4 Airport Noise

SUMMARY

The Metropolitan Airports Commission (MAC) has implemented one of the most extensive noise mitigation programs among U.S. airports, and it plans to extend the program to additional areas starting in 2005. Some people think that MAC's policies for the expanded program will not fulfill its 1996 commitments. But MAC's commitments in written documents were vague and subject to interpretation, and the planned program (if approved by the federal government) would be ambitious compared with programs at other airports.

For the existing sound insulation program, MAC still uses federally-approved 1992 projections of 1996 noise levels to determine eligibility. Several key assumptions underlying the projections proved to be off-target by the mid-1990s, so some homes that were subject to significant noise have not been eligible for insulation. The course of action prescribed in federal rules (a new forecast and noise contour) would not necessarily have resulted in expanded program eligibility, due to recent reductions in aircraft noise levels. Updates of the projections were delayed by uncertainties in the 1990s regarding the airport's future and by significant changes in the airline industry over the past two years.

For people who live near airports, noise from aircraft can be a significant intrusion—potentially interrupting sleep, conversations, and other aspects of daily life. State law establishes a goal to "minimize the public's exposure to noise and safety hazards around airports" and provide for noise abatement.[1] MAC uses a variety of approaches to mitigate the impact of airport noise, but a primary mechanism over the past decade has been a program to structurally modify homes and schools. In this chapter, we address the following questions:

- **What commitments regarding noise mitigation were made at the end of the dual track airport planning process? Has the Metropolitan Airports Commission fulfilled these commitments?**

- **How accurate were the noise projections underlying MAC's existing sound insulation program? What are the implications, if any, in cases where MAC's noise projections were incorrect?**

1 *Minn. Stat.* (2002), §473.602.

- **Which homes are eligible to participate in the Minneapolis-St. Paul Airport's sound insulation program? How does the scope of this program compare with those implemented elsewhere?**

- **What has been the trend in noise levels at locations near the Minneapolis-St. Paul International Airport?**

- **Why did maps that MAC developed for a draft noise mitigation plan in 2000 differ from the final maps that were submitted to the federal government in 2001? Was the public adequately informed about these changes?**

This chapter focuses primarily on MAC's sound insulation program and the noise projections that determine eligibility for the program. We did not evaluate other strategies that can affect airport noise, such as procedures governing runway use and flight departures.

BACKGROUND

Federal policy discourages excessive noise levels.

In 1968, the U.S. Congress authorized the federal government to prescribe standards for measuring aircraft noise and to regulate noise abatement.[2] Congress subsequently stated that "it is the policy of the United States to promote an environment for all Americans free from noise that jeopardizes their health or welfare."[3] Still later, Congress authorized the Federal Aviation Administration (FAA) to regulate "airport noise compatibility planning" and make funds available for airports' noise-related projects.[4]

Noise can be measured in decibels, ranging from the threshold of human hearing (0 decibels) to painful noise (about 130 decibels). Some examples of decibel levels include:

- A normal conversation between two people who are five feet away is about 60 decibels;

- A vacuum cleaner three feet away is about 70 decibels;

- A power lawn mower three feet away is more than 90 decibels; and

- An ambulance siren 100 feet away is about 100 decibels.

2 Aircraft Noise Abatement Act, Pub. L. 90-411 (1968), codified as amended in 49 U.S. Code §44715 (2000).

3 Noise Control Act, Pub. L. 92-574, sec. 2(b) (1972), codified in 42 U.S. Code §4901 (2000).

4 Aviation Safety and Noise Abatement Act, Pub. L. 96-193 (1979), codified as amended in 49 U.S. Code §§47501-47510 (2000).

People perceive a six to ten decibel increase as a doubling of loudness, so an 80-decibel noise would sound twice as loud as a 70-decibel noise. [5]

Large planes had to comply with quieter noise standards by 2000.

The federal Airport Noise and Capacity Act of 1990 required the conversion of the entire U.S. fleet of aircraft over 75,000 pounds to "Stage 3" noise standards by 2000.[6] For a given class of aircraft, Stage 3 standards are quieter than the previous "Stage 2" standards.[7] To comply with the federal requirements, airlines had to either retire or remanufacture ("hushkit") their Stage 2 aircraft. (The term "hushkitting" is often used to describe modifications to a Stage 2 plane's engines or engine enclosures to reduce noise to a level sufficient to achieve a Stage 3 classification.) Typical Stage 2 aircraft (such as Boeing 727s and DC-9s) generated peak noise levels upon takeoff of 98 to 102 decibels, as measured under the flight path four miles from the point of departure. In contrast, Stage 3 aircraft such as Boeing 757s and Airbus 320s have peak noise levels in the 87 to 91 decibel range from this distance.[8] Many of the Stage 2 planes that were modified to meet Stage 3 standards are among the noisiest Stage 3 aircraft.

Airports can get federal funds for noise-related projects if they obtain federal approval of programs pursuant to Federal Aviation Regulation Part 150.[9] These noise mitigation programs are commonly called "Part 150" programs. To get federal approval, airports must comply with regulations that prescribe methods for developing (1) "noise exposure maps" of the areas around airports, and (2) programs for reducing and preventing land uses that are not compatible with airport noise. Participating airports must develop the noise exposure maps using "a single system of measuring noise at airports for which there is a highly reliable relationship between projected noise exposure and surveyed reactions of people to noise."[10] For airports seeking federal noise mitigation funds, federal regulations prescribe a model (called the "Integrated Noise Model") and a noise metric (called "DNL," or day-night levels) to determine individuals' cumulative exposure to airport noise. In contrast to decibels—which measure the sound level of a single event—DNL represents a yearly *average* of sound levels over a 24-hour period.[11] The DNL metric also incorporates a ten-decibel penalty for each noise event that

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5 Two equally loud noises (such as two 70-decibel noises) would produce a noise level only three decibels louder (73 decibels) than one of the noises. Two unequal noises would produce a combined noise level just slightly above that of the louder source.

6 Airport Noise and Capacity Act of 1990, Pub. L. 101-508 (1990), codified as amended in 49 U.S. Code §§47521-47533 (2000).

7 Some of the larger Stage 3 aircraft generate higher noise levels than certain Stage 2 aircraft. In general, however, the new requirements resulted in reduced noise levels within various categories of planes.

8 These noise levels are based on Federal Aviation Regulation Part 36, peak levels documented per aircraft type during takeoff, measured in Effective Perceived Noise Level A-weighted decibels. See MAC, *Draft Technical Advisor's Report: Minneapolis-St. Paul International Airport* (Minneapolis, September 2002), 6, http://www.macnoise.com/pdf_files/monthly_reports/sep02_ta.pdf; accessed November 20, 2002.

9 Pursuant to the Aviation Safety and Noise Abatement Act of 1979, the federal government promulgated interim Part 150 regulations in 1981 and final regulations in 1985. See 14 *CFR* ch. 1, part 150 (2001). Airports are not required to seek federal funds for noise mitigation.

10 14 *CFR* ch. 1, part 150, A150.1 (2001).

11 In 1980, the Federal Interagency Committee on Urban Noise adopted DNL as the metric for noise studies.

occurs between 10 p.m. and 7 a.m.—to reflect the added intrusiveness of nighttime noise. Airports seeking Part 150 federal funds must use the Integrated Noise Model to determine the location of "continuous contours"—that is, boundary lines—for DNL levels of 65, 70, and 75. They may develop contours for other DNL levels "when appropriate,"[12] but federal assistance for projects addressing noise below 65 DNL is considered lower priority.[13]

A map of projected noise at the Minneapolis-St. Paul Airport for 1996 still determines eligibility for MAC's sound insulation program.

The Metropolitan Airports Commission submitted to the federal government its first Part 150 study for the Minneapolis-St. Paul Airport in 1987.[14] MAC prepared another Part 150 study in 1992 to address implementation of the noise measures previously approved by the Federal Aviation Administration and suggest additional strategies. The 1992 submission included updated noise maps, and Figure 4.1 shows the boundaries of the 65 DNL noise contour projected for 1996. The 1996 map is the most recently-approved noise exposure map for Minneapolis-St. Paul International Airport, and it is still used to determine eligibility for the airport's home insulation program. (Areas within the 65 DNL contour are eligible for sound insulation.)

MAC has used "passenger facility charges" to pay for about 80 percent of the cost of insulating homes within the 65 DNL contour. MAC has federal approval to assess these charges to each passenger using the Minneapolis-St. Paul Airport, and airlines collect these charges for MAC when air travelers purchase their tickets. The remainder of the residential sound insulation program's cost has been paid from federal funds, based on MAC's federally-approved participation in the Part 150 program.

NOISE MITIGATION COMMITMENTS

Following several years of discussion and debate about whether to build a new airport in the Twin Cities region, the 1996 Legislature decided to keep the Minneapolis-St. Paul International Airport at its present location. To address the need for greater capacity at the airport, the Legislature required MAC to implement a 2010 long-term comprehensive plan that included construction of a new runway and various other capital improvements at the terminal and airfield.[15] The Legislature also required MAC to study the environmental effects of the plan, including noise impacts and land use compatibility.[16] Table 4.1 identifies key events related to airport noise that have occurred since 1996.

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12 14 *CFR* ch. 1, part 150, A150.101 (2001).

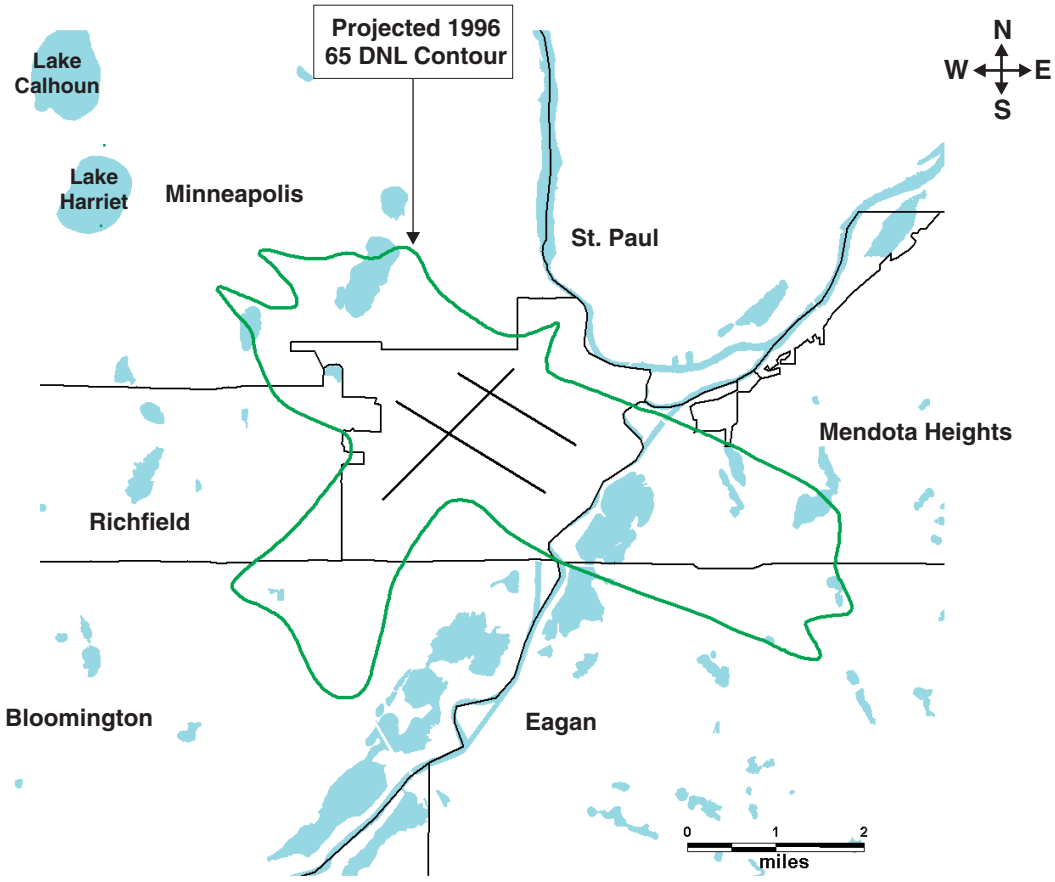
13 Federal Aviation Administration Order 5100.38B, *Airport Improvement Program Handbook*, ch. 8, sec. 1, para. 810.

14 The Federal Aviation Administration approved the noise exposure maps in 1989 and the noise compatibility program in 1990—although FAA disapproved several components of MAC's proposed noise compatibility program.

15 *Laws of Minnesota* (1996), ch. 464, art. 3, sec. 6.

16 *Laws of Minnesota* (1996), ch. 464, art. 3, sec. 11.

Figure 4.1: MAC's 1992 Projection of Area with 1996 Noise Levels of 65 DNL or Greater



NOTE: Areas inside the contour line were projected to have noise levels of 65 DNL or greater.

SOURCE: HNTB, *FAR Part 150 Study Update* (Minneapolis: Metropolitan Airports Commission, March 1992).

To address concerns about the impact of airport noise on nearby neighborhoods, the 1996 Legislature required the following:

> The [Metropolitan Airports Commission], with the assistance of its sound abatement advisory committee, shall make a recommendation to the state advisory council on metropolitan airport planning regarding proposed mitigation activities and appropriate funding levels for mitigation activities at Minneapolis-St. Paul International Airport and in the neighboring communities. The recommendation shall examine mitigation measures to the 60 [DNL] level.[17]

17 *Ibid.*

In 1996, MAC decided to expand its sound insulation program, but the nature of its commitment has been in dispute.

Table 4.1: Recent Events in MAC's Noise Mitigation Program

April 1996:	Legislature decided to expand existing airport rather than build a new one, and it asked MAC to prepare recommendations on noise mitigation.
October 1996:	MAC recommended continuation of its sound insulation program in the 65+ DNL area and expansion of the program to the 60-64 DNL area.
May 1998:	MAC submitted the dual track planning process' final environmental impact statement to the Federal Aviation Administration, including analysis of impacts from a new runway.
September 1998	Federal Aviation Administration approved MAC's environmental impact statement.
January 1999:	New operating agreement between MAC and airlines at Minneapolis-St. Paul International Airport contained agreements on funding levels for noise mitigation through 2010.
	MAC started to update its federal Part 150 noise mitigation program, last revised in 1993.
November 2000:	MAC issued a draft of its Part 150 report, including a projected noise exposure map for 2005.
August 2001:	MAC adopted a policy on its forthcoming 60-64 DNL noise mitigation program—to provide "full" mitigation to homes until the program budget is spent.
November 2001:	MAC submitted its final Part 150 report to the federal government.
December 2001:	MAC rescinded its August 2001 policy on the 60-64 DNL program.
April 2002:	MAC adopted a new policy for noise mitigation in the 60-64 DNL area—offering different levels of benefits for the 60-62 and 63-64 DNL areas.
May 2002:	MAC withdrew its November 2001 Part 150 report to the federal government so that noise forecasts could be updated.

SOURCE: Office of the Legislative Auditor.

MAC formed a Noise Mitigation Committee, comprised of six MAC commissioners, eight city representatives (including seven mayors), two Metropolitan Council members, one Northwest Airlines representative, and one member of MAC's ongoing sound abatement advisory committee. After considering input from the Noise Mitigation Committee, MAC adopted noise mitigation recommendations for the airport in October 1996. As required by law, MAC submitted the recommendations to the State Advisory Council on Airport Planning, which concurred with the recommendations.[18]

18 This council was established by the 1989 Legislature "to provide a forum at the state level for education, discussion, and advice to the legislature on the reports prepared for the legislature by the metropolitan council and metropolitan airports commission" (*Laws of Minnesota* (1989), ch. 279, sec. 7.) The council had 21 voting members, including 6 legislators. Two legislators co-chaired the council.

Airport noise mitigation programs are defined, in part, by the boundaries of the areas they address, and two of MAC's 1996 recommendations addressed the scope of the home insulation program. First, MAC recommended that the residential sound insulation program for the area with projected 1996 DNL levels of 65 and higher (see Figure 4.1) should be completed on the existing schedule (by 2000). Second, MAC recommended that "the program be expanded after completion of the current program to incorporate the area encompassed by the 2005 60 DNL."[19] MAC said that completion of its sound insulation programs would be contingent on its ability to maintain at least an "A" bond rating. MAC recommended funding its noise abatement programs at levels exceeding $25.5 million per year, using a combination of airport revenues. "To the extent that MAC cannot fund this expanded program in a reasonable period of time," MAC said, "support from the State of Minnesota should be sought."[20]

At the outset of our study, legislators asked us to examine whether MAC has fulfilled its noise mitigation commitments—particularly with respect to the "expanded" portion of the program, in the DNL 60-64 area. To better understand the nature of the noise commitments, we reviewed MAC documents and meeting minutes, and we interviewed most members of MAC's 1996 Noise Mitigation Committee. We found that:

- **MAC's initial commitments to expand its noise insulation program to homes with noise in the DNL 60-64 range were vague and subject to various interpretations.**

We found no evidence of explicit commitments by MAC to provide identical noise mitigation to all insulated homes.

In October 1996, MAC voted to expand "the [existing 65+ DNL] program" to the 60-64 DNL area, but it did not specify the nature of the expanded program. Some members of MAC's 1996 Noise Mitigation Committee told us that they thought that the commitment to expand "the program" meant that MAC intended for the 60-64 DNL program to be identical to the 65+ DNL program. In particular, they thought that all homes in the 60-64 DNL area would receive identical, *"full"* mitigation—that is, sound insulation that would absorb at least five additional decibels of external noise in homes.[21] (They made this assumption partly because MAC had considered but rejected the idea of a less stringent sound insulation program in the 54-60 DNL area—that is, a program that would have aimed for only a three-decibel reduction in noise. Consequently, MAC's final 1996 noise recommendations made no reference to a "reduced" noise program in any area, including the 60-64 DNL area.)[22] However, our review of documents and meeting minutes found no conclusive evidence that MAC explicitly committed to provide identical noise mitigation to all homes in the areas with noise levels of 60 DNL or greater.

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19 MAC, *MSP Noise Mitigation Program* (Minneapolis, November 1996), 2.

20 *Ibid.*

21 Without the treatments available through the sound insulation program, the average home in the Minneapolis-St. Paul area reduces the exterior to interior noise levels by about 27 decibels. MAC's goal for the sound insulation program in the 65+ DNL area was to provide an additional five-decibel reduction in interior noise.

22 MAC's 1996 policy recommendations addressed mitigation for homes with DNL levels of 60 or greater. MAC decided not to recommend mitigation for homes with DNL levels less than 60.

A 1999 agreement between MAC and the airlines authorized significant spending for noise mitigation.

In 1999, MAC negotiated an agreement with airlines operating at Minneapolis-St. Paul International Airport that reiterated the earlier commitment to fund a noise mitigation program in the 60-64 DNL area. The agreement authorized MAC to spend $150 million (in 1998 dollars) for the 60-64 DNL program ($70 million from the airlines and $80 million from MAC general revenues).[23] However, the agreement's descriptions of the expanded noise program may have added to confusion about the nature of MAC's commitment. First, the agreement's estimate of costs per home for the 60-64 DNL noise mitigation program ($37,100) were identical to the agreement's cost estimates for the 65+ DNL program—perhaps giving the impression that the 60-64 DNL program would employ mitigation strategies identical to those used in the 65+ DNL program. Second, the agreement stated that MAC and the airlines would fund a noise mitigation program within the "1996 DNL 60 contours." MAC officials contend that the inclusion of "1996" in this program description was a mistake—and that MAC always intended to insulate homes in the 60-64 DNL area based on *updated* noise contours, not the 1996 contours.[24] Because airport noise levels have decreased in recent years, a program based on 1996 noise contours would insulate more homes than a program based on updated noise contours.

In 1999, MAC began a process of updating the noise exposure maps and noise mitigation program for the Minneapolis-St. Paul International Airport. MAC later held public hearings to discuss this Part 150 update, including options for the sound insulation program in the 60-64 DNL area. Table 4.2 shows the options that were considered by MAC, and their estimated costs ranged from $136 million to $452 million. Several of these estimates far exceeded MAC's 1996 "high" estimate of 60-64 DNL program costs—$144 million for single-family homes.[25]

In August 2001, MAC voted 8 to 7 to adopt Option 1 for the 60-64 DNL area (based on noise projections for 2005), subject to a spending cap. That is, MAC planned to begin insulating homes in the portions of the 60-64 DNL area with the most noise and then move to lower noise areas—but the program would end when MAC spent $150 million (in 1998 dollars). This strategy would have provided "full" insulation to some homes, but a majority of homes in the 60-64 DNL area would have received no insulation. Consequently, some people contended that MAC's policy betrayed earlier commitments.

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23 MAC, *Airline Operating Agreement and Terminal Building Lease, Minneapolis-St. Paul International Airport, Effective January 1, 1999*, Exhibit 1, 6.

24 For example, the policies on noise mitigation that MAC adopted in 1996 favored expansion of the sound insulation program "to incorporate the area encompassed by the 2005 60 DNL." See MAC, *MSP Noise Mitigation Program* (Minneapolis, November 1996), 2. Also, MAC must still seek federal approval of a plan to insulate homes in the 60-64 DNL area, and federal officials will expect this plan to reflect an updated noise map.

25 The increase in estimated costs reflected changed assumptions about the average cost per home and the number of homes to be insulated. Later in this chapter, we discuss the increased cost per home for the 65+ DNL program. Regarding the number of homes to be insulated, MAC estimated in 1996 that between 3,943 and 6,357 single family homes would be in the 2005 DNL 60 contour; in contrast, MAC estimated in 2002 that more than 8,000 homes would be insulated in this contour. MAC staff attributed this change to improved information from Hennepin County regarding the number of homes within certain geographic areas.

Table 4.2: Sound Insulation Options Considered by MAC for the 60-64 DNL Area, 2001

Option 1: Five-Decibel Reduction Package

Description: Provide the same five-decibel reduction that has been offered to homeowners in the 65+ DNL area. The program would provide window and door treatments, wall and attic insulation, air conditioning, roof vent baffling, and modifications to address indoor air quality and ventilation.

Estimated cost: $451.8 million ($45,000 per home)

Option 2: Three-Decibel Reduction Package

Description: Provide the same sound insulation provided to homes in the 65+ area, but establish a lower acoustical standard for window and door treatments.

Estimated cost: $441.8 million ($44,000 per home)

Option 3: Window, Door, and Vent Package—No Air Conditioning

Description: Provide the same sound insulation provided to homes in the 65+ DNL area—except for air conditioning. *With the windows closed*, this package would provide the same noise reduction as Option 1.

Estimated cost: $339.4 million ($33,800 per home)

Option 4: Window Package

Description: Provide prime window treatment/replacement, new acoustical storm windows, and modifications to address indoor air quality and ventilation. This package would *not* include air conditioning, door treatment/replacement, wall and attic insulation, or roof vent baffling modifications.

Estimated cost: $271.1 million ($27,000 per home)

Option 5: Homeowner Participation Package

Description: Provide the five-decibel reduction package offered to homes in the 65+ DNL area (averaging $45,000 per home). However, homeowners would share in the cost—ranging from 14 percent of costs for homes at 64 DNL to 70 percent of costs for homes at 60 DNL.

Estimated cost: $206.7 million (MAC's share)

Option 6: Air Conditioning Package

Description: Provide central air conditioning, if not already present. This would enable homeowners to close their windows during warm weather months.

Estimated cost: $135.5 million ($13,500 per home)

SOURCE: Nigel D. Finney, MAC deputy executive director for planning and environment, memorandum to MAC Planning and Environment Committee, *Part 150 Sound Insulation Program—60-64 DNL Contour*, May 30, 2001.

In 2001-02, MAC considered several options for its expanded noise mitigation program.

In December 2001, MAC voted to rescind its August 2001 decision regarding the 60-64 DNL program. Following additional discussions by the commission, MAC voted unanimously in April 2002 to adopt a tiered mitigation program for the 60-64 DNL area:

- In the 63-64 DNL contours (based on noise projections for 2005), MAC would provide "full" mitigation (Option 1 in Table 4.2).

- In the 60-62 DNL contours, MAC would provide air conditioning (if needed) or reimbursement for sound insulation improvements up to the value of air conditioning installation. Based on acoustical testing, MAC

would provide additional mitigation if necessary to help houses meet an interior noise level of 45 DNL.[26]

Based on noise projections for 2005, MAC estimated that the 60-64 DNL sound insulation program approved in April 2002 would provide benefits of varying levels to about 8,000 homes. By contrast, the program that MAC approved in August 2001 (and then rescinded) would have provided benefits to only about 3,300 homes in the 60-64 DNL area.

The commission committed in May 2002 to spend $150 million for the 60-64 DNL program, consistent with the 1999 airline agreement.[27] At the same time, the commission voted to revise the forecasts that had been used in 2001 to estimate future noise contours. MAC decided that recent changes in the airport's number of operations and fleet mix justified a re-estimation of the noise contours. Thus, MAC withdrew its 2001 Part 150 submission to the federal government (which included noise exposure maps for 2005). MAC anticipates that it will submit a revised Part 150 report to the federal government this year, containing projected noise contours for 2007.

Since 1996, MAC has moved from a vague commitment to expand the sound insulation program to a more clearly defined policy. During this time, MAC's vacillation about the 60-64 DNL noise policy and its decision to withdraw the 2001 Part 150 noise mitigation proposal have probably contributed to public confusion about which homes will be eligible for mitigation. Overall, however, we conclude that:

- **In 2002, MAC adopted a policy for sound insulation in the 60-64 DNL area that was ambitious, did not violate earlier written commitments, and was significantly less expensive than some other options that were considered.**

The scope of MAC's expanded noise mitigation program would be unprecedented among major airports.

MAC's program is ambitious because it would be unprecedented among major U.S. airports. For airports choosing to participate in the federal Part 150 program, there are no requirements for airport noise mitigation in areas with noise levels below 65 DNL. Few U.S. airports provide any noise insulation in the 60-64 DNL area, and no airport has a program in this area as extensive as that proposed by MAC.[28] Some local officials told us that they expected MAC's 60-64 DNL program to be more extensive than what was proposed, yet MAC commissioners representing even the most noise-affected areas voted in 2002 in favor of the policy.

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26 In 1974, the U.S. Environmental Protection Agency (EPA) declared that 45 DNL was a noise level at which there were no adverse effects on public health and welfare due to interference with speech or other activity. EPA noted that this threshold was developed using a conservative approach and that it should not be construed as a standard for regulatory purposes.

27 In April 2002, MAC adopted a policy that would have allowed it to spend less than $150 million if the cost of completing the 60-64 DNL program did not require $150 million. The Metropolitan Council then threatened to not approve MAC's entire capital program if MAC retained this policy. In May 2002, MAC reaffirmed its commitment to spend $150 million for the 60-64 DNL program.

28 San Jose International Airport provides insulation treatments to homes in the 60-64 DNL area that have interior noise levels exceeding 45 decibels. Two airports in Hawaii offer insulation within the 60-64 DNL area to a small number of homes. Cleveland Hopkins International Airport plans to insulate 3,000 or more homes in the 60-64 DNL area, depending on the level of funding available for the program.

Some airline officials told us that the 60-64 DNL program is unnecessary and should be deferred, particularly in light of the airlines' current financial difficulties. However, the proposed program is consistent with prior financial commitments by MAC and the airlines, as expressed in the 1999 airlines operating agreement. In 2002, the Metropolitan Council threatened to hold up MAC's capital program if it did not clarify its intent to spend the $150 million (in 1998 dollars) cited in the airlines operating agreement—and MAC reiterated its commitment. It is also worth noting that MAC made decisions in 2001 and 2002 about the scope of the 60-64 DNL program following systematic consideration of alternatives and their costs; in contrast, MAC's initial program commitments in 1996 were based on very limited discussions of these topics.

Finally, we examined whether MAC has fulfilled previous expenditure commitments regarding its *existing* noise mitigation program in the 65+ DNL area. The 1996 Legislature required that:

> From 1996 to 2002, the commission shall spend no less than $185,000,000 from any source of funds for insulation and accompanying air conditioning of residences, schools, and other publicly owned buildings where there is a demonstrated need because of aircraft noise; and property acquisition, limited to residences, schools, and other publicly owned buildings, within the noise impacted area.[29]

We reviewed MAC expenditures and found that:

Over the past two decades, MAC has spent nearly $300 million on noise mitigation.

- **MAC has spent about $210 million on sound insulation and property acquisition since 1996, thus exceeding statutory requirements.**

From the beginning of 1996 through July 2002, MAC spent about $162 million for home insulation, $33 million for school insulation, and $14 million to acquire properties located near the airport (see Figure 4.2).[30] Altogether, MAC's spending for sound insulation and property acquisition from the 1980s to present totals about $282 million—including $191 million for home insulation, $43 million for school insulation, and $48 million for property acquisition.[31]

In addition, MAC recommended in 1996 that spending for its noise abatement program should increase beyond $25.5 million per year, to accelerate program implementation.[32] We found that spending for MAC's sound insulation program

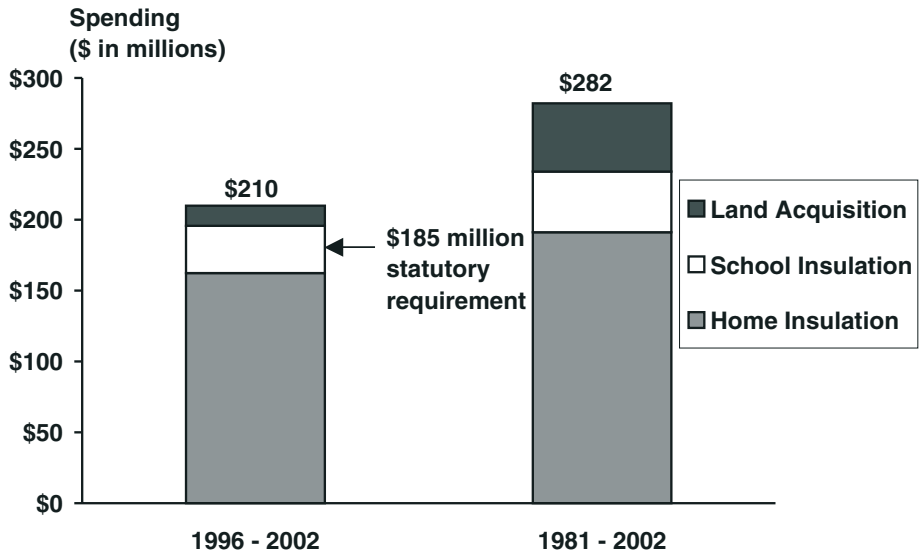
29 *Laws of Minnesota* (1996), ch. 464, art. 3, sec. 13.

30 *Laws of Minnesota* (1996), ch. 464, art. 3, sec. 13 also required MAC to insulate six schools in the 60 DNL contour (four in Minneapolis and two in Richfield) by the end of 2002. Their names were not specified in the law, so the cities identified their preferences for insulation. Of the six selected, five were completed by the end of 2002. Insulation of the sixth (in Minneapolis) is scheduled to begin in 2003.

31 MAC started its first school insulation project in 1981. It has insulated 17 schools over the past two decades.

32 MAC, *MSP Noise Mitigation Program* (Minneapolis, November 1996), 2.

Figure 4.2: Noise Mitigation Expenditures by MAC (Through July 2002)



SOURCE: Office of the Legislative Auditor analysis of MAC data.

MAC's spending levels for noise mitigation since 1996 met legislative requirements.

alone surpassed this goal over four consecutive years, starting in 1998.[33] MAC spent about $33 million in 2001 for sound insulation, but it significantly curtailed the program in the months following the September 11, 2001 terrorist attacks.

Finally, we examined how MAC's noise mitigation spending levels compare with the long-term plan it negotiated with the airlines in 1999. The operating agreement between MAC and the airlines established budgets for a variety of capital expenditures, including noise mitigation. The agreement estimated that MAC would spend $477 million (in inflation-adjusted dollars) between 1998 and 2010 on noise mitigation, including $136 million on sound insulation in the 65+ DNL area. We found that:

- **The projected cost of MAC's sound insulation program for homes with noise levels exceeding 65 DNL is significantly higher than the amount budgeted for this purpose in the airline operating agreement, but it will be covered by a contingency amount established for the noise programs.**

MAC has projected that its 1998-2010 expenditures for 65+ DNL sound insulation will total $186 million, or about $50 million over the $136 million budget in the operating agreement. MAC officials told us that the expenditure increases were mostly due to unanticipated increases in the insulation cost per home—for instance, due to the larger homes that MAC began to insulate as the program

33 Using MAC data on sound insulation, we determined that MAC spent $26.4 million in 1998, $26.0 million in 1999, $35.5 million in 2000, and $33.2 million in 2001.

reached neighborhoods farther from the airport.[34] Figure 4.3 shows that MAC's average construction costs per home have increased significantly over the course of the program, reaching $47,449 in 2001.[35] The highest construction cost for insulating an individual home has been $125,438.[36]

MAC's sound insulation construction costs for these two homes exceeded $120,000 each.

MAC will have to manage its remaining noise mitigation work carefully to stay within its budget.

So far, MAC's spending for noise programs is within the overall budget established by the 1999 airline agreement—mainly because the agreement contains a contingency amount of $50 million for noise-related programs ($61.5 million in inflated dollars). However, due to higher-than-expected spending levels for the 65+ DNL program, MAC will have to manage the remaining noise mitigation work carefully between now and 2010 to fulfill its noise mitigation commitments in the 60-64 and 65+ DNL areas within the budget constraints of the airline operating agreement.

ACCURACY OF MAC'S 1996 NOISE PROJECTIONS

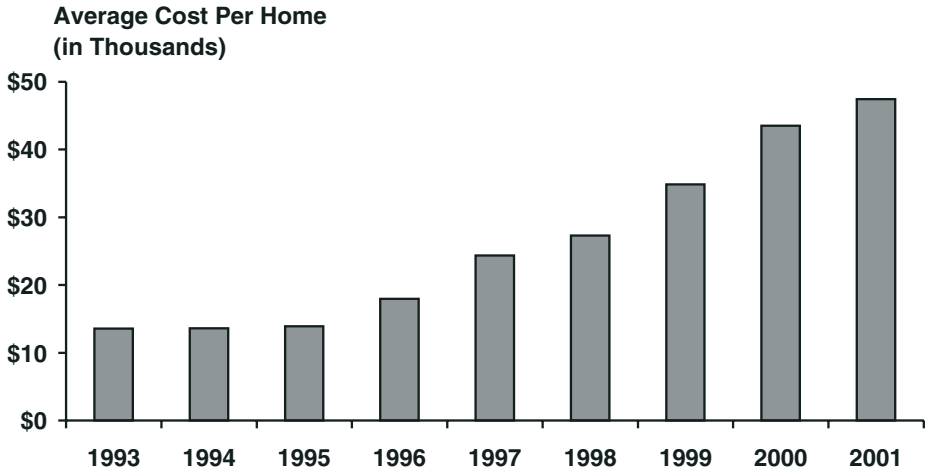
Airports' Part 150 submissions to the federal government must include a noise exposure map based on existing conditions and another map reflecting forecast conditions five years after the date of the submission. The forecast map must be "based on reasonable assumptions concerning future type and frequency of aircraft operations, number of nighttime operations, flight patterns, airport layout. . ., planned land use changes, and demographic changes in the surrounding

34 Arguably, MAC should have foreseen the increase in home size as the insulation program progressed. MAC staff said that several other factors contributed to escalating costs as the program progressed, including: (1) more homes with boiler heat, thus requiring the installation of ductwork to accommodate air conditioning, (2) more historic homes (although MAC records identified only 161 "historic" housing units among those that have been insulated), (3) indoor air testing, starting in 1997, and (4) increasing labor and material costs, partly due to the strong economy.

35 Average cost per home declined in the first part of 2002, based on very limited data. Among homes on which insulation bids were received in January through July 2002, there were only five homes for which 100 percent of costs had been paid as of July 2002. For these homes, the average insulation cost was about $26,000.

36 Construction costs do not include the costs of design work and program administration.

Figure 4.3: Residential Sound Insulation Program Average Cost Per Home, 1993 - 2001



NOTE: Based on date of bids received. Includes only those homes for which 100 percent of costs have been paid.

SOURCE: Office of the Legislative Auditor analysis of Metropolitan Airports Commission data.

MAC's average insulation cost per home increased to $47,449 in 2001.

areas."[37] Airports must certify that submitted maps are "true and complete."[38] The Federal Aviation Administration (FAA) reviews airports' Part 150 submissions and approves or disapproves them.

MAC's federally-approved noise program relies on projections of future noise levels.

MAC's federally-approved noise contours became the basis for a residential sound insulation program at Minneapolis-St. Paul International Airport that started in 1992. Homes that in 1992 were projected to have 1996 noise levels of 65 DNL and greater were eligible for MAC-financed modifications.

MAC's projected 1996 noise map is its most recent federally-approved map of projected noise. Thus, even today, eligibility for the sound insulation program relies on MAC's 1992 projection of the 1996 noise contours. Because the contours determine program eligibility, we examined how the noise levels *forecast* for 1996 compared with *actual* noise levels in 1996.[39] We found that:

- **MAC's forecasts of 1996 airport noise levels were considerably different from the actual levels of airport noise experienced by homes in 1996. For the most part, MAC underestimated the actual 1996 noise levels.**

37 14 *CFR* ch. 1, part 150.21 (2001).

38 14 *CFR* ch. 1, part 150.21 (2001).

39 The actual noise contour for 1996 was developed for the following document: Federal Aviation Administration, Great Lakes Region, Air Traffic Division, *Environmental Assessment for Revised Air Traffic Control Procedures Off of Runway 30L-30R* (Minneapolis, June 25, 1999). This "actual" contour map was developed by applying data on actual airport operations to the federal Integrated Noise Model—thus, estimating actual noise exposure levels.

For the most part, MAC's projections of noise for 1996 understated the actual noise levels.

For instance, Figure 4.4 compares the projected and actual DNL 65 noise contours for 1996. In most parts of the map, the actual 1996 noise contour extends farther from the airport than does the projected 1996 contour map. Thus, the actual 1996 contour covers more land area than the projected 1996 contour and reflects a higher-than-projected level of noise. For instance, the actual 1996 65+ DNL contour extends about one-half mile farther into south Minneapolis straight out from the end of the south parallel runway than does the comparable portion of the projected 1996 contour. In part of north Richfield, the actual 1996 noise contour exceeds the boundaries of the projected contour by more than a mile. Similarly, the actual noise contour extends from the parallel runways more than 3,000 feet farther into portions of Eagan and Mendota Heights than does the projected contour. In contrast, the projected noise contour in Bloomington extends well beyond the actual contour, indicating that actual noise in Bloomington was not as great in 1996 as MAC had projected.

We identified several factors that contributed significantly to the differences between the projected and actual 1996 noise contours.[40] First,

- **The airport had more arrivals and departures in 1996 than MAC had projected.**

Combined, arrivals and departures are commonly called "operations." To project the number of operations at Minneapolis-St. Paul International Airport for 1996, MAC relied on forecasts that had been developed in 1989 for the airport's long-term comprehensive plan. MAC projected a total of about 428,000 operations at the airport during 1996, which would have been a 10 percent increase over its estimated number of 1991 operations. As Figure 4.5 shows, however, the actual number of operations in 1996 was about 485,000—which was 25 percent higher than the 1991 baseline and 13 percent higher than MAC's projected number of 1996 operations. MAC staff told us that the projections seemed reasonable at the time the Part 150 report was developed. Northwest Airlines, which has hub operations at the Minneapolis-St. Paul Airport, had serious financial difficulties in the early 1990s, and its future was uncertain. Also, the economy came out of a recession in 1993, and few people predicted the strong economic boom that followed.[41] In any case, the larger-than-projected number of actual operations at the airport contributed to MAC's underestimation of airport noise.

A second reason for differences between projected and actual noise levels was that:

- **Aircraft meeting new, more restrictive noise standards comprised a smaller proportion of the fleet using the Minneapolis-St. Paul Airport in 1996 than MAC had anticipated.**

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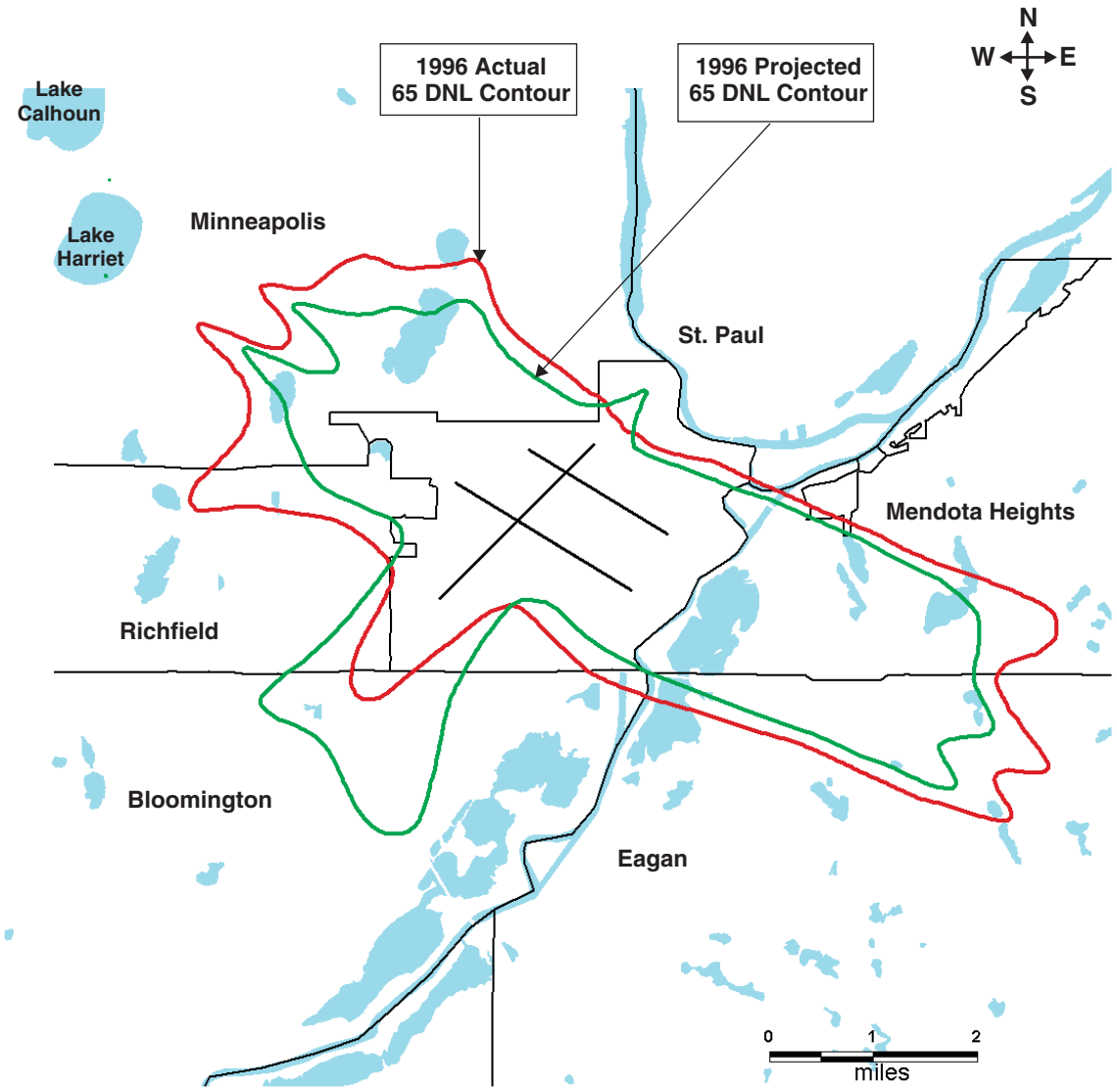
40 Other factors not discussed here could also have played a role. For instance, we were interested in comparing the projected and actual use of individual "flight tracks" from the various runways; however, MAC said that such data are not readily available for 1996.

41 As part of the dual track airport planning process, MAC developed "high" and "low" long-term forecasts of airport activity in 1993, and actual operations at the airport in subsequent years tracked much closer to the high estimate than the low estimate. MAC had not developed the high and low forecasts at the time it developed the noise exposure map in 1992 for the Part 150 report.

Figure 4.4: Comparison of Projected and Actual 1996 Noise Contours (65 DNL)

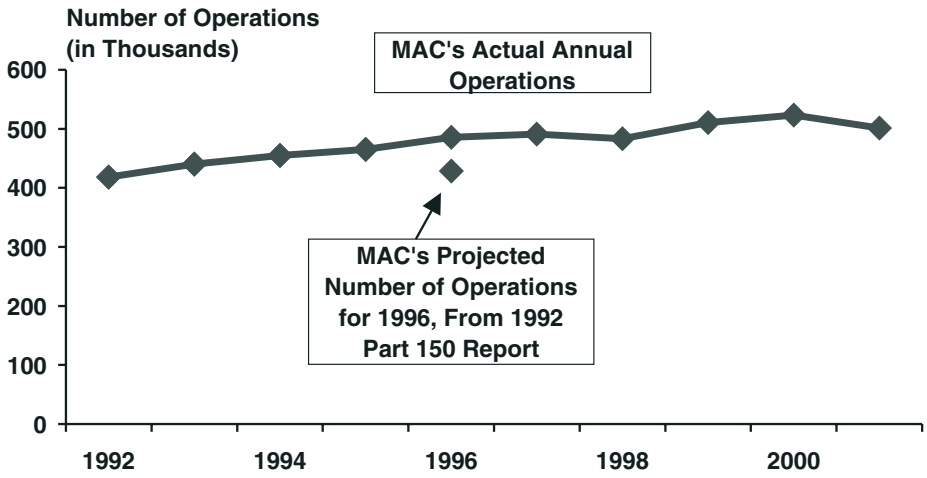


NOTE: The "actual" noise contour was developed using the federally-sanctioned Integrated Noise Model.

SOURCE: HNTB, *FAR Part 150 Study Update* (Minneapolis: Metropolitan Airports Commission, March 1992); Federal Aviation Administration, Great Lakes Region, Air Traffic Division, *Environmental Assessment for Revised Air Traffic Control Procedures Off of Runway 30L-30R* (Minneapolis, June 25, 1999).

The airport had 13 percent more operations in 1996 than MAC had projected.

Figure 4.5: Number of Operations at Minneapolis-St. Paul Airport (1992 - 2001 Actual and 1996 MAC Projection)



SOURCE: Metropolitan Airports Commission (1992-2001 actual data); HNTB, *Minneapolis-St. Paul International Airport, FAR Part 150 Study Update* (Minneapolis: Metropolitan Airports Commission, March 1992), D-8.

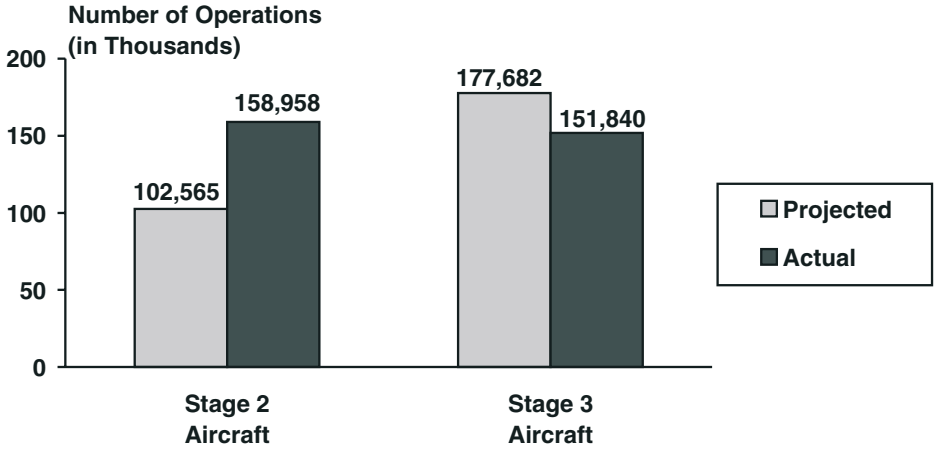
Earlier, we described how federal laws required airlines to change their aircraft from "Stage 2" to "Stage 3" standards by 2000. To meet the new standards, airlines had to either (1) acquire new planes built to meet Stage 3 standards (such as Airbus 320s and Boeing 757s), or (2) modify Stage 2 aircraft (such as Boeing 727s and DC-9s) to comply with the new standards. As shown in Figure 4.6, there were 55 percent more Stage 2 aircraft operations in 1996 than MAC had projected for that year. In addition, there were 15 percent fewer Stage 3 aircraft operations in 1996 than MAC had projected for that year. Or, stated in a different way, MAC projected that 63 percent of commercial aircraft over 75,000 pounds using Minneapolis-St. Paul Airport would meet Stage 3 standards in 1996—but, in fact, only 49 percent did. MAC staff told us that, at the time they developed the Part 150 report in 1992, they assumed that airlines would purchase new Stage 3 aircraft to comply with the new federal requirements. But Northwest Airlines delayed retirement of some of its older aircraft and even purchased *additional* Stage 2 aircraft for its fleet. These planes were eventually modified to comply with Stage 3 requirements, but this happened gradually in the years leading up to 2000. In addition, many of the modified planes were barely compliant with Stage 3 requirements, while new planes typically exceeded the Stage 3 requirements by a larger amount.

Third,

- **Aircraft used Runway 4-22 (sometimes called the "crosswind runway") far less in 1996 than MAC had anticipated, so other runways received more of the airport's traffic.**

Figure 4.6: Projected and Actual Number of Stage 2 and Stage 3 Operations at Minneapolis-St. Paul Airport, 1996

"Stage 2" aircraft—which were subject to less restrictive noise standards—accounted for more air traffic in 1996 than MAC had projected.



NOTE: The number of operations does not include general aviation aircraft, air carrier turboprop or piston aircraft, or military aircraft.

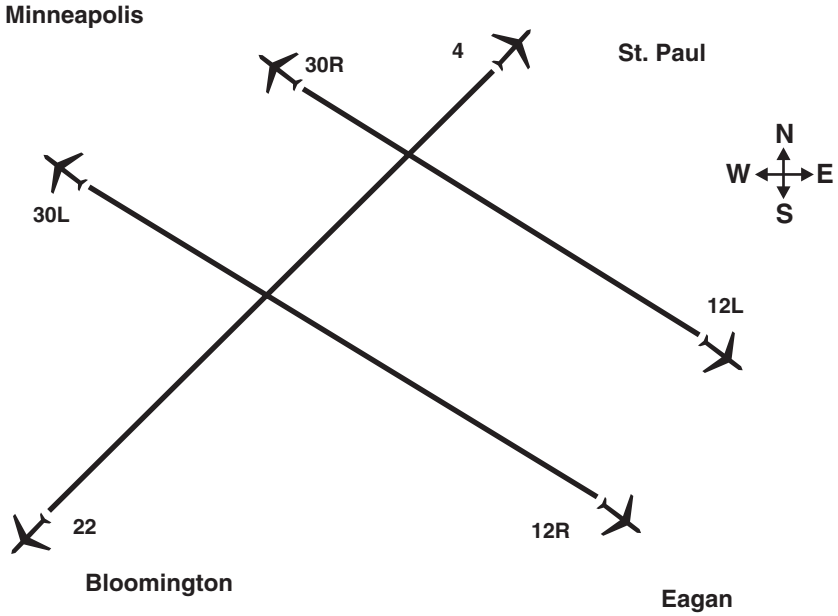
SOURCE: Metropolitan Airports Commission.

During the 1990s, Minneapolis-St. Paul International Airport had three runways, as shown in Figure 4.7. Two parallel runways ("12L-30R" and "12R-30L") face the northwest (toward south Minneapolis) and southeast (toward Eagan). A third runway (called "4-22") crosses the parallel runways and faces the southwest (toward Richfield and Bloomington) and northeast (toward Minnehaha Falls in Minneapolis and the Highland Park neighborhood in St. Paul).

In the early 1990s, MAC planned to extend Runway 4-22 so that larger planes could use it more often. At that time, MAC projected for 1996 that 23 percent of daytime departures and 6 percent of daytime arrivals would occur on this runway (see Table 4.3), mainly over Richfield and Bloomington. In fact, however, less than 3 percent of daytime departures and less than 1 percent of daytime arrivals occurred on Runway 4-22 in 1996. Two important factors contributed to this change. First, the extension of Runway 4-22 was delayed several years due to legal challenges by the city of Richfield. Second, as the overall level of operations at the airport grew faster than expected, it became necessary to accommodate more flights by using the airport's parallel runways (which allowed for simultaneous take-offs), rather than using a runway that crossed the other two.

Because Runway 4-22 was used less than expected, the parallel runways were used more than expected. The most important impacts were that Bloomington experienced less air traffic than had been projected, and the communities at both ends of the parallel runways experienced more. For instance, 47 percent of the airport's daytime departures took off over the northwest ends of the parallel runways (toward south Minneapolis) in 1996, compared with MAC's projection of 25 percent.

Figure 4.7: Minneapolis-St. Paul International Airport Runways



NOTE: The planes pictured next to the runway numbers indicate the direction faced by planes using the respective runways. For instance, Runway "12L" is used by planes that face 120 degrees (to the southeast), whether they are departing or landing. The parallel runways are labeled "L" or "R"—that is, the left or right runway for a plane facing a given direction.

SOURCE: Metropolitan Airports Commission.

Bloomington experienced less noise than expected, due to limited use of the "crosswind runway."

The 1996 projections are important even today because they affect eligibility for MAC's sound insulation program. Specifically, MAC's program to insulate homes in the 65+ DNL area has been—and continues to be—based on the *projected* 1996 noise contour maps. We recognize that that there are limitations in the ability of any agency to accurately project future noise levels, and there were many uncertainties in 1992 when MAC developed its projections. Still, because the actual 1996 noise contours were larger than the projected noise contours, we think it is noteworthy that:

- **Some homes that would have been eligible for insulation if MAC had projected 1996 noise levels more accurately are not eligible for the existing program.**

Federal regulations require airports to submit revised noise exposure maps if changes in airport operations would create any "substantial, new noncompatible use" in areas beyond what was previously forecast.[42] Federal regulations define areas with DNL levels of 65 and greater as incompatible land uses for residential purposes, although communities may determine whether homes may be allowed in the 65-75 DNL area. Airports are supposed to submit revised noise maps if

42 14 *CFR* ch. 1, §150.21 (d) (2001).

Table 4.3: Projected and Actual Percentage of Flights Using Various Runways at Minneapolis–St. Paul Airport, 1996

Departures

Runway	Main Area affected	1996 Daytime Departures Projected	1996 Daytime Departures Actual	1996 Nighttime Departures Projected	1996 Nighttime Departures Actual
12L	Mendota Heights	28.5%	26.5%	23.4%	21.1%
12R	and Eagan	24.2	24.3	34.8	40.8
30L	South	10.1	22.9	10.4	20.7
30R	Minneapolis	14.5	23.7	11.3	11.3
4	Minneapolis-St. Paul border	1.6	0.2	1.2	0.9
22	Bloomington and Richfield	21.1	2.5	18.9	5.1
Total		100.0%	100.0%	100.0%	100.0%
N		170,966	222,322	28,032	20,440

Arrivals

Runway	Main Area Affected	1996 Daytime Arrivals Projected	1996 Daytime Arrivals Actual	1996 Nighttime Arrivals Projected	1996 Nighttime Arrivals Actual
12L	South	22.4%	24.8%	15.8%	15.6%
12R	Minneapolis	24.2	23.5	19.1	18.5
30L	Mendota Heights	24.6	25.0	39.9	40.2
30R	and Eagan	22.8	25.9	18.3	23.8
4	Bloomington and Richfield	0.8	0.5	2.6	1.7
22	Minneapolis-St. Paul border	5.2	0.2	4.3	0.3
Total		100.0%	100.0%	100.0%	100.0%
N		178,047	217,102	20,951	25,623

SOURCE: Metropolitan Airports Commission.

Federal regulations require updates of noise maps if noise levels increase significantly.

there is an increase of at least 1.5 DNL that (1) increases the incompatibility of a presently incompatible area, or (2) causes a previously compatible land use to become incompatible.[43] Based on a review of data from the 24 noise monitors that MAC operated in the mid-1990s, we found that there were at least two monitoring sites where (1) the actual 1996 noise level was at least 1.5 DNL higher than the projected 1996 noise levels, and (2) the actual 1996 noise level was higher than 65 DNL, while the projected 1996 noise level was less than 65 DNL.[44]

43 14 *CFR* ch. 1, §150.21 (d) (2001).

44 A monitor near the intersection of Oakland and 49th streets in Minneapolis had a projected 1996 noise level below 65 DNL, but the actual DNL level during 1996 was 66.6 (average of 12 monthly DNL levels). A monitor near the intersection of Wentworth & 64th streets in Richfield had a projected 1996 noise level below 65 DNL, but the actual DNL level during 1996 was 66.9. There may have been other sites with increases of more than 1.5 DNL over projected levels, but MAC was unable to provide us with projected 1996 DNL readings for individual monitoring stations. We used MAC's projected 1996 noise contour map to determine sites that were projected to be above or below the 65 DNL threshold.

Federal officials think that MAC was justified in delaying noise map revisions until key issues about the airport's future were resolved.

From 1992 until late 2001, MAC submitted no revisions of its 1996 noise exposure map to the federal government. We talked with Federal Aviation Administration (FAA) officials about whether MAC was obligated by federal regulations to submit a revision, in light of the higher-than-expected noise levels that occurred in the mid-1990s. Local FAA officials told us that, in their opinion, MAC was justified in waiting to submit updated noise maps until key issues were resolved regarding Minneapolis-St. Paul International Airport—such as decisions regarding whether to build a new airport, and whether to construct a new runway at the existing airport. The Legislature decided in 1996 not to build a new airport, and the environmental impact statement for the dual track planning process (including an assessment of the impact of a new runway) was completed in late 1998.[45] In early 1999, MAC started to develop a new Part 150 noise mitigation proposal, and this process culminated in a submission to the federal government in November 2001.

MAC did not submit revisions to its Part 150 report during the mid-1990s, but it did make some changes to eligibility for noise mitigation in Bloomington. Because there was uncertainty about when (and whether) the Runway 4-22 extension would occur, MAC voted in 1993 to defer noise mitigation projects for more than 1,000 homes in Bloomington.[46] MAC's Part 150 report projected that these homes would have 1996 noise levels exceeding 65 DNL due to increased use of the extended Runway 4-22. The runway was eventually extended, but traffic on Runway 4-22 did not increase significantly and the deferred noise mitigation projects were not completed. In contrast, other parts of the metropolitan area received significantly more air traffic as a result of the higher-than-expected use of the parallel runways. MAC proposed no changes in sound insulation eligibility at either end of the parallel runways, although these areas had more homes than previously expected with noise levels above 65 DNL in the mid-1990s.

But even if MAC had initiated a revision of its Part 150 noise contours prior to 1999,

- **A revised noise forecast in the mid- to late-1990s might have resulted in reduced rather than expanded program eligibility for MAC's sound insulation program, due to changes in aircraft noise that were mandated by federal law.**

The Part 150 noise mitigation program is based on estimates of noise levels at a future time. Federal officials told us that if MAC had decided to revise its noise contour maps in 1995-98, they would likely have expected MAC to estimate noise levels for five years *from the date of the revision*. However, a new five-year forecast developed during this time period could have resulted in a smaller 65+ DNL contour than the one MAC developed in 1992 because of the federally-required phase-out of "Stage 2" planes by 2000. Thus, a Part 150

45 MAC submitted the environmental impact statement to the federal government in May 1998. It was approved by the Federal Aviation Administration in September 1998 and certified as adequate by the Minnesota Environmental Quality Board in December 1998.

46 In 1993, some MAC commissioners noted that (1) many Bloomington residents opposed the runway extension, and (2) the runway extension might not be built. They suggested that other areas in the 65+ DNL area should be higher priorities for funding. Consequently, MAC deferred sound insulation for about 1,000 homes and land acquisition for 75 homes.

revision could have caused some homes that were projected to be within the 1996 65+ DNL contour to lose eligibility for insulation. Meanwhile, homes that had *actual* 1996 noise exceeding 65 DNL (but were ineligible for funding under the 1996 projected contours) would not necessarily have had *projected* noise levels above 65 DNL under the revised contours. Overall, it is unclear whether a revision of the Part 150 contour maps would have remedied the concerns of homeowners who thought that forecasting inaccuracies caused them to be omitted from the sound insulation program.[47] On the other hand, we think that the 15-member Metropolitan Airports Commission should have discussed in the mid-1990s the accuracy of past noise forecasts and the implications of higher-than-expected noise levels; however, MAC staff did not bring these issues to the commission's attention.[48]

It is unclear whether revised forecasts would have remedied the concerns of homeowners who thought they were wrongly omitted from the sound insulation program.

In the 65 DNL area, MAC has reduced home noise by installing windows, doors, air conditioning, and insulation.

As we discuss later in this chapter, the airport's overall noise levels have declined since 1996. Although the number of airport operations grew after 1996 (see Figure 4.5), the types of planes using the airport have changed significantly. Stage 2 planes were phased out by 2000. In early 2001, Northwest Airlines announced plans to purchase 52 new planes, and various airlines announced plans to phase out older aircraft (such as DC-9s and DC-10s) in favor of newer, more cost-effective planes. These pre-September 2001 changes were forecast to reduce the number of operations by "hushkit"-modified planes by 10,000 annually at Minneapolis-St. Paul Airport, and such planes were often among the noisier planes in the fleet. Fleet changes continued to occur after the September 11, 2001 terrorist attacks, leading MAC to withdraw in May 2002 its November 2001 Part 150 submission to the FAA. MAC staff plan to update estimates of future noise levels and submit a revised Part 150 report to FAA later in 2003. Staff anticipate that the projected 2007 noise contours will be considerably smaller than those that MAC previously projected for 1996.

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47 Parties that feel aggrieved by the actions of MAC or the FAA may seek redress through administrative appeals or legal actions. We offer no opinion about the legality of previous actions by MAC or the FAA.

48 MAC staff told us that initiating a Part 150 revision in the late stages of the dual track airport planning process might have been viewed by some people as an attempt to influence the outcome of that process. In addition, MAC staff said that they did not see solid data before 1996 supporting a need for changes in the earlier noise projections.

COMPARISON OF MAC'S NOISE PROGRAM WITH OTHER AIRPORTS

Airports have varying needs for noise mitigation, depending on their location. For instance, some newer airports (such as Denver International Airport) were constructed at locations away from existing development—thus, reducing the need for noise mitigation. In contrast, the Minneapolis-St. Paul International Airport is located in a developed urban area, with extensive residential development in some of the airport's main flight paths.

Since 1992, the Metropolitan Airports Commission has administered a sound insulation program within the 65+ DNL contour. Through July 2002, MAC had completed work or received bids on more than 6,400 single-family homes and 200 duplexes.[49] As shown in Table 4.4, most of the insulated homes have been in Minneapolis. In 2002, MAC estimated that there were about 1,100 homes in the 65+ DNL area still scheduled to undergo insulation, at an estimated cost of $42 million. MAC estimates that it will complete residential sound insulation in the 65+ DNL area during 2004, and it will then begin insulating homes in the 60-64 DNL area.

Most of the homes insulated by MAC are in Minneapolis.

Table 4.4: Location of Homes That Have Been Sound-Insulated by MAC (Through July 2002)

City	Housing Units	Percent
Minneapolis	5,808	84.9%
Richfield	623	9.1
Eagan	188	2.7
Bloomington	128	1.9
Mendota Heights	93	1.4
Total	6,840	100.0%

SOURCE: Office of the Legislative Auditor analysis of MAC data.

To determine how MAC's noise mitigation program compares with those at other U.S. airports, we contacted noise officials at 20 large airports (mostly "large hub" airports).[50] One airport with an extensive noise mitigation program (Atlanta) did not respond to repeated requests for information, but we are not aware of other large noise mitigation programs that were not represented in our airport survey.[51]

49 MAC's noise mitigation database had records of 6,431 single-family homes and 203 duplexes insulated between the beginning of 1993 and July 2002. MAC's database does not contain information on some additional homes that were insulated in 1992. MAC estimates that the total number of single-family homes insulated from 1992 through the end of 2002 was about 6,900.

50 Large hub airports are those with at least a 1 percent share of total passenger enplanements in the country. We contacted the large hub airports with the most operations, plus two smaller airports (Cleveland and Chicago-Midway) that we knew had undertaken significant noise mitigation programs.

51 A 2001 MAC memorandum indicated that Atlanta had spent $175 million on residential sound insulation. (Roy Fuhrmann, Manager, Aviation Noise and Satellite Programs, memorandum to Nigel Finney, Deputy Executive Director, Planning and Development, *Comparison of MSP's Sound Insulation Program*, June 1, 2001).

Eleven of the 20 airports we contacted do not participate in the federal Part 150 noise mitigation program, although several of these airports operate noise mitigation programs with their own funds.

We found that:

- **The Minneapolis-St. Paul International Airport has one of the most extensive noise mitigation programs among U.S. airports—particularly for single-family home insulation.**

As shown in Table 4.5, the Minneapolis-St. Paul Airport's cumulative expenditures for single-family home insulation (about $190 million) rank near the top among U.S. airports. Only two airports (San Francisco and Seattle) reported that they have insulated more homes than the Minneapolis-St. Paul Airport. In addition, the Minneapolis-St. Paul Airport's home insulation program offers as many noise mitigation treatments as any airport we contacted. While airports with home insulation programs typically replace windows and doors, the Minneapolis-St. Paul Airport's program also includes components that some airports do not offer—such as installation of air conditioning, attic and wall

The extent of noise insulation by major airports varies considerably.

Table 4.5: Sound Insulation of Single-Family Homes, Selected Airports

Airport	Number of Single-Family Homes Insulated To Date	Total Single-Family Home Insulation Costs to Date (in Millions)
Seattle	8,700	$204.0
Minneapolis-St. Paul[a]	**6,431**	**190.2**
San Francisco	>10,000	170.0
Chicago - O'Hare	3,934	129.8
Cleveland	1,900	59.9
Los Angeles[b]	2,179	45.8
Chicago - Midway	1,170	38.0
Detroit	640	22.1
Phoenix	720	21.6
Boston	1,750	21.0
St. Louis	>100	4.6
Dallas/Ft. Worth	0	0.0
Denver	0	0.0
Houston	0	0.0
Las Vegas	0	0.0
Miami	0	0.0
Newark	0	0.0
New York - JFK	0	0.0
New York - LaGuardia	0	0.0
Orlando	0	0.0
Philadelphia	0	0.0

[a]Does not include $946,894 for multi-family home insulation. Includes homes for which bids were received from 1993 through July 2002.

[b]Data for Los Angeles represent the sum of four different program estimates and airport staff cautioned that they should be viewed as rough estimates.

SOURCE: Office of the Legislative Auditor phone survey, August-November 2002; Minneapolis-St. Paul Airport information from Metropolitan Airports Commission.

insulation, and ventilation improvements.[52] Finally, as discussed earlier in this chapter, MAC has proposed a noise mitigation program for the 60-64 DNL area that would be more extensive than any such program implemented by a major airport in the U.S.

The Minneapolis-St. Paul Airport's noise program has relied mostly on building insulation, while some other airports have relied more on property acquisition.

In contrast to the Minneapolis-St. Paul Airport, some airports have focused more of their noise mitigation efforts on activities other than sound insulation of single-family homes. For instance, the city of Chicago has spent $259 million on school insulation in the areas around O'Hare and Midway airports. Similarly, the sound insulation program of the three major airports operated by the New York-New Jersey Port Authority focuses exclusively on insulation of schools, not residences.[53] In addition, some airports have spent considerable amounts on land acquisition. For example, officials at the St. Louis airport told us they have spent $200 million to acquire 2,000 homes. Other airports with large land acquisition costs include Cleveland ($175 million), Dallas-Fort Worth ($86 million), and Los Angeles ($85 million). In contrast, MAC has spent $48 million to acquire about 430 housing units and several other properties.

AIRPORT NOISE TRENDS

The adverse effects of airport noise depend on (1) the levels of ambient noise, and (2) steps that have been taken to *minimize the effect* of airport noise (for instance, programs that insulate or acquire homes). Ambient noise levels depend considerably on the types and number of aircraft using an airport, which are largely beyond MAC's direct control. Still, we think it is instructive to consider whether the underlying noise problem at Minneapolis-St. Paul International Airport has grown better or worse in recent years.

We assessed airport noise levels using two main sources of information. First, we compared models of existing airport noise at the Minneapolis-St. Paul International Airport for 1996 and 2000. Using a federally-sanctioned computer program called the Integrated Noise Model plus data on actual airport operations, MAC and its consultants have estimated existing ground-level noise levels for a variety of sites surrounding the airport. MAC is required to use this model to estimate current and future noise when it submits Part 150 reports to the federal government. Second, MAC has operated monitors since 1993 to measure actual noise levels, and we examined the data collected by these monitors.[54] Presently, this system has 39 remote monitoring sensors at ground locations in the vicinity of airport flight paths. We found that:

- **In general, noise levels at sites near the Minneapolis-St. Paul Airport have declined since the mid-1990s.**

52 The other airports with noise programs that included all of these components were Los Angeles, Chicago-O'Hare, and Chicago-Midway.

53 The Port Authority has spent $40 million on school insulation near LaGuardia, Kennedy, and Newark airports.

54 This system is called the Airport Noise and Operations Monitoring System, or ANOMS.

Federal models used to estimate airport noise suggest that the size of the areas subject to significant noise decreased from 1996 to 2000.

Figure 4.8 shows models of actual noise levels around the airport in 1996 and 2000, based on the Integrated Noise Model. 1996 is the year which was the basis for MAC's most recent *federally-approved* Part 150 map of projected noise levels, and it was the year the Legislature decided to keep the airport at its present location. The 2000 noise exposure map is the most recent map of modeled noise exposure that MAC has developed. (This map was developed for the Part 150 report that MAC submitted to the federal government in 2001 but subsequently withdrew.) In Figure 4.8, most parts of the 65 DNL contour of actual noise levels for 2000 are inside the boundaries of the 65 DNL contour of actual noise levels for 1996—suggesting that there has been a reduction in noise.[55] The main place where the DNL 65 contour grew beyond its 1996 boundaries was at its westernmost portion, in south Minneapolis and Richfield.

In addition, we examined trends in noise measured by MAC's remote monitoring sensors. For each of the 24 noise monitors that have operated continuously since 1995, Table 4.6 shows the average monthly DNL noise level during the first three months of the year for 1995, 1996, 2001, and 2002.[56] Although the number of arrivals and departures have increased at the airport since 1995, MAC's noise monitors have generally measured declines in noise over this period. For instance, the table shows that all 24 monitors measured lower average DNL levels in 2001 and 2002 than they did in comparable months during 1995 and 1996.

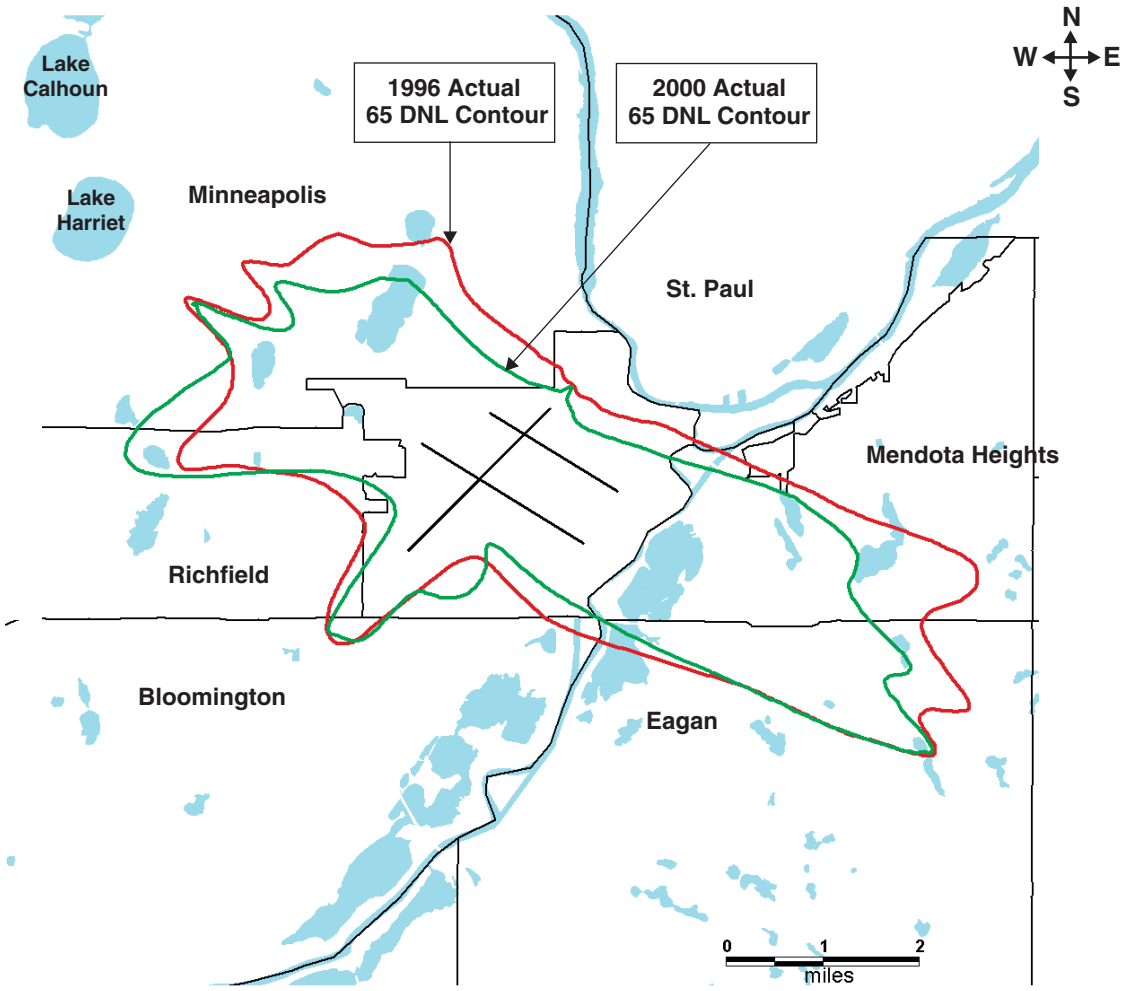
DNL is computed by averaging noise levels throughout the day, and some people have expressed concern that this measure does not adequately convey the disturbance caused by single, peak-level noise events. We examined annual trends since 1996 in the number of high-decibel noise events at two noise monitoring stations that are in the flight path of many arriving and departing planes: one in south Minneapolis (at 27th Avenue and 57th Street), and one in Mendota Heights (located at the end of Kenndon Avenue). Examples of the trends include the following:

- **Departure events exceeding 100 decibels**: At the south Minneapolis monitoring site, the number of departure-related noise events exceeding 100 decibels declined from 4,494 in 1996 to 1,379 in 2000, 995 in 2001, and 378 during the first eight months of 2002. At the Mendota Heights monitoring site, the number of such events declined from 538 in 1996 to 6 in 2000 and 6 in 2001.

55 The federal Integrated Noise Model was updated between 1996 and 2000—in particular, to account for humidity. For MAC's projected 2005 contour, this change resulted in a 65 DNL contour that was 13 percent larger than it would have been if the previous version of the model had been used. If the 1996 contour shown in Figure 4.8 had been estimated using the updated version of the noise model, there would have been more pronounced reductions in the DNL 65 noise contour from 1996 to 2000 than are shown in this map.

56 We selected January through March because (1) the data for these months were relatively complete (there are some other months for which MAC is missing monitoring data in some of the years we reviewed), (2) the monitoring stations did not appear to have unusually high or low noise readings during these months, compared with other nearby months, and (3) we avoided September through December to avoid comparisons involving the months immediately following the September 11, 2001 attacks.

Figure 4.8: Comparison of Actual 1996 and Actual 2000 Noise Contours (65 DNL)



NOTE: "Actual" noise contours were developed using the federally-sanctioned Integrated Noise Model.

SOURCE: FAA, *Revised Air Traffic Control Procedures Off of Runway 30L-30R* (Minneapolis, June 25, 1999); HNTB, *14 CFR Part 150 Update* (Minneapolis: MAC, November 2001).

- **Departure events exceeding 90 decibels**: At the south Minneapolis monitoring site, the number of departure-related noise events exceeding 90 decibels declined from 18,156 in 1996 to 12,757 in 2000 and 11,203 in 2001. At the Mendota Heights site, the accuracy of the data from the latter months of 1996 appear to be questionable, so we used 1995 as a comparison year. The number of such events went from 6,632 in 1995 (based on only 10 months of data) to 6,661 in 2000 and 5,711 in 2001.

Table 4.6: Measured Noise Levels at MAC Monitoring Stations, Selected Time Periods

Remote Monitoring Station Number	Location	Average January-March DNL Levels for: 1995	1996	2001	2002
1	Minneapolis	61.0	61.1	57.8	57.3
2	Minneapolis	61.4	60.7	59.3	58.6
3	Minneapolis	65.8	65.5	63.9	63.6
4	Minneapolis	66.1	66.1	63.0	63.1
5	Minneapolis	73.4	75.4	71.2	72.4
6	Minneapolis	77.5	77.4	72.4	71.8
7	Richfield	66.9	68.6	65.9	65.8
8	Minneapolis	63.8	64.2	62.4	62.1
9	St. Paul	56.1	54.0	46.6	46.4
10	St. Paul	59.7	60.9	49.4	52.3
11	St. Paul	54.3	54.4	44.5	48.6
12	St. Paul	57.2	60.5	43.2	43.5
13	Mendota Heights	61.4	61.1	56.2	55.2
14	Eagan	65.0	67.4	64.7	63.9
15	Mendota Heights	64.8	65.1	59.3	58.3
16	Eagan	71.2	70.8	68.8	67.8
17	Bloomington	62.5	60.7	52.7	53.1
18	Richfield	69.4	67.3	56.7	55.8
19	Bloomington	66.9	64.7	52.2	48.4
20	Richfield	62.7	59.0	52.7	52.9
21	Inver Grove Heights	58.8	58.8	52.5	51.8
22	Inver Grove Heights	62.5	61.2	57.1	58.1
23	Mendota Heights	71.7	71.7	66.2	64.3
24	Eagan	66.1	66.2	62.1	62.4

SOURCE: Office of the Legislative Auditor analysis of data from MAC's monthly technical advisor's reports.

MAC's noise monitors recorded lower noise levels in 2001-02 than in earlier years.

In addition, we examined trends in arrivals and departures during nighttime hours.[57] People living near airports have expressed particular concerns about sleep disruptions due to nighttime flights. Figure 4.9 shows the number of operations at Minneapolis-St. Paul Airport between 11:00 p.m. and 6:00 a.m. since 1995, plus the number of 10:30 to 11:00 p.m. flights since July 1999 (when MAC began to separately track the number of flights in this time period).[58] The number of 11:00 p.m. to 6:00 a.m. operations appear to have increased during the late 1990s and then declined to a fairly stable 1,000 to 1,400 night flights per month—until September 2001, when they declined significantly. Northwest Airlines eliminated its last daily "bank" of evening flights at the airport following the terrorist attacks that month.[59] The number of nighttime operations increased during 2002 but remained somewhat below pre-September 2001 levels.

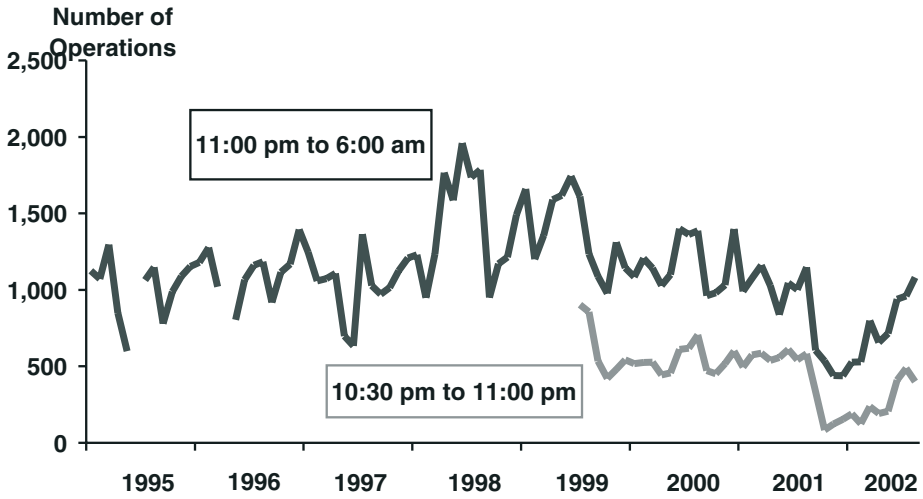
57 In recent years, MAC has produced monthly information on the number of nighttime flights—defined as 10:30 p.m. to 6:00 a.m since 1998, and 11:00 p.m. to 6:00 am before then.

58 For January 1998 to June 1999, MAC produced only aggregate data on the number of nighttime flights from 10:30 p.m. to 6:00 a.m. For this period, we estimated the number of 11:00 p.m. to 6:00 a.m. flights by assuming that 32 percent of nighttime flights occurred during the 10:30 p.m. to 11:00 p.m. period. (We adopted the 32 percent assumption based on a review of the percentage of flights occurring during this period from July 1999 to June 2000.)

59 Airlines typically cluster arriving and departing flights at their hub airports at various times during the day, to facilitate passengers trying to make connecting flights. These clusters are called banks of flights.

Figure 4.9: Number of Nighttime Operations at Minneapolis-St.Paul Airport, 1995 - 2002

The number of nighttime operations peaked in the late 1990s.



NOTE: Data are shown for January 1995 through August 2002; data were missing for June 1995 and April 1996. Data for 10:30-11:00 p.m. were not separately reported before July 1999.

SOURCE: Metropolitan Airports Commission.

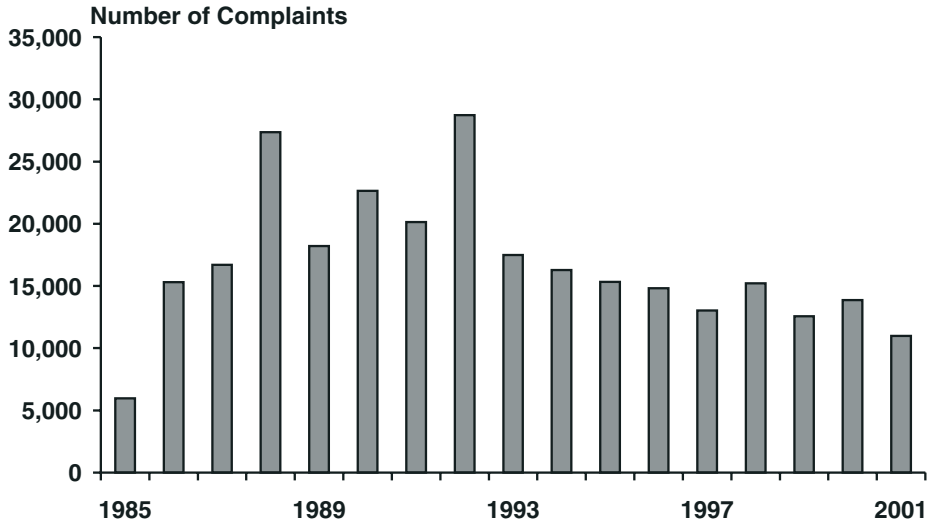
Finally, Figure 4.10 shows that noise-related complaints regarding Minneapolis-St. Paul International Airport peaked in 1992, with nearly 29,000 complaints that year. Since that time, noise complaints have declined—to 13,864 complaints in 2000 and 10,995 complaints in 2001. While this trend might reflect lower noise levels, it is also possible that residents near the airport have grown more reluctant to register complaints.

CHANGES IN NOISE MAPS, 2000-01

Early in our study, legislators raised questions about changes that MAC made in the airport's maps during development of a "Part 150" noise mitigation plan in 2000 and 2001. Specifically, they wondered why the noise contours submitted to the federal government in the final November 2001 Part 150 report were different from the contours that were presented in the November 2000 draft Part 150 report and discussed in public hearings during 2001. As we noted in Chapter 4, MAC eventually withdrew the final report it had submitted to the federal government so that it could revise the noise estimates, particularly to reflect recent changes in the airport's fleet mix.

Figure 4.11 shows a portion of the DNL 60 and 65 noise contour maps (projected for 2005) that appeared in the draft and final Part 150 reports. Although the differences between the draft and final contours appear to be relatively small, the final version of the 2005 60 DNL contour had 13 percent less non-airport land and about 3,000 fewer dwellings than the draft version. If MAC had decided to use the 2005 contour maps to determine eligibility for sound insulation, thousands of

Figure 4.10: Noise Complaints at Minneapolis-St. Paul Airport, 1985 - 2001



SOURCE: Metropolitan Airports Commission.

residents whose homes appeared to be eligible in the draft version would have found themselves ineligible in the final version. We found that:

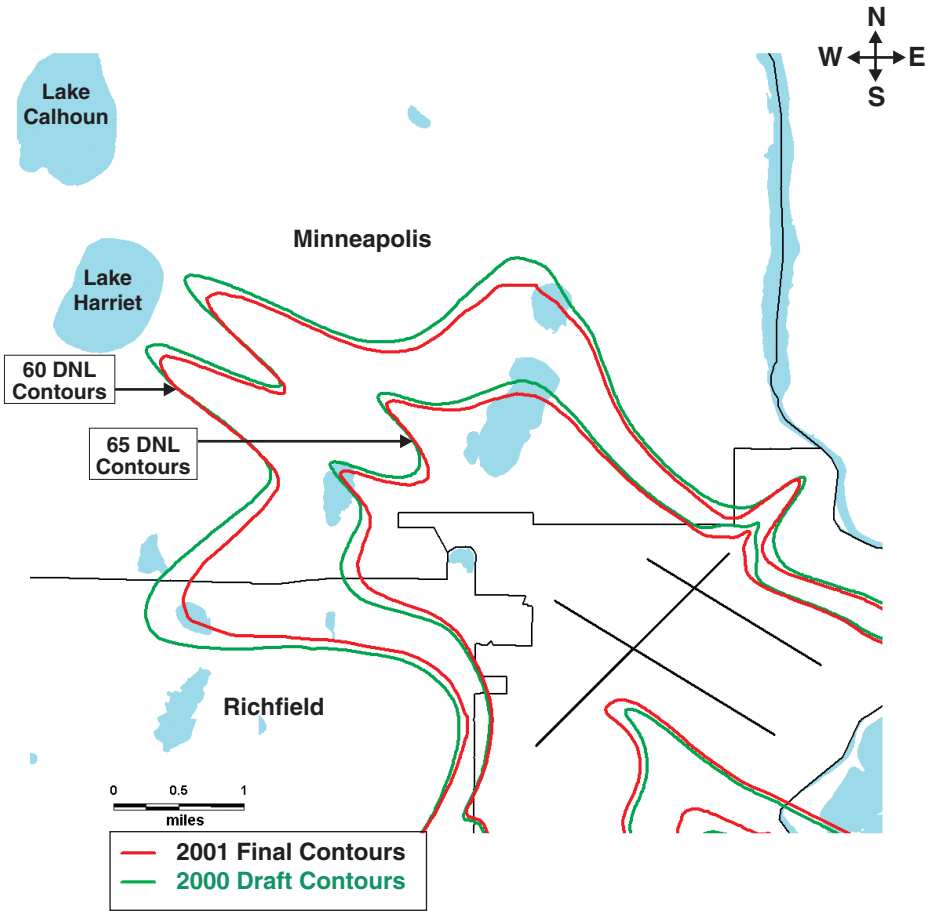
- **There were justifiable reasons that MAC changed the draft noise contours prior to publication of the final contours in 2001, but MAC could have done more to inform the public about these changes.**

MAC made reasonable adjustments to its noise maps but did not communicate these changes adequately.

The contours changed because of reasonable adjustments that MAC made to its assumptions about (1) aircraft flight patterns, and (2) fleet mix. During public hearings in 2001, some participants questioned why MAC's draft contours were based on the assumption that planes followed a single "arrival track" as they approached each of the Minneapolis-St. Paul Airport's runways. MAC agreed that planes' runway approaches can vary, and it subsequently revised its noise model to incorporate multiple arrival tracks (with estimates of the extent to which they would actually be used). The second reason that the contours changed was that the Metropolitan Airports Commission directed MAC staff in August 2001 to update the noise contours to reflect recent and expected changes in the mix of planes using the airport. For instance, MAC estimated that there would be 10,000 fewer arrivals and departures at the airport in 2005 that involved planes modified with "hushkits," based on fleet-related announcements made by several airlines subsequent to MAC's November 2000 issuance of the draft Part 150 report.

In our view, these adjustments reflected reasonable attempts by MAC to ensure that the projected noise contours were as accurate as possible prior to final publication. Also, we think that MAC's final version of the Part 150 report

Figure 4.11: Comparison of Projected 2005 Noise Contours (2000 Draft and 2001 Final; 60 and 65 DNL)



SOURCES: HNTB, *14 CFR Part 150 Update Draft Report* (Minneapolis: MAC, November 2000); and HNTB, *14 CFR Part 150 Update* (Minneapolis: MAC, November 2001).

adequately discusses these changes.[60] Nevertheless, we also think that MAC should have done a better job of (1) alerting the public that the draft noise contours might change, and (2) discussing the implications of the contour changes prior to publication of the final report.[61] The November 2000 draft report did not directly state that the noise exposure maps might be subject to revision, although the entire report was labeled as a draft. In addition, MAC did not have a functioning advisory group on noise issues during the months when it was finalizing the Part 150 report. Airline representatives withdrew from the

60 HNTB Corporation, *Minneapolis-St. Paul International Airport: 14 CFR Part 150 Update, Updated Noise Exposure Map and Noise Compatibility Program*, v. 1 (Minneapolis: Metropolitan Airports Commission, November 2001), M-1 to M-4.

61 State agencies that propose rules under the state Administrative Procedure Act must satisfy additional procedural requirements if a proposed rule is "substantially modified" and the public was not provided "fair warning" of the changes (*Minn. Stat. (2002),* §14.05, subd. 2). MAC is not covered by this act.

Metropolitan Airports Sound Advisory Committee (MASAC) in October 2000 because of dissatisfaction with the composition of the committee, and a new advisory committee was not formed until Summer 2002. MAC staff told us that MASAC would have discussed changes to the draft if it had been functioning in Fall 2001, but it was not. Staff also said that, in the absence of such a group, the commission probably should have played a larger role in facilitating public discussions regarding the changes.