TRAFFIC NOISE IN MONTANA:
Community Awareness and Recommendations for a Rural State

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16. Abstract:

This research focuses on current policies, practices and procedures for non-traditional noise abatement solutions, solutions that are alternatives to noise barrier walls or berms built by a state department of transportation (DOT). Reviews of the literature and the practice have been conducted on pavement related noise, noise -compatible land use planning, sound insulation, and traffic management techniques. Type II (retrofit) noise barrier programs have also been examined.

Also, a detailed examination of land use planning and development processes and procedures within the State of Montana has been completed, including discussions with a number of local agency planners. This work reveals that because of concerns over growth, many mechanisms are in place that are conducive to the implementation of a noise-compatible planning and development program.

Additionally, two surveys were developed and administered: one for citizens living near busy roads in four Montana urban areas and one for local Montana planners. The surveys deal with people's perceptions of noise and noise mitigation, and interest in noise-compatible planning and development. The analysis of the survey data, the literature and the practice have resulted in a number of recommendations to MDT regarding implementation of noise-compatible planning and development in Montana.

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ACRONYMS AND ABBREVIATIONS

AAMVA	American Association of Motor Vehicle Administrators
AASHTO	American Association of State Highway and Transportation Officials
AC	asphalt concrete
ADOT	Arizona Department of Transportation
APA	American Planning Association
ARFC	asphalt rubber friction course
Caltrans	California Department of Transportation
CDOT	Colorado Department of Transportation
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CIP	Capital Improvements Planning
CNEL	Community Noise Equivalent Level
CPX	Close Proximity
CRM	crumb rubber
dB	decibel (may be for unweighted or A-weighted sound level)
dBA	decibel, for A-weighted sound level
DGAC	dense-graded asphalt concrete
DNL	Day-Night Level (DNL is a single level averaging all sound energy in a 24-hour period, with 10 dB added to all levels between 10 p.m. and 7 a.m. as a nighttime sensitivity factor.)
DOC	Montana Department of Commerce
DOT	Department of Transportation
FAQ	frequently asked questions
FHA	Federal Housing Administration
FHWA	Federal Highway Administration
FY	Fiscal Year
GAO	General Accounting Office
HB	House Bill
HUD	Department of Housing and Urban Development
Hz	hertz
ISO	International Standards Organization

jake brake	truck engine compression brake
LA10	level exceeded ten percent of designated time period
L_{A10}(1h)	level exceeded ten percent of one hour
LA50	level exceeded fifty percent of designated time period
L_{A50}(1h)	level exceeded fifty percent of one hour
LAeq	equivalent continuous sound level
LAeq(1h)	equivalent continuous 1-hour sound level
LAeq(24h)	24-hour equivalent continuous sound level
LAmax	maximum A-weighted sound level
LOS	Level of Service
MAP	Montana Association of Planners
MCA	Montana Code Annotated
MCC	Montana Consensus Council
MDEQ	Montana Department of Environmental Quality
MDOT	Michigan Department of Transportation
MDT	Montana Department of Transportation
MnDOT	Minnesota DOT
MPCA	Minnesota Pollution Control Agency
MPOs	Metropolitan Planning Organizations
MSGC	Montana Smart Growth Coalition
MTD	mean texture depth
NAC	Noise Abatement Criterion
NCDOT	North Carolina Department of Transportation
NCHRP	National Cooperative Highway Research Program
NEPA	National Environmental Policy Act
NYSDOT	New York State Department of Transportation
ODOT	Ohio Department of Transportation
OGAC	open-graded asphalt concrete
PCC	Portland Cement Concrete
RAC	rubberized asphalt concrete
REMELs	Reference Energy Mean Emission Levels
RFP	Request for Proposal
SHA	Maryland State Highway Administration
SHRP	Strategic Highway Research Program

SMA	stone mastic asphalt
SOUND32	Caltrans traffic noise prediction model
SPBI	Statistical Pass-By Index
STAA	1982 Surface Transportation Assistance Act
TDOT	Tennessee Department of Transportation
TIP	Transportation Improvement Program
TNM	Traffic Noise Model
TWG	Technical Working Group
UDOT	Utah Department of Transportation
USDOT	United States Department of Transportation
VA	Veterans Administration
VDOT	Virginia Department of Transportation
WisDOT	Wisconsin Department of Transportation

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EXECUTIVE SUMMARY

Introduction

As with many urban and suburban areas around the country, Montanans are developing an increased awareness of traffic noise as a problem and an increased awareness that something can and should be done about it.

The traditional approach to traffic noise control throughout the country has been the installation of traffic noise barriers along the highway edge of pavement or along the right-of-way adjacent to noise-sensitive areas. Noise barriers are not always feasible, however. Examples include non-controlled access facilities where driveways are too numerous to allow barriers to effectively block the noise and lower density areas where the number of impacted homes may be too small to justify the cost of an expensive noise barrier. Nor are barriers always reasonable in cost or desirable. For example, barriers may pose safety problems and have potential road icing implications. In these cases, non-traditional methods of noise abatement could be very useful.

This research study has focused on current noise abatement policies, practices and procedures for non-traditional noise abatement solutions, solutions that are alternatives to noise barrier walls or berms built by a state department of transportation (DOT). Discussions with Montana Department of Transportation (MDT) staff regarding the scope for the research revealed four areas of particular interest:

- Pavement types and texturing;
- Noise-compatible land use planning and development;
- Sound insulation; and
- Traffic management techniques.

MDT was also interested in investigating Type II noise abatement programs (the adding of noise barriers to existing roads by a state DOT), with emphasis on the experiences in states that currently have Type II programs.

In addition to a review of published literature, this research involved extensive correspondence and discussions with the staff of numerous state DOT and local agencies across the United States and in Canada.

A detailed examination of land use planning and development processes and procedures within the State of Montana was made, and discussions held with a number of local agency planners in Montana. This work revealed that many mechanisms are in place that are conducive to implementing a noise-compatible planning and development program. Growth is recognized as a major issue within the urban areas of the state, and the attention to noise control or noise impact avoidance seems to fit right into the framework of "smart growth." Awareness of a problem and a potential solution, though, are different from having the resources to implement and manage a program.

The literature review, practice review and examination of Montana planning and development were done in conjunction with the development of two draft surveys: one for citizens living near busy roads in four Montana urban areas and one for local planners throughout the state. The residents survey explored opinions on neighborhood qualities, sources of community noise, the noise from the major road in their area, and people's attitudes regarding various noise-reducing measures, both for their current situation and if they were moving into new homes.

The planners survey gathered data on the planning jurisdictions represented by the respondents, and sought opinions on current and future traffic noise problems in their jurisdictions as well as various noise mitigation measures. The subject of noise-compatible development was explored, including MDT actions thought to be necessary for a successful program.

After the surveys were finalized, they were administered in the summer of 2003. Then, based on the analysis of the survey results and further analysis of the literature, this final report was prepared.

This Executive Summary presents a series of summaries by topic area, including recommendations in each area related to traffic noise abatement at the state and local levels, with emphasis on noise-compatible planning and development in Montana.

Pavement-related Noise

Summary

A considerable amount of research into quantifying the noise characteristics of alternative pavement surfaces has been completed to date. This research indicates that certain pavements are indeed quieter or louder than other pavements.

The National Cooperative Highway Research Program (NCHRP) Synthesis 268 analyzed numerous pavement studies completed prior to 1998. The results indicated that Portland Cement Concrete (PCC) pavements create more noise although they have the advantage of durability and superior surface friction when compared to dense-graded asphalt pavements. The study found that longitudinal tining reduced noise levels but surface friction was reduced when compared to transverse tining. Exposed aggregate surfaces also reduce noise levels but require added maintenance to minimize plugging and also deteriorate with freeze/thaw cycles and are less effective when deicing agents are used.

Dense-graded asphalt concrete (DGAC) pavements are 2 to 3 dBA quieter than PCC pavements but do not exhibit the strong frictional characteristics and durability of PCC pavements. Open-graded asphalt concrete (OGAC) pavements were shown to be 1 to 9 dBA quieter than DGAC pavements and have good frictional properties; however, the noise reductions declined with surface age. OGAC pavements also suffer from plugging, freeze/thaw impacts, and reduced effectiveness when deicing agents are used.

The study also notes that measurements made using the "trailer" and "passby" methods do not correlate, making comparison of results using the two methods invalid.

Numerous additional research studies have been completed since NCHRP Synthesis 268. Studies by state and local agencies in Arizona, California, Colorado, Ohio, Michigan, New York, Texas, Utah, and Wisconsin have added to the knowledge base regarding the noise characteristics of pavement surfaces. The conclusions from many of these studies, particularly Wisconsin, Ohio, and Texas, seem to further reinforce the conclusions of NCHRP Synthesis 268 regarding PCC, DGAC and OGAC pavements.

Studies conducted in Arizona and California indicate that rubberized asphalt concrete (RAC) pavements produce significantly lower sound levels than both PCC and DGAC pavements and that the reduction may not be degraded much over time. Results of the I-80 Davis study also indicate that OGAC can significantly reduce sound levels when compared to aged asphalt concrete as well as DGAC and that the reductions may not be degraded much over time.

Studies in California, Colorado, New York and Utah also indicate that sound levels of standard longitudinal or transverse tined PCC pavements may be reduced by using longitudinal, diamond-ground PCC pavements instead.

Little data has been collected for chip sealed pavements. Measurement data from Texas and South Africa and data from Australia indicates that chip sealed pavements create noise levels somewhat higher than for OGAC pavements and similar to those for tined concrete pavements.

The selection of a pavement should not be made based solely on noise characteristics. Other issues must be considered including safety, maintenance, cost, and seasonal and weather-related factors. These conditions may preclude the use of certain types of pavements regardless of their noise characteristics.

Recommendations

Since MDT uses chip sealing extensively, the following actions are recommended:

- MDT should undertake a study to assess the noise characteristics of chip sealed pavements.
- MDT should investigate the possibility of constructing test strips of alternative pavements including OGAC, stone mastic asphalt (SMA) and RAC, and then conducting studies of short-term and long-term sound levels along with other critical pavement parameters.
- The staff of the Environmental Services Bureau and Pavement Analysis Section of MDT should meet to discuss the implications of using chip sealed pavements in areas where noise-sensitive land uses exist.

If MDT determines that alternative pavements are desirable in noise-sensitive areas, MDT's current tools for pavement management could be modified to include a factor for the existence of noise-sensitive land uses near the project.

Sound Insulation

Summary

The Federal Highway Administration (FHWA) Noise Standards limit routine sound insulation to public use or nonprofit institutional structures except when severe traffic noise

impacts are anticipated and normal abatement measures are physically infeasible or economically unreasonable. A few states' noise policies specifically state that insulation of private residences is permitted when severe traffic noise impacts are anticipated. Several states reported insulating public and/or nonprofit buildings including schools and churches; however, few cases of insulating private residences were noted. Only two large-scale projects have been reported, one in Michigan along I-676 and one in San Diego, California, where California Department of Transportation (Caltrans) is in the process of insulating numerous homes. FHWA opted not to participate in the funding of the San Diego project, and Caltrans does not anticipate using sound insulation on a large-scale basis again in the future [Hendriks et al. 2003].

Recommendations

Sound insulation of private residences could be cost effective and worthwhile for those instances where a very few individual residences in a rural area may be severely impacted by a widening project or for projects involving construction of a highway on a new alignment.

Since FHWA will participate in funding for sound insulation of private residences where severe traffic noise impacts exist and traditional abatement measures and not feasible or reasonable,

- MDT may wish to consider a modification to its noise policy to allow consideration of sound insulation in these instances.

Noise policies of the state DOTs in Arizona, California, Colorado and Michigan could be used as guides.

Traffic Management

Summary

Traffic management measures can sometimes reduce noise problems although FHWA does not generally allow restrictions of truck trailer combinations on those facilities on the National Network for large trucks.

Florida, Maryland and Virginia have implemented truck restrictions on projects to reduce noise but only when parallel routes were available.

A truck restriction study conducted by the Massachusetts Highway Department in conjunction with the City of Cambridge Metropolitan Planning Council could serve as a model for similar truck studies in other jurisdictions.

Large trucks have been banned from using local roads in New Jersey since 1999 as the result of complaints from the public regarding safety and noise. The U.S. District Court recently rules the ban unconstitutional and the state is in the process of appealing the ruling.

Vehicle operating requirements on Montana's roads are addressed in Title 61, Chapter 8, Part 3 of the Montana Annotated Code 2003. Section 61-8-303 deals with speed limits and speed restrictions. Section 61-8-309 deals with establishment of special speed limit zones in cases of safety issues, and Section 61-8-310 lays out when local authorities may and shall alter limits, again mainly for safety reasons. Finally, Section 61-8-332 provides for restrictions on use of

controlled-access roadways, but again with reference to normal and safe operation of traffic. None of these sections makes reference to traffic management for the reason of reduced noise.

Any reductions in speed for safety reasons, such as from 65 to 60 miles per hour in larger cities, would only have a small noise reduction benefit. Restrictions of trucks would result in larger noise reduction benefits, however.

Recommendations

As noted above, traffic management strategies are often counter to the goal of a highway project. Reducing speeds and restricting trucks are, in most cases, not desirable on the Interstate system. Further, truck restrictions would only be acceptable if alternative routes are available. Due to the rural and mountainous nature of much of Montana, acceptable alternative routes would likely not exist. Therefore, active consideration of traffic management techniques to reduce noise on the Interstate system is not recommended. Restriction on non-Interstate and non-Federal-aid Primary highways, however, is certainly a possibility.

- In cases where local jurisdictions are interested in implementing other truck restrictions or other traffic management techniques on local roads to reduce noise, MDT should provide guidance as needed to ensure that the goal of reducing noise is not achieved at the expense of safety or access for commerce.

- MDT should keep track of the appeal of the state of New Jersey for a continuance of its ban on large trucks from local roads. If New Jersey is successful in its appeal, Montana could follow with similar policies in situations where alternative routes to the local roadway system exist.

One type of traffic management technique that has received considerable interest, and until recently was allowed and used in Montana, is the restriction of use of truck engine compression (jake brake) along certain portions of Montana's roads. As is pointed out many times in the Montana residents survey discussed in Section 8.0 of this report, noise from jake brakes is a source of much annoyance for many people. Several survey respondents specifically complained about the lack of enforcement of existing signage restricting engine brake use. Over half of the total survey respondents have indicated that restriction in the use of engine compression brakes is an acceptable method of noise control.

Unknown to the researchers at the time of the survey, the 2003 Montana Legislature passed House Bill (HB) No. 237, which prohibited such restrictions. The bill stated that as long as a vehicle has a factory-installed or equivalent after-market muffler, the operator may not be prohibited from using the engine compression brake device.

- It is recommended that MDT revisit this prohibition with the Legislature. Key sections of this report and the relevant survey results should be sent to legislators, both to those who introduced and supported the bill and to those who might support a change or rescission. One possible revision to the law might be to state conditions under which engine compression brake use could be restricted, such as when the route is within a certain distance of residential or other noise sensitive property.

- As preparation for addressing the prohibition with legislators, MDT should conduct a study to determine the locations of recent past engine compression brake restrictions in the state. MDT should then discuss with appropriate city and county officials the perceived

effectiveness of past restrictions and should identify any residents' complaints since the legislation. The need for increased enforcement, if the prohibition were to be lifted, should be addressed with local officials.

- Because truck safety issues are involved, MDT should thoroughly study the topic of engine compression brakes, and their usage and restrictions elsewhere in the country. MDT should also examine if policies and guidelines have existed for selecting engine compression brake restriction zones in Montana and elsewhere.

- Since some portion of the truck population is functioning without mufflers or with defective mufflers, MDT should investigate the possibility of incorporating an inspection of the muffler system of heavy trucks as part of the roadside safety inspections conducted by the Motor Vehicle Inspection Bureau. The American Association of Motor Vehicle Administrators (AAMVA) has published a simple procedure that can be used to determine whether or not a muffler is installed in the exhaust system of a heavy truck and, if so, whether or not the muffler is intact and functional [American Association of Motor Vehicle Administrators, 2004].

Type II Noise Barrier Program

Summary

Type II noise programs involve proposed federal, federal-aid, or state projects to provide noise abatement in the form of noise barriers along existing highways, with no other capacity-increasing highway improvement as part of the project. The development and implementation of a Type II program is optional and not an FHWA mandatory requirement.

The National Highway System Designation Act of 1995 restricted federal participation in Type II noise barriers to those Type II projects that were approved before November 28, 1995, or that are proposed along lands where land development or substantial construction predated the existence of the highway. Also ineligible are areas that were studied previously for abatement and were rejected as part of a Type I project (new roadway alignment or widenings with addition of through-traffic lanes.) The state or local jurisdictions could fund projects that do not meet these criteria.

Nineteen state DOTs currently have Type II noise programs, although all are not necessarily active and funded at this time. States that have had very active Type II programs over the years include California, Minnesota and Maryland.

FHWA has not specified any one method of analysis for Type II projects. Instead, states are encouraged to use good judgment in the consideration of all relevant factors and they have great flexibility in developing a Type II program. FHWA strongly encourages the use of some formal process for identifying areas eligible for Type II noise abatement and for prioritizing areas across the state or in a particular region for abatement. Also, some states require local matching funds for barrier construction.

Recommendations

Federal funding is available for retrofit noise abatement as long as the residences predated the initial construction of the highway and where there was no Type I noise analysis

completed. Due to the rural nature of much of Montana, the number of areas that would qualify for retrofit noise abatement would likely be small.

- It is recommended that MDT further investigate the possibility of implementing a Type II noise abatement program.

- If MDT chooses to investigate this possibility, it is strongly recommended that MDT initially conduct a Type II needs assessment to identify the areas that would be eligible for abatement and the potential costs associated with implementing a Type II program.

- If MDT subsequently decides to pursue a Type II program, it is recommended that a priority system be developed for deciding the order in which neighborhoods should be selected for abatement.

Noise-Compatible Land Use

Summary

Noise and land use compatibility focuses on noise control at receivers adjacent to the traffic noise source. Two general categories of receiver control are land use zoning and noise-mitigated development. Programs to ensure noise and land use compatibility are generally implemented at the local level and numerous local agencies in the United States and Canada have implemented programs to facilitate noise and land use compatibility.

California requires that noise be included as an element in the local planning process. , There are disparities, however, in the overall success of the local programs in California. Some local programs have been very successful while others have not.

The Arizona Department of Transportation (ADOT) has been very proactive in encouraging local governments to voluntarily address noise and land use compatibility. As a result, several communities have implemented successful noise and land use compatibility programs.

Recommendations

Noise-compatible planning development has the greatest potential for success in communities that are in the earlier stages of development. Since Montana has communities that are growing and developing, this is an excellent time to make an investment that will lead to long-term benefits. The strategies that comprise noise-compatible development planning are proactive and preventative in nature; therefore, supporting implementation of such strategies now can avert many problems in the future. To fully realize the potential of noise-compatible development planning, the following steps to implementation, which are based on the findings from the case studies, are recommended.

Montana Department of Transportation

- MDT should investigate the possibility of promoting legislation that would require local jurisdictions to consider noise in the planning process.

This recommendation is made acknowledging that citizen sentiment seems against state-level involvement in land use decisions. The success of the growth policy legislation could serve as a precedent, however, where the optional development and implementation of a growth policy is a local decision. Potential legislation should include statements of policy on noise-compatible land use zoning and noise-compatible development.

- If legislation is enacted, it is recommended that MDT initiate the formation of a consortium within the state to produce a state-level model noise guideline that could be adopted by local agencies within the state for use in noise and land use compatibility planning and development.

Any legislation should authorize the development of a model guideline and the establishment of a state office for technical assistance to provide needed support at the local level. This state-level step is necessary to prevent a wide variation in plans and procedures, as well as failures at the local level. Guidelines produced at the state level will ensure consistency and uniformity throughout the state. Close coordination and input would be required from local agencies that may wish to tailor the guidelines to best fit their own unique situations.

- Whether or not legislation is enacted, MDT should consider developing sample noise abatement design specifications and standards for use by local governments in working with developers and builders.

These specifications and standards could be implemented by interested local agencies to ensure that abatement measures constructed as part of new developments by developers are effective and durable. Compliance with these standards could be a requirement in any situation where municipalities might be assuming the ownership of developer-constructed noise walls, which is consistent with current practices of municipalities assuming ownership of infrastructure items such as roadways, and storm and sanitary sewers.

- MDT should also consider playing a role in the review of proposed noise abatement strategies for developments in the vicinity of state highways, if not on a routine basis, at least on an advisory basis as part of a broader technical assistance program.

- Whether or not legislation is enacted, MDT should consider initiating a thorough effort to educate local planning officials of the effects of allowing noise-sensitive development adjacent to major roadways and to inform them of MDT's policy regarding provision of noise abatement for existing communities.

- MDT may also wish to modify its noise policy to include a statement indicating that consideration of abatement for a road widening project will no longer normally be considered for residential developments constructed adjacent to the existing pre-widened highway after the date of the policy change.

Local Government

- If legislation is ultimately enacted, local agencies, in compliance with state requirements, should incorporate noise into their planning function.

- As part of the requirements they should adopt the model guideline, conduct required noise studies, produce noise contours, construct appropriate policy lines for various categories of development, and develop plan review and enforcement procedures.

Montana's Land Use Planning and Development Processes and Procedures

Summary

Montana's land use planning and development processes and procedures are described in some detail because an understanding of them is important for success with noise-compatible planning and development efforts.

As background, about two-thirds of Montana's residents live in its nine most populated counties. Most Montana municipalities are small; there are only seven incorporated areas with populations greater than 10,000. Nearly all of the state's population growth has been concentrated in a few counties, those with urban centers or adjacent to others with urban centers. Since 1960, over 60% of Montana's net increase in population has occurred in unincorporated areas outside of city and town boundaries, mainly in residential subdivisions. This trend complicates the ability to develop and implement noise-compatible land use programs, especially given recent actions of the State Legislature.

Planners from Montana's urban areas who were contacted during this research were readily able to identify examples within their planning jurisdictions where traffic noise-residential land use conflicts cause problems. These problems often resulted from combinations of roadway designs and traffic characteristics and the location and layout of nearby housing developments. Planners also cited instances where natural geographic features such as canyon walls and topography contributed to noise problems.

Local governments in Montana's populated areas seem to be "cautiously enthusiastic" about possible implementation of noise-compatible land use planning that might result from this research effort. Success in reducing existing noise impact problems or preventing or lessening future noise impacts in noise-sensitive areas is likely to be consistent with local government planning goals. There are many potential mechanisms for implementing noise-compatible planning and development at the city/county level.

- Of potential importance to the purposes of this project is that "traffic noise" is likely to fit the definition of "nuisance" contained in *Montana Nuisance Law* (45-8-111, Montana Code Annotated (MCA)). While separate from the actual planning processes and implementation measures, the Nuisance Law would help to legitimize actions of local governments to control noise problems within jurisdictions.

- Montana local governments are empowered to carry out administrative, regulatory, and financial functions through enabling legislation passed by the State Legislature. Montana's Local Planning Enabling Act authorizes the preparation and adoption of a *comprehensive*

plan and sets out required procedures. Enabling legislation also authorizes cities and counties to carry out planning functions in combination.

- The 1999 Growth Policy Act allows, but does not require, cities and counties to adopt and implement "*growth policies*." Under the new law, a local government's comprehensive plan is now called a growth policy. All of Montana's most populated cities and counties (with the possible exception of Billings) have adopted growth policies. After a growth policy is adopted, the local jurisdiction must be guided by and give consideration to the general policy and pattern of development set out in the growth policy in several areas, including adoption of subdivision controls and zoning ordinances or resolutions.

- Urban cities would be much more likely to incorporate noise management into their growth policies than corresponding county governments. City government planning generally benefits from more resources, public support and influence than county government planning. The problem, however, is that considerable new development is occurring in areas that are within the planning jurisdiction of county governments. Most new housing development is occurring in unincorporated areas where there is often opposition to local government planning.

- *Capital Improvements Planning (CIP)* is a very important growth policy implementation tool. Capital improvements include local government infrastructure such as streets and roads.

- Montana city and county governments are authorized to adopt *zoning ordinances*, aimed at preventing problems by separating incompatible land uses and at achieving a quality and character of development that ensures safe and healthy communities. Montana law requires that zoning be in conformance with comprehensive plans (growth policies). Cities and towns are authorized to extend their zoning regulations beyond their corporate boundaries, provided they have a comprehensive plan that includes the territory to be zoned. A county government retains primary authority to approve a subdivision in an unincorporated area affected by the city plan.

- A *development permit system* is an alternative to traditional zoning. Development standards are regulations that specify the standards or requirements that new development must meet. They are the easiest types of land use regulation to draft and enforce. Development standards are commonly drafted to regulate, among other items, areas unsuitable for development due to hazard or environmental risk, buffering or screening of adjacent uses, and setbacks. Montana law requires that development permit regulations also be in conformance with comprehensive plans (growth policies).

- Montana law requires all cities and counties to adopt and enforce *subdivision regulations.* Subdivision regulations regulate the process of plotting land into lots and providing public facilities. To approve a subdivision, local government must issue findings that consider the effect the subdivision would have on several factors, including the natural environment and public health and safety. In the past, in areas where a growth policy was adopted, a local government was required to review a proposed subdivision to ensure it conforms to the growth policy.

- Montana has both statewide and city/county *building standards* for new construction. Statewide building codes establish statewide building practices for most types of residential, business, and government buildings, and establish minimum standards for new building construction. State inspectors use a building permit system to enforce the codes. Montana's

statewide codes do not currently impose special construction standards for housing affected by high levels of exterior noise, such as from traffic, although they do address upgraded construction for the common walls of multi-family dwellings. State building permits are not required for residential buildings containing less than five dwelling units.

- Currently 37 cities, two city-county consolidated governments and one county have adopted their own building codes and permitting systems. City and county programs require building permits for *all* residential construction, including single-family projects. With strong justification, local governments may also adopt building code standards that exceed state code requirements. Thus, cities would have the ability to upgrade construction standards as part of a traffic noise compatibility program. Unfortunately, the 2003 session of the Montana Legislature took away the authority that cities had to enforce building code outside of their city boundaries, which seven cities had chosen to do. This change is a very important setback to overall urban planning because most residential development is occurring outside of cities' limits. This change also reduces the potential for using building permits as a means of upgrading construction standards in areas with high levels of traffic noise.

Despite this setback, a number of different organizations and groups in Montana have been very interested in issues related to planning and growth over the last several years. Some of these groups and related activities might play roles in building support for noise-compatible development or in helping implement noise-compatible development.

- The *Montana Consensus Council* (MCC) was established as a state agency by Executive Order in 1994 "to encourage public participation and provide a forum for cooperative and innovative problem-solving, particularly regarding natural resources used." The Council could be a direct resource to MDT, as it offers consultations and advice on public participation and collaborative problem solving to state government staff and officials.

- The Council could also be an ideal mechanism for introducing the subject of noise-compatible development to Montanans. As an example, an outgrowth of the Council's work on sanitation systems in subdivisions was the *Montana Growth Policy Forum*. The Forum's purpose was to be a way to sustain a dialog, by means of a series of seminars, among many different stakeholders on land use and growth issues in Montana.

- The *Montana Smart Growth Coalition* (MSGC) is a network of organizations and individuals from across the state "that advocates for sensible policy, both locally and statewide, regarding land use, transportation, housing, sustainable agriculture, conservation of habitat, cultural diversity, economic equity and the environment" [from the Coalition's Web site]. While noise mitigation is not specifically mentioned by the Coalition, the concept of noise-compatible development fits very well within the group's definition of "smart growth."

Also of relevance is a comprehensive study of Montana's growth, planning, and growth-control policies, published in 2001 by the American Planning Association (APA). According to an article in a MCC newsletter [Davis 2001], "The APA's report confirms that Montana, like Colorado and other western states, can no longer consider planning and land-use controls as luxuries. They are now essential to maintain the vitality and health of our towns, local economies, and lands." The report's many recommendations, however, received mixed reviews from Montana Growth Policy Forum members. While the report does not specifically mention noise mitigation, the concept of noise-compatible planning and development would seem to fit well within the thesis of the work.

A survey conducted by the Montana Association of Realtors on managing growth offers insights into the climate for noise-compatible planning and development. Another article in a MCC newsletter [Trenk 2001] notes, "Montanans are evenly divided on their approach to growth management…" Two-thirds of those surveyed said that town, city, or county governments should have the power to make land use decisions. A majority opposed increased State involvement in managing growth-related problems, and there was little support for federal involvement. These survey results suggest that even if MDT takes the lead promoting noise-compatible development, success will more likely come if the citizens perceive the initiative to be locally-driven and directed.

Finally, this research project has played a major role in introducing the subject in a formal way to the Montana Association of Planners (MAP). Two of the researchers and the head of the noise program at MDT made a series of presentations at the annual meeting of MAP in October 2003. The presentations were a starting point in building awareness of planning professionals in this subject and sparked strong interest among several attendees. It is clear from the total lack of mention of noise in the Growth Policy Act and in the APA land use planning study that noise impacts, which exist, are being overlooked. This overlooking is not at all uncommon around much of the rest of the country.

Recommendations

The previous section of this report, on Noise-Compatible Land Use, contained several recommendations that are reinforced by the findings in this section and are not repeated here. It is worth noting, however, that when MDT chooses to widen any of its federal-aid roads in its urban and suburban areas, MDT will be responsible for studying noise impacts for residential development that has occurred along these roads since their original construction. Where impacts are shown, MDT will be required to study and possibly provide noise abatement.

- A good way to try to avoid these circumstances is for MDT to be proactive in encouraging local governments to adopt noise-compatible planning and development, in some form.

- Promoting such efforts should be considered in conjunction with a change in the MDT traffic noise policy. This change should state that MDT will no longer be responsible for mitigating noise impacts where the local government has allowed adjacent residential development to occur without noise mitigation required of the developer or builder.

There is likely to be support for noise-compatible planning and development in the more urban cities and surrounding county areas experiencing residential growth, but there is not likely to be interest among smaller towns and unincorporated areas.

- Any efforts at implementation of noise-compatible planning and development must have the city or county governments in the forefront, with MDT or other state agencies having support roles.

This research has laid excellent groundwork to build upon for noise-compatible planning and development.

- It appears that MDT will need to continue to take the lead in educating legislators, local decision-makers, planners, developers, builders and other stakeholders on the problem of traffic noise and the solution of noise-compatible planning and development.

- MDT may wish to enlist the aid of the Montana Consensus Council, possibly through the mechanism of the Montana Growth Policy Forum, in this education process.

- The contacts made during this research study should be continued and expanded.

- Presentation of the results at statewide, regional and local planners meetings should be continued.

- Buy-in of the concept of noise-compatible planning and development by the MAP should be sought, perhaps in the formation of a technical committee on the subject within MAP.

Residents Survey Results

Over six hundred residents in four Montana communities responded to a survey on traffic noise and its mitigation. The communities were in Great Falls (near Country Club Boulevard and the I-15 Spur), Missoula (in the Lower Rattlesnake area near the end of Hellgate Canyon adjacent to I-90), Butte (the Hillcrest area near I-15/90), and Billings (along Rimrock Road from 5th Street to 38th Street).

Half of all of the respondents' dwellings were adjacent to the main road or one block away, with the other half two or more blocks away. The response rate was higher for people close to the road than for those farther from the road, which correlated with their expressed annoyance over traffic noise. Most of the respondents live in single-family homes, own their housing unit, have lived in their home for 10 or more years. Two or fewer people occupy most of the houses, and most of the responding households do not have children.

While generally ranking their neighborhood qualities as "very good" or "good," more than half of the survey's respondents rate "lack of traffic on the main road" as "poor" or "very poor." Likewise, one third rate "peace and quiet from outdoor manmade noises" as "poor" or "very poor." In a separate question, over half of all respondents saying they are frequently annoyed at their home site by "traffic noise from major roads and highways," which is the most commonly cited source of "frequent annoyance." The negative responses are much higher for those respondents within a block of the road compared to those farther away.

By area, much higher portions of respondents in Great Falls, Missoula and Butte than in Billings cite major road traffic noise as a frequent source of noise annoyance. Within Billings, the eastern and central sub-areas along Rimrock Road (east of Rehberg Lane) show a much lower rate of frequent annoyance than the sub-area west of Rehberg Lane, where Zimmerman Trail is also a noise source of concern to respondents.

Just over one-third of all respondents say they were "annoyed" or "highly annoyed" by traffic noise while inside their houses in the week prior to the survey; that percentage increases to 43% for outside the residence. The survey was administered during the last week in August and first week of September, when Montana's weather was ideal spending time out-of-doors. A quarter of all respondents say they are annoyed "all" or "much of the day" by traffic noise while outside, and nearly one-in-five report the same while inside. As with the previous questions, people living next to the main roadway are annoyed much more often by the roadway traffic noise than people living further from the main road.

Despite the high levels of annoyance, nearly three quarters of all respondents say they gave little or no consideration to traffic noise, or were unaware of traffic noise, before buying or renting their residence. Only a very small percentage, even among those living close to the roadways, gave traffic noise a great deal of consideration in their decisions. About a quarter feel that traffic noise has gotten "much louder" since they moved into their residence, and another quarter "a little louder." About 30% say that traffic noise has become "more bothersome" over time. Only two percent feel traffic noise is now "quieter," although just over a quarter say they have gotten "more used to (tolerant of) the traffic sounds."

Just over a quarter of the respondents say they have made adjustments in how they live because of traffic noise, ranging from almost half of all respondents in the Lower Rattlesnake area in Missoula to as little as 18% in Billings. By far the most common adjustment is to *close windows*, followed by *planting trees or bushes* (which actually do little to reduce noise), *turning on background sound (such as fans, air conditioning or music)* and *moving activities inside.*

Noise from jake brakes was cited as a source of much annoyance by many people in the comment section of the survey. Several people specifically complained about the lack of enforcement of existing engine brake use restrictions; however, the 2003 Montana Legislature passed HB No. 237, which prohibited such restrictions. The bill states that as long as a vehicle has a factory-installed or equivalent after-market muffler, the operator may not be prohibited from using the engine compression brake device.

Nevertheless, a majority of all respondents finds *restriction in use of engine compression brakes* to be a "very acceptable" or "acceptable" method of noise control. Nearly half feel that way about *noise barriers*, *repaving*, and *traffic regulation.* Also, noise barrier walls seem more desirable than earth berm barriers.

Respondents feel that *noise barriers*, *hedges*, *air conditioning (to allow windows to remain closed)*, and *upgrading doors and windows* are the methods most likely to noticeably reduce noise in their homes. Less than a quarter of all respondents, however, are willing to pay to have noise reduced at their current residence (ranging from 16% in Billings to 30% in Missoula), realizing that many have already done so. Of those indicating a willingness to pay, by far the most commonly chosen dollar range was $1,000 or less. Interestingly, when asked if they would pay more for a *new* house next to a highway if the house or neighborhood were designed to reduce the traffic noise effects, half the respondents say "yes, definitely" or "probably."

Nearly two-thirds of all respondents agree or strongly agree that developers should be required by the city or county to reduce excessive traffic noise levels when building residences on undeveloped land next to a major roadway. The most favored strategies are:

- *Subdivision design with areas least sensitive to noise (garages, streets) closest to the road;*
- *Provision of open or vegetated space (e.g., park) between road and residences; and*
- *Building noise barriers.*

Finally, the survey shows a fair level of interest among the respondents in participating in any of several possible programs aimed at helping to reduce traffic noise at the home site. Nearly half are willing to *read a brochure on traffic noise control for residences.* About a quarter of the respondents would be *interested in attending a seminar* or *allowing home inspections* as part of a

noise reduction inventory program. About 30% would *consider participation in a federal or state grant program* aimed at noise reduction at the home site.

Given that these results are for all of the respondents, and thus include a substantial number of people who say that they are not frequently annoyed by traffic noise, one can conclude that there is a fair amount of desire for quieter residential environments near highways. These findings suggest that there likely is support for noise-compatible planning and development at the local level.

When comparing those respondents who are *Frequently Annoyed* by traffic noise to those who are *Not Annoyed*, the differences in opinions are substantial.

- Two-thirds of the *Frequently Annoyed* feel traffic noise is louder or much louder since moving into their residence, compared to less than a quarter of those *Not Annoyed.*

- Half of the *Frequently Annoyed* say traffic noise has become more bothersome over time, compared to under ten percent of those *Not Annoyed.*

- Half of the *Frequently Annoyed* say they have made adjustments in their way of living because of traffic noise, compared to under ten percent of those *Not Annoyed.*

Clearly, traffic noise has caused many people to adjust their ways of living, including spending their own funds, in an attempt to reduce traffic noise levels.

Those people who are *Frequently Annoyed* are much more receptive to various mitigation strategies that could be done off the person's property to reduce traffic noise, such as building a noise barrier wall or berm and restricting jake brake use. Compared to those *Not Annoyed*, they are also more in favor of several suggested noise-reducing strategies that could be done by developers for new houses or developments built along existing busy roads, such as noise barrier walls or berms. They are also more willing than those *Not Annoyed* to participate in several possible programs aimed at reducing traffic noise, with nearly half expressing interest in a federal or state grant program for noise reduction.

While these differences highlight the severity of the problem for some, the differences point to the problem of promoting noise mitigation programs to the larger public, that is, those who do not feel negatively affected by traffic noise.

Planners Survey Results

Forty-two planners belonging to the MAP responded to the survey on traffic noise and its control. Three-quarters of the planners work or live in Gallatin, Lewis and Clark, Yellowstone, Flathead, Cascade, Missoula, and Silver Bow counties. Two-thirds of the planners are from jurisdictions of 20,000 or more people. In the past decade, 60% of the respondents' jurisdictions have had population growth of five or more percent. Nearly three-quarters of the jurisdictions adopt *growth policies*, and 40% or more adopt *capital improvement plans* and *comprehensive plans*. Only one-in-five adopt *land use plans.* Nearly all of the represented jurisdictions carry out zoning and subdivision regulation functions in either all or part of the jurisdiction.

The planners say the most prevalent source of noise problems in residential neighborhoods is *large trucks using major roads and highways*, with half citing them as a

"major" or "medium" problem. Three-in-ten cite noise from *general traffic on main roads*, while only 12% note noise from *general traffic on local roads*. Train and aircraft noise is also problematic.

Most responding planners feel that traffic noise is a major problem in more than one residential area in their jurisdictions, with 14% noting "about half" of the residential areas. They have listed nearly 100 roadway sections that currently cause noise problems or impacts on residential areas in their planning jurisdictions. These sections span thirteen counties. They also have listed an additional 29 sections that are likely to develop traffic noise impacts on residents within the next ten years. Bozeman, Billings and Helena account for nearly half of all listed sections, with Bozeman and Billings having sixteen of the future sections. Most of the planners feel that traffic noise impacts in their residential areas will become a greater problem over the next 10 years.

Many of the planning jurisdictions have some kind of noise regulations in place, including sound limits by time-of-day, sound limits by locations or land uses, sound criteria for "disturbing the peace," and sound limits for specific types of noises. These regulations are reactive rather than proactive in nature. In the large majority of the cases, the local police enforce these regulations.

The planners find *restricting the use of jake brakes, building an earth berm as a noise barrier*, and *repaving the road with quieter pavement* as the most acceptable of several listed methods for reducing traffic noise effects. (Unknown at the time of the survey was that the 2003 Montana Legislature was passing HB No. 237, which prohibited such restrictions on "jake" brakes.) While two-thirds find an *earth berm barrier* to be acceptable or very acceptable, only a third feel noise barrier *walls* are acceptable or very acceptable. Aesthetic issues or possible concerns over long-term maintenance may have influenced these responses.

The planning jurisdictions have infrequently required developers to reduce excessive traffic noise when the developer has wanted to locate residences on undeveloped land next to a major road or highway. The most common action is *provision of a buffer zone* between the highway and residences (one-third of the respondents), followed by *inclusion of nonresidential buildings and land uses close to the highway as a buffer or barrier* (one-in-five) and *development of the land as something other than residential* (17%).

In contrast, many more respondents were aware of developers having taken actions on their own. Around 30% say that developers have:

- *Included nonresidential buildings and land uses and put them close to the highway;*
- *Built rows of townhouses, apartments, etc., next to the road to serve as noise barriers;*
- *Laid out lots so that noise-sensitive areas (patios, decks, balconies, etc.) face away from the highway.*

A quarter note that developers have:

- *Built an earth berm between the highway and residences;*
- *Laid out the development so that areas less sensitive to noise are closest to the highway.*

Only 5% note the *use of windows, doors and possibly walls or roofs that were more sound-insulating than usual*, which seems low, given that insulation can improve the interior noise environment considerably.

Despite the relative inaction in the past, a fair portion of the planners seem positive about their jurisdictions being willing to consider requiring such actions in the future. Nearly three-quarters agree or strongly agree that a planning jurisdiction should require the developer to take action to reduce excessive traffic noise levels for new residential developments next to existing major roads. In particular, more than a third say their jurisdiction would consider requiring *studies to see if noise will negatively impact residences.* Twenty percent or more say they would consider requiring *buffer zones, earth berms, developing the land as nonresidential, site layout,* and *noise barrier walls.*

Nearly three-quarters say the developer should pay "all" or "a large share" of the cost for this noise mitigation, and nearly half say local government should pay "no share." There is some sentiment that the State, Federal or local government should pay "a small share."

Over three-quarters of the planners say that they are in favor or strongly in favor of having a noise-compatible development program in their planning jurisdiction, yet less than a quarter say it is likely or very likely that their jurisdiction will implement such a program. Half are uncertain, and a quarter say it is unlikely or very unlikely.

There is strong sentiment that assistance will be required for the development and implementation of successful noise-compatible development programs. Over 80% of the planners feel the following types of local government technical assistance are "important" or "very important":

- *Introductory publications;*
- *General guidelines for noise-compatible land use planning;*
- *Model subdivision ordinance and building code addendum for preventing/reducing traffic noise problems;*
- *Technical training (e.g. noise-compatible development workshop); and*
- *Ongoing technical assistance services.*

Nearly half feel that *financial assistance* is "very important" for local governments participating in program. Additionally, many of the planners feel that assistance aimed at developers, builders, realtors, homeowners, or homebuyers is "important" or "very important." The top-rated actions are:

- *Technical publications for developers, builders, and realtors on noise-compatible development and*
- *Introductory information on advantages of noise-compatible development.*

Also, *technical assistance in conducting noise studies* is rated as "Very important" by about 40% of the planners.

Finally, the planners feel very strongly that MDT must play several "important or "very important" roles in order to have success with noise-compatible residential development at the local planning level. The most important roles are:

- *Provision to the local jurisdiction of sound level information for undeveloped lands along proposed roads*;
- *Facilitation of training of city/county staff and/or consultants;*
- *Serve as information resource on statewide or nationwide noise-compatible development activities; and*
- *Education of developers and the public that MDT will not build noise barriers/berms for newly built developments along existing roads.*

Ironically, MDT already provides sound level information for undeveloped lands as part of the FHWA requirements for federal-aid Type I project noise studies done during the National Environmental Policy Act (NEPA) process.

Recommendations Based on Results of Surveys

Traffic noise from major roads clearly impacts residents, especially those immediately adjacent to or within one block of the road. Many people have made adjustments in how they live or have attempted to reduce the sound levels by improvements to their homes or properties. Many have spent their own funds on noise mitigation (many perceive planting of trees or bushes to be effective in reducing noise, which they are not). Few people consider traffic noise when buying or renting their dwelling, not realizing the extent of the impact until after moving in. Many perceive traffic noise to be getting louder and more bothersome over time. Virtually no one feels traffic noise is getting quieter.

- Regardless, MDT should not be responsible for abating traffic noise for people who live in newer developments built adjacent to existing highways unless and until MDT plans to widen the facility or through some other action causes the sound levels to increase. An exception could be that if MDT researches and adopts a quieter pavement overlay or friction course, MDT should consider its use when repaving in noise-impacted residential areas.
- MDT should give consideration to the abatement of existing traffic noise problems in older developments near its major roads, by means of a Type II barrier program. As noted earlier, there are eligibility restrictions on federal funds, and MDT should assess the scope of the problem and potential cost of such a program before committing to it.

As noted in the Traffic Management section and in the Survey sections, many people are greatly upset by truck engine compression (jake brake) noise. They are in favor of elimination of the use of jake brakes and enforcement of existing posted restrictions. Unknown at the time of the survey was that the 2003 Montana Legislature was passing HB No. 237, which prohibits such restrictions. The Traffic Management section has several recommendations on this subject.

Over 120 sections of road were identified in the survey by planners as being current or likely future causes of traffic noise impact.

- MDT should review the planners' listings of these current or likely future noise problem areas, relative to planned Transportation Improvement Program (TIP) projects.

- MDT should then develop a mechanism for informing local zoning and subdivision decision-makers of anticipated future traffic noise-compatibility conflicts for currently undeveloped or underdeveloped lands adjacent to these projects. Rather than waiting until a project has progressed to the end of the environmental studies stage to notify locals of future sound levels along undeveloped lands, MDT should consider identification and notification of potential noise-land use conflicts as part of the TIP development process. The goal would be to influence zoning decisions and subdivision design and approval decisions well in advance of the highway project development.

Most of the planners feel that traffic noise impacts in their residential areas will become a greater problem over the next 10 years. Most of the surveyed residents say they would be willing to spend more on a new home in a new development near a major road to reduce traffic noise levels. Also, a strong majority of the surveyed residents feel that a developer or the builder should shoulder the cost of this noise mitigation, although that cost would no doubt be passed onto the buyer. In general, people are in favor of the kinds of noise mitigation strategies that would be likely components of a noise-compatible planning and development program. Further, over three-quarters of the planners say that they are in favor or strongly in favor of having a noise-compatible development program in their planning jurisdiction. Therefore,

- MDT should promote development of noise-compatible planning and development programs by cities and counties.

- MDT should become a technical resource to local planners on noise-compatible planning and development, especially in the areas of:

    - Provision of sound level information along its highways;

    - Preparation of information publications for the public, planners, developers and builders;

    - Facilitation of training of city/county staff and/or consultants;

    - Serving as an information resource on statewide or nationwide noise-compatible development activities;

    - Education of developers and the public that MDT will not build noise barriers/berms for newly built developments along existing roads; and

    - Development of a model program guideline.

Improvement of public information about locations and effects of current and future traffic noise problems could serve to discourage some people who are likely to be annoyed by traffic noise from renting or purchasing housing in areas with high traffic noise levels. Better information could also foster more noise-sensitive land uses, better overall subdivision and individual lot design, and noise-sensitive housing and other building development. A more knowledgeable housing consumer would soon be reflected in the market's behavior, and the land development and housing industry would respond.

Finally, this study has already served to alert many Montana planners to the problem of traffic noise and land use incompatibility, and to begin to build interest in noise-compatible planning and development. This awareness and education process should continue.

- MDT should disseminate the study results to those planners who participated in the study and survey.

- The local planner contacts made during this research study should be continued and expanded.

1.0 INTRODUCTION

As in many urban and suburban areas around the country, Montanans are developing an increased awareness of traffic noise as a problem and an increased awareness that something can and should be done about it.

The traditional approach to traffic noise control throughout the country has been the installation of traffic noise barriers along the highway edge of pavement or along the right-of-way adjacent to noise-sensitive areas. Noise barriers are not always feasible, however, nor are they always reasonable in cost. Examples include non-controlled access facilities where driveways are too numerous to allow barriers to effectively block the noise and lower density areas where the number of impacted homes may be too small to justify the cost of an expensive noise barrier. In these cases, non-traditional methods of noise abatement could be very useful.

This report documents a research study into alternative noise abatement measures of interest to the Montana Department of Transportation (MDT). There were two major components of the study:

- A detailed review of the practice;
- Surveys of residents in four Montana communities where traffic noise from a major road is present, and surveys of local Montana planners on their perceptions of noise problems and noise mitigation.

The review of the practice involved published literature as well as extensive correspondence and discussions with the staff of numerous state departments of transportation (DOTs) and local agencies across the country. The review also included the development of an informal e-mail survey that was sent to the staff member of each state DOT responsible for traffic noise abatement.

In accordance with the project Request for Proposal (RFP), the literature review focused on current noise abatement policies, practices and procedures for non-traditional noise abatement solutions. Discussions with MDT staff regarding the scope for the research revealed four areas of particular interest including:

- Pavement types and texturing;
- Noise-compatible land use planning and development;
- Sound insulation; and
- Traffic management techniques.

Concerns associated with each of these non-traditional abatement methods are discussed including legislative policies local to Montana and elsewhere. Failures and success stories are discussed where applicable.

Additionally, MDT was interested in reviewing Type II noise abatement programs and experiences in states that currently have Type II programs; therefore, Type II programs were also included in the literature review.

The residents survey explored opinions on neighborhood qualities, sources of community noise, the noise from the major road in their area, and people's attitudes regarding various noise-reducing measures, both for their current situation and if they were moving into new homes.

The planners survey gathered data on the planning jurisdictions represented by the respondents, and sought opinions on current and future traffic noise problems in their jurisdictions as well as various noise mitigation measures. The subject of noise-compatible development was explored, including MDT actions thought to be necessary for a successful program.

Sections 2.0 through 6.0 of this report address each of the five areas of interest to MDT. Section 7.0 presents information on land use planning and development in Montana. Section 8.0 presents the results of the residents and planners surveys. Section 9.0 contains a brief summary, with the reader referred to the Executive Summary for a compilation of individual section summaries and recommendations.

2.0 PAVEMENTS

The selection of pavement types in the United States has historically been made by evaluating safety and durability with little or no consideration of the noise characteristics of the pavements despite the fact that past research has indicated that different pavement types textures affect sound levels.

Past research has indicated that different pavement types and textures can affect both interior (in vehicle) and exterior (roadside) sound levels. The focus of this literature review was on exterior sound levels since MDT is most concerned with sound levels at noise-sensitive land uses along highways and not within individual vehicles.

In addition to the review of numerous technical papers on pavement noise, the literature review included a discussion with staff of the Arizona Department of Transportation (ADOT) and a conference call with staff of the California Department of Transportation (Caltrans). Arizona and California have been extremely proactive in pavement research and are the only two states that have initiated Quiet Pavement Pilot Programs in accordance with a new Federal Highway Administration (FHWA) initiative.

The review also included a meeting with Dr. Roger Wayson, author of National Cooperative Highway Research Program (NCHRP) Synthesis 268, *Relationship Between Pavement Surface Texture and Highway Traffic Noise*. Dr. Wayson is also developing recommendations regarding pavement noise for *A Guide for the Construction of Reduced Noise Pavement* that is anticipated to be published in mid-to-late 2004. The guidebook is being done as part of a Purdue University/University of Central Florida research study.

An overview of pavement types and noise measurement methods is presented first, followed by the results of the literature review.

2.1 Pavement Types and Textures

Pavements are generally constructed using either asphalt concrete (AC) or Portland Cement Concrete (PCC). Asphalt concrete is the most widely used pavement in the United States. The four types of commonly used AC include dense-graded asphalt concrete (DGAC), open-graded asphalt concrete (OGAC), stone mastic asphalt (SMA) and rubberized asphalt concrete (RAC).

DGAC consists of a mixture of bituminous material and a close-graded aggregate ranging from coarse to very fine particles. The porosity of most dense asphalt mixes is about 5% [Crocker et al. 2004]. DGAC is designed as Type A or Type B depending on the specified aggregate quality and mix design criteria appropriate for the job conditions.

OGAC is a porous asphalt mix generally used as an overlay atop DGAC. The porosity of most porous asphalt mixes varies from about 15% to 30% [Crocker et al. 2004]. The primary benefit of OGAC is the reduction of wet pavement accidents by improving wet weather skid resistance, minimizing hydroplaning, reducing water splash and spray, and reducing nighttime wet pavement glare. Secondary benefits include better wet-night visibility of traffic stripes and markers, better wet weather (day and night) delineation between the traveled way and the DGAC

shoulders, and increased safety through reduced driver stress during rainstorms. OGAC surfacing is also called "open-graded friction course."

SMA is a proprietary open-grade hot-mix asphalt overlay that is heavily used in Sweden. The aggregates are coated with a mastic that contains sand, filler and asphalt cement [Wayson 1998]. SMA is also called "stone matrix asphalt."

RAC is a bituminous mix, consisting of blended aggregates, binding agents and crumb rubber (CRM). CRM consists of recycled rubber, often obtained from used tires, that has been reduced to sizes less than 6.3 mm. RAC is also called "asphalt rubber friction course" (ARFC).

If PCC pavements are utilized, FHWA requires that surface texturing be used to reduce skidding under wet pavement conditions. PCC pavements are textured to provide adequate resistance to skidding and to allow water to escape from under the tires to prevent hydroplaning. One type of texturing, known as "tining," has been shown to contribute to increased tire noise and the creation of "whines" caused by high sound levels at distinct frequencies. Other types of Tining is PCC texturing include brushing, dragging and grinding.

PCC pavements produce different safety and noise characteristics based on the way the pavement is grooved or tined. The different tining textures that are typically used in PCC pavements include:

- Uniform transverse tined PCC pavement;
- Random transverse tined PCC pavement;
- Longitudinally tined PCC pavement; and
- Random skewed tined PCC pavement.

Transverse tining is the most common pattern currently utilized in the United States. Longitudinal and skewed patterns may also be used and may reduce noise, but there has been some uncertainty regarding the safety characteristics of longitudinally tined PCC pavements, as well as concern regarding the service life and costs of the pavement.

Diamond grinding involves the removal of a thin layer of cured concrete using a machine with closely spaced diamond-coated circular saw blades. The diamond blades are spaced such that the thin fins of concrete left between the blade cuts break off during the grinding process, leaving a level surface with longitudinal texture [Burge et al. 2002].

In 1979, FHWA issued *Technical Advisory T5140.10, Texturing and Skid Resistance of Concrete Pavements and Bridge Decks* [FHWA 1979]. This Technical Advisory contained FHWA's guidance for texturing PCC pavements to provide an adequate level of wet pavement skid resistance. The recommendations for PCC texturing included:

> Transverse grooving will assist in providing a pavement surface with good durable pavement skid resistance characteristics at high speeds, will reduce splash and spray and headlight glare from wet roadway surfaces, and will continue to facilitate surface drainage until the depth of the wheel path ruts exceeds the depth of the grooves. Longitudinal grooving assists vehicle control at curves and sites involving lateral movements. Both types of grooving

> effectively reduce the hydroplaning potential. The longitudinal grooving of existing pavements, while not necessarily producing an improvement in skid number, has been found to be an effective means of reducing accidents at sites having high, wet weather accident rates.
>
> Although longitudinal grooving may be preferable under some circumstances, and particularly when dealing with existing pavements, transverse grooving is considered to be superior to longitudinal grooving for general use on new construction because of the improved pavement drainage provided. Also, with the increased use of smaller, lighter cars and radial tires, complaints of vehicle handling problems on longitudinal grooved pavements seem to be on the increase. [FHWA 1979].

Many states have used transverse tining almost exclusively since the publication of this Technical Advisory. One notable exception, is California, which never switched from longitudinal tining to transverse tining.

In May 1996, FHWA published a Policy Memorandum regarding the texturing of PCC pavements [FHWA 1996]. The memorandum included the Executive Summary from *Surface Finishing of Portland Cement Concrete Pavements – Final Report.* This report was prepared by the joint state, industry and FHWA PCC Surface Texture Technical Working Group (TWG) as updated guidance on PCC surface texturing. The Executive Summary stated the following regarding transverse tining:

> Transverse tining, preceded by a longitudinal artificial carpet or burlap drag, remains the most desirable PCC surface texture method for many high-speed (80 km/h or greater) locations. With quality design and construction, it has been shown that pavements with excellent friction characteristics and low-noise levels can consistently be provided. In particular, research demonstrates that transversely tined concrete pavements with low-noise characteristics and minimal splash and spray can be constructed. With high-quality mix design and construction practices, longitudinal tining or brushing and the exposed aggregate surface treatments will also provide sufficient macrotexture to prevent hydroplaning and reduce the number and severity of wet weather accidents on high-speed highways.

The Executive Summary also states, "when used, random transverse tine spacing (minimum spacing of 10 mm and a maximum spacing of 40 mm with no more than 50 percent of the spaces exceeding 25 mm) should be specified pending the results of further research." As a result, many states have implemented random transverse tining in their PCC pavements. The Executive Summary stated the following regarding longitudinal tining:

> Where longitudinal tining is desired (particularly in noise-sensitive areas or drier climates), it is recommended that the uniform tine spacing be 20 mm, actual tine width 3 mm (+/- 0.5 mm), and the individual tined depth be 3 to 6 mm (with an average surface texture depth of 0.8 mm and a minimum of 0.5 mm for individual tests as measured by the sand patch test ASTM-E 965). Wider longitudinal grooves are particularly objectionable to drivers of vehicles with small tires and must be avoided.

> Preliminary information indicates that longitudinal tining at 20 mm spacing, preceded by a burlap or artificial turf drag, will provide a safe, durable pavement if a high-quality surface mixture with adequate microtexture is used that includes a minimum of 25 percent siliceous sand. Caltrans specifies a minimum siliceous sand content of 30 percent of the fine aggregate portion and a minimum friction coefficient of 0.30 per its standard test procedure.
>
> When considering the use of longitudinal texturing, the disadvantages of slightly slower surface drainage and more splash and spray compared to transverse tining should be considered especially in wetter climates subject to freezing conditions. Where very high speeds are expected (130 km/h or greater), British research indicates that longitudinal textures may not provide satisfactory friction characteristics. The New South Wales, Australia, *Concrete Pavement Manual* also states that longitudinal grooving treatment is unsatisfactory for both stopping distance and for rotational stability of a braked vehicle at high speeds. [FHWA 1996].

2.2 Noise Measurement Methods

There are different methodologies for measuring tire/pavement noise. The two most common methodologies include the International Standards Organization (ISO) 11819-1, *Statistical Pass-By Method*, and ISO 11819-2, *Close Proximity (CPX) Method*. The CPX Method is also referred to as the "trailer" method.

Measurements using the Pass-By Method are conducted using microphones located along the side of a roadway at a specified distance from the near travel lane. Measurements using the CPX Method are conducted by mounting a microphone near the tire. Measurements taken by these two methods have not been shown to be comparable [Wayson 1998]. As a result, there has been some controversy regarding the accuracy of the results using the different methods.

2.3 Literature Review

Many states and municipalities have conducted tire noise research to gain an understanding of pavement noise characteristics. The following sections summarize the results from many of these studies.

2.3.1 NCHRP Synthesis 268

In 1998, a substantial review of the practice on the relationship between pavement types and textures and noise was sponsored by the Transportation Research Board National Research Council and conducted by Dr. Roger Wayson of the University of Central Florida. The resulting publication, *NCHRP Synthesis 268 Relationship Between Pavement Surface Texture and Highway Traffic Noise,* involved a survey of state transportation agencies and a comprehensive literature review [Wayson 1998].

The report provides detailed information on noise measurement techniques and noise emission results for different pavement surfaces and also reports on pavement wear and friction and safety characteristics.

The study notes that "In the United States, the two least expensive, proven construction methods for texturing PCC pavements are dragging and transverse tining. These proven methods have been used extensively on a global scale as well." Data on textured PCC pavements in Colorado, Missouri, Kentucky, New Jersey, Wisconsin, Minnesota, Iowa, North Dakota, Australia, Belgium and Spain were obtained and analyzed for the study.

In addition to the PCC pavement textures discussed previously, the study also included analysis of exposed aggregate pavements where the surface is brushed to expose the aggregate. Exposed aggregate pavements are common in Europe. Data on exposed aggregate pavements in the United Kingdom, Sweden and Australia were obtained and analyzed. Data from a research study in Michigan were also included. Wayson's conclusions for PCC pavements included the following:

- PCC pavements are in general, noisier than asphaltic surfaces.
- In general, transverse tining would also seem to cause the greatest sideline noise levels when compared to longitudinal tining or asphaltic surfaces. Randomized tine spacing tends to reduce the annoying pure tone that is generated by transverse tining.
- Studies show that the sound generation changes with speed. In addition, the most quiet pavement surface was found to be different for automobiles than for trucks.
- Construction quality is an important consideration for the final overall noise generation.
- Texture depth of the transverse tining also seems to play an important role. In some U.S. cases the greatest noise was generated with the greatest range in texture depth. The width of the groove also became an important parameter in these cases.
- The use of porous PCC pavement also results in a noise reduction along the highway. This surface may provide noise attenuation while also being more durable than asphaltic surfaces. [Wayson 1998].

OGAC asphalt data from Denmark, Italy, Germany, Sweden, France, Australia, Japan, Maryland and Oregon were analyzed as well as SMA data from New Jersey, Maryland and Wisconsin. The study also included rubberized asphalt data from Kansas. The conclusions for asphalt pavements included the following:

- Asphalt pavements are, in general, quieter than PCC pavements. The surface aggregate size is important and should be kept below 10 mm if possible. The porous surfaces tend to reduce noise in the higher frequency range, resulting in overall noise reductions.
- Open-graded asphalt is reported to be the quietest pavement, based on worldwide results. It is important that the porosity stay high, greater than 20 percent.

- SMA surfaces were reported to reduce the noise about one dBA when compared to dense-graded asphalt by several studies. More work is needed in the surface finishing and techniques.

- New processes, such as rubberized asphalt still need considerable developmental effort. Tests conducted in Japan and the United States showed no clear trends. Noise reductions were generally small. [Wayson 1998].

As described later in this report, chip sealing is used extensively in Montana. The Synthesis does not contain much data on chip sealing. The Synthesis does note that the Concrete Pavement Manual from New South Wales contains the list of typical differences in sound levels shown in Table 1 for free-flowing traffic when compared to DGAC.

Table 1: Sound Level Differences, Concrete Pavement Manual from New South Wales

Surface	***Level Difference Compared to DGAC, dB***
OGAC	-6.0
Hessian dragged concrete	-2.7
DGAC	0.0
Tined concrete	+0.3
Sprayed seal (14 mm)	+2.0

The values indicate the noise levels generated by spray-sealed pavements (another term for chip seal) are approximately 8 dB higher than for OGAC and approximately 2 dB higher than DGAC and tined concrete.

The Synthesis further investigated the wear and maintenance characteristics of concrete and asphalt pavements and concluded that PCC pavements are longer lasting and usually require less maintenance than asphalt pavements. Even after wear, PCC surfaces can be restored without repaving. Tire vibration is reduced as the PCC surface becomes polished thus reducing noise levels; however, noise generation increases as aggregate exposure increases.

The Synthesis noted that porous pavements also fill with grit and dirt, which may require special cleaning. Porous surfaces are also more susceptible to freeze/thaw cycles and may require either an increase in deicing agents or a change in deicing methods. Additionally, the study concluded that noise levels adjacent to porous pavements can increase over time.

The Synthesis also assessed the safety characteristics of pavements by analyzing data from Oregon, Minnesota, Virginia, Missouri, California, Colorado, Iowa, Michigan, Spain and Australia.

The surface friction of DGAC pavements is provided by the exposed aggregate. OGAC pavements provide increased friction by providing higher levels of macrotexture. Although hydroplaning is reduced by porous surfaces, such surfaces require additional periodic maintenance to ensure that the surface pores are not plugged.

PCC pavements may use hard fine aggregate to provide surface friction and surface tining aids drainage. The Synthesis concludes that, in general, transverse tining provides the best surface friction and lasts for long time periods. The surface friction provided by longitudinal tining is not as good as that provided by transverse tining and may degrade more quickly over time.

Finally, the Synthesis resulted in the following conclusions regarding safety:

- Dense-graded asphalt, although generally quieter than PCC pavements, has less surface friction.

- Porous asphalt provides low noise levels and among the best surface friction for asphalt surfaces that is adequate for safety considerations. Unfortunately, additional maintenance costs may be required since cleaning of the porous surface may be needed to prevent plugging.

- Longitudinally tined PCC surfaces provide good surface friction, but not as good as transversely tined PCC surfaces.

- Although transverse tining generally provides the best frictional characteristics, it can lead to undesirable noise impacts, especially a clearly audible "whine." The frequency of the whine is a factor of the tining spacing and vehicle speed.

- Random spaced transverse tining, proceeded by longitudinal artificial carpet dragging or burlap drag, continues to be the most desirable PCC pavement surface texture method for high-speed major highways. Wayson 1998].

The synthesis concluded that more research was needed to address the issues of noise created by the tire/pavement interactions and noted that more analysis was needed in order to allow direct comparisons of different surface textures.

Dr. Wayson is currently developing the section on pavement noise that will be included in *A Guide for the Construction of Reduced Noise Pavement.* A meeting was conducted with Dr. Roger Wayson to discuss his research in the area of pavement noise. Although Dr. Wayson's research is ongoing, he provided preliminary summary results of a detailed quantitative analysis of the data collected for numerous pavement research studies, including several of the studies discussed in this literature review. He indicated that the conclusions regarding the noise characteristics will be of a general nature and at this juncture he feels that the conclusions will indicate that OGAC pavements are the quietest followed by DGAC pavements and PCC pavements. For PCC pavements, longitudinally tined pavements are the quietest followed by transverse tined pavements. Random transverse tined pavements are comparable to uniform transverse tined pavements, however, the random transverse patterns eliminate the "whines" that can occur with uniform transverse tining. Results for rubberized asphalt pavements and skewed PCC pavements have not been incorporated.

2.3.2 Arizona

2.3.2.1 Arizona DOT

In 1995, the ADOT embarked on a study to evaluate the noise reduction benefits gained from the use of ARFC [ADOT April 2003]. This study was initiated in response to complaints from the public regarding the noise generated by PCC pavements in the Phoenix metropolitan area.

Roadside measurements and vehicle-based measurements were conducted on ARFC and PCC pavements. Three PCC tining textures were evaluated including uniform transverse tining, one-inch uniformly spaced longitudinal tining, and the "Wisconsin DOT random transverse tining" (to be described later in this literature review).

The vehicle-based measurements were completed in an attempt to assess pavement noise characteristics over time in an economical manner. The vehicle-based measurements, however, were subsequently determined to be inadequate and were abandoned.

The study concluded that roadside sound levels near a tined PCC surface were 3.3-5.7 dBA greater than the levels measured near an adjoining ARFC surface. Based on four separate hourly measurements, the average difference between the two surfaces was 4.7 dBA.

The study also reported that there were differences in properties between the ARFC of different ages, and dramatic differences between different PCC texture properties (i.e. grinding, grooving, and tining).

In 2002, ADOT had an ISO Standard CPX noise measurement trailer constructed and CPX testing was used to conduct a network level survey of ARFC's ranging in age between 3 and 12 years. Three PCC tining textures were also evaluated. The results indicated that ARFC surfaces typically produced CPX sound levels between 94 and 99 dBA throughout their ten-year design period. Regression analysis of the data suggested that there was approximately a 5 dBA reduction in noise attenuation (that is, an increase in the sound level) over a 12-year period using the CPX sound levels.

The CPX results indicated that the Wisconsin random texture did not produce a quieter pavement surface but did remove the tonal spikes in certain sound frequencies associated with uniform transverse tining. Additionally, the results indicated that the uniform transverse tining produced levels 2-3 dB higher than ARFCs.

Additional analyses of the PCC pavements were undertaken using pass-by testing. These results indicated that longitudinal tining produced the lowest sound levels followed by uniform transverse and random transverse tining. A one-mile stretch of PCC pavement on SR 101 in Scottsdale was subsequently overlaid with ARFC and CPX testing indicated that there was approximately an 11 dB difference in A-weighted sound levels before and after the overlay.

As part of this literature review, discussions were held with Ms. Angie Newton and Mr. Larry Scofield of ADOT to discuss similar topics. ADOT has developed a Quiet Pavement Pilot Program that was approved by FHWA in April 2003 [ADOT April 2003]. ADOT now uses ARFC on 80% of their asphalt pavements. For PCC pavement, ADOT exclusively uses uniform transverse tining except for the test sections noted above. Based on the data from the studies described above, ADOT proposed, and FHWA approved, a 4 dBA adjustment to FHWA Traffic

Noise Model (TNM) predictions of sound levels made using "average" pavement for situations where ARFC is planned. Therefore, TNM predictions for ADOT noise studies are reduced by 4 dBA.

If the sound level is still above the FHWA Noise Abatement Criterion (NAC) in the FHWA noise standards (23 Code of Federal Regulations (CFR) 772), then ADOT designs additional abatement to reduce the sound level below 64 dBA. The noise barriers are also designed to break the line of sight to the truck stacks and are designed not to be lower than 8 feet in height. As a result, installation of barriers will often result in "with barrier" sound levels well below 64 dBA.

Funds to complete the research to support the Quiet Pavement Pilot Program were set aside in the state's construction fund. Originally $1 million was set aside for the program and ADOT continues to look at how best to proceed [Scofield 2004].

Regarding the durability of ARFC in cold climates, Mr. Scofield stated that the issue for durability is not the temperature or climate but the characteristics of the asphalt crude elements used. He suggested that test strips should routinely be constructed before pavement is laid [Newton and Scofield 2003].

2.3.2.2 Maricopa County

Maricopa County has incorporated low-noise pavements in its strategies to reduce traffic sound levels, although low-noise pavement is not considered to be a primary strategy in the 2001 policy statement. Rubberized asphalt pavements were initially constructed only on roadways where noise walls were not feasible or cost-effective. The initial experience suggests that the rubberized asphalt pavements are more durable than conventional asphalt pavements; therefore they are expected to be the choice pavement in the future. The initial costs for rubberized asphalt pavements range from 10 to 15 percent more than conventional asphalt pavements. When lifecycle costs are considered, however, the rubberized asphalt pavements are expected to be more economical [McMullen 2003].

2.3.3 California

A conference call was conducted with staff of Caltrans to discuss pavement noise, land use compatibility, and sound insulation [Hendriks et al. 2003]. The land use compatibility and sound insulation discussions are summarized later in this report.

Caltrans discussed the possibility of developing a Quiet Pavement Pilot Program with FHWA and received authorization to move forward with the program in December 2002. Caltrans staff originally envisioned collecting detailed noise data from ten pilot projects. This data would then be used to develop adjustments that would be applied to TNM predictions for highway project noise studies similar to those used by ADOT. FHWA staff told Caltrans that the use of alternative pavements could not be used as a noise abatement measure, but Caltrans had already gathered a significant amount of data on the relationship between pavement surface type and noise generation.

The sound level measurement data collected and analyzed by Caltrans indicated that DGAC is approximately equal to the "average" pavement sound levels contained in the TNM program while OGAC is 3 dB lower and PCC is 2 dB higher than the TNM "average" level. On

August 27, 2003 Caltrans issued a Technical Advisory titled "Additional Calibration of Traffic Noise Prediction Models" [Hendriks 2003]. The Advisory states, "Caltrans HQ Environment feels confident with the basis of completed and ongoing studies indicating that the preliminary figures of +2 dBA for PCC and –3 dBA for OGAC are conservatively valid with reference to DGAC." The Advisory further states, "Using the above relationships with a conservative assumption that the 'average pavement' in Caltrans' traffic noise prediction model (SOUND32) and TNM is DGAC instead of the mix of DGAC and PCC, we can further adjust the models for PCC and DGAC pavement types." Conversations with Caltrans revealed that Caltrans is applying these adjustments based on feedback from the FHWA District office [Rymer 2004].

Caltrans staff indicated that the public is demanding that "quiet pavement" be used, particularly on new highway projects. Caltrans has no formal consideration of noise in the selection of a pavement type although pavement staff have on occasion requested noise data for different pavements.

As mentioned previously, PCC pavements in California are longitudinally tined. California is believed to be the only state that uses longitudinally tined PCC exclusively and has done so for many years [Hendriks et al. 2003].

2.3.3.1 Davis I-80 OGAC Study

An on-going study of OGAC pavement in Davis, California, has been sponsored by Caltrans. The goals of this study are to assess the noise reduction provided by an OGAC overlay on Interstate 80 (I-80) immediately after the overlay, and to assess if and how the noise reductions change as the pavement ages [Illingworth & Rodkin 2002].

The study involved overlaying a 9-kilometer stretch of I-80 in June and July of 1998. The pavement prior to the overlay was aged asphalt concrete. The existing pavement was removed and replaced with 60 mm of DGAC, which was subsequently overlaid with 25 mm of OGAC. Measurements were conducted prior to the project, shortly after application of the DGAC, and shortly after application of the OGAC. Measurements were then conducted every year for four years after project implementation. Measurements were conducted at reference locations on the eastbound and westbound sides of I-80, twenty meters from the edge of the near travel lane. Measurements were also conducted at more distant sites 140 meters from the edge of the near travel lane.

Table 2 from the study summarizes the measurement results at the reference sites. These results led to the finding that A-weighted sound levels decreased by 4 dB after replacement of the aged AC with the new DGAC. The levels decreased an additional 2 dB (for a total of 6 dB from baseline aged AC conditions) just after application of the OGAC overlay. The data continued to show this same reduction after four years.

Table 2: Summary of Results from I-80 Davis OGAC Study

Calculated Change in Traffic A-weighted Sound Level – Reference Sites (20 m)							
Measured Baseline (Aged AC)	***Very New DGAC***	***New OGAC***	***1-Mo. (August)***	***11-Mo. (June)***	***23-Mo. (June)***	***35-Mo. (June)***	***47-Mo. (June)***
78.6	-3.9	-5.6	-6.1	-6.0	-5.5	-6.4	-5.8

Additionally, sound pressure levels at frequencies between about 1000 Hz and 4000 Hz decreased by 3 to 5 dB with the new DGAC and up to 10 dB with the new OGAC compared to the baseline.

The study findings are particularly important because the measurements were conducted under real traffic conditions and not using individual vehicles. The study noted that I-80 is a major transcontinental Interstate freeway with an average of over 140,000 vehicles daily including almost 10% trucks. These results indicate that substantial reductions in wayside sound levels may be achieved even with heavy volumes of trucks.

This study is continuing and measurements were conducted during 2003. The results are currently being analyzed and should be available later this year. Conversations with Caltrans staff also indicated that they hope to continue the measurements as long as funding can be secured [Hendriks et al. 2003].

2.3.3.2 Route 101 in Sonoma County

A study was sponsored by Caltrans to determine whether the noise generated by the interaction of tires and pavement surfaces would be lower for a PCC surface that had been diamond-ground as compared to a surface that had longitudinal grooves. The study was conducted with the purpose of determining whether Route 85 in San Jose should be diamond-ground to reduce noise [Gharabegian and Tuttle 2002].

The site selected for analysis was along U.S. Highway 101 near the City of Geyersville where there was an adequately long section of longitudinally grooved pavement with a nearby section of smooth, diamond-ground pavement. The two sites were within several miles of each other. Single-vehicle pass-by spectrum noise measurements were made simultaneously at the site with longitudinal grooves and at the diamond-ground site. Only automobiles were studied for the single-vehicle pass-by measurements. Medium trucks were not included in the pass-by analysis due to an insufficient number of pass-bys. Additionally, heavy trucks on Highway 101 were not included in the study because there is a heavy truck ban on Route 85 in San Jose. Simultaneous 15-minute measurements were also made under real traffic conditions. The measurements were conducted in accordance with *Measurement of Highway Related Noise* [Lee and Fleming 1996] and ISO 11819-1, *Statistical Pass-By Method*.

The results of the pass-by measurements for automobiles indicated that the average difference in the measured single pass-by maximum sound levels was approximately 6 dB at 7.4 m (25 feet) and 4 dB at 15 m (50 feet), with diamond-ground pavement being quieter. These results indicate that noise from the tire/pavement interaction is likely to be perceptively quieter

for a diamond-ground pavement versus a longitudinally tined pavement. This finding is not necessarily applicable to a roadway with heavy truck traffic.

The results of the 15-minute simultaneous measurements at 15, 30 and 33 m were not conclusive, and indicated almost equal levels for the tined and ground roadway surfaces. The measurements at 10 m, however, indicated that there was about a 3 dB noise reduction due to the diamond grinding for all vehicles, including heavy trucks.

2.3.3.3 Sacramento Rubber Pavement Noise Study

Sacramento County has utilized RAC on numerous roadways since 1992. In November 1999 the Sacramento County Public Works Agency Transportation Division sponsored a study to assess the traffic noise effects of the use of RAC on the Alta Arden Expressway [Sacramento County 1999]. The paving of Alta Arden Expressway using RAC was completed in 1993 and was not associated with any widening or reconstruction of that roadway. The pavement prior to repaving was conventional asphalt. The "before" traffic noise measurement survey was conducted one month prior to the paving with RAC. The survey was repeated one month after paving, sixteen months after paving, and six years after paving.

The sound level measurement surveys initially consisted of continuous measurements over a minimum of 24 hours, and short-term (15-minute) measurements at various locations. It was not practical to monitor and account for all of the factors that affected the measured sound levels over the 24-hour periods, so the study concluded that the findings based on the continuous measurements are considered approximate.

The short-term sound level measurements were conducted at various distances from the roadway centerlines and provided a statistically smaller sample of data by which to evaluate the effects of rubberized asphalt. The short-term sampling periods also allowed for the monitoring of factors that affect the noise measurement results.

The study noted that heavy truck traffic accounted for a very low percentage of the total traffic. As a result, the traffic noise was generated primarily by the interaction of tires and pavement. The results were normalized and the average noise reduction of three test locations was calculated. The results indicated that the use of RAC reduced the pre-construction sound level by 6 dB one month after paving, 5 dB 16 months after paving and 5 dB 6 years after paving.

2.3.4 Colorado

The Colorado Department of Transportation (CDOT) Region I constructed several test sections of roadway in an effort to address noise problems on Phases I and II of US 285 southwest of Denver, where the transverse tining was causing an objectionable tire whine [LaForce and Schlaefer 2001]. The purpose of the project was to study the impact of the different surfaces on sound levels inside a vehicle, at the tire of a vehicle, and at the roadside.

The project included longitudinally tined, transverse tined, and diamond ground PCC pavement and 3/8-inch SMA. Three of the pavement types (longitudinally tined, transverse tined, and SMA) existed within four miles of each other. Measurements were completed on these three sections. The transverse tined section was then diamond ground to create the fourth surface. Wayside measurements were taken at 25 feet from the center of the near travel lane. The height of the microphone varied from 34 inches to 51 inches due to topography. Skid numbers

(resistance values) for all surfaces were measured. Table 3 from the study summarizes the results.

Table 3: Summary Results, Turkey Creek Canyon, Colorado

Surface	*Sound Level (dBA)*	*Skid Number 40 mph (SN40R)*
Transverse Tined Concrete	82	43.5
Longitudinally Tined Concrete	75	43.3
Asphalt Surface (3/8-inch SMA)	74	51.5
¼-inch Ground Test Section	76	47.4

These results led to the following conclusions:

- On the transverse tined concrete test section the ¼-inch grinding resulted in a reduction in the sound level of 6 decibels near the road.
- The majority of the annoying frequency components from tire/pavement noise lie between 700 and 2000 Hz. The average reduction in sound pressure level between 800-2500 Hz inclusive was 7 decibels for the test section (measured 25 feet from the vehicle).
- The current standard surface finish for concrete pavement (longitudinal tining) resulted in comparable sound level values to the ground surface and the 3/8-inch SMA asphalt surfacing. The skid number for the asphalt is considerably higher than the concrete surfaces, but the concrete skid numbers are adequate.
- The reduction in sound level after grinding away the transverse tining is very similar to those reported in the Wisconsin report, *Noise and Texture on PCC Pavements* [described later in this review]. The sound levels for the other surface treatments are also similar to those reported in the Wisconsin report [LaForce and Schlaefer 2001].

2.3.5 Michigan

Much of the information provided below is from a web site titled *Community Experience with I-275 Road Noise in Michigan* [Shoup 2002]. In 1994, the Michigan Department of Transportation (MDOT) installed a 2-inch AC overlay on a section of I-275 in Farmington Hills as a temporary measure until the road could be reconstructed. Residents noted an immediate and dramatic decrease in noise. In 1998, MDOT determined that I-275 would be resurfaced with concrete based on a Life Cycle Cost Analysis.

As a result of requests from residents and local officials, the Michigan State Transportation Commission agreed to look into methods to make the road surface quieter. In April 1999, the Commission instructed MDOT to reconstruct I-275 with concrete using transverse, skewed, random tining for the road surface. MDOT agreed to conduct a post-construction analysis of I-275 road noise.

In the summer of 1999, I-275 was reconstructed and the residents started reporting a noticeable increase in the noise coming from vehicles traveling on the road [Duggan 2000]. MDOT conducted a post-reconstruction sound analysis in November 1999 and noted that the noise generated was greater than expected. The Commission then directed MDOT to further investigate technologies to reduce noise. In March 2001, the MDOT Director presented the Commission with five options for abating I-275 road noise:

1. Do nothing;

2. Longitudinal grinding of pavement surface ($1.5 million expected 3 dBA reduction);

3. Landscaping (trees and shrubs) outside the ditch area ($1 million, little expected reduction in noise);

4. Noise walls or berms ($16 million, approximately 4-8 dBA reduction within 400 feet of wall); or

5. An overlay with bituminous pavement ($8 million plus, 5 dBA or more reduction); the MDOT Director reported that 6 to 8 dBA could be achieved with OGAC.

In June 2001, the Commission adopted a MDOT recommendation to longitudinally diamond-grind all I-275 concrete through lanes based on the success of the Colorado DOT grinding on US 285 (Deer Creek Canyon area) described previously. In July 2001, MDOT conducted noise measurements at five southbound and five northbound locations within the right-of-way. In November 2001, MDOT reported that the longitudinal diamond grinding of I-275 resulted in an average 5.4 dB reduction over the previous texture (transverse skewed random tining).

2.3.6 New York

A November 2001 study involved the construction and analysis of two new test sections of PCC pavement on I-190 (New York State Thruway) in Buffalo [Burge et al. 2002]. One test section was constructed using diamond grinding and a second section was constructed using random transverse tining in accordance with New York State Department of Transportation (NYSDOT) specifications. The test sections were compared based on safety, noise, construction cost, service life, reliability, handling, and maintenance requirements. An initial evaluation was completed and follow-up noise and skid resistance measurements were conducted one year later.

The measurement program included single vehicle pass-by measurements and aggregate traffic noise measurements. Noise measurements were conducted in accordance with specifications in *Measurement of Highway-Related Noise* [Lee and Fleming 1996] and *Development of National Reference Energy Mean Emission Levels for the FHWA TNM (FHWA TNM®), Version 1.0* [United States Department of Transportation (USDOT) 1995].

The single vehicle pass-by regression analysis indicated that the diamond ground pavement does not provide the same acoustic benefit to all vehicle types uniformly. The ground pavement provided an approximate 5 dBA sound level reduction for automobiles and light trucks relative to the transverse tined pavement, but only a 2 dBA sound level reduction for medium and heavy trucks.

The short-term real traffic noise measurements during the peak noise hour showed that the diamond ground pavement was about 3 dBA quieter than the transverse tined pavement. Noise measurements conducted approximately one year later showed essentially no change in absolute or relative sound levels.

Initial measurements showed a greater skid resistance for a longitudinally diamond-ground surface than for the transverse tined surface. The difference was shown to be less after about one year, but with the longitudinally diamond-ground pavement still superior. The dry skid resistance for both pavement surfaces was essentially the same. The study also concluded that the longitudinally diamond-ground pavement required more construction time and cost more; however, the researchers noted a higher initial cost for longitudinal diamond grinding would likely be partially offset by an extended service life.

2.3.7 Ohio

The Ohio Department of Transportation (ODOT) conducted a tire/road study to assess the noise characteristics of twelve ODOT pavement types [Herman et al. 2003]. The primary objective of the study was to develop rankings according to tire/road sound levels for ODOT pavement types. The rankings would provide an additional criterion for pavement selection. The pavement types tested included DGAC, OGAC, SMA, and PCC. DGAC sites were selected to represent limestone gravel and slag aggregate types. The PCC pavements included uniform transverse and random transverse tining. Pavements were selected with ages that varied from one year to seven years, with the majority of pavements being one year in age.

The road measurements were conducted using ISO 11819-1, *Statistical Pass-By Method* and *Measurement of Highway-Related Noise* procedure [Lee and Fleming 1996]. The study notes that a comparison of roadside tire/road sound levels measured for one pavement with those measured for another pavement is normally not valid since the traffic noise sources are not the same in terms of vehicles, speeds, and volumes. Nevertheless, the procedure specified in the ISO standard resulted in a valid basis for the comparison.

The sound level data was used to develop Statistical Pass-By Index (SPBI) values and Reference Energy Mean Emission Levels (REMELs) for each pavement type. The pavements are ranked in Table 4 in order of increasing SPBI values.

Table 4: Summary of Pavement Rankings, Ohio

Rank	***Pavement Type***	***Age (years)***	***SPBI (dB)***
1	OGAC	1	82.2
2	DGAC	1	85.0
3	DGAC	2	85.5
4	DGAC	7	86.4
5	SMA	3	86.8
6	PCC – Transverse Grooves	4	87.0
7	PCC – Random, Transverse Grooves	1	88.9

The study resulted in the following findings:

- There was a difference of 6.7 dB between the lowest (OGAC) and the highest (random transverse grooved PCC) SPBI for all of the pavements measured.

- There were no significant differences in SPBI due to aggregate size for all one-year old dense graded asphalt pavements.

- Sound levels for two-year old dense graded asphalt concrete pavements do not increase significantly from a one-year old dense graded asphalt pavement. However, there is an increase in sound levels of approximately 1.4 dB over a period of seven years.

- Sound levels for a three-year-old SMA are approximately 1.8 dB greater than those for the average one-year-old dense graded asphalt concrete pavement; a SMA exhibits greater sound levels in the frequency range of 630 to 10,000 Hz.

- The lowest tire/road sound levels were measured for the open graded asphalt concrete pavement.

- The random-transverse grooved PCC pavement produced the highest sound levels of all of the different pavement types measured. [Herman et al. 2003].

To date, the tire/pavement noise rankings have not been a consideration in the selection of Ohio's pavements. Often the choice of pavement is not made until the very end of the design phase (sometimes just before the project is let for bid), which is well after the environmental process has been completed. While this practice has been the general rule, an exception has occurred recently in the planning of a major project. A pavement recommendation based on the tire/pavement noise rankings was made by the environmental planning office well in advance of the design phase [Pinckney May 30, 2003].

2.3.8 Tennessee

The Tennessee Department of Transportation (TDOT) recently implemented three different tining patterns in new PCC pavement as part of the widening of I-65 north of Nashville in order to facilitate future assessment of the noise benefits of the different tining patterns [Bowlby 2002].

TDOT had planned to conduct short-term (30 to 60-minute) and long-term (24-hour) noise measurements as well as traffic count and speed measurements at several locations after the section was opened to traffic. Subsequent analysis of the collected data was planned to help develop conclusions regarding the noise characteristics of different pavement tining patterns under actual mixed traffic conditions.

Three different tining patterns were constructed including random transverse (contractor-selected pattern), random transverse (Wisconsin random texture) and random skewed (1:6). A significant portion of the tined pavement had to subsequently be longitudinally ground in order to meet a stringent ride specification for the project. An inspection of the pavement was conducted, and several issues were noted including failure by the contractor to use the proper patterns at the

specified locations. Additionally, significant differences in tining depth were noted throughout the project. As a result, the originally planned measurements for I-65 were abandoned.

2.3.9 Texas

The objective of a Texas Department of Transportation study was to measure and analyze the sound spectra and sound levels of individual passes of a test vehicle from as many different pavement types in Texas as possible [McNerney et al. 1998]. The layout of the roadside microphones was adopted from ISO standard 10844 for measuring the noise emitted by vehicles. The draft standard ISO 11819-2, *CPX Method,* was used for the onboard tire measurements. The resulting roadside data rankings from the study are provided in Table 5. Measurements were also conducted on six pavements in South Africa and the results of the roadside data rankings from the study are provided in Table 6. The study conclusions included:

- The pavements tested in Texas and South Africa showed significant differences in sound levels. The sound level difference ranges were 7 dBA in the Texas tests and 12 dBA in the South African tests. These results indicate that the noise characteristics of pavement surface types are significant and should be a consideration before selection for highway surfacing.

Table 5: Texas Pavement Study Results, Roadside Rankings

Pavement	***Roadside Data Rankings (dBA)***
	Average
Novachip (aged)	79.5
Microsurfacing (site: Mopac@45th)	80.1
Course Matrix High Binder	80.7
Asphalt (new)	81.5
Novachip (new)	81.6
Jointed Reinforced Concrete (ungrooved)	81.9
Continuously Reinforced Concrete (untined)	82.4
Microsurfacing (site: Corpus Christi)	82.5
Asphalt (aged, site: Mopac @ Duval)	83.1
Continuously Reinforced Concrete (tined, aged)	83.8
Continuously Reinforced Concrete (tined, new)	83.9
Chip Seal (Grade 4)	84.4
Asphalt (aged)	84.4
Jointed Reinforced Concrete (grooved)	84.8
Asphalt (grooved)	86.0

Table 6: South Africa Pavement Study Results, Roadside Rankings

Pavement	***Roadside Data Rankings (dBA)***
	Average
Whisper Course	77.2
Open Graded Asphalt	79.7
Dense Graded Asphalt	79.8
Seal Coat (19 mm)	84.5
Jointed Concrete	89.0
Seal Coat (13 mm)	89.4

- The frequency content of the measured noise, both at the roadside and near the tire for the different pavements shows significant differences in spectrum when noisy pavements are compared to quiet pavements. In particular the quiet pavements have a significant drop in the frequency content at 1600 Hz and above.

- The sound levels measured on board the test vehicles in the Texas tests show good correlation with the roadside measurements.

- Further testing of pavements for noise characteristics using both the roadside and on-board methods is recommended. Testing of sound absorption characteristics of different pavement surfaces should help to explain some of the reasons for the differences in the sound levels measured on the pavements.

Both the Texas and South Africa measurements included measurements of chip sealed pavements. As described later in this report, chip sealing is used extensively in Montana so this data is particularly pertinent. Of the 15 pavements in Texas, the chip seal (Grade 4) generated one of the highest measured noise levels. The measured level of 84.4 dBA was almost 5 dB higher than the quietest pavement (Novachip). This level was slightly higher than the two sections of tined continuously reinforced concrete and slightly lower than the level for grooved jointed reinforced concrete.

Of the six South African pavements, the seal coat (13 mm) generated the highest measured noise level of 89.4 dB -- almost 10 dB higher than the measured level for OGAC and DGAC. This level was slightly higher the measured level for jointed concrete of 89 dB. The measured level for the seal coat (19 mm) of 84.5 dBA was almost 5 dB higher than for OGAC and DGAC but almost 5 dB lower than for jointed concrete. These results indicate that chip sealed pavements generate noise levels somewhat higher than asphalt pavements and comparable to tined or grooved PCC pavements.

2.3.10 Utah

The Utah Department of Transportation (UDOT) conducted an experimental project that involved grinding a new texture into a 300 foot section of I-215 in Salt Lake City and monitoring the pavement performance over a two to three year period [Parsons Brinckerhoff Quade & Douglas, Inc. 2000]. The pre-construction pavement was uniform transverse tined. The tining was 1/8-inch wide, 1/16-inch deep and spaced ½-inch apart. After ten years, the tining was worn

down but enough of the tining existed to contribute to tire whine. The new surface texturing was performed by longitudinal diamond grinding at a depth of approximately 1/16-inch.

Measurements were conducted at six locations along the northbound lanes. All measurements were taken after the morning peak hour. The study resulted in the following conclusions:

- Since traffic noise consists of pavement/tire noise and vehicle engine/exhaust noise, the benefits of pavement grinding is reduced by the noise contribution from heavy truck engine stack noise.

- The potential traffic noise reduction to the communities along I-215 would be in the range of 1 to 2 dBA depending on the percentage of heavy trucks and their speed: the higher the percentage of cars and medium trucks, the better the noise reduction.

- The pavement grinding significantly reduced the high frequency pure tone noise, commonly known as tire whine.

- The use of pavement grinding as a traffic noise abatement measure for I-215 could be beneficial for both reducing tire pavement sound levels and muting the pure tone tire whine sound of the older concrete pavement's transverse tining texture.

2.3.11 Wisconsin

The objective of a major Wisconsin Department of Transportation (WisDOT) and FHWA study was to develop national guidelines for texturing PCC pavements based on national experience [Kuemmel et al. 1999]. These guidelines would combine the quietest possible PCC pavement texturing with superior friction and low noise characteristics. The WisDOT/FHWA study involved 57 test sites in Colorado, Iowa, Michigan, Minnesota, North Dakota and Wisconsin. The noise characteristics of the following types of pavements were evaluated:

- AC pavement (standard, Superpave, and SMA);

- Longitudinally tined PCC pavement;

- Uniform transverse tined PCC pavement;

- Random transverse tined PCC pavement; and

- Random skewed tined (1:4 and 1:6) PCC pavement.

Table 7 from the study summarizes the noise reductions that were observed for different tining patterns with similar textures (mean texture depth (MTD) of approximately 0.7 mm) when compared to a uniform, transversely tined PCC pavement with a MTD of 0.7 mm. The results for AC pavements are also provided for the purpose of comparison. Results are shown for both inside and outside the vehicle.

Table 7: Noise Reductions Compared to Uniform, Transversely Tined PCC Pavement from WisDOT/FHWA Study *

Tining Pattern	*Number of Test Sections*	*Noise Reductions*	
		Exterior (L_{Amax})	*Interior (L_{Aeq})*
Random transverse with no whine	3	1 to 3 dBA	Less than 1 dBA
Random skewed (1:6)	1	4 dBA	1.5 to 2 dBA
Longitudinal	3	4 to 7 dBA	2 dBA
Open textured AC	2	5 dBA	2 to 3 dBA

* For pavements with a MTD of 0.7 mm from the sand patch test.

While numerous test sections were constructed and tested for the WisDOT/FHWA study, the tining depths varied greatly from section to section. As a result, the comparisons presented in Table 7 are based on a subset of the test sections with approximately equal MTDs.

The WisDOT/FHWA study found that uniform, transversely tined PCC pavements exhibit the highest sound levels and produce discrete frequencies. As indicated in Table 7, longitudinally tined PCC pavements exhibited the lowest exterior noise of the tined pavements. Exterior sound levels resulting from implementation of a longitudinal pattern were 4 to 7 dBA lower than for a uniform, transversely tined PCC pavement indicating that use of this tining pattern could provide significant noise reductions. The study conclusions stated, "If overall noise considerations are paramount, longitudinal tining that provides satisfactory friction may be considered. A spacing of 19-mm uniform tining will provide adequate friction. It should follow AASHTO and FHWA guidelines, and according to other studies, it will minimize any effects on small tire vehicles." The study conclusions also stressed, "The safety aspects of longitudinal tining have not as yet been documented and caution is urged so that safety is not compromised."

As indicated in Table 7, the second best tining pattern for reducing exterior as well as interior sound levels is a random skewed (1:6) pattern. Exterior sound levels resulting from implementation of the random skewed (1:6) pattern were approximately 4 dBA lower than for a uniform, transversely tined PCC pavement, indicating that use of this tining pattern could provide significant noise reductions. The study stated, "The random skewed (1:6) pattern can be easily built and eliminates discrete frequencies." The authors recommended this pattern "if subjective perceptions and texture considerations are paramount." The summary conclusions also state "if texture considerations are paramount, and a skewed pattern is impractical, random transverse pattern may be utilized." The study did not elaborate, however, on why a random skewed pattern might be "impractical." Conversations with Mr. John Jaeckel, one of the lead authors of the report, indicated that the researchers felt that contractors might not be willing to try to correctly implement a skewed pattern [Jaeckel 2002]. Mr. Jaeckel did confirm, however, that the random skewed (1:6) pattern is easily constructed and the study noted "the advance notification of the skewed patterns allowed the contractor to experiment with skewing the tining machine by advancing one side (left hand forward) to accomplish the tining. The normal tining rake width of 3 meters (10 feet) had to be reduced to 2.4 meters (8 feet) to accomplish the skew."

A random skewed (1:4) pattern was also included in the study. The contractor reported that this pattern was more challenging to construct than the random skewed (1:6) pattern because the 1:4 pattern required the tining rake width to be further reduced.

As indicated in Table 7, random transverse tining (with no whine) also offers noise reductions over uniform transverse tining while reducing discrete tones. Exterior sound levels resulting from implementation of the random transverse patterns were 1 to 3 dBA lower than for the uniform, transversely tined PCC pavements. The study concluded that while random transverse tining can significantly reduce discrete frequencies, random transverse tining might still exhibit some discrete frequencies unless carefully designed and constructed. As a result, spectral analysis was used to design a random spaced rake that eliminated the discrete frequencies that can occur with other random transverse tining patterns (i.e., contractor-selected patterns). Two sections were built in Wisconsin using this rake, and objective sound level testing confirmed that no discrete frequencies were present.

Conversations with Mr. Jaeckel revealed that the project team conducted some measurements of heavy truck pass-bys early in the project, although these results were not documented as part of the study. These measurements were not conducted on the tined test sections but on existing asphalt and PCC tined sections. According to Mr. Jaeckel, analysis of the measurement data indicated that differences in the sound levels of heavy trucks traveling on different tining patterns were much smaller than for automobiles. Thus, noise differences that might occur with a single automobile pass-by might not occur under mixed traffic conditions, particularly if there is a high number of heavy trucks [Jaeckel 2002].

The study also noted that it is very important that the tining patterns be constructed as close to specification as possible to ensure a valid assessment for future sound levels and to ensure safety. All textures should be specified to the same tining depth. The tining depth for all pavements for the WisDOT/FHWA study was specified as 3 mm and all tining was preceded by a longitudinal turf drag. The WisDOT/FHWA study noted, however, that consistency of tining depth was a problem and that tining depths varied tremendously among the pavements constructed, even within a single test section. In many cases, the depths specified were not achieved. As a result, the study recommended, "Quality control of macrotexture needs to be improved so that a specified texture can be built to the depth required for safety. Curing and tining operations must be separate and continuous so each can be applied at the appropriate time by separate operators."

2.3.12 Montana

In order to develop recommendations regarding the potential implementation of quiet pavements in Montana, Mr. Jim Tompkins of MDT's Design Division was contacted to discuss the current practice in pavement selection and to assess whether certain pavements would or would not be desirable for use in Montana [Tompkins 2004].

Mr. Tompkins indicated that the majority of Montana's Interstates and highways are DGAC with a chip seal overlay. Small portions of the Interstate highways are PCC. The City of Great Falls is an advocate of PCC pavement.

Chip sealing involves spraying an asphalt binder on the pavement then immediately covering the surface with a layer of uniformly sized chips. The surface is then rolled to seat the chips and broomed to remove excess chips. Chip sealing can protect new pavements, prolong the

service life of structurally sound pavements, and provide additional macrotexture, although it can increase noise generation.

Montana had used OGAC in the 1983-84 to 1989 time frame; however, the friction course began to break up and separate after 10 to 12 years and had to be milled off and reapplied to avoid breakup problems. The first problems were encountered in 1994. As a result, there has been a moratorium on the use of OGAC since that time.

Mr. Tompkins also noted that MDT had tried a rubberized paving project in the northwestern part of the state on Bull Lake Road (Route 56) in Lincoln County. The rubber was actually used in the binder and not in the aggregate in this project. MDT discovered that the snow on the road did not pack down as badly as on their normal chip seal overlays and was easier to plow when packed.

Mr. Tompkins indicated that there is a move to use Superpave mixes on large paving projects but even in these instances a chip seal would be applied. The chip seal overlays are basically the same, using a grade for a chip and in many cases a CRS 2 polymer. He further indicated that if the chip seal is done properly, there is no problem with chips breaking off from the surface and damaging vehicles.

MDT has an extensive set of tools for pavement management. The focus on these tools is on deciding when and what type of maintenance action to take on the pavements and to help in the prioritization of those actions (rather than a selection of a particular pavement design). He indicated that MDT might be amenable to testing different pavement surfaces along the lines of the Caltrans projects, to study their noise properties, along with other important properties such as skid resistance, safety, and durability.

A conversation with Mr. Wayne Jones of the National Asphalt Institute indicated that there were many problems with OGAC 25 years ago when FHWA was strongly advocating its use [Jones 2004]. He noted that the problems were caused by not having enough voids. As a result, the pavements did not drain well enough and would freeze underneath in winter conditions causing popping of the pavement sections. This problem has largely been solved with the use of 17-18% voids that allows the friction course to drain well. He noted a service life of 12 years for the open-graded friction course, which is similar to Montana's experience. Mr. Jones remarked that recent developments in the use of open-graded friction course have led to courses that are as thin as a single height of the aggregate size diameter.

Mr. Jones also indicated that SMA (known as stone mastic in Europe) has been shown to be quieter than DGAC but not as quiet as OGAC. He noted that the SMA overlay is very hard and consists of a large aggregate size and a fine aggregate size that are part of a thick asphalt binder. He noted that SMA gives good cold weather performance compared to RAC, which he felt was not as good in cold climates. He described the Superpave pavement as a series of different mixes resulting where the aggregate, the binder and the combination of the two all meet very strict performance tests. There are a variety of different mixes that meet these tests. Superpave pavement resulted from extensive research in the Strategic Highway Research Program (SHRP) in the late 1980's and early 1990's.

Mr. Paul Jagoda of MDT Construction developed a proposed modification to MDT's Transverse Grooving of Concrete Specification in November 2000 [Jagoda 2000]. Mr. Jagoda states that a modification to the specification was desired due to the current industry standards for transverse tining versus transverse grooving. Discussions with Mr. Jagoda [Jagoda 2004]

indicated that the proposed texturing modification is currently going through the specification process which involves soliciting comments from numerous departments in MDT. Currently, MDT is using either uniform transverse or broomed texturing on their concrete sections depending on speed. The revised specification will require random transverse tining for higher speed interstates.

2.4 Pavement Summary

A considerable amount of research into quantifying the noise characteristics of alternative pavement surfaces has been completed to date. This research indicates that certain pavements are indeed quieter or louder than other pavements.

NCHRP Synthesis 268 by Dr. Roger Wayson analyzed numerous pavement studies completed prior to 1998. The results indicated that PCC pavements create more noise although they have the advantage of durability and superior surface friction when compared to dense-graded asphalt pavements. The study found that longitudinal tining reduced noise levels but surface friction was reduced when compared to transverse tining. Exposed aggregate surfaces also reduce noise levels but require added maintenance to minimize plugging and also deteriorate with freeze/thaw cycles and are less effective when deicing agents are used. DGAC pavements are 2 to 3 dBA quieter than PCC pavements but do not exhibit the strong frictional characteristics and durability of PCC pavements. OGAC pavements were shown to be 1 to 9 dBA quieter than DGAC pavements and have good frictional properties; however, the noise reductions declined with surface age. OGAC pavements also suffer from plugging, freeze/thaw impacts, and reduced effectiveness when deicing agents are used. The study also notes that measurements made using the "trailer" and "passby" methods do not correlate, making comparison of results using the two methods invalid.

Numerous additional research studies have been completed since NCHRP Synthesis 268. Studies by state and local agencies in Arizona, California, Colorado, Ohio, Michigan, New York, Texas, Utah, and Wisconsin have added to the knowledge base regarding the noise characteristics of pavement surfaces. The conclusions from many of these studies, particularly Wisconsin, Ohio, and Texas, seem to further reinforce the conclusions of NCHRP Synthesis 268 regarding PCC, DGAC and OGAC pavements.

Studies conducted in Arizona and California indicate that RAC pavements produce significantly lower sound levels than both PCC and DGAC pavements and that the reduction may not be degraded much over time. Results of the I-80 Davis study also indicate that OGAC can significantly reduce sound levels when compared to aged asphalt concrete as well as DGAC and that the reductions may not be degraded much over time.

Studies in California, Colorado, New York and Utah also indicate that sound levels of standard longitudinal or transverse tined PCC pavements may be reduced by using longitudinal, diamond-ground PCC pavements instead.

Little data has been collected for chip sealed pavements. Measurement data from Texas and South Africa and data from Australia indicates that chip sealed pavements create noise levels somewhat higher than for OGAC pavements and similar to those for tined concrete pavements. The selection of a pavement should not be made based solely on noise characteristics. Other issues must be considered including safety, maintenance and costs. These conditions may preclude the use of certain types of pavements regardless of their noise characteristics.

2.5 Pavement Recommendations

Since MDT using chip sealing extensively, the following actions are recommended:

- MDT should undertake a study to assess the noise characteristics of chip sealed pavements.

- MDT should investigate the possibility of constructing test strips of alternative pavements including OGAC, SMA and RAC, and then conducting studies of short-term and long-term sound levels along with other critical pavement parameters.

- The staff of the Environmental Services Bureau and the Pavement Analysis Design Section of MDT should meet to discuss the implications of using chip sealed pavements in areas where noise-sensitive land uses exist.

- The staff of MDT's Environmental Services Bureau should become actively involved in the review of the proposed modification to the transverse tining specification.

If MDT determines that alternative pavements are desirable in noise-sensitive areas, MDT's current tools for pavement management could be modified to include a factor for the existence of noise-sensitive land uses near the project.

3.0 SOUND INSULATION

Sound insulation of buildings is a method of receiver noise control designed to reduce interior sound levels. For certain land uses where there is little or no outdoor activity, this strategy can be very effective. For land uses where outdoor activity exists but where traditional noise mitigation measures are not feasible, building sound insulation may also be effective.

In order to reduce interior sound levels, the building must be altered to reduce the sound transmission through the structure. In some cases, the existing structure provides adequate noise reduction when the windows are closed but levels are unacceptable when the windows are open to provide ventilation. A common solution in these cases is to install central air conditioning to eliminate the need to open the windows. In other cases, windows and doors may need to be replaced to provide greater noise reduction. Other openings such as chimneys and exhaust vents may need to be redesigned.

The FHWA Noise Standards in 23 CFR 772 [FHWA 1997] limit routine sound insulation to public use or nonprofit institutional structures. Many state DOT policies permit sound insulation of public use or nonprofit institutional structures. In addition to Montana, these states include Alabama, Alaska, Delaware, Kentucky, Louisiana, Maryland, Mississippi, New Hampshire, North Dakota, Ohio, Pennsylvania, and Texas. Maine and New York allow only for the insulation of public school buildings.

The majority of federal-aid highway funds used for sound insulation has been spent to sound-insulate schools. In many parts of the country, highway agencies do not have the authority to insulate buildings; thus, in those states insulation cannot be included as part of a highway project [FHWA 2000]. For example, Illinois DOT, like many state DOTs, is prohibited by law from spending highway funds off the highway right-of-way [Rogers 2003]. This precludes using insulation or other materials of any kind, on any type of building off the right-of-way, even though it is allowed by FHWA. In one unique situation, Illinois DOT provided money to a public school along IL Route 59 in the Aurora-Naperville area to accomplish sound insulation activities. These activities were supervised by the school district as a result of and due to adamant objections to a DOT-proposed noise abatement wall adjacent to this school.

23 CFR 772 states:

> There may be situations where (1) severe traffic noise impacts exist or are expected, and (2) the abatement measures listed above are physically infeasible or economically unreasonable. In these instances, noise abatement measures other than those listed in paragraph 771.13c of this directive may be proposed for Type I and Type II projects by the highway agency and approved by the Regional Federal Highway Administrator on a case-by-case basis when the conditions of paragraph 772.13a of this directive have been met. [FHWA 1997].

FHWA further clarifies this section by stating that this paragraph allows the states the flexibility to propose innovative noise abatement measures when severe traffic noise impacts are anticipated and normal abatement measures are physically infeasible or economically unreasonable [FHWA 1995]. When considering extraordinary abatement measures, a state highway agency must demonstrate that the affected activities experience traffic noise impacts to a far greater degree than other similar activities adjacent to highway facilities. Examples would be

residential areas with absolute A-weighted sound levels of 75 dB L_{Aeq}(1h) or more and residential areas with sound level increases of 30 dB or more over existing sound levels. Examples of extraordinary abatement measures would be the sound insulation of private residences or the purchase of private dwellings from willing sellers. Very few private-use buildings have been sound-insulated with federal-aid highway funds. Arizona, California, Colorado and Michigan DOTs include specific provisions for sound insulation of residences and other private-use buildings (in addition to public use and nonprofit institutional structures) in their noise policies. The sections of their policies regarding insulation are provided below.

Arizona DOT

> ADOT's policy on noise insulation and air conditioning will comply with a recent USDOT FHA paper, *Highway Traffic Noise in the United States, Problems and Responses*, August 1994, which states that "Federal-aid highway funds may be used for noise insulation of public use or nonprofit institutional structures. Such funds may also be used for noise insulation of residences and other private-use buildings where noise impacts are especially severe, and where no other abatement is possible. An 'especially severe' noise impact will be defined as noted in the above examples: a sound level of 75 dB L_{Aeq}(1h) or more, or when the sound level increases by 30 dBA or more over existing levels. [ADOT 2001].

California DOT

> Noise insulation will not normally be provided in private residential dwellings, and may be provided only when severe traffic noise impacts are anticipated and normal abatement measures are physically not feasible or are economically unreasonable. [Caltrans 2001].

A detailed case study of a Caltrans sound insulation project is described later in this section of the report.

Colorado DOT

> The noise insulation of receiver structures is limited to public or non-profit institutions, unless extremely unique circumstances and severe sound levels are present. Under these conditions, building insulation will only be considered when it may be more cost effective than barrier construction. Usually, insulation will not be installed in combination with another form of noise mitigation. [CDOT 1995].

Michigan DOT

> For highway projects along new alignment, if there is a 30 dBA or greater sound level increase, or if the absolute sound level is 75 dBA or more, and no other abatement measures are feasible, air conditioning and insulation will be considered as a mitigation measure for residential land use. [Michigan DOT 1996].

Most of the remaining states and the District of Columbia do not specifically include or exclude sound insulation as a noise abatement measure in their policies although some have

insulated private facilities as described later in this section. Florida DOT specifically prohibits use of sound insulation as a noise abatement measure. Florida DOT's policy states that "sound proofing a building, while often appealing, is not to be considered due to constraints within Chapter 339 of the Florida Statutes." [Florida 2000]. If right-of-way taking is involved, insulation can be handled in the cost-to-cure settlement. Similarly, sound insulation is not included as an allowable noise abatement measure by Tennessee DOT.

It is noteworthy that on December 28, 2000, the FHWA issued an Advance Notice of Proposed Rulemaking, in 65 FR 82301, to seek comments on allowing the use of federal funds for sound insulation of private residences as an interior noise abatement measure [FHWA March 2002]. Members of Congress had suggested that the sound insulation of private residences be added to the listing of abatement measures that might be routinely considered whenever a traffic noise impact occurs. Such consideration would not require the occurrence of a severe traffic noise impact, but could require that all other measures be evaluated and be determined not to be reasonable and feasible before the noise insulation of private residences could be considered. As with all elements of highway traffic noise analysis and abatement, consideration for the sound insulation of private residences should be applied uniformly and consistently on a statewide basis. The FHWA sought comments on the following questions:

1. Should the FHWA revise its noise regulation to allow federal participation in the sound insulation of private residences whenever a traffic noise impact occurs, not only when a severe traffic noise impact occurs?

2. Should the FHWA revise its noise regulation to routinely allow federal participation in the sound insulation of private residences, i.e., add it to the listing of abatement measures which may be included in "Type I" and "Type II" projects, or should federal participation in the sound insulation of private residences be allowed only after all the other listed abatement measures have been determined not to be reasonable and feasible?

3. Should the FHWA revise its noise regulation to address the sound insulation of private residences in a manner that is different from that discussed in the first two questions? If so, how?

The agency received comments on the proposed revision from one member of Congress, two federal agencies, one metropolitan planning organization, one insulation contractor, and 15 state DOTs. The member of Congress supported making a regulatory change to allow private home insulation where "conventional exterior noise barriers are found to be impractical or excessively expensive." This would increase a state DOT's flexibility to participate in alternative noise abatement projects and would provide noise abatement in many instances where it would not be provided under existing FHWA regulations.

The Department of Housing and Urban Development (HUD) recommended a "total, multi-modal noise modeling package" be considered for noise effects and mitigation. The U.S. Environmental Protection Agency encouraged the provision of more flexibility in the use of sound insulation for private residences, i.e., sound insulation should be available for consideration in all situations. The metropolitan planning organization supported a regulatory revision to allow greater flexibility in using federal funds for the sound insulation of private homes. The insulation contractor strongly supported a revision to routinely provide sound insulation. One state DOT commented that the FHWA's noise regulations should be re-crafted to allow federal participation

in any reasonable and feasible noise abatement methodology, provided specific performance criteria have been satisfied.

The other fourteen state DOTs voiced opposition to the proposed regulatory change, indicating the change will result in the following:

- A substantial increase in the cost and complexity of the noise abatement program (one state DOT estimated its average annual noise mitigation cost would increase from $1.9 million to $30.6 million, approximately doubling the annual expenditure for all planning, analysis, design, and construction related to all environmental disciplines);

- A dramatic increase in the amount of time and effort invested to complete noise studies/final abatement designs, with the potential for causing significant and costly project delays;

- Inequities in the noise abatement program, since the costs associated with insulating private residences would vary greatly (this could increase the potential for discrimination complaints);

- Unnecessary additional burdens for states (since building insulation cannot be accurately modeled, its cost would have to be estimated on a house-by-house basis and its application would be far too difficult to manage in a reasonable and cost effective manner);

- No provision of benefits for the exterior areas of residences;

- Legal concerns related to maintenance of the home insulation and the consideration of future homeowner remodeling/changes;

- A tremendous administrative burden, since extensive, comprehensive contractual agreements would be required among all involved parties, e.g., State DOTs, consultants, contractors, local government officials, and homeowners, to minimize the possibility of litigation; and

- Unnecessary complications of a noise abatement program that has been easily understood and accepted by the public for an extended period of time.

The same fourteen state DOTs indicated that the current regulatory guidance is adequate and appropriate and that the sound insulation of private residences should remain, as noted by one, a "technique of last resort." The rulemaking proceeding was terminated on March 26, 2002 [FHWA March 2002].

The following sections discuss sound insulation experiences of several State DOTs.

3.1 California

3.1.1 SR15/40th Street Noise Abatement Demonstration Project

In 2001, Caltrans District 11 in San Diego initiated the SR15/40th Street Noise Abatement Demonstration Project. The project results are summarized in a paper prepared for the Transportation Research Board 2003 Annual Meeting [Khanis and Wolf 2002].

The project was developed to determine alternative noise abatement measures that could be provided for residences of the Mid-City community in San Diego, located along the top of canyon rims that overlook the State Route 15/40th Street freeway. Earlier Caltrans studies had concluded that noise barriers within the right-of-way were not feasible and that barriers could not be located outside the right-of-way due to steep terrain and poor soil conditions. As a result, a demonstration project was conducted that involved achieving the interior FHWA Noise Abatement Criterion of 52 dBA through installation of air-conditioning and replacement windows.

A total of 171 properties were identified as impacted and for which conventional noise abatement measures were not feasible. Of these, 37 residences were severely impacted with predicted future sound levels (L_{Aeq}(1h)) at or above 75 dBA. The current FHWA Noise Standards in 23 CFR 772 and the Caltrans' State Noise Policy and Protocol [Caltrans 1998] consider interior noise abatement options only in severe circumstances. The Department proposed that a demonstration project be developed whereby an interior noise abatement option was considered based on the unique terrain conditions. The concept of a demonstration project was discussed with FHWA. FHWA elected not to participate in the funding of this project.

The residences impacted by the project in the previous studies were identified as being eligible to participate in the demonstration project. The noise abatement project consisted of the following steps:

1. Exterior 24-hour measurements at each of the eligible residences to determine the worst-hour traffic sound level;

2. Sound insulation tests at each of the residences to determine the noise reduction provided by existing walls;

3. Determination of interior sound levels; and

4. Identification of sound insulation treatments for residences where the NAC of 52 dBA was exceeded. Treatments that were considered included:

    - Air-condition the living areas and sleeping quarters;
    - Install replacement windows or doors;
    - Caulk windows, window frames, and all architectural and mechanical exterior wall penetrations;
    - Insulate walls, roof and attic;
    - Weather-strip all exterior doors and interior operable window frames; and
    - Installation of sound insulation treatments.

The originally anticipated plan for installation of the sound insulation was to provide each homeowner with a written report containing the results of the traffic noise measurements, insulation tests, a detailed cost estimate, and a bid package of plans and specifications [Khanis and Wolf 2002]. This package would to be used to procure Contractor's bids and homeowners were referred to the local Better Business Bureau for qualified contractors. The homeowner

would receive two checks from Caltrans in order to complete the work. The first check would be issued to the homeowner for half of the total amount to initiate construction and the second check would be issued to the homeowner upon completion of the work. Conversations with Caltrans staff indicated that this process was subsequently modified as a result of the anticipated staff labor required to implement this system [Hendriks et al. 2003]. Caltrans decided to simply issue each homeowner a check for the estimated amount of the treatments as long as the homeowner agreed to have a rider added to their property deed stating that they received compensation from Caltrans to install the treatments. The homeowner would not be obligated to install the treatments and Caltrans would not need to monitor compliance. This decision greatly simplified the process for Caltrans.

There were also two areas in the project vicinity where sound walls were determined to be an effective and reasonable option. The first was a condominium complex with 17 severely impacted units facing the freeway. A contract was signed by the director of the Homeowners Association and the Department for the wall to be contracted privately by the Homeowners Association. A payment was made to an escrow account to be paid out based on a pre-assigned schedule and based upon actual invoices. The Department will review the work prior to the first few payments.

The other sound wall would abate traffic noise for three single-family residences that were proposed to receive a wall as part of the original highway project but whose homeowners decided that they did not want a wall. After the highway project was completed, the homeowners regretted their decision and when the option of a wall presented itself for a second time, they selected it. The payment for the wall was placed in an escrow account to be drawn by the contractor or the construction management firm of the homeowner's choice. All homeowners signed the contract and must agree with the selection of the contractor or construction oversight company.

The time frame specified in the noise wall contracts is 18 months from the date the funds are placed in escrow. The contract permits the Department to enter the properties within six months after the completion of the walls to measure effectiveness.

Prior to this effort, California had tried two experimental projects on sound insulation of private facilities [Hatano and Hendriks 1985]. The first, in San Francisco, involved three houses where ventilation was improved and windows were sealed. The second project involved ventilation and air conditioning work in one residence in Los Angeles.

3.1.2 School Noise Abatement Program

California allocates funds for the acoustical attenuation of classrooms along existing highways through the Caltrans "School Noise Abatement Program" [Caltrans 1999] mandated in California's Streets & Highway Code Section 216. This very extensive program, in existence for many years, requires Caltrans to abate freeway traffic noise within school classrooms under certain circumstances. The goal of the program is to ensure that classroom learning environments are free of excessive freeway traffic noise or freeway construction noise.

Classrooms, libraries, multipurpose rooms, and other spaces used for pupil personnel services at existing public or private elementary or secondary schools are eligible when interior sound levels, or projected sound levels produced from the freeway traffic or freeway construction exceed 52 dBA $L_{Aeq}(1h)$. The program does not include universities. Allowable abatement measures include, but are not limited to, installing acoustical material, replacing or eliminating

windows, installing air conditioning, or constructing sound baffling structures. Approximately eighty percent of the completed projects involved sealing windows and providing air conditioning. In a few cases, noise barriers were constructed where the project is located right next to the school.

The Caltrans School Noise Abatement Program has been substantially complete since the 1980s. Caltrans will continue to identify and abate eligible school classroom locations, with $1 million allocated to this program annually. Caltrans staff report that most of the schools are satisfied with the abatement [Hendriks et al. 2003].

3.2 Colorado

Colorado reports that one non-profit building proposal is pending for an HVAC system so the occupants can close their windows [Mero 2003].

3.3 Georgia

Georgia DOT provided insulation for five dormitories at Georgia Tech that were impacted by I-75/I-85 in Atlanta a number of years ago [Hood, Greg 2003]. A 25-foot barrier had been proposed although many of the receptors on the upper stories of the buildings would still not benefit. As an alternative, air conditioning was added to the buildings and some reglazing of windows was accomplished rather than installing the barrier. The treatment achieved a 25 dB interior noise reduction. Georgia DOT has not been involved in any sound insulation projects since then.

3.4 Iowa

Iowa DOT reports that insulation of a single private residence was accomplished because the alignment of the road was changed after the home construction began, so the Department assumed some special liability [Ridnour 2003]. Mr. Ridnour of Iowa DOT indicated that this approach is not considered a practical solution for general traffic noise concerns.

3.5 Michigan

The I-676 construction project in Michigan included the insulation of numerous private residences. Prior to 1988, approximately 60 residences had been insulated and approximately 70 more were scheduled to be treated at that time. The cost per residence at that time was estimated to be $3,500 to $4,500 per residence. The treatments included air conditioning and some attic insulation [Herman, Lloyd and William Bowlby. 1993. *Noise Mitigation Strategies: Final Technical Report. Report WA-RD 327.2*]. Follow-up information on this program was requested from MDOT but not received.

3.6 New York

NYSDOT has insulated a school. Its policy limits insulation to public schools only [McColl 2003].

3.7 Ohio

ODOT has used the building sound insulation option for a couple of public schools and a synagogue [Pinckney April 8, 2003].

3.8 Oregon

Oregon DOT completed seven insulation projects a number of years ago [Herman and Bowlby 1993]. Six of these projects involved schools and one involved a church. Three of the school projects involved only ventilation improvements and three involved ventilation work plus storm windows. The addition of storm windows resulted in one school wanting the State to finance the maintenance and operating costs due to any air-handling insulation measures. The State investigated storm windows, finding that they only added approximately 10 percent to the total cost and resulted in a reduction in the school's operating costs. Cost for the school insulation projects ranged from $22,000 to $85,000. Modifications were only done on the impacted rooms of the schools. For the church, the State provided a ventilation system to which the church could add an air conditioning system at its own cost at some future time.

Oregon DOT has not done any insulation projects recently [Goodwin 2003].

3.9 Virginia

Virginia Department of Transportation (VDOT) has insulated a number of public schools and libraries by providing air conditioning and has also insulated some private facilities including churches and private schools. When air-conditioning was installed, only the impacted areas of the buildings were treated. Window units were used most of the time. In one case, a church installed central air conditioning throughout the facility but VDOT only paid for the installation cost for the impacted areas [Herman and Bowlby 1993].

3.10 Wisconsin

WisDOT has used sound insulation "on a school or two" [Waldschmidt 2003]. WisDOT would not insulate residential homes for highway noise impacts, but has participated in a sound insulation program for the General Mitchell Field Airport.

3.11 Sound Insulation Summary

The FHWA Noise Standards limits routine sound insulation to public use or nonprofit institutional structures except when severe traffic noise impacts are anticipated and normal abatement measures are physically infeasible or economically unreasonable. A few states' noise policies specifically state that insulation of private residences is permitted when severe traffic noise impacts are anticipated.

Several states reported insulating public and/or nonprofit buildings including schools and churches. Few cases of insulating private residences were noted and only two large-scale projects have been reported, one in Michigan along I-676 and one in San Diego, California, where Caltrans is in the process of insulating numerous homes. FHWA opted not to participate in the funding of the San Diego project, and Caltrans does not anticipate using sound insulation on a large-scale basis again in the future [Hendriks et al 2003].

3.12 Sound Insulation Recommendations

Sound insulation of private residences could be cost effective and worthwhile for those instances where a very few individual residences in a rural area may be severely impacted by a widening project or for projects involving construction of a highway on a new alignment.

- Since FHWA will participate in funding for sound insulation of private residences where severe traffic noise impacts exist and traditional abatement measures and not feasible or reasonable, MDT may wish to consider a modification to its noise policy to allow consideration of sound insulation in these instances. Noise policies of the state DOTs in Arizona, California, Colorado and Michigan could be used as guides.

If MDT chooses to allow sound insulation of private residences, a reasonable definition of "severe traffic noise impacts" could be "when the predicted design year one-hour L_{eq} exceeds 75 dBA for Activity Category B land uses (including exterior residential activities) and there will be a 30 or more dBA increase in the one-hour Leq." As noted in 23 CFR 772, special measures must be approved by FHWA on a case-by-case basis. The MDT policy could be revised to include the following statement: "If severe impacts will occur and other measures are determined to be not feasible or reasonable, MDT may consider sound insulation of private residences and relocation of isolated residences as potential abatement measures."

4.0 TRAFFIC MANAGEMENT TECHNIQUES

Traffic management measures can sometimes reduce noise problems. For example, if acceptable alternative truck routes are available, trucks could be prohibited from certain streets and roads, or they could be permitted to use certain streets and roads only during daylight hours. Traffic signals could be changed to smooth the flow of traffic and to eliminate the need for frequent stops and starts. Speed limits could be reduced, although very large reductions in speed are needed to accomplish a modest decrease in sound levels.. Modeling shows that a 32 kilometer per hour (20 mile per hour) reduction is needed for a noticeable (5 dB) decrease in the $L_{Aeq}(1h)$ [FHWA 2000].

In its June 1989 guidance on "unusual" noise abatement measures, FHWA noted the following regarding truck restrictions:

> FHWA does not generally allow restrictions of truck trailer combinations on those facilities on the National Network for large trucks. Facilities on the National Network were designated by FHWA in response to the 1982 Surface Transportation Assistance Act [STAA], as amended, and include interstates and some other federal-aid primaries. An exception to this position is possible only if environmental considerations necessitate truck restrictions as part of a particular federal-aid highway project or if the state can justify removal of the facility from the National Network based on safety considerations. [FHWA 1989].

The National Network is listed in 23 CFR Part 658 ("Truck Size and Weight, Route Designations - Length, Width and Weight Limitations"), Appendix A. Reference is made to "STAA-dimensioned commercial vehicles," which are the larger trucks that were authorized by the 1982 STAA to operate on these facilities. For Montana, these larger trucks may legally operate on all Federal-aid Primary highways, including the Interstate highways. No additional routes have been federally designated for the National Network in Montana.

While residents may request truck bans to address noise issues, commerce and trade that involve interstate trucking have state and federal legal protection. Therefore, restriction of interstate commerce is difficult and generally requires substantial supporting evidence such as accident data and a reasonable alternate route.

Vehicle operating requirements on Montana's roads are addressed in Title 61, Chapter 8, Part 3 of the Montana Annotated Code 2003. Section 61-8-303 deals with speed limits and speed restrictions. Section 61-8-309 deals with establishment of special speed limit zones in cases of safety issues, and Section 61-8-310 lays out when local authorities may and shall alter limits, again mainly for safety reasons. Finally, Section 61-8-332 provides for restrictions on use of controlled-access roadways, but again with reference to normal and safe operation of traffic. None of these sections make reference to traffic management for the reason of reduced noise.

Only a handful of states reported prohibiting trucks for noise purposes although many states prohibit trucks for purposes such as safety. Cases involving truck restrictions to reduce noise are described below.

4.1 Florida

The Florida DOT case involved two parallel spurs (I-375 and I-175) off of I-75 in Petersburg. Since the routes were parallel, there was no need for both spurs to carry trucks. As a result, the south spur (I-175) was designated a truck route and trucks were prohibited on the north spur. The truck prohibition allowed the noise barriers on I-375 to be reduced in height to 6 feet at an approximate savings of $50,000. Local police enforce the ban and good motor carrier compliance was reported [Herman and Bowlby 1993]. Florida DOT has not used traffic management strategies like the ones on I-375 in a while, but these measures are encouraged, since the cost of walls keeps going up (currently almost $25.00/sq ft) [Berrios 2003].

4.2 Illinois

Illinois DOT considers traffic management strategies as a form of mitigation in the development of "Phase I" studies, but most of these strategies run counter to what they are trying to accomplish [Rogers 2003]. Most of the roadways over which Illinois has jurisdiction (including several interstates that converge in Chicago) are higher-speed, high-volume routes or Strategic Regional Arterials that accommodate a very high percentage of trucks. Lowering speed limits are not an option, and most of the time, vertical or horizontal roadway profile shifts are either not possible, or make the noise problem worse. Mr. Mitchell Rogers of Illinois DOT reported that the only traffic management strategies implemented in Illinois to control noise of which he was aware involved local jurisdictions. One example was where the City of Chicago banned heavy truck traffic on Lake Shore Drive (US 41), a major route through downtown Chicago adjacent to Lake Michigan.

4.3 Maryland

A project to relocate MD-702 in Baltimore County involved the prohibition of trucks and resulted in much lower height noise barriers than would have been required without the prohibition [Herman and Bowlby 1993]. Parallel routes are available, and the prohibition continues to be successful [Polcak May 14, 2003].

4.4 Massachusetts

The Massachusetts Highway Department in conjunction with the City of Cambridge Metropolitan Planning Council completed a regional truck study for the Cambridge Metropolitan area in 2001, resulting in a series of final recommendations [City of Cambridge 2001]. Most of the information provided below was obtained from a summary of the study provided on the City's web site

The study was completed after the City enacted a zoning ordinance that banned through trucks from Cambridge during the hours of 11 p.m. to 7 a.m. to reduce noise in residential areas. The ordinance was met with strong opposition from surrounding communities and trucking organizations. The Massachusetts Attorney General intervened to prevent litigation and asked for all parties to work together to solve the problem. In doing so, all parties signed a memorandum of understanding that prevented them from suing and prevented Cambridge from enforcing the ordinance until the study was concluded [Berger 2003]. An agreement was reached whereby in lieu of litigation, a regional truck study would be conducted.

The study involved the development of detailed maps showing the regional truck study network, the proposed daytime and nighttime trucking networks, truck restrictions, and approved truck routes for construction activity. Maps and recommendations are available on the City of Cambridge web site. The Committee on Regional Truck Issues published its final recommendations on June 27, 2001. Detailed recommendations were included regarding truck routes, truck exclusions, nighttime restrictions, hazardous cargo routes, infrastructure needs, noise, enforcement, outreach to the trucking community, and ongoing agency and community efforts. The recommendations, however, were reached without a consensus (no other community agreed to sign truck routes through their "backyards" to help Cambridge). The result has led to pending lawsuits [Berger 2003].

The trucking industry agreed to promote a voluntary limit on the unnecessary use of engine-compression or "jake" brakes in densely populated areas, especially at night.

4.5 Minnesota

One Minnesota project, along I-35E in St. Paul and Maplewood, is unique in its combination of a truck ban, a speed limit reduction to 45 mph, use of bituminous (asphalt concrete) surface, and use of relatively low earth berms with barriers atop them [Herman and Bowlby 1993].

4.6 New Hampshire

On January 9, 2003, the New Hampshire House of Representatives introduced House Bill (HB) 0272 to mandate the conduct of the Portsmouth Large Truck Restriction Pilot Study. HB 0272 was subsequently tabled [Hood, Charles 2003], but is an interesting example. The information provided below was included in HB 0272 [New Hampshire 2003].

The study would have prohibited travel by tractor-trailer trucks on Ocean Road and Peverly Hill Road in Portsmouth. The pilot study would have been designed and implemented by the New Hampshire DOT and would have involved data collection and analysis data to determine the differences in traffic volume, total number of trucks, and sound levels as a result of restricting large trucks from these roads. The bill stated that the pilot study was to be conducted from 10 p.m. to 6 a.m. from March 1, 2004, through June 1, 2004, unless otherwise directed by the Legislature.

This bill would have increased state highway fund expenditures by $164,600 in fiscal year (FY) 2004 and $3,600 in FY 2005. The proposed expenditures in FY 2004 represented the purchase and installation of three permanent traffic recorders at $50,000 each, signs, travel, and personnel costs for traffic data collection. The expenditures in FY 2005 represented personnel costs to analyze data and to prepare and present the required report to the Legislature.

The Department would have been required to collect data for three months prior to March 1, 2004, to monitor existing conditions, and from March 1 through June 1, 2004, to monitor restricted conditions as required in the bill.

4.7 New Jersey

In July 1999 Governor Christine Todd Whitman issued an emergency order to ban large tractor-trailers from state routes and highways. The order was followed by permanent regulations

in September 1999. The regulations were followed by legislation on January 13, 2000 that created a commission to study and make recommendations concerning enforcement of the laws relating to trucks [New Jersey 2000]. The fines subsequently enacted were $400 for first offense, $700 for a second offense and $1,000 for every violation afterward.

The ban confines 102-inch wide trucks and tandem trailers that do not do business in New Jersey to interstate highways and the National Network. New Jersey had received confirmation from USDOT that the state has the authority to regulate commercial motor vehicle traffic on routes that are not part of the National Network [USDOT 1999].

The ban followed years of complaints from residents and local officials that out-of-state truckers using local roads as shortcuts were a safety hazard and a noisy nuisance. Several accidents on country roads involving collisions with trucks stoked the public's anger. Big-rig traffic is particularly heavy in New Jersey due to its status as a corridor between large East Coast cities. Each day about 135,000 large semis pass through New Jersey. In recent years, many truckers started taking shortcuts between major highways and veering off the New Jersey Turnpike to avoid tolls. The ban has already reduced truck traffic by as much as 30 percent on some roads [New Rules Project 2000].

Lawsuits were subsequently filed by the American Trucking Association and U.S. Xpress citing the interstate commerce clause of the U.S. Constitution. Truckers also claimed that the ban cost them $20 million a year in tolls and fuel to comply with the ban. Arguments were held in September 2003 in U.S. District Court. On March 24, 2004, U.S. District Court Judge Stanley R. Chester agreed with the plaintiffs and declared the ban unconstitutional. Governor James McGreevey promised an immediate appeal saying that the law saved lives [Newsday 2004].

4.8 Virginia

Interstate 66 in Fairfax County, Virginia outside of Washington, D.C. is a unique example of traffic management to reduce sound levels. During rush hour, only car pools or other high occupancy vehicles are allowed on the roadway. Other routes are available to access communities along the corridor and to enter Washington, D.C.

The project was controversial and as a result, the U.S. Secretary of Transportation mandated that noise abatement be provided along the project. Enforcement of the truck prohibition is handled by normal police patrol and the abatement strategies have been successful in reducing community sound levels [Herman and Bowlby 1993].

Virginia is also one of the few states with jurisdiction over secondary road systems, including residential streets. In response to public requests for measures to reduce speeding in residential communities, VDOT developed guidelines for approving traffic calming measures on local streets. The *Residential Traffic Calming Guide* contains guidance on implementing through truck restrictions, cut-through traffic measures and traffic calming measures [VDOT 1997]. The aim of the through truck restriction is to restrict through trucks from the excessive use of a residential street. This restriction will reduce the adverse impacts of large trucks. Local governments may request the Commonwealth Transportation Board to restrict trucks on a secondary highway classified as a local or collector road [Fairfax County 1998]. One adverse impact that would be reduced would be noise.

4.9 Traffic Management Summary

Traffic management measures can sometimes reduce noise problems, although FHWA generally does not allow restrictions of truck trailer combinations on those facilities on the National Network for large trucks, except under very special circumstances. In Montana, the National Network consists of all Federal-aid Primary highways, including the Interstate highways.

Florida, Maryland and Virginia have implemented truck restrictions on projects to reduce noise but only because parallel routes were available.

A truck restriction study conducted by the Massachusetts Highway Department in conjunction with the City of Cambridge Metropolitan Planning Council could be serve as a model for similar truck studies in other jurisdictions.

Large trucks have been banned from using local roads in New Jersey since 1999 as the result of complaints from the public regarding safety and noise. The U.S. District Court recently rules the ban unconstitutional and the state is in the process of appealing the ruling.

Vehicle operating requirements on Montana's roads are addressed in Title 61, Chapter 8, Part 3 of the Montana Annotated Code 2003. Section 61-8-303 deals with speed limits and speed restrictions. Section 61-8-309 deals with establishment of special speed limit zones in cases of safety issues, and Section 61-8-310 lays out when local authorities may and shall alter limits, again mainly for safety reasons. Finally, Section 61-8-332 provides for restrictions on use of controlled-access roadways, but again with reference to normal and safe operation of traffic. None of these sections make reference to traffic management for the reason of reduced noise.

Any reductions in speed for safety reasons, such as from 65 to 60 miles per hour in larger cities, would only have a small noise reduction benefit. Restrictions of trucks would result in larger noise reduction benefits, however.

4.10 Traffic Management Recommendations

As noted above, traffic management strategies are often counter to the goal of a highway project. Reducing speeds and restricting trucks are, in most cases, not desirable on the Interstate system. Further, truck restrictions would only be acceptable if alternative routes are available. Due to the rural and mountainous nature of much of Montana, acceptable alternative routes would likely not exist. Therefore, active consideration of traffic management techniques to reduce noise on the Interstate system is not recommended. Restriction on non-Interstate and non-Federal-aid Primary highways, however, is certainly a possibility.

- In cases where local jurisdictions are interested in implementing other truck restrictions or other traffic management techniques on local roads to reduce noise, MDT should provide guidance as needed to ensure that the goal of reducing noise is not achieved at the expense of safety or access for commerce.

- MDT should keep track of the appeal of the state of New Jersey for a continuance of its ban on large trucks from local roads. If New Jersey is successful in its appeal, Montana could follow with similar policies in situations where alternative routes to the local roadway system exist.

One type of traffic management technique that has received considerable interest, and until recently was allowed and used in Montana, is the restriction of use of jake brakes along certain portions of Montana's roads. As is pointed out many times in the Montana residents survey discussed in Section 8.0 of this report, noise from jake brakes is a source of much annoyance for many people. Several survey respondents specifically complained about the lack of enforcement of existing signage restricting engine brake use. Over half of the total survey respondents have indicated that restriction in the use of engine compression brakes is an acceptable method of noise control.

Unknown to the researchers at the time of the survey, the 2003 Montana Legislature passed HB No. 237, which prohibited such restrictions. The bill stated that as long as a vehicle has a factory-installed or equivalent after-market muffler, the operator may not be prohibited from using the engine compression brake device.

- It is recommended that MDT revisit this prohibition with the Legislature. Key sections of this report and the relevant survey results should be sent to legislators, both to those who introduced and supported the bill and to those who might support a change or rescission. One possible revision to the law might be to state conditions under which engine compression brake use could be restricted, such as when the route is within a certain distance of residential or other noise sensitive property.

- As preparation for addressing the prohibition with legislators, MDT should conduct a study to determine the locations of recent past engine compression brake restrictions in the state. MDT should then discuss with appropriate city and county officials the perceived effectiveness of past restrictions and should identify any residents' complaints since the legislation. The need for increased enforcement, if the prohibition were to be lifted, should be addressed with local officials.

- Because truck safety issues are involved, MDT should thoroughly study the topic of engine compression brakes, and their usage and restrictions elsewhere in the country. MDT should also examine if policies and guidelines have existed for selecting engine compression brake restriction zones in Montana and elsewhere.

- Since some portion of the truck population is functioning without mufflers or with defective mufflers, MDT should investigate the possibility of incorporating an inspection of the muffler system of heavy trucks as part of the roadside safety inspections conducted by the Motor Vehicle Inspection Bureau. The American Association of Motor Vehicle Administrators (AAMVA) has published a simple procedure that can be used to determine whether or not a muffler is installed in the exhaust system of a heavy truck and, if so, whether or not the muffler is intact and functional [American Association of Motor Vehicle Administrators, 2004].

5.0 TYPE II TRAFFIC NOISE ABATEMENT PROGRAMS

MDT has expressed interest in the concept of a Type II, or "retrofit" noise program. Type II noise programs involve proposed federal, federal-aid, or state projects to provide noise abatement in the form of noise barriers along existing highways, with no other capacity-increasing highway improvement as part of the project. The development and implementation of a Type II program is optional and not an FHWA mandatory requirement.

5.1 Type II Program Information

When FHWA first addressed Type II projects in its noise regulations, it indicated that Type II projects would not normally be approved for those activities that came into existence after May 14, 1976 (the date of the revision to the original regulations). The reason for that cut-off was that FHWA publicly stated at the time that local governments must help control highway traffic noise impacts through noise-compatible land use planning and zoning. The intent of this provision was to establish a date to determine federal-aid eligibility for Type II projects and then consistently apply this date to all Type II abatement locations [FHWA 1995].

At the time, FHWA stated that noise abatement measures could be approved for activities and land uses that came into existence after May 14, 1976, if local authorities had taken measures to exercise land use control over the remaining undeveloped lands adjacent to highways in the local jurisdiction to prevent further development of incompatible activities. These measures could include any of the noise abatement measures contained in the FHWA publication *The Audible Landscape* [FHWA 1972].

The National Highway System Designation Act of 1995 changed the rules for federal participation in Type II noise barriers, leading to a revision in the FHWA noise regulations in 23 CFR 772. The regulations now state that Type II noise abatement measures "will only be approved for projects that were approved before November 28, 1995, or are proposed along lands where land development or substantial construction predated the existence of any highway. The granting of a building permit, filing of a plat plan, or a similar action must have occurred prior to right-of-way acquisition or construction approval for the original highway." [United States Code, 1995].

Also ineligible for federal funds are areas that were studied previously for abatement as part of a Type I project (new roadway alignment or widenings with addition of through-traffic lanes) and were rejected for that abatement as being infeasible or unreasonable. Retrofit abatement projects that do not meet these criteria would have to be funded by the state or local jurisdictions.

Nineteen state DOTs currently have Type II noise programs, although all are not necessarily active and funded at this time:

- California
- Colorado
- Connecticut
- Illinois
- Iowa
- Maryland
- Michigan
- Minnesota
- Missouri

- New Jersey
- New Mexico
- New York
- Ohio
- Oregon
- Pennsylvania
- Rhode Island
- Utah
- Washington
- Wisconsin

States that have constructed the most square footage of Type II barriers over the years include California, Minnesota, Maryland, New Jersey and Ohio.

FHWA has not specified any one method of analysis for Type II projects. Instead, states are encouraged to use good judgment in the consideration of all relevant factors and they have great flexibility in developing a Type II program.

Type II programs differ from state to state in essentially two ways. First, the process of identifying areas eligible for Type II noise abatement may be different depending on the state. Some states use a formal process to prioritize areas across the state or in a particular region for abatement. FHWA strongly encourages the use of such systems [FHWA 1995]. Other states use a more informal process whereby a local government can request that the state consider providing abatement for an area in the community. Second, the funding mechanisms differ from state to state. For example, some states require local matching funds for barrier construction. Table 8 summarizes the Type II programs in sixteen of the states (information on California, New Jersey and Washington programs was not included in their noise policies).

5.2 Type II Program Recommendations

It is recommended that MDT further investigate the possibility of implementing a Type II noise abatement program. Federal funding is available for retrofit noise abatement as long as the residences predated the initial construction of the highway and where there was no previous Type I noise analysis completed where a barrier was found to be infeasible or unreasonable. Due to the rural nature of much of Montana, the number of areas that would qualify for retrofit noise abatement would likely be small. MDT could conduct a Type II needs assessment to identify the areas that would be eligible for abatement and the potential costs associated with implementing a Type II program.

Table 8: Summary of Type II Programs

*State**	*Process for Identification of Eligible Areas*	*Local Financing Requirement*	*Conditions on Local Governments*
Colorado	The statewide Type II Noise Barrier Location list is revised periodically in accordance with the CDOT Procedural Directive on Noise Abatement.	None	Must either routinely coordinate new subdivision proposals with CDOT or have local land use restrictions in place to control incompatible land use next to road corridors.
Connecticut	A project priority ranking is utilized to rank barrier locations relative to each other. Locations with combinations of high noise levels, dense population, and lower abatement cost would rank higher than those areas with moderate noise levels, sparse population density, and high abatement cost.	None	None
Illinois	Proposed retrofit projects must have a state or local government sponsor. Local government conducts a noise study in accordance with the state's requirements to document an abatable noise problem including documentation of the date on which the land uses abutting the proposed barrier project came into existence.	50/50 cost sharing program	Must provide a land use ordinance that guarantees any future development adjacent to state highways will be noise-compatible to avoid need for state-funded noise barriers in the future.
Iowa	Type II projects are initiated by a petition to the Department by the affected residents or city officials. If traffic noise abatement is warranted, the Office of Project Planning presents to staff the results of the noise analysis and a recommended traffic noise abatement plan based on this analysis.	None	None

*State**	*Process for Identification of Eligible Areas*	*Local Financing Requirement*	*Conditions on Local Governments*
Maryland	Programming of Type II barriers that are reasonable and feasible is based upon the availability of funds in the Consolidated Transportation Program.	Local jurisdiction funds 20% of the project cost.	Sound barriers will be approved only in counties that have enacted local controls, consistent with state requirements, to address noise impacts for future noise sensitive development adjacent to state highways.
Michigan	Sites are selected from the Michigan Inventory of Noise Sensitive Sites.	Local jurisdiction(s) may be asked to share cost if costs per residence become unreasonable.	Must provide documentation of intentions to control future land development that reasonably precludes the necessity for MDOT to provide noise barriers for future developments.
Minnesota	The receptors shall have been ranked and included on MnDOT's retrofit barrier priority list (dated 2/1/97) compiled for the State Legislature. If a location is not on the priority list, MnDOT will decide whether or not to evaluate and rank the noise barrier project.	None	Documentation of its land use controls which apply to land adjacent to federal-aid highway and would reasonably eliminate the need for state-funded noise barriers for future developments.
Missouri	The Type II noise abatement project must be eligible for federal funds and must be requested by a local government entity. The majority of the affected residents (primary and benefited receptors) must concur that a noise wall is desired.	Must provide 75% of cost. If cost exceeds $30,000 per benefited receptor, local government will pay 100% of cost exceeding the $30,000 per receptor.	None
New Mexico	Not stated	None	The use of State Funds for Type II projects for analysis and abatement of noise levels will be considered only if an active local land use control program was adopted prior to the existence of the new activities and land uses.
New York	The development and implementation of Type II projects requires separate additional funding by the Legislature.	None	None

*State**	*Process for Identification of Eligible Areas*	*Local Financing Requirement*	*Conditions on Local Governments*
Ohio	HB 201 effective July 1, 1991, prompted the prioritization of noise sensitive areas around the state. A Noise Abatement Priority Index is used to achieve a fair and equitable prioritization process.	None	None
Oregon	After a noise complaint is received, a study area is defined and agreed upon by Region. A noise study is completed and the amount to be contributed by the local residents and, if warranted, local government is defined.	Substantial percentage (at least 25%) of mitigation cost is paid by benefiting property owners, 25% paid by local government when warranted, and remainder paid with either federal or state funds.	None
Pennsylvania	The Department will consider retrofit noise abatement projects only after such projects have been programmed, budgeted, and approved by the Program Management Committee. Requests for Type II projects shall be directed through the local planning organization.	None	None
Rhode Island	The local community identifies the locations they believe are impacted by an existing roadway, and bears the entire cost of any studies necessary to establish the existence of mitigatible noise impacts in accordance with Road Island's DOT Noise Abatement Policy.	Must participate in design and construction costs of proposed measures by assuming the required state matching share, which varies from 10% to 20% of total cost.	Must have in effect an ordinance requiring developers to include noise abatement in their plans for residential and other noise sensitive developments adjacent to existing highways or approved highway corridors.
Utah	As requests are received by the Department from local government agencies, noise studies are conducted and qualifying projects are prioritized. A "Priority Index" used to prioritize these projects, is based upon noise level and waiting time on the prioritized list.	None	Must have taken measures to exercise land use control over the remaining undeveloped lands adjacent to State highways in the local jurisdiction to prevent further development of incompatible activities.

*State**	*Process for Identification of Eligible Areas*	*Local Financing Requirement*	*Conditions on Local Governments*
Wisconsin	The department, upon receiving a community request for a noise barrier project, shall evaluate and program eligible retrofit noise barrier projects in the highway programming process.	None	Documentation of its land use controls that apply to land adjacent to federal-aid highway and would reasonably eliminate the need for state-funded noise barriers in highway rights-of-way adjacent to future developments.

* Information on California, New Jersey and Washington programs not included in noise policies.

6.0 NOISE-COMPATIBLE LAND USE PLANNING AND DEVELOPMENT

Noise and land use compatibility focuses on noise control at receivers adjacent to the traffic noise source. Two general categories of receiver control are (1) land use zoning and (2) noise-mitigated development. The purpose of land use zoning is to zone undeveloped land adjacent to traffic noise sources for uses that are compatible with the noise environment. The purpose of noise-mitigated development is to allow typically incompatible land uses to be constructed adjacent to traffic noise sources as long as any anticipated noise impacts are mitigated as part of the development.

Programs to ensure noise and land use compatibility are generally implemented at the local level because local governments possess great power to control land use and to require developers to mitigate sound levels to certain standards. Additionally, the federal government advocates that local governments use their power to regulate land development in such a way that noise-sensitive land uses are either prohibited from being located adjacent to a highway, or that the developments are planned, designed, and constructed in such a way that noise impacts are minimized [FHWA 2000].

These strategies are proactive in their approach and it would be desirable to include both strategies in the development of a successful land use compatibility program although the emphasis on the two different strategies should depend on the stage of community development.

Communities in early stages of development could benefit greatly through the land use zoning process since rezoning land adjacent to traffic noise sources might be possible, while still maintaining compatibility between the land uses themselves. On the other hand, communities that are more heavily developed would not benefit as much from a land use zoning strategy since land use patterns are already well established and rezoning undeveloped tracts might result in incompatibility between adjacent land uses. For example, it would be undesirable to rezone land adjacent to a highway from residential (typically incompatible) to industrial (typically compatible) if the adjacent tracts were already developed as residential.

As a result, communities that are more heavily developed would benefit more from a program requiring noise-mitigated development so that established land use patterns are not affected but noise impacts are prevented through implementation of mitigation measures for incompatible land uses.

This research has identified several communities that have implemented either one or both types of programs. It should be noted that the most common form of local noise control involves enforcement of local noise ordinances found in most communities. This approach tends to be reactive in nature and typical complaints involve loud music, barking dogs, lawn mowers and stationary sources such as air conditioners, chillers, exhaust fans, and industrial sources. Local police or city staff typically enforce the ordinances. Transportation noise sources including commercial water-borne traffic, transportation vehicles, air transportation and rail transportation are typically exempt from local noise ordinances.

The FHWA has published two documents to provide local officials, planners, developers and the public with information about noise and land development. *The Audible Landscape* was originally published by FHWA in 1972 (and republished in 1995), and contains guidance on how to prevent further development of incompatible activities [FHWA 1972]. More recently, FHWA

published *Entering the Quiet Zone*. This brochure "summarizes the general nature of the problem, provides examples of noise-compatible land use strategies either constructed or planned, and encourages a proactive posture by local decision makers, developers and citizens to share in and actively influence land use next to highways." [FHWA May 2002].

The following sections discuss the concepts of land use zoning and noise-mitigated development. Several case studies are then presented.

6.1 Land Use Zoning

The goal of land use zoning is to create a pattern of development in which transportation noise sources and adjacent receivers are compatible. The strategy involves first determining the compatibility of various land uses with transportation noise and then defining and zoning those areas adjacent to transportation sources for compatible types of development.

In some cases, this process is accomplished by developing sound level contours for a community. The contours are based on either noise measurements or predictions at various distances from transportation noise sources. These contour lines can become policy lines because certain land uses may automatically be restricted from certain areas due to the noise environment.

Examples of compatible land uses include industrial, commercial and manufacturing. These land uses are compatible with traffic noise because of the noise environment created by the land use itself and the types of activities that occur on site. As a result, these types of developments can generally be located adjacent to transportation sources without creating noise impacts.

The land use zoning strategy is preventative in nature and is designed to eliminate costly solutions for conflicts due to incompatibility between transportation noise sources and adjacent receivers. The responsibility for carrying out and enforcing this strategy rests with the local planning department. In effect, land use zoning for noise compatibility simply incorporates another factor into the planning process, that of noise planning. This strategy is not only designed to minimize total costs of noise mitigation, but is relatively inexpensive to administer. The incremental cost of considering noise in the planning process is generally considered to be small [Herman and Bowlby 1993].

A 1989 General Accounting Office (GAO) report on transportation noise stated that FHWA officials at that time held the opinion that state and local government efforts to control land use along highways have generally not been successful [GAO 1989]. While this assessment may be true in the general sense, some of the agencies studied for this literature review have been successful in their efforts to produce land use compatibility with transportation noise.

NCHRP Report 173, *Highway Noise: Generation and Control*, described a number of land use strategies to reduce noise impacts [Bolt Beranek & Newman 1976]. The study concluded that restricting the use of land bordering the right-of-way of transportation noise sources to unoccupied structures (such as warehouses) appeared to be the most attractive alternative. Further, this attractiveness is especially true for communities in the earlier stages of development. In contrast, fully developed communities would require unacceptable levels of economic investment to acquire land and impose restrictions based on the noise environment.

While the concept of land use zoning is straightforward and would seem easy to apply, particularly in the case of communities in early stages of development, it does have limitations.

A number of planning organizations suggested that this strategy could lead to "strip" development. These communities tend to have a high level of demand for residential development along with many miles of freeways within their communities. To zone the land areas along these highways as commercial or industrial would not only produce strip development but would result in an imbalance in demand and land availability. Usually there simply is not enough commercial and industrial type land use to occupy all the land near transportation sources. Further, in the overall scheme of community planning, clustering of industrial or commercial land uses is being seen as more desirable than strip development. These communities prefer to use noise-mitigated development [Herman and Bowlby 1993].

With the exception of California, local agencies throughout the country are not required to consider noise in their planning process although some local agencies have voluntarily incorporated noise into the planning process. Only California requires that noise be included as a separate element in the planning process.

6.2 Noise-Mitigated Development

The goal of noise-mitigated development is to ensure that impacts at proposed noise-sensitive land uses adjacent to traffic noise sources are mitigated by the developer as part of the project design. Mitigation of the noise impact is accomplished through methods selected for each individual project. Examples of these methods are changes in highway alignment, construction of noise walls or berms, buffer zones, building orientation and insulation.

As a basic tenet of this strategy, the proponent of the development must propose and fund noise abatement in order to achieve noise and land use compatibility although the cost of providing abatement would likely be passed on to those purchasing or renting in the development. For example, if the development were to be comprised of single-family homes, the abatement cost would likely be built in to the cost of the homes.

Typically, the developer would be required to have a consultant conduct a noise study to determine if impacts will occur and propose and design abatement if impacts are predicted. The environmental planning department would then review the study and proposed abatement measures to determine if the abatement is reasonable or if modifications are needed.

As with the land use zoning strategy, the local agency's environmental planning department is the key agency in noise-mitigated development. The environmental department must develop noise impact criteria for various types of land uses, develop guidelines for acceptable abatement methods and design goals, and enforce the entire process.

The administrative costs associated with maintaining such a program within the planning department are minimal. Satisfying the guidelines for a new development is seen as simply another "check-off" item in the process of project approval. There are start up costs for such a program, however, associated with developing the program guidelines, establishing criteria, procedures, and the like. Maintaining in-house staff in the agency could be another cost [Herman and Bowlby 1993].

6.3 Case Studies

Much of the material in the case studies was developed from interviews with agency staff. There is also extensive referencing to the study by Herman and Bowlby for Washington State DOT in 1993 [Herman and Bowlby 1993].

6.3.1 Arizona

Although there are no state requirements regarding the consideration of noise in the local planning process, Arizona DOT is proactive in encouraging local efforts to address noise. ADOT's programs resulted from complaints of residents to local officials who in turn contacted ADOT [Newton and Scofield 2003]. ADOT now provides information to local officials to aid in developing requirements for developers to address noise.

As part of their effort, ADOT developed a publication titled *Freeway Coordination Issues & Strategies For Transportation Planning* that it provides to local planning bodies [ADOT November 2003]. The purpose of the document is to "give local governments and developers a better understanding of ADOT's roles and responsibilities as we plan, design, construct, and maintain our highway corridors." The document serves as a point of reference only and is not intended to establish policy or process.

The document includes a section of frequently asked questions (FAQ) relating primarily to right-of-way and utility coordination and a section titled "Categories" that includes an "environmental" subsection addressing noise mitigation, air quality and construction activities. The subsection on noise mitigation provides a brief overview of the State's official noise policy and states, "Set-backs, buffer zones, manner in which properties are sub-divided should be considered by local governments (for example, front of house towards freeway and backyard will be more enjoyable to resident – house would acts as a buffer to freeway noises). (Drainage facilities or green-belt buffers adjacent to freeway R/W [right of way])." The noise mitigation subsection also incorporates a list of recommendations and practices that include:

- Recommendations for building permits: design of multi-story buildings; using double or triple pane glass, sound deadening materials in walls, etc; minimizing openings on multi-story buildings on freeway side.
- Changing the standard tining of concrete pavement from transverse to longitudinal tining as a slightly quieter pavement surface.
- A study of ARFC overlay (rubberized asphalt) as a future noise mitigation strategy.
- Conducting research on atmospheric conditions and their relationship to noise propagation
- Building ADOT sound barriers with consideration of future expansion (offset for future widening possibility and able to support height extension without reconstruction).

Some of the cities that have such residential development requirements include Gilbert, Phoenix, Peoria, Glen Dale, Tempe and Sun City. The program in Peoria is discussed below, along with the program in Maricopa County.

ADOT will provide technical assistance or guidance to local governments on noise related issues if requested and has also developed a 12-minute noise video and brochure that

addresses noise fundamentals and mitigation that it provides to local governments. ADOT will also build walls for developers as long as the developer funds the design and construction of the barrier.

6.3.1.1 Maricopa County

Much of the Maricopa County information presented below was obtained though an interview with Mr. Kelly McMullen of the Maricopa County Department of Transportation [McMullen 2003].

Maricopa County considers traffic noise impacts as part of its environmental studies during the planning phase for new roadways. These roadways range in classification from local streets to major arterials, and more recently, a freeway is being planned. The county uses a noise abatement policy based on FHWA guidelines and ADOT policy [Maricopa County 2001]. In contrast to ADOT policy, however, a standard of 66 dB is used to define "approach" in the abatement criteria rather than 64 dB. The need, feasibility, and reasonableness of noise abatement measures for pre-existing noise receptors will be evaluated when: (1) through lanes are added to increase capacity, (2) the horizontal alignment is changed by 10 feet or more, or (3) a vertical alignment is altered by 3 feet or more. Maricopa County currently does not have a Type II noise barrier program (adding noise barriers to existing roads with no other road improvement).

The County has constructed concrete block noise walls as a result of its environmental studies. These barriers have tended to be relatively low in height (7-10 feet) due to the geometry of the roadways relative to receivers. The County policy also allows for the acoustical insulation of both public and private buildings under circumstances where the traffic noise impacts are severe or other abatement measures are not feasible. Further, truck restrictions, speed restrictions, and highway alignment design are abatement strategies also considered by the County.

It is the policy of Maricopa County to provide traffic noise abatement to existing residential areas when roadways facilities are being constructed or upgraded. While the county has a definition of "existing" residential areas, this definition is not always easy to implement due to the fast-paced development that is occurring within the County.

Maricopa County has not developed zoning and planning guidelines to require developers to abate traffic noise impacts for developments adjacent to existing county roadways.

6.3.1.2 City of Peoria

Much of the information for the City of Peoria presented below was obtained though an interview with City Engineer Mr. David Moody [Moody 2003].

The City of Peoria, due to its proximity to Phoenix, has a number of transportation corridors that pass through it. Traffic noise concerns led to a truck noise study, which was conducted in the late 1990s. Among other things, the study identified noise sensitive areas that were impacted by traffic noise. As a result of the findings, a noise policy was established for the City.

Steps to Program Implementation

While the program is only a few years old it has been well received. The Engineering Department feels that it chose a simple but effective approach to the development of the noise policy. First, they worked with Planning and Zoning to develop noise guidelines. Second, they decided to adopt the abatement criteria used by ADOT, which is based on the FHWA Noise Abatement Criteria.

Noise Impact Determination

The FHWA Noise Abatement Criteria for various land uses and approved noise models are used to determine both existing and future conditions. A proposed development for noise sensitive land use must be analyzed for noise impacts if the development is located adjacent to a freeway.

Noise-Compatible Development Strategies

The City of Peoria does not consider noise sensitivity in its land use zoning decisions. If the noise analysis for a proposed development concludes that noise abatement is warranted, the developer is responsible for the cost. The City, however, assumes responsibility for noise impacts to existing residential areas. The City has constructed one noise wall and is planning a second. These projects are funded by the City's capital improvement fund; therefore, noise abatement projects must compete for funding with other proposed projects for improving the City's infrastructure.

The City relies on the developer's acoustical consultants to propose noise-compatible development strategies. Depending upon the topography and the type of development, strategies such as setbacks, buffer zones, open spaces and building shielding by unoccupied buildings have been used. The building requirements for storm water runoff detention have led to the strategy of placing detention ponds between the traffic noise source and the proposed residential dwellings. These areas are landscaped to become common, open space areas that can be used by the residents.

The City of Peoria requires that noise barriers be “permanent.” Wooden barriers are not considered by the City to be permanent. Therefore, the typical noise wall is constructed of 8-inch masonry block. The cells or cores in the block are also filled with concrete.

Masonry walls have traditionally enclosed subdivisions as well as individual lots in the City. These standard walls, also known as privacy walls, are typically 6-8 feet in height and are not inspected by the City during construction. Walls constructed higher than 8 feet are considered structural walls and must be inspected for compliance with codes. Noise walls are typically higher than 8 feet; therefore, they are inspected during the construction process.

6.3.2 California

A Noise Element has been required as part of local General Plans in California since 1971 [Rivasplata and McKenzie 1998]. The State Legislature adopted the California Noise Control Act of 1973, which defined the State’s noise policy as the following:

- Excessive noise is a serious hazard to the public health and welfare.
- Exposure to certain levels of noise can result in physiological, psychological, and economic damage.
- There is a continuous and increasing bombardment of noise in the urban, suburban, and rural areas.
- Government has not taken the steps necessary to provide for the control, abatement, and prevention of unwanted and hazardous noise.
- It is the policy of the State to provide an environment for all Californians free from noise that jeopardizes their health or welfare.

In 1976, the Department of Health Services issued *Noise Element Guidelines* followed shortly thereafter by a model noise ordinance. Assembly Bill 2038 revised the general plan statutes by making extensive changes to the Noise Element requirements. Generally, these revisions shortened the list of state-required issues and encouraged local governments to design their own approaches to noise control. The underlying purpose of the Noise Element, to limit community exposure to excessive sound levels, remains unchanged.

Local governments must "analyze and quantify" sound levels and the extent of noise exposure through actual measurement or the use of noise modeling. Sound level contours must be mapped and the conclusions of the element used as a basis for land use decision-making.

The Noise Element should guide the location of new roads and transit facilities as well as land use since these future arterial roads and transit systems may become major sources of noise. Furthermore, the Noise Element must include a discussion of methods to implement noise policies and standards sufficient to comply with State sound insulation requirements.

The 1998 version of the *General Plan Guidelines* includes an appendix of guidelines on the preparation and content of the Noise Element of the General Plan [Rivasplata and McKenzie 1998]. The following sections document several example programs that have been established in several jurisdictions as a result of the requirements.

6.3.2.1 City of Carlsbad

The noise-compatible planning program in Carlsbad became effective in 1990. The noise policy addresses both traffic and air noise sources. Much of the information for the City of Carlsbad presented below was obtained from the Carlsbad Planning Departmental Administrative Policy No. 17 [Carlsbad 1990].

Program Requirements

The noise impact study must be conducted for all proposed residential developments of five or more dwelling units that are located within specified distances from the major roadways in the City. For a major freeway this distance is 2,000 feet.

Noise Impact Determination

The impact and abatement criterion and standard for residential developments with areas of outdoor activity is an A-weighted CNEL of 60 dB. (CNEL is the Community Noise Equivalent Level, a single number representing a 24-hour, energy-averaged, A-weighted sound level. Before the averaging in its calculation, 5 dB is added to all levels between 7 p.m. and 10 p.m., and 10 dB is added to all levels between 10 p.m. and 7 a.m.) The outdoor living area is defined as the area located within five feet of the proposed property line at a height of six feet above the finished grade. The impact and abatement criterion and standard for residential development interior spaces is a CNEL of 45 dB.

Noise-Compatible Development Strategies

Developers are required to select appropriate strategies to reduce noise to the required levels. In rare cases where the developer has demonstrated to the satisfaction of the planning commission that abatement is not feasible, the development may be approved without abatement. In these instances, all purchasers of the impacted property must be notified in writing prior to purchase, and by deed disclosure in writing, that the property they are purchasing is noise-impacted and does not meet Carlsbad noise standards for residential properties.

For cases where a proposed development is located in an area adjacent to a future transportation corridor, prospective purchasers must be given notice that noise impacts may occur in the future.

6.3.2.2 City of Fullerton

The City of Fullerton was the first of the four cities that were the subjects of a series of USDOT case studies in the 1970s [USDOT 1979]. The noise-compatible development program for Fullerton was further described in the *Noise Mitigation Strategies* report to the Washington State DOT [Herman and Bowlby 1993]. Much of the information presented below was obtained though an interview with the City Chief Planner Mr. Joel Rosen [Rosen 2003].

Steps to Program Implementation

Legislation enacted at the state level was described as a first and critical step toward successful local noise-compatible development. At the local level, “flexibility” was cited as a key ingredient required for successful implementation of local noise-compatible development plans. This flexibility can be obtained by having many noise abatement strategies and approaches available for consideration on individual projects. In addition to the traditional noise mitigation strategies used by Fullerton, new strategies involving legal means were given as examples.

In one case a development was proposed in the vicinity of an airport. The noise analysis indicated that there would be some noise impacts that were not mitigated. The City required navigation easements as a condition for allowing the development to proceed. These easements were legally recorded for each property. As a result, property owners were made aware of the potential for noise impacts, and through their agreement to purchase the property waived their right to seek further noise mitigation.

In another case a development was proposed near a freeway. In order to comply fully with outdoor noise standards, a very high noise wall was required. A high noise wall, however,

was obtrusive and limited sunlight to open areas, which was undesirable. A noise wall with a more acceptable height was approved on the condition of legal acceptance by the property owners. Through this acceptance the property owners were balancing somewhat higher sound levels in exchange for the perceived benefits they received with the lower wall. The legal means given in these two examples were chosen after other strategies such as setbacks and buffer spaces were considered.

Citywide noise studies were also cited as a critical step to program implementation. These studies are expensive, but they provide the required baseline for noise-compatible planning on the local level.

The local agency must have access to adequate acoustical expertise. The City of Fullerton relies on acoustical consultants. These consultants may be retained by the City or hired by developers to perform noise analyses for new developments. During the history of Fullerton's noise-compatible planning program there were times when acoustical expertise was readily available at the county level. This sharing of acoustical expertise can be a good approach for local agencies within a region.

Noise Impact Determination

Fullerton has chosen to use the A-weighted CNEL with a standard of 60 dB instead of the 65 dB value that is used by most other local agencies in southern California. The 65 dB was typically adopted by most of the other local agencies since the county used a CNEL of 65 dB. There is, however an “escape clause” in the Fullerton guidelines. If it is not feasible for a development to reach the CNEL of 60 dB, then up to 65 dB is permissible. Under no circumstances can the predicted levels be above 65 dB.

The State requires a maximum interior A-weighted sound level of 45 dB for multiple family dwellings. There is no State requirement for single-family dwellings. Fullerton and many other local agencies in southern California, have adopted the 45 dB maximum level for single-family dwelling interiors as well.

The standard applies to “useable outdoor living space.” This definition is significant because some outdoor areas within the property are not considered useable. The front yard is considered one of these areas, and side yards also are generally not considered useable outdoor living areas. These non-useable areas may be above the maximum allowable standards referred to above, but if a backyard living area meets the requirements, the guidelines are satisfied.

Because of this interpretation, it is possible that the orientation of a house on a lot may mean that the interior levels become critical in terms of the guidelines. That is, the interior levels might exceed the maximum allowable even though the outdoor useable space might be acceptable. Most consultants consider that an outdoor level of 60 dB will produce an indoor level of 45 dB with standard construction. Therefore, an outdoor level higher than 60 dB requires special construction techniques to maintain the required indoor level [Herman and Bowlby 1993].

Program Enforcement

On-site inspections of new developments are conducted to ensure that all plans for noise mitigation are implemented. Therefore, building orientation, elevations, noise walls and other components are checked for compliance.

Noise-Compatible Development Strategies

Fullerton does not attempt to zone areas along freeways for industrial and commercial use on the basis of noise compatibility since such practices promote strip development.

Fullerton has a specification that all apartments and condominiums have an outdoor patio or deck. This requirement presents a problem for developers, particularly where second-floor units are proposed. Generally, decks must face away from the traffic source. Second-story units might involve non-standard construction to achieve acceptable interior levels while first-story units may achieve acceptable interior levels with standard construction. For example, a noise wall built to shield the outdoor living area would shield the first floor but not the second floor [Herman and Bowlby 1993].

Fullerton uses site layout strategies including setbacks, buffer zones, and open spaces. Building orientation strategies such as shielding of common ground areas or other buildings by unoccupied structures within the development are also used. The layout of rooms within a dwelling unit is generally not considered.

Challenges to the Effective Program Operation

Although compliance with the standards has been satisfactory, there have been a few times when the commission has not defended the guidelines against developers. Additionally, sound measurements have not been made in residential developments to verify that the standards are being met [Herman and Bowlby 1993].

The policies and guidelines used by the City of Fullerton are working well for them, and there are no plans to change them; however, a few problems have occurred over time. For example, residents within a few subdivisions have sought to change the noise barriers common to the subdivision properties. For example, the removal of clear Lexan barriers and the replacement with wood barriers was proposed, but the wood barriers did not meet the City's acoustical specifications. Further, not all residents could agree on the proposed change.

Problems can also arise in the acoustical modeling phase of noise analyses for proposed developments. The assumptions from consultant to consultant are not always consistent. Further, some consultants use more sophisticated noise models than others do. The differences become important where there is a significant variation in topography. Models that account for this variation in the noise analysis are preferred, but they are not always utilized.

Over the years there have been cases when developers, through political action, obtained waivers to stipulations within the noise compatibility guidelines. These cases have been the exception and not the rule in the City of Fullerton.

Benefits

The program assessment in 1992 was as follows:

> Prior to the development of noise standards in Fullerton, the planning department received a lot of complaints from residents concerning traffic noise. Since this program has been in effect, they receive essentially no complaints from those residents living in developments constructed after the guidelines were in place.

However, they still receive complaints from previous developments where noise remains a problem.

The administrative costs for the program are "minimal." Noise is just one element of the many considerations in the planning process, so it requires little additional time. Developers are familiar with the guidelines and consultants are experienced in carrying out the requirements, which facilitates the process. [Herman and Bowlby 1993].

A check on the program in 2003 revealed that the noise-compatible planning program for the City of Fullerton has mostly remained unchanged. There has been a refinement in the noise contours for the local municipal airport. Also, some new uses of legal means to address noise impacts for new developments have been added.

6.3.2.3 City of Cerritos

The City of Cerritos was the second of the four cities that were the subjects of a series of USDOT case studies in the 1970s [USDOT 1979]. The noise-compatible development program for Cerritos was further described in *Noise Mitigation Strategies* [Herman and Bowlby 1993]. Much of the information for the City of Cerritos presented below was obtained though an interview with Mr. Ali Soliman, Acting Director of Community Development [Soliman 2003].

Steps to Program Implementation

A statewide plan that includes noise as one of its elements was cited as a critical component to the success of local planning guidelines such as those in Cerritos. As another critical step, sound level contours should be developed at the beginning of any new plan for land areas within 1,000-1,500 feet of traffic noise sources.

Noise Impact Determination

Cerritos has a noise ordinance that requires an A-weighted CNEL of 55 dB in the area of outdoor living and 60 dB at the property line closest to the freeway. Interior levels in residences are not to exceed the maximum CNEL of 45 dB. Industrial levels at the property line are not to exceed a CNEL of 70 dB [Herman and Bowlby 1993].

Noise-Compatible Development Strategies

Cerritos originally considered rezoning the land adjacent to freeways for commercial use. This was impractical, however, because there was not enough demand for commercial use to occupy the vacant land adjacent to the large number of freeway miles in the City. Additionally, the City did not want the commercial strip-type development that might result. Therefore, the City reached a conclusion that residential development must occur adjacent to freeways [Herman and Bowlby 1993].

Several strategies are used to promote noise-compatible development. The first strategy, referred to as a buffer area, consists of a landscaped berm and noise wall combination. The second strategy involves treatments to the residential buildings. These treatments may include windows and drywall with improved acoustical properties, air conditioning and filtering

equipment to allow windows to be closed at all times, as well as actions to limit noise propagation through drains and vents. Further, all new residential developments subsequent to the program's inception were required to have single story houses in the first row of buildings adjacent to roadways to reduce the required height of the berm and wall combination.

Along with the establishment of noise-compatible development plans, the City of Cerritos also decided that a retrofit program was needed for existing properties impacted by traffic noise. The retrofit plan was funded through the redevelopment agency. The expenditure of these funds was justified to avoid the likely deterioration of the City due to noise impacts from the transportation facilities. A total of 25,000 linear feet of "buffer areas" were constructed for over five miles of freeway at a cost ranging from $200 to $325 per foot.

The retrofit "buffer area" included a combination earth berm and masonry wall with a total height that averaged 22-24 feet. This height was specified so that the top of the wall would be about 3-4 feet above the top of second-story windows of the houses, which were built prior to the planning requirement for single story houses. Earth berms were constructed with a 2-to-1 slope. Masonry wall heights typically ranged from 6 to 9 feet. Climbing plants covered the walls to eliminate the problem of graffiti.

For the case of state-owned roadways, the right-of-way is extended toward the subdivision to within one foot of the noise wall. Therefore, Caltrans does not own or maintain the noise wall. An agreement is in place between Caltrans and the City so that the City has access to the wall. Also, arrangements were made with Caltrans to allow encroachment of the buffer zone on state right-of-way. Further, the City enters into an agreement, which is recorded with the property deed, with each property owner requiring the property owner to maintain the berm on the property owner's side of the wall. This maintenance includes irrigation of the vegetation growing on the berm. The irrigation system is connected to the rest of the system used for the homeowner's lawn and landscaping. The property owner's responsibility to maintain their buffer area is enforced through the code enforcement office of the City. Pine trees and creeping figs are planted along with other vegetation to hide the wall as the trees mature. These plantings are made on both sides of the wall.

"Cypress Lylandie" trees were planted on six-foot centers to help control highway dust. These trees grow to heights of 30-40 feet and tend to have roots that grow straight down and, therefore, do not interfere with foundations [Herman and Bowlby 1993]. Acoustical windows were also installed in the houses as well as air conditioning and electrostatic filters to remove road dust. Charcoal filters were used to absorb pollutants from the air.

Residents have attested to the benefit of these trees. They tend to filter the air, which contains black dust from the abrasive action of the pavement on vehicle tires. Therefore, the presence of this dust in their homes is greatly reduced.

The City has conducted measurements to evaluate noise mitigation measures. Houses that were measured prior to mitigation typically had indoor levels of 48-53 dB. After mitigation, interior sound levels were well below 45 dBA [Herman and Bowlby 1993].

The berm and wall combination is the dominant barrier system used in Cerritos. This system offers an advantage in addition to the aesthetics. The slope of the berm protects the noise wall on top of the berm, as well as residential dwellings, from vehicles that may veer off of the highway. All the noise walls are constructed of concrete block, either rough-faced or slump-block styles, or stucco walls supported with concrete pilasters.

Cerritos has also restricted trucks as another strategy for noise-compatible planning, as described in the 1993 study:

> The City continues to designate certain routes as truck routes. One example was a new industrial area that was located adjacent to an existing residential area. As a buffer, the City constructed a divided street between the industrial and residential areas. Further, a large setback was required for any buildings in the industrial area. Only automobile traffic was allowed to enter the industrial area from this divided street. An access road for truck traffic was placed at the back of the industrial area to allow trucks to have access to the buildings without driving on the residential street. [Herman and Bowlby 1993].

Challenges to Effective Program Operation

Cerritos has a very detailed program of guidelines, planning interaction with developers, and construction inspection. This detailed program was cited as a critical component to effective program operation. As a further benefit of a well-specified and detailed program, the planning department does not feel that it has been over-ruled by political actions to support the requests for waivers by developers.

Caltrans had entered into an agreement with Cerritos, as well as other local agencies, to compensate them for locally funded noise abatement. Under this agreement Caltrans was to reimburse the City if the City had funded noise abatement prior to the decision by Caltrans to add lanes to increase capacity. When this situation arose in Cerritos, however, Caltrans would only contribute $670,000 towards the $16 million cost for the abatement constructed by Cerritos.

Potential Program Improvements

The program could be improved by requiring larger lots for single-family dwelling units located adjacent to roadways.

Benefits

The program assessment in 1992 was:

> The success of the program is judged in part by the property values that have been maintained for houses adjacent to freeways. In many cases, the houses sell for more than the other houses in the subdivision because noise is not an issue and the additional buffer zone landscaping is appealing. The mitigation efforts have essentially eliminated the noise problem for residences. [Herman and Bowlby 1993].

A program update and assessment in 2003 follows:

The Cerritos planning guidelines for noise-compatible development have been continued since its inception in the 1970s. The noise-compatible development policies apply not only to residential subdivisions adjacent to freeways, but also to subdivisions adjacent to arterials.

A creative development plan was described for a more recent problem area near the intersection of two freeways. A developer proposed a residential subdivision in this area where

traffic sound levels were high. At the same time the City of Cerritos was looking for a location to develop a new water reservoir. The final design placed the reservoir at an elevation that created an earth berm of appropriate height to allow the construction of a standard height noise wall. The combination earth and wall barrier to traffic noise, as well as the buffer created by the presence of the reservoir, provided a quiet park environment for the subdivision that was built on the far side of the reservoir from the freeway.

All property that borders on freeways within the city limits has been developed. Cerritos is virtually free of traffic noise impacts. There is strong demand for residential properties adjacent to transportation noise sources, and property values have continued to increase.

6.3.2.4 City of Irvine

The City of Irvine was the third of the four cities that were the subjects of a series of USDOT case studies in the 1970s [USDOT 1979]. Irvine's Noise Element, developed as part of its General Plan in the 1970s, addresses traffic, rail, and aviation noise sources. Aircraft flyovers from three nearby airports were a major source of noise in Irvine until the Marine Corps air bases in both Tustin and El Toro were closed in 1999. The Tustin base was a major source of noise from helicopters while the El Toro base was a major source of jet aircraft noise. A redevelopment plan is now in place for Tustin that will include residential, golf courses, parks, and industry [Herman and Bowlby 1993].

Much of the information for the City of Irvine presented below was obtained though an interview with Ms. Jennifer Winn, Senior Planner in Community Development [Winn 2003].

Program Requirements

Noise measurements were made and noise contour lines were produced from the measurement data for the entire city in the early 1980s. The noise contour lines were subsequently converted to policy lines. Within contour lines at the highest levels, no development is permitted. For example, these locations would be very close to airports. As the sound level decreases by each contour line, various types of development become options for consideration. Developers must conduct a noise study for proposed developments. This study, which is carried out by acoustical consultants, must consider predicted sound levels based upon projected traffic growth for the design year. If noise impacts are predicted the developer must propose abatement to achieve the standards listed in the Noise Element, Challenges to Program Implementation.

The development community or landowners did not welcome the initiation of a noise-compatible development plan in general, and especially where some development had already occurred. Landowners with property near sources of noise, in particular, were concerned that such action may decrease the value of their land.

Noise Impact Determination

The Planning Department will only consider proposed developments that are consistent with the land use recommendations. Noise impacts, however, are often predicted even when the proposed development is consistent with the planned land use. In this case, the developer must include noise abatement in the development plans to reach the required standards. Sound levels in outdoor living spaces must not be equal to or greater than 65 dB CNEL. The requirements for

residential interior sound levels are 45 dB CNEL with the windows closed (55 dB windows open).

Noise-Compatible Development Strategies

The City's Land Use Element determines the types of development that would be considered for different parts of the city. The established sound level contours are considered during the land use planning phase. Though a variety of common noise-compatible development strategies may be used, the most common strategies are noise walls and building insulation.

Challenges to Effective Program Operation

As traffic volumes and speeds have increased through the years, the City is receiving more complaints from residents. These complaints tend to come from residents living in the older areas of the City where the existing developer-built noise barriers are no longer adequate. While most of the barriers were made of concrete and are structurally stable, many either contain gaps or are not high enough to reduce sound levels by an acceptable amount under current conditions. This situation underscores the importance of constructing quality barriers with sufficient acoustical design properties to ensure that sound level standards are maintained for the long-term.

In a number of cases Caltrans has added lanes to existing freeways within the City of Irvine. The environmental documents indicated that increased abatement would not be warranted for these cases. The City of Irvine has been receiving complaints from residents living near these freeways, however. Most of these complaints come from residents living adjacent to noise barriers built in the late 1960s along the south side of I-405.

Apart from the two examples given above there have not been significant problems with the operation of the program in the City of Irvine. This positive report is due in large measure to the highest standards of operation by the Irvine Company. As the City's largest developer, it maintains strict controls on urban design and environmental issues for all builders associated with its developments.

Program Personnel

The environmental planning section in the City of Irvine was discontinued. This action was taken to be consistent with the idea that planners should be generalists. Therefore, each planner must have the background to perform the noise-related tasks as well as the other environmental work required for the planning function. While the planners do not consider themselves acoustical experts, they do have the experience to judge whether a noise report written by consultants is adequate. Many of the planners in the City of Irvine are members of the American Institute of Certified Planners and are involved in continuing education programs.

Other Program Features

Churches and child-care centers are examples of discretionary cases that need a conditional use permit under Irvine planning regulations. The noise guidelines are a factor in consideration of these land uses.

Benefits

The planning process to comply with the requirements of the Noise Element is one step out of many required for the development process. Therefore, the cost to administer the noise compatibility program is minor for the City. Further, developers must pay fees, which offset the planning costs. As a result of Irvine's noise-compatible development program, the City's residential areas, with few exceptions, are not impacted by transportation noise.

6.3.2.5 Orange County

The Noise Element of the Orange County General Plan became effective in 1975, prior to the era of rapid development and the resulting incorporation of County land into city jurisdictions. The Noise Element addresses traffic, rail, and air noise sources. Environmental planning in Orange County is guided by its noise and land use compatibility manual in addition to its Noise Element [Orange County 1993]. The manual, which is intended to help developers and others to prepare accurate noise reports, was first published in 1984 followed by revisions in 1987 and 1993.

Much of the Orange County information presented below was obtained though interviews with Mr. Ben Chin and Mr. Doug Friedman of the Planning and Development Services Department [Chin and Friedman 2003].

Program Authority

Noise-compatible development planning is mandated by the Legislature of the State of California by the Noise Element in the General Plan. Also, the California Environmental Quality Act (CEQA) fostered the formation of the Acoustics Section in Orange County.

Challenges to Program Implementation

Competent acoustical consultants must be available for noise-compatible development; however, acoustical engineering or consulting is not a licensed discipline in the State of California. At the start of the program the County feared a sudden appearance of charlatan consultants in the wake of the new requirements for acoustical analysis and reporting. Therefore, prospective consultants are required to undergo review before being certified and added to the approved list of acoustical consultants who are authorized to prepare and submit acoustical reports for Orange County.

Program Requirements

The proponents of a development must submit planning proposals to the County planning group. The plans are then sent to the environmental group for review under the CEQA review requirements. Depending on the nature of the proposal, either an Environmental Assessment (EA) or an Environmental Impact Report (EIR) must be prepared. Generally, any developments proposed for more than forty homes require the EIR. This report stipulates the conditions for plan approval. These conditions then become a requirement for plan approval.

The County maintains an arterial master plan that describes the locations of future arterials, as well as plans for improvements and capacity increases. The proposed development

must be considered in light of this master plan. The developer is required to abate sound levels based on future traffic volumes anticipated in the master plan, and the County is required to fund any abatement measures needed for future projects that are not included in the master plan at the time that plans are approved for the proposed development.

The community of Rancho Santa Margarita was approved as a planned community. The noise impacts were considered in light of the County's arterial master plan. A future freeway was planned for construction through the proposed community. As a result of the noise analysis, the developer was required to provide noise walls, acoustical windows and additional insulation for houses located adjacent to the proposed freeway.

Noise Impact Determination

Orange County uses the A-weighted CNEL as its noise descriptor and all outdoor living areas in new developments must comply with a CNEL of 65 dB or less (for all noise sources combined). Additionally, interior spaces must meet a CNEL of 45 dB or less. An outdoor CNEL greater than 75 dB is considered "normally unacceptable" and no building permit would be issued. CNELs between 65 to 75 dB are considered "conditionally acceptable" and mitigation is required to reduce the levels to 65 dB [Herman and Bowlby 1993].

Noise-Compatible Development Strategies

Orange County uses both land use zoning and proponent mitigated development strategies for noise-compatible development planning. The land use zoning strategy is used very little, however, to produce noise-compatible development along freeways. Planners prefer to avoid "strip" development of commercial property. Further, there is more land available for development along freeways than can be used by commercial land uses.

Early in the program Orange County developed sound level contour lines for major noise sources such as freeways, railroads, and airports. Subsequently, the decision was made to convert these sound level contour lines to policy lines. The policy lines dictated where noise sensitive land uses could be developed. This action was cited as an important contribution to the overall success of the program in Orange County: "As a result, there is not an annual fluctuation (i.e., update) of these lines nor is there constant litigation to challenge the lines. The overall effect is to remove the debate and exceptions regarding land use plans." [Herman and Bowlby 1993].

The most common strategy to create noise-compatible development near freeways or higher speed arterials has been the use of noise walls or berm-wall combinations along with building insulation. These strategies are chosen by developers rather than site layout and building orientation strategies to maximize the number of residences in the development. Further, California energy conservation laws mandate building insulation, in terms of items such as high R-factor wall insulation and double-glass windows.

There is little residential building near freeways at this stage in the County's development. Since most of the new subdivision proposals are for locations near local streets or connectors, developers can avoid constructing sound walls. A typical strategy is to place the first row of houses far enough from the centerline of the local streets to obtain an acceptable sound level in areas of outdoor activity. For example, the CNEL may be approximately 57 dB at distances of approximately 100 feet from the typical roadway centerline. To ensure that the interior sound levels are within the allowable limits the developers will include "mechanical

ventilation" as part of the plan. To implement the plan, air conditioning equipment will be installed in the residence. Therefore, windows can remain closed to provide acceptable interior sound levels.

Program Costs

The noise-compatible-planning program is not financially self-sustaining in Orange County, because no separate fees are charged to cover the costs of plan reviews and inspections. Support for the program comes from the general building fund.

Program Personnel

Significant staff downsizing has occurred in recent years due to the unavailability of funding. Through attrition, the former high level of acoustical expertise is no longer available in the department. This deteriorating condition has occurred since the early 1990s. Further, the pool of consultants (currently 23) available to developers has decreased in size. As a result, there has been a decrease in competition among consultants.

Program Enforcement

Noise walls are treated as an exception to the building code in Orange County. In general, a building permit is not required for screens and fences, etc. The building code was modified to require a permit to construct noise walls. As a result, noise walls are inspected for compliance with the specifications.

Challenges to Effective Program Operation

A significant challenge to effective program operation occurs when local government officials use administrative power to permit proposed developments in violation of the guidelines. Therefore, every effort should be made to develop regulations and guidelines that cannot be easily bypassed through political action.

Through the years Orange County has seen more and more of the developer-paid noise analysis and reporting concentrated in the work of a few consultants. While these consultants were developing larger and larger databases from noise studies in the area, as well as more and more sophisticated techniques of modeling and viewing data, the acoustical expertise of agency personnel was deteriorating. This deterioration resulted from natural attrition, the inability of the County government to attract acoustical experts due to the mismatch between government salaries and consultant salaries, and the limited funding available for the program. Orange County personnel feel that consultants have taken advantage of this mismatch in expertise between the government sector and the private sector. As a result, planning personnel are not equipped to thoroughly evaluate the acoustical reports and plans. Therefore, Orange County personnel are concerned that it is possible for approval to be given to deficient plans.

Since some acoustical consultants have developed their own noise models, it has been difficult for planning personnel to check the results. The model available to planners is the FHWA *Highway Traffic Noise Prediction Model* based on the FHWA-RD-77-108 report [FHWA 1977], which was modified to report levels with the CNEL descriptor. Further, small changes by consultants to model input data can affect the output results. For example, if the receiver is

located at a lower elevation in the model compared to the as-built condition, lower sound levels will be predicted. There have been cases in which planning personnel have been able to field-check elevations and compare them to acoustical planning information. When discrepancies were noted, developers often resorted to political power to gain waivers for the discrepancies. In summary, the acoustical reports are often well prepared, thorough, and acoustically accurate, yet these plans are not always implemented.

The process of land development in Southern California has also caused some additional complications. Usually, the land developer has large holdings of land. The developer will perform rough grading and construct major components of the infrastructure; however, builders, who do the final grading and establish building size, orientation, and so forth, carry out the actual residential construction. The acoustical plan for the original developers' land area may have been carried out. Subsequently, new acoustical plans must be developed as builders purchase a few acres and construct houses, since these builders often alter the grade.

The quality of developer-built noise walls has not been a problem. Masonry walls are typically constructed. These walls meet the mass density requirements for noise reduction. Further, walls made of other materials do not provide the quality appearance of masonry walls. Therefore, developers would be reluctant to use other materials. Due to other subdivision regulations, walls cannot be more than five or six feet in height. Therefore, berm-wall combinations are used to attain the heights required for noise abatement. As a notable exception to masonry walls, a combination Plexiglas and masonry wall system is often used for residences with oceanfront views.

Benefits

The benefit of acceptable sound levels to the health and welfare of citizens was the basis for the mandated requirements for the Noise Element in the California General Plan. The attainment of acceptable sound levels in Orange County is not directly measured and quantified as part of the program; however, residents who live in areas developed under the noise-compatible planning guidelines voice relatively few complaints. In cases where complaints have been raised, investigations usually uncover noise-planning omissions on the part of developers.

6.3.2.6 San Diego County

The San Diego County noise program addresses traffic, rail and air noise sources. As a local agency in the State of California, the authority for San Diego County's noise program comes from the California State General Plan. The noise-compatible development program for San Diego County was one of the local agency plans reviewed in *Noise Mitigation Strategies* [Herman and Bowlby 1993]. Much of the San Diego County information presented below was obtained though an interview with Mr. John Bennett of the Planning and Land Use Department [Bennett 2003].

Program Documents

The primary document is a 61-page Noise Element, which is included in the San Diego County General Plan. The Noise Element was established in 1975, and a revision was made in 1980. The stated objectives of the Noise Element are:

> Establish a coordinated set of policies and noise standards for the reduction of irritating and harmful effects of noise to people within the County of San Diego through effective planning, and, if necessary, regulation.
>
> Protect and enhance the County's acoustical environment by simultaneously controlling noise at its source, along its transmission path, and at the site of the ultimate receiver. First priority shall be given to residential areas to assure an environment free from excessive or damaging noise. Control of noise at its source shall be given priority over changes to residential structures or neighborhoods where practical. [San Diego County 1990].

The first policy in the plan is "to establish and support a coordinated program to protect and improve the acoustical environment of the County." Nine action programs are given in support of this policy. The second policy addresses this noise control at the source and includes eight action programs. The third policy addresses control of noise along its transmission path and contains six action programs.

The Noise Element also references other relevant codes and regulations from other departments such as Motor Vehicles and Health and Safety. In addition, tables are provided that give the sound attenuation properties of various soundproofing technologies and construction methods. Further, an extensive listing of research findings on the effects of noise, as well as a glossary of acoustical terms, is provided.

Noise Impact Determination

The County of San Diego has two policies in its Noise Element to address control of noise at the receiver. The first of these policies emphasizes the standards and acoustical properties of building design. The second of these policies addresses outdoor sound levels at receiver locations. The policy states,

> Development should be planned and constructed so that noise sensitive areas are not subjected to noise in excess of an A-weighted CNEL of 55 dB.
>
> Whenever it appears that a new development will result in any (existing or future) noise sensitive area being subjected to a CNEL of 60 or more decibels, an acoustical study should be required. [San Diego County 1990]

If the acoustical study shows that sound levels at any noise sensitive area will exceed a CNEL of 60 dB, the development should not be approved unless the following findings are made:

> Modifications to the development have been or will be made which reduce the exterior sound level below CNEL equal to 60 decibels; or
>
> If with current noise abatement technology it is infeasible to reduce exterior CNEL to 60 decibels, then modifications to the development have been or will be made which reduce the interior noise below CNEL equal to 45 decibels. Particular attention shall be given to noise sensitive interior spaces such as bedrooms. [San Diego County 1990].

In order for approval to be given for the second alternative, adequate social and economic justification must be provided. No development is to be approved where sound levels are predicted to exceed a CNEL of 75 dB.

The County has developed noise contours based upon extensive measurements to describe sound levels adjacent to major transportation corridors. The contours were developed for over 180 miles of highways and 120 miles of railroad track. These contours become the basis for land use decisions. For example, residential development is prohibited in the contours that exceed the stated limits regardless of the developer proposed techniques to mitigate noise impacts. The Noise Element also provides ambient sound level limits for each land use zone designation.

Noise-Compatible Development Strategies

Approved residential developments in the County of San Diego have made use of a full range of strategies such as setbacks, open spaces, building orientation, noise walls, berms, and acoustical insulation of houses. The County has funded construction of a number of noise barriers where warranted due to capacity increases and other improvements on roadways. Also, the County has used the strategy of designating certain roadways as truck routes to reduce sound levels elsewhere in noise sensitive areas.

Other Program Features

San Diego County has maintained a policy to assess developers for off-site impacts. For example, a large proposed development could generate enough traffic to impact adjacent existing residential areas. If this impact were to occur, the developer would be required to contribute funds toward the noise abatement costs for the other areas.

6.3.2.7 Caltrans' Perspective

From the perspective of Caltrans noise staff, the local programs have had some success. Caltrans staff would like to see "more teeth" in the legislation, however. There are several issues that hinder the effectiveness of the programs. First, developers can request exceptions or variances from the noise requirements. Second, developer-constructed noise barriers are often substandard and do not stand the test of time. Finally, Caltrans does not formally or routinely review the local noise studies so there is no guarantee that impacts are adequately addressed [Hendriks et al 2003].

6.3.3 Colorado

Colorado does not have any formal policy for encouraging noise and land use compatibility planning at the present time; however, CDOT is currently conducting scoping meetings and stressing this issue to local officials. Mr. Robert Mero of CDOT notes that several new developments in and around the Denver area have built some very nice berms, walls and combination barriers for their developments, but CDOT is not aware of any particular locales that have a policy at this time [Mero 2003].

6.3.4 Illinois

Illinois DOT notes that land use compatibility is a continuing problem that its Type II noise program currently addresses. Illinois DOT's Type II program is a 50/50 cost-sharing program for noise abatement retrofitting of fully access-controlled state highways in urban areas. If a local unit of government conducts a noise study and documents it has an abatable noise problem in accordance with the guidelines and criteria, Illinois DOT provides 50% of the funding. Part of the deal is that the locals must provide a land use ordinance that guarantees that any future land development adjacent to any portion of that state highway within their city/village will be noise-compatible to avoid the need for government funded noise barriers in the future.

This policy is pretty much the extent of Illinois DOT's involvement to date with land use compatibility. Illinois DOT Central Office personnel are going to be getting local agencies more involved in this type of planning, so that they will have fewer residential areas right next to major interstates in the future. This may be in the form of some type of workshop class [Rogers 2003].

Illinois DOT staff note that some local municipalities factor land use planning into their zoning designs (in regards to noise), but most do not. There are still cases where the developers are building single-family residences right up to the state right-of-way line near major roadways, and then direct residents to Illinois DOT when they complain about the traffic noise. This process is very frustrating, not only for Illinois DOT, but also for the homeowner. Often times, Illinois DOT staff hear stories that "someone" (usually the developer) promised the residents that the "Highway Department" was going to install noise abatement for them. Then Illinois DOT is blamed when the homeowner is told this is not the case, but by then the developer could be out of the picture.

Illinois DOT recently, though, had a group of communities band together regarding a specific route in northeastern Illinois (US 41). Large numbers of tractor-trailers use this route as an alternate to Interstate 94 (Tollway) in northern Illinois to avoid the tolls. The many trucks constantly using jake brakes to stop at the various traffic signals along this route were disturbing the local residents at all hours of the day and night. So, in conjunction with the Department posting "no air braking signs" and getting local and state police to patrol more frequently and enforce the signs, the residents have affected a general change in the A-weighted sound levels within their communities [Rogers 2003].

6.3.5 Iowa

Iowa DOT has no active campaigns for encouraging noise-compatible development [Ridnour 2003]. While Iowa DOT does hear of complaints from residents in some developments built along highways, there is much new and marketable development adjacent to Iowa DOT's highway network from which they hear no complaints. As a result, Iowa DOT staff question whether transportation agencies should be involved with development efforts adjacent to the existing system unless DOT involvement is requested.

6.3.6 Maryland

The State of Maryland has a statute in its environmental regulations concerning noise. This statute established the Environmental Noise Advisory Council, which is made up of representatives from the Legislature, academia, the Acoustical Society of America, the medical field, and the public. The Interagency Noise Control Committee meets with and supports the

Council regarding technical matters. A representative from the Maryland State Highway Administration (SHA) serves on the Committee along with other state agency representatives. The Environmental Noise Advisory Council is charged with the responsibility of reviewing noise ordinances and guidelines within the State of Maryland. This review is limited to ordinances and guidelines that address community noise from stationary industrial, commercial, and residential sources. Also, individual vehicle violations due to faulty mufflers, and the like, are addressed. The Council does not consider guidelines that may exist to address transportation noise.

At one point the Environmental Noise Advisory Council considered adding statements to noise ordinances that would encourage local agencies to consider noise in the approval of new development plans. This action was strongly opposed by the Maryland Municipal League and the Maryland Association of Counties. They saw this action as essentially an unfunded mandate, and they realized that local governments did not have the expertise required to meet the technical demands of addressing noise issues.

Overall, there is no statewide legislation or regulation to promote traffic noise-compatible planning by agencies within Maryland. The SHA noise policy, which was approved by the FHWA, does contain a provision to answer requests by local agencies for assistance in developing policies and programs to address traffic noise issues in the planning process. With the exception of a couple of minor requests for information, the local agencies have not availed themselves of this assistance. In an effort to stimulate interest in this area the SHA has discussed noise-compatible development ideas with representatives from the counties and provided them with a copy of the FHWA publication, *Entering the Quiet Zone*.

The strongest force for noise-compatible development in the State of Maryland is the Maryland-National Capital Park and Planning Commission. This commission supports planning operations in Montgomery County and Prince Georges County, which are adjacent to Washington D.C. With this support Montgomery County, in particular, has developed very comprehensive noise-compatible development plans as discussed below [Polcak April 10, 2003].

6.3.6.1 Montgomery County

Much of the Montgomery County information presented below was obtained though interviews with Mr. Steve Federline and Mr. Mark Pfefferle of the Montgomery County Department of Park and Planning, Maryland-National Capital Park and Planning Commission [Federline and Pfefferle 2003]. The noise-compatible planning program in Montgomery County addresses traffic, rail, and air noise sources. As stated in the program guidelines:

> The environmental planning division, working under the auspices of the Montgomery County Planning Board and the Montgomery County Department of Environmental Protection, has incorporated noise analysis into all elements of the land-use planning process, including master and sector plans. Since 1978, every master plan, where there has been reason to consider noise, has included an assessment of potential noise problems and recommendations relating to abatement of excessive sound levels. Existing and future traffic conditions are evaluated to determine projected noise impacts and their effects on future land use. [Montgomery County 1983].

Program Authority

The Maryland-National Capital Park and Planning Commission is a state-chartered, locally funded, bi-county agency that provides park and planning services for Montgomery County and Prince Georges County, which are the northwest and northeast counties around Washington, D.C. The commission is made up of five-member planning boards in both Montgomery County and Prince Georges County, which make land use and zoning recommendations. While the commission does not make zoning decisions, it does have authority to develop master plans, make land use decisions and make subdivision decisions.

Challenges to Program Implementation

The need to provide technical expertise is a major challenge to the implementation of the noise-compatible development program. As a first step, staff must have a basic understanding of noise sources, sound propagation, and noise abatement strategies to administer the program. Montgomery County is fortunate to have a strong tax base, and therefore, the resources to fund in-house staff. Staff without the required acoustical expertise can be trained, and the state transportation agency can be a valuable resource for this training. Developer-paid consultants, as an alternative, could furnish much of the noise analysis work. In the same way that site engineers perform analyses for storm water runoff and design facilities to accommodate the runoff, noise consultants could analyze the potential for noise impacts and design abatement.

An effective noise-compatible development guideline is a second critical requirement for the successful implementation of a planning Noise Element according to Montgomery County planners. A clearly defined abatement hierarchy has helped make Montgomery County's guidelines effective. As a result, staff require less training and can make more expedient decisions regarding the acceptability of proposed abatement strategies.

Noise Impact Determination

Sound level contours are produced in the master planning stage for areas in the vicinity of transportation noise sources. The contours are developed from predicted sound levels using noise models with very generalized topographic inputs.

The criterion for noise impact determination and abatement requirements is the A-weighted Day-Night Level (DNL). These required standards vary by location within the County. The standard for impact and abatement in the area within the Washington Beltway (I-495), which is an area with high-density development, is an A-weighted DNL of 65 dB for residential areas with outside activity. By contrast, the standard in an agricultural reserve area, which has 25-acre lot size minimums, is a DNL of 55 dB for areas of outside activity. Between these two categories, areas referred to as developing areas have a standard of a 60 dB DNL for areas of outside activity. When certain conditions are met, a waiver to the outdoor standards may be granted. In such cases the interior DNL standard of 45 dB is applied.

Noise-Compatible Development Strategies

Land use compatibility zoning is carried out during the master planning stage. The zoning decisions are based in part on sound level contours and on other factors that might affect the feasibility of noise-compatible development such as the size and location of tracts of land. Only residential land uses are considered in the noise guidelines since commercial and industrial

land uses are assumed to be compatible with noise. Land uses such as nonprofit institutions and places of worship do not fall into the residential, commercial, or industrial categories, and are therefore considered on an individual basis.

Montgomery County's guidelines provide a hierarchy of noise-compatible development strategies. The land use compatibility approach is first in the hierarchy. Land uses that are less sensitive to noise impacts, such as municipal facilities, parking lots, and local streets, are to be located closer to noise sources.

Site layout strategies such as setbacks, buffer zones and open spaces are to be considered where the land use compatibility approach does not address all noise impacts. Building orientation strategies such as self-shielding, shielding by unoccupied buildings, and layout of rooms within dwelling units are to be considered.

Where predicted noise impacts remain, developers can consider noise barriers to achieve noise-compatible development. Earth berms are the preferred noise barriers, with berm and wall combinations second. The guidelines state that the County is willing to adjust right-of-way lines, where feasible, to accommodate the land area required by berms. Noise walls are permitted when earth berms have not proved to be feasible.

Finally, acoustical insulation of buildings may be permitted where the 65 dB DNL standard for outdoor activity areas cannot be achieved.

Challenges to Effective Program Operation

The most basic challenge to effective program operation is the prevailing opinion by developers and some officials that any noise problem can be corrected as an add-on at the end of the planning process. To confront this challenge, environmental noise planners must continually convince others that successful noise-compatible development requires consideration of noise at all levels of planning.

Montgomery County is a mature county, finding itself at the point where most of its land either has been developed or is in the process of being developed. Further, Maryland is thought of as a "Smart Growth State." A smart growth objective is to more fully utilize the existing infrastructure in urban areas by redeveloping and intensifying the land uses to produce higher densities, which foster mass transportation.

Smart growth strategies tend to undermine some noise mitigation strategies. For example, density maximization and in-fill development strategies run counter to noise mitigation strategies such as building setbacks and compatible uses. As a result, noise abatement using acoustical treatments becomes more likely, though less desirable. Further, developers are now reconsidering land areas that were previously passed by for development due to noise considerations. Noise buffer areas that were previously set aside are also being considered for development.

Planners are feeling increasing pressure to grant waivers to the plan guidelines for various reasons. There is a need to provide affordable housing developments; the resulting in-fill development might not be feasible if the guidelines would be strictly adhered to. There is also pressure to bypass the hierarchy of abatement strategies and default to acoustical treatments, which were intended to be a last recourse in the plan guidelines.

As a result of these trends and pressures, planners must be more creative. Where building setbacks and berms are not compatible with high densities, alternatives must be sought. Two examples are cited.

In the first example, planners did not support a proposal for residential development near a freeway as part of a mixed-use development. Ultimately, the mid-rise residential development was approved. Subsequent to the approval, planners persuaded the developer to alter the construction, which consisted of rows of condominiums oriented parallel to the freeway. An exterior wall was added to enclose the walkways on each floor that provided access to individual units. In effect, a double wall was created to reduce the interior sound levels for building occupants. Further, parking garages were installed in a row near the property line closest to the freeway, which provided some noise attenuation, as well as positioning the living spaces a little farther from the freeway.

Another residential development was approved in which rows of townhouses were oriented perpendicular to the highway noise source. The Montgomery County planners discussed the situation with the developer and pointed out the difficulty in marketing the units closest to the highway. The suggestion was made to enhance those end units to make them more attractive to buyers by constructing a garage, and changing an entryway along with some other modifications. As a result, the additional construction formed a two-story barrier that protected the balconies of subsequent townhouses within the rows.

The quality of developer-built noise barriers has been another significant challenge to the effective operation of noise-compatible development plans. For those cases where no other alternative is feasible, noise barriers can be approved; however, developers and their suppliers often consider a board-on-board fence as a noise wall. In spite of efforts by planners to convince developers that it makes no sense to protect residences having an expected life of 50 years or more with a wall that will be effective for two years or less, developers continue to construct walls of this quality. The lack of incentive for builders to construct a durable noise wall has resulted in a huge problem to the effectiveness of the program. Even a simple wall made of 1-inch thick tongue-in-groove plywood panels, as advocated by noise planners, has met with strong resistance by both developers and other non-acoustical planners.

Environmental and noise planners in Montgomery County would very much like to have a solution to the problem of poor quality noise walls. Conversely, the opinion was expressed that it is probably not feasible to require developers to build walls to the Maryland SHA standards. Only once in the history of the program has a developer built a wall to such standards (for a very high-end residential development).

In lieu of a direct solution to the problem of low quality noise walls, noise planners push for an earth berm rather than a wall, where feasible. Creative strategies are being sought to reduce the amount of space actually occupied by a berm. For example, the location of adjacent houses might be altered by incorporating a short retaining wall, perhaps even incorporating the wall as part of the structure. Outdoor amenities such as patios could then be designed to make use of a portion of the area previously occupied solely by the berm.

Program Enforcement

The planning board does not enforce noise mitigation requirements by direct inspection during construction. Rather, the developer's consultant must certify compliance with Montgomery County's noise-compatible development guidelines. This self-certification process

is required for the results of all noise analyses, which may include noise modeling and/or noise measurements. Also, the consultant must approve any deviation by the developer from the approved plan.

Potential Program Improvements

The first improvement suggested is to clarify when a noise analysis is required for a proposed development. Clarifying statements will be proposed as changes to the zoning ordinance, which is approved by the County Council. Identical clarifying statements will also be added to the plan guidelines, and approval for these guidelines sought by the planning board.

Second, the guidelines will be edited to correct outdated information. For example, predicted sound levels are now developed from the FHWA TNM rather than the STAMINA 2.0 computer program. Further, the wording is to be changed to require noise analysts to submit the parameters used in predicting future sound levels, including Average Daily Traffic, peak hour volumes, vehicle mixes, and design year (20 years in the future) sound levels. Also, sound level contours in 5 dB intervals will be required on developer submitted plans. In addition, full disclosure of noise-impacted areas will be required by designating these areas on site plans and by statements added to the deed of conveyance at the time of property transfer.

6.3.6.2 Howard County

Much of the Howard County information presented below was obtained though interviews with Mr. Chuck Dammers, Division Chief of Development Engineering [Dammers 2003].

The noise-compatible development program in Howard County was initiated in 1989 following a period in which members of the public works staff researched several noise-compatible development programs in other local agencies. The State of Maryland assisted the start of the program by funding the services of an acoustical consultant for approximately six months prior to the official start up date. There have been no changes in guidelines [Howard County 1989] or procedures, which address rail and traffic noise, in the last 10 years.

Steps to Program Implementation

Several critical steps to program implementation were identified:

- Source Description - Howard County plans for noise-compatible development with both rail and traffic noise sources. The traffic noise sources are further described according to the roadway facility type: minor arterials, intermediate or principal arterials, and any other roadway where the projected Average Daily Traffic exceeds 10,000 or more vehicles per day.

- Noise Standard - Howard County uses an A-weighted DNL of 65 dB, which was chosen to match the HUD sound level standards. Therefore, potential homeowners find financing homes in new developments to be easier and more affordable, as compliance with HUD standards allows Veteran Administration and Federal Housing Administration loans to be obtained.

- Computer Noise Model - An acceptable model must be stipulated for noise predictions. Howard County originally used the HUD method of noise prediction. Later STAMINA 2.0 was used, and currently the FHWA TNM is approved for use.

- Planning Horizon - An adequate planning horizon must be used for traffic growth projections. If the horizon is too short or if the growth rate is too small, traffic noise impacts may occur for residents at some point in the future. Howard County uses a twenty-year planning horizon.

Noise Impact Determination

Proposed residential developments must be evaluated for potential traffic noise impacts if the development lies within specified distances from traffic noise sources. For the three facility types: minor arterial, principal or intermediate arterial, and facilities with an Average Daily Traffic over 10,000 vehicles per day, these distances are 250 feet, 500 feet, and 1,000 feet, respectively.

As noted above, the A-weighted DNL is the noise descriptor used for both impact determination and noise abatement design goals. Howard County adopted the HUD standards of 65 dB for outdoor activity spaces and 45 dB for interior spaces.

Areas of outdoor activity are defined by the "50-foot building curtilage," defined as the area within a boundary located 50 feet from any outside wall of the building. If only portions of a lot are noise-impacted, the building placement can be adjusted to avoid impacts to this defined area.

Noise-Compatible Development Strategies

Howard County does not specify the types of abatement that must be used for a specific development. Developers have used the strategies of building orientation, open spaces, and dense foliage plantings (the latter where only small noise reductions were required). When noise barriers are required, the County recommends that earth berms be used.

Sound insulation has been added to homes in order to bring the interior DNL to 45 dB or less where noise barriers did not supply adequate attenuation to reach the 65 dB DNL design goal for exterior areas. Also, the label "noise sensitive area" must be placed upon any subdivision plat map where abatement design goals may only be partially met.

Program Personnel

Personnel who review developer plans to avoid traffic noise impacts must have a basic knowledge of traffic noise characteristics, modeling, and abatement methods. At Howard County, personnel have received this background through HUD materials, TNM reference books, workshops and other means.

Program Enforcement

The developer-proposed strategies to avoid noise impacts must be documented and described on the plan submittals. The submitted plans are reviewed for accuracy. Earth berms

are strongly recommended for cases where a noise barrier is required. In some cases there may not be enough land area to construct a berm of adequate height. Therefore a berm-wall combination will be permitted. The program guidelines do not provide noise wall specifications. Instead, developers are given manufacturer information on the types of noise walls that are acceptable. All noise wall plans are checked for adequate wind load capacity.

Challenges to Effective Program Operation

Plan reviewers must scrutinize developer-submitted plans for errors. It is not uncommon to find errors in the coordinate system that describes the geometric relationships between the roadway and receivers. The model inputs must also be checked. Developers may argue that with a twenty-year planning horizon the Level of Service (LOS) for the roadway will be poor due to growth in traffic volumes. A lower LOS implies lower speeds; therefore, the consultant may suggest using a 30 mile-per-hour speed in the model, which would mean lower sound levels; however. Howard County requires the posted speed limit be used since traffic capacity increases may occur over the life of the facility.

Potential Program Improvements

The program could be improved by providing training to update and extend the understanding of noise fundamentals and recent developments for program personnel.

6.3.6.3 Anne Arundel County

The following information was obtained from Anne Arundel County's ordinance containing the requirements and design standards for new subdivisions [Anne Arundel County Council 1998].

In 1998, the County Council of Anne Arundel County, MD, introduced Bill No. 5-98, entitled *An Ordinance Concerning: Subdivisions - Design Standards and Requirements - Highway Noise Mitigation.* The purpose was to establish the distance that residential lots must be set back from certain specified highways in order to mitigate highway noise. The specified setback distances range from 190 to 660 feet depending on which highway would be adjacent to the development. The specified distances could be reduced subsequent to analysis and prediction of sound levels at the property line using the Maryland SHA's TNM. Such reductions would be approved only if (1) noise mitigation measures would achieve a one-hour average sound level ($L_{Aeq}(1h)$) of 66 dBA or less at the property line or (2) a setback less than the specified distance would produce a level of 66 dBA or less. Further, any proposed noise mitigation measures must be approved by the SHA.

6.3.7 Michigan

The City of Livonia, Michigan, has had a noise compatibility program since the 1970s. Much of the information presented below was obtained though an interview with Mr. Scott Miller of the City's Planning Department [Miller 2003].

Livonia was the fourth of the four cities that were the subject of a series of USDOT case studies in the 1970s [USDOT 1979]. The case study pamphlet described the noise-compatible development strategy used by the City of Lavonia as a greenbelt.

Noise-Compatible Development Strategies

Any new development near a road must provide a 30-foot buffer containing a landscaped berm between the right-of-way line for a roadway and the first row of residences. The combination of added distance between the traffic noise source and the receiver, along with the shielding provided by the berm, attenuates the traffic noise sufficiently to preclude the need for a wall. This strategy was chosen not only to abate noise but also to avoid the use of developer-built noise walls, which the City generally considers to be unsightly. This requirement is enforced for new developments adjacent to all roadways, including freeways, major arterials, collectors and local streets. In the case of local streets, a buffer distance less than 30 feet may be approved depending on other site conditions.

The City of Livonia has not changed its program since its inception in the 1970s. The program has been effective in both minimizing noise impacts and improving the appearance for new residential developments for both residents and drivers on adjacent roadways. Residents have found the lots closest to the freeway, that border on the landscaped berm, to be appealing to the extent that developers are often able to sell these lots as "premium" lots.

6.3.8 Minnesota

The information presented below on the State of Minnesota was obtained from the *Noise Mitigation Strategies* report by Herman and Bowlby [Herman and Bowlby 1993].

Minnesota, unlike most states in the U.S., has a state noise ordinance. This ordinance is binding on the entire state, but local agencies can adopt or modify the noise ordinance as long as any changes are not interpreted as being more stringent. Should a local agency choose not to adopt the ordinance, the ordinance is still in effect as it is written at the state level. Some enforcement is carried out on the state level. Also, training in the use of noise measuring equipment and other technical support is provided to local agencies that want to be involved in noise enforcement.

The Minnesota Pollution Control Agency (MPCA), which was started in 1967, was given authority to write state noise regulations in 1971. Rules were finalized and went into effect in 1974. The state noise standard for outdoor residential areas stipulates use of an $L_{A10}(1h)$ with a maximum of 65 dB for daytime hours and 55 dB for nighttime hours. This time distinction has caused a problem with highway noise. Though nighttime hours are considered to be from 10:00 p.m. to 7:00 a.m., there is typically a large increase in traffic during the 6:00 am to 7:00 am hour. Since this increase makes it difficult to achieve the lower standard of 55 dB in residential areas, there has been some thought to changing this hour to be grouped with the daytime hours. Sometimes an $L_{A50}(1h)$ maximum of 60 dB is used for daytime hours with an $L_{A50}(1h)$ of 50 dB maximum used during nighttime hours. This descriptor is typically used for facility noise, referring to point sources such as factories or machinery in contrast to traffic noise.

As noted, the noise ordinance is unusual because it does not exempt traffic noise. There is a partial exemption for the case of highways where federal funds are involved, however. For such cases, the FHWA NAC given in 23 CFR 772 apply (that is, an $L_{A10}(1h)$ of 70 dB or an $L_{Aeq}(1h)$ of 67 dB). Since the Minnesota State Noise Standards are more stringent than the FHWA NAC, this exemption is provided. If the FHWA NAC are met, the State of Minnesota is satisfied even though FHWA Headquarters Office of Environmental Policy insists that the NAC are impact indicators, not design standards. Usually, Minnesota Department of Transportation (MnDOT) attempts to meet not only the FHWA NAC but also the Minnesota standards.

For the case of non-federally funded highway projects, MnDOT comes under the Minnesota noise ordinance. MPCA reviews a new construction or reconstruction project for noise impacts. If impacts are predicted, abatement is required to meet the standards of the noise ordinance. For those cases where it may not be feasible to meet the standards, the state or local agency proposing the transportation facility must obtain a variance.

The USDOT case study of Minnesota made in the mid-1970s regarding noise and land use compatibility planning emphasized the key role played by MnDOT. Currently, MnDOT continues to review all proposed developments adjacent to state highways. This review is limited to an advisory role. MnDOT makes suggestions for possible measures that could be implemented to reduce sound levels. While this process alerts local planners to potential problems, it does not ensure compliance with the MnDOT recommendations.

MnDOT has frequently asked for authority to do land use planning along their freeways and major arterials in Minnesota. The authority to do so has not yet been granted. Currently, there is no noise barrier retrofit program for dealing with noise problems due to existing highways; however, in the 1970's millions of dollars were spent on dozens of miles of retrofit noise barriers on existing highways, primarily in the Minneapolis-St. Paul area.

The state noise program coordinator is in the Air Quality Division of the MPCA. The noise coordinator deals with aircraft noise as well as highway noise. Assisting the coordinator is a noise specialist who does field monitoring and noise measurements, and who handles the technical aspects of the program. The noise group reviews all noise analysis done for new projects whether they are for residential developments or for transportation facilities proposed by MnDOT.

The trend toward increased land use planning for highway noise compatibility is expanding in Minnesota. The trend seems to be occurring on a city-by-city basis. An example of a recent activity in this area took place for the City of Shakopee. State Highway 101 was an existing highway along which a new development had been proposed. In the review process, MnDOT predicted that noise impacts from highway noise would affect the residential development. Since MnDOT already had a permit for this transportation facility, which was in operation, it was not required to mitigate the noise. MnDOT provided noise abatement recommendations anyway and suggested that approval for the new development be contingent upon the recommendations.

There are cases in which developments are approved without consideration of noise impacts or without regard for MnDOT's recommendations. Residents suffer as a result. In general, MnDOT and MPCA see the municipality as being responsible in these cases. It is the intention of the MPCA that a municipality either provides noise abatement or requires developers to include abatement as part of the approval to develop the land. This requirement is not as clear-cut where other local agencies have defined their procedures; that is, the responsibility falling on the developers is not as clearly defined and is often shared with the municipality. The MPCA noise group encourages the communities to require that developers provide mitigation where it is required.

6.3.9 North Carolina

Generally, the North Carolina Department of Transportation (NCDOT) provides sound level contour information and sound level information in the environmental documentation prepared for the proposed highway project to local jurisdictions to encourage compatible

development [Walker 2003]. Also, NCDOT provides technical support upon the request of local jurisdictions. NCDOT is not aware of any local jurisdictions that are active in "noise-compatible development" or other interesting methods of traffic noise control beyond the basic muffler, nuisance and disturbing the peace types of ordinances.

6.3.10 Ohio

ODOT staff are in the process of presenting a research scenario to ODOT management that will enable analysis and quantification of sound levels along undeveloped areas of a major interstate highway [Pinckney April 8, 2003]. ODOT staff would like to present the data from this study to the local planning bodies in hopes that they would include the data in their decision making process for zoning. There are no areas in Ohio that are active in noise-compatible development. Additionally, Ohio is a "home rule" state where municipal bodies have constitutionally-granted powers including the power of local self-government, the exercise of certain police powers, and the ownership and operation of public utilities. These powers inhibit any local government interference.

6.3.11 Wisconsin

The WisDOT State Noise Policy (Wisconsin Administrative Code - Chapter Trans 405) has a provision that requires any municipality that accepts construction of a WisDOT noise barrier to develop a land use policy that ensures no future development will occur in areas that are currently impacted by noise [Waldschmidt 2003]. Different municipalities have responded in different ways, as illustrated below.

6.3.11.1 Madison

Madison has very detailed language in its zoning ordinance to deal with noise. Many developers are building berms along the interstate and other roadways so they can develop property in these areas. The developer must provide sound level modeling to show that the location of residential houses will not be impacted.

6.3.11.2 Dane County

WisDOT considers Dane County to be a real success story. Dane County has adopted a Noise Control Overlay district along all divided highways. No development may occur within 500 feet of the highway right-of-way unless the WisDOT grants the developer a waiver. That waiver would be based on sound level modeling evidence.

6.3.11.3 City of Appleton

The City of Appleton only has a distance requirement. According to Mr. Jay Waldschmidt of WisDOT, the distance is probably not great enough [Waldschmidt 2003].

6.3.12 Canada

6.3.12.1 Ontario

Much of the information on local agencies in Ontario presented below was obtained though an interview with Mr. Chris Blaney, Senior Environmental Planner – Acoustics, Ontario Ministry of Transportation [Blaney 2003].

Noise-compatible development planning at the local level officially began in Ontario on February 8, 1977, with the announcement that noise barriers would no longer be built by the Ontario Ministry of Transportation to protect new residential development impacted by traffic noise from existing roadways. The Ontario Ministry of Housing publication, *Guidelines on Noise and New Residential Development Adjacent to Freeways* was issued in 1979 for province-wide use by local agencies. Therefore, the noise-compatible development plans are identical for all local agencies in Ontario. While the basic standards, criteria, and procedures remain essentially the same, the guidelines have been replaced by several documents produced by the Ontario Ministry of the Environment in 1995 [Ontario Ministry of the Environment 1995].

Steps to Program Implementation

Several critical steps leading to a successful program were identified.

- Land Use Planning Policy -- A province-level (or state-level) policy on land use planning must be put in place. The policy should provide wording that promotes noise-compatible land use zoning.

- Province-wide Requirements -- Province-wide guidelines must be written to produce noise-compatible development for an area where land use zoning does not prevent impacts. This step is critical to prevent a wide variation in plans and procedures that may be generated on the local level.

- Province-level Review of Proposed Developments -- The provincial department of transportation should review noise-sensitive developments that are proposed at sites near provincial transportation facilities. Only local review of proposed developments adjacent to local facilities would be required. This step was identified as critical because local agencies do not generally have the expertise to perform this review. Further, the requirement for approval at the provincial level will tend to limit the number of waivers granted to developers through political action on the local level. Also, province-level review reduces the possibility of local agencies choosing to ignore the guidelines in order to attract development to their city, which could result in future complaints by residents to the provincial ministry of transportation.

Noise Impact Determination

Traffic sound level predictions must be based on a ten-year planning horizon. The 24-hour equivalent continuous sound level (L_{Aeq}(24h)) descriptor is used. The L_{Aeq}(24h) descriptor is similar to DNL and CNEL descriptors, but with no sound level penalty added to evening or nighttime levels before the averaging. The traffic volume used for sound level prediction is the Summertime Average Daily Traffic or the Annual Average Daily Traffic, whichever is greater.

Noise abatement for outdoor living areas with predicted traffic noise impacts must reduce the L_{Aeq}(24h) to 55 dB or less.

Noise-Compatible Development Strategies

The guidelines state that residential areas should normally be located away from freeways. Whenever possible, commercial, light industrial, recreational and agricultural uses should buffer residential areas from noisy freeway traffic. If residential areas must be located near a freeway, developments should include suitably designed medium and high-density residential buildings rather than low-density single-family units. For the case of existing residential areas adjacent to freeways where noise is considered excessive, the guidelines provide for noise barriers to be built where feasible.

In all cases where a proposed development is within one kilometer of the edge of a freeway right-of-way, the developer must make early contact with the Ontario Ministry of the Environment.

Developers are encouraged to employ strategies such as buffer zones, building orientation, building installation, and noise barriers including berms, walls, or berm-wall combinations.

The requirements for developers are different for the case where the proposed development will be located adjacent to a proposed freeway. Rather than construct abatement, the developer may be required to either provide land, at no cost to the local government, for construction of a future noise barrier, or to contribute to the cost of construction of a future noise barrier.

Program Enforcement

In Ontario there is little inspection by local agencies for compliance with plans during the construction of barriers and other noise abatement features.

Program Costs

The Ontario Ministry of the Environment has reviewed the proposed plans for local developments throughout most of the time period when noise-compatible development guidelines have been in place. The program costs were limited to the salaries and benefits for a staff of four to five reviewers to handle the review process workload in Ontario. The recent change in administration, however, placed this responsibility with local agencies. Local agencies now provide the required acoustical expertise by hiring consultants to review the work of other consultants, a less than desirable situation from the provincial point of view.

Challenges to Effective Program Operation

The quality of developer-built walls was cited as one problem with effective program operation. The Ministry of the Environment stated that noise walls should meet a density of 4 lb/sq. ft. and have no gaps. This limited standard did not prove to be adequate in Ontario. Therefore, province-wide requirements for noise barriers are needed. The *Noise Barrier Design Handbook* manual developed for the U.S. FHWA was recommended for use [Knauer et al. 2000].

Further, it was recommended that developers be required to warrant barrier performance for a minimum of two years.

Potential Program Improvements

The program could be improved by including a provision for municipalities to assume the ownership of developer constructed noise walls. This action would be consistent with the current practice of municipalities, in both the U.S. and Canada, of assuming ownership of infrastructure items such as roadways, storm and sanitary sewers, and the like. The quality of noise walls would be improved as a direct result of this requirement. As with other utilities, a municipality will not assume ownership of utilities unless they are inspected and found to meet specifications. Further, residents would be protected from future noise wall failures, as they would be for failures with other utilities.

6.3.12.2 Calgary, Alberta

Much of the information on the City of Calgary presented below was obtained though an interview with Mr. Sunny Wong, Transportation Engineer [Wong 2003].

The noise guidelines for the City of Calgary address traffic noise sources for both major arterials and freeways and rail noise sources for both light and heavy rail. The guidelines focus on noise-compatible development for residential developments rather than schools, hospitals, and similar institutions. The guidelines were developed in 1988 and there have been two additions. A truck route policy was developed in 1996 and an administrative and budgeting policy was adopted in 2000. The truck route policy established the L_{A10} descriptor with a 65 dB standard for noise abatement criterion on specified truck routes. The administrative and budgeting policy provides guidance for funding the City's noise abatement retrofit program.

Noise Impact Determination

Noise analysis reports for new developments are currently based upon the U.S. FHWA TNM. Analyses are required to consider both 10 and 20 year planning horizons. The noise descriptor is the (L_{Aeq}(24h) except on truck routes where the L_{A10} is used. The impact and abatement standard is 60 dB. The abatement methods must be chosen to reduce sound levels to 60 dB or less and the minimum noise barrier height is 1.8 m (6 ft).

Noise-Compatible Development Strategies

The basic approach used by the City of Calgary to attain noise-compatible development is based upon one of four “case types” [City of Calgary 1988].

- *Case I: Residential Development or Redevelopment Adjacent to an Existing or Imminent (within 10 years) Transportation Noise Source.* A noise analysis must be made to predict sound levels 10 years into the future. The developer must propose and fund abatement if warranted. Following acceptance by the City, the City will maintain the constructed noise abatement.

- *Case II: Residential Development or Redevelopment Adjacent to a Future (beyond 10 years) Transportation Noise Source.* The developer is responsible for designing and constructing

the residential area in such a way as to facilitate the necessary attenuation at the time of construction of the roadway. The City of Calgary would then be responsible for completing the required noise attenuation.

- *Case III: Upgrading a Roadway Adjacent to the Existing Residential Developments.* The City of Calgary is responsible to provide any noise abatement warranted by the project.

- *Case IV: Present Residential Development Adjacent to an Existing Transportation Noise Source.* This is a retrofit situation. Residential areas with noise impacts are placed on the City's Noise Barrier Retrofit Program for review by the City council.

Potential Program Improvements

The need for more detailed policy and guideline information was cited as one means of improving the program. The guidelines were written with single-family residential developments in mind. Currently, these guidelines are applied to multi-family developments in ground-level areas of outdoor activity. Therefore, specific guidelines for noise-compatible development where apartments or condominiums are planned would be helpful.

Developers frequently install noise walls as an abatement strategy, but developers are not required to comply with specific noise barrier standards. The typical noise wall is a wooden board-on-board fence. The requirement to use treated wood could be added as a first step to improve longevity. Currently, wooden noise barriers deteriorate rapidly while traffic volumes increase. When these barriers are no longer effective, residents complain to the City. As a result of these complaints, the development will be placed upon the City's retrofit priority list for replacement. The development of new noise barrier standards was cited as an objective to produce consistency, quality, and durability in the developer-built noise walls. The noise walls constructed by the City, which are most often composed of concrete, are more substantial than the walls constructed by developers. Detailed specifications have been written for wood and two kinds of precast concrete noise barriers for projects funded by the City of Calgary.

A buffer zone strategy was cited as another strategy for noise mitigation on high volume roadways. This buffer zone would be within the right-of-way. Currently, the right-of-way is 30-36 m (98-118 ft) wide for major roads in Calgary. A right-of-way width of 72-75 m (236-246 ft) was suggested as ideal to provide an effective noise buffer.

6.3.12.3 Saskatoon, Saskatchewan

Much of the information on the City of Saskatoon presented below was obtained though an interview with Mr. Brian Boyes, Parking Services Manager [Boyes 2003]. The noise and land use compatibility program for Saskatoon was initiated in 1984 following a study by planning personnel of programs used by other local agencies. The City did not receive funding or technical assistance for the program from either the Saskatchewan Ministry of Transportation or Ministry of the Environment.

Noise Impact Determination

The original guideline specified the $L_{Aeq}(24h)$ with the standard of 65 dB as the criterion for impact. In 1990 the criterion was changed to the DNL and the 65 dB standard was maintained.

Noise-Compatible Development Strategies

A noise study must be conducted for proposed residential developments located adjacent to traffic noise sources. If this study concludes that impacts will occur to the residential area in the design year, the developer must propose abatement. Once the City approves the developer's proposed abatement, the abatement measure becomes part of the development plan. In cases where noise impacts are predicted for a proposed development near a planned roadway the developer is assessed fees, which will be used to fund abatement at the time of roadway construction. These costs are added to the other prepaid service charges such as the costs of streets and sewers.

The City of Saskatoon also has a retrofit plan to fund traffic noise abatement projects for existing impacts. Priorities are assigned to those areas qualifying for noise abatement based on a cost-benefit evaluation.

Earth berms are preferred to walls when noise barriers are chosen for abatement. The earth berms provide added buffer space between residences and roadways. The right-of-way line is established at the top of the berm. The resident owns one-half of the berm and, therefore, is responsible for its maintenance. For cases where adequate attenuation is not provided by the berm, a wall may be constructed at the top of the berm.

In 1992, the City was in the process of designing its first noise barrier; however, funding did not become available for construction and the barrier was not built. The City has recently allocated funds for noise barrier construction. Two million dollars was set aside for barrier construction in 2003. Two of the barriers are being designed for two different sections of a high-speed, four-lane divided arterial, and a third barrier will be constructed along a freeway. A portion of the barrier designed in 1992 is scheduled for construction in 2004.

The City is moving toward the policy of including noise barrier costs with capital improvement projects associated with adding lanes, etc., to existing highways to avoid using retrofit barrier funding. The barriers currently being planned will be constructed in post and panel configuration using interlocking, mortar-less cinder blocks. The City has required that these barriers meet the Canadian standards for traffic noise barriers (*CAS Z107.9 Standards for Certification of Noise Barriers*).

Most residential subdivisions that have been built since the guidelines have been in place have not been located near major highways, so noise abatement has not been warranted. Planners do anticipate an increased need for noise abatement, however, with future developments. Strategies such as setbacks, building orientation, and buffer zones will be utilized where possible.

The City of Saskatoon may be unique in North America by having its own land development branch. The City develops residential subdivisions from time to time. When noise barriers are required, earth berms have been constructed where feasible. In the last year, the City has built approximately 1,500-1,600 m (4,922-5,250 ft) of earth berms. While the City prefers earth berms, it is anticipated that there will not be adequate right-of-way area for earth berms at many locations in the future.

6.3.13 State DOT Policy Responses

Many state transportation agencies continue to have concerns regarding the proliferation of new residential development adjacent to state highways due to lack of land use and noise compatibility planning by local governments. For example, Montana's noise policy states:

> MDT will give greater consideration to (1) residential areas along highways on a new location, (2) residential areas that were constructed before an existing highway, and (3) residential areas that have been in place along an existing highway for an extended period of time. MDT will give less consideration to residential areas that have developed along an existing highway without proper consideration of traffic noise impacts by the local community or developer. [MDT 2001].

State transportation agencies that include similar language include Alabama, Arizona, Hawaii, Missouri, South Dakota, Tennessee, Wyoming and Puerto Rico.

Due to a lack of noise and land use compatibility planning at the local level, several state transportation agencies have modified their policies to more specifically address the reasonableness of providing abatement for recently constructed development. These states include Alaska, Iowa, Kentucky, Maryland, Oregon and the District of Columbia, as described below. While these policy revisions are reactive in nature, the changes may aid in increasing awareness of the need for noise and land use compatibility planning among local governments.

6.3.13.1 Alaska

Alaska DOT considers seven factors when considering the reasonableness of noise abatement. Two of the factors deal with development date as stated below:

> Reasonableness will be determined based on the following factors . . .
>
> . . . (C) The sensitive receivers predated initial highway construction - "most" impacted homes were built before initial construction of the highway. The date of development is an important part of the determination of reasonableness. More consideration is given to developments that were built before the highway. For the purposes of definition, "most" will be defined as at least 50%.
>
> (D) The sensitive receivers have been in place for at least 10 years - "most" impacted receivers have existed for at least 10 years. More consideration is given to residents who have experienced traffic noise impacts for long periods of time. For the purposes of definition, "most" will be defined as at least 50%. [Alaska 1996].

Mr. Jerry Really of the Alaska DOT clarified that if points C and D were the only criteria that were not met, Alaska DOT would not necessarily deem a barrier unreasonable. Alaska DOT very recently had a case, however, where a development was under construction and these criteria were used to help justify the decision to not build a barrier [Really 2003].

6.3.13.2 Iowa

Iowa considers nine factors when considering the reasonableness of noise abatement. One of the factors deals with development date, "The timing of development adjacent to the highway as compared to the time of initial construction of the highway. Noise barriers shall generally not be constructed for developments occurring after original highway construction." [Iowa DOT 1997].

Mr. Ron Ridnour of the Iowa DOT revealed that this factor was included as a signal that all new development occurring directly adjacent to the network (primarily next to the interstate system) "generally" would not be favorably considered for special noise abatement [Ridnour 2003]. As a result, a barrier is pretty much determined to be unreasonable under this circumstance. The word "generally" provides some flexibility for site-specific conditions and political decisions. Mr. Ridnour indicated that they have had no unfavorable reaction from the public, primarily because it makes sense to reasonable people. At the same time development is continuing because there is a market for residential land use near highways. Iowa DOT does get inquiries about traffic noise, but they are small in number (so far, at least) compared to the number of residential units exposed.

6.3.13.3 Kentucky

The Kentucky Transportation Cabinet's policy states:

> Generally, barrier construction will not be reasonable under the following conditions . . .
>
> . . . 2. At locations involving improvements to existing highways which were undeveloped when the original highway was completed and at which the new project does not appreciably alter (> 3 dBA) the future noise environment. [Kentucky 2000].

Mr. David Waldner of the Kentucky Transportation Cabinet revealed that the State has avoided placing barriers along corridors where new developments rise adjacent to the existing roadway although the State has attempted, for the most part unsuccessfully, to encourage a requirement for buffers, etc. through local zoning [Waldner 2003]. He noted one exception where a barrier is currently being designed. The Kentucky Transportation Cabinet is considering a change to its policy.

6.3.13.4 Oregon

Oregon DOT's policy states, "Noise mitigation will not normally be recommended for residences constructed after 1996 unless the project causes the sound levels to increase by 5 dBA or more." [Oregon DOT 1996]. Mr. David Goodwin of the Oregon DOT has noted that Oregon DOT modified its policy in 1996 to state that any new development adjacent to highways after 1996 will not be eligible for noise abatement unless the increase from "existing" to "build" is 5 or more dB [Goodwin 2003]. This factor is addressed in its policy's reasonableness section by including a statement that the cost is not reasonable under these circumstances. FHWA approved the policy without issue. Oregon DOT has not had a case against which to apply this criterion until recently when they determined that noise barriers were not reasonable for an apartment

complex constructed after 1996. Mr. Goodwin expects that there will be some reaction to this determination that barriers are not reasonable.

6.3.13.5 Maryland

The Maryland State Highway Administration (SHA) policy for Type I barriers states:

> For Type I projects, if a change over no-build levels of less than 3 decibels [in terms of $L_{Aeq}(1h)$] would result from a build condition, a sound barrier could be considered not to be reasonable. In the assessment of the no-build to build sound level change, consideration will be given to the cumulative effects of highway improvements made after the original highway construction. If the cumulative increase in design year build sound levels at noise sensitive receivers that existed when prior improvements were made is equal to or greater than 3 decibels, noise abatement could be considered reasonable.
>
> If sound levels equal or exceed 72 decibels [$L_{Aeq}(1h)$] at impacted noise sensitive receivers, SHA will consider a sound barrier reasonable for any proposed highway expansion that will increase sound levels provided that other feasibility and reasonableness criteria are met. [Maryland SHA 1998]

Mr. Ken Polcak of the SHA indicated that the SHA routinely applies this criterion [Polcak May 14, 2003]. For residences built recently, the baseline is generally the no-build case since these homes did not exist when prior improvements may have been made. If the development is older and a 3 dBA increase is not predicted from no-build to build, then they will assess the condition that existed when the residences were constructed. The increase from this baseline to the build condition will usually be greater than 3 dBA. The SHA has had instances of recent development where application of this criterion led to a determination that a barrier was not reasonable. Mr. Polcak noted that if the predicted build levels are 72 dBA or higher [$L_{Aeq}(1h)$], abatement is considered reasonable regardless of the increase. At FHWA's suggestion, the SHA is currently in the process of restructuring the policy to clarify the baseline condition that is assumed for the analysis using a step-by-step process.

6.4 Noise-Compatible Land Use Summary

Noise and land use compatibility focuses on noise control at receivers adjacent to the traffic noise source. Two general categories of receiver control are (1) land use zoning and (2) noise-mitigated development. Programs to ensure noise and land use compatibility are generally implemented at the local level and numerous local agencies in the United States and Canada have implemented programs to facilitate noise and land use compatibility.

California requires that noise be included as an element in the local planning process. There are disparities in the overall success of the local programs in California, however. Some local programs seem to be very successful while others have not.

The Arizona Department of Transportation has been very proactive in encouraging local governments to voluntarily address noise and land use compatibility. As a result, several communities have implemented successful noise and land use compatibility programs.

6.5 Noise-Compatible Land Use Recommendations

Noise compatible development planning has the greatest potential for success in communities that are in the earlier stages of development. Since Montana has communities that are growing and developing, this is an excellent time to make an investment that will lead to long-term benefits. The strategies that comprise noise compatible development planning are proactive and preventative in nature; therefore, supporting implementation of such strategies now can avert many problems in the future. To fully realize the potential of noise compatible development planning, the following steps to implementation, which are based on the findings from the case studies, are recommended.

6.5.1 Implementation

6.5.1.1 MDT

- MDT should investigate the possibility of promoting legislation that would require local jurisdictions to consider noise in the planning process.

This recommendation is made acknowledging that citizen sentiment seems against state-level involvement in land use decisions. The success of the growth policy legislation could serve as a precedent; however, where the optional development and implementation of a growth policy is a local decision. Potential legislation should include statements of policy on noise-compatible land use zoning and noise-compatible development.

The surveys of residents and planners conducted in this research provided additional insight into the desirability of a variety of technical, administrative and educational assistance tools for implementation noise compatible development planning. The reader is referred to Section 8 for details. Many of these items would be useful regardless of whether statewide legislation for noise compatible development planning is pursued. Education and awareness would even be useful if no restrictions were to be applied to residential land developers under local government initiatives. These items have the potential of affecting purchase decisions of an informed public, as well as development/building decisions of informed developers and builders.

- If legislation is enacted, it is recommended that MDT initiate the formation of a consortium within the state to produce a state-level model noise guideline that could be adopted by local agencies within the state for use in noise and land use compatibility planning and development.

Any legislation should authorize the development of a model guideline and the establishment of a state office for technical assistance to provide needed support at the local level. This state-level step is necessary to prevent a wide variation in plans and procedures, as well as failures at the local level.

- Whether or not legislation is enacted, MDT should consider developing sample noise abatement design specifications and standards for use by local governments in working with developers and builders.

These specifications and standards could be implemented by interested local agencies to ensure that abatement measures constructed as part of new developments by developers are effective and durable. Compliance with these standards could be a requirement in any situation where

municipalities might be assuming the ownership of developer-constructed noise walls, which is consistent with current practices of municipalities assuming ownership of infrastructure items such as roadways, and storm and sanitary sewers.

- MDT should also consider playing a role in the review of proposed noise abatement strategies for developments in the vicinity of state highways, if not on a routine basis, at least on an advisory basis as part of a broader technical assistance program.

- Whether or not legislation is enacted, MDT should consider initiating a thorough effort to educate local planning officials of the effects of allowing noise-sensitive development adjacent to major roadways and to inform them of MDT's policy regarding provision of noise abatement for existing communities.

- MDT may also wish to modify its noise policy to include a statement indicating that consideration of abatement for a road widening project will no longer normally be considered for residential developments constructed adjacent to the existing pre-widened highway after the date of the policy change.

6.5.1.2 Local

- If legislation is ultimately enacted, local agencies, in compliance with state requirements, should incorporate noise into their planning function.

- As part of the requirements they should adopt the model guideline, conduct required noise studies, produce noise contours, construct appropriate policy lines for various categories of development, and develop plan review and enforcement procedures.

6.5.2 Noise Guidelines

- If legislation is enacted, it is recommended that MDT initiate the formation of a consortium within the state to produce a state-level model noise guideline that could be adopted by local agencies within the state for use in noise and land use compatibility planning and development. The following are recommended, based on the findings from the case studies, as essential elements to a noise guideline.

- Designation of noise sources to be considered

- Noise compatible land use zoning requirements

- Noise contour and policy line requirements

- Noise impact determination

    - Criteria

    - Standards

    - Planning horizon

    - Required noise model

  - Noise model input requirements, such as specification of speeds, volumes, lane distribution of vehicle classes, etc.

- Noise abatement
  - Criteria for abatement
  - Standards for abatement
- Noise compatible development strategies
  - Acceptable strategy categories with prioritization
  - Reference to abatement standards
- Program enforcement procedures
  - Planning personnel
  - Plan review
  - Construction inspection

Guidelines produced at the state level will ensure consistency and uniformity throughout the state; however, close coordination and input would be required from local agencies that may wish to tailor the guidelines to best fit their own unique situations.

7.0 LAND USE PLANNING AND DEVELOPMENT IN MONTANA

7.1 Introduction

This report section addresses conditions that contribute to occurrence of traffic noise/land use conflicts in Montana. It presents results of discussions with a number of local planners in Montana as a precursor of the survey that has a broader distribution. Montana's land use planning and development processes and procedures are described in some detail because an understanding of them is important for success with noise-compatible development efforts. Finally, some other statewide activities related to growth issues are discussed.

7.2 Montana Primer

As noted in Table 9, Montana encompasses just over 147,000 square miles, and is the nation's fourth largest state (ranking behind Alaska, Texas and California). The 2000 census reported Montana to have 902,195 residents making it the country's 44th most populated state (ranking ahead of Delaware, South Dakota, North Dakota, Alaska, Vermont and Wyoming). In 2000, Montana accounted for 4% of the national land area, and 0.3% of the nation's total population. Montana's overall population density was 6.1 persons per square mile.

Table 9: Montana Characteristics

Characteristic	*Amount*	*Percent of National Total*
Montana Land Area (sq. mi.)	147,045	4.0%
Montana Population (total residents)	902,195	0.3%

Nearly all of Montana is rural. The greatest portion of Montana's acreage is devoted to grain farming and ranching. Areas with agriculturally based economies are often capable of supporting only small populations. Montana also contains large amounts of publicly owned lands. The US National Forest Service, the Bureau of Land Management, and National Park Service are major federal landowners. Montana also has retained more of its original School Trust Lands than any other state. People are generally restricted from living within these federal and state lands.

In recent decades, Montana has experienced alternating cycles of slower and faster growth. As shown in Table 10, between 1990 and 2000 the population of Montana increased from 799,000 to 902,000, a net population increase of 103,000 people. Montana's ten-year growth rate was 12.9%, which was very similar to the nation's 13.2% growth rate.

7.2.1 County Populations and Population Trends

Montana is divided into 56 counties. As shown in Table 11, about two-thirds of Montana's residents (601,000 out of 902,000 people) live in the State's nine most populated counties. Only Yellowstone County (which includes the city of Billings) has more than 100,000

residents. Five counties have populations of 50,000 to 99,999 and three counties have populations between 20,000 and 49,999. The remaining 47 counties have populations less than 20,000.

Table 10: Montana Statewide Population Change, 1950-2000

Year	*Montana Population*	*10-Year Population Change*	*10-Year Percentage Change*
1950	591,024	31,568	5.6%
1960	674,767	83,743	14.2%
1970	694,409	19,642	2.9%
1980	786,690	92,281	13.3%
1990	799,065	12,375	1.6%
2000	902,195	103,130	12.9%

Source: US Bureau of the Census, 2003.

Table 11: Population Distribution of Montana Counties, Number of Counties within Population Group, 2000 Census

Population Group	*Number of Counties*	*Sum of Residents*	*Percent of State Population*
100,000 or more	1	129,352	14.6%
50,000 to 99,999	5	374,177	41.5%
20,000 to 49,999	3	62,577	10.8%
10,000 to 19,999	10	131,607	14.6%
5,000 to 9,999	15	117,296	13.0%
Less than 5,000	22	52,580	5.8%
Totals	*56*	*902,195*	*100.0%*

Most population growth has been concentrated in a few counties. The counties experiencing the greatest population growth are those with urban centers and those adjacent to other counties with urban centers. In the past decade, approximately 90% of the State's population growth occurred in these nine counties:

- Gallatin: 17,368 (34% increase)
- Missoula: 17,115 (22% increase)

- Yellowstone: 15,933 (14% increase)
- Flathead: 15,253 (26% increase)
- Ravalli: 11,060 (44% increase)
- Lewis & Clark: 8,221 (17% increase)
- Lake: 5,466 (26% increase)
- Cascade: 2,666 (3% increase)
- Jefferson: 2,110 (27% increase)

7.2.2 Municipalities

Montana also has 129 incorporated cities and towns (municipalities). As shown in Table 12, 54% of Montanans were living inside these cities and towns in 2000. This percentage is much lower than the national norm of 70%.

Most Montana municipalities are small. Montana has seven incorporated areas with populations of greater than 10,000 (Class 1 cities) including Billings (with 89,847 people, the State's most populated city), followed by Missoula, Great Falls, Butte-Silver Bow (a consolidated city-county government), Bozeman, Helena and Kalispell.

Table 12: Population Distribution of Montana Cities and Towns, Number of Cities and Towns within Population Group, 2000 Census

Population Group	***Number of Municipalities***	***Sum of Residents***	***Percent of State Population***
100,000 or more	0	0	0.0%
50,000 to 99,999	3	203,509	22.6%
20,000 to 49,999	3	87,181	9.7%
10,000 to 19,999	1	14,223	1.6%
5,000 to 9,999	8	57,204	6.3%
1,000 to 4,999	41	91,692	5.8%
999 or less	73	30,494	3.4%
Totals	*129*	*484,384*	*53.7%*

An area's status as an incorporated community may be relevant to implementation of this research. Under Montana law, cities and towns are vested with greater ability and flexibility to provide public services and regulate activities than are county governments.

There are very few instances where Montana cities and towns are contiguous (adjoin each other). Unincorporated lands surround most municipalities.

7.2.3 Urban Area Population Shift

It is also notable that the portion of Montana residents living inside municipalities has been gradually decreasing. Since 1960, over 60% of Montana's net increase in population has occurred in unincorporated areas (outside of city and town boundaries). This growth in population in unincorporated areas has occurred despite continuing declines in the State's farm and ranch population. Much of the State's recent net increases in population have resulted from residential development occurring in subdivisions located outside of city and town boundaries.

For the Year 2000, the US Census summarized population information by Urban Area and Urban Clusters, both of which are new census information geography categories. A cluster includes people living in the unincorporated areas surrounding a Montana city.

Table 13 lists the urban areas in Montana in order of population. The third column shows the total population for each urban area and the fourth and fifth columns show the populations inside and outside the city boundaries. The sixth column shows the data in the fifth column as a percentage of the urban area population inside city boundaries. Finally, the last column shows the total urban population as a percentage of the overall state population of 902,195.

These data are useful in at least two regards. First, they show which urban areas have the greatest populations, an indication of where efforts might be best focused in a noise compatibility program. Second, they show the extent to which the urban area populations are outside the city boundaries. Urban areas such as Helena and Kalispell have high percentages of population outside the city. This complicates the ability to develop and implement noise-compatible land use programs, especially since the 2003 State Legislature took away the authority that cities had to enforce building code outside of their city boundaries, which seven cities had chosen to do.

7.2.4 Montana American Indian Reservations

Montana also has seven Native American Indian Reservations, as shown in Table 14. Populations living on reservations are increasing. Importantly tribal governments experience considerable independence from state and local government authority. State and local governments have limited regulations affecting management on reservations.

Table 13: Urban Population Data Inside and Outside of Cities in Montana

Name of Urban Area	*County*	*Urban Population Sum*	*Urban Population Inside City*	*Urban Population Outside City*	*Percent Outside City*	*Percent of Montana Population*
Billings	Yellowstone	100,317	89,847	10,470	10.4%	11.1%
Missoula	Missoula	69,491	57,053	12,438	17.9%	7.7%
Great Falls	Cascade	64,387	56,690	7,697	12.0%	7.1%
Helena	Lewis & Clark	38,451	25,780	12,671	33.0%	4.3%
Bozeman	Gallatin	31,591	27,509	4,082	12.9%	3.5%
Butte-Silver Bow	Silver Bow	30,615	30,615	0	0.0%	3.4%
Kalispell	Flathead	25,336	14,223	11,113	43.9%	2.8%
Havre	Hill	10,413	9,621	792	7.6%	1.2%
Miles City	Custer	9,720	8,487	1,233	12.7%	1.1%
Livingston	Park	8,322	6,951	1,371	16.5%	0.9%
Laurel	Yellowstone	7,684	6,255	1,429	18.6%	0.9%
Belgrade	Gallatin	6,893	5,728	1,165	16.9%	0.8%
Lewistown	Fergus	6,395	5,813	582	9.1%	0.7%
Anaconda-Deer Lodge	Deer Lodge	6,223	6,223	0	0.0%	0.7%
Glendive	Dawson	6,188	4,729	1,459	23.6%	0.7%
Hamilton	Ravalli	6,070	3,705	2,365	39.0%	0.7%
Whitefish	Flathead	5,485	5,032	453	8.3%	0.6%
Sidney	Richland	5,253	4,774	479	9.1%	0.6%
Deer Lodge	Powell	5,045	3,421	1,624	32.2%	0.6%
Columbia Falls	Flathead	4,652	3,645	1,007	21.6%	0.5%
Browning	Glacier	4,517	1,065	3,452	76.4%	0.5%
Dillon	Beaverhead	4,306	3,752	554	12.9%	0.5%
Libby	Lincoln	4,248	2,626	1,622	38.2%	0.5%
Polson	Lake	4,247	4,041	206	4.9%	0.5%
Hardin	Big Horn	3,575	3,384	191	5.3%	0.4%
Wolf Point	Roosevelt	3,427	2,663	764	22.3%	0.4%
Glasgow	Valley	3,272	3,253	19	0.6%	0.4%
Cut Bank	Glacier	3,154	3,105	49	1.6%	0.3%
Shelby	Toole	3,222	3,026	196	.06%	0.3%
Poplar	Roosevelt	2,828	911	1,917	67.8%	0.3%
Conrad	Pondera	2,784	2,753	32	.01%	0.3%
Totals		*488,113*	*406,681*	*81,230*	*83.4%*	*16.6%*

Table 14: Montana Indian Reservation Populations

Reservation	***2000***	***1990***	***1980***
Blackfeet Reservation	10,100	8,549	6,600
Crow Reservation	6,894	6,370	5,973
Flathead Reservation	26,172	21,259	19,628
Fort Belknap Reservation	2,959	2,508	2,060
Fort Peck Reservation	10,321	10,595	9,921
Northern Cheyenne Reservation	3,923	3,664	4,470
Rocky Boy's Reservation	2,676	1,954	1,650
Totals	*63,592*	*55,165*	*49,564*

7.3 Some General Observations of Montana Planners

During April and May 2003 prior to the planners survey, telephone and in-person interviews were held with planners from Montana's most populated cities and counties. In addition, conversations were also held with Richard Weddle, recently retired attorney for the Local Government Assistance Division in the Department of Commerce.

Information about the State's traffic noise-residential land use issues was obtained through interviews. There is no comprehensive compilation of the location and character of Montana's major traffic noise-residential land use problems. The background on status of problems was obtained by contacting local government planning agencies in Montana's seven most populated urban areas:

- Billings in Yellowstone County
- Missoula in Missoula County
- Great Falls in Cascade County
- Bozeman in Gallatin County
- Helena in Lewis and Clark County
- Kalispell in Flathead County
- Butte in Silver Bow County

Planning agencies from Montana's larger urban areas were contacted because of the presence of high volume roadways near residential areas. Each urban area has examples of highways and other primary roads that carry high volumes of traffic near developed and developing residential areas. There are often more people living within potential noise impact areas in Montana's larger urban areas than in other Montana communities. The focus of the

interviews on Montana's most populated cities and counties is not to say that it will not be worthwhile to contact officials from mid-size and smaller local governments, however.

Urban planners were asked to identify examples of where noise problems exist or have the potential to develop in the future. Planners also were asked to provide general background on causes and effects of their community's traffic noise/residential land use problems. Finally, planners were asked for observations regarding possible approaches for resolving or avoiding traffic noise/residential land use conflicts.

Planners from each urban area were readily able to identify examples where traffic noise-residential land use conflicts cause problems within their planning jurisdiction. No attempt was made to develop a comprehensive inventory of all traffic noises within an urban area. Planners talked generally about traffic noise/land use issues in their jurisdictions and then focused on a few particular problem sites.

Planners often cited traffic noise-residential problems resulting from combinations of roadway designs and traffic characteristics and the location and layout of nearby housing developments. Planners also cited instances where natural geographic features such as canyon walls and topography contributed to noise problems.

7.3.1 Increased Urban Residential Growth

In recent decades, the Billings, Missoula, Bozeman, Helena and Kalispell urban areas have experienced substantial population and economic growth. Great Falls has experienced cycles of slower growth. Butte is the only urban area that has lost population and jobs, but even Butte has expanded physically. Most, if not all, of the Montana urban areas are geographically larger than they were when the Interstate highways were first built. As a result, the number of people living within areas potentially impacted by traffic noise is increasing.

Each urban area has some locations where previously uninhabited lands next to an Interstate have been in-filled by residential and business development. Additionally, much of Montana's recent urban population growth is occurring on city peripheries. New houses are being located such that traffic noise problems are developing and are likely to intensify. Growth in traffic volumes on established urban corridors has expanded noise impact zones into previously unaffected residential areas. There are also instances where new housing has been built within current noise impact areas.

Traffic noise-residential land use conflicts also exist in Montana's medium-sized and smaller-sized communities. Many of these communities are traversed by or adjoin Interstates or other highways. In many communities, federal or state highways also serve as a city's or town's main street. However, many of these communities are also experiencing population and economic downturns, which might make them less likely to impose noise-compatible development requirements that might be perceived as discouraging potential development.

Many urban arterials and collectors have been built through or near previously established residential areas. As urban areas expand, arterials and collectors tend to be flanked by residential neighborhoods.

7.3.2 Location of Highways

Highways serve mixtures of interstate, intercity, and local travel, both for commercial and personal purposes. Six of Montana's seven urban centers are served (traversed) by Interstate highways. Other federal and state highways serve all of Montana's urban centers.

Some urban noise problems were created by the location of the Interstate Highway System. Most of Montana's urban Interstate system was constructed in the 1960s and 1970s. Attempts were made to site the Interstate highways outside of established residential and business areas. As a result, Interstates were often located through sparsely settled areas on the urban periphery. In some instances, however, interstate segments needed to be located through and/or near previously established residential areas. In these instances, the interstate system resulted in traffic noise impacts to adjacent residential areas.

The locations of interstate highways and interchanges have influenced the locations for business developments, as well as the general locations for peripheral residential development. Highways and interchanges have made commuter trips from urban periphery to jobs and services in cities more practical. Of interest is that since the construction of Montana's Interstate highways, some new residential development has occurred on lands adjacent to the highway. For example, substantial suburban-type residential development has occurred along I-90 northwest of Bozeman, I-90 west of Billings, I-90 west of Missoula and I-15 in the north Helena Valley.

7.3.3 Increase in Urban Traffic Congestion

Also contributing to urban traffic noise has been growth in urban traffic congestion. There has been an increase in the number of vehicle trips per household as a result of ongoing changes in the Montana lifestyle. There are more vehicles per household and more jobs per household (work trips). A high portion of the Montana population is in the working age-cohorts (16-65 years old). A much greater percentage of women are in the labor force than in previous generations. Urban residents also tend to drive greater distances than in previous decades.

Peripheral residential development continues to add more and more traffic to urban travel corridors. Housing and business development has become more decentralized. Additionally, personal vehicle use and travel distances have increased. As a result, Montanans drive more frequently and for greater distances.

Each of Montana's urban areas has instances where major roadways are operating at capacity. On many arterials and collectors, increases in traffic prompt commercial development, which increases truck traffic to, from and within business sites.

7.3.4 Shift in Economy

The Montana economy also is gradually shifting away from its historic agricultural/natural resource/industrial base. The recent focus of job growth into retail and service-type business also adds to roadway use. Retail and service-type businesses generate many more vehicle trips per job than do jobs in agriculture, resource and industrial businesses.

7.3.5 Growth in Truck Traffic

Growth in commercial truck traffic also adds to Montana's urban traffic noise. The Montana and American economies have become more truck-oriented. Historic truck traffic count data are available for many primary roads. These data identify noteworthy increases in both intra-urban and inter-community truck traffic. Examples where growth in interstate truck traffic contributes importantly to noise include:

- I-15 pass-through in Butte
- I-90 Hellgate Canyon passage of Missoula
- I-15 route through west Great Falls

Urban centers have also experienced major increases in local commercial truck travel. Large trucks generate more noise than do automobiles and pickups due to louder acceleration, idle and deceleration operations (especially with the use of engine compression "jake" brakes). Residential areas located near commercial truck corridors are some of Montana's most impacted areas.

7.4 Local Government Planning Authorities

7.4.1 Comprehensive Planning

Montana local governments are empowered to carry out administrative, regulatory, and financial functions through enabling legislation passed by the State Legislature. Municipal and county governments were initially empowered to adopt and implement comprehensive plans by the Local Planning Enabling Act in 1957. Amendments by subsequent legislative sessions pieced together systems of municipal and county planning authorities, procedures, and finances (76-1-101 through 76-1-606, MCA). Section 76-1-102, MCA, states:

> The object of this chapter is to allow local units of government to improve the present health, safety, convenience, and general welfare of their citizens and to plan for the future development of their community to the end that highway systems be carefully planned; that new community centers grow only with adequate highway, utility, health, educational, and recreational facilities; that needs of agriculture, industry, and business be recognized in future growth; that residential areas provide healthy surroundings for family life; and, the growth of the community be commensurate with the efficient and economic use of public funds.

Montana's Local Planning Enabling Act authorizes the preparation and adoption of a comprehensive plan and sets out required procedures. The act authorizes municipal (cities and towns) and county governments to prepare comprehensive plans. The act requires establishment of a planning board and authorizes the board to impose property taxes and accept and spend money for planning purposes. The act specifies procedures for preparing and adopting a comprehensive plan. Enabling legislation also authorizes cities and counties to carry out planning functions in combination.

7.4.2 Montana Nuisance Law

Of potential importance to the purposes of this project is that "traffic noise" is likely to fit the definition of "nuisance" contained in Montana Nuisance Law (45-8-111, MCA). While separate from the actual planning processes and implementation measures, the Nuisance Law would help to legitimize actions of local governments to control noise problems within jurisdictions. The law is as follows:

> 45-8-111. Public nuisance.
>
> (1) "Public nuisance" means:
>
> (a) a condition which endangers safety or health, is offensive to the senses, or obstructs the free use of property so as to interfere with the comfortable enjoyment of life or property by an entire community or neighborhood or by any considerable number of persons;
>
> (b) any premises where persons gather for the purpose of engaging in unlawful conduct; or
>
> (c) a condition which renders dangerous for passage any public highway or right-of-way or waters used by the public.
>
> (2) A person commits the offense of maintaining a public nuisance if he knowingly creates, conducts, or maintains a public nuisance.
>
> (3) Any act which affects an entire community or neighborhood or any considerable number of persons (as specified in subsection (1)(a)) is no less a nuisance because the extent of the annoyance or damage inflicted upon individuals is unequal.
>
> (4) No agricultural or farming operation, place, establishment, or facility or any of its appurtenances or the operation thereof is or becomes a public nuisance because of the normal operation thereof as a result of changed residential or commercial conditions in or around its locality if the agricultural or farming operation, place, establishment, or facility has been in operation longer than the complaining resident has been in possession or commercial establishment has been in operation.
>
> (5) Noises resulting from the shooting activities at a shooting range during established hours of operation are not considered a public nuisance.
>
> (6) A person convicted of maintaining a public nuisance shall be fined not to exceed $500 or imprisoned in the county jail for a term not to exceed 6 months, or both. Each day of such conduct constitutes a separate offense. History: En. 94-8-107 by Sec. 1, Ch. 513, L. 1973; and. Sec. 30, Ch. 359, L. 1977; R.C.M. 1947, 94-8-107(1) thru (4); and. Sec. 2, Ch. 123, L. 1981; and. Sec. 9, Ch. 415, L. 1991.

The Montana nuisance law authorizes local governments to take actions to control (regulate) nuisances. Noise, other than from a shooting range, which is exempt, is not

specifically identified in Montana's Nuisance Law. However, noise has been ruled as a nuisance in Montana and, indeed, motorboat noise has been recognized as nuisance in state law [Weddle 2003].

7.4.3 Growth Policy Act

Both city and county planning were affected by passage of the Growth Policy Act in 1999 (76-1-601 through 76-1-606m MCA). This Act allows but does not require cities and counties to adopt and implement "Growth Policies." Under the new law, a local government's "Comprehensive Plan" is now called a "Growth Policy."

The State's initial comprehensive planning enabling legislation did not establish minimum requirements. Local government planning law was sometimes criticized for being indeterminate. However, the Growth Policy Act now establishes minimum requirements to be addressed in a local government's Growth Policy.

The Growth Policy law also reinforces the linkage between a local government's Growth Policy and its uses of zoning, development permits, subdivision regulations, building codes, capital improvements development and local government planning powers. A local government's uses of these implementation measures should be consistent with (rationalized by) its Growth Policy.

Development and adoption of a Growth Policy is a voluntary activity of a municipal (city or town) or county government. However, for those policies that are developed by a local government, the Growth Policy Act establishes several elements that must be addressed. Required elements are:

- Community goals and objectives;
- Maps and text which describe the jurisdictional area (including information on land uses, population, housing needs, economic conditions, local services, public facilities, natural resources, and other jurisdictional characteristics);
- Projected trends for life of the Growth Policy;
- Description of measures to be used to implement the Growth Policy;
- A strategy for development, maintenance, and replacement of public infrastructure;
- Implementation strategy that includes a timetable for implementation and for updating the policy;
- A statement explaining how local governments will coordinate and cooperate with other jurisdictions;
- A statement explaining how subdivisions will be reviewed; and
- A statement explaining under what conditions the local government may exempt subdivisions from environmental review criteria 76-3-608(3).

The statute does not define, however, the extent to which each element must be described. As a result, local governments have the option of adopting either exhaustive or minimalist Growth Policies or anything in between.

A city or county Growth Policy must also have "a description of policies, regulations, other measures to be implemented in order to achieve goals and objectives." The statute also clarifies the relationships between a Growth Policy's goals and objectives, and land use and other plan implementation. The statute also helps to clarify the relationships between local governments.

After a Growth Policy is adopted, the local governing body within the territorial jurisdiction of the board must be guided by and give consideration to the general policy and pattern of development set out in the Growth Policy in the following:

- Authorization, acceptance, construction, alteration, or abandonment of public ways, public places, public structures, or public utilities;
- Authorization, acceptance, or construction of water mains, sewers, connections, facilities, or utilities;
- Adoption of subdivision controls; and
- Adoption of zoning ordinances or resolutions.

While adoption of a Growth Policy continues to be optional, all of Montana's most populated cities and counties (with the possible exception of Billings) have adopted Growth Policies. For urban areas, it is impractical to evolve without some level of logic and control over change. Planning by urban governments is generally more aggressive and complex than planning by rural governments. Furthermore, planning within the jurisdictions of urban cities is generally more aggressive and complex than planning by corresponding county governments.

The fact that planning generally is more influential within an urban city's planning jurisdiction than the corresponding county's planning jurisdiction is important to this study. In 2003, urban cities would be much more likely to incorporate noise management into their Growth Policies than corresponding county governments. City government planning generally enjoys better resources and more public support than do county governments. The problem is that considerable new development is occurring in areas that are within the planning jurisdiction of county governments. In the 1990-2000 period, most new housing development occurred in unincorporated areas where there is often strong public opposition to local government planning.

7.4.4 Capital Improvements Planning

Capital Improvements Planning (CIP) is one of local government's most important Growth Policy implementation tools. Capital improvements are major, high cost facilities, having an operating life of two years or more. Capital improvements include local government infrastructure such as public water systems, streets, roads, bridges, and solid waste management facilities.

A CIP is a local government's plan to prioritize, finance, and construct or repair public facilities over a period of time. How, when and where public facilities are provided greatly affects the patterns of future land development and also the costs of these major public services.

For example, provision of public sewer services is often a strong motivator for annexation of an unincorporated area into a city.

The locations, capabilities and costs of capital facilities are powerful influences on community land use patterns. A CIP can be used to encourage appropriate land development and to limit land development in locations where a community deems certain types of development to be inappropriate.

7.4.5 Zoning

Montana's municipal zoning authorities were initially established in the 1920s. Montana city and county governments are authorized to adopt zoning ordinances. Zoning is the legal method by which local governments can divide their jurisdictions into use districts (zones), and restrict uses of land and impose requirements that the permitted uses of land must meet.

The basic objective of zoning is to separate incompatible uses so as to prevent the adverse or undesirable effects they can have on each other. Modern zoning focuses on preventing problems by separating incompatible land uses, and on achieving a quality and character of development that ensures safe and healthy communities by requiring land uses to meet standards that protect both public and private property owners. Components of zoning regulations include:

- A zoning map, showing the precise boundary of each zone is an essential part of zoning regulations;

- Text that specifies the required standards, necessary procedures, circumstances for requesting and deciding appeals, and enforcement and administrative requirements.

Montana law requires that zoning and development permit regulations be in conformance with comprehensive plans. Land use regulations must closely conform to comprehensive plans. Regulations carry out the direction and policy of the plan by articulating in specific language the requirements that govern the use of the land.

Before amendments to a zoning ordinance may be made, the plan may have to be amended to ensure that the zoning ordinance will conform. The purpose of this requirement is to ensure that land use regulations are drafted and enforced in the context of a broad, carefully considered public purpose. The plan is the public's expression of a planning vision for the community. Regulations adopted in conformance with the plan are less likely to be arbitrary than those adopted otherwise.

Montana municipalities are empowered to adopt zoning under separate enabling legislation. The Municipal Zoning Enabling Act (76-2-301 through 76-2-328, MCA) authorizes cities to:

- Regulate the size, height, and location of buildings and other structures on lots;

- Regulate the densities; and

- Divide the municipality into zoning districts to regulate the location of various uses.

Zoning regulations give consideration to general policy and pattern of development set out in the Growth Policy (formerly, must conform to the comprehensive plan). Adoption of

interim zoning in cities and towns is done where a Growth Policy has not been adopted, but is in the process of being developed.

Enabling legislation also establishes authorities and procedures for zoning commissions and boards of adjustment. Cities and towns are authorized to extend their zoning regulations beyond their corporate boundaries, provided they have a comprehensive plan that includes the territory to be zoned. Extra-territorial zoning area for Class 1 cities is up to three miles, for Class 2 cities up to two miles, and Class 1 cities up to one mile. Of note is that county government retains primary authority to approve subdivisions in unincorporated areas affected by the city plan.

County governments are empowered to adopt zoning under two separate enabling acts. The County Zoning Enabling Act (76-2-201 through 76-2-228, MCA) authorizes counties to adopt zoning or development permit regulations for all or part of a county. The county may create zoning districts to control the location of various uses within the jurisdiction, regulate buildings and other structures, and provide a process to issue permits.

As with municipalities, county zoning regulations give consideration to general policies and patterns of development set out in the Growth Policy (formerly, the comprehensive plan). The county commission is required through its planning board or zoning commission to recommend regulations.

The law also establishes a protest procedure whereby potentially affected property owners may prevent adoption of zoning regulations. The law exempts agriculture, forestry, and mining from zoning regulation.

The second piece of legislation affecting counties is the County Planning and Zoning Districts (76-2-101 through 76-2-112, MCA). Specific areas of greater than 40 acres in size are affected. The law enables real property owners to petition the county commission to establish a planning and zoning district, and to adopt zoning regulations for the district. A planning and zoning commission is required. The planning and zoning commission must prepare a development plan for the district, may identify desirable and undesirable locations for future land uses, and may identify express issues, goals, objectives and policies relating to the district. The governing body also must provide an appeals procedure. Aggrieved landowners may receive variances from a county commission. The law exempts agriculture and forestry zoning regulation.

7.4.6 Development Permit Systems

A development permit system is an alternative to traditional zoning, and is also called a "permit system," "performance zoning," "performance standards," and "development standards." Regulation of development permits focuses on the *character of and/or quality* of new development. There is less emphasis on regulating the location of new development. Regulations can be drafted, however, to regulate *location* of new land uses and to apply different requirements in different areas within a county.

Development permit regulations often eliminate use districts and set out requirements that apply throughout a jurisdiction. A new use may be approved in most locations, provided it meets the standards and requirements. Development permit regulations are most suitable for rural, unincorporated areas or small towns.

Development standards are regulations that specify the standards or requirements that new development must meet. They are the easiest types of land use regulation to draft and enforce. Development standards are commonly drafted to regulate:

- Traffic;
- Off-street parking and loading areas;
- Emergency vehicle access;
- Areas unsuitable for development due to hazard or environmental risk; effects on agriculture;
- Buffering or screening of adjacent uses;
- Signs; and
- Setbacks.

A scoring system awards points to encourage desirable actions and assigns negative points to discourage undesirable actions. A development's composite score determines whether or nor it receives approval.

7.4.7 Subdivision Regulations

Montana law requires all cities and counties to adopt and enforce subdivision regulations. These regulations are used to review and decide on development proposals that would:

- Divide land into parcels of less than 160 acres;
- Construct more condominiums; or
- Provide multiple spaces for mobile homes, or recreational camping vehicles.

Subdivision regulations regulate the process of plotting land into lots and providing public facilities. Subdivisions must be properly surveyed, comply with local design standards and provide legal and physical access and utility easements. To approve a subdivision, local government must issue findings that consider the effect subdivision would have on:

- Agriculture;
- Natural environment;
- Wildlife and wildlife habitat;
- Local services; and
- Public health and safety.

In the past, in areas where a Growth Policy was adopted, a local government was required to review a proposed subdivision to ensure it conforms to the Growth Policy. The recent 2003 legislative session eliminated that requirement.

A proposed subdivision must still receive approval from the Montana Department of Environmental Quality (MDEQ). MDEQ approves sanitation facilities for any subdivision containing land divisions of less than 20 acres in size. Sanitation facilities include sewage, solid waste disposal, water supply, and drainage ways.

7.4.8 Building Codes

The following information on building codes is based on interviews with local government planners and Montana Department of Commerce (DOC) building code administrators.

Montana has statewide building standards for new construction. State building codes are administered by the Montana DOC. Building codes establish statewide building practices for most types of residential, business, and government buildings and establish minimum standards for new building construction. Standards are needed to ensure a new building is structurally sound and not a hazard to the health and welfare of its occupants.

Montana's building codes for residential construction are based on model (national) building codes, which are adopted by reference. The International Code is used to create standards for one and two-family housing units. The Uniform Building Code provides standards for residential buildings containing three or more units.

Montana codes do not generally establish noise control standards for new housing construction. However, the codes do require upgraded construction for the common walls of multi-family housing. These higher standards are intended to reduce noise travel between dwellings with common walls.

Montana's statewide code does not currently impose noise standards for housing affected by high levels of *exterior* noise. That is, special construction standards are not imposed for areas affected by high levels of traffic noise.

The DOC uses a permit system to enforce its building codes. DOC building inspectors issue building permits. A noteworthy limitation in the State's code enforcement system is that building permits are not required for residential buildings containing less than five dwelling units. The vast majority of new housing construction in Montana is for single-family houses. Thus, the State does not provide code enforcement for nearly all new residential construction. Compliance is also based on the "honor system."

The Montana Legislature also has empowered municipal and county governments to adopt and enforce building codes. Currently 37 cities, two city-county consolidated governments, and one county have adopted their own building codes and permitting systems. The DOC must certify city and county building code programs. At a minimum, building codes administered by cities and counties must require and enforce the standards established in the state building codes.

Local building inspectors must receive training and local governments are authorized to provide building code inspection services through a contract with a private service provider. In at least one instance, building inspections are provided through contract.

All seven of the Montana's urban cities with 10,000+ populations have established municipal building code programs. This total includes Butte-Silver Bow, which is a consolidated city-county government. All eight of the eight cities with populations of 5,000 have established

municipal building codes. This total includes Anaconda-Deer Lodge, which is a consolidated city-county government. Twenty-three of forty-one cities with populations of between 1,000 and 5,000 have established municipal building codes. However, only three of the 73 towns with populations of less than 1,000 have municipal codes.

Montana's local government enabling legislation allows municipalities to provide more thorough code enforcement of residential building codes. Cities and counties are allowed to require building permits for all residential construction. Building code enforcement is provided for one, two, three, and four-unit family housing projects. This fills a huge gap in the DOC's code enforcement system.

Also of interest is that the local governments are empowered to adopt building code standards that exceed requirements of state codes. Thus, cities would have the ability to upgrade construction standards to deal with a citywide or localized noise control program. The flexibility to adopt area-specific standards may allow cities to deal with location-specific problems. A city would need to justify strongly the higher standards. However, this capability is something that should be discussed further in implementing noise-compatible development programs.

Counties also may adopt more rigorous building standards, but counties lack the option to adopt area or sub-area-specific building codes. A county would need to adopt higher building standards on a countywide basis. Currently, Richland County (on the North Dakota border) is the only Montana county that has adopted building codes.

The most recent (2003) session of the Montana Legislature took away the authority that cities have had to enforce building code outside of their city boundaries. Prior to this change, seven cities implemented city-building codes outside of city boundaries. This change is very important because most recent residential development is occurring outside of cities' limits. Prior to the change, Billings, Bozeman, and Missoula enforced city codes for four and a half miles outside city boundaries. Kalispell had enforced its codes for three and a half extra miles. Columbia Falls, Miles City and Whitefish had enforced codes for one extra mile.

Beginning in the fall of 2003, these cities and others were no longer able to enforce building codes outside their boundaries. This loss of the extra-territorial power of building permit authority is a setback to overall urban planning. It also reduces the potential for using building permits as a means of upgrading construction standards in areas with high levels of traffic noise.

7.5 Other Activities Related to Planning and Growth

A number of different organizations and groups in Montana have been very interested in issues related to planning and growth over the last several years. Some of these groups and related activities are described in this section because of the potential roles they might play in building support for noise-compatible development or in helping implement noise-compatible development.

7.5.1 Montana Consensus Council

The Montana Consensus Council (MCC) was established as a state agency by an Executive Order from the Governor in 1994 "to encourage public participation and provide a forum for cooperative and innovative problem-solving, particularly regarding natural resources

used." The Council was established from a grant awarded to the Office of the Governor by the 1993 Montana Legislature. Quoting from the Executive Order:

> Now more than ever we must work together to meet the challenges ahead: jobs, education, sustainable communities, and environmental protection. Together, Montanans of all walks of life must seek ways to find agreement, to equitably and effectively resolve these and other important issues.
>
> As Governor, I hereby create The Montana Consensus Council. Its mission is:
>
> -- To provide assistance for building agreement on natural resource and other public policy issues;
>
> -- To anticipate and resolve controversial issues before disputes occur, thereby reducing the social and financial costs associated with prolonged disagreement;
>
> -- To encourage and support opportunities for citizens to work together and build agreement among diverse interests;
>
> -- To enhance the capacity of citizens, communities, agencies, and organizations to jointly solve problems and resolve disputes; and,
>
> -- To increase public awareness and understanding of cooperative approaches to building agreement on public policy. [Racicot 1994].
>
> The Council's web site notes,
>
> In 1992, a cross-section of Montanans -- including ranchers, farmers, environmental advocates, state legislators, and federal officials -- decided it was time to find a better way to make natural resource decisions and to resolve controversial issues. The ad hoc group envisioned a 'center for excellence' designed to help people on all sides build mutually satisfying public policies . . . Today the Council is a small public organization attached to the Office of the Governor for administrative purposes. It consists of a board of directors, a full-time executive director, two part-time staff, and a handful of consultants. The Council is funded through a mix of a state general fund, grants, and fees-for-service. The Council is an impartial and non-partisan forum; it is not an advocate for any particular interest or outcome. [MCC 2003].

By act of the 2003 Legislature, the MCC was to become part of the Department of Administration as of July 1, 2003, instead of being under the Office of the Governor [Montana State Legislature 2003].

The Council's Board of Directors includes the representatives from the following organizations related to real estate, taxpayers, wildlife, the environment, farming, forest service, Indian tribes and government:

- Montana Environmental Information Center
- U.S. Senate
- U.S. House
- Crow Tribe

- Lt. Governor
- U.S. Forest Service
- Local Government Center, MSU
- Montana Wildlife Federation
- Director of Planning, Butte
- Government Affairs Liaison, Montana Association of Realtors
- Montana Farm Bureau
- Montana Taxpayers Association

The Council would appear to be an ideal mechanism for introducing the subject of noise-compatible development to Montanans. One approach could be similar to the Montana Growth Policy Forum described below. The Council could also be a direct resource to MDT. For example, the Summer 2002 Council newsletter (the last newsletter published to date) suggests that state government staff and officials should "call [Council staff] for one-on-one consultations and advice on public participation and collaborative problem solving strategies that will meet your agency's needs and interests." [MCC 2002].

7.5.2 The Montana Growth Policy Forum

One outgrowth of the Council's work on sanitation systems in subdivisions was the establishment of the Montana Growth Policy Forum. Its purpose was to be a way to "sustain a dialog among all stakeholders on issues related to land use and growth in Montana." MCC reported in a Fall 2001 newsletter that the Forum had met four times since October 2000: "Participants have included builders and developers; realtors; city, county, and state governments; conservationists; advocates for smart growth; advocates for affordable housing; ranchers and farmers; other landowners; surveyors, engineers, and planners; contractors; and transportation interests." [MCC 2001].

The organizations represented by the members of the Coordinating Committee for the Growth Policy Forum (according to the Fall 2001 MCC newsletter) demonstrate this diversity of participation:

- MT Department of Commerce
- MT Smart Growth Coalition
- MT Environmental Information Center
- City of Great Falls and MT Association of Planners
- School of Law, The University of Montana
- MT Association of Surveyors
- MT Association of Counties
- MT Building Association
- Consulting Engineer
- MT Association of Realtors

The Fall 2001 newsletter listed several seminars sponsored by the Forum in 2001 and 2002 that are of potential relevance to this research project [MCC 2001].

- Montana Growth Policy Act: The Law and Its Implementation
- The Benefits and Costs of Growth Policies and Planning
- Reviewing and Permitting Subdivisions

- Zoning
- Annexation
- Capital Improvement and Infrastructure
- Building Local Capacity Through Technical Assistance

The purpose of each seminar was "to develop a common understanding of the topic, identify strengths and weaknesses of the existing system for making land use decisions, and develop options on how to improve the system." The publication noted that,

> At the end of the series of educational seminars, the participants may choose to move forward independently or as a group on one or more initiatives. There is no explicit expectation that the participants will or will not seek agreement on a package of strategies to improve land use decisions in Montana. The primary objective of the Forum is to foster an informed dialogue about land use and growth in Montana. [MCC 2001].

One possible implementation activity resulting from this Traffic Noise Abatement research project could be a Forum seminar on noise-compatible development, possibly run by the MCC as part of the Growth Policy Forum.

That same Fall 2001 MCC newsletter also had several relevant articles. Two that will be discussed below are:

- "APA Study on Land-use Planning," by Tim Davis, Montana Smart Growth Coalition [Davis 2001]; and
- "What Citizens Think About Growth," by Peggy Trenk, Montana Association of Realtors [Trenk 2001].

7.5.3 Montana Smart Growth Coalition

Before discussing the articles, it is useful to describe the Montana Smart Growth Coalition (MSGC). According to its web site, the Coalition is "a network of organizations and individuals from across the state who share a commitment to just, affordable and sustainable communities. The Coalition advocates for sensible policy, both locally and statewide, regarding land use, transportation, housing, sustainable agriculture, conservation of habitat, cultural diversity, economic equity and the environment." [MSGC 2003].

The Coalition's membership is quite diverse. In addition to many individuals, the following organizations are members:

- Alternative Energy Resources Organization
- American Conservation Real Estate
- American Farmland Trust
- American Wildlands
- Artisan LLP
- Bitterrooters for Planning
- Brown Bear Resources
- Citizen Advocates for a Livable Missoula
- Citizens for a Better Flathead
- City of Bozeman, Planning Board

- Clark Fork Coalition
- Downtown Billings Partnership, Inc.
- Flathead Lakers
- Flathead Resource Organization
- Friends of the Bitterroot
- Highway 93 Citizens' Coalition for Responsible Planning
- High Plains Architects
- HomeWORD
- Montana Association of Conservation Districts
- Montana Audubon
- Montana Environmental Information Center
- Montana Farmers Union
- Montana Human Rights Network
- Montana Public Interest Research Group
- Montana Wildlife Federation
- National Center for Appropriate Technology
- Northern Plains Resource Council
- Park County Environmental Council
- Plan Helena
- Sierra Club - Montana Chapter
- Smart Growth Missoula
- Soil and Water Conservation Society - Montana Chapter
- Sonoran Institute
- Tracy-Williams Consulting
- Wheeler Center
- Women's Voices for the Earth

The Coalition's web site states:

> To grow smart is to use land in a way that strengthens rather than weakens our economy, environment, and communities. Smart growth is conservative. By building compactly and protecting farmland and open space, we cut the need for taxpayer-funded infrastructure while we simultaneously protect water and air, make housing affordable, reduce traffic, revive and create beloved traditional neighborhoods, and sustain community bonds. [MSGC 2003].

While noise is not specifically mentioned, the concept of noise-compatible development fits very well within this definition.

7.5.4 APA Study on Land-use Planning

The American Planning Association (APA) published a comprehensive study of Montana's planning and growth-control policies in January 2001 after a year of "research and outreach." [Meck et al. 2001]. According to the article by Tim Davis, the study was sponsored by the MSGC and was aimed at assessing "the need for statutory changes to improve planning and land-use control in Montana." [Davis 2001]. The study is part of a larger national effort called the Growing Smart Project [American Planning Association 2002].

According to Davis, the Montana report addresses the "realities of planning and the reasons for sprawling growth in Montana." The work is based on focus groups and surveys of "planners, city, county, and state officials, realtors, builders, developers, affordable housing activists, farmers and ranchers, environmental activists, and many others." The APA report contains:

- An analysis of existing laws, Montana Supreme Court and Attorney General opinions, and other statewide studies of planning in Montana;
- The results of the six focus groups and the responses from a survey APA and MSGC conducted around the state;
- A review of recommendations of previous studies by the Environmental Quality Council; and
- APA's recommendations for changes to Montana's laws regarding planning and land use.

Davis notes,

> The report's recommendations are not designed to please everyone. Not even all of MSGC's 33 member groups agree with all of the recommendations. The recommendations are listed in five categories, including planning for growth, managing growth, planning and development review, paying for growth, and supplemental recommendations concerning an enhanced state role in planning.

The report was presented to the Montana Growth Policy Forum. According to Davis,

> The overall sentiment of the Growth Policy Forum was approval for the report's analysis and mixed opinions about the recommendations . . . The APA's report confirms that Montana, like Colorado and other western states, can no longer consider planning and land-use controls as luxuries. They are now essential to maintain the vitality and health of our towns, local economies, and lands. [Davis 2001].

A brief synopsis on the report's summary of legislative material can be found on the web at http://www.planning.org/growingsmart/States/Montana.htm.

7.5.5 Montana Association of Realtors Survey on Growth

The second relevant article in the MCC Fall 2001 newsletter was by Peggy Trenk of the Montana Association of Realtors [Trenk 2001]. Ms. Trenk reported on a survey conducted by the Montana Association of Realtors on managing growth. She noted "Montanans are evenly divided on their approach to growth management, with 45% indicating growth should be managed more, and 49% stating it should be managed less."

She also indicated that, "Montana voters overwhelmingly support local control in managing growth," with 67% of those surveyed saying that town, city, or county governments should have the power to make land use decisions. She noted that 59% opposed having the State "become more involved in managing growth-related problems," and that there was "virtually no support for federal involvement."

These survey results suggest that even if MDT takes the lead promoting noise-compatible development, success will more likely come if the citizens perceive the initiative to be locally-driven and directed.

7.6 Summary

Montana is experiencing growth in its urban areas, and in many cases on the periphery of those urban areas. A by-product of that growth is the increase in traffic noise and in the number of people impacted by that noise. Many different stakeholders in Montana have recognized that growth, especially if uncontrolled or unmanaged, is an issue in the state.

The Legislature addressed the issue in part through the Growth Policy Act, providing a means for addressing growth in the urban areas through the long-range, comprehensive planning process. Recent legislative activity that will reduce the ability of cities to exercise control over development immediately outside their boundaries, however, is a cause of concern to planners. In addition to long range planning, land use development is managed through the mechanisms of capital improvements planning, zoning, subdivision regulations and building code enforcement.

Based on interviews with planners in the planning agencies of Montana's most populated areas, local governments are "cautiously enthusiastic" about possible implementation of noise-compatible land use planning that might result from MDT's traffic noise abatement research efforts. Montana's planners can readily identify locations within their jurisdictions that are adversely affected by noise from road, rail, air and water transportation. Success in reducing existing noise impact problems or preventing or lessening future noise impacts in noise-sensitive areas is likely to be consistent with local government planning goals.

The fact that growth is an issue at the forefront of the news, coupled with Montanans' desire for, and right to, a healthy environment, creates a climate where the timing for noise-compatible development activities may be right. While many citizens and individual communities are impacted by traffic noise daily, noise has not typically been recognized as a problem that can or should be controlled through intelligent planning and development. Education of the planning community, the citizenry of Montana, and state and local elected officials will be an important step in the process of trying to avoid creating new traffic noise problems in the state.

This research project has actually already played a major role in introducing the subject in a formal way to the Montana Association of Planners (MAP). Two of the researchers and the head of the noise program at MDT made a series of presentations at the annual meeting of MAP in October 2003. While the session was lightly attended, the presentations were a starting point in building awareness of planning professionals in this subject and sparked strong interest among several attendees. It is clear from the total lack of mention of noise in the Montana Growth Policy Act and in the APA land use planning study that noise impacts, which exist, are being overlooked. This overlooking is not at all uncommon around much of the rest of the country.

8.0 SURVEYS OF MONTANA RESIDENTS AND PLANNERS

8.1 Introduction

The RFP for the project called for a survey related to the perceptions of traffic noise and traffic noise control. Given the diverse nature of potential respondents, it was thought that a single survey would not be as successful as two separate targeted surveys to the residents and to the public officials. For example the information desired from a resident near a highway is different from the information desired from a local planning official who has jurisdiction over site approval and zoning decisions. As a result, two different surveys were conducted:

1. A mailed, mail-back survey of residents who are both affected and unaffected by traffic noise.

2. A mailed, mail-back survey of commissioners, Metropolitan Planning Organizations (MPO), and city/county planning staff.

Draft surveys and draft survey plans were developed and submitted to MDT for review. The surveys were then finalized and administered and the results were analyzed.

The initial proposal indicated that the survey of residents would be conducted in three urbanized areas of Montana: Great Falls, Billings, and Missoula. Ms. Cora Helm of MDT expressed interest in surveying a fourth area, along I-90 in Butte, and that area was included in the survey. The following sections discuss each survey and the results.

8.2 Survey of Residents

This section describes the survey plan, the areas that were surveyed, the survey questions, and the results.

8.2.1 Residents Survey Plan

The polling of residents was best accomplished through a mail-back survey. The original intent was to hand-deliver the surveys in the communities and neighborhoods in order to eliminate the need for development of a pre-delivery database and the requirement to pre-address and mail out the surveys to specifically defined residences. The local planning agencies, though, were able to provide lists of addresses for the desired survey streets in formats easily converted into mailing labels. In addition, a local mailing service was found that could quickly and relatively inexpensively take care of survey copying, producing return envelopes, folding, inserting in envelopes, applying labels and postage, and mailing.

The surveys were addressed to reference the neighborhood name, rather than simply being addressed to “Resident” in an attempt to increase the interest of the resident. A postage paid return envelope was included. Planning officials in several areas expressed interest in endorsing the survey as a means of increasing the response rate and their cooperation was noted in the cover letter.

8.2.2 Areas Selected for the Residents Surveys

Four areas were selected for surveying. Table 15 lists the areas and the surveyed streets in each area.

Table 15: Survey Areas and Surveyed Streets in Each Area

Area	***Streets***
Butte, I-15/I-90 corridor	Albany Avenue, Banks Avenue, Edwards Street, Evans Avenue, Gladstone Avenue, Goodwin Street, Hancock Avenue, Hannibal Street, Meadowbrook Lane, Neighborly Lane, Phillips Street, Richardson Street, Sheridan Avenue, Sherman Avenue, Wharton Street
Great Falls Southwest (I-15 Spur/ Country Club Boulevard near Fox Farm Road)	Alder Drive, Fox Farm Road, Meadowlark Drive, Beech Drive, Cherry Drive, Treasure State Drive, 17th Avenue SW, 18th Avenue SW, 16th Avenue SW, 10th Street SW
Missoula, Lower Rattlesnake area (I-90)	Poplar Street, Cherry Street, Vine Street, Harrison Street, Monroe Street, Taylor Street, Van Buren Street
Billings, Rimrock Road (from 5th Street to 38th Street)	Green Terrace Drive, Country Club Circle, Rimrock Road, Moreledge Street, Farnam Street, Forsythia Blvd., Marguerite Blvd., Timberline Drive, Silverwood, Thousand Oaks Street, Ramada Drive, Mulberry Drive, Sycamore Lane, Brentwood Lane, Gregory Drive S, Gregory Drive W, Gregory Drive N, Stanford Drive, Radcliff Drive, Harrow Drive, Placer Drive, Cascade Avenue, Teton Avenue, Granite Avenue, Palm Drive, McDonald Drive, Snowcrest Drive, Powderhorn Circle, Flagstone Drive, Fairway Drive, Edmond Street, Glacier Drive, McBride Street, Gloxinia Drive, Smokey Lane, 17th Street W, Fairview Place, Zimmerman Trail, Copper Blvd., Silver Blvd., Leeann Blvd., Carl Street, Beartooth Drive, Rehberg Lane, Stinson Avenue, Racquet Drive, Ocotillo Road, Avalon Road, Poly Drive, Arlene Street

Appendix A contains a census map for each of these areas.[1] Each map is labeled in the upper right hand corner. A small index map below the legend locates the study area within the larger urbanized area. The legend indicates that the census map is color-coded and shaded by population in each census block. This color-coding was used to aid in the final selection of the specific blocks to be surveyed. Each surveyed area is briefly discussed below.

[1] All census maps in this survey plan were prepared for this project at no cost, courtesy of the: Census & Economic Information Center, Montana Department of Commerce, 301 South Park Avenue, Helena, Montana 59620-0505; Telephone: 406-841-2740; e-mail: ceic@state.mt.us, Web site: http://ceic.commerce.state.mt.us.

8.2.2.1 Great Falls, Southwest -- I-15 Spur (I-315) -- and Country Club Boulevard areas near Fox Farm Road

In southwestern Great Falls, questionnaires were administered to households living on both sides of the I-15 Spur/Country Club Boulevard corridor. The I-15/Country Club corridor delivers traffic to and from Interstate 15 and the city road system of Great Falls. Importantly, Country Club Boulevard evolves into Great Falls' 10th Avenue South to the east, which is the city's major commercial strip. The roadway also serves as the intracity sections of US Highways 87 and 89, which are traffic routes connecting Great Falls and I-15 with communities in central and eastern Montana.

This area was chosen in part because of relatively recent complaints by the residents living near Country Club Boulevard after it was repaved with tined concrete pavement as part of the Fox Farm Road intersection improvement project. The area is also one of the faster growing residential areas in the state. MDT is separately studying the noise issue for residents along this stretch of road. Sub-areas included residences east and west of Fox Farm Road and residences near the I-15 spur.

8.2.2.2 Missoula, Lower Rattlesnake area, I-90

To the east of the City of Missoula, traffic noise surveys were mailed to persons living in the Lower Rattlesnake area. This southern extension of Rattlesnake Valley area furnishes a brief bottomland between chains of western Montana mountains. The unique lowland status of the Rattlesnake Valley also causes it to be used as an east-west route for Interstate Highway 90 and the Montana Rail Link Railroad. Interstate 90 supports long-distance and regionally-oriented car and truck traffic. Area railroad tracks are used for long-distance trains and Montana-oriented freight trains.

Surveys were administered to residences on the north sides of I-90, the railroad tracks, and Clark Fork River. Sub-areas included residences east and west of Van Buren. This area is an older neighborhood, in existence prior to construction of I-90. Important to traffic noise effects is the fact that abrupt vertical cliffs form the southern boundary of the Rattlesnake Valley. These cliffs have the potential of reflecting highway and railroad noise back northward, contributing to sound levels for the residences on the north side of I-90.

8.2.2.3 Butte, Hillcrest area along I-15/90

In Butte, questionnaires were sent to persons living within and nearby to the city's "Hillcrest Community," which is a long-established residential area located on the down slope of the Butte Hill. In the 1960s, the Hillcrest area was traversed by construction of a joint section of Interstate 90 and Interstate 15. The merging of north-south bound I-15 and east-west bound I-90 into a common highway section causes Montana's long-distance east-west and north-south bound car and truck traffic to use the same road link.

Surveyed sub-areas included residences north and south of I-15/90. Ms. Cora Helm of MDT was particularly interested in this area because of complaints from the residents and because the Interstate bisected this portion of Butte when constructed. The area consists of both older homes in existence prior to interstate construction and newer homes.

8.2.2.4 Billings, Rimrock Road (from 5th Street to 38th Street)

Billings is Montana's most populated urban area. In Billings, the survey focuses on households along a four-mile long section of Rimrock Road, from 5th Street to 38th Street. In recent decades, the Billings metropolitan area has experienced substantial amounts of population and employment growth. Rimrock Road has evolved into being one of Billings' main east-west arterials and one that is not a state highway. Growth and change in Rimrock Road's car and truck traffic has increased sound levels in adjacent residential areas. In the western section of the Rimrock Road survey area Zimmerman Trail is a steep switchback road that carries car and truck traffic up and down from the Billings Rims area, which sits approximately 500 feet above the Rimrock Road area.

8.2.3 Residents Survey Contents

The survey of affected and non-affected residents included questions regarding:

- Demographics (to aid in sorting and understanding the results);
- How noise affects quality of life compared to other factors;
- Neighborhood noise environment;
- Perceptions of possible noise mitigation strategies;
- Responsibility of residential developers for mitigating noise impacts; and
- How to fund noise mitigation.

The residents survey was tailored to each survey area by reference to the nearest major noise-producing road adjacent to the surveyed neighborhood and by reference to the name of the particular survey area such as: Missoula Lower Rattlesnake, Billings Rimrock, Butte Hillcrest, and Southwest Great Falls. Each survey had a cover letter signed by Mr. Dave Hill, Environmental Services Bureau Chief at MDT. A sample survey is included in Appendix B. The reasons for including each group of questions are briefly noted below.

8.2.3.1 Household characteristics

The initial section of the survey gathers background information about respondent and neighborhood characteristics. Background characteristics are used to analyze how environmental and social conditions influence how residents are impacted by roadway noise. The survey asked residents to provide:

- Years living in current home;
- Number of people in household (and whether or not the household included children);
- Type of housing unit (single-family, apartment, condominium;
- Whether their home is owned or rented;
- Proximity of their housing unit to the main roadway; and

- The section of the main roadway along which the residence is located, referred to in this report as "sub-area").

This information is requested in Questions 1 through 6.

8.2.3.2 Characteristics of the neighborhood affecting quality of life

Question 7 lists a variety of qualities or characteristics of the neighborhood and asks if the respondent finds them to be positive or negative. *Peace and quiet from man-made noise from outdoor sources* was one characteristic, in an attempt to get an indication of where noise ranks in terms of a neighborhood issue.

8.2.3.3 Neighborhood noise environment

The next series of questions seek information on annoyance of community noise sources, focusing in on traffic noise from the main road, and on changes over time.

Question 8 lists a variety of types of community sounds, and asks if they frequently annoy the respondent while either inside or outside the residence. Question 9 then asks about where on their property *traffic* noise is heard.

Questions 10 and 11 ask whether the respondent was annoyed or disturbed by traffic noise in the past week, both inside and immediately outside the residence. Question 12 asks how often traffic noise is annoying, separately for inside and immediately outside the residence.

Question 13 asks if the person had considered traffic noise from the main road when he or she decided to purchase or rent the residence. Question 14 asks whether or not the traffic noise from the main road has gotten better or worse since the person moved into the residence. Question 15 asks the related question of whether or not traffic noise from the main road has become more bothersome over time. These latter two questions address changing perceptions over time.

8.2.3.4 Perceptions of possible noise mitigation strategies

Question 16 asks if the resident has made adjustments in how he or she lives because of traffic noise, and asks the resident to identify those methods from a list of possibilities. These methods include things done to the property (*building a wall*), things done to the house (*upgrading windows*) and things done to lifestyle (*changing the location of an activity in the house*).

Question 17 lists a variety of possible noise abatement methods that might be done by a public agency off the person's property to reduce traffic noise at their residence, and asks the respondent about their acceptability. The question notes, "No actions are being considered for your neighborhood; we just want your opinions in general."

Question 18 asks a related, but slightly different question of which of several improvements to the person's property or residence would noticeably reduce traffic noise from the main road. Question 19 asks the person to choose from several dollar ranges regarding how much the person might be willing to pay to reduce traffic noise noticeably at the *current* residence.

8.2.3.5 Responsibility of residential developers for mitigating noise impacts

Question 20 asks if developers should be required by the city or county to reduce excessive traffic noise levels in the development or inside the residences, when building residences on undeveloped land next to a major roadway. Question 21 then asks opinions on several development strategies that would reduce traffic noise effects in the yard (or common area) or inside the residence, assuming the respondent was buying a new home in a new development along a major roadway.

Question 22 asks if the person would pay more for a *new* house next to a highway, if the house or neighborhood were designed to reduce the traffic noise effects.

Finally, in Question 23, residents are asked to indicate if they would be interested in participating in any of several potential programs aimed at helping to reduce traffic noise at the home site. The question clearly noted however: "No specific actions are planned at this time."

Respondents were also offered the opportunity to provide additional comments on any aspects of the survey or the subject.

8.2.4 Residents Survey Results

A total of 627 surveys were completed and returned to the Montana Department of Transportation. Table 16 shows the number of surveys mailed and received and the response rate for each area and the totals.

Based on the responses, it was determined that many of the results could be aggregated across the different survey areas. This aggregation simplified presentation and understanding of the results. In some instances, however, disaggregation by survey area showed interesting differences, and those results are presented as well. In any case, because of the expected interest by planners in each area in the specific responses for that area, results by area are contained in Appendix C, but without additional discussion.

Also, within each area, the survey response rate varied by proximity to the main road: a higher percentage of responses were received from people living closest to the main road. The responses of these people indicate that, in the aggregate, they tend to be more annoyed by traffic noise than people farther from the road, and thus were more willing to spend time on the survey. For those residents farther from the road, the lower rate is an indicator that traffic noise is a less important issue (or non-issue). Therefore, some questions were analyzed by proximity to the road: those people living immediately adjacent to the road or one row back were included in one group, and those living farther away were put in a second group.

Finally, the results showed some significant differences in opinions between those people who say that they are frequently annoyed by traffic noise and those who say that they are not annoyed. The last subsection of this section presents those comparisons.

Table 16: Number of Surveys Mailed and Received and Response Rate for Each Area

Area	*Number of Surveys Mailed*	*Number of Surveys Received*	*Response Rate*
Great Falls, Southwest	247	91	37%
Missoula, Lower Rattlesnake	123	68	55%
Butte, Hillcrest	398	148	37%
Billings, Rimrock Road	690	324	47%

Responses to each question are presented and discussed below. The actual survey forms will be kept by MDT as part of the project file, as will the spreadsheets that contain the results. The first several questions present a picture of the demographics of the respondents.

8.2.4.1 Household characteristics

General observations about survey respondents include:

- Nearly 60% of survey respondents have lived in their homes for 10 or more years, with a full one-third for 20 or more years. It appears that the majority of respondents are very stable in their living situation. These people have watched traffic, and the resultant noise, in their areas grow over the years.

- Most houses are occupied by two or fewer people (65% say only one or two people lived in the dwelling).

- Most responding households do not have children (only 15% have checked that there are children living in the home). These data along with the time-in-residence data seem to indicate that a high number of the respondents are empty-nesters.

- Over 90% of the respondents own their housing unit. This high percentage should be kept in mind when reviewing the results for several of the survey questions. It speaks to a financial investment in the property and a resultant concern over its value. It may also speak to a possible reduced freedom of being able to easily move away from an undesirably noisy situation.

- Nearly 90% of the respondents live in single-family homes, consistent with the 90% home ownership result. Eleven percent lives in multi-family dwellings, which includes duplexes, condominiums and apartments.

- Half of the respondents' dwellings are adjacent to the main road or one block away, with the other half two or more blocks away. The noise and noise mitigation questions were analyzed both collectively and separately for these two groups.

Detailed results for each of the first six questions are in Appendix C. Of note regarding the results by individual survey area:

- Butte's respondents have lived in their homes the longest (69% said 10 or more years), and Great Falls' respondents the shortest (23% for two years or less).

- In Great Falls, 23% of the respondents live in duplexes, condominiums or apartments, although overall, 92% of the Great Falls respondents are owners of their dwellings.

- In the Missoula survey area, 13% are renters, compared to 1% in the Billings survey area.

8.2.4.2 Qualities of the neighborhood affecting quality of life

In response to Question 7, the residents are positive about most of the listed neighborhood qualities, with the exception of: *peace and quiet from outdoor manmade noise* and *lack of traffic on the main road*. Figure 1 summarizes results for all the survey areas.

Over two-thirds of the respondents rate the following qualities of their neighborhood as "Very Good" or "Good:"

- *Physical quality of neighborhood (buildings, landscaping, attractiveness, cleanliness, etc.)*
- *Convenience to shopping, school or work*
- *Security/freedom from crime*
- *Affordability of housing/cost of living*

Q7: Please rate your neighborhood for the following qualities.

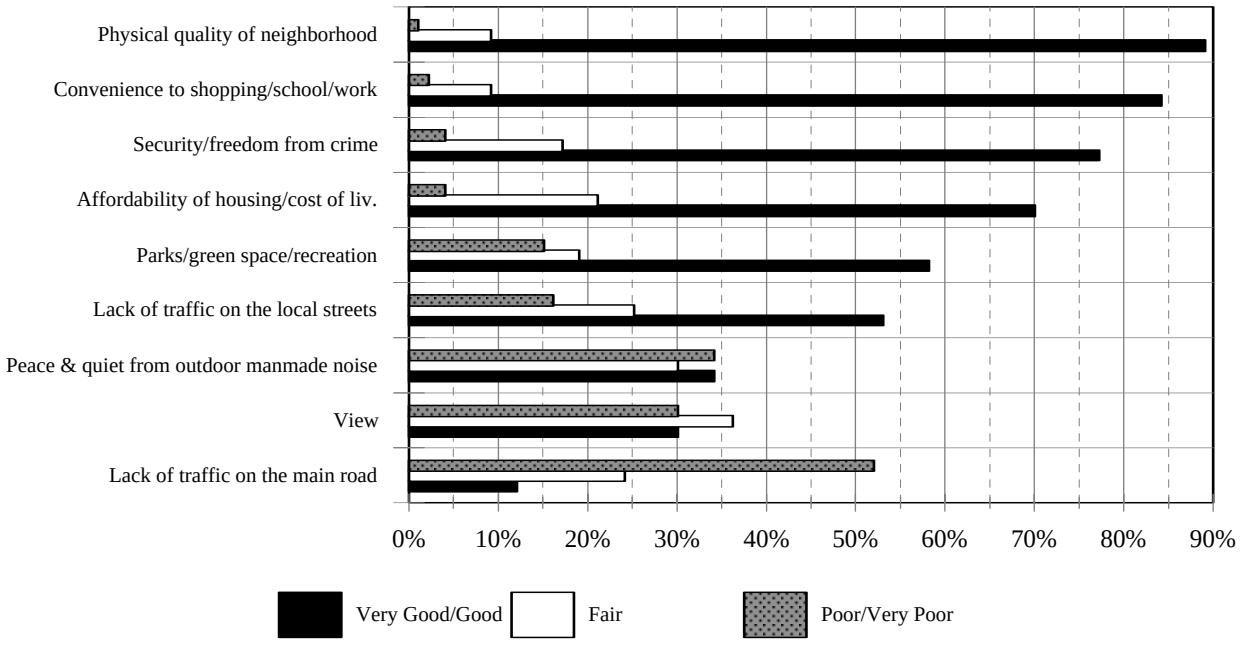

Figure 1. Residents' ratings of neighborhood qualities.

More than half of the respondents are positive regarding their neighborhood's:

- *View*
- *Parks, green space or recreational opportunities*
- *Lack of traffic on the local streets*

Only two qualities are rated "Very Good" or "Good" by a minority of residents:

- *Peace and quiet from outdoor manmade noises (34%)*
- *Lack of traffic on the main road (12%)*

Further, these same two qualities have the highest ratings of "Poor" or "Very Poor":

- *Lack of traffic on the main road* (more than half of the respondents)
- *Peace and quiet from outdoor manmade noises* (more than a third of the respondents)

As is evident in subsequent questions' responses, these two qualities, or their absence, are related. Even though the survey neighborhoods experience undesirable amounts of traffic on the main road and negative traffic noise effects, respondents are still very favorable about their neighborhoods' characteristics.

The results of Question 7 were also looked at in terms of proximity to the main road, with all respondents next to the road or within one block (or one or two houses) in one category and all respondents farther away in a second category. The results showed, as expected, that a much higher percentage of those close to the road (60%) rated *lack of traffic on the main road* as "Poor" or "Very poor" than those farther from the road (40%).

Related to those responses, over 40% within one block of the major road rated *peace and quiet from outdoor manmade noises* "Poor" or "Very poor", compared to one-quarter of those who were two or more blocks away.

Of importance to this study is that for many people, traffic noise is likely to contribute to overall dissatisfaction with conditions for the main road. Alternatively, traffic noise is one of multiple factors contributing to people's dissatisfaction with main road traffic conditions. In any case, however, even though the surveyed neighborhoods experience traffic noise effects from the main roadway, area respondents are favorable about most neighborhood characteristics.

Details on results by individual survey areas are in Appendix C. It is worth noting that *lack of traffic on the main road* is the most poorly rated neighborhood quality in all four survey areas:

- Traffic conditions on I-90 are rated poorly by over two-thirds (68%) of Missoula's respondents.
- Traffic conditions on the I-15 Spur are rated poorly by half (51%) of the Great Falls respondents.
- Traffic on Rimrock Road is rated poorly by half (50%) of the Billings respondents.

- Traffic conditions along the joint I-15/I90 are rated poorly by half (49%) of the persons in Butte's Hillcrest area.

Also, *peace and quiet from outdoor manmade noises* is rated "Poor" or Very Poor" by about half of the Missoula (51%) and Great Falls (48%) respondents, and by about a third of the respondents in Butte (36%) and Billings (33%).

8.2.4.3 Noises that "frequently annoy" residents

Question 8 lists nine types of community noises. Respondents were asked to check which ones "frequently annoy" them (while either inside or outside the residence). This question provides information about the neighborhood's noise environment. The question also allows for comparisons of respondent attitudes regarding impacts of *traffic noise from major roads & highways* with impacts for other common neighborhood noise sources.

Figure 2 shows that over half (51%) of all respondents (both close to and farther from the main road) indicate *traffic noise from major roads & highways* frequently annoys them at their home site. This source of noise had the highest annoyance frequency among the survey's noise categories. Noises caused by *dogs/other pets*, *aircraft*, and *car boom boxes or other car stereo music* receive the next highest frequently annoyance percentages.

Q8: Please check any of the following sounds that frequently annoy people in your household when inside or outside your residence.
All Areas

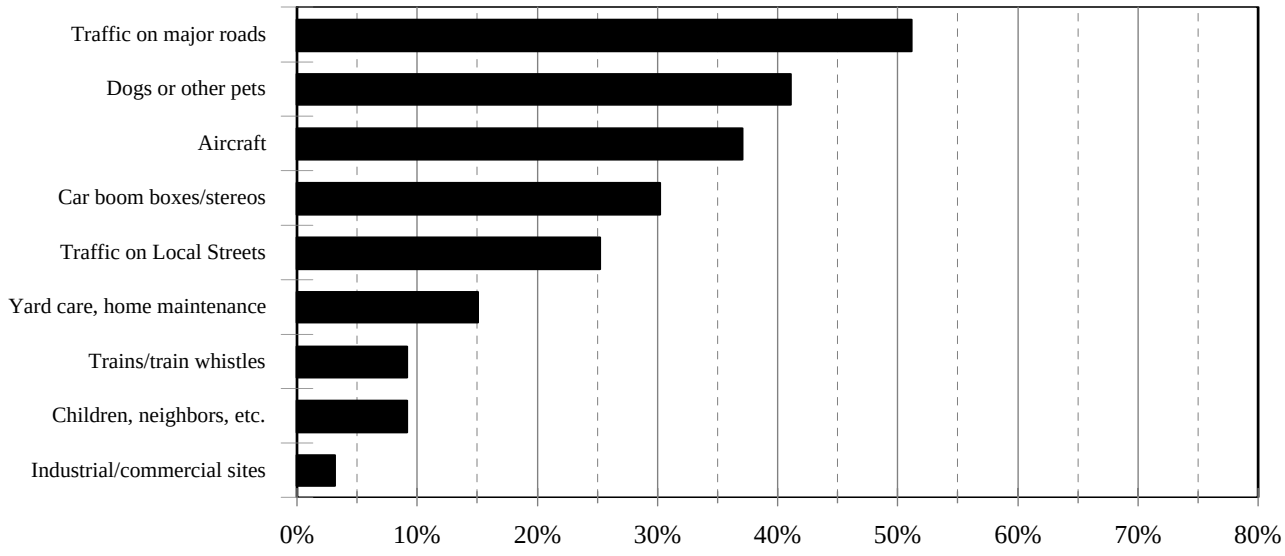

Figure 2. Residents' ratings of frequently annoying outdoor noise sources.

In terms of proximity to the main road, 60% of all respondents next to the road or within one block say that they are frequently annoyed by *traffic noise from major roads & highways*, compared to only 40% of those farther from the road. These percentages are consistent with the

poor or very poor ratings in Question 7 for *lack of traffic on the main road* and *peace and quiet from outdoor manmade noises*.

Details on results by individual survey areas are in Appendix C. These results indicate that *traffic noise from major roads & highways* is a much greater problem in the Great Falls, Missoula, and Butte survey areas than in the Billings Rimrock community. High portions of Great Falls (74%), Missoula (74%), and Butte (66%) respondents identify major road traffic noise to be a frequent source of noise annoyance.

Along Billings' Rimrock Road, however, only 33% of respondents identify major road traffic noise as a frequent source of annoyance at their residences. This difference in the Billings results led to a more in-depth examination of the results, in terms of a sub-area analysis. (Question 6 had asked respondents to indicate in which sub-area they were located.)

Survey results indicate people living in the western portion of the Billings' Rimrock survey area to be much more frequently annoyed by major road traffic noise than persons living central and eastern portions of the Rimrock study area. Rimrock's western sub-area extends from Rehberg Lane to 38th Street, and includes the juncture of Zimmerman Trail with Rimrock Road. In this western sub-area, 57% of respondents indicate *traffic noise from major roads & highways* is a frequent source of annoyance at their residence. Zimmerman Trail is a switchback road that heads off the top of the Rims area – a sandstone bluff that overlooks the majority of the Billings urban area -- from State Highway 3 and down into the Billings/Yellowstone River Valley. It is a commuter route, but is also used by many heavy trucks, which use their engine compression brakes due to the several-hundred foot drop in elevation.

Rimrock's eastern sub-area extends from Virginia Lane to 17th Street. In this eastern segment, only 33% of respondents indicated traffic noise to be a frequent source of annoyance. Rimrock's central segment extends from 17th Street to Rehberg Lane. In the central segment, only 23% of respondents indicated traffic noise to be a frequent source of annoyance. The annoyance rates for Rimrock's eastern and central sub-areas were much lower than for western Rimrock and for the other three survey areas.

High rates of "frequent annoyance" occur in all of the Great Falls, Missoula, and Butte sub-areas. The highest annoyance rates were for people living in Great Falls on the north side of the I-15 Spur (89%, based on only nine respondents), in Great Falls on west side of Fox Farm Road (79%), and in the Missoula Lower Rattlesnake sub-area east of Van Buren Street (76%). In the remaining sub-areas, about two-thirds (64% to 69%) of respondents identify *traffic noise from major roads & highways* to cause frequent annoyance.

The low rates of traffic noise annoyance for the Rimrock central and eastern sub-areas, coupled with the very high number of returned surveys from these sub-areas, raise a large concern about skewing of results that were summarized over *all* of the areas and sub-areas. It was decided to keep this concern in mind.

As a result, in some instances, this discussion will refer to the total data after excluding the Rimrock eastern and central sub-area responses; this grouping is referred to as "frequently annoyed sub-areas." For the "frequently annoyed sub-areas," fully two-thirds of the respondents cited major road noise as a source of frequent annoyance, compared to only half when also including the Rimrock eastern and central sub-areas. The next most often cited responses, but by only one-third of the respondents, was noise from dogs/pets and car boom boxes.

As suggested above, however, even within the "frequently annoyed sub-areas," a substantial number of respondents were not annoyed. Conversely, in the Rimrock central and eastern sub-areas, a substantial minority *was* frequently annoyed. Thus, it was decided to look at the responses of all that were frequently annoyed by traffic, regardless of their sub-area, and to contrast their responses with those who were not annoyed, regardless of their sub-area. These results are presented at the end of the residents survey discussion.

8.2.4.4 Location on the residential property from which traffic noise from the main road is highly noticeable

Question 9 lists five locations on the residential property – inside the residence, in the front yard, in the back yard, in a common area, and "nowhere" – and asked residents if traffic noise from the main road was "highly noticeable" in these locations.

As shown in Figure 3, for all the survey areas combined, traffic noise is highly noticeable in 51% of front yards and 50% of back yards. Interestingly, 40% choose "inside the residence," a likely indicator of high outdoor noise levels, and a more serious indicator of potential impacts on quality of life. Other responses include the bedrooms, upstairs rooms, inside in the summer when windows are open, the side yard, and "everywhere."

For the "frequently annoyed sub-areas" (not shown in the figure) nearly two-thirds of the respondents listed the backyard and almost 60% noted the front yard. Over half said "inside the residence."

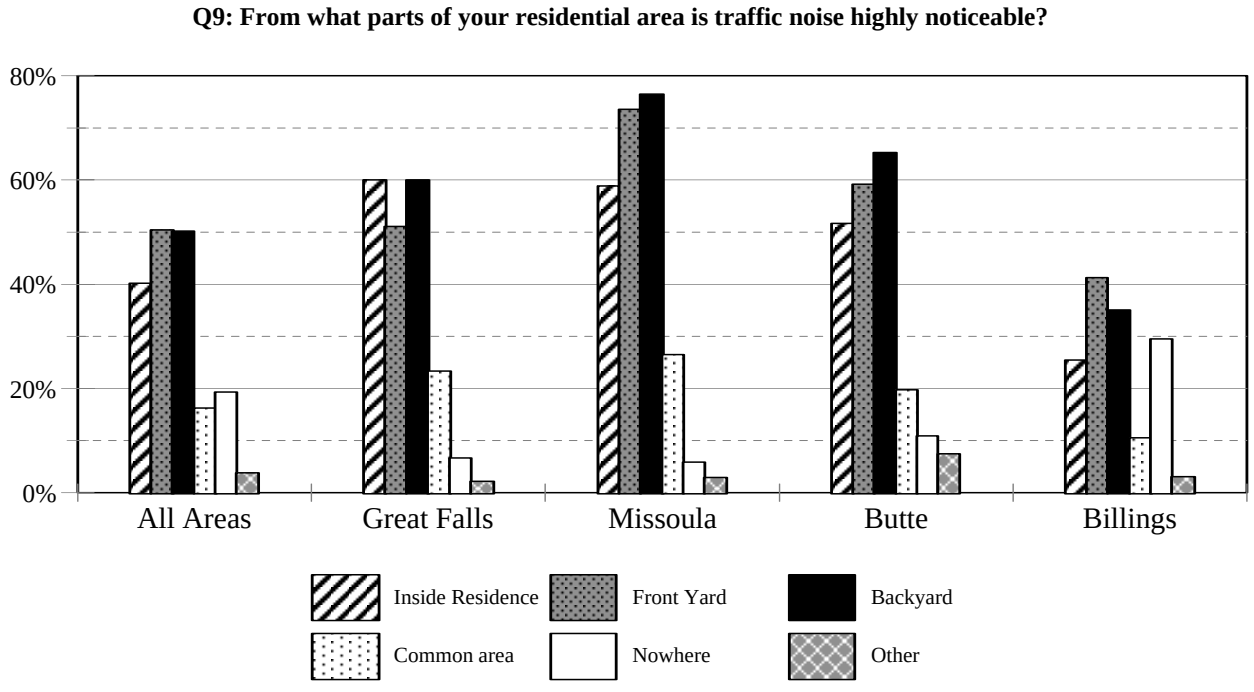

Figure 3. Residents' ratings of areas where traffic noise is highly noticeable.

In looking at the results by individual survey area, Missoula, Butte and Billings respondents say traffic noise was more noticeable outside than inside the residence. For the Great Falls respondents, traffic noise is more noticeable from inside the residence. This difference seems to result from a higher portion of Great Falls respondents living in multi-family dwellings. Survey respondents living in multi-family housing tend to have less exterior-use spaces and are thus more likely to be inside when on their property.

Respondents could choose multiple locations for their answers. Nearly three-of-four of all respondents (73%) indicate that traffic noise from the main road is highly noticeable in one or more of the listed locations (27% chose one location and 46% chose more than one location). Looking at the individual survey areas:

- In Missoula, 90% of respondents list one or more locations where traffic noise is highly noticeable.

- Both in Great Falls and Butte, 81% of respondents list at least one location.

- In Billings, 61% of respondents list one or more locations where traffic noise was highly noticeable. In terms of the sub-areas, 75% of residents of the Billings' western Rimrock sub-area identify noisy locations, compared to 59% in the eastern Rimrock sub-area and 57% in the central Rimrock sub-area.

8.2.4.5 Annoyance of residents in the past week by traffic noise from the main road

Questions 10 and 11 ask how often residents were annoyed or disturbed by traffic noise in the past week. Question 10 addresses when inside the residence, and Question 11 asks about outside the residence. The questionnaire was administered during the last week in August and first week of September, when Montana's weather was ideal for spending time out-of-doors. These questions are felt to better present a person's annoyance than questions that do not give a specific timeframe.

Figure 4 and Figure 5 show the results for inside and outside, respectively. Just over one-third (36%) of the respondents were "Annoyed" or "Highly annoyed" in the past week while inside the residence, and 61% were not. Separately, 43% of the respondents indicated they were "Annoyed" or "Highly annoyed" while outside the residence, and 53% were not. (In the graphs, the fact that the bars do not reach 100% is an indication of the percentage of respondents who did not answer the question.)

Missoula's respondents had the highest rate of annoyance and disturbance in the previous week -- 68% -- compared to 65% in the Great Falls survey area and 57% in Butte. A much lower 32% of the Billings respondents were annoyed or disturbed in the past week. In all communities, respondents are more susceptible to traffic noise effects outside of their housing unit compared to inside. Appendix C includes a table on these results.

If one leaves out the central and eastern Rimrock sub-areas in Billings (because of the previously noted low rates of "frequent annoyance" caused by traffic noise), nearly half of the remaining respondents (western Rimrock plus the other three communities) were "Annoyed" or "Highly annoyed" in the past week while inside the residence and over half were "Annoyed" or "Highly annoyed" while outside the residence.

Q10: In the past week, were you annoyed or disturbed by traffic noise from the main road while *inside* your residence?

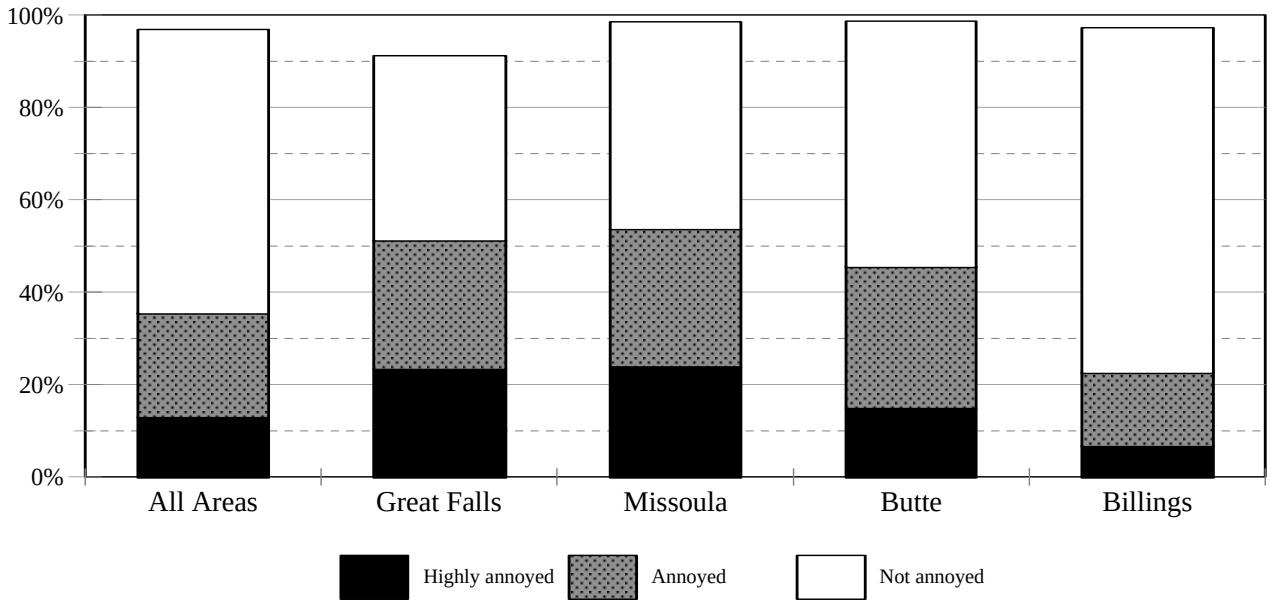

Figure 4. Residents' annoyance due to traffic noise while inside in the previous week.

Q11: In the past week, were you annoyed or disturbed by traffic noise from the main road while *outside* your residence?

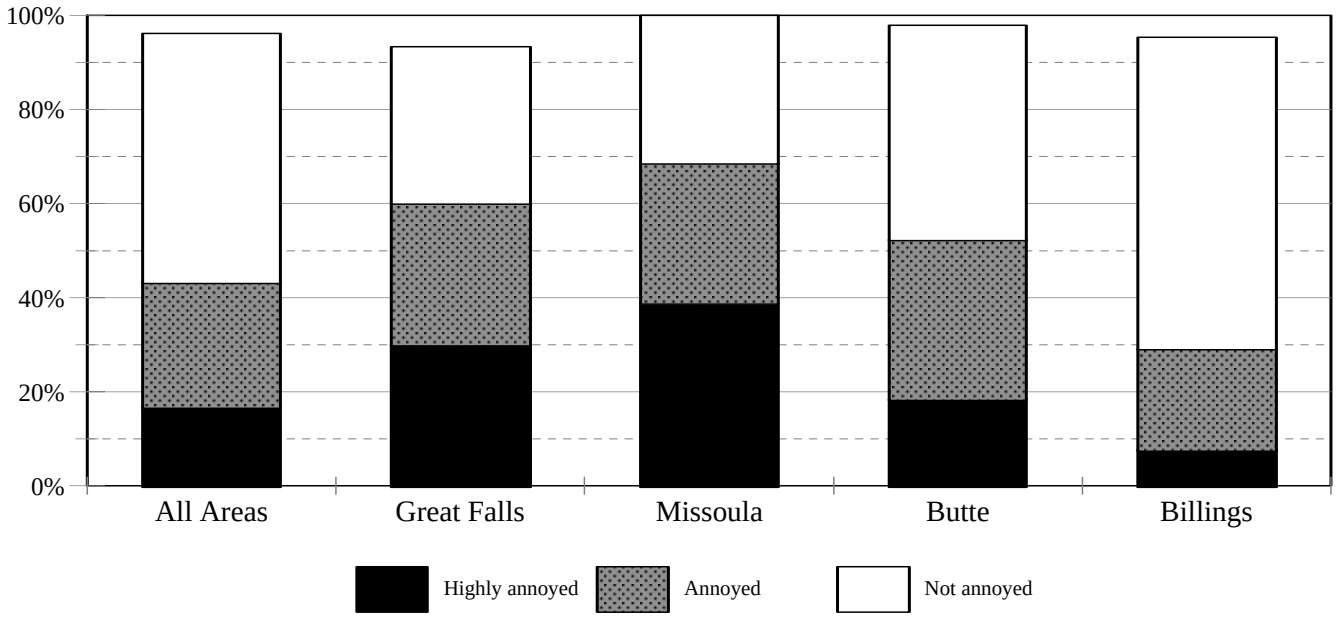

Figure 5. Residents' annoyance due to traffic noise while outside in the previous week.

8.2.4.6 In the summer time, how often are residents annoyed by traffic noise?

Question 12 asks residents how often traffic noise is annoying during the summer -- first, while inside the residence -- and second, while outside. (As noted earlier, the questionnaire was administered during the last week in August and first week of September.) The analysis combined the "All of the time" or "Much of the day" response categories. People selecting "All of the time" or "Much of the day" can find traffic noise to be irritating most of the time they are at their home site. As shown in Figure 6, when outside their homes, 25% of respondents are annoyed "All or Much of the day." When inside their homes, 18% of respondents are annoyed by traffic noise for "All or Much of the day."

For "Peak travel periods" (mainly morning and late afternoon commuter times), the results are 13% inside and 14% outside. People identifying noise annoyance as a "A few brief travel times each day" are often referring to individual noise events created by jake brakes, boom boxes, mufflers, or other individual vehicle passages; "a few brief moments" is identified by 11% for inside and 12% for outside. Of interest is that 42% of respondents indicate they are "Never or almost never" annoyed while inside and 37% while outside their residence.

The results vary widely by individual survey area (tables are in Appendix C). In Missoula, 47% of people said they are annoyed "All or Much of the day" when outside, and 34% while inside. In Great Falls, the annoyance rate is only 37% while outside and 29% while inside. In the Butte area, the annoyance rate is similar to Great Falls: 35% while outside and 26% while inside. However, for respondents living nearby to Rimrock Road in Billings, only 12% are annoyed "All or Much of the day" when outside and 7% while inside. The respondents in the eastern and central sub-areas heavily influence the Rimrock results.

Looking at the individual survey area in more detail, Rimrock residents cite "Peak travel periods" as their most common time of annoyance with traffic noise. This response is understandable given Rimrock Road's role as one of Billings' main commuter routes. In Butte, Hillcrest residents have a high rate of annoyance with nighttime noises from inside their homes. This response could be influenced by sounds of nighttime interstate traffic through open windows in the summer.

Table 17 illustrates that a housing unit's proximity to the main road can influence its susceptibility to traffic noise impacts. People living in residences next to the main roadway are much more likely to be annoyed by the roadway's traffic noise than other people are. While inside, nearly half (48%) of people living next to the main roadway find traffic noise to be annoying "All or Much of the day," with an additional 38% choosing during special time periods. Only 12% choose "Never or Almost never" while inside.

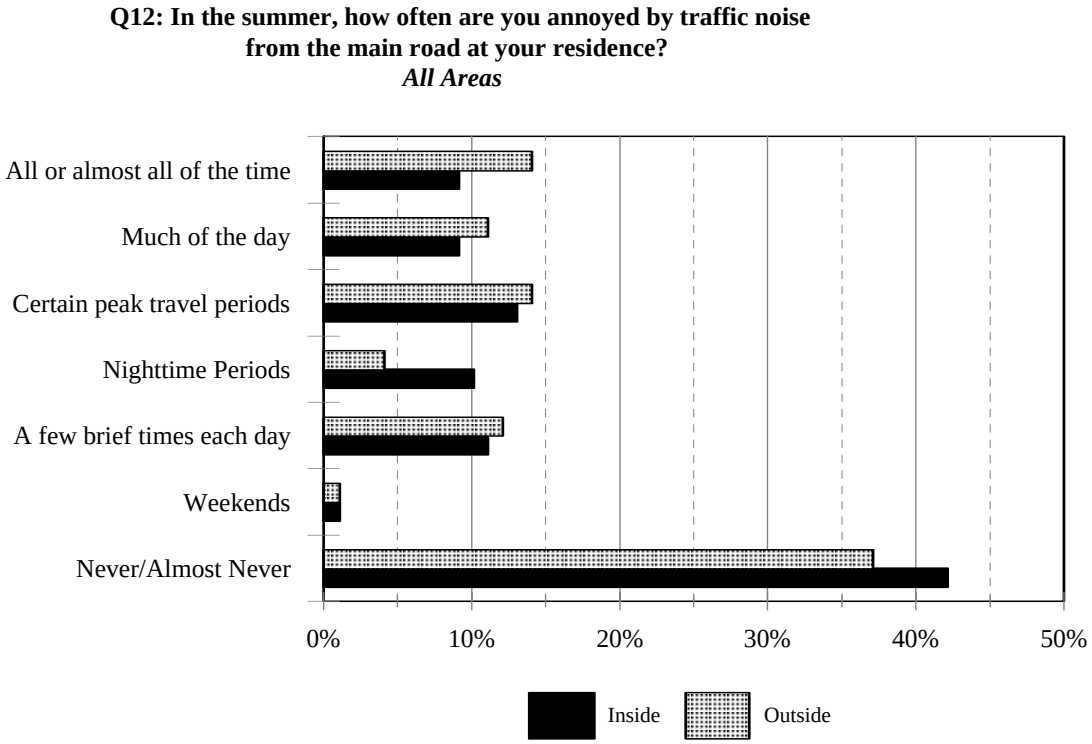

Figure 6. Time periods of residents' annoyance due to traffic noise in the summer.

Table 17: Annoyance Rate by Proximity to Main Road, Summary of Results for All Survey Areas (Percentage of Responses)

Distance from Main Road	*Annoyed All or Most of Time*		*Annoyed During Special Time Periods*		*Never or Almost Never Annoyed*	
	Inside	*Outside*	*Inside*	*Outside*	*Inside*	*Outside*
Next to Main Road	48%	56%	36%	27%	12%	12%
1 Block Away	15%	24%	43%	37%	37%	34%
2 Blocks Away	7%	12%	35%	36%	52%	46%
3 Blocks Away	10%	15%	23%	27%	58%	49%

One block away, only 15 % are annoyed "All or Much of the day" while inside and 43% were annoyed during special time periods while inside. The percentage choosing "Never or Almost never" while inside rises to 37%. These trends of annoyance decreasing with increased distance from the main road noise source are further evident in the responses for people living two and three blocks away from the main road.

These trends are also evident in the responses for when the person is outdoors on the home site. Next to the road, 56% are annoyed "All or Much of the day" while outside, compared to only 12% and 15% for those people two and three blocks away from the main road. Likewise,

the percentage of "Never or Almost never" annoyed increases dramatically from 12% next to the road to 46% two blocks away.

Tables for the results by distance from the road for the individual survey areas are in Appendix C. Of interest is the variation in the data by survey area. For example, nobody (0%) who lives next to the road in the Great Falls area is "Never or Almost never" annoyed while inside their residence, contrasting with nearly a quarter (23%) of the respondents in Butte. For residents next to the road, annoyance "All or Much of the day" while either inside or outside is greatest in Great Falls (61% and 68%), followed by Butte (57% and 67%), Missoula (55% and 55%), and Billings (36% and 46%).

8.2.4.7 Consideration of traffic noise before purchasing or renting residences

Question 13 asks if the person had considered traffic noise from the main road when he or she decided to purchase or rent the residence. As shown in Figure 7, nearly three-in-four of all respondents gave little or no consideration to traffic noise, or were unaware of traffic noise, before buying or renting their residence. Less than a quarter (21%) gave some consideration, while only 6% gave the decision a great deal of consideration. It is typical for most people to not give noise a great deal of attention until after they are in their residence.

Q13: How much consideration did you give to traffic noise from the main road when you rented/purchased your current residence?

Figure 7. Consideration of traffic noise during the home purchase/rental decision.

8.2.4.8 Change in traffic noise "loudness" since moving in

Question 14 asks whether or not the traffic noise from the main road has gotten better or worse since the person moved into the residence. Twenty percent of the respondents did not answer this question. Figure 8 shows that about half of the respondents (48%) feel that traffic noise has gotten "Much louder (23%)," or "A little louder (25%)" since they moved into the residence. A third of the respondents (33%) feel the loudness is about the same and about one-in-eight (13%) were not sure. Very few people (2%) feel traffic noise is now "Quieter."

Responses are somewhat similar across the survey neighborhoods. In Great Falls, 31% of respondents felt that traffic noise has gotten "Much louder"; compared to 26% of respondents in Missoula, 24% of Butte, and 20% in Billings.

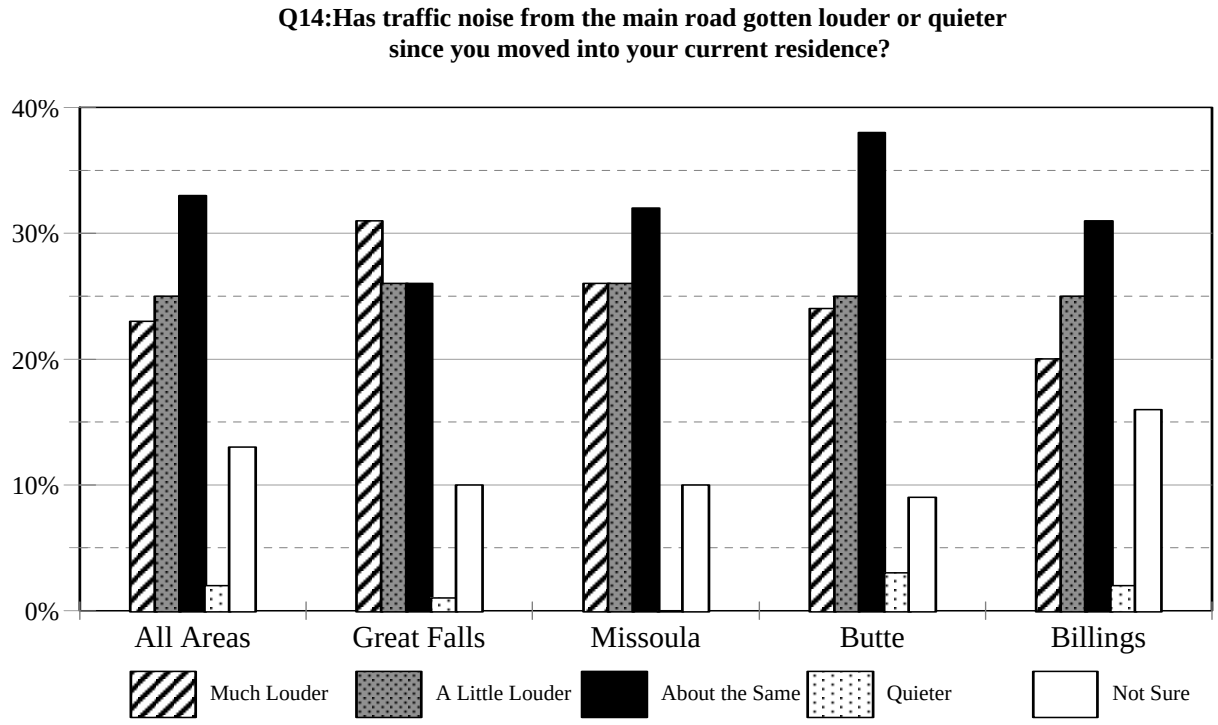

Figure 8. Change in traffic noise loudness since resident moved in.

8.2.4.9 Has traffic from the main road become more or less bothersome over time?

Question 15 asks the related question of whether or not traffic noise from the main road has become more bothersome over time. Figure 9 shows that for some people the traffic noise problem has increased: nearly a third (29%) say traffic noise has become "More bothersome." Just over a third (29%) say they are bothered "About the same" as before. For only 6% of the respondents has traffic noise become "Less bothersome." Nineteen percent of people answering the survey indicated they are "Not disturbed" by traffic noise.

The survey also asks if people are "getting more used to (tolerant of) the traffic sounds." Twenty-eight percent of respondents say "Yes."

Analysis of the neighborhood results shows that for 41% of the Great Falls respondents, traffic noise has become "More bothersome." This percentage is higher than for the other areas, which are 35% for Butte, 34% for Missoula, and 22% for Billings. In the Billings Rimrock area, 27% of respondents indicate they were "Not disturbed" by traffic noise; compared to 16% in Butte, and less than ten percent % in the Great Falls and Missoula areas.

Butte residents have the highest increased tolerance of traffic noise (36%); compared to 32% in Missoula, 27% in Great Falls, and 23% in Billings.

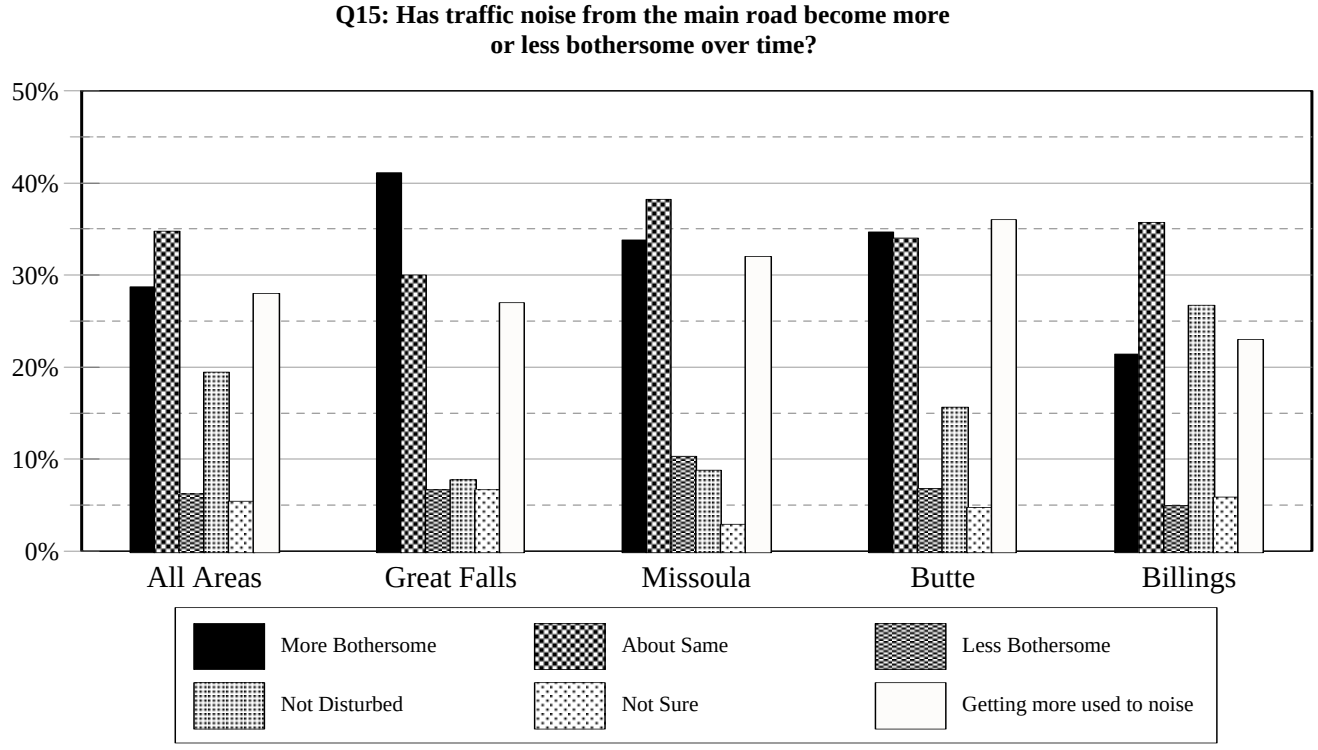

Figure 9. Change in disturbance due to traffic noise over time.

8.2.4.10 Adjustments made in way of living because of traffic noise

Question 16 asks if the resident has made adjustments in how he or she lives because of traffic noise. Figure 10 shows that across all the areas, just over a quarter say they have, while nearly two-thirds say they have not (9% did not answer). By individual survey areas, the responses vary quite a bit. Only 18% along Rimrock Road in Billings say they have made adjustments and nearly half (47%) in the Lower Rattlesnake area in Missoula say they have. Those results are consistent with the expressed annoyance in both areas in response to an earlier question. Higher sound levels, especially at night, would be expected along the higher speed Interstate route in the Lower Rattlesnake area compared to along the Rimrock Road arterial.

As shown in Figure 11, by far the most common adjustment is to *close windows*, cited by nearly a quarter of those people responding to this question. This percentage ranges up to 40% for the Missoula area, as shown on the graphs by individual survey areas in Appendix C. The most often cited outdoor adjustment is *planting trees or bushes* (12%), which, according to TNM, actually provides little reduction in sound level; the visual screening, however, seems to make some people feel as if the sound level has been reduced.

Twelve percent also say they turn on *background sound (such as fans, air conditioning or music)* inside the residence in an attempt to mask the traffic noise. That percentage ranges as high as 26% for the Lower Rattlesnake area in Missoula (see Appendix C). Also, one-in-five Missoula respondents say that they have *moved activities inside* because of traffic noise.

Q16: Has traffic noise from the main road caused you to make adjustments in how you live?

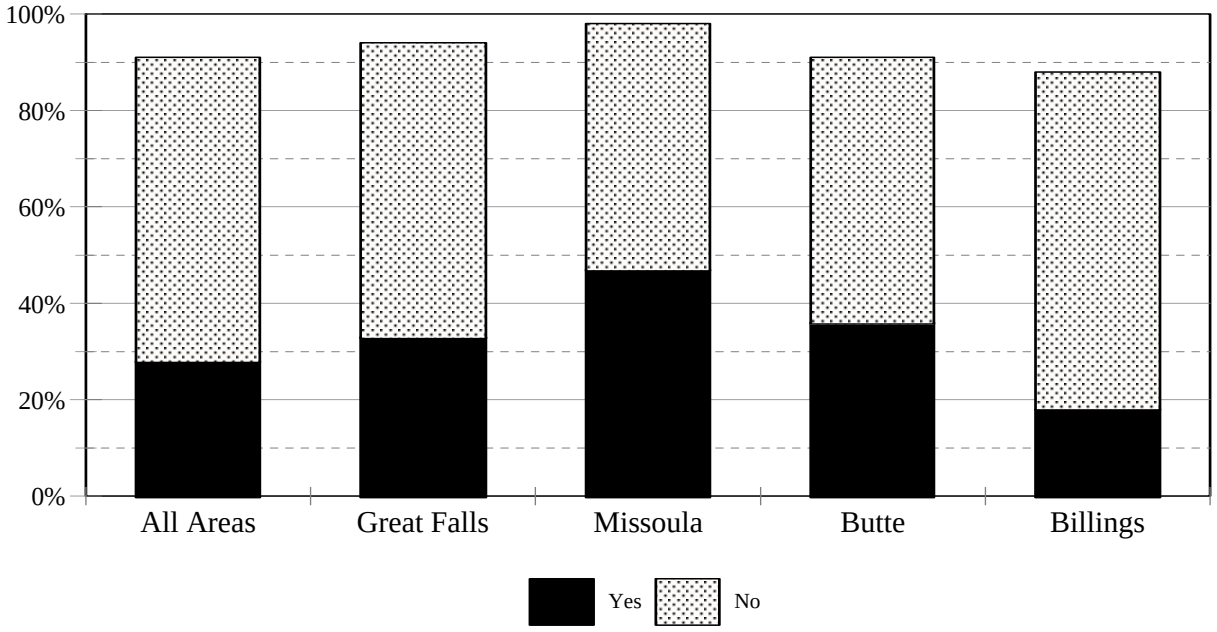

Figure 10. Percentage of residents who have made adjustments to how they live because of traffic noise.

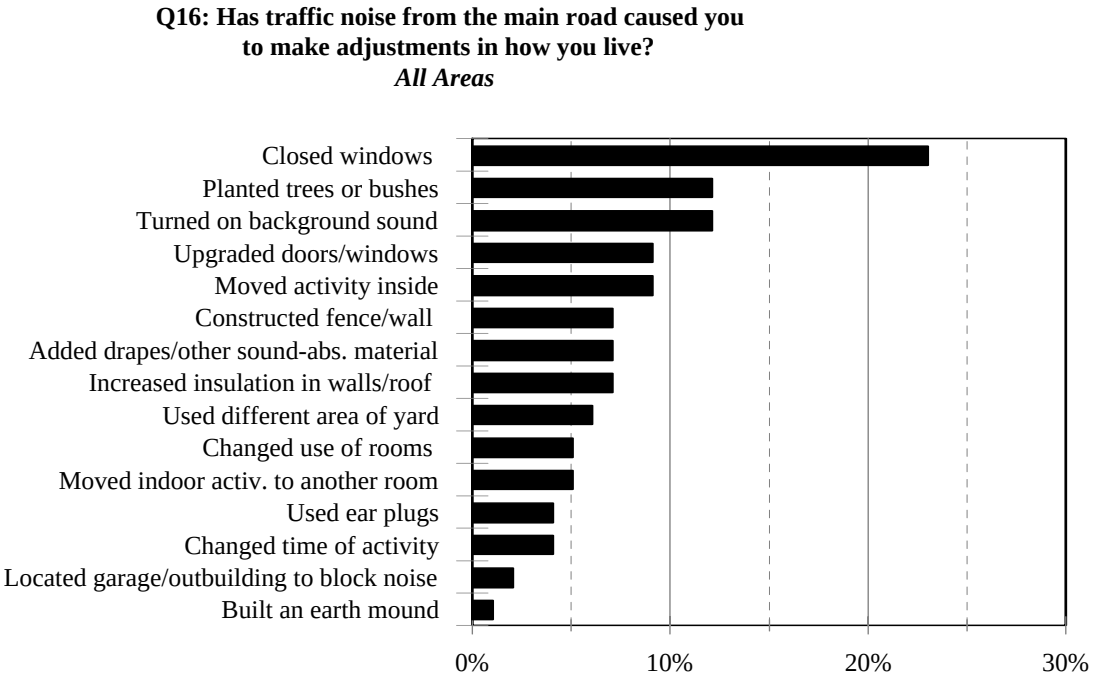

Figure 11. Percentages of residents making adjustments to how they live because of traffic noise, by type of adjustment.

An effective technique for noise reduction inside the residence is sound insulation. Nine percent of the respondents say they have *upgraded doors or windows (or added storm windows*), while 7% say they have *increased insulation in the walls or roof*. In the Butte survey area, a full 16% say they have *upgraded doors or windows*. These percentages are felt to be strong indicators of interior noise impact since these strategies can be costly.

8.2.4.11 Acceptability of traffic noise reduction methods at the current residence

Question 17 lists five possible traffic noise abatement methods that might be implemented by a public agency off the person's property. Respondents are asked to rate each of them independently as very acceptable, acceptable, not acceptable or not applicable to their situation. The question notes, "No actions are being considered for your neighborhood; we just want your opinions in general."

The results are very interesting, as shown in Figure 12, which shows the sums of the "Very acceptable" and "Acceptable" responses. Over half of the total respondents, as well as the respondents in each individual survey area, say that *restriction in use of jake brakes* is "Very acceptable" and "Acceptable." That fraction is two-thirds for Great Falls, which already has signs posted on engine brake use on the main road in the survey area, I-15 Spur/Country Club Boulevard. At the time this survey was developed, the writers were unaware of recent legislation regarding "jake" brakes.

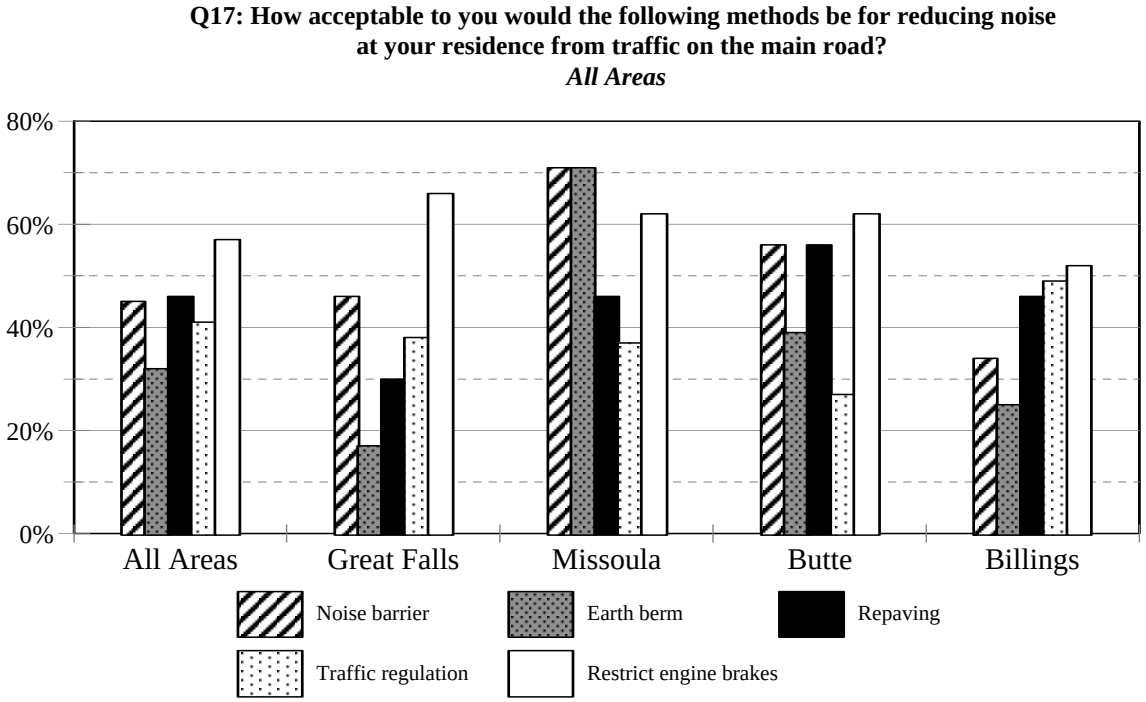

Figure 12. Percentages of respondents rating noise control methods as "Acceptable" or "Very acceptable."

Over 40% of all respondents rate *noise barriers*, *repaving*, and *traffic regulation* as "Very acceptable" and "Acceptable." In the Missoula survey area, seven-in-ten respondents rate both *noise barriers* and *earth berms* as "Very acceptable" and "Acceptable." Over half of the Butte respondents rate *noise barriers* and *repaving* highly.

While not shown in the figure, 40% of the Missoula respondents say that *traffic regulations* are "Not acceptable" or "Not applicable." Nearly a third of Butte respondents feel the same way. These high rates show either an understanding that these types of regulations would do little to reduce noise or that they would be unrealistic to try to enforce on an Interstate highway.

Along Rimrock Road in Billings, a third of the respondents feel that *noise barriers* were "Not acceptable" or "Not applicable," while 39% feel the same way about *earth berms*. These responses are not unreasonable, given the arterial nature of Rimrock Road.

In Great Falls, while 45% rate *noise barriers* "Very acceptable" or "Acceptable," only 17% feel the same about *earth berms*. This difference may be a comment on the restricted amount of room between the edge of pavement and the property lines east of Fox Farm Road, and the steep embankment slopes west of Fox Farm Road.

In addition to the listed items, respondents were asked to add other items. Appendix C presents these items.

8.2.4.12 Improvements to a residence that would noticeably reduce traffic noise

Question 18 is related to, but slightly different from Questions 16 and 17. Residents are asked which of several improvements to the person's residence would noticeably reduce traffic noise from the main road.

Constructing a fence, wall or earth mound to be a noise barrier has been selected by a quarter of all respondents, as shown in Figure 13. The percentage by survey area (as shown in Appendix C) ranges from a low of 18% for Rimrock in Billings to a high of 34% for Missoula and Butte. The second most often chosen improvement is to *plant a major hedge to create noise barrier*: one-in-five of all respondents chose it (by area, the range is from 18% for Great Falls to 29% for Missoula).

The next two most often selected items relate to the housing structure itself: *installing air conditioning to allow windows to remain closed*, and *upgrading windows or doors on the side facing traffic.*

Q18: Which of the following improvements to your residence area do you believe would noticeably reduce traffic noise?
All Areas

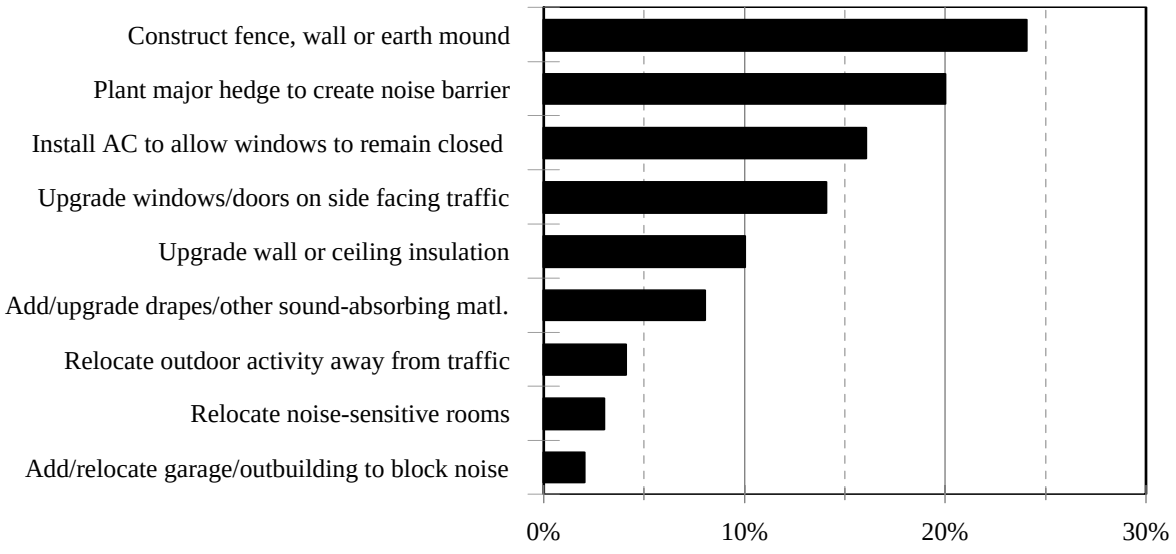

Figure 13. Percentages of residents feeling certain residential improvements would noticeably reduce traffic noise.

8.2.4.13 Willingness to pay to reduce traffic noise noticeably at the current residence

Question 19 asks the person to choose from several dollar ranges regarding how much the person might be willing to pay to reduce traffic noise noticeably at the *current* residence. Figure 14 shows that, collectively, less than a quarter of all respondents are willing to pay to have noise reduced at their current residence. Of those indicating a willingness to pay, by far the most commonly chosen dollar range is $1,000 or less, with just a few willing to pay over $5,000. Half of the respondents have chosen "Noise is not enough of a problem" (34%) or "I chose to live here" (17%). Ten percent did not respond.

In the individual survey areas, the responses vary quite a bit (see Appendix C for the data). Only 16% in Billings are willing to pay some amount, with 46% choosing "Nothing, noise is not enough of a problem." In contrast, 30% of the Missoula respondents indicate a willingness to pay, with only 13% saying "Nothing, noise is not enough of a problem." The Missoula respondents have the highest percentage that say they are *not able to afford to pay* (22%).

Q19: How much would you be willing to pay to reduce noise noticeably at your residence from traffic on the main road?
All Areas

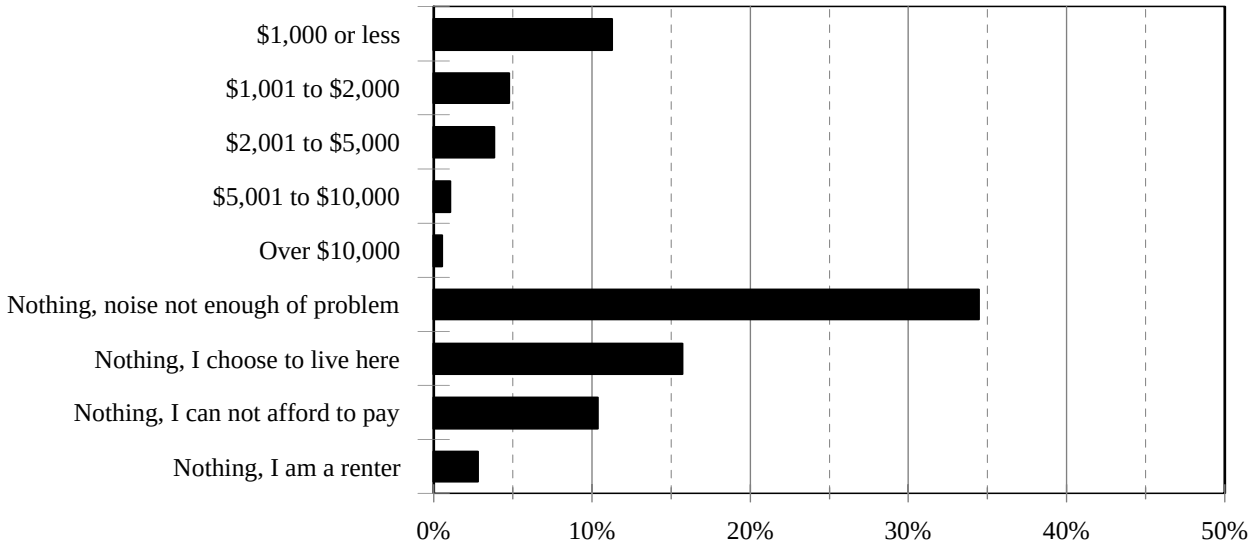

Figure 14. Percentages of residents willing to pay to reduce traffic noise at current residence.

8.2.4.14 Requiring the developer to reduce excessive traffic noise levels when building residences on undeveloped land next to a major roadway

As shown in Figure 15, nearly two-thirds of all respondents agree or strongly agree that developers should be required by the city or county to reduce excessive traffic noise levels when building residences on undeveloped land next to a major roadway. The question includes both "in the development" and "inside the residences" in its phrasing. Only 11% disagree or strongly disagree. The response percentages are similar across the four survey areas.

Q20: Do you agree that the city or county should require a developer building houses on undeveloped land next to a major roadway to reduce excessive traffic noise levels?

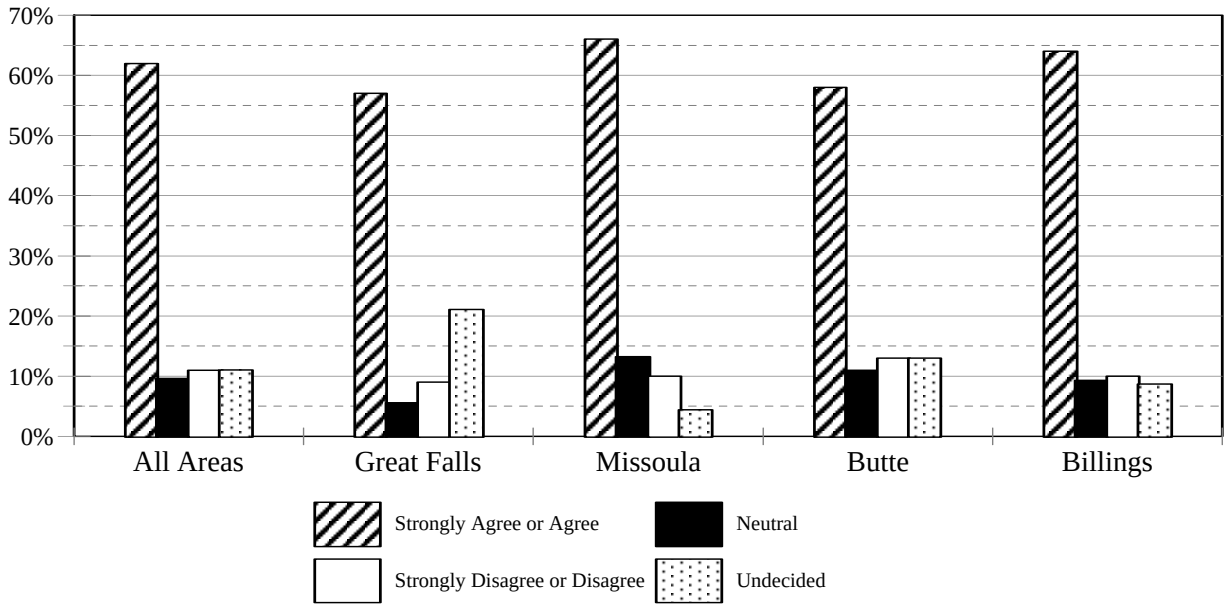

Figure 15. Percentages of residents agreeing or disagreeing that residential developers should be required to reduce traffic noise near major roadways.

8.2.4.15 Actions to reduce traffic noise effects for homes in new developments along busy roads

Question 21 then asks opinions on several development strategies that would reduce traffic noise effects in the yard (or common area) or inside the residence, assuming the respondent was buying a new home in a new development along a busy road or highway. Respondents were asked to rate the choices from "Strongly favor" to "Undecided." The strategies are:

- *Provide open or vegetated space (like a park) between road and residences*
- *Build on deep lots so homes will be far back from road*

- *Build a noise barrier wall between road and residences*
- *Build an earth berm between road and residences*
- *Design subdivision so that areas least sensitive to noise (garages, streets) are closest to road*
- *Lay out lots or residences so that noise-sensitive areas (patios, decks, balconies) face away from road*
- *Use windows and doors or walls/roofs that are more sound-insulating than usual*
- *Include retail, office or other non-residential buildings or land uses in the development and put them nearest to the road to block noise*

Figure 16 shows the results, summed over the four survey areas, combining the "Strongly favor" and "Favor" answers, and also combining the "Strongly opposed" and "Opposed" answers. Note that many people did not select an answer, or chose "Neutral" or "Undecided."

A majority of those responding are in favor of all of the strategies except having the developer *build an earth berm* or *include non-noise sensitive land uses in the development* as a buffer from the road. The relatively low 44% favorable response for *earth berms* is surprising because many people often prefer berms to walls for a noise barrier (note that 56% reacted favorably to *noise barrier*). Perhaps there is uncertainty on the meaning of the word "berm"; perhaps "earth mound" would have been a better choice. Only small percentages of the respondents are opposed to any of the strategies.

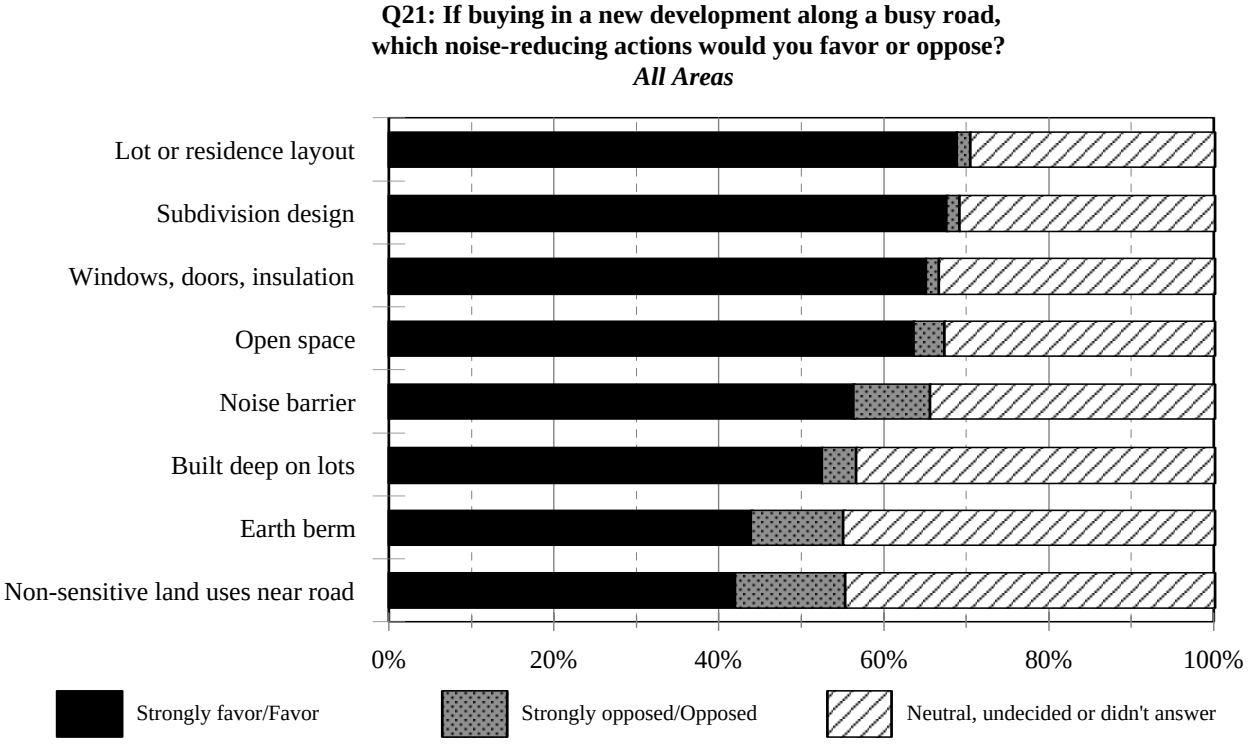

Figure 16. Percentages of residents favoring or opposing traffic noise reduction actions when buying a new home along a busy road.

8.2.4.16 Willingness to pay more for a new house next to a highway if the house or neighborhood were designed to reduce the traffic noise effects

Question 22 asks if the person would pay more for a *new* house next to a highway, if the house or neighborhood were designed to reduce the traffic noise effects. Figure 17 shows that half of all respondents say "Yes, definitely" (12%) or "Probably" (37%). One-in-five say "No," and the rest are either undecided or did not answer the question. The results do not vary substantially across the four surveyed communities.

Given that these results are for all respondents, and thus include a substantial number not frequently annoyed by traffic noise, one can conclude that there is a fair amount of desire for quieter residential environments near highways. This finding, coupled with the results of the previous question, shows that there would likely be support for noise-compatible planning and development at the local city or county level.

Q22: Would you be willing to pay more for a new house next to a highway, if the house or neighborhood were designed to reduce the traffic noise effects?

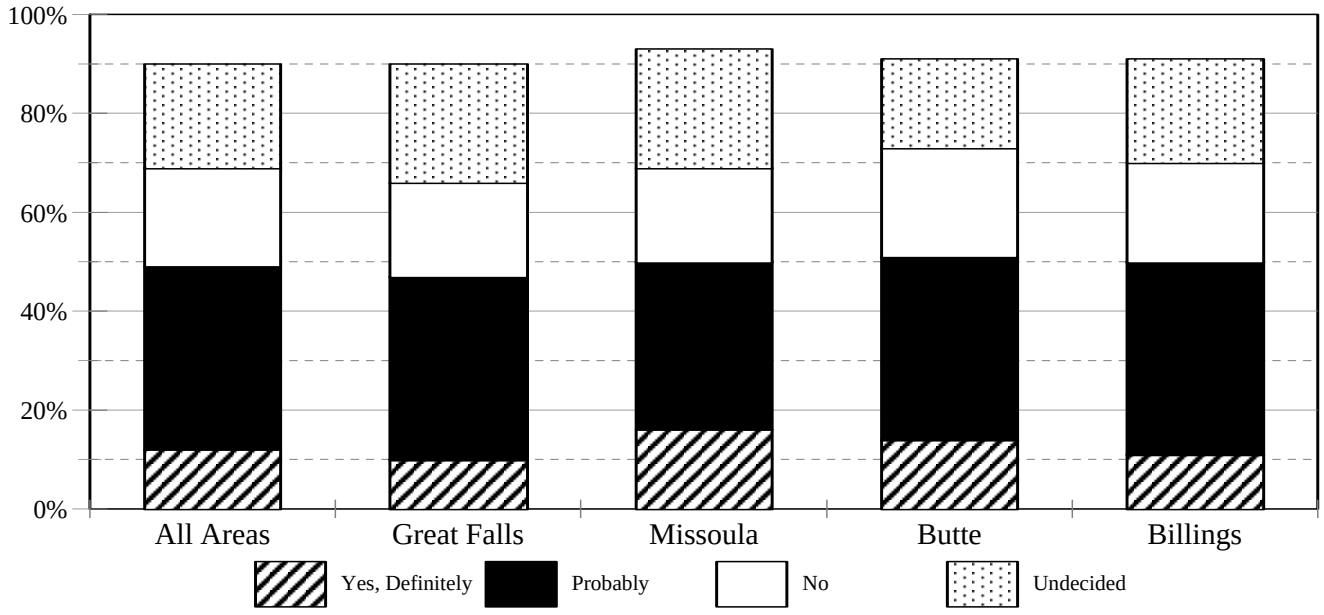

Figure 17. Percentages of residents willing to pay more for traffic noise reduction for a new house next to a highway.

8.2.4.17 Interest in participating in programs aimed at helping to reduce traffic noise at residential sites

Finally, Question 23 asks respondents to indicate if they would participate in any of several possible programs aimed at helping to reduce traffic noise at the home site. Items range from *reading a brochure on traffic noise control for residences* to *voting for a neighborhood improvement district to pay to reduce traffic noise in the residential area*. The question clearly notes, however, "No specific actions are planned at this time."

The results in Table 18 show a fair level of interest among the respondents. Nearly half are willing to *read a brochure on traffic noise control for residences*. About a quarter of the respondents would be *interested in attending a seminar* or *allowing home inspections*. Only 16% are interested in *participating in a low interest loan program for reducing traffic noise impacts at the home site*, although that percentage nearly doubles (30%) for *participation in a federal or state grant program* with the same goal.

There is a wide variation among the individual survey areas. For all of the possible programs, the respondents in the Lower Rattlesnake area in Missoula have the highest positive response rates.

Table 18: Percentages of Respondents Interested in Participating in Programs Aimed at Helping to Reduce Traffic Noise at Residential Sites

Possible Program	*Sum for All Areas*	*Great Falls*	*Missoula*	*Butte*	*Billings*
Read brochure on traffic noise control for residences	48%	36%	62%	56%	45%
Read brochure on land use planning near a noisy roadway	33%	22%	50%	35%	30%
Participate in federal or state grant program for reducing traffic noise impacts at your home site	30%	31%	46%	41%	22%
Allow home inspection to identify ways to reduce traffic noise at your home site	26%	23%	38%	36%	20%
Attend seminar on ways to reduce traffic noise at your home site	24%	23%	29%	31%	19%
Vote for neighborhood improvement district to pay to reduce traffic noise in your residential area	21%	21%	35%	29%	15%
Participate in low interest loan program for reducing traffic noise impacts at your home site	16%	10%	21%	24%	13%

Respondents were given the opportunity to add other items. Many of these items are more general comments on the subject of traffic noise rather than specific suggestions for programs in which to participate. Nonetheless, they provide some useful insights and add some color behind the numbers. The actual comments are in Appendix C. Items include:

- Great Falls: Support for noise barrier and elimination of engine compression brakes.
- Missoula: Support for noise barrier and reduced speeds on I-90; train noise is a major noise source; traffic on Van Buren is a major noise source; closing windows and installing air conditioners is not desirable.
- Butte: Plant trees; residents should not pay for problems they did not cause.
- Billings: Better planning; installation of new windows has reduced noise; purchase house elsewhere; move; make quiet asphalt as a standard city spec for pavements; enforce speed limits or slow down traffic; enforce against boom boxes in residential areas; put up sign prohibiting engine compression brakes; eliminate trucks hauling construction materials; noise from traffic on Zimmerman Trail is a major problem; airport noise is an issue; subject small planes that fly over to the same restrictions as commercial planes; motorcycle racing on Rimrock is annoying; car stereos are major noise sources; reflections off a solid fence on south side of road are a problem.

8.2.4.18 Additional comments on the survey or the subject

Question 24 invites the respondents to provide additional comments on any aspects of the survey or the subject. Over sixty respondents provided comments, including one six-page letter. The actual comments are contained in Appendix C.

By far the major source of complaints is the use of "jake" brakes, often despite posted restrictions and the lack of enforcement of those restrictions (12 separate comments). Other comments include requests for noise barriers (5 comments), quieter pavements (4 comments), restrictions on car stereo boom boxes (6 comments), thoughts on buying next to roads (5 comments), house design and improvements (2 comments), and concerns about traffic, motorcycles and bad mufflers (5 comments). One person emphatically stated that taxes should not be raised to solve problems for people who bought or built a house by the interstate.

8.2.4.19 Comparison of respondents "frequently annoyed" or "not annoyed" by traffic noise

This last section takes a closer look at the respondents who say they are frequently annoyed by noise from traffic on major roads, compared to those who say they are not annoyed by traffic noise. The focus is on those survey areas and sub-areas where over half the respondents say they are frequently annoyed by traffic noise (that is, all of the survey areas excluding the eastern and central Rimrock sub-areas in Billings). Within these areas of "frequent annoyance," roughly 60% of the respondents said they are frequently annoyed by traffic noise and 40% say they are not.

The differences in opinions of these two groups of respondents are substantial. These differences point to the problem of promoting noise mitigation programs to those who do not feel negatively affected by traffic noise.

In the following discussion, these two groups of respondents are labeled *Frequently Annoyed* and *Not Annoyed*. As might be expected, the majority of the *Frequently Annoyed* live next to or within one block of the road, and the majority of the *Not Annoyed* live two or more blocks away.

Table 19 presents the responses of the two groups for a number of the survey questions.

Table 19: Comparison of Responses of Those Residents Frequently Annoyed by Traffic Noise from the Main Road and Those Not Annoyed

Question #	*Item*	*Frequently Annoyed*	*Not Annoyed*
7	Lack of traffic on main road: Rated poor or very poor	73%	21%
7	Peace and quiet from manmade noises: Rated poor or very poor	53%	41%
9	Traffic noise is highly noticeable inside residence	71%	13%
9	Traffic noise is highly noticeable in front yard	69%	36%
9	Traffic noise is highly noticeable in back yard	87%	36%
9	Traffic noise is highly noticeable nowhere	2%	27%
10	Annoyed or highly annoyed last week while inside residence	65%	10%
11	Annoyed or highly annoyed last week while outside residence	75%	12%
13	Gave great deal or some consideration to noise when buying/renting	31%	20%
14	Traffic noise is louder or much louder since moving in	67%	22%
15	Traffic noise has become more bothersome over time	49%	8%
16	Have made adjustments in way of living because of traffic noise	50%	8%
19	Willing to pay some amount to reduce traffic noise noticeably at current residence	35%	6%
20	City or county should require developer to reduce excessive traffic noise levels in the development or inside the residences: Percent agreeing or strongly agreeing	68%	47%
22	Would be willing to pay more for new house next to highway, if house or neighborhood were designed to reduce traffic noise effects	58%	35%

Of particular interest are the differences for questions 14,15, 16, 19 and 20:

- Two-thirds of the *Frequently Annoyed* feel traffic noise is louder or much louder since moving in, compared to less than a quarter of those *Not Annoyed.*

- Half of the *Frequently Annoyed* say traffic noise has become more bothersome over time, compared to fewer than ten percent of those *Not Annoyed.*

- Half of the *Frequently Annoyed* say they have made adjustments in their way of living because of traffic noise, compared to under 10 percent of those *Not Annoyed.*

- Over a third of the *Frequently Annoyed* are willing to pay some amount to reduce traffic noise noticeably at current residence, compared to only six percent of those *Not Annoyed.*

- Two-thirds of the *Frequently Annoyed* agree or strongly agree that a city or county should require developers building next to existing roads to reduce excessive traffic noise levels in the development or inside the residences, compared to less than half of those *Not Annoyed.*

Table 20 shows the differences in the types of adjustments that the two groups have made in their way of living. Of note:

- Eight percent of the *Frequently Annoyed* have constructed a fence or wall as a noise barrier, compared to three percent of those *Not Annoyed*.

- Sixteen percent of the *Frequently Annoyed* have upgraded doors or windows (or added storms), compared to four percent of those *Not Annoyed.*

- Forty-four percent of the *Frequently Annoyed* have closed windows, compared to five percent of those *Not Annoyed.*

- Eighteen percent of the *Frequently Annoyed* have moved outdoor activities indoors, compared to two percent of those *Not Annoyed.*

- Twenty-two percent of the *Frequently Annoyed* have turned on background sounds (fans, air conditioning, music, etc.) to mask the traffic noise, compared to three percent of those *Not Annoyed*

Clearly, traffic noise has caused many people to adjust their ways of living, including spending of their own funds in an attempt to reduce traffic noise levels.

Table 21 shows a much higher rate of acceptance by those *Frequently Annoyed* of various mitigation strategies that could be done off the person's property to reduce traffic noise, especially in terms of building a noise barrier wall or berm and restricting jake brake use.

Table 22 shows much stronger beliefs among those *Frequently Annoyed* that noise barriers, major hedges and air conditioning/closed windows would be effective traffic-noise reduction measures.

Table 20: Comparison of Residents Frequently Annoyed and Not Annoyed by Traffic Noise: Percent Who Have Made Adjustments to Way of Living

Type of Adjustment	*Frequently Annoyed*	*Not Annoyed*
Closed windows	44%	5%
Turned on background sound	22%	3%
Moved activity inside	18%	2%
Planted trees or bushes	18%	6%
Upgraded doors/windows	16%	4%
Added drapes/other sound-absorbing material	14%	3%
Used different area of yard	12%	1%
Increased insulation in walls/roof	12%	3%
Changed use of rooms	10%	2%
Used ear plugs	9%	0%
Moved indoor activities to another room	9%	2%
Constructed fence/wall	8%	3%
Located garage/outbuilding to block noise	4%	1%
Built an earth mound	1%	1%

Table 21: Comparison of Residents Frequently Annoyed and Not Annoyed by Traffic Noise: Percent Rating Traffic Noise Reduction Methods as Acceptable or Very Acceptable

Method	*Frequently Annoyed*	*Not Annoyed*
Noise barrier wall between residences and the road	65%	29%
Earth berm (mound) between residences and the road	46%	17%
Repaving the road with quieter pavement	53%	36%
Traffic regulation (banning certain vehicle types, restricting hours on road, reduce speed)	43%	26%
Restrict use of jake brakes	73%	41%

Table 22: Comparison of Residents Frequently Annoyed and Not Annoyed by Traffic Noise: Percent Believing Improvement Would Noticeably Reduce Traffic Noise

Improvement	*Frequently Annoyed*	*Not Annoyed*
Constructing a fence, wall or earth mound to be a noise barrier	41%	8%
Add or relocate garage or outbuilding to block noise	2%	0%
Add or upgrade drapes or other sound-absorbing material in rooms facing traffic	11%	5%
Relocate more noise-sensitive rooms to quieter side of house	3%	1%
Install air conditioning to allow windows to remain closed	22%	9%
Plant major hedge to create noise barrier	26%	13%
Upgrade wall or ceiling insulation levels	11%	6%
Upgrade windows or doors on side facing traffic	19%	8%
Relocate outdoor activity to side facing away from traffic	4%	3%

Table 23 shows that those *Frequently Annoyed* are more in favor of all eight suggested noise-reducing strategies for new houses or developments built along existing busy roads than those *Not Annoyed*, with the greatest differences regarding support of noise barrier walls or berms.

Table 23: Comparison of Residents Frequently Annoyed and Not Annoyed Traffic Noise: Percent Favoring or Strongly Favoring Noise-reducing Strategies for a New Home Along a Busy Road

Strategy	*Frequently Annoyed*	*Not Annoyed*
Open space	62%	51%
Built deep on lots	51%	47%
Noise barrier	71%	35%
Earth berm	52%	23%
Subdivision design	69%	56%
Lot or residence layout	72%	62%
Windows, doors, insulation	68%	55%
Include non-sensitive land uses	52%	37%

Finally, Table 24 shows that the *Frequently Annoyed* are more willing than those *Not Annoyed* to participate in all of the mentioned possible programs aimed at reducing traffic noise. In particular, nearly half of the Frequently Annoyed expressed interest in a federal or state grant program.

Table 24: Comparison of Residents Frequently Annoyed and Not Annoyed Traffic Noise: Percent Who Would Participate in Programs Aimed at Reducing Traffic Noise

Possible Program	***Frequently Annoyed***	***Not Annoyed***
Read brochure on traffic noise control for residences	57%	38%
Read brochure on land use planning near a noisy roadway	37%	25%
Attend seminar on ways to reduce traffic noise at your home site	36%	15%
Allow home inspection to identify ways to reduce traffic noise at your home site	37%	21%
Participate in low interest loan program for reducing traffic noise impacts at your home site	26%	6%
Participate in federal or state grant program for reducing traffic noise impacts at your home site	47%	17%
Vote for neighborhood improvement district to pay to reduce traffic noise in your residential area	32%	13%

8.2.4.20 Summary of residents survey results

Over six hundred residents in four Montana communities responded to a survey on traffic noise and its mitigation. The communities were in Great Falls (near Country Club Boulevard and the I-15 Spur), Missoula (in the Lower Rattlesnake area near I-90), Butte (the Hillcrest area near I-15/90), and Billings (along Rimrock Road from 5th Street to 38th Street).

Half of all of the respondents' dwellings were adjacent to the main road or one block away, with the other half two or more blocks away. The response rate was higher for people close to the road than for those farther from the road, which correlated with their expressed annoyance over traffic. Nearly 90% of the respondents live in single-family homes (with only 75% in the Great Falls area). Over 90% own their housing unit, with nearly 60% having lived in their homes for 10 or more years. Most of the houses are occupied by two or fewer people, and most of the responding households do not have children.

High proportions of respondents rate seven different neighborhood qualities as "Very Good" or "Good," with two exceptions:

- More than half of the survey's respondents rate *lack of traffic on the main road* as "Poor" or "Very Poor."

- Likewise, one third rate *Peace and quiet from outdoor manmade noises* as "Poor" or "Very Poor."

The negative responses are much higher for those respondents within a block of the road compared to those farther away, and are higher for respondents in Missoula and Great Falls compared to Butte and Billings.

Over half of all respondents say that *traffic noise from major roads and highways* frequently annoys them at their home site. Traffic noise is the most frequently cited noise annoyance, followed by *dogs and other pets, aircraft*, and *car boom boxes or stereos.* Noise from *traffic on local streets* (excluding car stereos) was not a major source of annoyance. Sixty percent of those living next to the road or within one block say that they are frequently annoyed by *traffic noise from major roads and highways*, compared to only 40% of those farther from the road.

By area, much higher portions of respondents in Great Falls, Missoula, and Butte cite major road traffic noise as a frequent source of noise annoyance compared to residents in Billings. Focusing on Billings, the eastern and central sub-areas along Rimrock Road (east of Rehberg Lane) show a much lower rate of frequent annoyance than the sub-area west of Rehberg Lane, where Zimmerman Trail is a noise source of concern to respondents.

Excluding the eastern and central Rimrock sub-area responses, fully two-thirds of the remaining respondents (in western Rimrock, Great Falls, Missoula and Butte) cite major road noise as a source of frequent annoyance, which was twice as much as the next highest noise source. Also, nearly two-thirds of this remaining group of respondents say that traffic noise is highly noticeable in their backyards, almost 60% say the front yard and over half say "inside the residence."

Just over one-third of the respondents say they were "Annoyed" or "Highly annoyed" by traffic noise while inside their houses in the week prior to the survey; that percentage increases to 43% for outside the residence. The survey was administered during the last week in August and first week of September, when Montana's weather was ideal for spending time out-of-doors. A quarter of all respondents say they are annoyed "All" or "Much of the day" by traffic noise while outside, and nearly one-in-five report the same while inside. People living next to the main roadway are much more likely to be annoyed by the roadway's traffic noise than others are. While inside, nearly half of these people find traffic noise to be annoying "All" or "Much of the day," compared to only 15% of those who live a block or more away. Missoula residents show the most annoyance, followed by Great Falls, Butte, and Billings.

Nearly three quarters of all respondents say they gave little or no consideration to traffic noise, or were unaware of traffic noise, before buying or renting their residence. About a quarter feel that traffic noise has gotten "Much louder" since they moved into their residence, and another quarter "A little louder." About 30% say that traffic noise has become "More bothersome" over time. Only two percent (25%)" feel traffic noise is now "Quieter," although just over a quarter say they have gotten "more used to (tolerant of) the traffic sounds."

Just over a quarter of the respondents say they have made adjustments in how they live because of traffic noise, ranging from almost half in the Lower Rattlesnake area in Missoula to as little as 18% in Billings. By far the most common adjustment is to *close windows*, followed by *planting trees or bushes, turning on background sound (such as fans, air conditioning or music)* and *moving activities inside.*

Noise from jake brakes was cited as a source of much annoyance by many people in the comment section of the survey. Several people specifically complained about the lack of

enforcement of existing engine brake use restrictions. Over half of the total respondents find *restriction in use of jake brakes* to be a "Very acceptable" or "Acceptable" method of noise control. Over 40% of all respondents rate *noise barriers*, *repaving*, and *traffic regulation* as "Very acceptable" and "Acceptable." Differences in opinion on noise barrier walls compared to earth berms do exist, however: walls seem more desirable than berms.

When asked about which of several methods would noticeably reduce noise in their homes, respondents most often cited *noise barriers*, *hedges*, *air conditioning to allow windows to remain closed*, and *upgrading doors and windows*. However, less than a quarter of all respondents are willing to pay to have noise reduced at their current residence (ranging from 16% in Billings to 30% in Missoula). Twenty-two percent of those in Missoula say they are unable to afford to pay. Of those indicating a willingness to pay, by far the most commonly chosen dollar range was $1,000 or less.

Interestingly, when asked if they would pay more for a *new* house next to a highway if the house or neighborhood were designed to reduce the traffic noise effects, half the respondents say "Yes, definitely" or "Probably."

Nearly two-thirds of all respondents agree or strongly agree that developers should be required by the city or county to reduce excessive traffic noise levels when building residences on undeveloped land next to a major roadway. The most favored strategies are:

- *Subdivision design with areas least sensitive to noise (garages, streets) closest to the road*
- *Provision of open or vegetated space (e.g., park) between road and residences*
- *Building of noise barriers.*

Finally, the survey shows a fair level of interest among the respondents in participating in any of several possible programs aimed at helping to reduce traffic noise at the home site. Nearly half are willing to *read a brochure on traffic noise control for residences.* About a quarter of the respondents would be *interested in attending a seminar* or *allowing home inspections program.* About 30% would *consider participation in a federal or state grant program* aimed at noise reduction at the home site.

Given that these results are for all of the respondents, and thus include a substantial number of people who say that they are not frequently annoyed by traffic noise, one can conclude that there is a fair amount of desire for quieter residential environments near highways. These findings suggest that there likely is support for noise-compatible planning and development at the local level.

When comparing those respondents who are *Frequently Annoyed* by traffic noise to those who are *Not Annoyed*, the differences in opinions are substantial.

- Two-thirds of the *Frequently Annoyed* feel traffic noise is louder or much louder since moving into their residence, compared to less than a quarter of those *Not Annoyed.*
- Half of the *Frequently Annoyed* say traffic noise has become more bothersome over time, compared to under ten percent of those *Not Annoyed.*

- Half of the *Frequently Annoyed* say they have made adjustments in their way of living because of traffic noise, compared to under ten percent of those *Not Annoyed.*

Clearly, traffic noise has caused many people to adjust their ways of living, including spending their own funds, in an attempt to reduce traffic noise levels.

Those people who are *Frequently Annoyed* are much more receptive to various mitigation strategies that could be done off the person's property to reduce traffic noise, such as building a noise barrier wall or berm and restricting jake brake use. Compared to those *Not Annoyed*, they are also more in favor of several suggested noise-reducing strategies that could be done by developers for new houses or developments built along existing busy roads, such as noise barrier walls or berms. They are also more willing than those *Not Annoyed* to participate in several possible programs aimed at reducing traffic noise, with nearly half expressing interest in a federal or state grant program for noise reduction.

While these differences highlight the severity of the problem for some, the differences point to the problem of promoting noise mitigation programs to the larger public, that is, those who do not feel negatively affected by traffic noise.

8.3 Survey of Planning Officials

8.3.1 Planning Officials Survey Plan

The planning officials survey is aimed at determining the extent to which traffic noise is a problem, relative to other quality of life issues and other types of noise. In addition, opinions on the effectiveness of noise mitigation methods are sought. Next, the whole issue of noise mitigation requirements for developers is explored. Finally, the survey addresses the important issues for success of a noise-compatible program and important roles for MDT.

The survey was targeted to particular individuals. A pre-distribution database was developed containing the names, addresses and telephone numbers of the individuals whose response was desired. The surveys were mailed directly to these individuals.

The planners were given the options to either use their name in connection with the survey, refer to their organization by name, keep their name anonymous, have someone check with them before using their name or organization, and state if they wanted a copy of the final report.

Follow-up telephone calls were made to some of those individuals who did not respond and who worked for the more populated jurisdictions. Additionally, several surveys were handed out to attendees at a presentation on noise-compatible planning made by the study team at the October 2003 Annual Meeting of the Montana Association of Planners.

8.3.2 Planners Survey Contents

The survey includes questions on the following subjects:

- Characteristics of the planning jurisdiction

- The degree to which various types of noises are a problem in residential areas

- Residential areas in the planning jurisdiction where traffic noise is a problem;
- If the city/county has any noise-related ordinances (requesting information on who handles enforcement);
- The respondent's opinions on the acceptability of a variety of highway traffic noise reduction methods for residential areas. The methods are the same as those in the residents survey;
- If the jurisdiction has required a residential developer who wants to build on undeveloped land next to a highway to take any of a variety of actions for reducing excessive traffic noise;
- The respondent's opinions on who should pay to reduce excessive traffic noise when a residential developer builds *new* residences alongside an *existing* highway or major road;
- The importance of various actions for the success of a noise-compatible residential development program in the city/county; and
- The importance of a variety of potential activities or roles for MDT for success of a noise-compatible development program in the city/county.

Appendix B includes a copy of the survey.

8.3.3 Planners Survey Results

In late summer of 2003, the final six-page written survey was mailed to 113 members of the MAP. Responses were received from 42 of the MAP members, for a 38% response rate (one survey was completed jointly Great Falls-Cascade Co. City-County). Most responses from Montana Association of Planner members came from people living and/or working in the state's most urban counties.

Table 25 displays number of survey results by county.

Nine surveys were returned from planners working in Gallatin County. Gallatin County includes the cities of Bozeman, Belgrade, and Manhattan. From 1990-2000, Gallatin County was the State's fastest growing county.

8.3.3.1 Characteristics of planning jurisdictions of respondents

As shown in Figure 18, most (40 of 42) survey responses are from persons affiliated with local government planning agencies. Thirty-nine responses are from persons working as city and/or county planning professionals. One survey response is from a person serving as a board member for a Montana local government planning commission. The remaining two responses are by persons employed in providing planning consulting services.

The survey response rates are 45% (40 out of 87) for MAP members associated with local governments. The response rate is 8% (2 out of 24) for MAP members not directly affiliated with local governments. The response pattern indicates a greater interest in "traffic noise management" among local government planners, and among other persons providing planning services in Montana.

Table 25: Number of Survey Responses by County

County	*Largest Cities*	*# Survey Responses*
Gallatin	Bozeman, Belgrade, Manhattan	9
Lewis & Clark	Helena, E. Helena	5
Yellowstone	Billings, Laurel	5
Flathead	Kalispell, Whitefish, Col. Falls	4
Cascade	Great Falls	3
Missoula	Missoula	3
Silver Bow	Butte, Walkerville	2
Beaverhead	Dillon	1
Broadwater	Townsend	1
Carbon	Red Lodge	1
Custer	Miles City	1
Daniels	Scobey	1
Fallon	Baker	1
Fergus	Lewistown	1
Lake	Polson, Ronan	1
Roosevelt	Wolf Point	1
Sheridan	Plentywood	1
Teton	Choteau	1

Two-thirds of the respondents (29 of 42) were from jurisdictions of 20,000 or more people, as shown in Figure 19.

In the past decade, 60% of the respondents' jurisdictions have had population growth of five or more percent, as shown in Figure 20. Ten percent have had no change and ten percent have had a decrease in population.

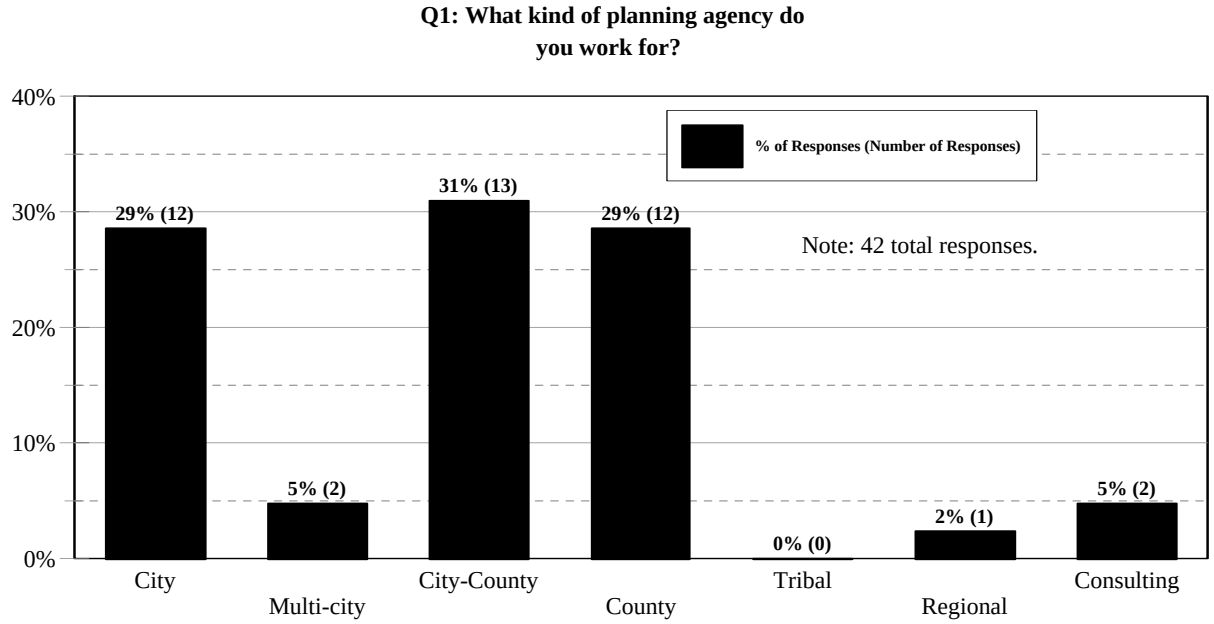

Figure 18. Distribution of planner respondents by type of agency.

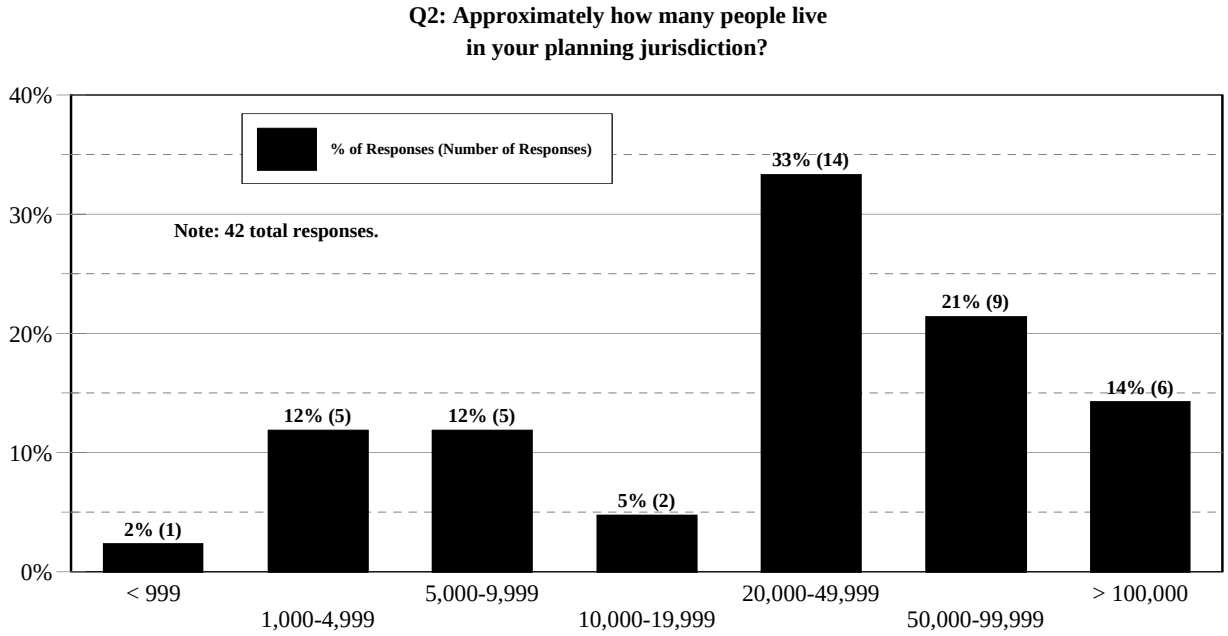

Figure 19. Distribution of planning jurisdiction populations for the responding planners.

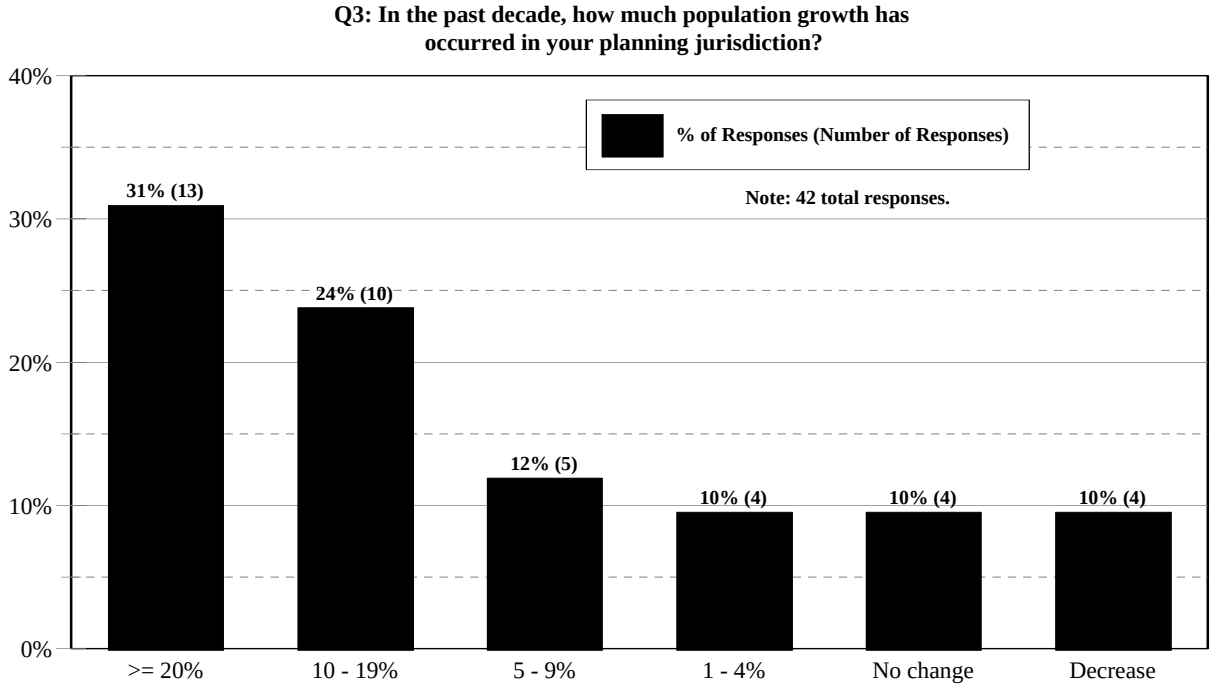

Figure 20. Population growth in past decade for jurisdictions of responding planners.

The planners were asked to indicate which of several planning documents are adopted by either all or part of their planning jurisdictions. Figure 21 shows the results. Nearly three-quarters adopt *Growth Policies* for parts of their jurisdiction and 40% or more adopt *Capital Improvement Plans* and *Comprehensive Plans* for parts of their jurisdiction. Only one-in-five adopt *Land Use Plans* for parts of their jurisdiction.

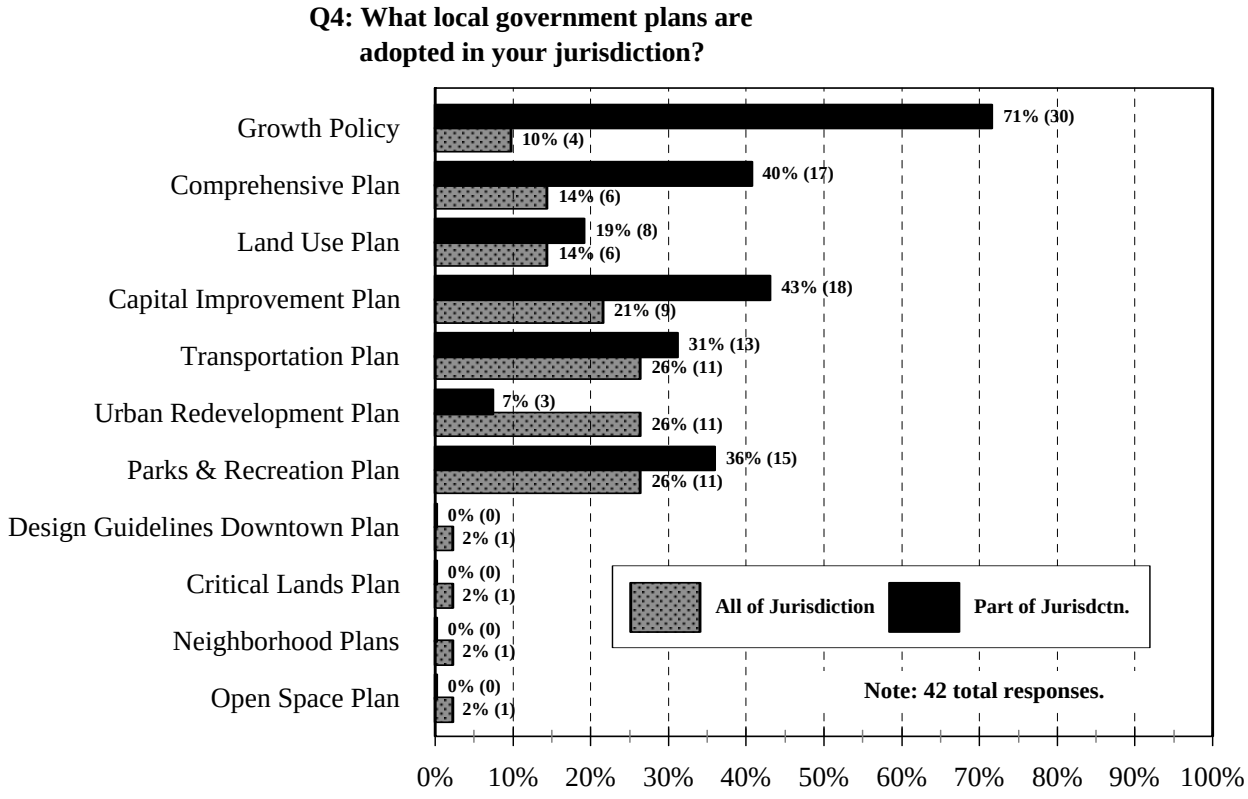

Figure 21. Percentage of planners whose jurisdictions adopt various plans.

The planners were also asked which of several plan implementation actions are carried out in their jurisdiction. Figure 22 shows the results. Nine-in-ten carry out zoning and subdivision regulations in either all or part of their jurisdictions. Nearly two-thirds have responsibility for building codes and Special Improvement Districts. Only one handles land use permits.

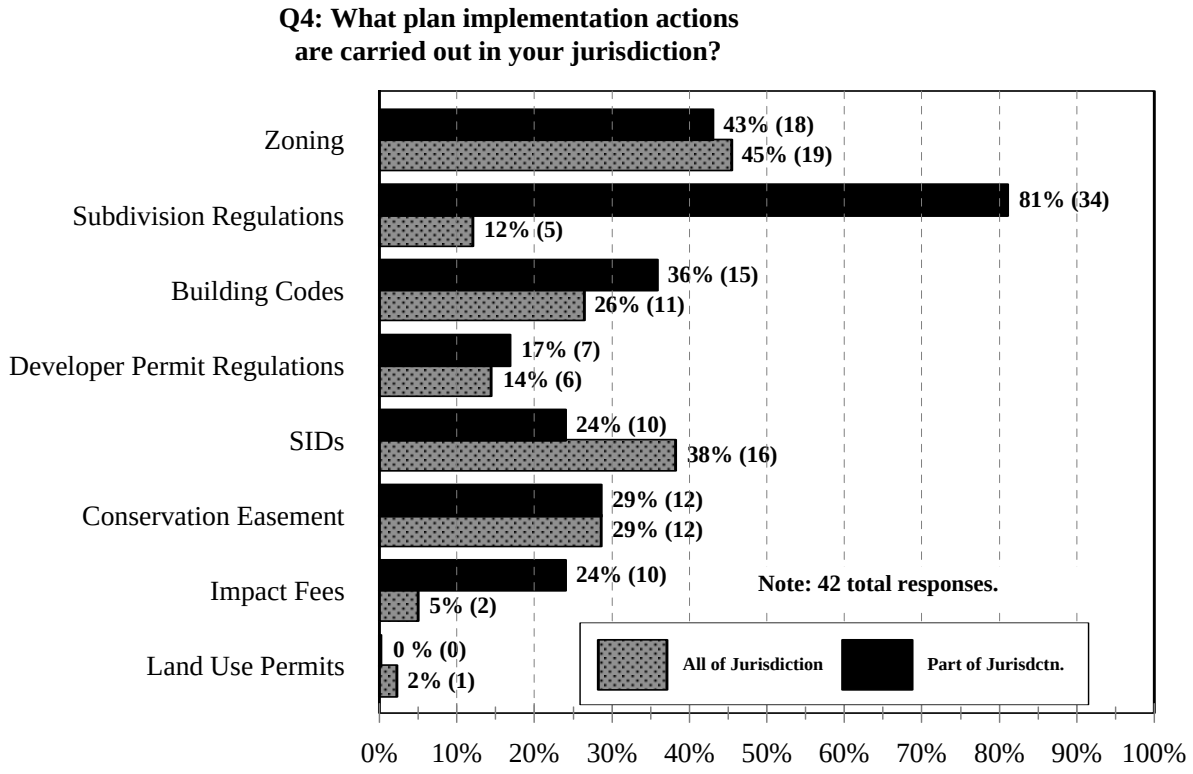

Figure 22. Percentage of planners whose jurisdictions carry out various plan implementation actions.

8.3.3.2 Degree of noise as a problem in the jurisdiction's residential areas

Question 5 asks about the problem of noise impacts in residential neighborhoods. Figure 23 and Figure 24 show the results. Planners indicate the most prevalent source of noise problems in residential neighborhoods is *large trucks using major roads and highways*, with half citing them as a "Major or Medium" problem. Three-in-ten cite noise from *general traffic on main roads*, while only 12% note noise from *general traffic on local roads*. *Train noise* is a "Major or Medium" problem in one-third of the planning jurisdictions, and *aircraft noise* in 21%.

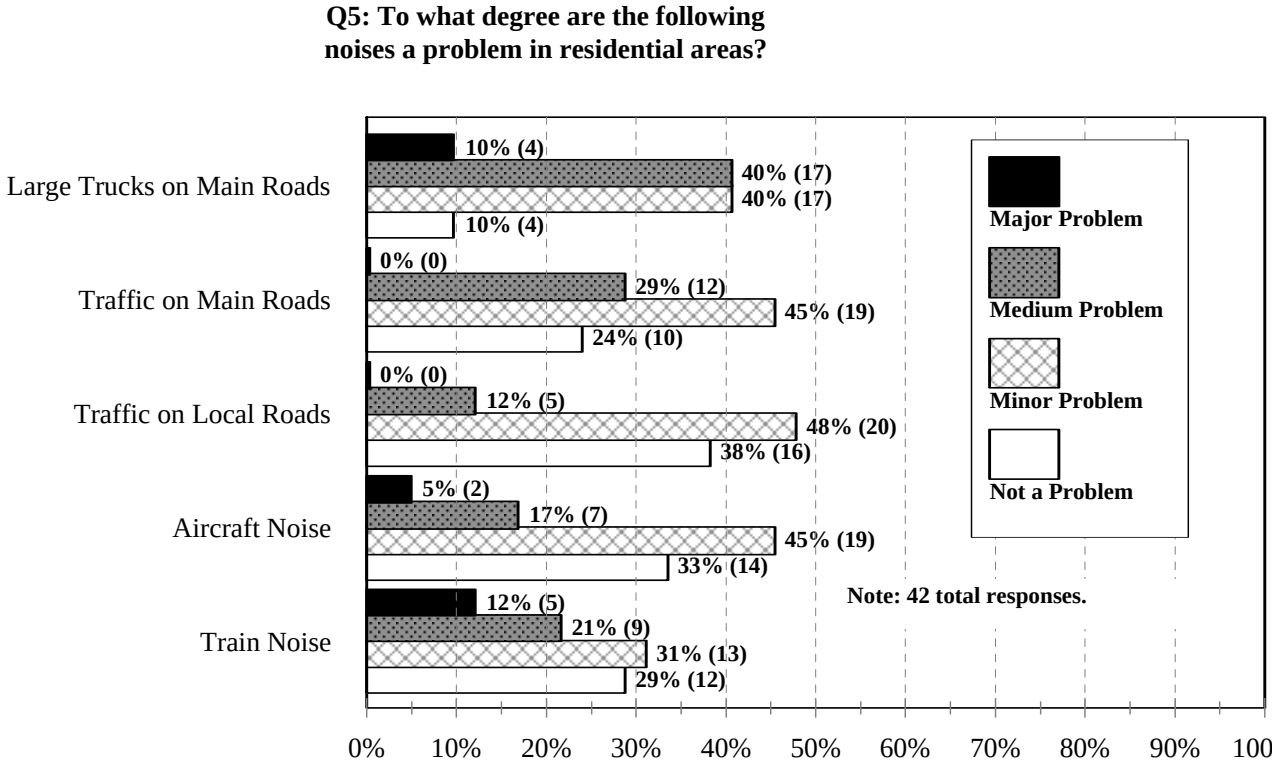

Figure 23. Percentage of planners whose jurisdictions have various transportation noise problems.

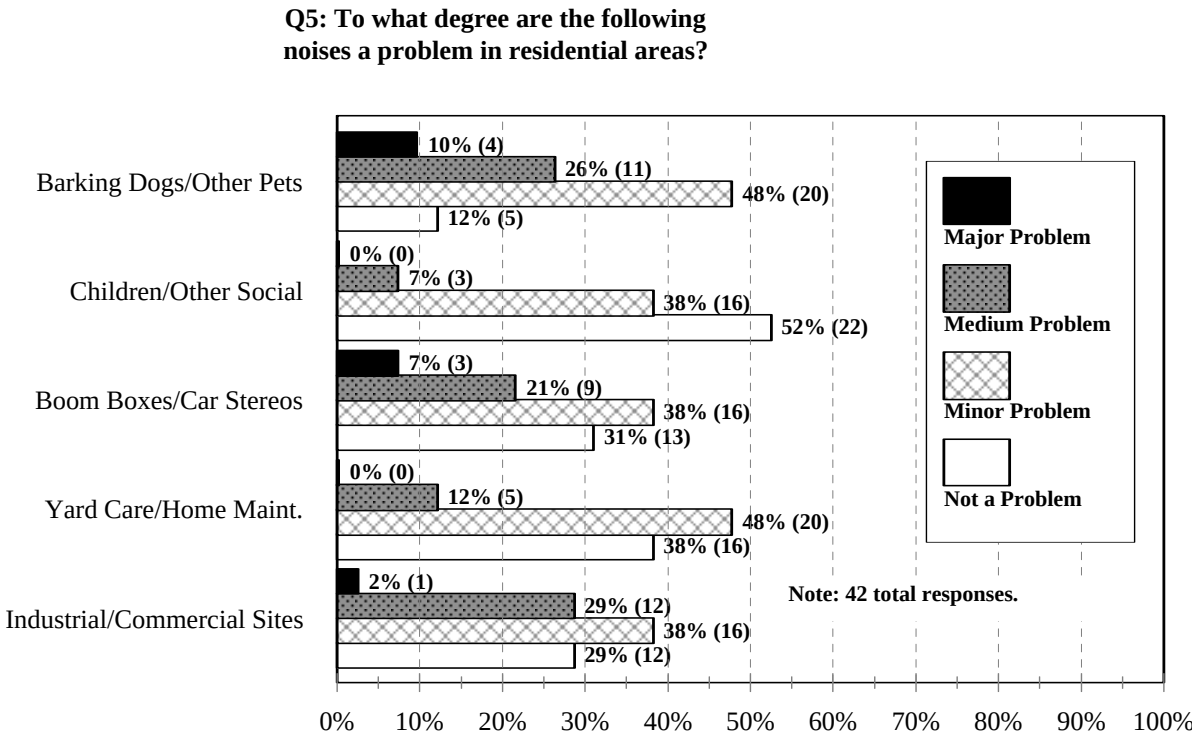

Figure 24. Percentage of planners whose jurisdictions have various non-transportation noise problems.

Most responding planners feel that traffic noise is a major problem in more than one residential areas in their jurisdictions, with 14% noting "About half" of the residential areas. Only five percent (two planners) said "None." Figure 25 displays the results of Question 6.

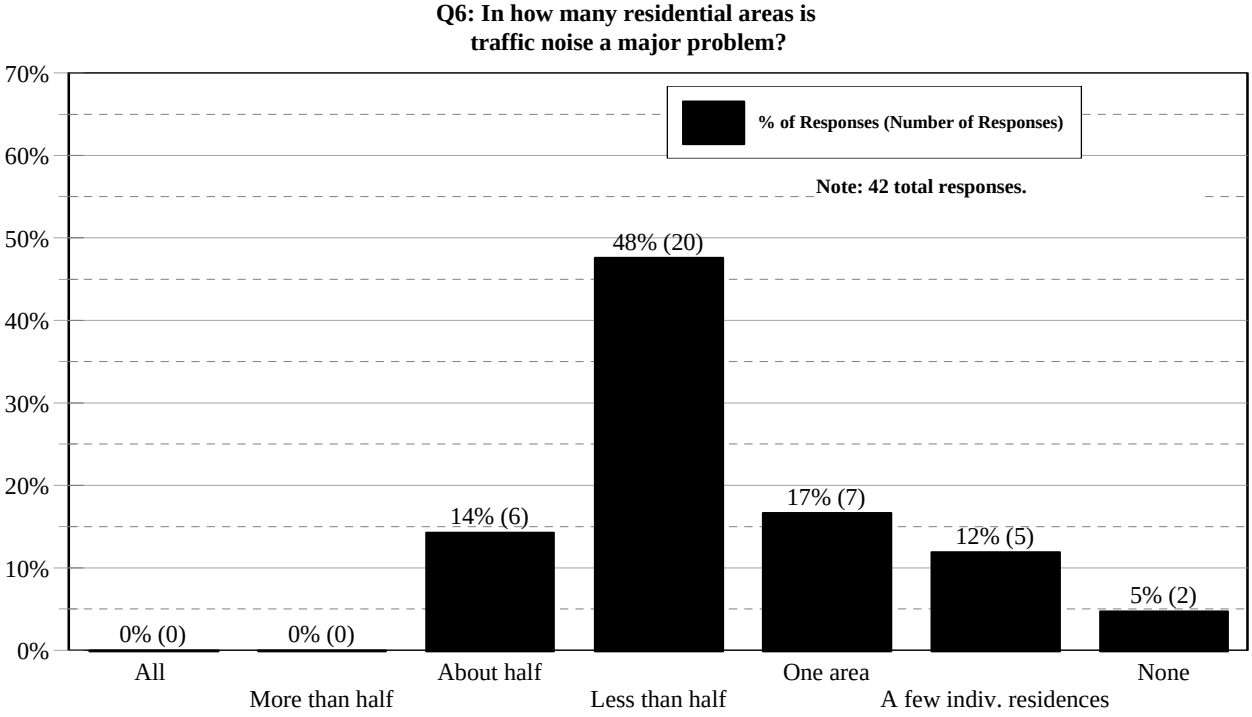

Figure 25. Extent of traffic noise problems in residential areas, by percentage of planners.

Question 7 then asks the planners to identify highway sections and other main roadway sections that currently cause noise problems or impacts on residential areas in their planning jurisdiction. They are also asked to identify sections that are likely to develop traffic noise impacts on residents within the next 10 years. Over 120 roadway sections, spanning 13 counties, have been listed:

- Major traffic noise impact area: 54 roadway sections
- Minor traffic noise impact area: 44 roadway sections
- A traffic noise impact area will likely develop in next 10 years: 29 roadway sections

These 127 sections are tabulated in Appendix D. Table 26 below lists the number of cited roadway sections in each of the 13 counties, separately by nearest city or town. The cities of Bozeman, Billings and Helena have the most existing sections, amounting to nearly half of all listed sections. Bozeman and Billings also have the most future sections, numbering 16 of the listed 29.

Table 26: Number of Areas Impacted by Traffic Noise by County and City, as Listed by Planners Responding to Survey

County	*City, Nearest City, or Town*	*Major Traffic Noise Impact Area*	*Minor Traffic Noise Impact Area*	*Noise Impact Area Developing within 10 Years*
Beaverhead	Dillon		1	1
Broadwater	Townsend	1	1	
Cascade	Great Falls	2	1	2
Custer	Miles City	1		
Fegus	Lewistown	2		
Flathead	---	3	1	1
Flathead	---			
Flathead	Kalispell	1		2
Flathead	Whitefish	1		1
Gallatin	Belgrade	3		
Gallatin	Belgrade/Bozeman	3		
Gallatin	Bozeman	14	9	9
Lake	---		3	
Lewis & Clark	Helena	9	9	3
Missoula	Missoula	5	6	3
Silver Bow	Butte		4	
Teton	Fairfield		2	
Yellowstone	Billings	9	10	7

In general, most respondents feel that traffic noise impacts in their jurisdictions' residential areas will become a greater problem over the next 10 years. Nearly one-in-five say these impacts will be a "Much greater problem", and half say a "Slightly greater problem." No one thinks it will be less of a problem, although two of MAP members (5%) feel that noise will never be a problem in their planning areas.

8.3.3.3 Current noise regulations

Interestingly, many of the planning jurisdictions have some kind of noise regulations in place. These regulations are reactive in nature, rather than proactive. Figure 26 shows that forty or more percent have regulations on: sound limits by time-of-day; sound limits by locations or land uses; or sound criteria for "Disturbing the peace." Also, a third have sound limits for specific types of noises.

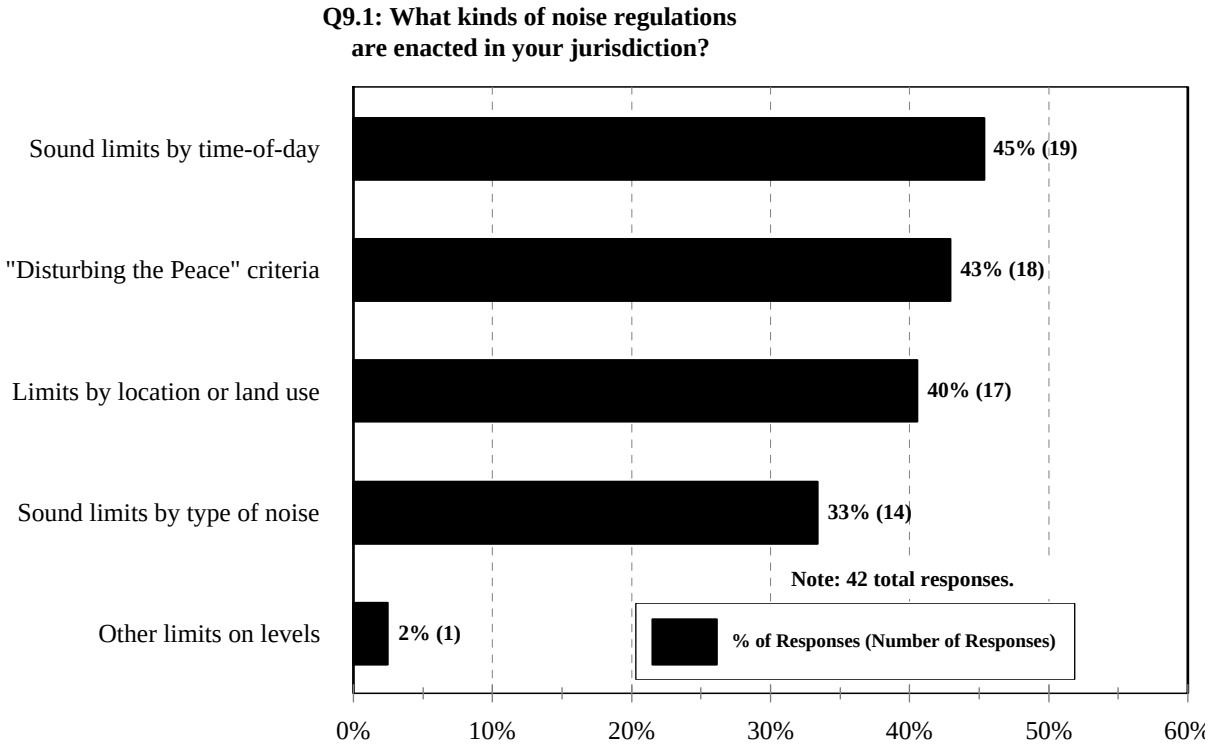

Figure 26. Percentage of jurisdictions with various noise regulations.

Planners were given four types of community noise sources and asked which are regulated in their jurisdictions.

Figure 27 shows that 40% regulated jake brakes *(prior to 2003 State Legislative action)*. A quarter regulate *construction vehicles* and *car stereo/boom boxes*, and 19% regulate *mufflers*.

In most cases, the local police enforce these regulations. Additional or alternative enforcement is provided by Codes Administration in several instances for sound limits in specific locations or land uses. Other mentioned entities include: sheriff, highway patrol, planning department, zoning administration, and health department.

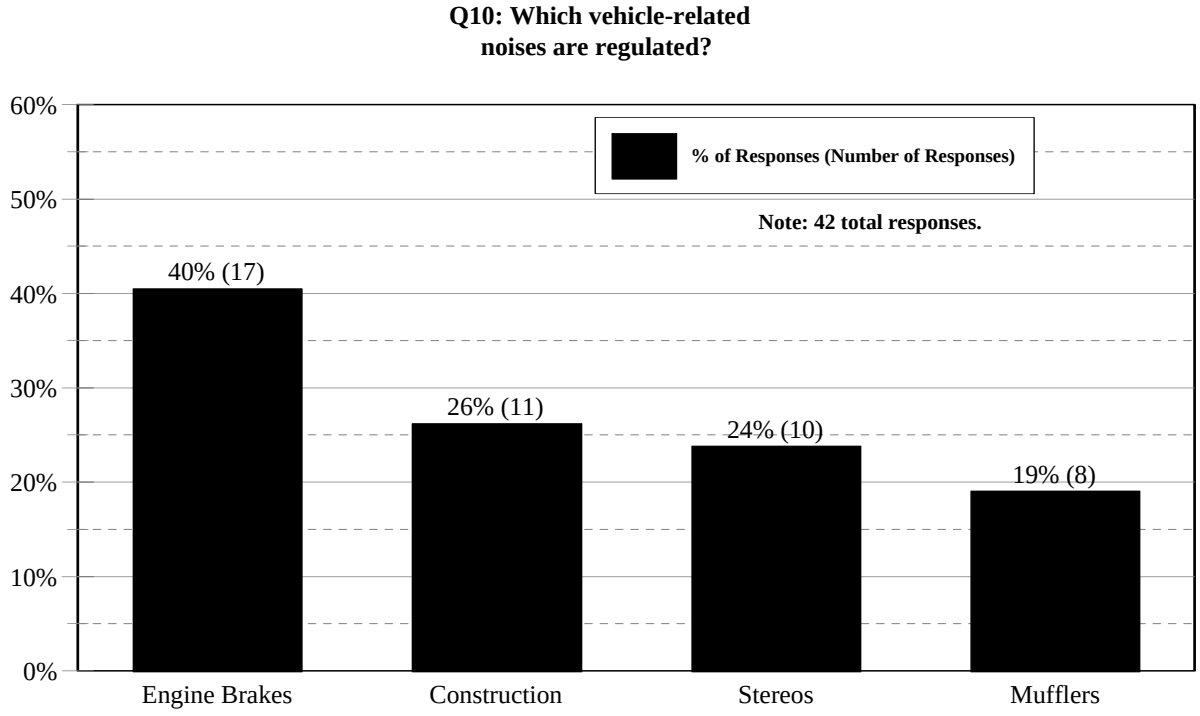

Figure 27. Percentage of jurisdictions with various vehicle-related noise regulations.

8.3.3.4 Acceptability of various methods for reducing traffic noise effects in the jurisdiction

Question 11 asked about the acceptability of six methods for reducing traffic noise effects in the planner's jurisdiction. The results, shown in Figure 28, are interesting. The most acceptable methods are:

- *Restrict use of jake brake* (69% choose acceptable or very acceptable), although this option is no longer available due to the action of the 2003 State Legislature.

- *Build an earth berm (mound) as a "noise barrier"* (67% choose acceptable or very acceptable)

- *Repave the road with quieter pavement* (62% choose acceptable or very acceptable, although this method had the highest percentage of "Very acceptable" responses at 38%)

While two-thirds find an *earth berm* to be acceptable or very acceptable, only a third feel noise barrier *walls* are acceptable or very acceptable (with another third finding to be walls unacceptable, the highest degree on unacceptability of the six listed methods). Aesthetic issues, or possible concerns over long-term maintenance may have influenced these responses.

Half the planners feel *traffic regulations restricting hours, speed, or "other" noise-producing conditions* (separate from engine compression brakes) would be acceptable or very acceptable; one-in-five are opposed to such regulations.

Just over 40% of the planners feel *traffic regulations banning types of noisy vehicles* to be acceptable or very acceptable, with one-in-five again opposed to such regulations.

Two planners added their own methods to the list: one rating regulation of motorcycles as very acceptable, and one rating planting of vegetative noise barriers as very acceptable.

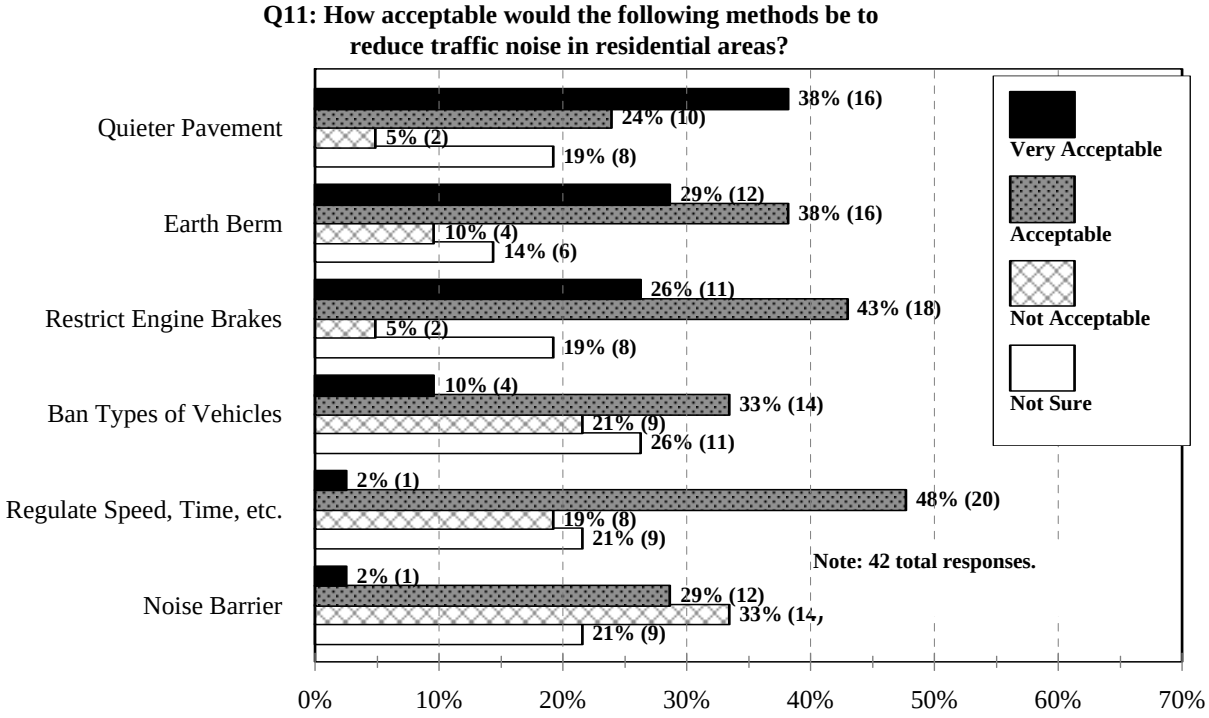

Figure 28. Ratings of traffic noise reduction methods by responding planners.

8.3.3.5 "Noise-compatible development" actions required of residential developer building next to major roads

Question 12 focuses on "noise-compatible development" actions required of a developer (or builder) by the jurisdiction when the developer wants to locate residences on undeveloped land next to a major road or highway. The question lists twelve actions aimed at reducing excessive highway traffic noise levels or their impacts. The questions also ask the planners if they are aware of the developers having taken "noise-compatible development" actions on their own initiative. Finally, the question asks if the planning jurisdiction would consider requiring such actions in the future.

Figure 29 and Figure 30 show the results. What is most interesting is that there are many more respondents noting that developers have taken actions on their own than there are noting actions being required by the local jurisdiction. Around 30% of the planners say that developers have:

- *Included nonresidential buildings and land uses and put them close to the highway;*
- *Built rows of townhouses, apartments, etc., next to the road to serve as noise barriers;*
- *Laid out lots so that noise-sensitive areas (patios, decks, balconies, etc.) face away from the highway.*

A quarter of the planners note that developers have:

- *Built an earth berm between the highway and residences;*
- *Laid out the development so that areas less sensitive to noise are closest to the highway.*

The figures also show a fair amount of use of some of the other listed methods including: *building on deep lots so homes will be far back from highway* (21%); *providing a buffer zone (open or vegetated space) between highway and residences* (19%); and *developing the land as something other than residential* (17%).

The least cited developer-initiated actions are: *conducting a study to see if noise will negatively impacted residences* (0%); and *using windows, doors and possibly walls or roofs that were more sound-insulating than usual* (5%). The low response on the latter item – *improved sound insulation* – is somewhat surprising, given that insulation can improve the interior noise environment considerably.

In contrast to these developer-initiated actions, the planning jurisdictions have less frequently required developers to take action. Of note, one-third have required *provision of a buffer zone* between the highway and residences. One-in-five have required *inclusion of nonresidential buildings and land uses close to the highway* as a buffer or barrier. Slightly less (17%) have required *development of the land as something other than residential.*

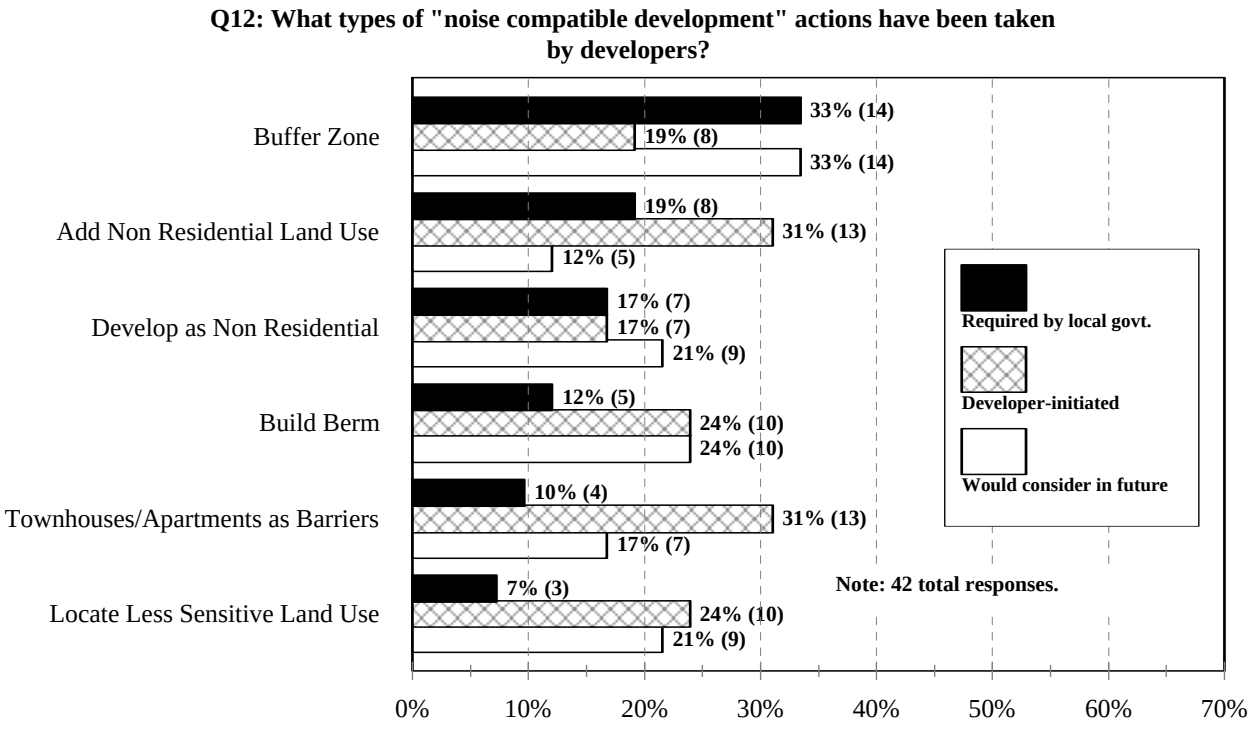

Figure 29. Percentages of planners whose jurisdictions have required noise-compatible development actions of developers (part 1).

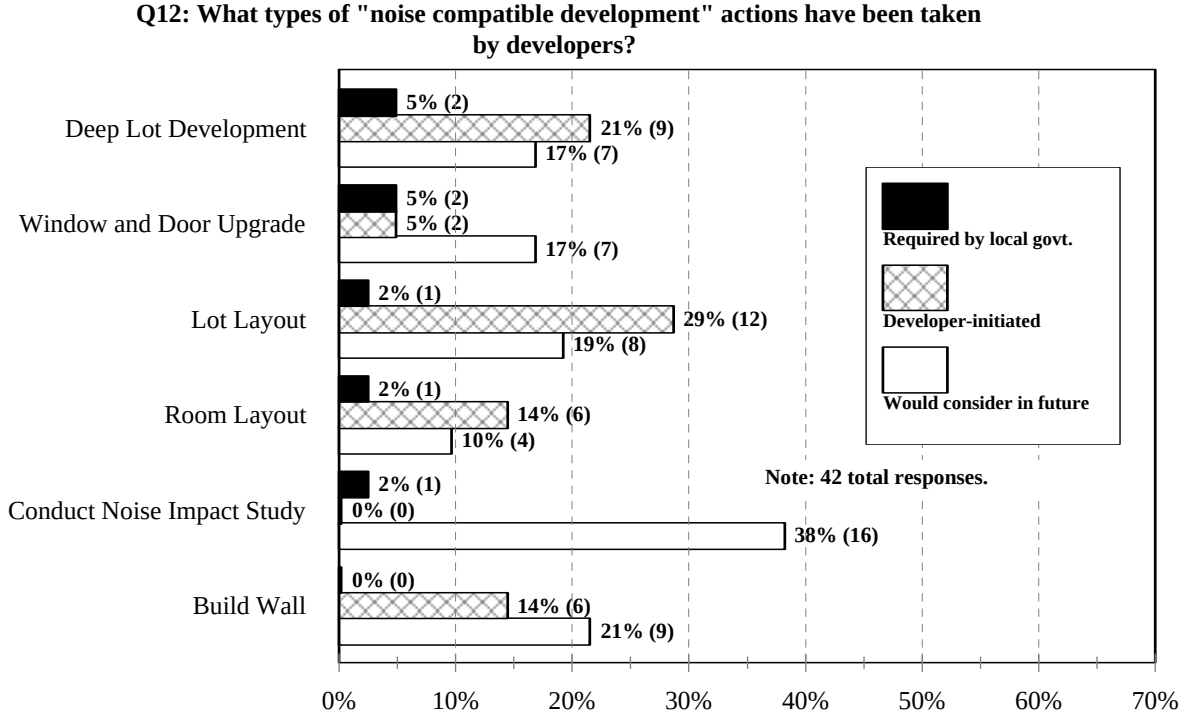

Figure 30. Percentages of planners whose jurisdictions have required noise-compatible development actions of developers (part 2).

Despite the relative infrequent past requirements, the planners seemed relatively positive about their jurisdictions being willing to consider such actions in the future:

- More than a third say their jurisdiction would consider *requiring studies to see if noise will negatively impact residences*.
- A third or more would consider *provision of buffer zones.*
- A quarter say they would consider *requiring building of earth berms.*
- About 20% say they would consider:

    1. *Developing the land as something other than residential;*
    2. *Laying out the development so that areas less sensitive to noise are closest to the highway;*
    3. *Building a noise barrier wall between the highway and residences*; and
    4. *Laying out lots so that noise-sensitive areas (patios, decks, balconies, etc.) face away from the highway*.

The actions least likely to be considered by the jurisdictions as requirements placed upon a developer are:

- *Orienting or designing residences so that rooms sensitive to noise (bedrooms, etc.) faced away from the highway.*
- *Including nonresidential buildings and land uses and putting them close to the highway.*

The former is a low-cost and effective way of reducing interior noise impacts. Education of planners and builders about its effectiveness would seem worthwhile.

Furthermore, in general, the planners feel quite strongly that a planning jurisdiction should require the developer to take action, at the developer's expense, to reduce excessive traffic noise levels for new residential developments next to existing major roads or highways. As shown in Figure 31, in response to Question 13, nearly three-quarters say they agree (45%) or strongly agree (26%) with this idea. Only two planners (5%) disagree (saying they strongly disagree).

Additionally, as shown in Figure 32, which is based on Question 14, nearly three-quarters say the developer should pay "All" (29%) or "A large share" (43%) of the cost for noise mitigation when building new residences along an existing highway or major road. Twelve percent say the owner should pay "All" (5%) or "A large share" (7%) of the cost.

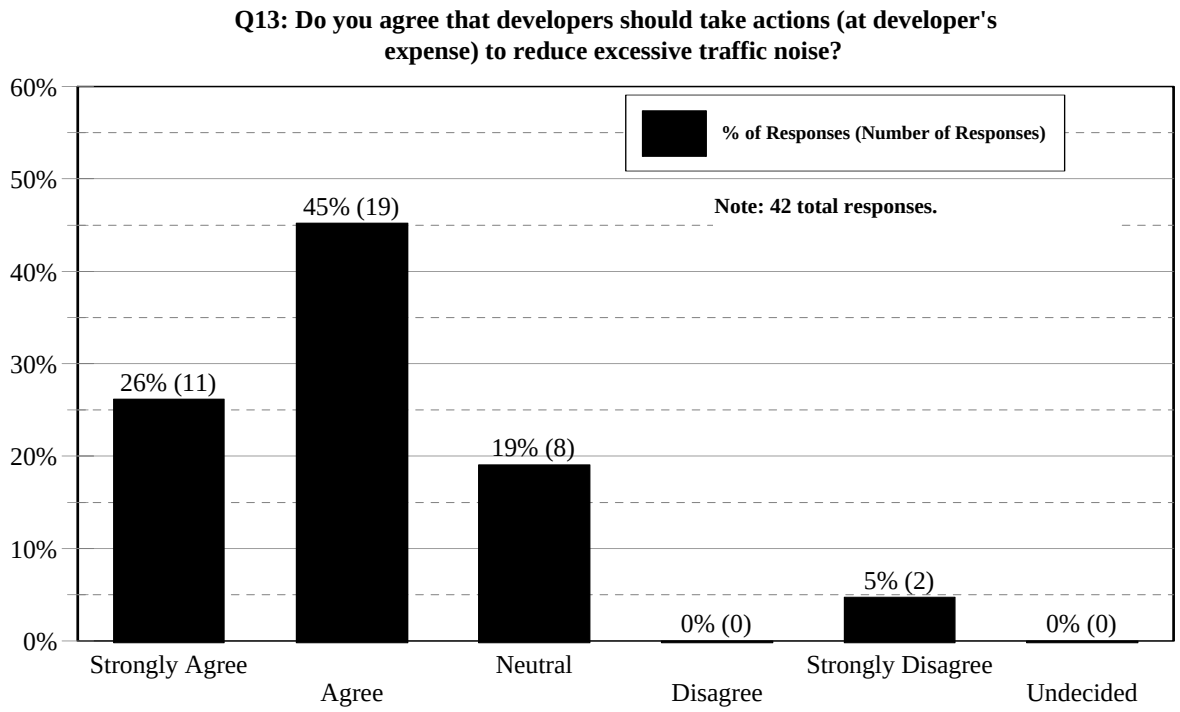

Figure 31. Percentages of planners agreeing or disagreeing that developers should reduce traffic noise at their own expense.

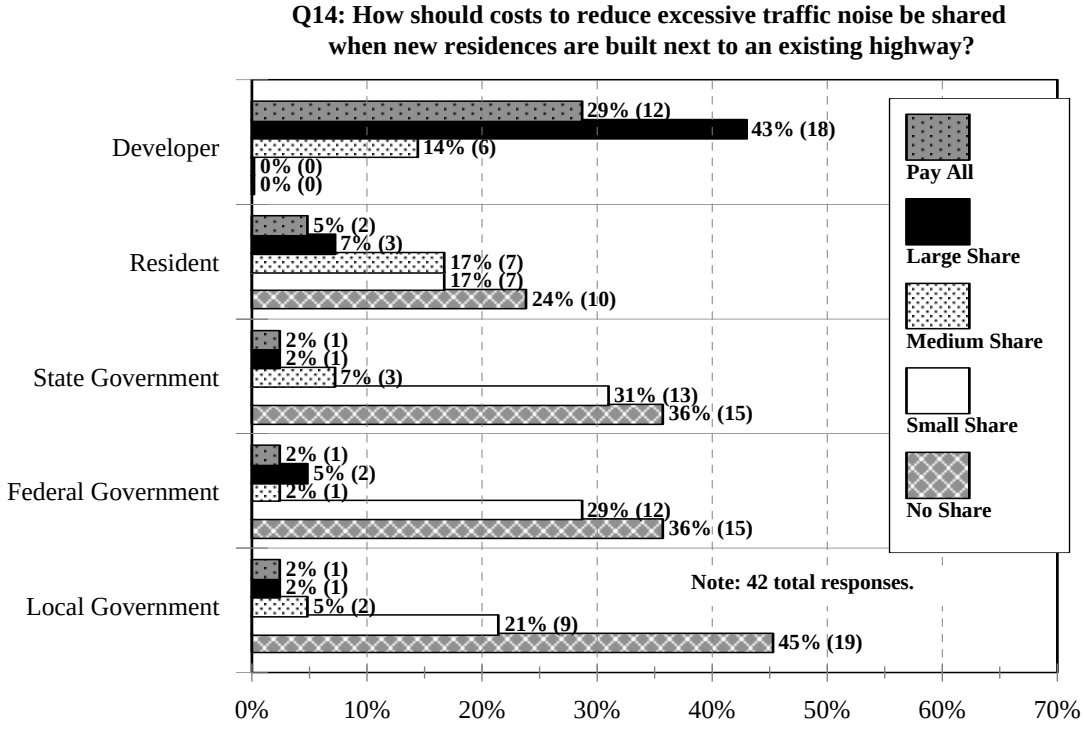

Figure 32. How traffic noise reduction costs should be shared for new residences.

Conversely, nearly half (45%) say local government should pay "No share" of the costs and over a third say the state (36%) or federal government (36%) should pay "No share." However, there was some sentiment that the various levels of government should pay "A small share":

- Local government: 21% of the planners
- State government: 31%
- Federal government: 29%

8.3.3.6 Implementation of noise-compatible development programs

One way to formalize requirements on developers for mitigating noise for new developments along existing roads is through establishment of a noise-compatible development program. Examples of such programs have been described earlier in this report.

In response to Question 17, over three-quarters of the planners say that they are in favor (60%) or strongly in favor (17%) of a noise-compatible development program in their planning jurisdiction, with the focus on new residential development or redevelopment-type construction near major roads and highways. Only one planner is opposed. See Figure 33.

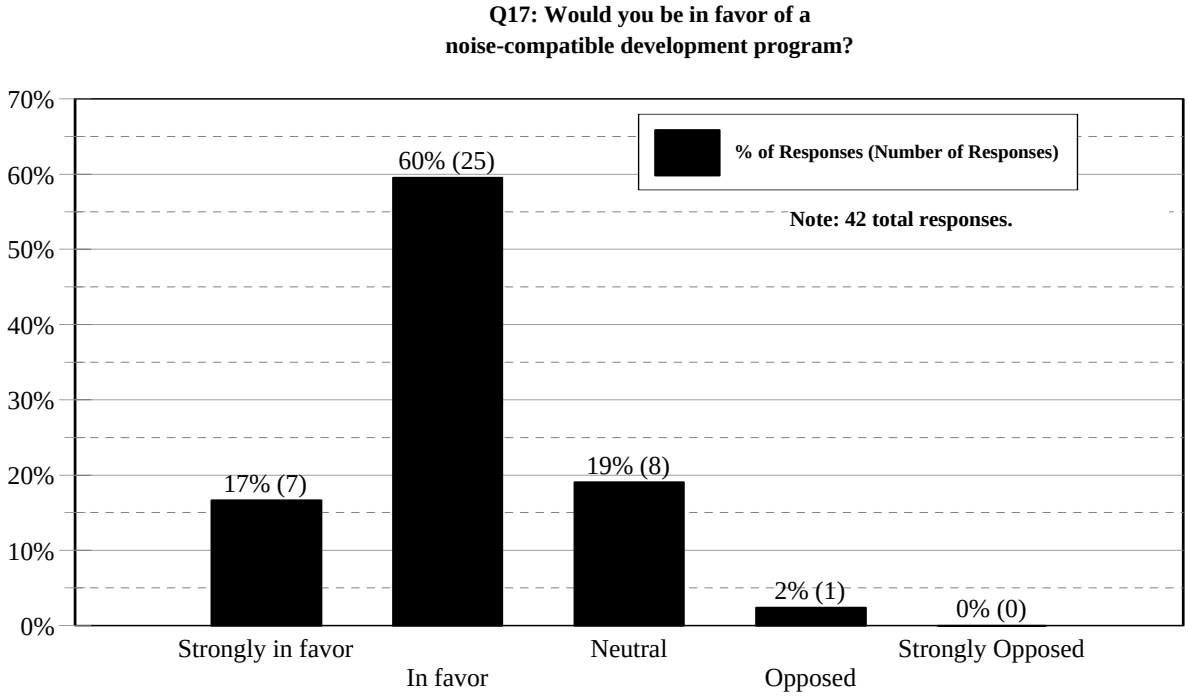

Figure 33. Percentages of planners favoring or opposing noise-compatible development plans.

In response to Question 18, however, less than a quarter say it is likely or very likely that their jurisdiction will implement a noise-compatible development program. Half are uncertain, and a quarter say it is unlikely or very unlikely. See Figure 34.

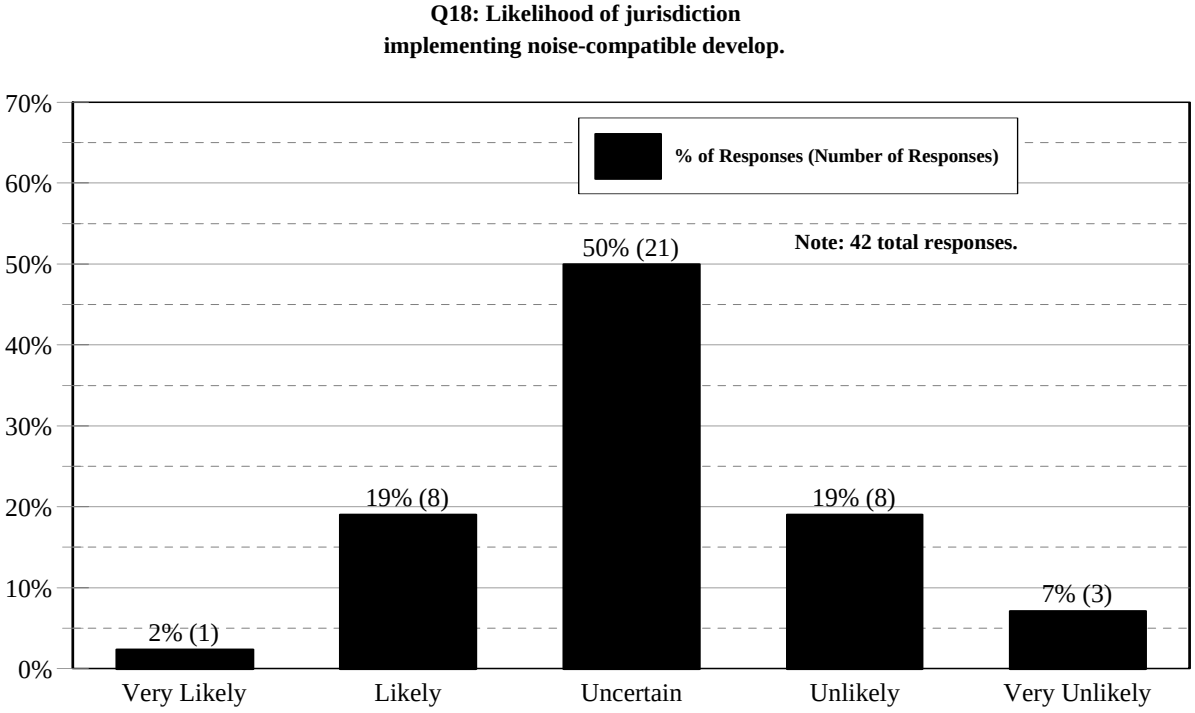

Figure 34. Likelihood of implementing a noise-compatible development program.

Question 15 asks how important several actions would be for a successful noise-compatible development program for the respondent's planning jurisdiction. There are two categories of suggested actions, each with several different choices:

- Local government technical assistance, planning guidelines and model ordinances:

    1. Introductory publication explaining traffic noise effects and benefits of noise compatible development;

    2. Development of general guidelines for land use planning in areas where traffic noise is or will be high;

    3. Model zoning ordinance addendum for preventing/reducing traffic noise problems;

    4. Model subdivision ordinance addendum for preventing/reducing traffic noise problems;

    5. Model building code addendum for preventing/reducing traffic noise problems;

6. Technical training services for local government officials (e.g., noise compatible development workshop);

7. Ongoing technical assistance services for local government officials (on-site/on-line);

8. Financial assistance for local governments participating in program.

- Publications, training, and technical assistance for developers, builders, realtors, homeowners, homebuyers:

1. Community workshops on noise compatible development for builders, developers, and realtors;

2. Introductory information on advantages of noise-compatible development in sensitive areas;

3. Technical publications for developers, builders, and realtors on noise-compatible development;

4. Technical assistance in conducting noise impact mitigation study for developers and/or builders;

5. Community workshops on noise compatible development for homeowners and buyers; and

6. Publications targeting homeowners and home buyers.

Figure 35 shows the results for the first group of actions (local government technical assistance). The planners feel all of the suggested actions would be "Important" or "Very important" (all of the actions are so identified by two-thirds or more of the respondents). In fact, with the exception of *financial assistance* and *model building codes*, all of the actions are identified as "Important" or "Very important" by over 80% of the planners. *Financial assistance* actually has the highest "Very important" response rate (45%), along with *development of general guidelines*.

Figure 36 shows the results for the second group of actions (publications, training, technical assistance for developers, builders, realtors, homeowners and homebuyers). Again, the planners feel all of the suggested actions would be "Important" or "Very important" (all of the actions are so identified by 60% or more of the respondents). In this group, however, there is a greater spread in the responses between the various actions. The two actions with the highest percentage of "Important" or "Very important" responses are:

- *Technical publications for developers, builders, and realtors on noise-compatible development* (93%);

- *Introductory information on advantages of noise-compatible development* (86%).

In looking at just the "Very important" category, both *technical publications* and *technical assistance in conducting noise studies* have the highest response rate, being selected by about 40% of the planners. The least important actions appear to be those focusing on information for the homeowner or home buyer.

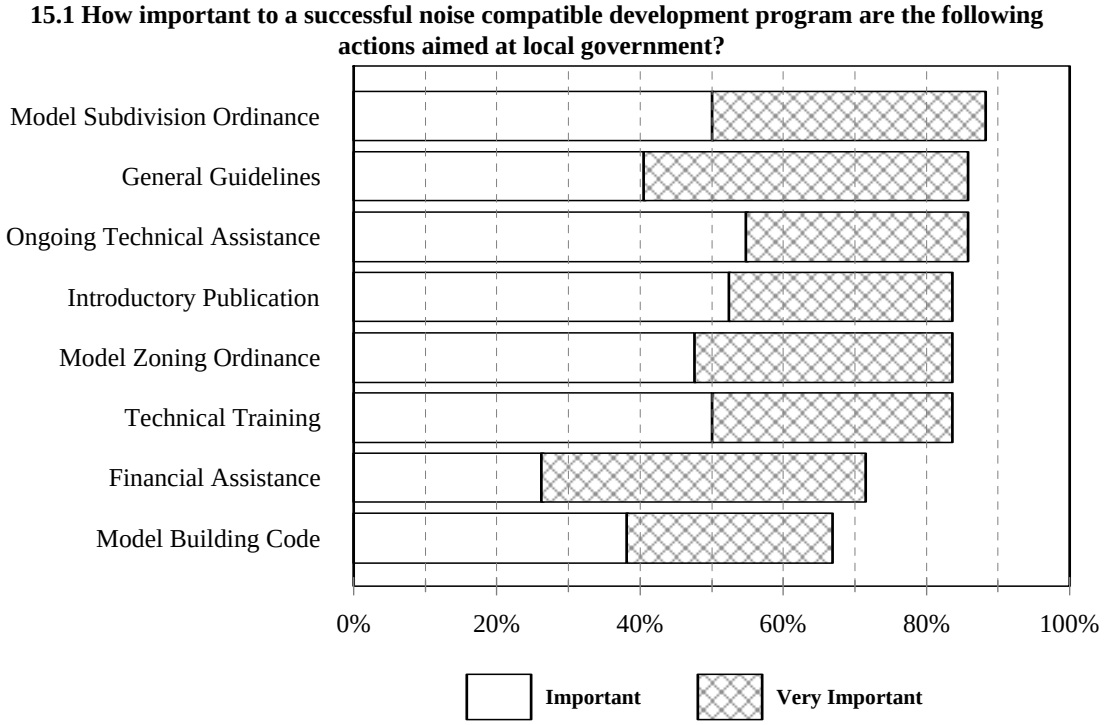

Figure 35. Importance of actions aimed at local government for successful program.

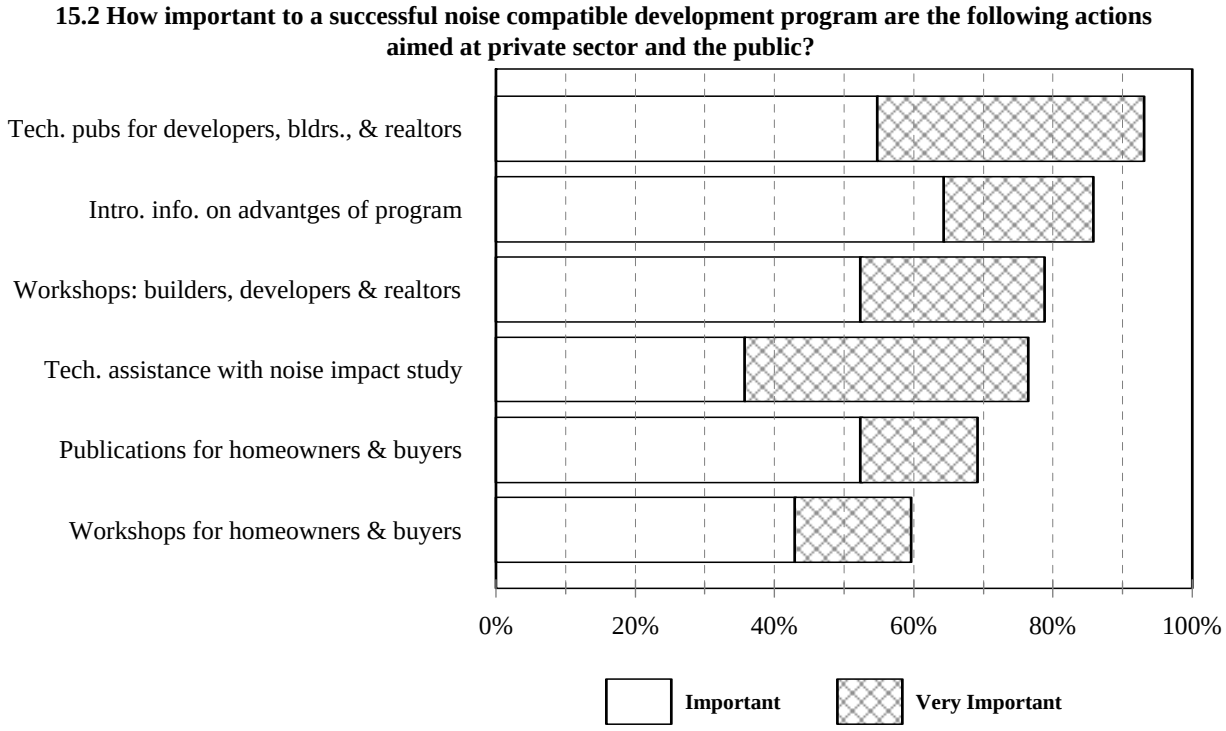

Figure 36. Importance of actions aimed at private sector and the public for successful program.

The last surveyed aspect on the needed components of a successful program for noise-compatible residential development in local planning jurisdiction is the role that MDT should play. The nine possible MDT roles listed in the survey are, in order of selection as "Important or "Very important":

- *Provide city/county with sound level information for undeveloped lands along proposed roads* (88%);
- *Facilitate training of city/county staff and/or consultants* (88%);
- *Serve as information resource on statewide or nationwide noise-compatible development activities* (86%);
- *Educate developers and the public that MDT will not build noise barriers/berms for newly built developments along existing major roads and highways* (83%);
- *Be available to assist local government in reviewing the developer's noise study for the city/county* (81%);
- *Develop noise barrier standards* (79%);
- *Assist in review/approval of noise barrier materials or systems* (74%);
- *Develop program implementation guidelines* (71%) ; and
- *Allow developer-built noise barriers to be on state right-of-way when needed* (67%).

Again, the planners feel all of the items are important. Clearly, however, the most important roles are the *provision of sound level information to the local jurisdiction, facilitation of training,* and *education of the public on when MDT will not provide barriers*. Ironically, the most important item, *provision of sound level information*, is something that MDT is already doing for Type I projects as part of the requirements in the FHWA noise regulations in 23 CFR 772 for its federal-aid project noise studies.

8.3.3.7 Summary of planners survey results

Forty-two planners belonging to the MAP responded to the survey on traffic noise and its control. Three-quarters of the planners work or live in Gallatin, Lewis and Clark, Yellowstone, Flathead, Cascade, Missoula, and Silver Bow counties. Two-thirds of the planners are from jurisdictions of 20,000 or more people. In the past decade, 60% of the respondents' jurisdictions have had population growth of five or more percent. Nearly three-quarters of the jurisdictions adopt *growth policies*, and 40% or more adopt *capital improvement plans* and c*omprehensive plans*. Only one-in-five adopt *land use plans.* Nearly all of the represented jurisdictions carry out zoning and subdivision regulation functions in either all or part of the jurisdiction.

The planners say the most prevalent source of noise problems in residential neighborhoods is *large trucks using major roads and highways*, with half citing them as a "Major" or "Medium" problem. Three-in-ten cite noise from *general traffic on main roads*, while only 12% note noise from *general traffic on local roads*. Train and aircraft noise is also problematic.

Most responding planners feel that traffic noise is a major problem in more than one residential area in their jurisdictions, with 14% noting "About half" of the residential areas. They list nearly 100 roadway sections that currently cause noise problems or impacts on residential areas in their planning jurisdictions. These sections span thirteen counties. They also list an additional 29 sections that are likely to develop traffic noise impacts on residents within the next ten years. Bozeman, Billings and Helena account for nearly half of all listed sections, with Bozeman and Billings having sixteen of the future sections. Most of the planners feel that traffic noise impacts in their residential areas will become a greater problem over the next ten years.

Many of the planning jurisdictions have some kind of noise regulations in place, including sound limits by time-of-day, sound limits by locations or land uses, sound criteria for "Disturbing the peace," and sound limits for specific types of noises. These regulations are reactive rather than proactive in nature. In the large majority of the cases, the local police enforce these regulations.

The planners find *restricting the use of jake brakes, building an earth berm as a noise barrier,* and *repaving the road with quieter pavement* as the most acceptable of several listed methods for reducing traffic noise effects. Somewhat surprisingly, while two-thirds find an *earth berm barrier* to be acceptable or very acceptable, only a third feel noise barrier *walls* are acceptable or very acceptable. Aesthetic issues, or possible concerns over long-term maintenance may have influenced these responses.

The planning jurisdictions have infrequently required developers to reduce excessive traffic noise when the developer has wanted to locate residences on undeveloped land next to a major road or highway. The most common action is *provision of a buffer zone* between the highway and residences (one-third of the respondents), followed by *inclusion of nonresidential buildings and land uses close to the highway as a buffer or barrier* (one-in-five) and *development of the land as something other than residential (17%).*

In contrast, many more respondents were aware of developers having taken actions on their own. Around 30% say that developers have: *included nonresidential buildings and land uses and put them close to the highway, built rows of townhouses, apartments, etc., next to the road to serve as noise barriers* or *laid out lots so that noise-sensitive areas (patios, decks, balconies) face away from the highway.*

A quarter note that developers have*: built an earth berm between the highway and residences,* or *laid out the development so that areas less sensitive to noise are closest to the highway.* Only 5% note the *use of windows, doors and possibly walls or roofs that were more sound-insulating than usual,* which seems low, given that insulation can improve the interior noise environment considerably.

Despite the relative inaction in the past, a fair portion of the planners seem positive about their jurisdictions being willing to consider requiring such actions in the future. Nearly three-quarters agree or strongly agree that a planning jurisdiction should require the developer to take action to reduce excessive traffic noise levels for new residential developments next to existing major roads. In particular, more than a third say their jurisdiction would consider requiring *studies to see if noise will negatively impact residences.* Twenty percent or more say they would consider requiring *buffer zones, earth berms, developing the land as nonresidential, site layout,* and *noise barrier walls.*

Nearly three-quarters say the developer should pay "All" or "A large share" of the cost for this noise mitigation, and nearly half say local government should pay "No share." There is some sentiment that the State, Federal or local government should pay "A small share."

Over three-quarters of the planners say that they are in favor or strongly in favor of having a noise-compatible development program in their planning jurisdiction; however, less than a quarter say it is likely or very likely that their jurisdiction will implement such a program. Half are uncertain, and a quarter say it is unlikely or very unlikely.

There is strong sentiment that assistance will be required for the development and implementation of successful noise-compatible development programs. Over 80% of the planners feel the following types of local government technical assistance are "Important" or "Very important":

- *Introductory publications;*
- *General guidelines for noise-compatible land use planning;*
- *Model subdivision ordinance and building code addendum for preventing/reducing traffic noise problems;*
- *Technical training (e.g. noise-compatible development workshop); and*
- *Ongoing technical assistance services.*

Nearly half feel that *financial assistance* is "very important" for local governments participating in program.

Additionally, many of the planners feel that assistance aimed at developers, builders, realtors, homeowners, or homebuyers is "Important" or "Very important." The top-rated actions are:

- *Technical publications for developers, builders, and realtors on noise-compatible development;*
- *Introductory information on advantages of noise-compatible development.*

Also, *technical assistance in conducting noise studies* is rated as "Very important" by about 40% of the planners.

Finally, the planners feel very strongly that MDT must play several "Important or "Very important" roles in order to have success with noise-compatible residential development at the local planning level. The most important roles are:

- *Provision to the local jurisdiction of sound level information for undeveloped lands along proposed roads*;
- *Facilitation of training of city/county staff and/or consultants;*
- *Serve as information resource on statewide or nationwide noise-compatible development activities; and*

- *Education of developers and the public that MDT will not build noise barriers/berms for newly built developments along existing roads.*

Ironically, MDT already provides sound level information for undeveloped lands as part of the FHWA requirements for federal-aid Type I project noise studies done during the National Environmental Policy Act (NEPA) process.

8.4 Recommendations Based on Results of Surveys

Traffic noise from major roads clearly impacts residents, especially those immediately adjacent to or within one block of the road. Many people have made adjustments in how they live or have attempted to reduce the sound levels by improvements to their homes or properties. Many have spent their own funds on noise mitigation (many perceive planting of trees or bushes to be effective in reducing noise, which they are not). Few people consider traffic noise when buying or renting their dwelling, not realizing the extent of the impact until after moving in. Many perceive traffic noise to be getting louder and more bothersome over time. Virtually no one feels traffic noise is getting quieter.

- Regardless, MDT should not be responsible for abating traffic noise for people who live in newer developments built adjacent to existing highways unless and until MDT plans to widen the facility or through some other action causes the sound levels to increase.

- MDT should give consideration to the abatement of existing traffic noise problems in older developments near its major roads, by means of a Type II barrier program. As noted earlier, there are eligibility restrictions on federal funds, and MDT should assess the scope of the problem and potential cost of such a program before committing to it.

As noted in the Traffic Management section and in the survey responses, many people are greatly upset by jake brake noise. They are in favor of elimination of the use of jake brakes and enforcement of existing posted restrictions. Yet, the Montana 2003 State Legislature passed a bill that says use of engine compression brakes may not be prohibited. The Traffic Management section has several recommendations on this subject.

Over 120 sections of road were identified in the survey by planners as being current or likely future causes of traffic noise impact.

- MDT should review the planners' listings of these current or likely future noise problem areas, relative to planned Transportation Improvement Program (TIP) projects.

- MDT should then develop a mechanism for informing local zoning and subdivision decision makers of anticipated future traffic noise-compatibility conflicts for currently undeveloped or underdeveloped lands adjacent to these projects. Rather than waiting until a project has progressed to the end of the environmental studies stage to notify locals of future sound levels along undeveloped lands, MDT should consider identification and notification of potential noise-land use conflicts as part of the TIP development process. The goal would be to influence zoning decisions and subdivision design and approval decisions well in advance of the highway project development.

Most of the planners feel that traffic noise impacts in their residential areas will become a greater problem over the next 10 years. Most of the surveyed residents say they would be willing to spend more on a new home in a new development near a major road to reduce traffic noise

levels. Also, a strong majority of the surveyed residents feel that a developer or the builder should shoulder the cost of this noise mitigation, although that cost would no doubt be passed onto the buyer. In general, people are in favor of the kinds of noise mitigation strategies that would be likely components of a noise-compatible planning and development program. Further, over three-quarters of the planners say that they are in favor or strongly in favor of having a noise-compatible development program in their planning jurisdiction. For that reason,

- MDT should promote development of noise-compatible planning and development programs by cities and counties.

- MDT should become a technical resource to local planners on noise-compatible planning and development, especially in the areas of:

    - Provision of sound level information along its highways;

    - Preparation of information publications for the public, planners, developers and builders;

    - Facilitation of training of city/county staff and/or consultants;

    - Serving as an information resource on statewide or nationwide noise-compatible development activities;

    - Education of developers and the public that MDT will not build noise barriers/berms for newly built developments along existing roads; and

    - Development of a model program guideline.

Improvement of public information about locations and effects of current and future traffic noise problems could serve to discourage some people who are likely to be annoyed by traffic noise from renting or purchasing housing in areas with high traffic noise levels. Better information could also foster more noise-sensitive land uses, better overall subdivision and individual lot design, and noise-sensitive housing and other building development. A more knowledgeable housing consumer would soon be reflected in the market's behavior, and the land development and housing industry would respond.

Finally, this study has already served to alert many Montana planners to the problem of traffic noise and land use incompatibility, and to begin to build interest in noise-compatible planning and development. This awareness and education process should continue.

- MDT should disseminate the study results to those planners who participated in the study and survey.

- The local planner contacts made during this research study should be continued and expanded.

9.0 SUMMARY

This research study has focused on current noise abatement policies, practices and procedures for non-traditional noise abatement solutions, solutions that are alternatives to noise barrier walls or berms built by a state DOT. There were four areas of particular interest:

- Pavement types and texturing;
- Noise-compatible land use planning and development;
- Sound insulation; and
- Traffic management techniques.

Additionally, MDT was interested in reviewing Type II noise abatement programs (the adding of noise barriers to existing roads by a state DOT), with emphasis on the experiences in states that currently have Type II programs.

This research involved a review of published literature as well as extensive correspondence and discussions with the staff of numerous state DOTs and local agencies across the United States and in Canada. Also, this research included a detailed examination of land use planning and development processes and procedures within the State of Montana. Discussions were held with a number of local agency planners in Montana.

This investigation revealed that many mechanisms are in place that are conducive to implementing a noise-compatible planning and development program. Growth is recognized as a major issue within the urban areas of the state, and the attention to noise control or noise impact avoidance seems to fit right into the framework of "smart growth." Awareness of a problem and a potential solution, though, are different from having the resources to implement and manage a program.

Local governments in Montana's populated areas seem to be "cautiously enthusiastic" about possible implementation of such a program. Success in reducing existing noise impact problems or preventing or lessening future noise impacts in noise-sensitive areas is likely to be consistent with local government planning goals.

The literature review, practice review and examination of Montana planning and development were supplemented by the development of two surveys: one for citizens living near busy roads in areas within Great Falls, Missoula, Butte and Billings, and one for local planners throughout the state. The surveys were administered in the late summer of 2003.

The residents survey explored opinions on neighborhood qualities, sources of community noise, the noise from the major road in their area, and people's attitudes regarding various noise-reducing measures, both for their current situation and if they were moving into new homes. Noise from traffic on major roads is a major source of frequent annoyance to the surveyed residents. Many have made adjustments to how they live or have taken actions to try to reduce noise levels. Many feel that traffic noise has gotten louder and become more bothersome over time, even though very few people considered it when buying or renting their homes. Many respondents are in favor of developers being responsible for mitigating noise if they want to build

new homes adjacent to existing highways, and many would be willing to pay more for a new house next to a road if the noise could be reduced. A fair number would be willing to participate in activities aimed at learning more about the problem of traffic noise and what can be done to reduce its impacts.

The planners survey gathered data on the planning jurisdictions represented by the respondents, and sought opinions on current and future traffic noise problems in their jurisdictions as well as various noise mitigation measures. The subject of noise-compatible development was explored, including MDT actions thought to be necessary for a successful program.

Responding planners identified numerous road sections in their jurisdictions where traffic noise is a problem or is likely to become one in the future. Many planners expect traffic noise problems to increase in the future. Most feel developers should be required to mitigate traffic noise if building residences along existing roads, solely or mostly at their own cost. Most planners are in favor of a noise-compatible planning and development program for their jurisdiction, but much fewer believe that such a program would ever actually come to pass. Most feel that technical information, assistance, and education of planning staff, developers and builders are essential to program success, and many feel financial assistance is also needed. A large majority also feels that MDT needs to play a major role in providing technical assistance as well as information on the future sound levels along the roads in their communities.

Based on the analysis of the survey results and further analysis of the literature and communication with Montana planners, this final report was prepared. Each major section of this report has included a brief summary and recommendations specific to the topic of that section. These summaries and recommendations are brought together in the Executive Summary and the reader is referred to it for that information.

In conclusion, it is worth reiterating that when MDT chooses to widen any of its federal-aid roads in its urban and suburban areas in the future, MDT will be responsible for studying noise impacts for all residential areas along the corridor. Those areas currently include any residential development that has occurred along these roads since the roads' original construction. Where impacts are shown, MDT will be required to study and possibly provide noise abatement.

A good way to try to avoid having to mitigate for these "new" developments is for MDT to be proactive in encouraging local governments to adopt, in some form, noise-compatible planning and development. There is likely to be support for such activities in the more urban cities and surrounding county areas experiencing residential growth, but there is not likely to be much interest among smaller towns and unincorporated areas. Any efforts at implementation of noise-compatible planning and development must have the city or county governments in the forefront, with MDT or other state agencies having support roles.

Through the discussions with Montana planners and their completion of the surveys, this research has already laid excellent groundwork for MDT to build upon as it seeks to improve the noise climate along its roads. It appears, however, that MDT will need to continue to take the lead in educating planners, local decision-makers, legislators, developers, builders, and the general public on the problem of traffic noise and on its mitigation.

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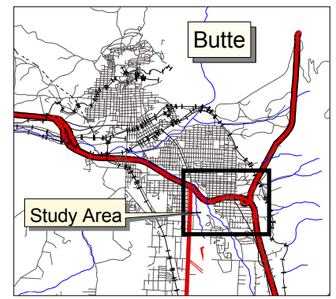
APPENDIX A

CENSUS MAPS OF SURVEY AREAS

Population of the Area Surrounding I-90 in Butte, MT

Cenus Block Population
- No People
- 1 - 49
- 50 - 99
- 100 - 149
- 150 - 199
- 200 - 249
- 250 People or More

1001 Census Block Number
Census Tract
000100 Census Tract Number
Water
Road
Interstate Highway
Primary Highway
Secondary Highway
Local road or street
Railroad
Airport or transportation terminal
Perennial water body



0.05 0 0.05 0.1 0.15
Scale of Miles

Created by:
Census & Economic Information Center
Montana Department of Commerce
301 S Park Av, Helena, MT 59620-0505

406-841-2740 ceic@state.mt.us
http://ceic.commerce.state.mt.us

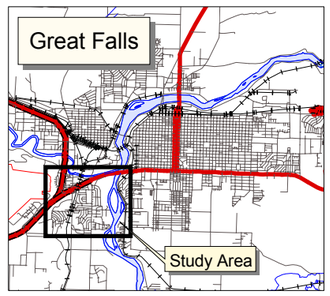
Source: U.S. Census Bureau, Census 2000, Summary File 1 (SF1).

April 22, 2003 noise_maj_cities.apr

Population of the Fox Farm Area in Great Falls, MT

Cenus Block Population
- No People
- 1 - 49
- 50 - 99
- 100 - 149
- 150 - 199
- 200 - 249
- 250 People or More

1001 Census Block Number
Census Tract
000100 Census Tract Number
Water
Road
Interstate Highway
Primary Highway
Secondary Highway
Local road or street
Railroad
Airport or transportation terminal
Perennial water body



0.1 0 0.1 0.2
Scale of Miles

N W E S

Created by:
Census & Economic Information Center
Montana Department of Commerce
301 S Park Av, Helena, MT 59620-0505

406-841-2740 ceic@state.mt.us
http://ceic.commerce.state.mt.us

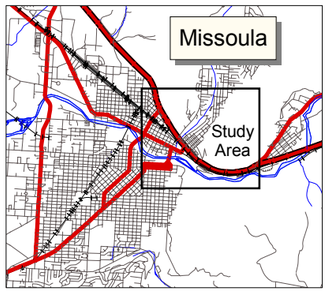
Source: U.S. Census Bureau, Census 2000, Summary File 1 (SF1).

April 22, 2003 noise_maj_cities.apr

Population of the Rattlesnake Area in Missoula, MT

Cenus Block Population
- No People
- 1 - 49
- 50 - 99
- 100 - 149
- 150 - 199
- 200 - 249
- 250 People or More

1001 Census Block Number
Census Tract
000100 Census Tract Number
Water
Road
Interstate Highway
Primary Highway
Secondary Highway
Local road or street
Railroad
Airport or transportation terminal
Perennial water body



0.1 0 0.1 0.2

Scale of Miles

N W E S

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Census & Economic Information Center
Montana Department of Commerce
301 S Park Av, Helena, MT 59620-0505

406-841-2740 ceic@state.mt.us
http://ceic.commerce.state.mt.us

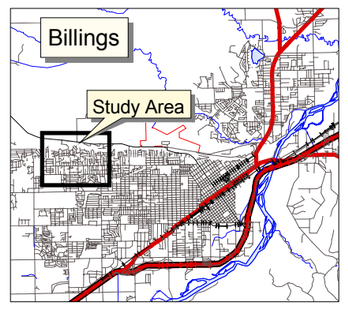
Source: U.S. Census Bureau, Census 2000, Summary File 1 (SF1).

noise_maj_cities.apr

Population Near Rimrock and Rehberg in Billings, MT

Cenus Block Population
- No People
- 1 - 49
- 50 - 99
- 100 - 149
- 150 - 199
- 200 - 249
- 250 People or More

1001 Census Block Number
Census Tract
000100 Census Tract Number
Water
Road
Interstate Highway
Primary Highway
Secondary Highway
Local road or street
Railroad
Airport or transportation terminal
Perennial water body



0.1 0 0.1 0.2

Scale of Miles

N W E S

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406-841-2740 ceic@state.mt.us
http://ceic.commerce.state.mt.us

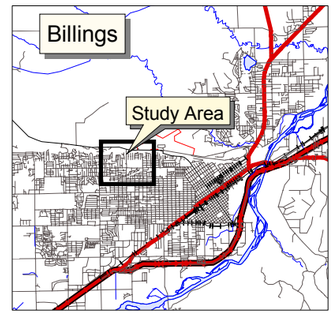
Source: U.S. Census Bureau, Census 2000, Summary File 1 (SF1).

April 23, 2003 noise_maj_cities.apr

Population Near Rimrock and 17th in Billings, MT

Cenus Block Population
- No People
- 1 - 49
- 50 - 99
- 100 - 149
- 150 - 199
- 200 - 249
- 250 People or More

1001 Census Block Number
Census Tract
000100 Census Tract Number
Water
Road
Interstate Highway
Primary Highway
Secondary Highway
Local road or street
Railroad
Airport or transportation terminal
Perennial water body



0.05 0 0.05 0.1 0.15
Scale of Miles

N W E S

Created by:
Census & Economic Information Center
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406-841-2740 ceic@state.mt.us
http://ceic.commerce.state.mt.us

Source: U.S. Census Bureau, Census 2000, Summary File 1 (SF1).

April 23, 2003 noise_maj_cities.apr

APPENDIX B

RESIDENTS AND PLANNING OFFICIALS SURVEYS

Please mail this two-sided survey in the attached postage-paid envelope by September 6, Thanks.

1. Approximately how long have you lived in your current residence?
___Less than a year ___1-2 yrs ___3-4 yrs ___5-9 yrs __10-19 yrs ___20+ yrs

2. How many people, including children, live in your current residence?
__One __Two __Three __Four or more ☐ Check here if there are children living in your home

3. In what type of residence do you reside?
__Single-family house __Apartment __Townhouse __Condominium __Duplex __Dorm __Other

3b. Other DU Describe_____

4. Do you own or rent your current residence? __Own ___ Rent

5. About how close is your residence to *[Main Road]*? ___Next to it
__ One block (or one or two houses) away ___ Two blocks (or three or four houses) away
__ Three blocks (or five or six houses) away ___ Other distance (_____)
5b. Other Distance Describe_____

6. Which side of *[Main Road]* is your home located?
Southwest Great Falls: ___East Fox Farm Rd __West Fox Farm Rd __North I-15 Spur
Missoula L Rattlesnake: ___East side of Van Buren St. __West side of Van Buren St
Butte Hillcrest: ___North side I-15/90 __South side I-15/90
Billings Rimrock: ___5th-17th St__17th St-Rehberg Ln __Rehberg Ln-38 St

7. Please rate your neighborhood for the following qualities.

Quality	***Very Good***	***Good***	***Fair***	***Poor***	***Very Poor***	***Does Not Apply***
• Physical quality of neighborhood (buildings, landscaping, attractiveness, cleanliness, etc.)	( )	( )	( )	( )	( )	☐
• Affordability of housing/cost of living	( )	( )	( )	( )	( )	☐
• Parks, green space or recreational opportunities	( )	( )	( )	( )	( )	☐
• View	( )	( )	( )	( )	( )	☐
• Security/freedom from crime	( )	( )	( )	( )	( )	☐
• Lack of traffic on your local streets	( )	( )	( )	( )	( )	☐
• Lack of traffic on *[Main Road]*	( )	( )	( )	( )	( )	☐
• Peace and quiet from outdoor manmade noises	( )	( )	( )	( )	( )	☐
• Convenience to shopping, school or work	( )	( )	( )	( )	( )	☐
• Other (optional)_____	( )	( )	( )	( )	( )	☐

8. Please check any of the following sounds that **frequently annoy** people in your household when **inside** your residence or **outside** near your residence. (Check all that apply.)
___ Barking dogs or noise from other pets
___ Noise from children, neighbors, etc.
___ Noise from yard care, home maintenance, etc.
___ Car boom boxes or other car stereo music
___ Noise from industrial or commercial bus. Sites
___ Traffic noise from major roads & hwys.
___ Traffic noise from local streets
___ Aircraft noise(jets, helicopter, small planes)
___ Train noise or train whistles/horns
___ Other Noise_____

9. From what parts of your residential area is traffic noise from *[Main Road]* highly noticeable? Check all that apply

___ Inside residence ___Front yard ___Backyard ___Common area ___Nowhere ___Other_____

10. In the **past week**, were you **annoyed or disturbed** by traffic noise from *[Main Road]* while **INSIDE** your residence? (Check one.)

___Yes, I was highly annoyed inside _____Yes, I was annoyed inside ___No, I was not annoyed inside

11. In the **past week**, were you **annoyed or disturbed** by traffic noise from *[Main Road]* while on the **OUTSIDE** of your residence? (Check one.)

___Yes, I was highly annoyed outside ___Yes, I was annoyed outside ___No, I was not annoyed outside

12. In the summer, how **often** are you **annoyed** by traffic noise from *[Main Road]* at your residence?

12a While INSIDE your residence (check only one response)

- ☐ All the time/ nearly all the time
- ☐ Much of the day (such as most of daylight or evening hours)
- ☐ Certain peak travel periods (such as rush hours, shift changes, school starts/ends)
- ☐ During nighttime periods
- ☐ A few brief times each day
- ☐ On weekends
- ☐ Never or almost never

12b While OUTSIDE your residence (check only one response)

- ☐ All the time/ nearly all the time
- ☐ Much of the day (such as most of daylight or evening hours)
- ☐ Certain peak travel periods (such as rush hours, shift changes, school starts/ends)
- ☐ During nighttime periods
- ☐ A few brief times each day
- ☐ On weekends
- ☐ Never or almost never

13. How much consideration did you give to traffic noise from *[Main Road]* **when you rented/purchased** your current residence? (Check one.)

___A great deal ___Some ___Little ___None 13b ☐ I wasn't aware of the traffic noise

14. Has traffic noise from *[Main Road]* gotten **louder or quieter** since you moved into your current residence? (Check one.)

___Much louder ___A little louder ___About the same ___Quieter ___Not sure

15. Has traffic noise from *[Main Road]* become **more or less bothersome over time**? (Check one.)

___More bothersome ___Stayed about same ___Less bothersome ___Not disturbed ___Not sure

15b. ☐ Also, check here if you think you are getting more used to (more tolerant of) the traffic sounds.

16. Has traffic noise from *[Main Road]* caused you to make adjustments in how you live?___No ___Yes

If you answered "yes," which of the following have you done? (Check all that apply.)

___Constructed fence or wall to create a noise barrier
___Built an earth mound to create noise barrier
___Located garage or outbuilding to block noise
___Increased insulation in walls or roof
___Upgraded doors or windows (or added storms)
___Added drapes or other sound-absorbing material
___Changed use of rooms (e.g., moved a bedroom)
___Other: _____
___Planted trees or bushes
___Closed windows or windows
___Used ear plugs
___Moved indoor activity to a different room
___Changed time of activity
___Used different area of yard
___Moved activity inside
___Turned on background sound (fan, AC, music)

17. How acceptable to you would the following methods be for reducing noise at your residence from traffic on *[Main Road]? Note: No actions are being considered for your neighborhood; we just want your opinions in general.*

	Very Acceptable	Acceptable	Not Acceptable	Not Applicable	Undecided
• A "noise barrier" wall between residences and the road	( )	( )	( )	( )	( )
• An earth berm (mound) between residences and the road	( )	( )	( )	( )	( )
• Repaving the road with quieter pavement	( )	( )	( )	( )	( )
• Traffic regulation (banning certain vehicle types, restricting hours allowed on road, reducing speeds, etc.)	( )	( )	( )	( )	( )
• Restrict use of truck engine-compression (jake) brakes	( )	( )	( )	( )	( )
• Other_____	( )	( )	( )	( )	( )

18. Which of the following improvements to your residence area do you believe would **noticeably reduce traffic noise**? (Check all that apply.)

___Construct fence, wall or earth mound to be a noise barrier
___Add or relocate garage or outbuilding to block noise
___Add or upgrade drapes or other sound-absorbing material in rooms facing traffic
___Relocate more noise-sensitive rooms to quieter side of house
___Install air conditioning to allow windows to remain closed
___Plant major hedge to create noise barrier
___Upgrade wall or ceiling insulation levels
___Upgrade windows or doors on side facing traffic
___ Relocate outdoor activity area to side facing away from traffic
__ Other: _____

19. How much would **you be willing to pay** to reduce noise noticeably at your residence from traffic on *[Main Road]?* (As examples, payment could be through a one-time payment, payments over time, payments added to a real estate tax bill, etc.) (Check one.)

___$1,000 or less
___$1,001 to $2,000
___$2,001 to $5,000
___ $5,001 to $10,000
___Over $10,000
___Nothing, I cannot afford to pay
__Nothing, noise is not enough of a problem
__Nothing, I am a renter
__Nothing, I chose to live here

☐ I would move instead of paying if noise was too much of a problem

20. Assume a developer wants to build residences on undeveloped land next to a major roadway. Do you agree or disagree that the city or county should require the developer to take action to reduce excessive traffic noise levels in the development or inside the residences?

___Strongly Agree ___Agree ___Neutral ___Disagree ___Strongly Disagree

☐ Check here if you are undecided

21. If you were buying a **new home in a new development** that was being built along a busy road or highway, which of the following actions would you favor or oppose for reducing the traffic noise effects in your yard (or common area) or inside your residence?

Action by Developer	***Strongly favor***	***Favor***	***Neutral***	***Opposed***	***Strongly opposed***	***Undecided***
• Provide open or vegetated space (like a park) between road and residences	( )	( )	( )	( )	( )	( )
• Build on deep lots so homes will be far back from road	( )	( )	( )	( )	( )	( )
• Build a noise barrier wall between road and residences	( )	( )	( )	( )	( )	( )
• Build an earth berm between road and residences	( )	( )	( )	( )	( )	( )
• Design subdivision so that areas least sensitive to noise (garages, streets, parking) are closest to road	( )	( )	( )	( )	( )	( )
• Lay out lots or residences so that areas sensitive to noise (patios, decks, balconies, bedrooms, etc.) face away from road	( )	( )	( )	( )	( )	( )
• Use windows and doors (and possibly walls/roofs) that were more sound-insulating than usual	( )	( )	( )	( )	( )	( )
• Include retail, office or other non-residential buildings or land uses in the development and put them nearest to road to block noise reaching residences	( )	( )	( )	( )	( )	( )

22. Would you be willing to pay more for a new house next to a highway, if the house or neighborhood were designed to reduce the traffic noise effects?

___Yes, Definitely ___Probably ___Undecided ___No

23. Please check whether you would participate in any of the following programs aimed at helping to reduce traffic noise at your home site. (Check all that apply.) *Note: No specific actions are planned at this time*

___Read brochure on traffic noise control for residences
___Read brochure on land use planning near a noisy roadway
___Attend seminar on ways to reduce traffic noise at your home site
___Allow home inspection to identify ways to reduce traffic noise at your home site
___Participate in low interest loan program for reducing traffic noise impacts at your home site
___Participate in federal or state grant program for reducing traffic noise impacts at your home site
___Vote for neighborhood improvement district to pay to reduce traffic noise in your residential area
___Other? _____

24. Feel free to add or attach comments (and check here if you do: □). Thank you very much for your time!

1. What kind of planning agency or other organization do you work for? ☐City ☐Multi-city ☐City-County ☐County ☐Tribal Gov. ☐Other(_____)

2. Approximately how many people live in your planning jurisdiction?
___ 100,000 or more ___ 50,000 to 99,999 ___ 20,000 to 49,999 ___ 10,000 to 19,999
___ 5,000 to 9,999 ___ 1,000 to 4,999 ___ 999 or less ___ Statewide

3. In the past decade, how much population growth has occurred in your planning jurisdiction?
___ 20% or more ___ 10-19% ___ 5-9% ___ 1-4% ___ None ___Lost pop.

4. Please check which of the following planning documents and implementation actions are adopted and carried out by your planning jurisdiction(s)?

Adopted Local Government Plans	***All of Jurisdiction***	***Part of Jurisdiction***	**Adopted and Enforced Implementation Actions**	***All of Jurisdiction***	***Part of Jurisdiction***
• Growth Policy	☐	☐	• Zoning Ordinance	☐	☐
• Comprehensive Plan	☐	☐	• Subdivision Regulations	☐	☐
• Land Use Plan	☐	☐	• Building Codes	☐	☐
• Capital Improvement Plan	☐	☐	• Development Permit Reg.	☐	☐
• Transportation Plan	☐	☐	• Special Improvement District	☐	☐
• Urban Redevelop Plan	☐	☐	• Conservation Easement	☐	☐
• Parks & Recreation Plan	☐	☐	• Impact Fees	☐	☐
• Other_____	☐	☐	• Other_____	☐	☐

5. To what degree are the following **noises a problem** in your jurisdiction's residential areas?

Sounds	***Major Problem***	***Medium Problem***	***Minor Problem***	***Not a Problem***
• Barking dogs or noise from other pets	( )	( )	( )	( )
• Noise from children and other social activities, etc.	( )	( )	( )	( )
• Car boom boxes or other car stereo music	( )	( )	( )	( )
• Noise from yard care, home maintenance, etc.	( )	( )	( )	( )
• Noise from nearby industrial or commercial sites	( )	( )	( )	( )
• Noise from large trucks using major roads & hwys	( )	( )	( )	( )
• Noise from general traffic using major roads & hwys	( )	( )	( )	( )
• General traffic noise on local streets	( )	( )	( )	( )
• Aircraft noise (jets, helicopters, small airplanes)	( )	( )	( )	( )
• Train noise or train whistles/horns	( )	( )	( )	( )
• Other (optional):_____	( )	( )	( )	( )

6. 6. For how many of your residential areas is traffic noise a major problem?
___All areas ___More than half ___About half ___Less than half ___One area
___A few individual residences ☐Check here if there are no traffic noise problems

7. Please identify highway and other main roadway sections that **currently cause noise problems or impacts on residential areas** in your planning jurisdiction. Also, identify highway and other main roadway sections that are likely to develop traffic noise impacts on residents within the next 10 years.

Highway or Main Roadway Section Causing Traffic Noise Impacts on Nearby Area Residences	***Major Noise Impact Area***	***Minor Noise Impact Area***	**Traffic Noise Impact Area will likely develop in next 10 years**
_____	( )	( )	( )
_____	( )	( )	( )
_____	( )	( )	( )
_____	( )	( )	( )
_____	( )	( )	( )
_____	( )	( )	( )
_____	( )	( )	( )

8. Overall, how do you feel your traffic noise impacts will change in your planning area in 10 years?

___Much greater problem ___Slightly greater problem ___About the same ___Less of a problem

☐ Traffic noise will never be a problem in this planning area.

9. Check if your jurisdiction has the following types of noise regulations.

Ordinance type	***Enforced by whom?***
___Sound limits for specific-type of noises	_____
___Sound limits by time-of-day	_____
___Sound limits by locations or land uses	_____
___Sound criteria for "Disturbing Peace"	_____
___Other _____	_____

10. Check which of the following vehicle noises are regulated in all parts of your jurisdiction.

☐ Faulty or improper muffler operations ☐ Boom box volumes stereo operations ☐ Noisy operation of of construction vehicles ☐ Noisy operations of "Jake Brakes"

11. How acceptable are the following methods for **reducing traffic noise** effects in your planning jurisdiction. Think about an instance where highway traffic noise affects nearby residences?

Method	***Very Acceptable***	***Acceptable***	***Not Acceptable***	***Not Sure***
• Build a "noise barrier" wall	( )	( )	( )	( )
• Build an earth berm (mound) as a "noise barrier"	( )	( )	( )	( )
• Repave the road with quieter pavement	( )	( )	( )	( )
• Traffic reg. banning types of noisy vehicles	( )	( )	( )	( )
• Traffic reg. restricting hours, speed, other....	( )	( )	( )	( )
• Restrict use of engine compression "Jake Brakes"	( )	( )	( )	( )
• Other _____	( )	( )	( )	( )

12. Has your jurisdiction required a developer to take any of the following "noise-compatible development" actions to reduce excessive highway traffic noise levels **when the developer (or builder) wanted to locate residences on undeveloped land next to a major road or highway**? Also indicate instances when developer took "noise-compatible development actions on own initiative. Check all that apply for each action.

Action by Developer (Subdivider or Builder)	***Required by city or county***	***Developer took action on own***	**Do you think your jurisdiction would consider requiring action in future:**
• Had study done to see if noise neg. impacted residences	( )	( )	☐
• Developed the land as something other than residential	( )	( )	☐
• Provided a buffer zone (open or vegetated space) between highway and residences	( )	( )	☐
• Built on deep lots so homes will be far back from hwy	( )	( )	☐
• Laid out development so that areas less sensitive to noise are closest to hwy (garages, streets, parking, open space)	( )	( )	☐
• Included nonresidential buildings and land uses (e.g., retail or offices) and put them closest to highway	( )	( )	☐
• Built rows of townhouses, apartments, etc. next to road to serve as noise barriers for other residences farther from road	( )	( )	☐
• Built a noise barrier wall between hwy and residences	( )	( )	☐
• Built an earth berm between highway and residences	( )	( )	☐
• Laid out lots so that noise-sensitive areas (patios, decks, balconies, etc.) face away from highway	( )	( )	☐
• Oriented or designed residences so that rooms sensitive to noise faced away from highway (bedrooms, etc.)	( )	( )	☐
• Used windows and doors (and possibly walls/roofs) that were more sound-insulating than usual	( )	( )	☐
Other(optional)_____	( )	( )	☐

13. Assume a developer (or builder) wants to build residences (houses, apartments, condominiums, etc.) on undeveloped land next to an existing major road or highway. Do you agree or disagree that a planning jurisdiction should **require** the developer to take action, **at the developer's expense,** to reduce excessive traffic noise levels in the development or in the residences?

__1 Strongly Agree __2 Agree __3 Neutral __4 Disagree __5 Strongly Disagree __6 Not sure

14. How should costs to reduce excessive traffic noise be shared (if at all) when a residential developer builds **new** residences alongside an **existing** highway or major road?

Person/Organization that should pay	***Pay All***	***Large Share***	***Medium Share***	***Small Share***	***No Share***	***No Opinion***
• Developer	( )	( )	( )	( )	( )	( )
• Owners of the houses or residential buildings	( )	( )	( )	( )	( )	( )
• Local government	( )	( )	( )	( )	( )	( )
• State government	( )	( )	( )	( )	( )	( )
• Federal government	( )	( )	( )	( )	( )	( )
Other _____	( )	( )	( )	( )	( )	( )

15. How important would the following actions be for a successful noise-compatible development program for your planning jurisdiction?

15.1 Local Government Technical Assistance, Planning Guidelines and Model Ordinances	***Very Important***	***Important***	***Not Important***	***Undecided***
• Introductory publication explaining traffic noise effects and benefits of noise compatible development	( )	( )	( )	( )
• Development of general guidelines for land use planning in areas where traffic noise is or will be high	( )	( )	( )	( )
• Model zoning ordinance addendum for preventing/reducing traffic noise problems	( )	( )	( )	( )
• Model subdivision ordinance addendum for preventing/reducing traffic noise problems	( )	( )	( )	( )
• Model building code addendum for preventing/reducing traffic noise problems	( )	( )	( )	( )
• Technical training services for local government officials (e.g. noise compatible development workshop)	( )	( )	( )	( )
• Ongoing technical assistance services for local government officials (on-site/on-line)	( )	( )	( )	( )
• Financial assistance for local governments participating in program	( )	( )	( )	( )
• Other _____	( )	( )	( )	( )

15.2 Publications/Training/Technical Assistance for Developers, Builders, Realtors, Homeowners, Homebuyers	***Very Important***	***Important***	***Not Important***	***Undecided***
• Community workshops on noise compatible development-for builders, developers, and realtors	( )	( )	( )	( )
• Introductory information on advantages of noise-compatible development in sensitive areas	( )	( )	( )	( )
• Technical publications for developers, builders, and realtors on noise-compatible development	( )	( )	( )	( )
• Technical assistance in conducting noise impact mitigation study for developers/ and or builders	( )	( )	( )	( )
• Community workshops on noise compatible development- for homeowners and buyers	( )	( )	( )	( )
• Publications targeting home owners & home buyers	( )	( )	( )	( )
• Other _____	( )	( )	( )	( )

16. What roles should MDT play for a successful program of noise-compatible residential development in your jurisdiction?

MDT Roles?	***Very Important***	***Somewhat Important***	***Not Important***	***A Detriment***	***Undecided***
• Develop program implementation guidelines	( )	( )	( )	( )	( )
• Develop noise barrier standards	( )	( )	( )	( )	( )
• Assist in review/approval of noise barrier materials or systems	( )	( )	( )	( )	( )
• Facilitate training of city/county staff and/or consultants	( )	( )	( )	( )	( )
• Serve as information resource on statewide or nationwide noise-compatible development activities	( )	( )	( )	( )	( )
• Be available to assist local government in reviewing the developer's noise study for the city/county	( )	( )	( )	( )	( )
• Allow developer-built noise barriers to be on state right-of-way when needed	( )	( )	( )	( )	( )
• Provide city/county with sound level information for undeveloped lands along proposed roads	( )	( )	( )	( )	( )
• Educate developers and the public that MDT will not build noise barriers/berms for newly built developments along existing major roads and highways	( )	( )	( )	( )	( )
• Other_____	( )	( )	( )	( )	( )

Check if MDT should have **no role** in a noise compatible-development program: ☐

17.1 Would you be in favor of a "noise-compatible development" program for new or redevelopment-type construction near major roads and highways in your planning jurisdiction?
___Strongly in favor ___In favor ___Neutral ___Opposed ___Strongly opposed

18. What is the likelihood of your jurisdiction implementing a "noise-compatible development" program?
___Very likely ___Likely ___Uncertain ___Unlikely ___Very unlikely

19. (Optional) Comments:_____
_____
_____
_____
_____

Please mail this survey in the attached postage-paid envelope by _____. Thank you very much.

Optional (please fill in):

Name:		
Title:		
Organization:		
Address:		
Address:		
Telephone:	Fax:	email:

Please check all that apply and sign below:

___ You may quote me by name in your report.
___ You may refer to my organization by name in discussing my responses.
___ Please check with me before using my name or my organization in the report.
___ Please keep my name and organization anonymous and confidential.
___ Please provide me with a copy of the final report.

_____

Signature Date

APPENDIX C

RESIDENTS SURVEY RESULTS FOR INDIVIDUAL SURVEY AREAS

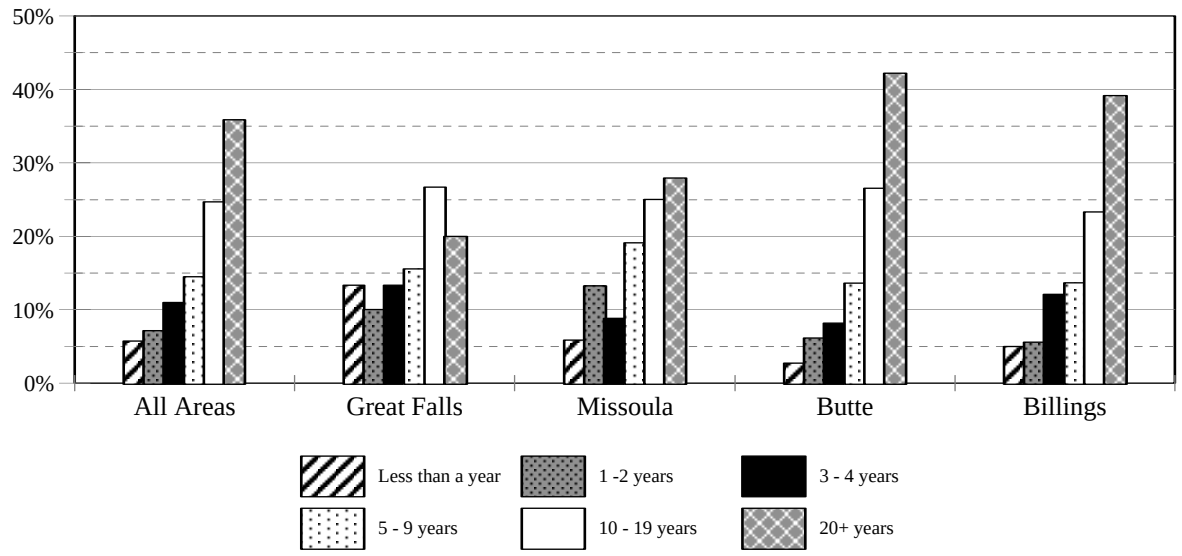
RESIDENTS SURVEY RESULTS FOR INDIVIDUAL SURVEY AREAS

Q1: Approximately how long have you lived in your current residence?

	Responses				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	6	1	0	1	4
Less than a year	36	12	4	4	16
1 -2 years	45	9	9	9	18
3 - 4 years	69	12	6	12	39
5 - 9 years	91	14	13	20	44
10 - 19 years	155	24	17	39	75
20+ years	225	18	19	62	126
Total	***627***	***90***	***68***	***147***	***322***

	Percentages				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	1.0%	1.1%	0.0%	0.7%	1.2%
Less than a year	5.7%	13.3%	5.9%	2.7%	5.0%
1 -2 years	7.2%	10.0%	13.2%	6.1%	5.6%
3 - 4 years	11.0%	13.3%	8.8%	8.2%	12.1%
5 - 9 years	14.5%	15.6%	19.1%	13.6%	13.7%
10 - 19 years	24.7%	26.7%	25.0%	26.5%	23.3%
20+ years	35.9%	20.0%	27.9%	42.2%	39.1%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q1: Approximately how long have you lived in your current residence?



Q2: How many people, including children, live in your current residence?

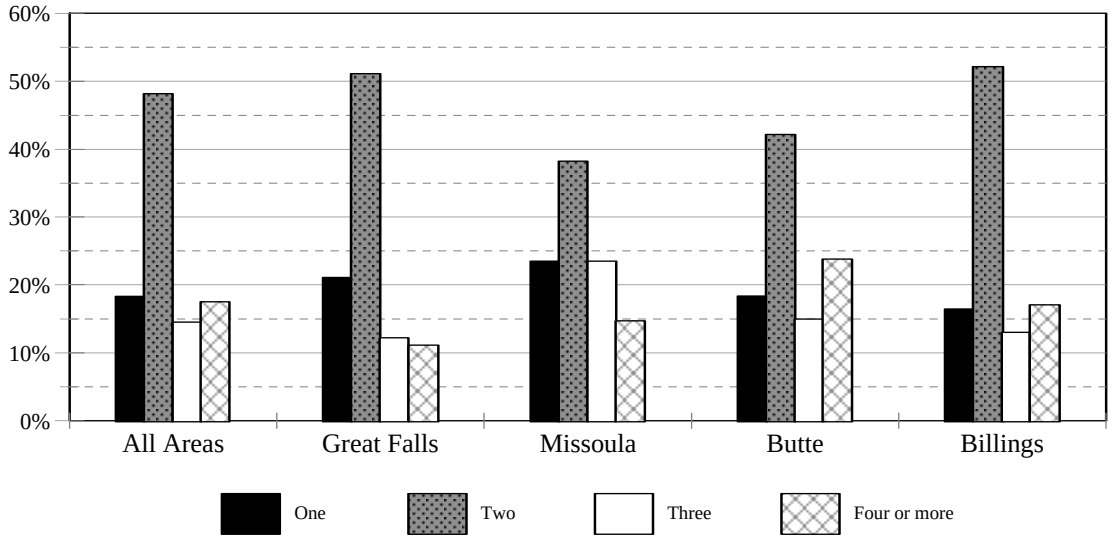
	Responses				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	9	4	0	1	4
One	115	19	16	27	53
Two	302	46	26	62	168
Three	91	11	16	22	42
Four or more	110	10	10	35	55
Total	***627***	***90***	***68***	***147***	***322***

	Percentages				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	1.4%	4.4%	0.0%	0.7%	1.2%
One	18.3%	21.1%	23.5%	18.4%	16.5%
Two	48.2%	51.1%	38.2%	42.2%	52.2%
Three	14.5%	12.2%	23.5%	15.0%	13.0%
Four or more	17.5%	11.1%	14.7%	23.8%	17.1%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q2b: Are children living in your home?

	Responses				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Yes	90	12	9	25	44
	14.4%	13.3%	13.2%	17.0%	13.7%

Q2: How many people, including children, live in your current residence?

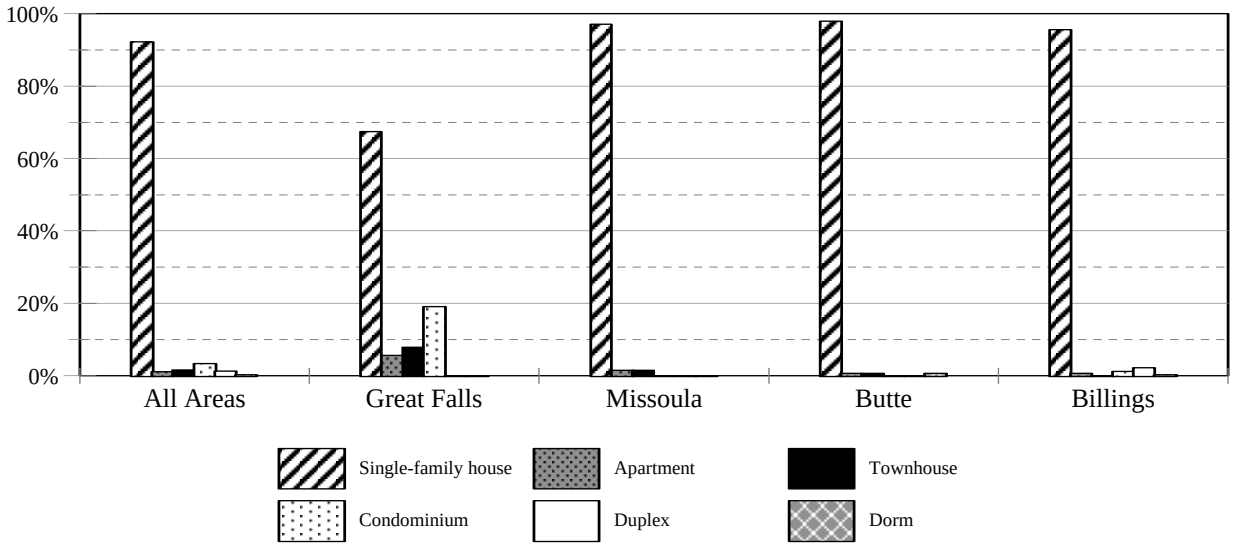


Q3: In what type of residence do you reside?

	Responses				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	7	1	0	2	4
Single-family house	572	60	66	142	304
Apartment	7	5	1	1	2
Townhouse	10	7	1	1	0
Condominium	21	17	0	0	4
Duplex	8	0	0	0	7
Dorm	2	0	0	1	1
Total	***627***	***90***	***68***	***147***	***322***

	Percentages				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	1.1%	1.1%	0.0%	1.4%	1.2%
Single-family house	91.2%	66.7%	97.1%	96.6%	94.4%
Apartment	1.1%	5.6%	1.5%	0.7%	0.6%
Townhouse	1.6%	7.8%	1.5%	0.7%	0.0%
Condominium	3.3%	18.9%	0.0%	0.0%	1.2%
Duplex	1.3%	0.0%	0.0%	0.0%	2.2%
Dorm	0.3%	0.0%	0.0%	0.7%	0.3%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q3: In what type of residence do you reside?

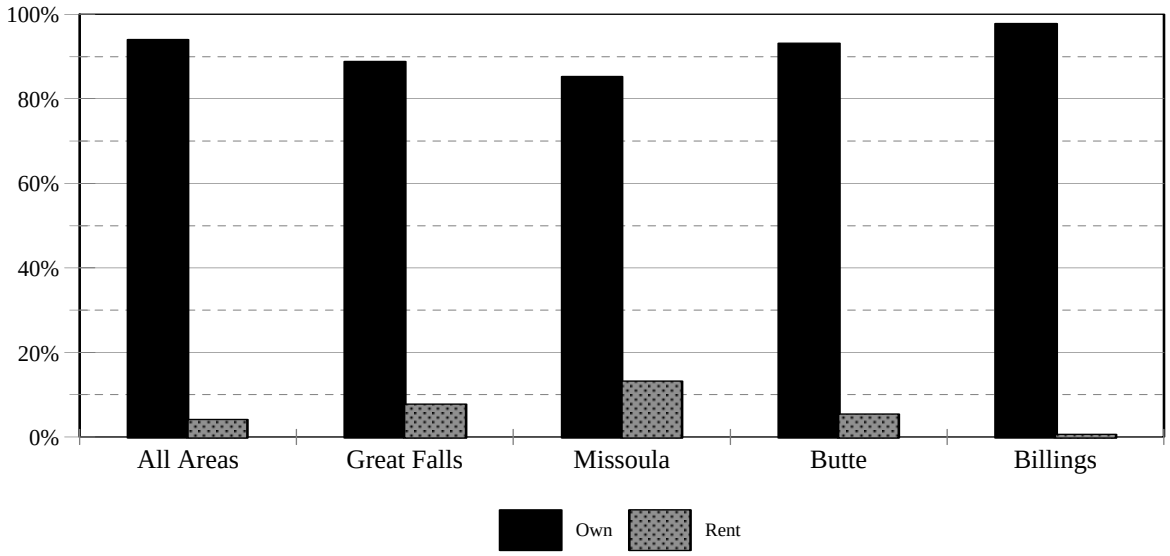


Q4: Do you own or rent your current residence?

		Responses				
		All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing		11	3	1	2	5
Own		590	80	58	137	315
Rent		26	7	9	8	2
	Total	***627***	***90***	***68***	***147***	***322***

		Percentages				
		All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing		1.8%	3.3%	1.5%	1.4%	1.6%
Own		94.1%	88.9%	85.3%	93.2%	97.8%
Rent		4.1%	7.8%	13.2%	5.4%	0.6%
	Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q4: Do you own or rent your current residence?

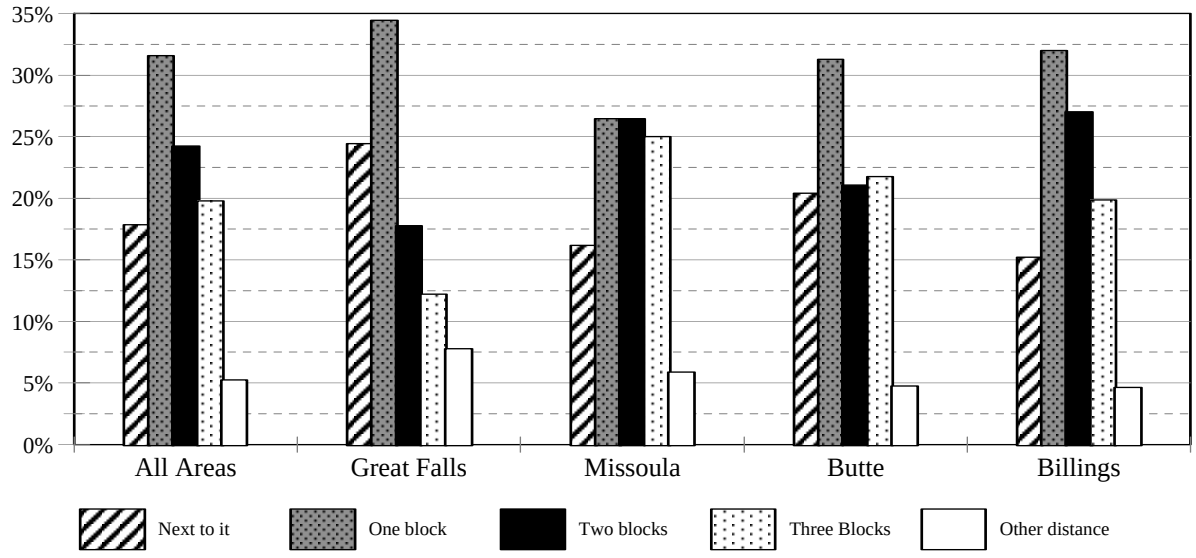


Q5: About how close is your residence to Main Road?

	Responses				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	8	3	0	1	4
Next to it	112	22	11	30	49
One block	198	31	18	46	103
Two blocks	152	16	18	31	87
Three Blocks	124	11	17	32	64
Other distance	33	7	4	7	15
Total	***627***	***90***	***68***	***147***	***322***

	Percentages				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	1.3%	3.3%	0.0%	0.7%	1.2%
Next to it	17.9%	24.4%	16.2%	20.4%	15.2%
One block	31.6%	34.4%	26.5%	31.3%	32.0%
Two blocks	24.2%	17.8%	26.5%	21.1%	27.0%
Three Blocks	19.8%	12.2%	25.0%	21.8%	19.9%
Other distance	5.3%	7.8%	5.9%	4.8%	4.7%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q5: About how close is your residence to Main Road?



Q6: Which side of Main Road is your home located?

Great Falls	***Number***	***Cumulative Number***	***Percent***	***Cumulative Percent***
Missing	1	1	1.1%	1.1%
East Fox Farm Road	48	49	53.3%	54.4%
West Fox Farm Road	33	82	36.7%	91.1%
North I-15 Spur	8	90	8.9%	100.0%

Missoula	***Number***	***Cumulative Number***	***Percent***	***Cumulative Percent***
Missing	0	0	0.0%	0.0%
East side of Van Buren St.	42	42	61.8%	61.8%
West side of Van Buren St.	26	68	38.2%	100.0%

Butte	***Number***	***Cumulative Number***	***Percent***	***Cumulative Percent***
Missing	0	0	0.0%	0.0%
North side I-15/90	64	64	43.5%	43.5%
South side I-15/90	83	147	56.5%	100.0%

Billings	***Number***	***Cumulative Number***	***Percent***	***Cumulative Percent***
Missing	0	0	0.0%	0.0%
5th - 17th St.	117	117	36.3%	36.3%
17th St. - Rehberg Ln.	140	257	43.5%	79.8%
Rehberg Ln. - 38th St. -	65	322	20.2%	100.0%

Q7: Please rate your neighborhood for the following qualities.

	Physical quality of neighborhood	*Affordability of housing/cost of living*	*Parks, green space, recreational opportunities*	*View*	*Security/freedom from crime*	*Lack of traffic on local streets*	*Lack of traffic on main road*	*Peace & quiet from outdoor manmade noises*	*Convenience to shopping/school/ work*	*Other*
All Areas					***Responses***					
Missing	11	23	16	30	13	20	42	16	30	569
Very Good	296	96	153	157	152	124	13	45	210	16
Good	259	341	208	225	332	211	64	166	317	9
Fair	54	130	120	142	105	158	153	189	57	3
Poor	6	20	68	49	18	53	165	116	11	3
Very Poor	1	5	25	9	7	49	159	94	2	25
Does Not Apply	0	12	37	15	0	12	31	1	0	2
Total	***627***	***627***	***627***	***627***	***627***	***627***	***627***	***627***	***627***	***627***

All Areas					***Percentages***					
Missing	1.8%	3.7%	2.6%	4.8%	2.1%	3.2%	6.7%	2.6%	4.8%	90.7%
Very Good	47.2%	15.3%	24.4%	25.0%	24.2%	19.8%	2.1%	7.2%	33.5%	2.6%
Good	41.3%	54.4%	33.2%	35.9%	53.0%	33.7%	10.2%	26.5%	50.6%	1.4%
Fair	8.6%	20.7%	19.1%	22.6%	16.7%	25.2%	24.4%	30.1%	9.1%	0.5%
Poor	1.0%	3.2%	10.8%	7.8%	2.9%	8.5%	26.3%	18.5%	1.8%	0.5%
Very Poor	0.2%	0.8%	4.0%	1.4%	1.1%	7.8%	25.4%	15.0%	0.3%	4.0%
Does Not Apply	0.0%	1.9%	5.9%	2.4%	0.0%	1.9%	4.9%	0.2%	0.0%	0.3%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Great Falls					***Responses***					
Missing	3	4	4	6	3	5	7	4	7	85
Very Good	47	20	30	20	26	23	5	8	31	1
Good	31	44	34	20	42	27	9	17	42	1
Fair	5	18	9	25	14	18	17	16	8	0
Poor	3	2	3	12	2	6	22	22	1	0
Very Poor	1	1	5	5	3	7	23	22	1	3
Does Not Apply	0	1	5	2	0	4	7	1	0	0
Total	***90***	***90***	***90***	***90***	***90***	***90***	***90***	***90***	***90***	***90***

Great Falls					***Percentages***					
Missing	3.3%	4.4%	4.4%	6.7%	3.3%	5.6%	7.8%	4.4%	7.8%	94.4%
Very Good	52.2%	22.2%	33.3%	22.2%	28.9%	25.6%	5.6%	8.9%	34.4%	1.1%
Good	34.4%	48.9%	37.8%	22.2%	46.7%	30.0%	10.0%	18.9%	46.7%	1.1%
Fair	5.6%	20.0%	10.0%	27.8%	15.6%	20.0%	18.9%	17.8%	8.9%	0.0%
Poor	3.3%	2.2%	3.3%	13.3%	2.2%	6.7%	24.4%	24.4%	1.1%	0.0%
Very Poor	1.1%	1.1%	5.6%	5.6%	3.3%	7.8%	25.6%	24.4%	1.1%	3.3%
Does Not Apply	0.0%	1.1%	5.6%	2.2%	0.0%	4.4%	7.8%	1.1%	0.0%	0.0%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q7: Please rate your neighborhood for the following qualities.

	Physical quality of neighborhood	*Affordability of housing/cost of living*	*Parks, green space, recreational opportunities*	*View*	*Security/freedom from crime*	*Lack of traffic on local streets*	*Lack of traffic on main road*	*Peace & quiet from outdoor manmade noises*	*Convenience to shopping/school/ work*	*Other*
Missoula	***Responses***									
Very Good	9	1	33	13	16	4	1	2	38	4
Good	42	18	29	33	36	17	2	11	27	1
Fair	17	31	3	14	12	18	15	18	0	1
Poor	0	11	1	7	3	16	18	16	1	2
Very Poor	0	3	2	0	0	10	28	19	0	6
Does Not Apply	0	1	0	0	0	1	1	0	0	0
Total	***68***	***68***	***68***	***68***	***68***	***68***	***68***	***68***	***68***	***68***

Missoula	***Percentages***									
Missing	0.0%	4.4%	0.0%	1.5%	1.5%	2.9%	4.4%	2.9%	2.9%	79.4%
Very Good	13.2%	1.5%	48.5%	19.1%	23.5%	5.9%	1.5%	2.9%	55.9%	5.9%
Good	61.8%	26.5%	42.6%	48.5%	52.9%	25.0%	2.9%	16.2%	39.7%	1.5%
Fair	25.0%	45.6%	4.4%	20.6%	17.6%	26.5%	22.1%	26.5%	0.0%	1.5%
Poor	0.0%	16.2%	1.5%	10.3%	4.4%	23.5%	26.5%	23.5%	1.5%	2.9%
Very Poor	0.0%	4.4%	2.9%	0.0%	0.0%	14.7%	41.2%	27.9%	0.0%	8.8%
Does Not Apply	0.0%	1.5%	0.0%	0.0%	0.0%	1.5%	1.5%	0.0%	0.0%	0.0%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Butte	***Responses***									
Missing	1	5	7	10	4	5	11	4	8	134
Very Good	71	26	25	38	37	28	3	11	38	4
Good	63	89	31	55	78	58	20	32	74	2
Fair	10	26	39	32	23	40	36	47	21	2
Poor	2	0	23	7	4	7	36	31	6	4
Very Poor	0	0	10	2	1	8	35	22	0	0
Does Not Apply	0	1	12	3	0	1	6	0	0	0
Total	***147***	***147***	***147***	***147***	***147***	***147***	***147***	***147***	***147***	***146***

Butte	***Percentages***									
Missing	0.7%	3.4%	4.8%	6.8%	2.7%	3.4%	7.5%	2.7%	5.4%	91.8%
Very Good	48.3%	17.7%	17.0%	25.9%	25.2%	19.0%	2.0%	7.5%	25.9%	2.7%
Good	42.9%	60.5%	21.1%	37.4%	53.1%	39.5%	13.6%	21.8%	50.3%	1.4%
Fair	6.8%	17.7%	26.5%	21.8%	15.6%	27.2%	24.5%	32.0%	14.3%	1.4%
Poor	1.4%	0.0%	15.6%	4.8%	2.7%	4.8%	24.5%	21.1%	4.1%	2.7%
Very Poor	0.0%	0.0%	6.8%	1.4%	0.7%	5.4%	23.8%	15.0%	0.0%	0.0%
Does Not Apply	0.0%	0.7%	8.2%	2.0%	0.0%	0.7%	4.1%	0.0%	0.0%	0.0%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q7: Please rate your neighborhood for the following qualities.

Billings	***Physical quality of neighborhood***	***Affordability of housing/cost of living***	***Parks, green space, recreational opportunities***	***View***	***Security/freedom from crime***	***Lack of traffic on local streets***	***Lack of traffic on main road***	***Peace & quiet from outdoor manmade noises***	***Convenience to shopping/school/ work***	***Other***
	Responses									
Missing	7	11	5	13	5	8	21	6	13	293
Very Good	169	49	65	86	73	69	4	24	103	7
Good	123	190	114	117	176	109	33	106	174	5
Fair	22	55	69	71	56	82	85	108	28	0
Poor	1	7	41	23	9	24	89	47	3	1
Very Poor	0	1	8	2	3	24	73	31	1	14
Does Not Apply	0	9	20	10	0	6	17	0	0	2
Total	***322***	***322***	***322***	***322***	***322***	***322***	***322***	***322***	***322***	***322***

Billings	***Percentages***									
Missing	2.2%	3.4%	1.6%	4.0%	1.6%	2.5%	6.5%	1.9%	4.0%	91.0%
Very Good	52.5%	15.2%	20.2%	26.7%	22.7%	21.4%	1.2%	7.5%	32.0%	2.2%
Good	38.2%	59.0%	35.4%	36.3%	54.7%	33.9%	10.2%	32.9%	54.0%	1.6%
Fair	6.8%	17.1%	21.4%	22.0%	17.4%	25.5%	26.4%	33.5%	8.7%	0.0%
Poor	0.3%	2.2%	12.7%	7.1%	2.8%	7.5%	27.6%	14.6%	0.9%	0.3%
Very Poor	0.0%	0.3%	2.5%	0.6%	0.9%	7.5%	22.7%	9.6%	0.3%	4.3%
Does Not Apply	0.0%	2.8%	6.2%	3.1%	0.0%	1.9%	5.3%	0.0%	0.0%	0.6%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

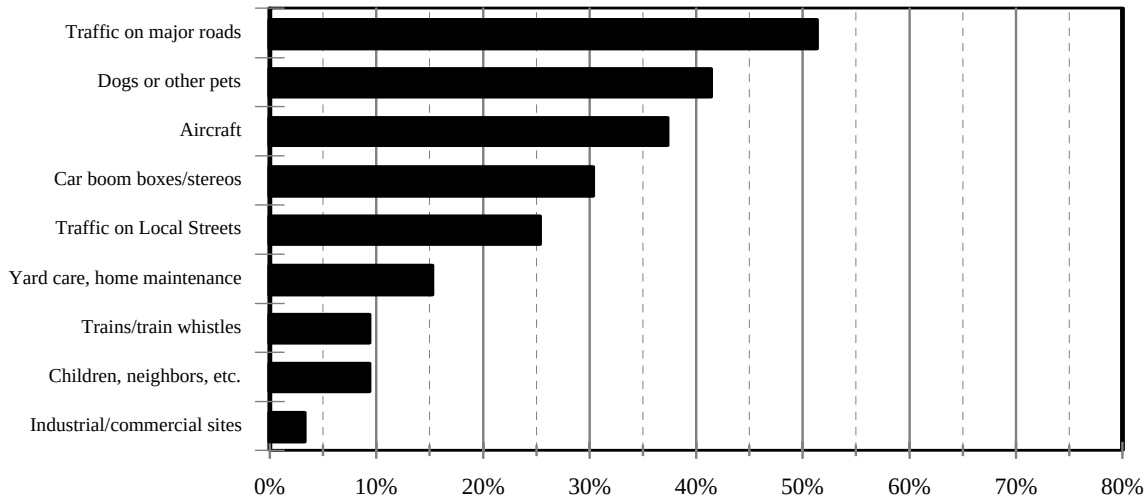
Q8: Please check any of the following sounds that frequently annoy people in your household when inside or outside your residence.

	Responses				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Barking dogs or noise from other pets	257	17	24	65	151
Noise from children, neighbors, etc.	54	5	6	12	31
Noise from yard care, home maintenance, etc.	96	6	13	14	63
Car boom boxes or other car stereo equipment	189	43	22	30	94
Noise from industrial or commercial	16	5	4	2	5
Traffic noise from major roads	320	66	50	96	108
Traffic noise from local streets	154	19	32	24	79
Aircraft noises	229	59	9	23	138
Train noises	57	8	45	1	3
Other	45	10	6	8	21

	Percentages				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Barking dogs or noise from other pets	41.0%	18.9%	35.3%	44.2%	46.9%
Noise from children, neighbors, etc.	8.6%	5.6%	8.8%	8.2%	9.6%
Noise from yard care, home maintenance, etc.	15.3%	6.7%	19.1%	9.5%	19.6%
Car boom boxes or other car stereo equipment	30.1%	47.8%	32.4%	20.4%	29.2%
Noise from industrial or commercial	2.6%	5.6%	5.9%	1.4%	1.6%
Traffic noise from major roads	51.0%	73.3%	73.5%	65.3%	33.5%
Traffic noise from local streets	24.6%	21.1%	47.1%	16.3%	24.5%
Aircraft noises	36.5%	65.6%	13.2%	15.6%	42.9%
Train noises	9.1%	8.9%	66.2%	0.7%	0.9%
Other	7.2%	11.1%	8.8%	5.4%	6.5%

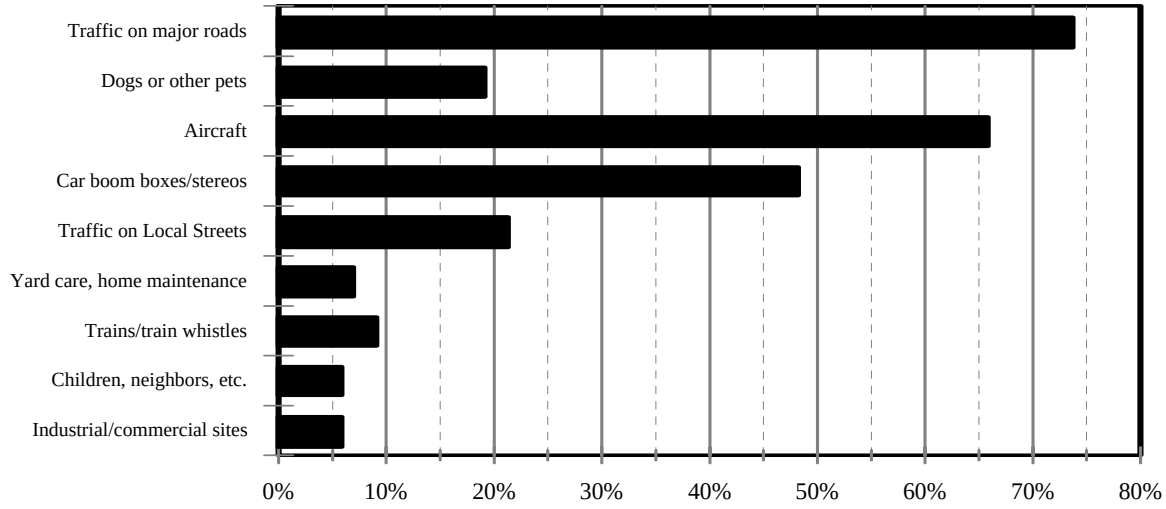
Please check any of the following sounds that frequently annoy people in your household when inside or outside your residence.

All Areas



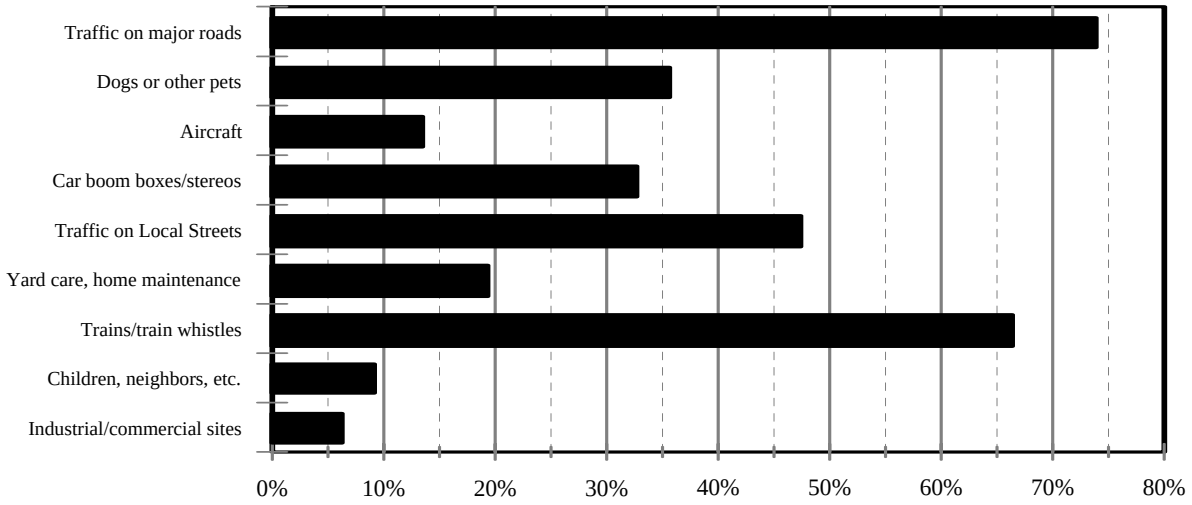
Q8: Please check any of the following sounds that frequently annoy people in your household when inside or outside your residence.

Great Falls



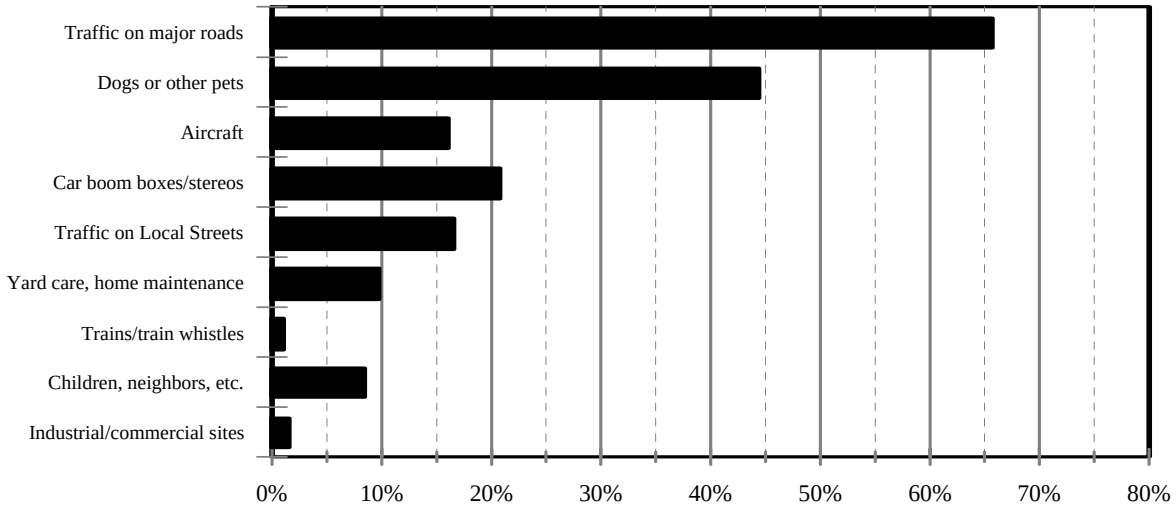
Q8: Please check any of the following sounds that frequently annoy people in your household when inside or outside your residence.

Missoula



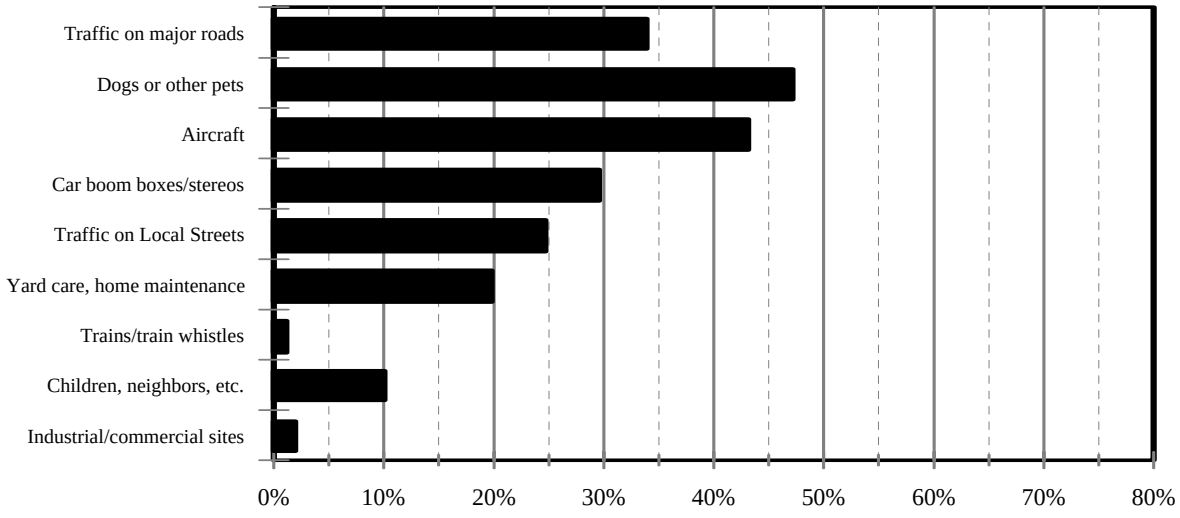
Q8: Please check any of the following sounds that frequently annoy people in your household when inside or outside your residence.

Butte



Q8: Please check any of the following sounds that frequently annoy people in your household when inside or outside your residence.

Billings

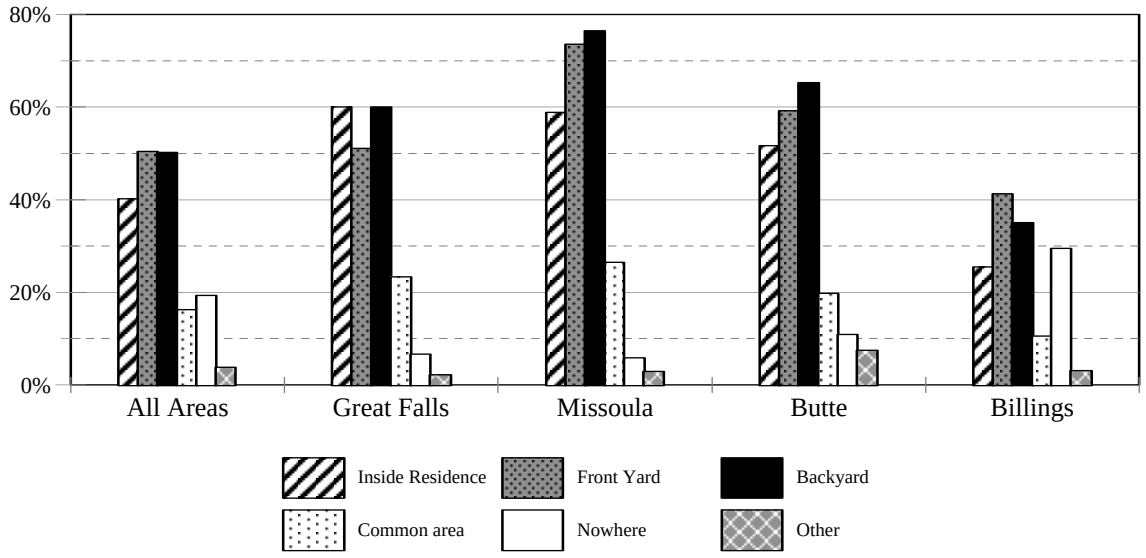


Q9: From what parts of your residential area is traffic noise highly noticeable? Check all that apply.

	Responses					
	Inside Residence	***Front Yard***	***Backyard***	***Common area***	***Nowhere***	***Other***
All Areas	252	316	315	102	121	24
Great Falls	54	46	54	21	6	2
Missoula	40	50	52	18	4	2
Butte	76	87	96	29	16	11
Billings	82	133	113	34	95	10

	Percentages					
	Inside Residence	***Front Yard***	***Backyard***	***Common area***	***Nowhere***	***Other***
All Areas	40.2%	50.4%	50.2%	16.3%	19.3%	3.8%
Great Falls	60.0%	51.1%	60.0%	23.3%	6.7%	2.2%
Missoula	58.8%	73.5%	76.5%	26.5%	5.9%	2.9%
Butte	51.7%	59.2%	65.3%	19.7%	10.9%	7.5%
Billings	25.5%	41.3%	35.1%	10.6%	29.5%	3.1%

Q9: From what parts of your residential area is traffic noise highly noticeable?

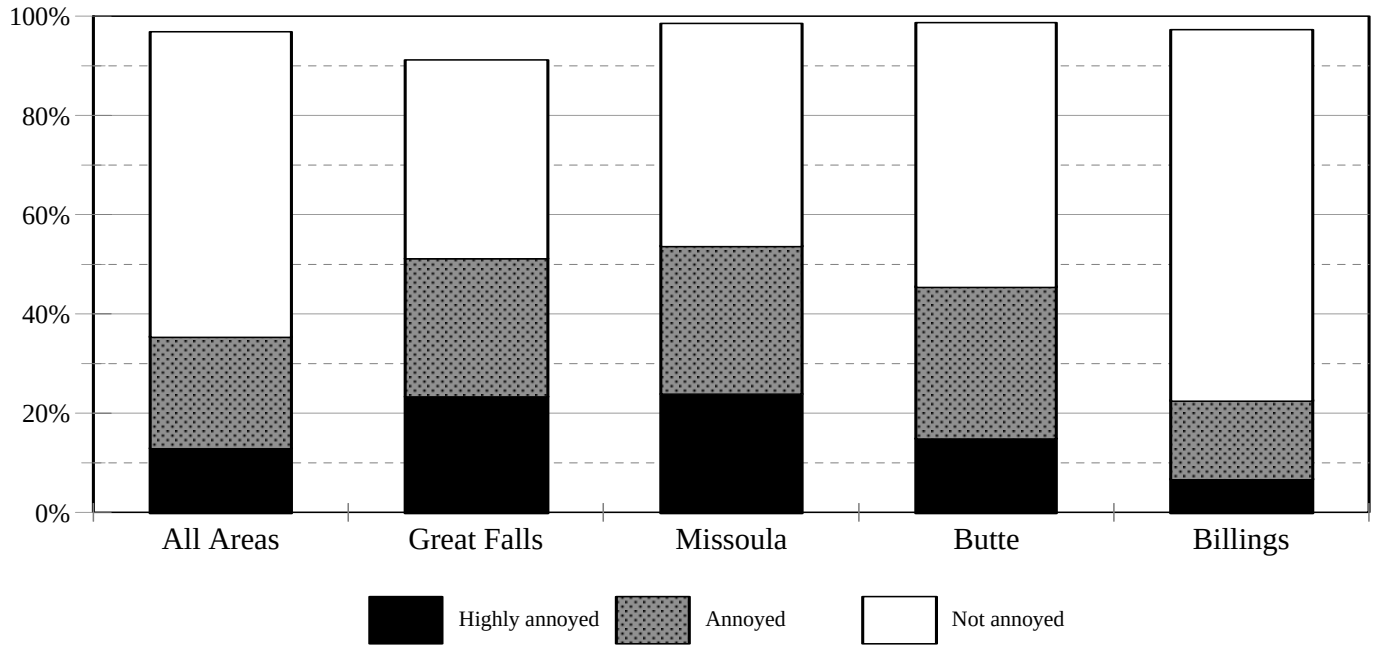


Q10: In the past week, were you annoyed or disturbed by traffic noise from the main road while inside your residence?

	Responses				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	21	8	2	2	9
Highly annoyed	81	21	16	22	22
Annoyed	141	25	20	45	51
Not annoyed	384	36	30	78	240
Total	***627***	***90***	***68***	***147***	***322***

	Percentages				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	3.2%	8.9%	2.9%	1.4%	2.8%
Highly annoyed	12.9%	23.3%	23.5%	15.0%	6.8%
Annoyed	22.5%	27.8%	29.4%	30.6%	15.8%
Not annoyed	61.3%	40.0%	44.1%	53.1%	74.5%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q10: In the past week, were you annoyed or disturbed by traffic noise from the main road while inside your residence?

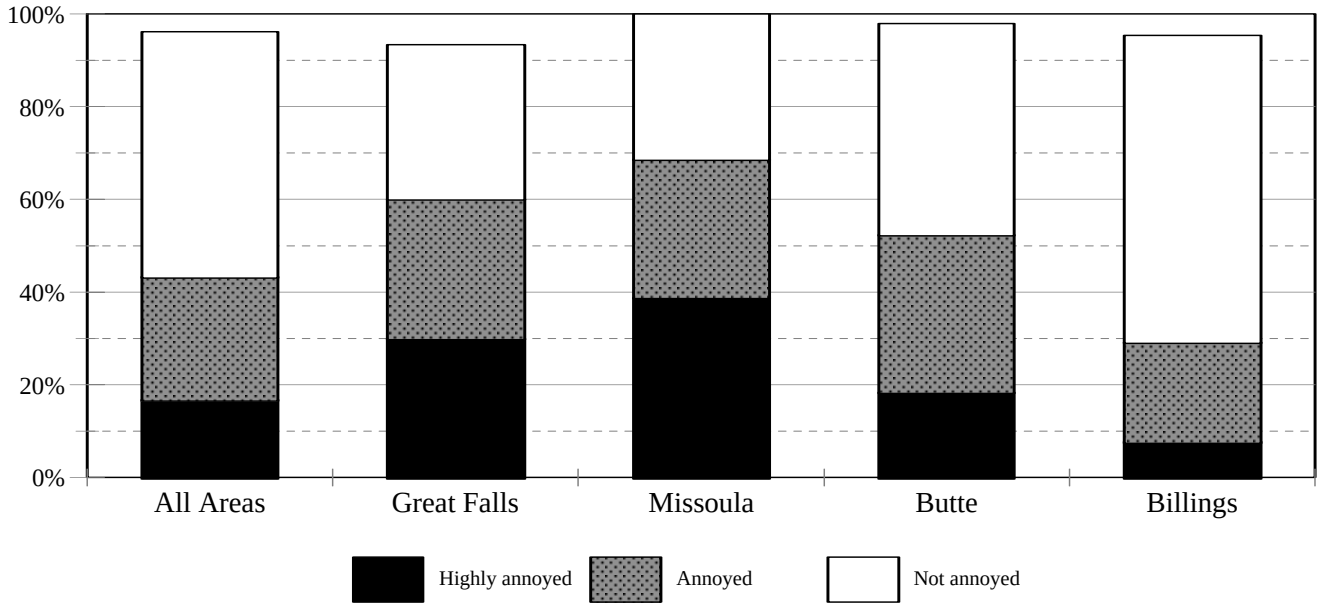


Q11: In the past week, were you annoyed or disturbed by traffic noise from the main road while outside your residence?

	Responses				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	25	6	1	3	15
Highly annoyed	105	27	26	27	25
Annoyed	166	27	20	50	69
Not annoyed	331	30	21	67	213
Total	***627***	***90***	***68***	***147***	***322***

	Percentages				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	4.0%	6.7%	1.5%	2.0%	4.7%
Highly annoyed	16.7%	30.0%	38.2%	18.4%	7.8%
Annoyed	26.5%	30.0%	29.4%	34.0%	21.4%
Not annoyed	52.8%	33.3%	30.9%	45.6%	66.1%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q11: In the past week, were you annoyed or disturbed by traffic noise from the main road while outside your residence?



Q12: In the summer, how often are you annoyed by traffic noise from the main road at your residence?
Q12a: While inside your residence.

	Responses				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	38	7	2	9	20
All of the time/nearly all the time	57	17	12	22	6
Much of the day	53	9	11	16	17
Certain peak travel hours	79	16	7	11	45
During nighttime periods	64	8	9	30	17
A few brief times each day	69	14	7	13	35
On weekends	5	0	0	1	4
Never or almost never	262	19	20	45	178
Total	***627***	***90***	***68***	***147***	***322***

	Percentages				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	6.1%	7.8%	2.9%	6.1%	6.2%
All of the time/nearly all the time	9.1%	18.9%	17.6%	15.0%	1.9%
Much of the day	8.5%	10.0%	16.2%	10.9%	5.3%
Certain peak travel hours	12.6%	17.8%	10.3%	7.5%	14.0%
During nighttime periods	10.2%	8.9%	13.2%	20.4%	5.3%
A few brief times each day	11.0%	15.6%	10.3%	8.8%	10.9%
On weekends	0.8%	0.0%	0.0%	0.7%	1.2%
Never or almost never	41.8%	21.1%	29.4%	30.6%	55.3%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q12b: While outside your residence.

	Responses				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	38	9	1	7	21
All of the time/nearly all the time	88	18	25	31	14
Much of the day	67	15	7	21	24
Certain peak travel hours	88	8	4	18	58
During nighttime periods	27	5	4	11	7
A few brief times each day	77	8	10	15	44
On weekends	9	2	1	2	4
Never or almost never	233	25	16	42	150
Total	***627***	***90***	***68***	***147***	***322***

	Percentages				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	6.1%	10.0%	1.5%	4.8%	6.5%
All of the time/nearly all the time	14.0%	20.0%	36.8%	21.1%	4.3%
Much of the day	10.7%	16.7%	10.3%	14.3%	7.5%
Certain peak travel hours	14.0%	8.9%	5.9%	12.2%	18.0%
During nighttime periods	4.3%	5.6%	5.9%	7.5%	2.2%
A few brief times each day	12.3%	8.9%	14.7%	10.2%	13.7%
On weekends	1.4%	2.2%	1.5%	1.4%	1.2%
Never or almost never	37.2%	27.8%	23.5%	28.6%	46.6%

Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	

Question 12: Neighborhood Annoyance Rates by Proximity to Main Road, Summary of Results for All Survey Areas

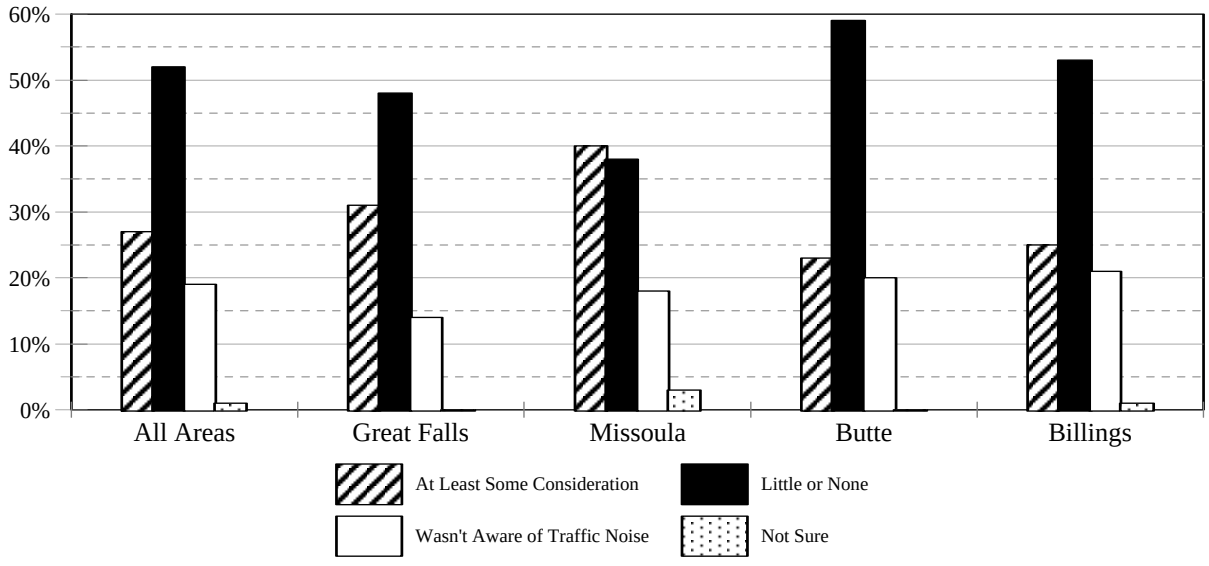
	All/Most of Time		***Special Time Periods***		***Never or Almost Never***	
Great Falls, SW	***Inside***	***Outside***	***Inside***	***Outside***	***Inside***	***Outside***
Next to Main Road	61%	68%	39%	18%	0%	14%
1 Block from Main Road	29%	42%	48%	23%	16%	26%
2 Blocks from Main Road	6%	13%	50%	38%	38%	44%
3 Blocks from Main Road	11%	16%	37%	37%	37%	32%
Missoula L. Rattlesnake	***Inside***	***Outside***	***Inside***	***Outside***	***Inside***	***Outside***
Next to Main Road	55%	55%	27%	27%	9%	18%
1 Block from Main Road	28%	50%	44%	39%	22%	11%
2 Blocks from Main Road	28%	44%	39%	22%	33%	28%
3 Blocks from Main Road	28%	44%	39%	22%	33%	28%
Butte Hillcrest	***Inside***	***Outside***	***Inside***	***Outside***	***Inside***	***Outside***
Next to Main Road	57%	67%	17%	13%	23%	17%
1 Block from Main Road	28%	38%	47%	30%	21%	23%
2 Blocks from Main Road	10%	16%	52%	48%	32%	32%
3 Blocks from Main Road	15%	23%	31%	33%	44%	38%
Billings Rimrock	***Inside***	***Outside***	***Inside***	***Outside***	***Inside***	***Outside***
Next to Main Road	36%	46%	48%	40%	12%	8%
1 Block from Main Road	3%	8%	40%	44%	52%	45%
2 Blocks from Main Road	2%	5%	26%	34%	65%	55%
3 Blocks from Main Road	1%	4%	16%	23%	75%	62%

Q13: How much consideration did you give to traffic noise from the main road when you rented/purchased your current residence?

	Responses				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	123	19	13	26	65
A great deal	36	6	2	6	22
Some	134	22	25	28	59
Little	125	22	15	32	56
None	204	21	11	55	117
I wasn't aware of the traffic noise	5	0	2	0	3
Total	***627***	***90***	***68***	***147***	***322***

	Percentages				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	19.6%	21.1%	19.1%	17.7%	20.2%
A great deal	5.7%	6.7%	2.9%	4.1%	6.8%
Some	21.4%	24.4%	36.8%	19.0%	18.3%
Little	19.9%	24.4%	22.1%	21.8%	17.4%
None	32.5%	23.3%	16.2%	37.4%	36.3%
I wasn't aware of the traffic noise	0.8%	0.0%	2.9%	0.0%	0.9%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q13: How much consideration did you give to traffic noise from the main road when you rented/purchased your current residence?

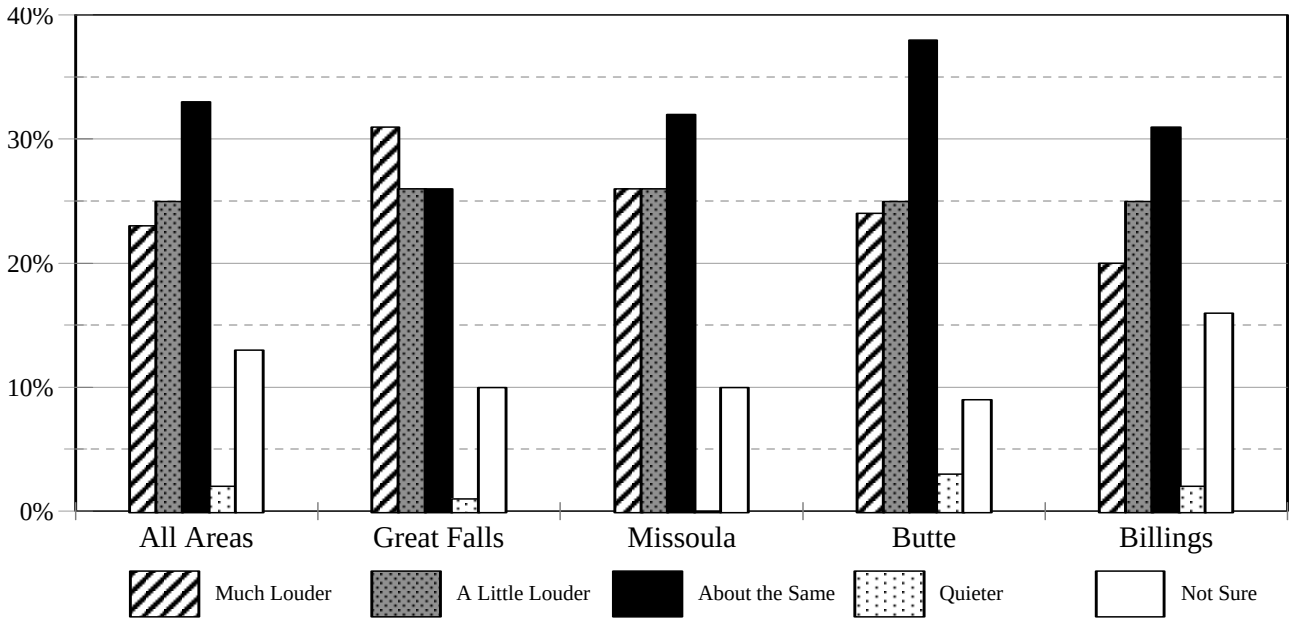


Q14: Has traffic noise from the main road gotten louder or quieter since you moved into your current residence?

	Responses				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	20	6	3	1	10
Much louder	145	28	18	36	63
A little louder	159	23	18	36	82
Bout the same	211	23	22	56	110
Quieter	10	1	0	4	5
Not sure	82	9	7	14	52
Total	***627***	***90***	***68***	***147***	***322***

	Percentages				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	3.2%	6.7%	4.4%	0.7%	3.1%
Much louder	23.1%	31.1%	26.5%	24.5%	19.6%
A little louder	25.4%	25.6%	26.5%	24.5%	25.5%
Bout the same	33.7%	25.6%	32.4%	38.1%	34.2%
Quieter	1.6%	1.1%	0.0%	2.7%	1.6%
Not sure	13.1%	10.0%	10.3%	9.5%	16.1%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q14: Has traffic noise from the main road gotten louder or quieter since you moved into your current residence?



Q15: Has traffic noise from the main road become more or less bothersome over time?

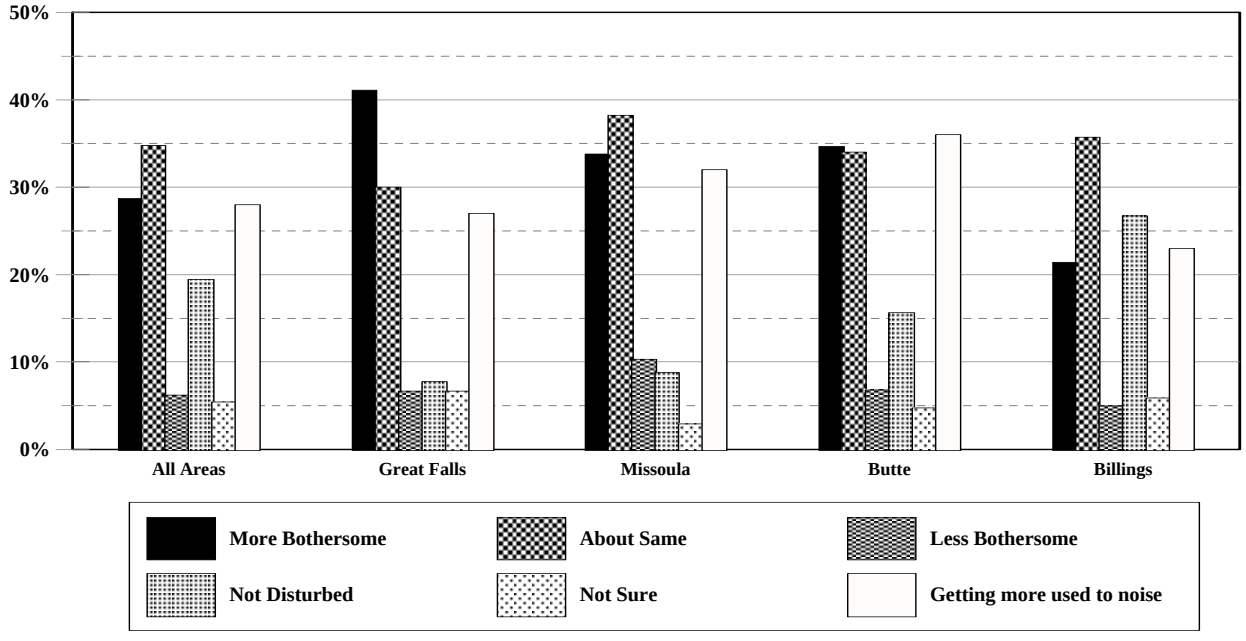
	Responses				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	34	7	4	6	17
More bothersome	180	37	23	51	69
Stayed about the same	218	27	26	50	115
Less bothersome	39	6	7	10	16
Not disturbed	122	7	6	23	86
Not sure	34	6	2	7	19
Total	***627***	***90***	***68***	***147***	***322***

	Percentages				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	5.4%	7.8%	5.9%	4.1%	5.3%
More bothersome	28.7%	41.1%	33.8%	34.7%	21.4%
Stayed about the same	34.8%	30.0%	38.2%	34.0%	35.7%
Less bothersome	6.2%	6.7%	10.3%	6.8%	5.0%
Not disturbed	19.5%	7.8%	8.8%	15.6%	26.7%
Not sure	5.4%	6.7%	2.9%	4.8%	5.9%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q15b: Check here if you think you are getting more used to (more tolerant of) traffic sounds.

Responses				
All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
175	24	22	53	76
27.9%	26.7%	32.4%	36.1%	23.6%

Q15: Has traffic noise from the main road become more or less bothersome over time?

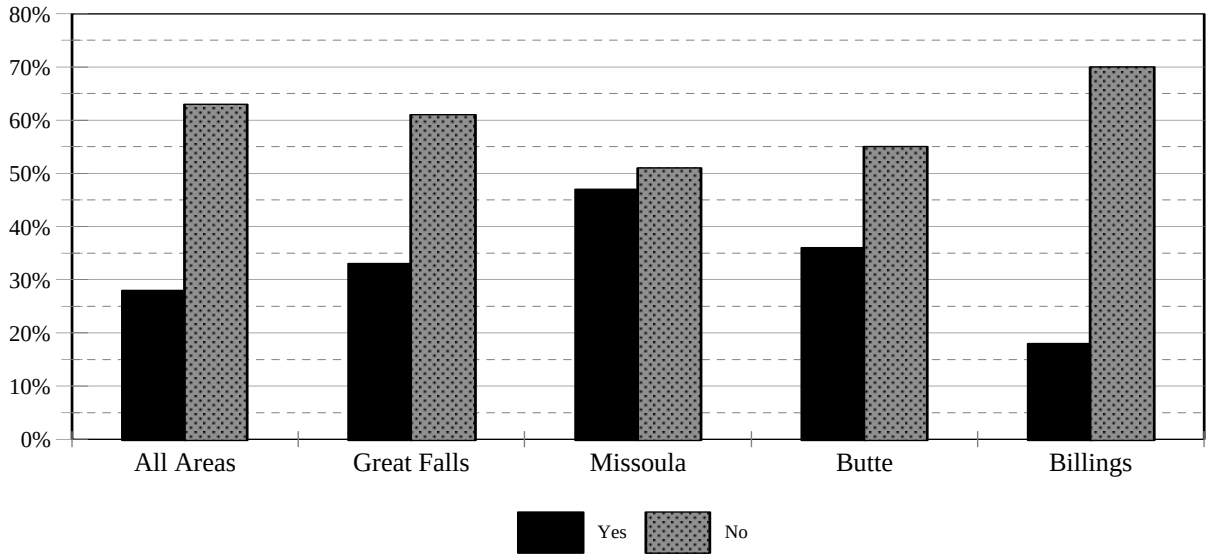


Q16: Has traffic noise from the main road caused you to make adjustments in how you live?

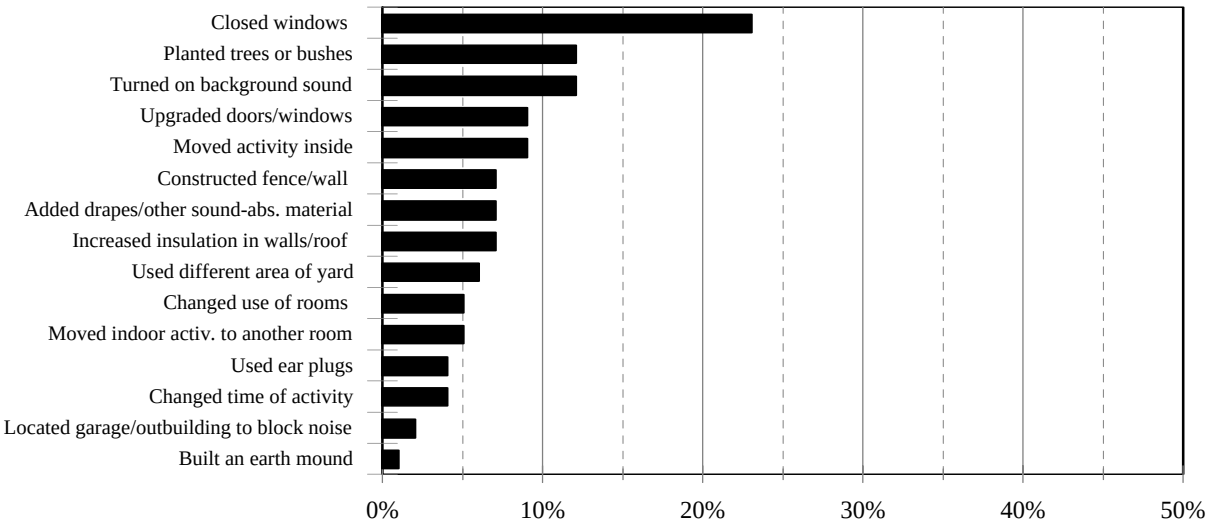
	Responses				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	59	5	1	13	40
No	395	55	35	81	224
Yes	173	30	32	53	58
Total	***627***	***90***	***68***	***147***	***322***

	Percentages				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	9.4%	5.6%	1.5%	8.8%	12.4%
No	63.0%	61.1%	51.5%	55.1%	69.6%
Yes	27.6%	33.3%	47.1%	36.1%	18.0%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

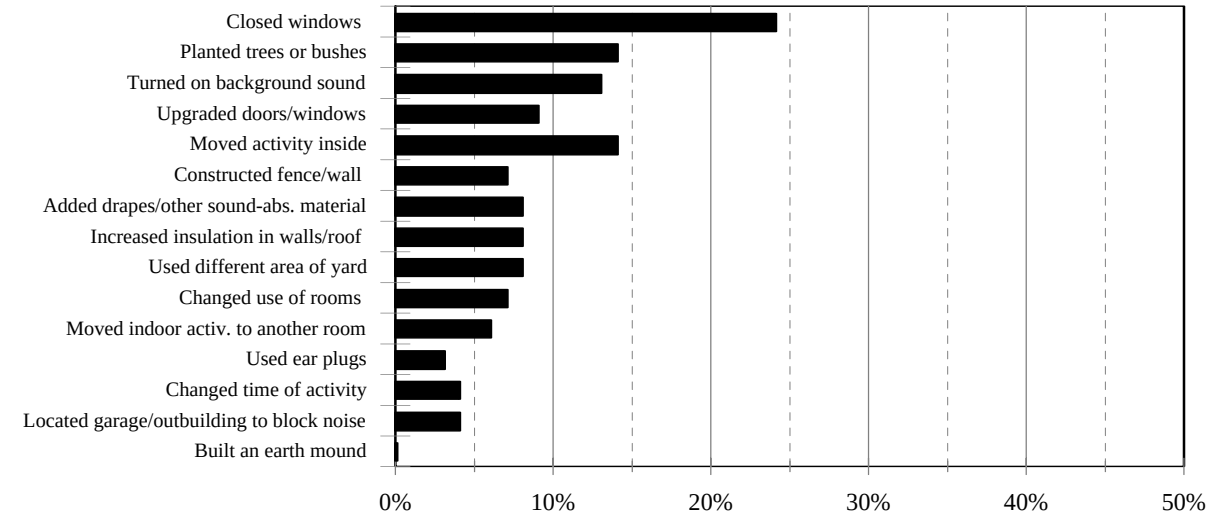
Q16: Has traffic noise from the main road caused you to make adjustments in how you live?



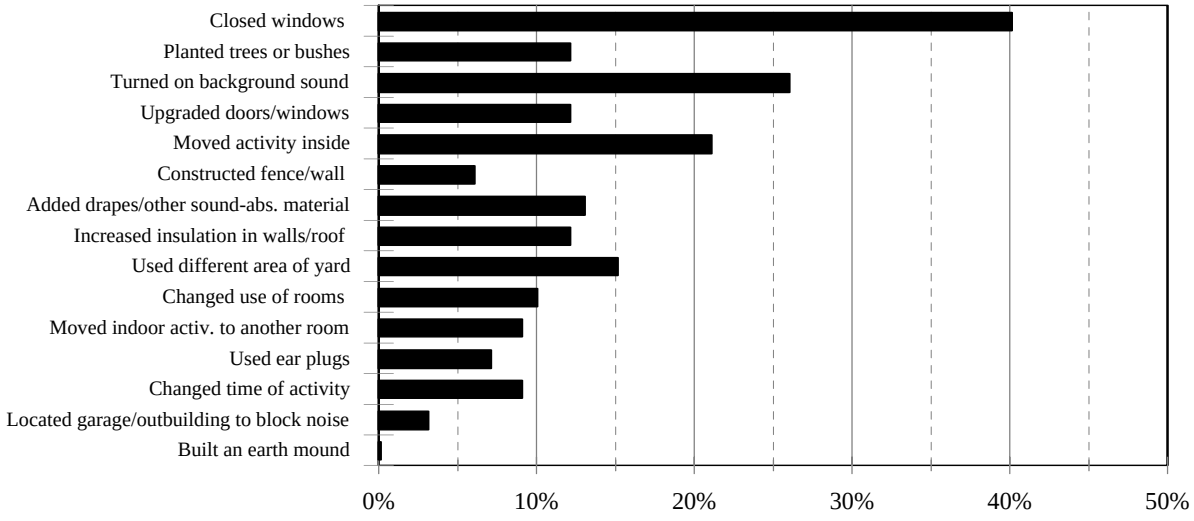
Q16: Has traffic noise from the main road caused you to make adjustments in how you live?
All Areas



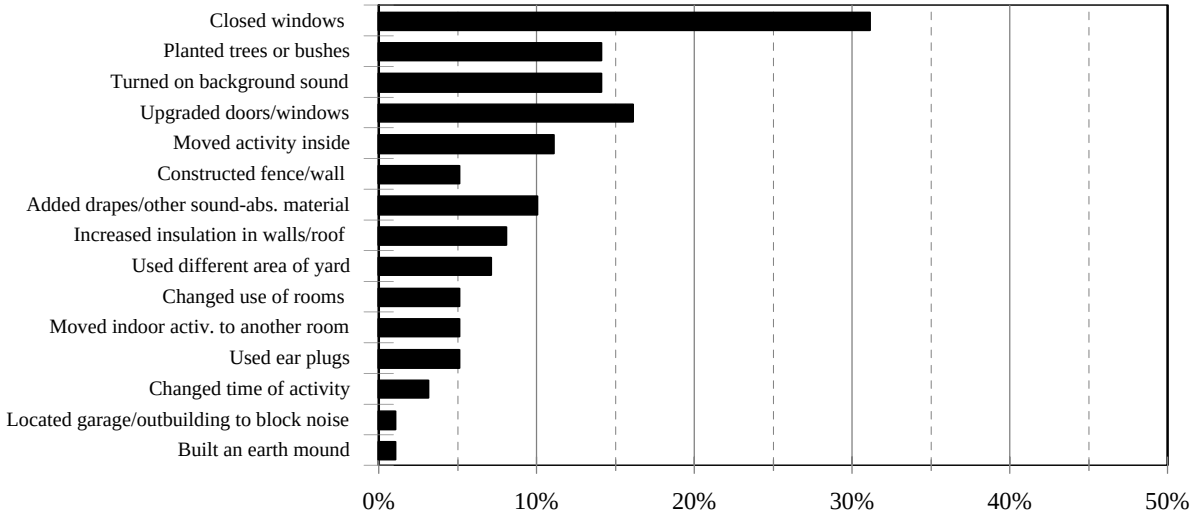
Q16: Has traffic noise from the main road caused you to make adjustments in how you live?
Great Falls



Q16: Has traffic noise from the main road caused you to make adjustments in how you live?
Missoula

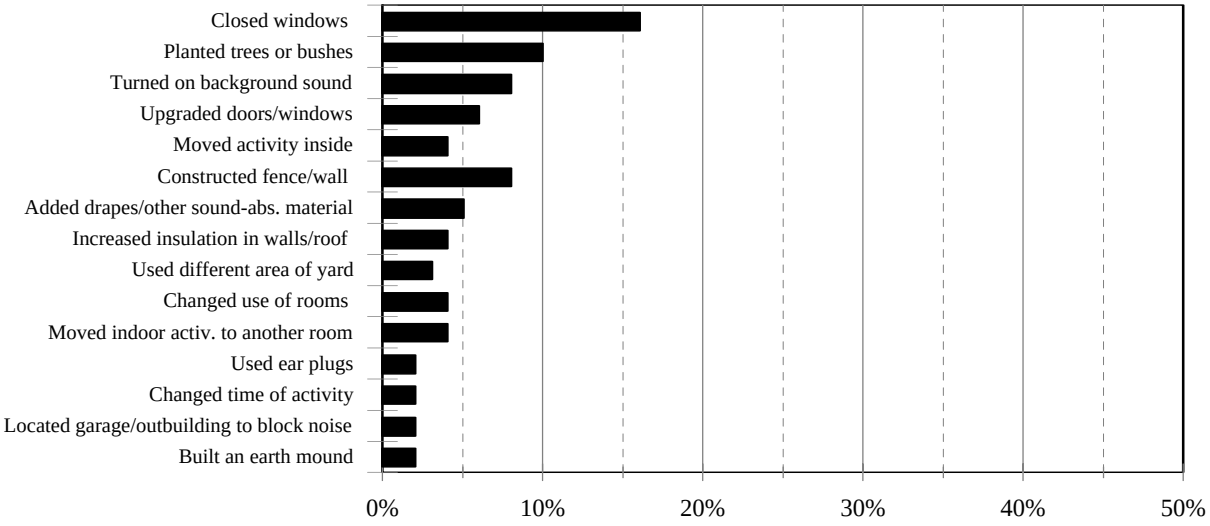


Q16: Has traffic noise from the main road caused you to make adjustments in how you live?
Butte



Q16: Has traffic noise from the main road caused you to make adjustments in how you live?

Billings



Q17: How acceptable to you would the following methods be for reducing noise at your residence from traffic on the main road?

	A noise barrier wall between residences and road	*An earth berm (mound) between residences and road*	*Repaving the road with quieter pavement*	*Traffic regulation (banning certain vehicle types, etc.)*	*Restrict use of truck-engine compression (jake) brakes*
All Areas			***Responses***		
Missing	137	167	171	148	134
Very acceptable	168	105	127	132	229
Acceptable	112	98	160	124	129
Not acceptable	87	112	50	88	21
Not applicable	74	96	63	73	70
Undecided	49	49	56	62	44
Total	***627***	***627***	***627***	***627***	***627***
All Areas			***Percentages***		
Missing	21.9%	26.6%	27.3%	23.6%	21.4%
Very acceptable	26.8%	16.7%	20.3%	21.1%	36.5%
Acceptable	17.9%	15.6%	25.5%	19.8%	20.6%
Not acceptable	13.9%	17.9%	8.0%	14.0%	3.3%
Not applicable	11.8%	15.3%	10.0%	11.6%	11.2%
Undecided	7.8%	7.8%	8.9%	9.9%	7.0%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***
Great Falls			***Responses***		
Missing	31	42	41	31	22
Very acceptable	28	8	10	19	42
Acceptable	13	7	17	15	17
Not acceptable	5	15	7	11	3
Not applicable	10	13	9	10	5
Undecided	3	5	6	4	1
Total	***90***	***90***	***90***	***90***	***90***
Great Falls			***Percentages***		
Missing	34.4%	46.7%	45.6%	34.4%	24.4%
Very acceptable	31.1%	8.9%	11.1%	21.1%	46.7%
Acceptable	14.4%	7.8%	18.9%	16.7%	18.9%
Not acceptable	5.6%	16.7%	7.8%	12.2%	3.3%
Not applicable	11.1%	14.4%	10.0%	11.1%	5.6%
Undecided	3.3%	5.6%	6.7%	4.4%	1.1%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

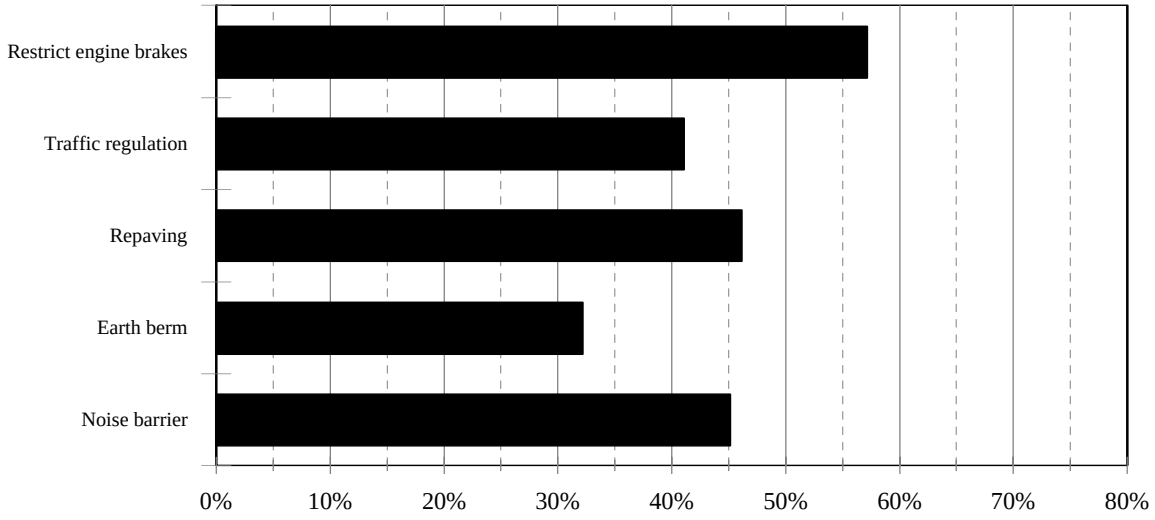
Q17: How acceptable to you would the following methods be for reducing noise at your residence from traffic on the main road?

	A noise barrier wall between residences and road	*An earth berm (mound) between residences and road*	*Repaving the road with quieter pavement*	*Traffic regulation (banning certain vehicle types, etc.)*	*Restrict use of truck-engine compression (jake) brakes*
Missoula			***Responses***		
Missing	9	8	13	10	11
Very acceptable	33	33	13	12	24
Acceptable	15	15	18	13	18
Not acceptable	3	2	11	19	4
Not applicable	4	6	5	8	5
Undecided	4	4	8	6	6
Total	***68***	***68***	***68***	***68***	***68***
Missoula			***Percentages***		
Missing	13.2%	11.8%	19.1%	14.7%	16.2%
Very acceptable	48.5%	48.5%	19.1%	17.6%	35.3%
Acceptable	22.1%	22.1%	26.5%	19.1%	26.5%
Not acceptable	4.4%	2.9%	16.2%	27.9%	5.9%
Not applicable	5.9%	8.8%	7.4%	11.8%	7.4%
Undecided	5.9%	5.9%	11.8%	8.8%	8.8%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***
Butte			***Responses***		
Missing	21	33	33	40	27
Very acceptable	55	30	42	19	61
Acceptable	28	28	40	21	30
Not acceptable	21	26	10	25	6
Not applicable	9	18	11	20	9
Undecided	13	12	11	22	14
Total	***147***	***147***	***147***	***147***	***147***
Butte			***Percentages***		
Missing	14.3%	22.4%	22.4%	27.2%	18.4%
Very Acceptable	37.4%	20.4%	28.6%	12.9%	41.5%
Acceptable	19.0%	19.0%	27.2%	14.3%	20.4%
Not acceptable	14.3%	17.7%	6.8%	17.0%	4.1%
Not applicable	6.1%	12.2%	7.5%	13.6%	6.1%
Undecided	8.8%	8.2%	7.5%	15.0%	9.5%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

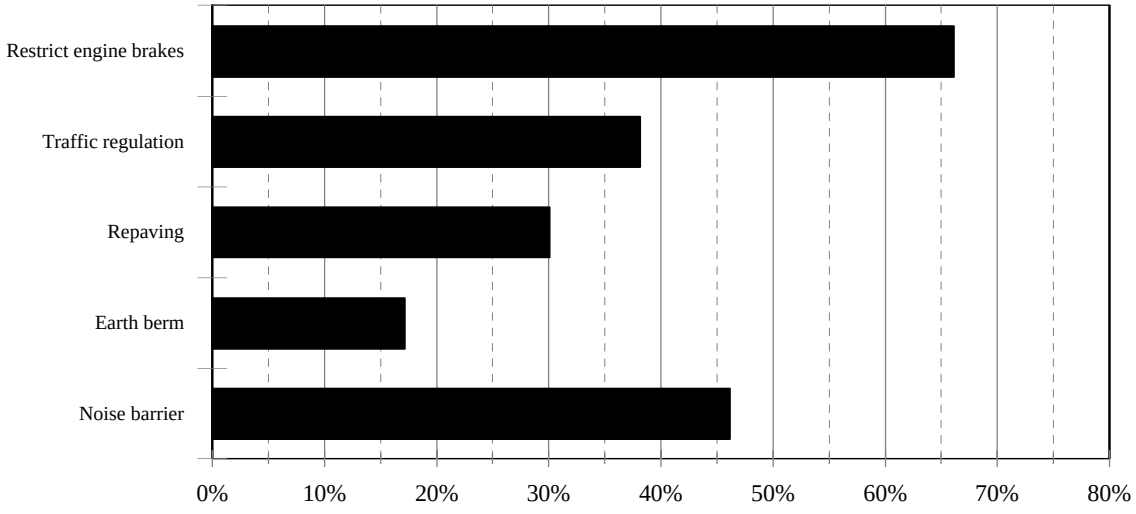
Q17: How acceptable to you would the following methods be for reducing noise at your residence from traffic on the main road?

	A noise barrier wall between residences and road	*An earth berm (mound) between residences and road*	*Repaving the road with quieter pavement*	*Traffic regulation (banning certain vehicle types, etc.)*	*Restrict use of truck-engine compression (jake) brakes*
Billings			***Responses***		
Missing	76	84	84	67	74
Very acceptable	52	34	62	82	102
Acceptable	56	48	85	75	64
Not acceptable	58	69	22	33	8
Not applicable	51	59	38	35	51
Undecided	29	28	31	30	23
Total	***322***	***322***	***322***	***322***	***322***
Billings			***Percentages***		
Missing	23.6%	26.1%	26.1%	20.8%	23.0%
Very acceptable	16.1%	10.6%	19.3%	25.5%	31.7%
Acceptable	17.4%	14.9%	26.4%	23.3%	19.9%
Not acceptable	18.0%	21.4%	6.8%	10.2%	2.5%
Not applicable	15.8%	18.3%	11.8%	10.9%	15.8%
Undecided	9.0%	8.7%	9.6%	9.3%	7.1%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

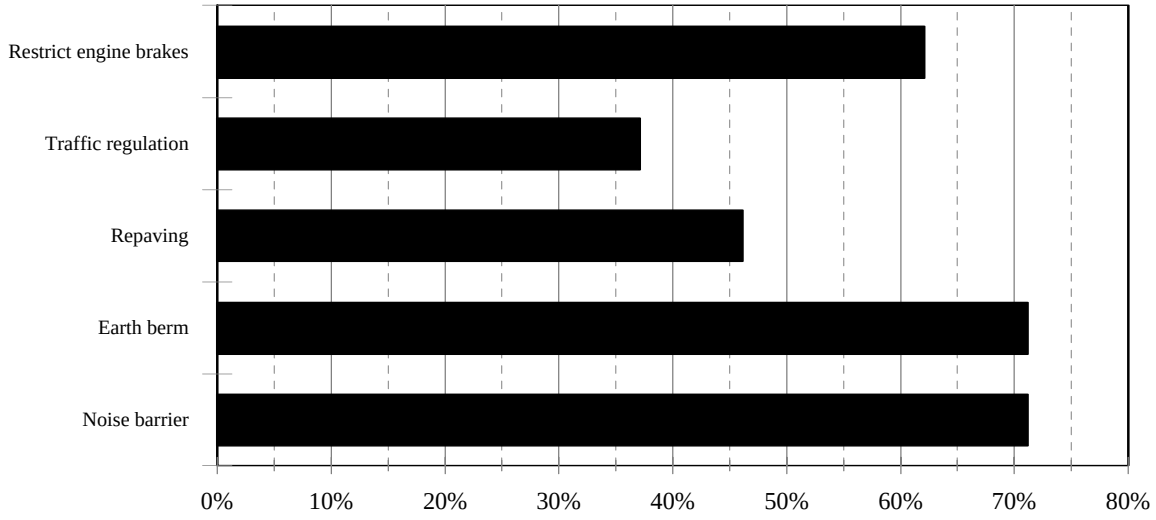
Q17: How acceptable to you would the following methods be for reducing noise at your residence from traffic on the main road?
All Areas



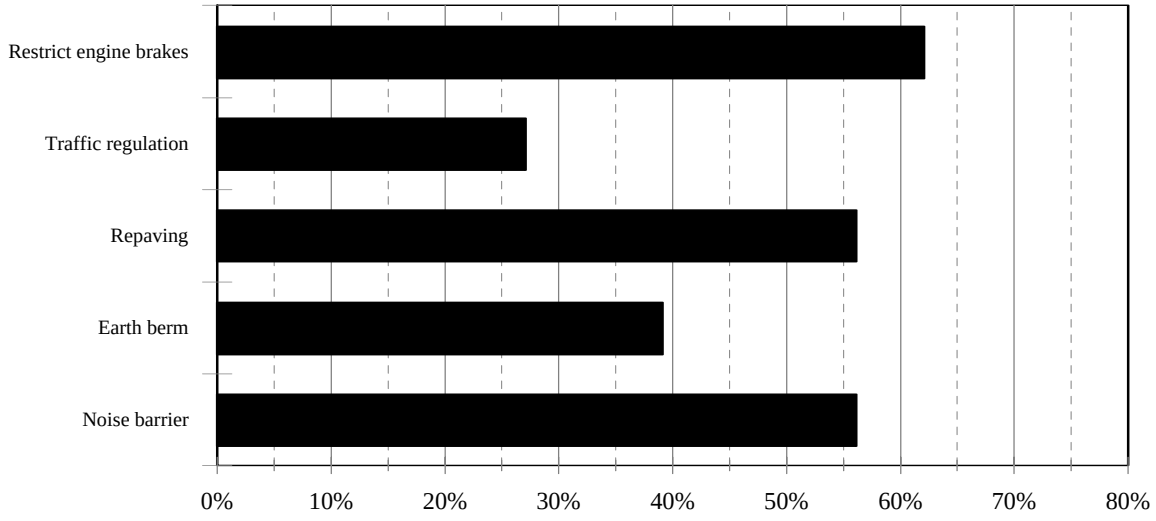
Q17: How acceptable to you would the following methods be for reducing noise at your residence from traffic on the main road?
Great Falls



Q17: How acceptable to you would the following methods be for reducing noise at your residence from traffic on the main road?
Missoula

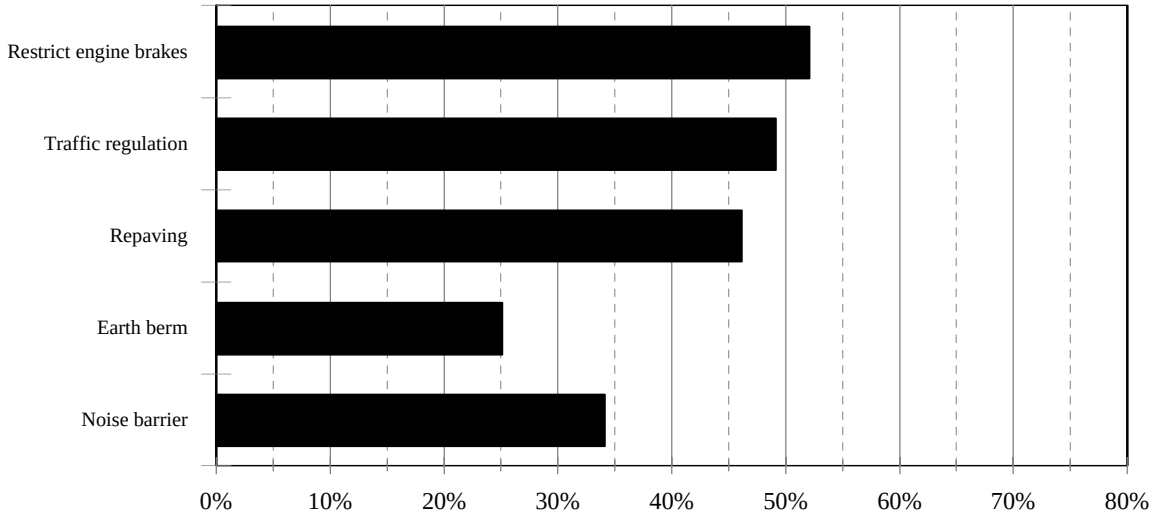


Q17: How acceptable to you would the following methods be for reducing noise at your residence from traffic on the main road?
Butte



Q17: How acceptable to you would the following methods be for reducing noise at your residence from traffic on the main road?

Billings



Q17: Other Suggested Acceptable Traffic Noise Reduction Methods for Current Residence

Great Falls
Enforce use of jake brakes; larger & more lighted signs banning engine compression
Evergreen trees
Motorcycles, especially noisy
No straight pipes for exhaust
Missoula
Concrete noise barrier on I-90; trees/noise barrier; something that would create a visual wall & neighborhood feeling like a neighborhood; use aesthetic noise barriers - e.g., Alaska
Remove highway; underground tunnel for I-90
Require mufflers on all vehicles
Under 50 mph for all trucks
Boom boxes
Butte
Jake brakes: are illegal but still used; the sign on jake brakes is a joke - highway patrol needs to stop them; trucks ignore jake brakes [signs] especially in middle of night
Plant: evergreen trees, trees & shrubs; trees-pine, fir, etc.; tree barrier
Billings
Roadway improvements: 4th lane south to the freeway west of Zimmerman would eliminate traffic; make Rimrock double lane; more lanes, less bottleneck; divert traffic to other streets New highway to be wider & built with quieter pavements; traffic light at Rehberg & Rimrock; signal light at Zimmerman & Rimrock
Traffic operations: Too many vehicles on street, noisy trucks; large trucks don't belong on Zimmerman; no trucks on Shiloh; no trucks allowed now; reduce truck traffic; motorcycles; restrict motorcycles; restrict jake breaks especially on top of rims
Enforcement: Enforce speed limit at night; law enforcement; enforce city ordinance for loud motorcycles; better enforcement of music and muffler laws; need officer to give citations; give tickets to loud boom boxes; car stereo restrictions; outlaw loud car stereos
Other: Plant trees as barrier; planting of trees; tree barriers; plant bushes on street line; airplanes

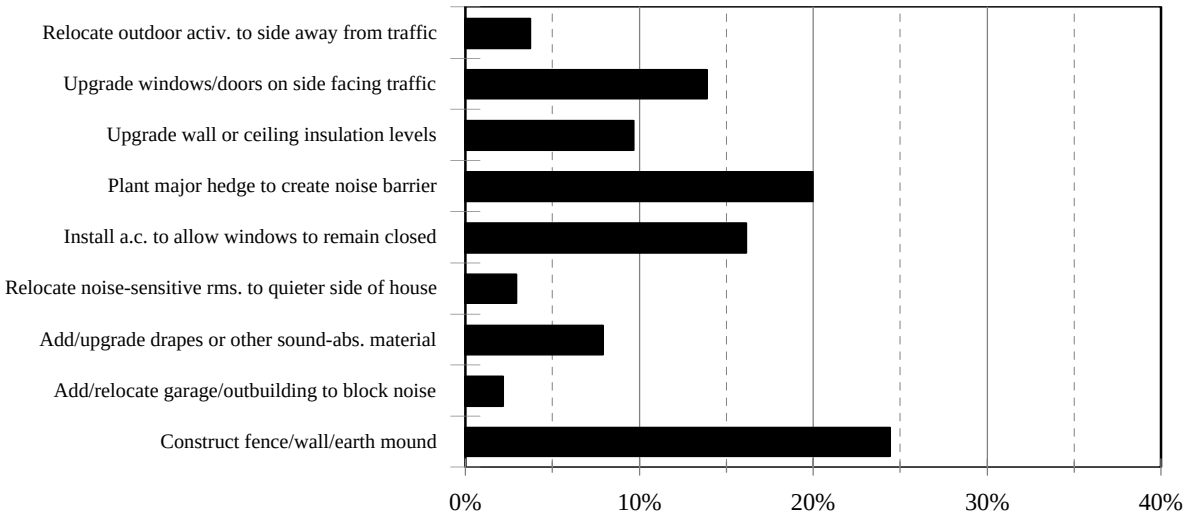
Q18: Which of the following improvements to your residence area do you believe would noticeably reduce traffic noise?

	Responses				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Construct fence, wall or earth mound	153	21	23	50	59
Add or relocate garage or outbuilding to block noise	13	0	3	1	9
Add or upgrade drapes or other sound-absorbing material	49	6	7	17	19
Relocate more noise-sensitive rooms to quieter side of house	18	0	2	5	11
Install air conditioning to allow windows to remain closed	101	15	13	33	40
Plant major hedge to create noise barrier	125	12	20	34	59
Upgrade wall or ceiling insulation levels	60	4	14	10	32
Upgrade windows or doors on side facing traffic	87	10	17	20	40
Relocate outdoor activity area to side facing away from traffic	23	3	4	1	15
Other	17	3	1	3	11

	Percentages				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Construct fence/wall/earth mound	24.4%	23.3%	33.8%	34.0%	18.3%
Add/relocate garage/outbuilding to block noise	2.1%	0.0%	4.4%	0.7%	2.8%
Add/upgrade drapes or other sound-abs. material	7.8%	6.7%	10.3%	11.6%	5.9%
Relocate noise-sensitive rms. to quieter side of house	2.9%	0.0%	2.9%	3.4%	3.4%
Install a.c. to allow windows to remain closed	16.1%	16.7%	19.1%	22.4%	12.4%
Plant major hedge to create noise barrier	19.9%	13.3%	29.4%	23.1%	18.3%
Upgrade wall or ceiling insulation levels	9.6%	4.4%	20.6%	6.8%	9.9%
Upgrade windows/doors on side facing traffic	13.9%	11.1%	25.0%	13.6%	12.4%
Relocate outdoor activ. to side away from traffic	3.7%	3.3%	5.9%	0.7%	4.7%
Other	2.7%	3.3%	1.5%	2.0%	3.4%

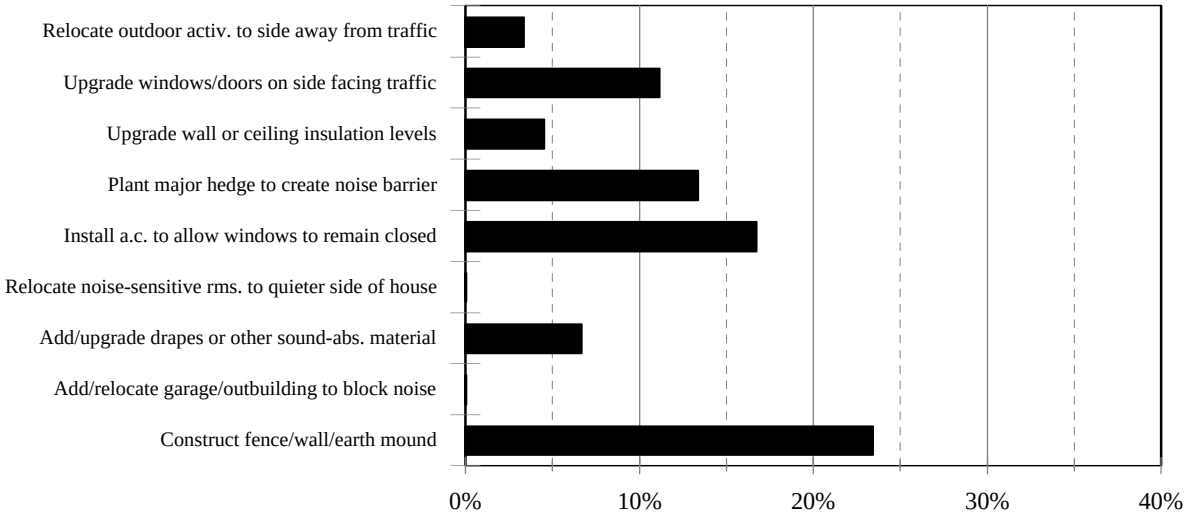
Q18: Which of the following improvements to your residence area do you believe would noticeably reduce traffic noise?

All Areas



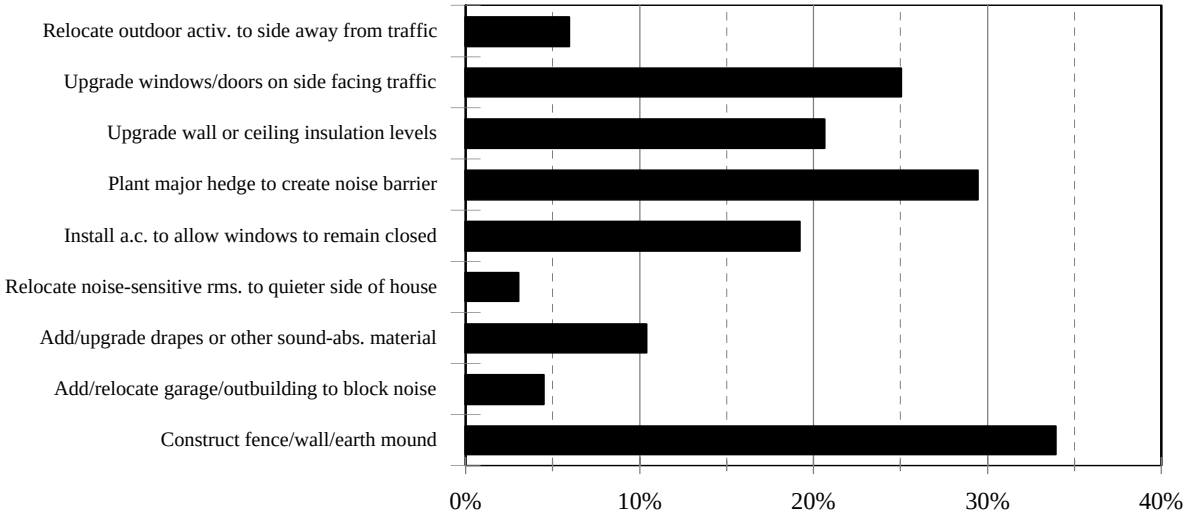
Q18: Which of the following improvements to your residence area do you believe would noticeably reduce traffic noise?

Great Falls



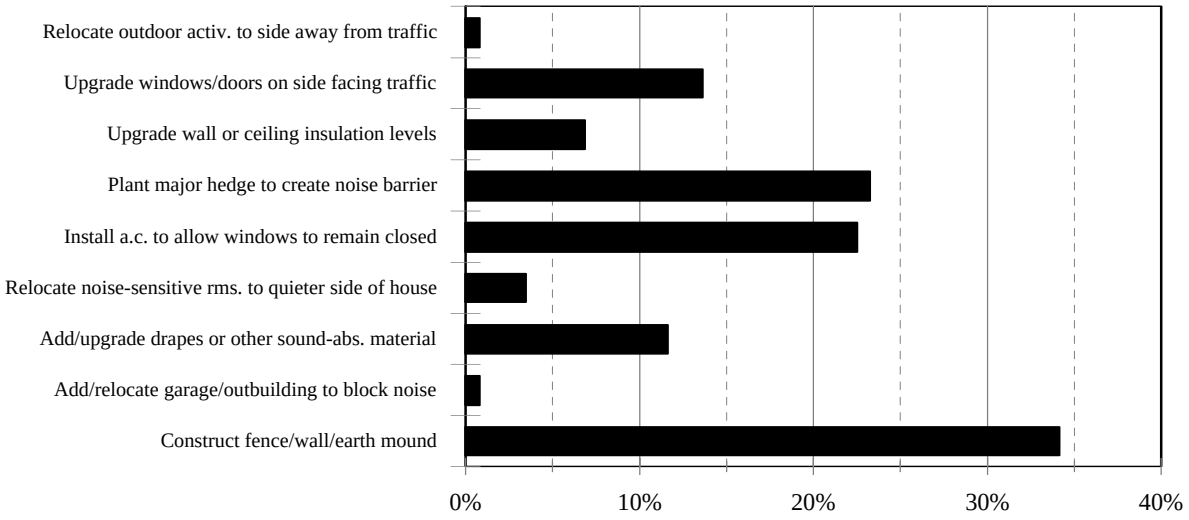
Q18: Which of the following improvements to your residence area do you believe would noticeably reduce traffic noise?

Missoula



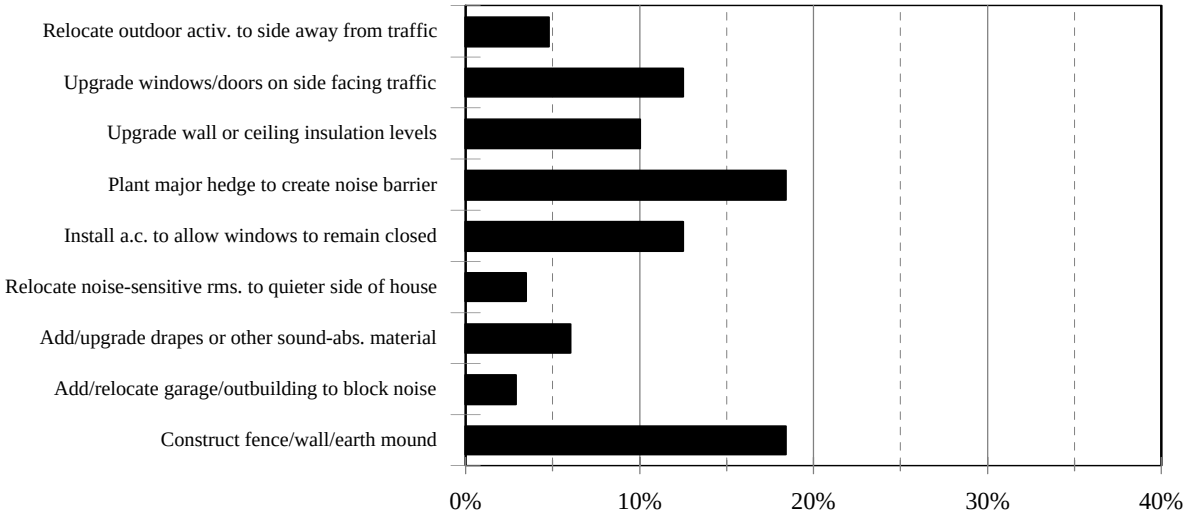
Q18: Which of the following improvements to your residence area do you believe would noticeably reduce traffic noise?

Butte



Q18: Which of the following improvements to your residence area do you believe would noticeably reduce traffic noise?

Billings

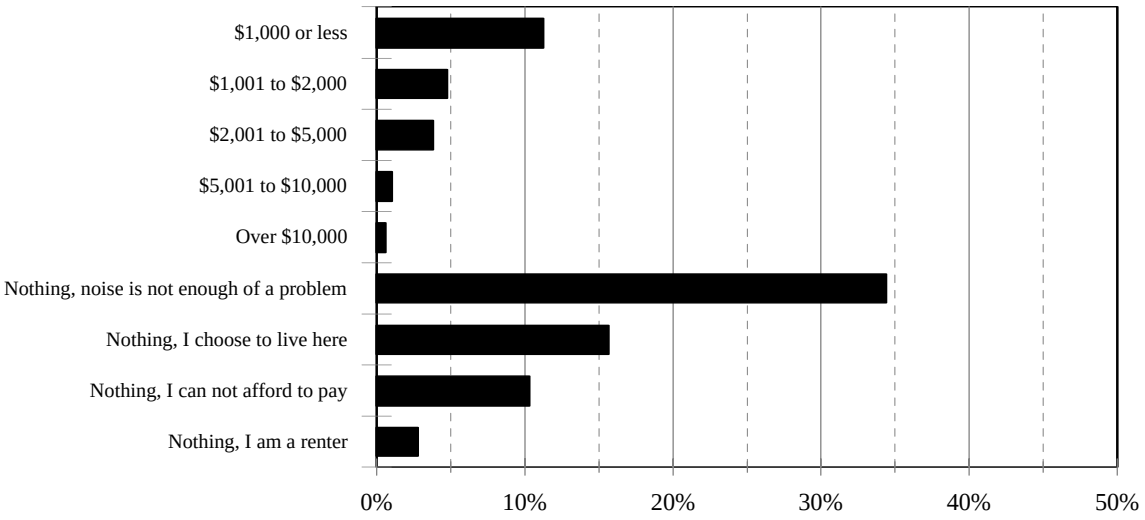


Q19: How much would you be willing to pay to reduce noise noticeably at your residence from traffic on the main road?

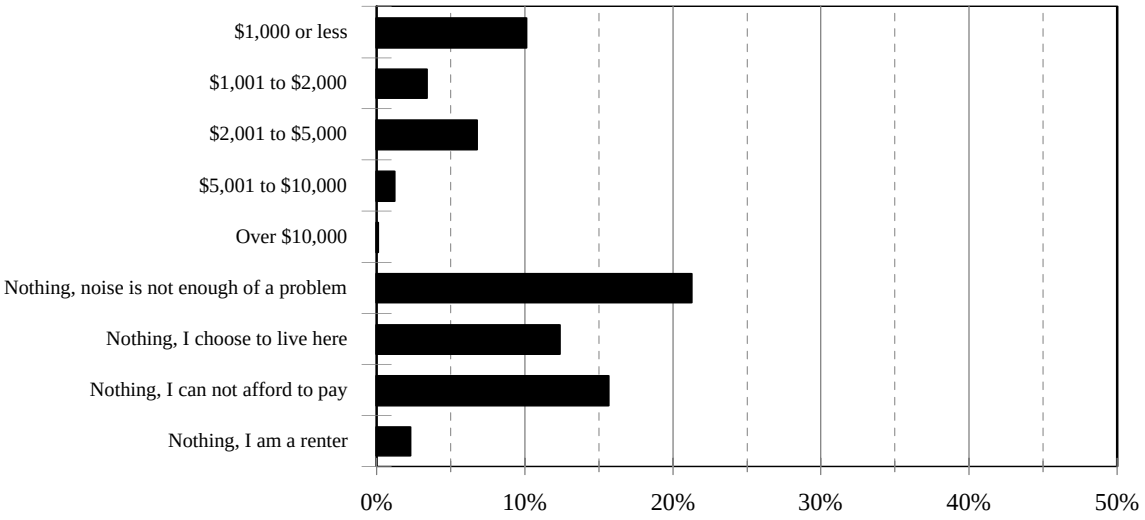
	Responses				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	61	14	4	11	32
$1,000 or less	70	9	13	20	28
$1,001 to $2,000	29	3	6	7	13
$2,001 to $5,000	23	6	0	6	11
$5,001 to $10,000	6	1	1	3	1
Over $10,000	3	0	1	1	1
Nothing, I can not afford to pay	64	14	15	15	20
Nothing, noise is not enough of a problem	215	19	9	38	149
Nothing, I am a renter	17	2	8	4	3
Nothing, I choose to live here	98	11	10	34	42
Other	40	10	1	7	22
Total Responses	***627***	***90***	***68***	***147***	***322***

	Percentages				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	9.7%	15.6%	5.9%	7.5%	9.9%
$1,000 or less	11.2%	10.0%	19.1%	13.6%	8.7%
$1,001 to $2,000	4.6%	3.3%	8.8%	4.8%	4.0%
$2,001 to $5,000	3.7%	6.7%	0.0%	4.1%	3.4%
$5,001 to $10,000	1.0%	1.1%	1.5%	2.0%	0.3%
Over $10,000	0.5%	0.0%	1.5%	0.7%	0.3%
Nothing, I can not afford to pay	10.2%	15.6%	22.1%	10.2%	6.2%
Nothing, noise is not enough of a problem	34.3%	21.1%	13.2%	25.9%	46.3%
Nothing, I am a renter	2.7%	2.2%	11.8%	2.7%	0.9%
Nothing, I choose to live here	15.6%	12.2%	14.7%	23.1%	13.0%
Other	6.4%	11.1%	1.5%	4.8%	6.8%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q19: How much would you be willing to pay to reduce noise noticeably at your residence from traffic on the main road?
All Areas

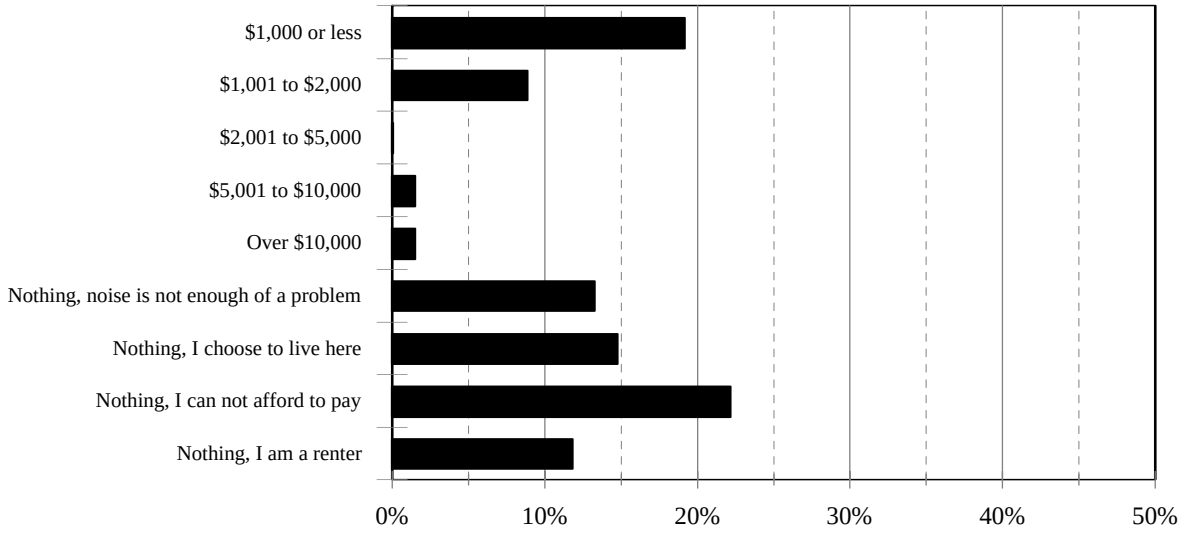


Q19: How much would you be willing to pay to reduce noise noticeably at your residence from traffic on the main road?
Great Falls



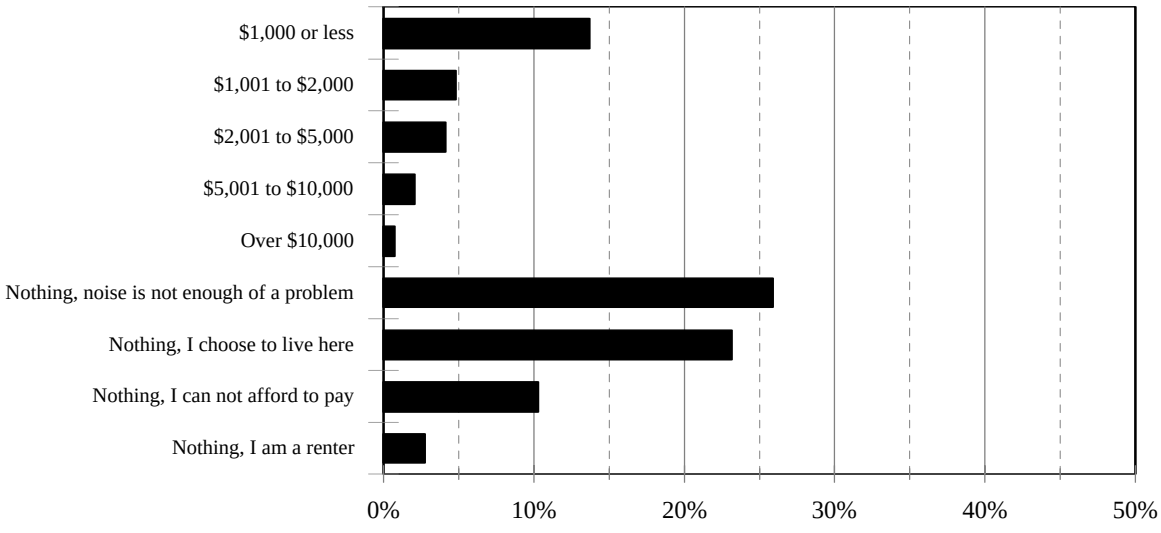
Q19: How much would you be willing to pay to reduce noise noticeably at your residence from traffic on the main road?

Missoula



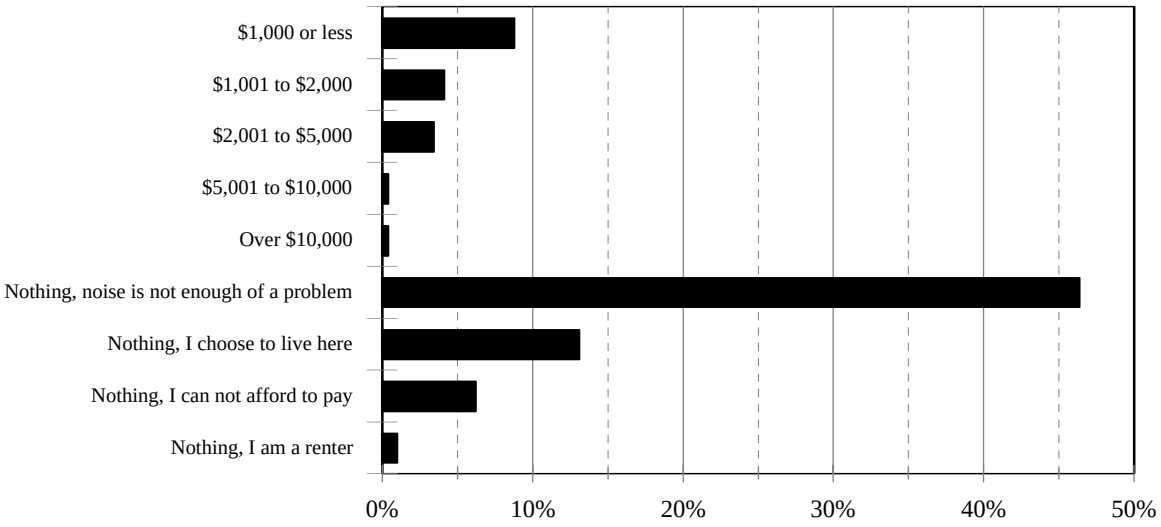
Q19: How much would you be willing to pay to reduce noise noticeably at your residence from traffic on the main road?

Butte



Q19: How much would you be willing to pay to reduce noise noticeably at your residence from traffic on the main road?

Billings

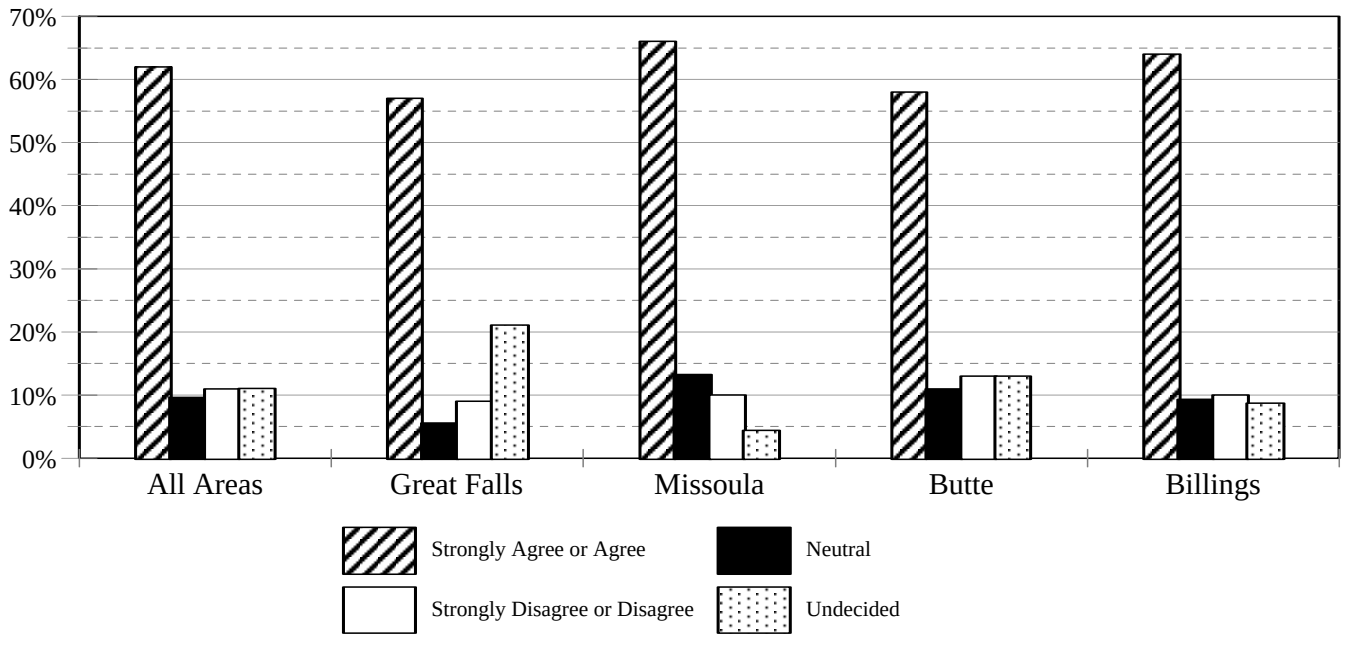


Q20: Assume a developer wants to build residences on undeveloped land next to a major roadway. Do you agree or disagree that the city or county should require the developer to take action to reduce excessive traffic noise levels in the development or inside the residences?

	Responses				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	43	7	4	7	25
Strongly Agree	206	27	29	41	109
Agree	183	24	16	45	98
Neutral	60	5	9	16	30
Disagree	44	7	4	12	21
Strongly Agree	22	1	3	7	11
Undecided	69	19	3	19	28
Total Responses	***627***	***90***	***68***	***147***	***322***

	Percentages				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	6.9%	7.8%	5.9%	4.8%	7.8%
Strongly Agree	32.9%	30.0%	42.6%	27.9%	33.9%
Agree	29.2%	26.7%	23.5%	30.6%	30.4%
Neutral	9.6%	5.6%	13.2%	10.9%	9.3%
Disagree	7.0%	7.8%	5.9%	8.2%	6.5%
Strongly Agree	3.5%	1.1%	4.4%	4.8%	3.4%
Undecided	11.0%	21.1%	4.4%	12.9%	8.7%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q20: Do you agree that the city or county should require a developer building houses on undeveloped land next to a major roadway to reduce excessive traffic noise levels?



Q21: If you were buying a new home in a new development that was being built along a busy road or highway, which of the following actions would you favor or oppose for reducing the traffic noise effects in your yard (or common area) or inside your residence?

	Provide open/vegetated space between road & residences	*Build on deep lots - homes will be far from road*	*Build noise barrier between road & residences*	*Build earth berm between road & residences*	*Design subdivision: areas least sensitive closest to road*	*Lots/residences: areas least sensitive face away from road*	*Use windows/doors that were more sound-insulating*	*Include non-residential bldngs/land uses closest to road*	*Other*
All Areas	***Responses***								
Missing	111	124	101	143	98	102	113	153	600
Strongly favor	222	138	199	127	177	181	186	115	2
Favor	177	191	154	148	246	250	222	148	0
Neutral	66	120	92	110	75	65	78	99	1
Opposed	19	21	48	55	8	5	6	56	1
Strongly opposed	4	5	10	15	2	5	4	28	0
Undecided	28	28	23	29	21	19	18	28	0
Total	***627***	***627***	***627***	***627***	***627***	***627***	***627***	***627***	***604***

All Areas	***Percentages***								
Missing	17.7%	19.8%	16.1%	22.8%	15.6%	16.3%	18.0%	24.4%	99.3%
Very Good	35.4%	22.0%	31.7%	20.3%	28.2%	28.9%	29.7%	18.3%	0.3%
Good	28.2%	30.5%	24.6%	23.6%	39.2%	39.9%	35.4%	23.6%	0.0%
Fair	10.5%	19.1%	14.7%	17.5%	12.0%	10.4%	12.4%	15.8%	0.2%
Poor	3.0%	3.3%	7.7%	8.8%	1.3%	0.8%	1.0%	8.9%	0.2%
Very Poor	0.6%	0.8%	1.6%	2.4%	0.3%	0.8%	0.6%	4.5%	0.0%
Does Not Apply	4.5%	4.5%	3.7%	4.6%	3.3%	3.0%	2.9%	4.5%	0.0%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q21: If you were buying a new home in a new development that was being built along a busy road or highway, which of the following actions would you favor or oppose for reducing the traffic noise effects in your yard (or common area) or inside your residence?

	Provide open/vegetated space between road & residences	*Build on deep lots - homes will be far from road*	*Build noise barrier between road & residences*	*Build earth berm between road & residences*	*Design subdivision: areas least sensitive closest to road*	*Lots/residences: areas least sensitive face away from road*	*Use windows/doors that were more sound-insulating*	*Include non-residential buildings/land uses closest to road*	*Other*
Great Falls	***Responses***								
Missing	25	27	17	29	19	20	21	26	89
Strongly favor	16	8	37	15	17	20	26	18	1
Favor	29	24	16	18	34	35	26	23	0
Neutral	9	18	7	10	10	10	13	12	0
Opposed	6	3	7	8	4	1	2	5	0
Strongly opposed	0	1	2	2	0	2	0	1	0
Undecided	5	9	4	8	6	2	2	5	0
Total	***90***	***90***	***90***	***90***	***90***	***90***	***90***	***90***	***90***

Great Falls	***Percentages***								
Missing	27.8%	30.0%	18.9%	32.2%	21.1%	22.2%	23.3%	28.9%	98.9%
Very Good	17.8%	8.9%	41.1%	16.7%	18.9%	22.2%	28.9%	20.0%	1.1%
Good	32.2%	26.7%	17.8%	20.0%	37.8%	38.9%	28.9%	25.6%	0.0%
Fair	10.0%	20.0%	7.8%	11.1%	11.1%	11.1%	14.4%	13.3%	0.0%
Poor	6.7%	3.3%	7.8%	8.9%	4.4%	1.1%	2.2%	5.6%	0.0%
Very Poor	0.0%	1.1%	2.2%	2.2%	0.0%	2.2%	0.0%	1.1%	0.0%
Does Not Apply	5.6%	10.0%	4.4%	8.9%	6.7%	2.2%	2.2%	5.6%	0.0%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q21: If you were buying a new home in a new development that was being built along a busy road or highway, which of the following actions would you favor or oppose for reducing the traffic noise effects in your yard (or common area) or inside your residence?

	Provide open/vegetated space between road & residences	*Build on deep lots - homes will be far from road*	*Build noise barrier between road & residences*	*Build earth berm between road & residences*	*Design subdivision: areas least sensitive closest to road*	*Lots/residences: areas least sensitive face away from road*	*Use windows/doors that were more sound-insulating*	*Include non-residential buildings/land uses closest to road*	*Other*
Missoula	***Responses***								
Missing	11	11	6	10	7	9	9	12	65
Strongly favor	27	15	28	23	22	18	21	17	1
Favor	19	25	18	20	29	32	28	22	0
Neutral	5	11	10	8	8	6	6	13	0
Opposed	4	4	5	3	1	2	3	3	0
Strongly opposed	1	1	1	2	0	1	1	1	0
Undecided	1	1	0	2	1	0	0	0	0
Total	***68***	***68***	***68***	***68***	***68***	***68***	***68***	***68***	***66***

Missoula	***Percentages***								
Missing	16.2%	16.2%	8.8%	14.7%	10.3%	13.2%	13.2%	17.6%	98.5%
Very Good	39.7%	22.1%	41.2%	33.8%	32.4%	26.5%	30.9%	25.0%	1.5%
Good	27.9%	36.8%	26.5%	29.4%	42.6%	47.1%	41.2%	32.4%	0.0%
Fair	7.4%	16.2%	14.7%	11.8%	11.8%	8.8%	8.8%	19.1%	0.0%
Poor	5.9%	5.9%	7.4%	4.4%	1.5%	2.9%	4.4%	4.4%	0.0%
Very Poor	1.5%	1.5%	1.5%	2.9%	0.0%	1.5%	1.5%	1.5%	0.0%
Does Not Apply	1.5%	1.5%	0.0%	2.9%	1.5%	0.0%	0.0%	0.0%	0.0%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q21: If you were buying a new home in a new development that was being built along a busy road or highway, which of the following actions would you favor or oppose for reducing the traffic noise effects in your yard (or common area) or inside your residence?

Butte	***Provide open/vegetated space between road & residences***	***Build on deep lots - homes will be far from road***	***Build noise barrier between road & residences***	***Build earth berm between road & residences***	***Design subdivision: areas least sensitive closest to road***	***Lots/residences: areas least sensitive face away from road***	***Use windows/doors that were more sound-insulating***	***Include non-residential buildings/land uses closest to road***	***Other***
	Responses								
Missing	29	29	26	35	26	24	30	41	141
Strongly favor	41	28	50	31	40	43	42	29	1
Favor	38	46	33	26	52	54	49	34	0
Neutral	23	32	21	32	21	17	16	19	1
Opposed	5	5	6	9	2	1	1	11	0
Strongly opposed	2	0	3	5	0	0	1	3	0
Undecided	9	7	8	9	6	8	8	10	0
Total	***147***	***147***	***147***	***147***	***147***	***147***	***147***	***147***	***143***

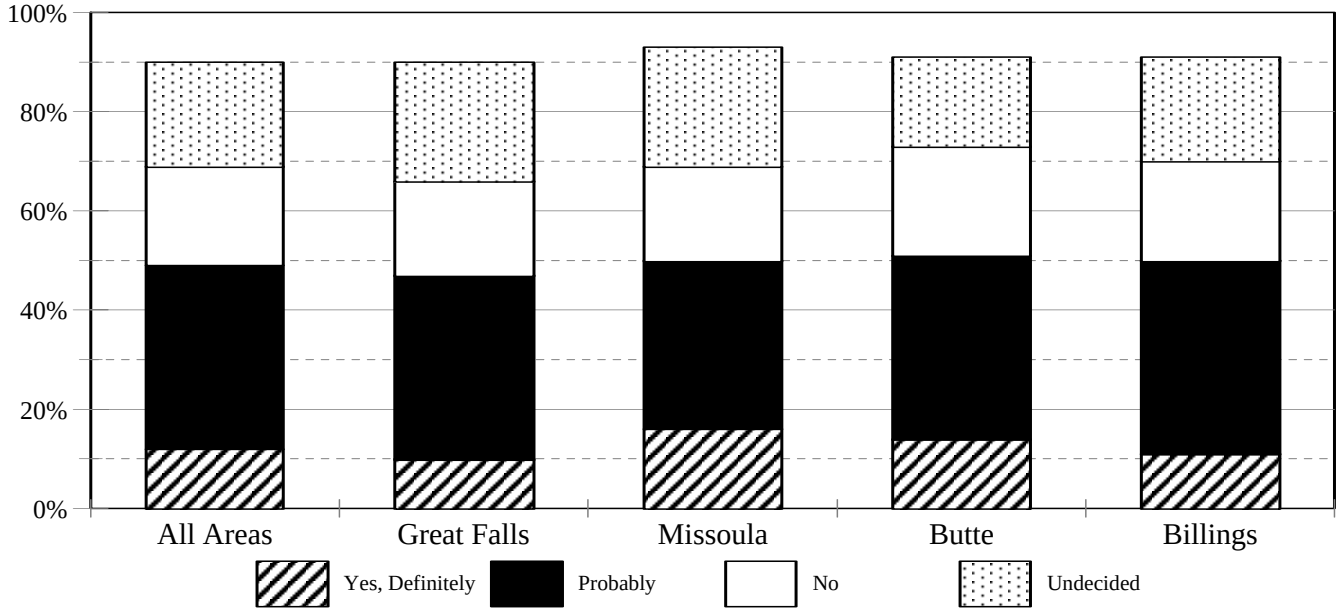
Butte	***Percentages***								
Missing	19.7%	19.7%	17.7%	23.8%	17.7%	16.3%	20.4%	27.9%	98.6%
Very Good	27.9%	19.0%	34.0%	21.1%	27.2%	29.3%	28.6%	19.7%	0.7%
Good	25.9%	31.3%	22.4%	17.7%	35.4%	36.7%	33.3%	23.1%	0.0%
Fair	15.6%	21.8%	14.3%	21.8%	14.3%	11.6%	10.9%	12.9%	0.7%
Poor	3.4%	3.4%	4.1%	6.1%	1.4%	0.7%	0.7%	7.5%	0.0%
Very Poor	1.4%	0.0%	2.0%	3.4%	0.0%	0.0%	0.7%	2.0%	0.0%
Does Not Apply	6.1%	4.8%	5.4%	6.1%	4.1%	5.4%	5.4%	6.8%	0.0%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q22: Would you be willing to pay more for a new house next to a highway, if the house or neighborhood were designed to reduce the traffic noise effects?

	Responses				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	61	9	5	14	33
Yes, Definitely	75	9	11	20	35
Probably	235	33	23	55	124
Undecided	130	22	16	26	66
No	126	17	13	32	64
Total Responses	***627***	***90***	***68***	***147***	***322***

	Percentages				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Missing	9.7%	10.0%	7.4%	9.5%	10.2%
Yes, Definitely	12.0%	10.0%	16.2%	13.6%	10.9%
Probably	37.5%	36.7%	33.8%	37.4%	38.5%
Undecided	20.7%	24.4%	23.5%	17.7%	20.5%
No	20.1%	18.9%	19.1%	21.8%	19.9%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Q22: Would you be willing to pay more for a new house next to a highway, if the house or neighborhood were designed to reduce the traffic noise effects?

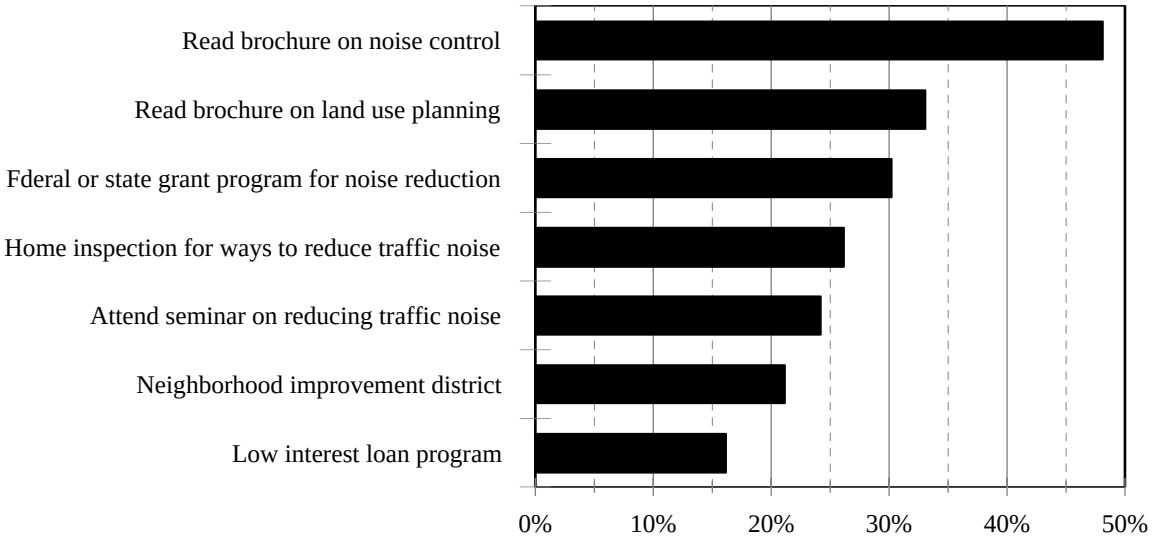


Q23: Please check whether you would participate in any of the following programs aimed at helping to reduce traffic noise at your home site.

	Responses				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Read brochure on traffic noise control for residences	300	32	42	82	144
Read brochure on land use planning near a noisy roadway	204	20	34	52	98
Attend seminar on ways to reduce traffic noise at your home site	149	21	20	46	62
Allow home inspection to identify ways to reduce traffic noise at your home site	164	21	26	53	64
Participate in low interest loan program for reducing traffic noise impacts at your home site	99	9	14	35	41
Participate in federal or state grant program for reducing traffic noise impacts at your home site	190	28	31	60	71
Vote for neighborhood improvement district to pay to reduce traffic noise in your residential area	134	19	24	43	48
Other	70	3	16	3	48

	Percentages				
	All Areas	***Great Falls***	***Missoula***	***Butte***	***Billings***
Read brochure on traffic noise control for residences	47.8%	35.6%	61.8%	55.8%	44.7%
Read brochure on land use planning near a noisy roadway	32.5%	22.2%	50.0%	35.4%	30.4%
Attend seminar on ways to reduce traffic noise at your home site	23.8%	23.3%	29.4%	31.3%	19.3%
Allow home inspection to identify ways to reduce traffic noise at your home site	26.2%	23.3%	38.2%	36.1%	19.9%
Participate in low interest loan program for reducing traffic noise impacts at your home site	15.8%	10.0%	20.6%	23.8%	12.7%
Participate in federal or state grant program for reducing traffic noise impacts at your home site	30.3%	31.1%	45.6%	40.8%	22.0%
Vote for neighborhood improvement district to pay to reduce traffic noise in your residential area	21.4%	21.1%	35.3%	29.3%	14.9%
Other	11.2%	3.3%	23.5%	2.0%	14.9%

Q23: Would you participate in any of the following programs aimed at helping to reduce traffic noise at your home site?
All Areas



Q23: Additional Comments on Interest in Participating in Traffic Noise Reduction Programs

Great Falls
In all major metropolitan areas we see sound walls, so why not here? The highway has become busier and addition of exits since we built here, plus the concrete added three-fold to the noise level.
We were here first.
Eliminate jake brakes.
Missoula
I assume the real purpose of this questionnaire is #20.
I feel trains need to be in the mix. Some engineers like their air horns more than others.
I find the idea of closing our windows and installing air conditioners very disturbing.
I really don't care about the noise as I'm young and don't yet own a home.
I'm disappointed that no actions are being considered for our neighborhood.
I've lived her for 54 years before I-90. Noise doesn't bother me.
I-90 noise is not nearly as irritating as the increased traffic because once single-family houses are now occupied by 406 students all with cars or pick-up trucks.
Please build a sound barrier on I-90 requiring trucks to go under 50 mph, that's the only way we'll get peace.
Please put up a barrier. There are environmental concerns with pollution and noise.
Primary problem created by I-90. Significant noise during university football games from stadium/ increased use by emergency vehicles.
The Van Buren area has a high noise level due to its proximity to I-90 and the railroad.
Van Buren has become much worse in last 10 yrs.
Van Buren is much noisier than I-90.
We feel the worst noise is the train at 3 a.m., car stereos and noisy motorcycles.
Reduce speed limit on Interstate for 1/2 mile on each side of town to 55 would reduce noise.
Trains are much louder than traffic noise.
Word annoyed was too strong.
Butte
There is no noise problem.
Plant trees around highway south of 15/90.
Too old to participate in programs.
Why should we pay for situation we didn't cause?
Billings
Airport noise is more bothersome, especially at night.
At 83 I am happy to have the home and neighbors I have.
At this time I see traffic noise as a problem further west of our neighborhood.
Do not anticipate any noise problems from Rimrock Rd or construction in the area..
How much has this survey cost taxpayers?
I don't have a problem of noise from Rimrock.
I had new windows installed so noise is less.
I have lived in my home for 40 yrs and there was no traffic to speak of on Rimrock 40 yrs ago.
I have no problem with noise.
I live directly under Zimmerman Trail and the noise from it is a problem.

I view noise as a modern day occurrence. I enjoy hearing people drive their autos and enjoy life.
I would appreciate the ban on fireworks being enforced. The noise is annoying but the fire hazard is even worse since the roofs are cedar shake.
It [school island] was put in this spring. Only a few children live above Rimrock and don't use the island. A waste of taxpayer's money and a big irritant to me.
Jake breaks should not be allowed in city limits. Fisher water trucks use jake breaks 100% of all trips on Rimrock.
Keep trucks off Zimmerman Trail & Rimrock.
Kids scream at day care center on Augusta.
Most of the noise is worse in summer.
Move.
No jake breaks. Put up a sign. We have no freeways yet, that's when the noise begins.
Quite happy with location & lack of noise.
Rimrock Rd is not a real problem but we live on Zimmerman Trail, which is very very noisy. I feel it is extremely dangerous to allow trucks on Zimmerman. We are considering on moving because of it.
Since I don't live on Rimrock I do not have a problem with traffic.
Speed limit needs to be enforced on Arlene St. No one obeys 25mph, not even police.
We are 2 blocks west of Zimmerman Trail, 2 blocks north of Rimrock. Most noise comes from Zimmerman with trucks and breaks. None from Rimrock.
We are happy clams.
We get more noise from Highway 3 above the rims than Rimrock.
We live on Fairway Dr, which does not have a noise problem. Homes on Green Terrace have a big problem.
Zimmerman Trail has more noise & trucks than Rimrock.
Zimmerman trail is a bigger noisemaker for us than Rimrock Rd. Sirens are biggest culprit on Rimrock. Jake breaks and motorcycles on Zimmerman are a problem.
Airport noise is greater than Rimrock Rd.
Better planning.
Noise from small planes coming low over Rimrock is very bad, why aren't they subject to same restrictions as commercial planes?
Not an issue for us.
Not purchase home in this area or sell & buy elsewhere noise is a problem.
Please remember the seniors on social security trying to keep their homes.
Probably not buy if noise was an issue.
Quiet asphalt as a standard city spec for pavements.
Solid fencing on south side of street reflects/bounces all traffic noise to the north side.
Sometimes motorcycle racing on Rimrock at all hrs is annoying.
Traffic needs to be slowed down. Need to eliminate trucks hauling construction materials.
Traffic noise from Rimrock Rd not that bad!
We hate boom boxes and wish there was an enforcement against them in residential areas.

Q24: Additional comments on any aspects of the survey or the subject.

Great Falls
A by-pass would solve the problem in this area.
A good start would be to have current laws that are posted, enforced. I've recently called State, County and City cops and received no action.
Family moved to area 1884-- when there were no noise problems.
Be careful where you by a home. Design homes so living are is away from St.
Said they had no complaints.
Eliminate trucks with jake brakes & no mufflers.
I believe the law should step in and do something with the boom boxes.
Jake brakes is the major & probably the only problem on 10th Ave S.
New casino & gas station louder than t-noise.
No problems at this time.
Noise problem exists in my yard and home, also emissions from exhaust. I was here since 1964 and did not create the problem. The highway dept. did and it should have been addressed during construction.
None of solutions will work-- tired of noise impacts.
On Country Club Rd there is a sign (no engine brakes) that trucks do not abide by. Need to police this area.
Regular road noise is acceptable. It is the jake brakes that are horrible.
Speed, noisy mufflers, cycles, boom boxes are my biggest complaint.
Start ticketing jake brake users. Noise check Harley-Davidson and ot.her motorcycles
The airport noise is our only issue, especially early in the morning when the planes are first started up.
The government, state or federal should provide a wall for noise barriers, as is the case in all other states, through grant money because this development is already established.
The noise is much worse now with the concrete than it was with the oil.
The traffic from I-15 does not bother me. The noise from aircraft, fire trucks, and the business area are sometimes annoying in the early morning and evening.
There's hardly any traffic noise here except stupid boom boom music.
Traffic increased when Market Place exchange was added. The appearance of this road has deteriorated since the exchange was added.
When can the university addition between 15-1752 SW & 16-18th Ave SW get paved?
When the highway was built we asked for some barrier and we were ignored.
When the state rebuilt Country Club Blvd they didn't take into consideration the noise the tires would cause against the cut in the concrete. Other states which have similar roads in residential areas have built sound walls.
Missoula
Ban jake brakes and enforce it.
Butte
Don't use cement roads around neighborhoods close to highways.
I have lived here for 25 yrs. Why is it so important now????
I knew the noise would be bothersome when I built my house. There were no other land options I could afford at the time.
I would never buy again next to a busy highway. Traffic noise has been much louder since the concrete pavement was re-done in the 80's. Asphalt would be much quieter.

If my taxes go up because some meathead bought or built a house by the interstate and doesn't like the noise, I would seek legal action.
Jake brakes are illegal but still used.
Jake brakes signs already present, but ignored.
Jake brakes, loud semi engines, all vehicles with loud engines should definitely be outlawed both during day & night. I can't hear TV or talk on the phone.
Noise doesn't bother me much and we're right across from I-90 & I-15.
None of these are feasible for my area.
Please add noise wall to block noise.
Some of the nicest housing in Butte is located in this noisy interstate area. There should be a sound reducing wall built along the south side of the interstate to further improve one of the better housing areas in Butte.
The truckers seem to like using jake brakes during nighttime hours in our area. You don't hear them during the daytime.
There are "no jake brakes" warning signs near our residence & the truckers use their jake brakes right after they see the sign.
This is a highway dept. problem.
Traffic in general is okay. However, the truckers are very inconsiderate. They know they are in residential areas yet still use jake brakes Enforcing the use of jake brakes wouldn't cost us anything.
We already made improvements to reduce noise, however, they do not totally reduce the noise level. Sometimes it's hard to carry on a conversation.
We are retired and traffic is not a problem.
Would not buy.
Billings
Annoyance & tolerance are subjective.
Built house in 1956, when we were last house north side of Rimrock Rd.
I notice more road noise at night in the summer (windows open). I believe, but am not certain that it is from the highway on top of the Rimrocks, not Rimrock Rd.
I would not purchase a home next to a highway.
Jake breaks a very bad problem.
Lots of traffic on Rimrock Rd.
Loud music from cars very annoying.
Most annoyed by traffic exceeding speed limit.
No New Taxes.
Noise not a problem.
Over the years, the traffic on Poly, Rehberg & Rimrock has increased tremendously with the growth of the Westend. It will only get worse if something isn't done.
Patrol Rimrock more.
Please cont. improvement from N27th-17thSt.W.
Something has to be done with Zimmerman Trail.
Something needs to be done about Zimmerman Trail. Is really noisy. Trucks should be banned.
The park closest to us is across Rimrock. I'm uncomfortable with crossing with young children. Our dog was hit by a van on Rimrock & killed this July.
The problem is not Rimrock Rd but Shiloh Rd. Shiloh should not be a truck route. Shilo Rd causes Rimrock Rd to be a truck route also. Zimmerman Trail is the problem.
The use of jake breaks on the trucks using airport road (Hwy 3) above the rims should not be allowed. They are a great annoyance.

Waits at Rimrock lights is too long @ peaks.
We are not as near to the Rimrock as some of our neighbors, but are far enough up the hill that we rarely hear traffic noise.
We are very happy where we are.
When cars & trucks hit the water connection in the street on north side of our house, makes a very banging noise.
With our location and present traffic levels, we have no noise from Rimrock.

APPENDIX D

ROADWAY SECTIONS WHERE TRAFFIC NOISE IS OR IS ANTICIPATED TO BECOME A PROBLEM FOR RESIDENTIAL AREAS

ROADWAY SECTIONS WHERE TRAFFIC NOISE IS OR IS ANTICIPATED TO BECOME A PROBLEM FOR RESIDENTIAL AREAS

Question 7: Highway or Main Roadway Section Causing Traffic Noise Impacts In Nearby Area Residences, as Reported in the Planners Survey

County	*City, or Nearest City or Town*	*Major Traffic Noise Impact Area*	*Minor Traffic Noise Impact Area*	*Noise Impact Area Developing within 10 Years*
Beaverhead	Dillon		I-15 near Dillon city limits	I-15 near Dillon city limits
Broadwater	Townsend	Hwy 287 thru Townsend	Hwy 12	
Cascade	Great Falls	I-315/Country Club Blvd.		St. Hwy 87-89-200 Near residences
Cascade	Great Falls	I-15	10th Ave S.	I-15 & Frontage roads near residences
Custer	Miles City	Hwy 59		
Fegus	Lewistown	Truck by-pass		
Fegus	Lewistown	US 87		
Flathead		US Hwy 2		
Flathead		US Hwy 93		
Flathead		US Hwy 2	US Hwy 2	US Hwy 2
Flathead	Kalispell			3rd Ave E-4th Ave one-way couplet
Flathead	Kalispell	Willow Glen (secondary)		Willow Glen (secondary)
Flathead	Whitefish	US Hwy 93		US Hwy 93
Gallatin	Belgrade	I-90 @ Belgrade		
Gallatin	Belgrade	Amsterdam Rd		
Gallatin	Belgrade	Jackrabbit Lane/I-90 overpass		
Gallatin	Belgrade/Bozeman	Jackrabbit Lane		
Gallatin	Belgrade/Bozeman	Jack Rabbit/Belgrade - 4Corners		
Gallatin	Belgrade/Bozeman	Frontage Road		

County	*City, or Nearest City or Town*	*Major Traffic Noise Impact Area*	*Minor Traffic Noise Impact Area*	*Noise Impact Area Developing within 10 Years*
		Belgrade/Bozeman		
Gallatin	Bozeman	N. 19th Avenue		
Gallatin	Bozeman	Willson Ave		
Gallatin	Bozeman	N. Rouse Avenue		
Gallatin	Bozeman	Main Street		Main Street
Gallatin	Bozeman	I-90 @ Bozeman		
Gallatin	Bozeman	19th Ave	I-90	N&S19th Ave
Gallatin	Bozeman	7th Avenue	I-90 @ Bozeman	I-90 @ Bozeman
Gallatin	Bozeman	Bridger Drive	Kagy Blvd	North 7th Ave
Gallatin	Bozeman	Durston Rd	Norris Rd	S 3rd Ave
Gallatin	Bozeman	Huffine Lane	N&S19th Ave	19th Ave
Gallatin	Bozeman	Hwy 10	South 11th Ave	Norris Rd- 4 Corners
Gallatin	Bozeman	Hwy 191	South 8th Ave	W. Main St/Hwy 191
Gallatin	Bozeman	Hwy 90	West Babcock	7th Avenue
Gallatin	Bozeman	Hwy191-4 Corners	W. Main St/Hwy 191	
Lake			Mt Hwy 212	
Lake			Mt Hwy 35	
Lake			US Hwy 93	
Lewis & Clark	Helena	I-15	US 12	Green Meadow Dr
Lewis & Clark	Helena	Custer	Main St/Cedar	I-15
Lewis & Clark	Helena	Broadway	Montana Ave	U-5802(Custer Ave)
Lewis & Clark	Helena	Benton Ave	Montana Ave	
Lewis & Clark	Helena	11th Ave.	Prospect	
Lewis & Clark	Helena	11th Ave.	Prospect & Fee	
Lewis & Clark	Helena	Railroad Corridor	Prospect & Montana	
Lewis & Clark	Helena	Montana Ave	Roberts	
Lewis & Clark	Helena	N. Benton	U-5809 (Montana Ave)	
Missoula	Missoula	SW Higgins/39th	Broadway St	39th
Missoula	Missoula	S 5thW & 6thW couplet	Brooks St	Miller Creek Rd
Missoula	Missoula	I-90 @ Missoula	Reserve Street	Broadway St
Missoula	Missoula	Hillview	Russell-3rd-Mount	Brooks St
Missoula	Missoula	All of I-90 Missoula	S 3rd W Higgins-Reserve	
Missoula	Missoula		Van Buren-Rattlesnake	

County	*City, or Nearest City or Town*	*Major Traffic Noise Impact Area*	*Minor Traffic Noise Impact Area*	*Noise Impact Area Developing within 10 Years*
Silver Bow	Butte		Amherst St	
Silver Bow	Butte		Excelsior St	
Silver Bow	Butte		I-15/90 corridor Harrison Ave E	
Silver Bow	Butte		I-15/90 corridor, especially near intersection of I-90/I-15	
Teton	Fairfield		Secondary 408 / Fairfield	
Teton	Fairfield		US Hwy 89 (no jake brakes)	
Yellowstone	Billings	I-90 @ Billings	Lewis Ave	Molt Hwy
Yellowstone	Billings	I-90 S. Billings & exit @ 27th	Molt Hwy	Bench Blvd.
Yellowstone	Billings	Grand E of 8thW	Broadwater	Shiloh Rd
Yellowstone	Billings		Governor's Blvd	Governor's Blvd
Yellowstone	Billings	Bench Blvd.	Governor's/Hilltop	S. Billings Blvd
Yellowstone	Billings	Zimmerman Trail	Hwy 3 - Airport to Z Trail	Hwy 3 - Airport to Z Trail
Yellowstone	Billings	Monad W of 27th St W	I-90 Jct w/ I-94: SE and NE quads	
Yellowstone	Billings	Rimrock Rd	Rimrock Road	
Yellowstone	Billings		S. Billings Blvd	
Yellowstone	Billings		Wicks Lane, E&W	Wicks Lane, E&W
Yellowstone	Laurel	Laurel Frontage Rd		
Yellowstone	Billings	Grand Ave Division - 8th		