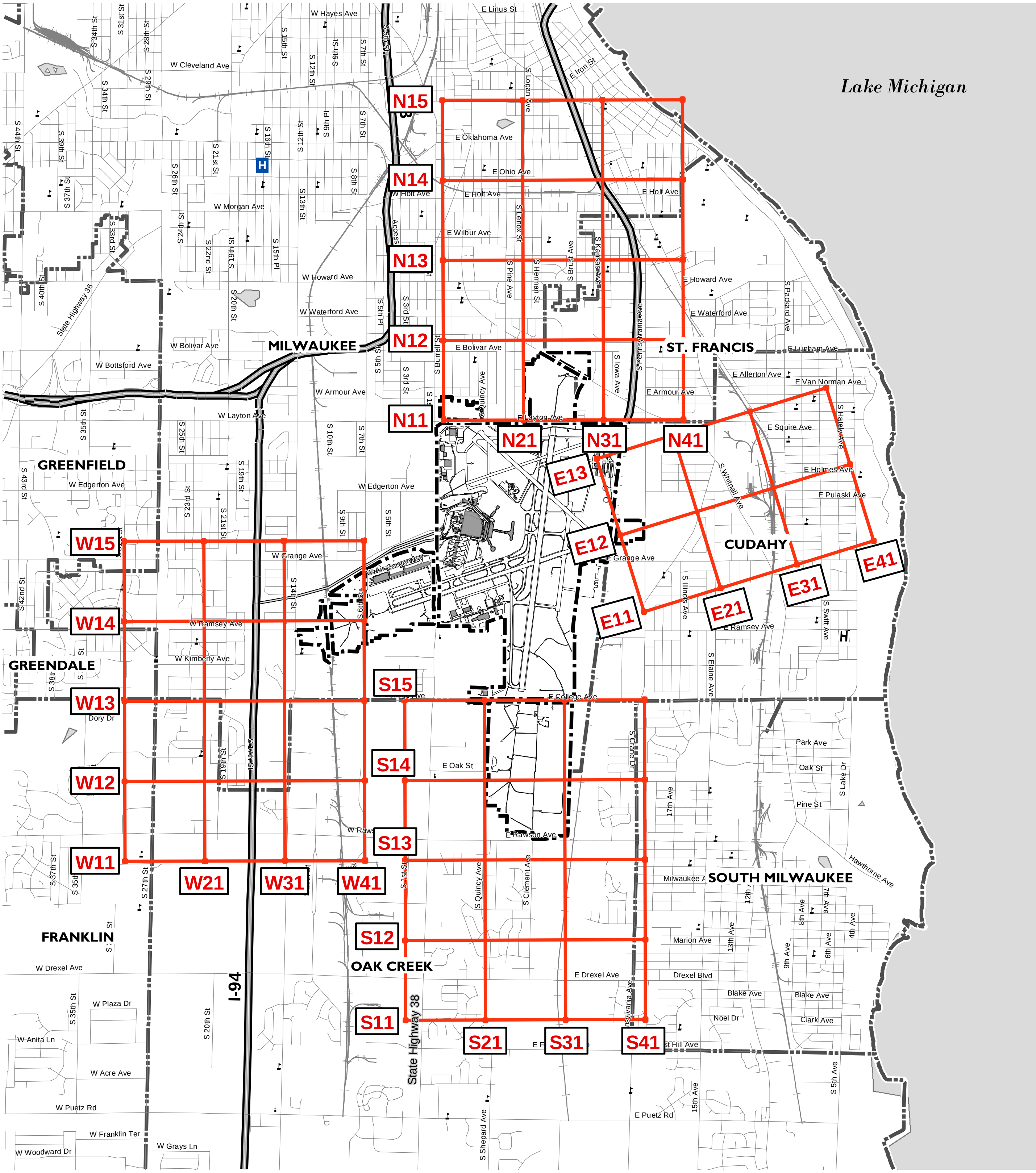
1 Housing units that have not been sound attenuated because they are either outside of the 1997 68.5 DNL contour or units eligible for sound insulation that refused assistance

Note: Population numbers derived from the average number of persons per household per census tract times the number of housing units, rounded to the nearest five.

Note: Numbers are cumulative between contours; the 65 DNL contains the 70 and 75 DNL numbers.

Grid Analysis

Tables G5 through G10 present the results of the representative grid analysis completed for each of the alternatives for which DNL noise contours were generated. These grids can be used to identify the potential change in noise that may occur in a neighborhood as a result of each of the alternatives. Only the grids in the quadrant for which a change may potentially occur as a result of that alternative are presented. The location of each of the grids is presented in Figure G17. The noise metrics that are calculated are the DNL, Time Above 65 (TA65) and the Number Events Above 65 dBA (NA65) that were described at the beginning of this Working Paper.



North

Figure G17 Representative Receptor Grid

Table G5

CHANGE IN NOISE GRIDS (ALTERNATIVE 1A - SATELLITE BASED DEPARTURE PROCEDURE FOR RUNWAY 19R - EAST), BASE CASE 2009 NOISE LEVELS AND ALTERNATIVE 1A CHANGE

General Mitchell International Airport FAR Part 150 Noise Compatibility Study

Grid ID	2009 Base Case DNL	DNL Change	2009 Base Case Time Above 65 DNL (Minutes)	Time Above 65 DNL Change (Minutes)	2009 Base Case Number of Events Above 65 DNL	Number of Events Above 65 DNL Change (Events)
S11	56.2	0.0	6.7	0.1	33.2	1.3
S12	59.3	0.1	10.9	0.2	46.7	0.0
S13	61.9	0.0	17.6	0.1	62.1	-1.1
S14	60.9	0.0	19.6	-0.1	65.4	-0.4
S15	58.0	0.0	17.4	0.0	68.5	-0.3
S21	59.9	-0.1	21.0	-0.3	91.2	0.3
S22	62.9	-0.1	28.4	0.5	120.2	1.1
S23	65.2	-0.1	39.7	-0.1	164.7	2.5
S24	67.9	-0.1	52.6	1.0	203.0	4.6
S25	68.6	0.0	82.5	0.2	223.7	0.5
S31	59.0	1.6	13.9	4.1	61.5	18.8
S32	61.8	1.7	20.5	1.9	82.9	4.4
S33	64.0	0.9	26.8	0.4	106.1	1.5
S34	65.4	-0.5	37.8	0.3	143.5	1.0
S35	66.0	-0.1	69.8	0.2	203.7	0.0
S41	58.3	-1.3	13.1	0.0	57.0	8.1
S42	58.7	-2.9	12.0	-2.5	53.6	-10.9
S43	56.8	-1.6	10.8	-2.1	50.5	-6.2
S44	55.4	-0.4	8.9	-0.9	37.3	-2.6
S45	54.6	-0.1	6.9	-0.2	33.2	0.4

Table G6

CHANGE IN NOISE GRIDS (ALTERNATIVE 1B - SATELLITE BASED DEPARTURE PROCEDURE FOR RUNWAY 19R - WEST), BASE CASE 2009 NOISE LEVELS AND ALTERNATIVE 1B CHANGE

General Mitchell International Airport FAR Part 150 Noise Compatibility Study

Grid ID	**2009 Base Case DNL**	**DNL Change**	**2009 Base Case Time Above 65** (Minutes)	**Time Above 65 Change** (Minutes)	**2009 Base Case Number of Events Above 65 DNL**	**Number of Events Above 65 DNL Change** (Events)
S11	56.2	0.2	6.7	1.0	33.2	4.7
S12	59.3	1.5	10.9	3.1	46.7	9.9
S13	61.9	1.3	17.6	2.0	62.1	3.9
S14	60.9	-1.5	19.6	-1.6	65.4	-1.3
S15	58.0	-0.2	17.4	-0.8	68.5	-0.9
S21	59.9	-0.1	21.0	-0.2	91.2	-2.3
S22	62.9	-0.2	28.4	-0.3	120.2	-1.1
S23	65.2	-0.2	39.7	1.3	164.7	2.5
S24	67.9	0.5	52.6	0.0	203.0	0.0
S25	68.6	0.0	82.5	-0.1	223.7	0.0
S31	59.0	0.0	13.9	-0.1	61.5	0.0
S32	61.8	0.0	20.5	0.1	82.9	0.3
S33	64.0	0.0	26.8	-0.1	106.1	-2.3
S34	65.4	0.0	37.8	-0.2	143.5	-0.7
S35	66.0	0.0	69.8	0.1	203.7	0.0
S41	58.3	0.0	13.1	0.0	57.0	0.0
S42	58.7	0.0	12.0	0.0	53.6	-0.6
S43	56.8	0.0	10.8	-0.1	50.5	0.4
S44	55.4	0.0	8.9	-0.1	37.3	0.4
S45	54.6	0.0	6.9	-0.1	33.2	-0.2

Table G7

CHANGE IN NOISE GRIDS (ALTERNATIVE 2 - SATELLITE BASED DEPARTURE PROCEDURE FOR RUNWAY 7R), BASE CASE 2009 NOISE LEVELS AND ALTERNATIVE 2 CHANGE

General Mitchell International Airport FAR Part 150 Noise Compatibility Study

Grid ID	**2009 Base Case DNL**	**DNL Change**	**2009 Base Case Time Above 65** (Minutes)	**Time Above 65 Change** (Minutes)	**2009 Base Case Number of Events Above 65 DNL**	**Number of Events Above 65 DNL Change** (Events)
E11	55.7	0.0	13.0	-0.6	66.1	-7.2
E12	73.6	-0.1	55.4	-0.1	236.2	0.0
E13	64.3	0.0	71.2	-0.2	228.5	-0.5
E21	54.4	-0.3	9.2	-0.6	41.9	-4.9
E22	68.4	0.2	50.6	-0.2	195.9	0.0
E23	57.2	0.0	16.6	0.3	81.7	-3.6
E31	53.8	-1.1	8.2	-1.6	35.1	-5.4
E32	65.9	0.3	47.6	0.0	186.5	0.0
E33	55.5	-0.1	10.9	-0.2	49.7	-4.8
E41	55.0	-3.2	8.0	-2.4	33.0	-7.7
E42	63.4	0.7	45.6	2.3	175.4	1.2
E43	55.5	-1.3	8.7	0.7	41.3	-3.0

Table G8

CHANGE IN NOISE GRIDS (ALTERNATIVE 3 - SATELLITE BASED DEPARTURE PROCEDURE FOR RUNWAY 1L), BASE CASE 2009 NOISE LEVELS AND ALTERNATIVE 3 CHANGE

General Mitchell International Airport FAR Part 150 Noise Compatibility Study

Grid ID	**2009 Base Case DNL**	**DNL Change**	**2009 Base Case Time Above 65** (Minutes)	**Time Above 65 Change** (Minutes)	**2009 Base Case Number of Events Above 65 DNL**	**Number of Events Above 65 DNL Change** (Events)
N11	56.9	0.0	11.0	0.0	43.8	0.0
N12	53.5	-0.1	3.8	0.0	14.1	-0.1
N13	52.5	-0.4	3.1	-0.3	11.8	-1.1
N14	53.3	-1.7	4.0	-1.1	15.8	-4.9
N15	54.9	-1.7	5.0	0.1	19.7	-1.7
N21	68.8	-0.1	114.0	0.1	251.0	0.0
N22	61.2	-0.3	15.3	-0.1	58.1	0.0
N23	60.0	-1.1	10.4	-0.5	40.8	-1.7
N24	59.6	-0.3	8.0	0.3	31.0	-0.2
N25	56.8	2.2	6.3	0.8	26.9	0.1
N31	63.3	0.0	50.2	0.0	191.3	0.1
N32	61.4	-0.3	16.1	0.3	62.0	0.0
N33	61.9	0.5	17.6	0.6	75.7	0.2
N34	60.3	-0.5	17.2	0.7	73.4	3.4
N35	58.5	-0.4	14.3	-0.2	60.7	-0.1
N41	57.4	0.0	13.9	0.0	70.5	0.2
N42	53.8	-0.1	6.7	-0.1	28.0	-0.4
N43	54.4	-0.6	5.8	-0.3	24.4	-2.8
N44	55.4	1.5	5.7	0.6	25.3	1.5
N45	53.1	-0.9	4.3	-0.3	21.4	3.7

Table G9

CHANGE IN NOISE GRIDS (ALTERNATIVE 4 - SATELLITE BASED DEPARTURE PROCEDURE FOR RUNWAY 25L), BASE CASE 2009 NOISE LEVELS AND ALTERNATIVE 4 CHANGE

General Mitchell International Airport FAR Part 150 Noise Compatibility Study

Grid ID	2009 Base Case DNL	DNL Change	2009 Base Case Time Above 65 (Minutes)	Time Above 65 Change (Minutes)	2009 Base Case Number of Events Above 65 DNL	Number of Events Above 65 DNL Change (Events)
W11	54.4	0.9	7.8	1.1	33.5	4.0
W12	55.2	0.5	8.5	0.9	39.6	2.4
W13	59.3	-0.2	24.8	0.2	102.7	3.5
W14	53.4	-0.1	5.8	-0.2	31.7	-1.6
W15	49.5	0.0	2.2	0.0	13.6	0.0
W21	55.8	-0.3	8.9	-0.1	37.9	-1.1
W22	56.0	-0.3	9.9	0.4	41.9	4.1
W23	58.8	0.4	24.5	0.4	110.2	0.0
W24	55.9	-0.2	12.5	0.2	67.2	1.5
W25	50.8	0.0	3.6	-0.1	21.5	0.2
W31	57.6	-0.1	10.3	-0.4	41.6	-1.9
W32	56.9	-0.1	10.0	-0.3	40.3	-1.9
W33	56.9	-0.2	13.7	-0.1	58.1	0.0
W34	60.9	-0.1	26.5	0.1	111.2	0.0
W35	52.9	0.0	5.1	-0.1	29.8	-1.9
W41	60.3	0.0	14.6	-0.1	52.4	-0.5
W42	59.0	0.0	13.8	-0.1	50.4	0.0
W43	56.6	0.0	14.4	0.0	60.8	2.7
W44	71.8	0.2	24.2	-0.1	129.8	0.0
W45	54.4	0.0	10.8	0.0	42.6	-0.7

Table G10

CHANGE IN NOISE GRIDS (ALTERNATIVE 8 - INTERSECTION DEPARTURES FOR SOUTH-BOUND DEPARTURES AT NIGHT), BASE CASE 2009 NOISE LEVELS AND ALTERNATIVE 4 CHANGE

General Mitchell International Airport FAR Part 150 Noise Compatibility Study

Grid ID	**2009 Base Case DNL**	**DNL Change**	**2009 Base Case Time Above 65** (Minutes)	**Time Above 65 Change** (Minutes)	**2009 Base Case Number of Events Above 65 DNL**	**Number of Events Above 65 DNL Change** (Events)
N11	56.9	-0.1	11.0	-0.2	43.8	0.0
N12	53.5	-0.3	3.8	-0.1	14.1	0.0
N13	52.5	-0.1	3.1	0.0	11.8	0.0
N14	53.3	-0.1	4.0	0.0	15.8	0.0
N15	54.9	-0.1	5.0	0.0	19.7	0.0
N21	68.8	-2.0	114.0	-9.0	251.0	-0.7
N22	61.2	0.0	15.3	-0.2	58.1	-0.7
N23	60.0	0.0	10.4	-0.1	40.8	0.0
N24	59.6	0.0	8.0	0.0	31.0	0.0
N25	56.8	0.0	6.3	0.0	26.9	0.0
N31	63.3	-1.0	50.2	-2.5	191.3	-11.0
N32	61.4	-0.1	16.1	-0.2	62.0	-0.9
N33	61.9	0.0	17.6	0.0	75.7	0.0
N34	60.3	0.0	17.2	0.0	73.4	0.0
N35	58.5	0.0	14.3	0.0	60.7	0.0
N41	57.4	-0.2	13.9	-0.1	70.5	-0.9
N42	53.8	-0.2	6.7	-0.1	28.0	0.0
N43	54.4	-0.1	5.8	0.0	24.4	0.0
N44	55.4	0.0	5.7	0.0	25.3	0.0
N45	53.1	0.0	4.3	0.0	21.4	0.0
S11	56.2	0.4	6.7	0.0	33.2	0.1
S12	59.3	0.4	10.9	0.0	46.7	-0.1
S13	61.9	0.3	17.6	0.1	62.1	0.1
S14	60.9	0.2	19.6	0.0	65.4	0.2
S15	58.0	0.0	17.4	0.0	68.5	-0.3
S21	59.9	0.0	21.0	0.0	91.2	0.1
S22	62.9	0.1	28.4	0.1	120.2	0.2
S23	65.2	0.2	39.7	0.1	164.7	0.5
S24	67.9	0.5	52.6	0.3	203.0	0.7
S25	68.6	0.1	82.5	-0.1	223.7	0.0
S31	59.0	0.3	13.9	0.1	61.5	0.6
S32	61.8	0.3	20.5	0.1	82.9	0.8
S33	64.0	0.4	26.8	0.1	106.1	0.2
S34	65.4	0.4	37.8	0.3	143.5	1.0
S35	66.0	-0.2	69.8	-0.2	203.7	0.4
S41	58.3	0.5	13.1	0.1	57.0	0.4
S42	58.7	0.3	12.0	0.1	53.6	0.3
S43	56.8	0.1	10.8	0.0	50.5	0.2
S44	55.4	0.0	8.9	-0.1	37.3	0.1
S45	54.6	-0.3	6.9	-0.2	33.2	-0.2