Proactive Noise Avoidance and Mitigation Measures

Study SD2005-06-X
Executive Summary

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ACKNOWLEDGEMENTS

This work was performed under the supervision of the SD2005-06 Technical Panel.

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The work was performed in cooperation with the United States Department of Transportation Federal Highway Administration.
The focus of this research project is the mitigation and avoidance of highway noise through a program of shared responsibility between the South Dakota DOT and local governments. Its objectives are to equip the South Dakota DOT and local communities with education and tools to implement noise compatible land use planning; to recommend policies and guidelines for the South Dakota DOT to use to determine appropriate designs and roadway surfaces in noise sensitive areas; and to define performance measures to assess the effectiveness of the program. The research project included summarizing existing research; interviewing state and local stakeholders, and other state DOT officials; developing model local regulations; revising the South Dakota DOT’s noise policy; conducting workshops; developing a 15-minute DVD, brochure, guidebook and PowerPoint presentation; designing, developing, testing and documenting GIS noise planning tools; and providing planning level noise contours for South Dakota interstate highways.
I. EXECUTIVE SUMMARY

A. Problem Description

The South Dakota Department of Transportation (SDDOT) seeks to work cooperatively with local governments, community leaders and developers to minimize the impacts of highway noise through an approach of shared responsibility. Although the Federal Highway Administration (FHWA) has and continues to encourage communities to adopt noise compatible land use practices (23CFR772.13), the incentives for its use are sometimes weak, and aid to local governments, community leaders and developers is limited or nonexistent. With the cost of noise barriers ranging between $1M and $4M per mile, there is financial incentive on the part of SDDOT and local communities to minimize the construction of noise barriers where it is possible, so that the limited, available federal and state matching funds can be used for other important highway uses.

Increasing highway traffic noise is an important issue in South Dakota. Highway traffic noise increases as traffic and truck volumes grow over time, causing noise impacts on the adjacent land uses. This scenario has occurred in many parts of South Dakota. Some of the problems with highway traffic noise growth have been aggravated by the use of certain pavement surface textures and rumble strips. Some of the problem has occurred because there’s a perception on the part of planners, developers and residents that the SDDOT will construct noise barriers if the highway traffic noise becomes too loud or annoying. Some of the problem has occurred because the SDDOT has not provided local communities with the tools that are needed to plan and implement more noise compatible land use planning. The intent of this research project is the mitigation and avoidance of highway noise, by promoting a relationship of shared responsibility between SDDOT and local governments who are responsible for regulating development. SDDOT’s responsibilities will be defined primarily through revisions to its Noise Analysis and Abatement Policy. This will enable planners and engineers to implement policy that is consistent with 23CFR772, and current with respect to pavement types and textures and rumble strips. SDDOT will also encourage local governments, community leaders, and developers through education and provision of guidelines, to take more responsibility to regulate land development in a manner that is consistent with the principles of noise compatible development.

B. Project Objectives

1. Objective 1 – Equip SDDOT and Local Communities

Objective 1 of the research project is to equip the Department and local agencies to educate elected officials, business and community leaders, developers, local staff, and interested citizens, on the application, advantages, and public and private benefits of noise mitigation and avoidance measures.

Objective 1 focused attention on what SDDOT can do to enable local governments to implement noise compatible land use planning practices in their communities by providing the tools needed by local governments. The outcome of this portion of the research has been a revised SDDOT noise policy, and a battery of tools that the SDDOT and local officials can use to implement noise compatible land use planning in their communities.

2. Objective 2 – Recommend Policies and Guidelines for SDDOT
Objective 2 of the research project is to recommend policies and guidelines for the SDDOT to use to determine appropriate designs and roadway surfaces in noise sensitive areas.

Objective 2 focused attention on what SDDOT can do to improve its pavement policies and designs. The outcome of this portion of the research has been a series of recommendations for pavement surface textures and rumble strips for SDDOT to follow. Use of quieter pavements and more judicious use of rumble strips helps address the highway noise problem by minimizing annoyance from pavement and rumble strips while maintaining safe pavement conditions.

3. Objective 3 – Define Performance Measures

Objective 3 of the research project is to define performance measures, identify sources of supporting data, and validate their ability to assess the effectiveness of noise avoidance and mitigation measures applied in South Dakota.

Performance measures are necessary to evaluate the effectiveness of the program, to financially justify its continuation, and to identify improvements that may be needed to increase its effectiveness. Raw data used directly or indirectly as performance measures is useful in identifying not only successes but shortcomings, so the program can be improved. The implementation plan includes recommended performance measures.

C. Study Tasks

The objectives were addressed through a number of tasks. The tasks specified in the original request for proposals, and one additional task (Task 18) are listed below along with a summary of the steps used to complete them.

Task 1: Meet with the project's technical panel to review the project's scope and work plan.

The Principal Investigator attended a meeting with the Technical Panel on June 14, 2005 to review the project’s scope and approved research work plan.

Task 2: Review and summarize existing research concerning design and construction of roadways that mitigate or avoid noise, as well as the highway noise analysis and abatement policies and guidelines of state and local agencies in South Dakota.

This task focused on summarizing current research pertaining to quiet pavement design and rumble strip noise vs. rumble strip effectiveness; and reviewing the noise policies of South Dakota state and local agencies.

Task 3: Through interviews with state and local planning professionals and other stakeholders, develop background and identify key issues related to noise pollution in South Dakota.

During June and July 2005, the consultant team contacted the Technical Panel and a SDDOT furnished list of local stakeholders, and a summary of findings was created. The interviews identify perceptions of community noise impacts and current or potential
regulatory tools to reduce noise impacts. The findings from this task were used to develop the most useful guidance information for local planning officials, and SDDOT.

Task 4: Through review of current and recent literature, and through contact with other states that are geographically and demographically similar to South Dakota, identify concepts and techniques for avoiding, abating, and controlling roadway noise.

Eight key noise specialists in the planning and environmental sections of other state DOT’s that are geographically and demographically similar to South Dakota were contacted in July 2005. They completed a questionnaire and were subsequently interviewed to find out what actions state DOT’s had either implemented or were considering implementing to avoid, abate or control highway noise, and to find out what types of assistance other state DOT’s were providing to local communities, and what types of assistance local governments were requesting.

Task 5: Prepare a technical memorandum based on prior tasks to support scoping and design considerations related to noise avoidance, as well as noise compatible planning measures such as land use planning, ordinances, zoning, subdivision regulations, and building codes. Discuss the costs, benefits, advantages, disadvantages, and feasibility of such measures.

The results of Tasks 1 – 4 were summarized in Technical Memorandum #1, issued July 28, 2005. Technical Memorandum #1 summarized the team’s research on pavements and rumble strips, South Dakota state and local noise policies, review of SDDOT’s noise policy, interviews with the Technical Panel and local stakeholders, interviews with representatives of other State Highway Agencies (SHAs), and background research and approaches to support local noise compatible land use planning in South Dakota. Technical Memorandum #1 Update was issued October 24, 2005 and incorporated input received at the August 16, 2005 review meeting and subsequent follow-up.

Task 6: Identify effective noise avoidance, mitigation and abatement measures designed to protect and preserve land uses in existence prior to initiation of Type I (new location or alignment) and Type II (noise abatement on an existing highway) highway projects.

The research team interviewed two planners and a legal counsel to the SDDOT regarding the local planning and zoning tools available in South Dakota, summarized South Dakota’s existing regulations, and provided additional alternative approaches to noise compatible land use planning.

Task 7: Meet with the project’s technical panel to summarize the findings of prior tasks and to propose, for the panel’s approval, concepts that will form the technical basis for the remaining tasks.

The Principal and Co-Principal Investigators attended a meeting on August 16, 2005, to summarize the findings of the previous tasks, and received comments on Technical Memorandum #1.

Task 8: If approved by the panel after Task 7, draft an improved noise analysis and abatement policy for the Department, identifying additional guidelines and implementation procedures for the SDDOT to facilitate consistent and effective noise management. This task should include scoping, environmental, and design
guidelines that are consistent with the 1995 FHWA “Highway Traffic Noise Analysis and Abatement Policy and Guidance.” The task should also provide recommendations on the use of rumble strips, surfacing types and textures for roadways in noise sensitive areas.

The current SDDOT noise policy and design practices for pavements and rumble strips were reviewed and recommendations for improvements were developed and included as part of the implementation recommendations.

Task 9: Draft model ordinances or ordinance sections to support noise compatible measures such as land use planning, ordinances, zoning, subdivision regulations, and building codes, that can be used for noise compatible design, construction, and placement of buildings, improvements and structures.

This task included analysis of alternative approaches to providing noise compatible land use planning in South Dakota, and proposed an approach with three alternative levels of assistance to local communities.

Task 10: Prepare a technical memorandum and meet with the project's technical panel to review the draft noise policy, recommended design guidelines, model ordinances, and effectiveness measures.

Technical Memorandum #2 compiled the results of Tasks 8 and 9.

Task 11: Conduct workshops in Sioux Falls and Rapid City, with elected officials, business leaders, developers, and other professionals as identified by the technical panel, to validate the draft noise policy, design guidelines, model ordinances, and effectiveness measures.

The Principal and Co-Principal Investigators conducted workshops in Rapid City on April 11, 2006 and Sioux Falls on April 12, 2006 with local planners, government officials and developers.

Task 12: Revise the draft noise policy, design guidelines, model ordinances, and effectiveness measures, based on the comments and direction of the technical panel as well as feedback obtained from the two workshops.

This task incorporated the input from the Technical Panel and from feedback received at the workshops, for use in subsequent tasks. The product was a revision to the draft noise policy, design guidelines, model ordinances, and effectiveness measures.

Task 13: Prepare materials, including a 10 to 15 minute South Dakota based noise avoidance and abatement video that state and local agencies can use to educate elected officials, business and community leaders, developers, interested citizens, and local staff on the application and benefits of the noise policy, ordinances, and effectiveness measures.

This task included development of a 15 minute DVD, a tri-fold brochure, and a guidebook with planning tools for preventing adverse effects from highway noise.

Task 14: Prepare an implementation plan that identifies resources and strategies that state and local officials can use to market the noise policy, design guidelines,
model ordinances, and effectiveness measures, including organizational procedures for implementing the policy by the Department.

An implementation plan, based on the workshop and technical panel input, was developed to assist SDDOT in rolling out the recommendations of the research.

**Task 15: Complete an analysis of the research benefits that identifies and quantifies the benefits that can be expected as a result of this research.**

The research benefits were developed in detail as a part of the research conducted for the final report.

**Task 16: Prepare a final report summarizing the research methodology, findings, conclusions, and recommendations.**

This Final Report summarizes the work of previous tasks and of all the research work that was not included in prior technical memorandums. The outline of the final report was presented for discussion and approval at the Task 10 review meeting.

**Task 17: Make an executive presentation to the SDDOT’s Research Review Board at the conclusion of the project.**

The Principal Investigator made an executive presentation to SDDOT’s Research Review Board on June 14, 2006. This included a Power Point presentation summarizing the highlights of the project, and a review of the materials prepared as a part of the project.

**Task 18: Design, develop, test and document GIS Noise Planning tools and prepare noise contours in GIS for 150 interstate highway segments in South Dakota.**

This additional task involved designing, developing, testing and documenting two GIS Noise Planning Tools (a Distance Calculation Tool and a Contour Calculation Tool); and preparing noise contours in GIS for 150 interstate highway segments in South Dakota. The GIS Noise Contour Tools, written as ArcGIS 9.1 extensions, consisted of: a Distance Calculation Tool that used the road median and traffic information to calculate distances to user specified noise levels; and a Contour Calculation Tool that calculates and plots the noise contours based on the distances from the road median.
D. Products

In addition to the findings, conclusions and recommendations, several products have been prepared as a part of the research project. They include:

1. Proposed noise policy that: clarifies confusing elements of the existing Type I noise policy; updates the policy to be consistent with current FHWA policy and guidelines; places greater emphasis on SDDOT’s responsibility to provide tools to local governments that will better enable local communities to implement noise compatible land use planning; and integrates the planning of Type I noise projects into the Department’s scoping and design process.

2. 15 minute DVD that illustrates highway traffic noise growth, describes its many adverse effects, defines a cooperative means to solve the problem, and provides examples and a proposed plan of action.

3. 40 page guidebook for local planners entitled “Tools For Preventing Adverse Effects From Highway Noise”, containing: Federal Highway Administration requirements related to highway noise; areas affected by highway noise; key elements to include in a local comprehensive plan; sample ordinance sections to support noise compatible measures in local subdivision regulations; a sample section of a local zoning ordinance on highway noise prevention and mitigation; sample language to support noise compatible measures in local building codes; guidance on relevant provisions for local official maps; guidance on relevant provisions for local capital improvement programs; guidance on a proposed site plan review coordination mechanism between the local government and SDDOT; and guidance on noise analyses for proposed noise sensitive developments.

4. Tri-fold brochure summarizing key elements from the guidebook.

5. 3-hour, 202 slide PowerPoint presentation for use at training programs for local planners.

6. GIS based noise contour calculating tool, based on the TNM Lookup Tables. SDDOT planning officials will use the tool to provide the future condition 61, 66, and 71 dBA noise contours to local planning officials.

7. Future conditions 61, 66, and 71 dBA noise contours for all interstate highway segments in South Dakota, calculated using the GIS based noise contour plotting tool.

E. Recommendations

The findings and conclusions of the research led the research team to the following recommendations, organized into groupings pertaining to noise policy, design and public outreach to support noise compatible land use planning, to achieve the project objectives:
1. Noise Policy

**Recommendation #1:** SDDOT should revise their noise policy to define “substantial increase” as some value between 10 and 15 dBA.

State DOTs surveyed in the research define “substantial increase” as anywhere from 6 to 15 dBA. In general the more rural states define “substantial increase” as a value between 10 and 15 dBA. South Dakota uses 66 dBA as its NAC B criteria. Therefore, where the existing loudest hour noise levels are less than 51 dBA, it takes a 15 dBA increase or greater to cause a noise impact. 51 dBA is considered a quiet urban daytime noise level. In terms of loudness, a 10 dBA increase in sound pressure level is twice the loudness, so a 15 dBA increase is perceived as more than twice as loud.

**Recommendation #2:** SDDOT should establish a rating form for determination of reasonableness.

A significant portion of the FHWA policy guidance to State DOTs is devoted to the factors that should be included in the determination of reasonableness. The list of considerations can be used to develop a rating form. The weight, given to each item is determined by the SHA. In South Dakota, where the Department is seeking to encourage noise compatible land use planning, a relatively greater weight can be given to the age of development along the highway. In locations where a high percentage of residential development occurred adjacent to the highway, before the original highway construction, greater consideration should be given to providing noise abatement for a lane addition project. Such information can be determined using: the original project drawings; historic aerial photography, and if necessary, review of building permit filings. Similarly, if the adjacent community has developed and implemented noise compatible land use planning, since the residential development was constructed adjacent to the highway, some consideration of this should be a part of the decision making process. Lastly, if adjacent land use is changing from less to more noise compatible, less consideration should be given to providing noise abatement.

**Recommendation #3:** SDDOT should establish a guideline for evaluating whether a proposed SDDOT project is a Type I project, requiring a noise study.

Under FHWA 23CFR772, new highways on new alignment, significant modifications of existing highways, and the addition of through travel lanes to existing highways, qualify as Type I projects. FHWA does not provide specific guidelines on the “significance” of horizontal and vertical alignment changes, or the type and length of additional through travel lanes that qualify a project as Type I. Such guidance will assist SDDOT planners during scoping and preliminary design to better define and prepare for Type I projects.

**Recommendation #4:** SDDOT should increase the allowable cost per benefited receiver to the FHWA minimum of $25,000.

Although only one of several criteria, cost per benefited receiver is an important criteria used to determine reasonableness. The maximum cost per benefited receiver should reflect real estate acquisition prices and the cost of the noise abatement, and should also address price escalation. The SDDOT policy, in effect since 1996, uses a value of $15,000 as the maximum cost per benefited receiver. Escalating that value
to 2005 dollars yields a value of $20,213. The soon to be released updated FHWA policy and guidance document establishes a minimum value of $25,000. To comply with the FHWA policy, the cost per benefited receiver should be raised to $25,000.

Recommendation #5: SDDOT should adopt the proposed SDDOT noise policy, forward it to FHWA and distribute it to SDDOT main office, district office and consultants.

The proposed updated SDDOT noise policy (DOT-E&P-PD-3.0) has been reviewed by the Technical Panel and by FHWA, but must still be officially adopted by SDDOT’s Executive Team. Following its adoption, the policy should be distributed as a new policy to SDDOT main office, district offices, and consultants. The policy itself should be reviewed and updated biennially.

2. Design

Recommendation #6: SDDOT should modify their PCC longitudinal tining specifications to require termination of longitudinal grooves at a minimum distance of 100 mm and a maximum distance of 380 mm from the transverse joints.

SDDOT presently provides longitudinal tining of PCC pavements, but does not have a requirement in their specifications for terminating longitudinal tining a safe distance from roadway joint systems to prevent spalling at the joints. The research identified that other states, with similar problems, have incorporated measures into their specifications to terminate the grooves in the vicinity of the joints.

Recommendation #7: SDDOT should change the bridge transverse tining specification to require a spacing pattern of: (1) 3mm wide (+/- 0.5mm) and 3 mm deep maximum; and (2) random spacing of either 13 mm or 26 mm average tine spacing. The 13 mm random tine spacing should have the following tine pattern (in millimeters): 10/14/16/11/10/13/15/16/11/10/21/13/10. The 26mm random tine spacing should have the following tine pattern (in millimeters): 24/27/23/31/21/34.

SDDOT uses a random transverse tined surfacing on bridge decks based on safety considerations. Transverse tining is noticeably louder than longitudinal tining, and some transverse tining patterns have proven to be particularly annoying. The research identified the FHWA Technical Advisory T5040.36, “Surface Texture for Asphalt and Concrete Pavements”, that recommends a pattern to minimize tire-pavement noise on transverse tined PCC surfaces.

Recommendation #8: SDDOT should continue the practice of using the dense type hot mix asphalt (HMA) surface textures.

The SDDOT standard specifications and standard special provisions call for asphalt surfaces with top course aggregates that are consistent with “normal” dense type hot mix asphalt (HMA) surface textures (i.e. stone matrix asphalt, superpave asphalt, etc.). The research showed that neither rubberized nor open graded friction course (OGFC) asphalts have been proven to be durable, or provided consistent and long term noise reductions in climates similar to South Dakota’s. Rubberized asphalt has not been proven to ensure safe riding conditions for extreme winters, and temperature variations that result from numerous freeze-thaw cycles.
Recommendation #9: SDDOT should include two alternative options for resurfacing PCC pavement where a quieter pavement is desired: resurface with Dense Graded Friction Course (DGFC) pavement or diamond grinding of the PCC pavement.

In locations where SDDOT is considering rehabilitation of an existing pavement, and a quieter pavement is desired due to the proximity of noise sensitive land uses, the research findings indicated that providing a Dense Graded Friction Course (DGFC) pavement overlay or diamond grinding the PCC pavement can provide a quieter pavement surface.

Recommendation #10: For chip seal applications on road projects where quieter pavement is desired, SDDOT should use Type 1B aggregate for the upper course and Type 2A aggregate for the lower course.

The SDDOT has not received noise complaints subsequent to applying chip seal treatments, however due to its rougher texture it may be noticeably noisier than HMA surface textures. The research found that the increase in noise levels with chip seal treatments can be partially mitigated by using a two-course surface treatment where a small size aggregate is used for the top layer. The smaller aggregate size results in reduced vehicle tire/surface noise. The SDDOT Type 1B (upper course), and Type 2A (lower course) aggregates should be used because of their smaller sieve requirements as per the SDDOT standard specifications.

Recommendation #11: SDDOT should continue to follow the progress of FHWA and state highway agency quiet pavement noise research programs and make adjustments to pavement surface finishes.

SDDOT should continue to follow the progress of quiet pavement noise research programs and make adjustments to their pavement surface finishes, consistent with other performance goals (ex. safety). SDDOT should not participate in pavement research involving its standard pavements, as their performance has been well documented by SDDOT. If SDDOT wanted to use a pavement surface finish that had limited acoustical, skid and durability test information, then the research team recommends SDDOT participates in that specific research.

3. Shoulder Rumble Strips

Recommendation #12: SDDOT should provide public information and education about shoulder rumble strip policy.

The benefits of shoulder rumble strips are proven, and SDDOT policy has adopted their use on multiple highway types (i.e. 2-lane, 4-lane divided, interstate, etc.). Rumble strips are also annoying. Therefore, the SDDOT should provide public information and education regarding rumble strip policy and the highway safety benefit they provide.

Recommendation #13: SDDOT should continue to use rumble strips in rural areas, avoid rumble strips in urban areas and provide guidance for transition areas between rural and urban areas.
Based on the lack of current references regarding adverse effects of shoulder rumble strips related to noise, it is recommended that the SDDOT continue to use them in rural areas, avoid using them in urban areas (or remove them in urban areas where highway improvements are being planned and designed) and develop guidance on their use in transition areas (rural to urban).

4. Assistance Services for Local Governments

**Recommendation #14: SDDOT should incorporate all elements of Level One technical assistance services for local governments**

A major aspect of the research involved the interviewing of the 12 Technical Panel members; 13 South Dakota local stakeholders; and 11 key individuals at the Planning/Environmental sections of other State DOT’s to determine the level of technical assistance, and the specific tools needed by local units of government to implement proactive noise avoidance and mitigation measures in their communities. Interviewees completed an extensive questionnaire that was used to formulate the specific elements of a desired technical assistance program. The majority of the Technical Panel was comprised of SDDOT employees, and also included representatives from the Cities of Pierre, Rapid City, and Sioux Falls, and FHWA. The majority of the local stakeholders were municipal planners, municipal engineers or city council people, from the Cities of Sioux Falls, Rapid City, Spearfish, and Minnehaha County, one representative from the private sector, and a landscape architect. Eleven key individuals at the Planning/Environmental sections of other state DOT’s, were contacted. Eight of the eleven completed the questionnaire, and were subsequently interviewed. They included: Arizona, Colorado, Iowa, Nebraska, North Dakota, Michigan, Montana, and Wisconsin.

Three local experts (including SDDOT’s legal counsel) were interviewed to determine the legal constraints of implementing noise compatible land use planning at the local level. It was found that South Dakota communities have available to them all the traditional local planning and zoning tools and a few more contemporary ones. However, the statutes authorizing these tools are not closely based on the model state planning and zoning enabling acts like most other states in the country. Instead, they are more an outline version of them with very brief statements of purpose, power, procedure and standards. South Dakota is a state with a limited view of the role of state government vis a vis that of local government, and hence limited authority has been delegated to state agencies, beyond the obvious main function of an agency (such as building and maintaining roads, as in the case of SDDOT). There are only about a dozen home rule cities and counties, and an independently prepared charter (as opposed to a model charter) is the basis for governance in such communities. Home rule communities can take any action not expressly prohibited by state law. South Dakota is a Dillon’s Rule state as relates to non-home rule communities. However, few home rule communities appear to have exercised much of the independent authority in the planning and zoning arena that usually rests in home rule communities. Thus, nearly all jurisdictions are effectively Dillon’s Rule communities as far as local planning and zoning go.

Based on the input from interviewees and local experts, 7 alternative approaches were evaluated for noise compatible land use planning and development regulation in South Dakota. The following observations were significant in reaching a decision on the appropriate approach to avoid future noise mitigation along interstate and SD State highways:
• If there are no noise sensitive land uses next to the highway there are no highway noise impacts to mitigate (now or in the future);

• If there are no highway noise impacts that SDDOT is required to mitigate, there are no expenses for noise barriers and the money that would have been spent for that purpose (often between $1M and $4M/mile on each side the road) can be used for other highway purposes;

• Road authorities have no authority over the land use decisions which allow noise sensitive land uses next to highways, but road authorities have responsibilities after the fact for noise impacts if the traffic which causes the problem results in a Type I capacity improvement project and noise barriers are found to be reasonable and feasible;

• Local governments have exclusive local land use planning, zoning, subdivision regulation and building code authority which if properly used can prevent future highway noise impacts by only permitting noise compatible land uses next to highways, or by requiring future development of noise sensitive land uses to mitigate highway noise at the time of construction;

• Therefore, the costs of providing education, technical assistance and a wide variety of guidance materials to local governments and developers, including providing one full time equivalent (FTE) noise specialist, is a fraction of the cost of just one noise barrier. Such expenses would be easily justified if they resulted in prevention of future highway noise impacts. If these education and technical assistance efforts resulted in local planning, zoning and development approval of noise compatible land development next to highways or, if noise sensitive land uses were permitted by local governments next to highways, but only with noise barriers or super-insulation in place so that there were no adverse highway noise impacts to address as noise levels rose, the costs would be even more easily justified.

These simple observations presented a compelling case for a SDDOT initiated technical assistance program on highway noise prevention targeted to local governments.

It was also reasoned that local governments will do nothing significant to prevent adverse effects from highway noise without some technical assistance, because:

• Local governments do not know about the potential problems or their role in preventing them;
• Local governments do not know what options are available to prevent adverse highway noise impacts;
• Local governments are unlikely to adopt any noise barrier regulations if they do not receive technical assistance on the design, construction and maintenance of noise barriers from SDDOT;
• If local governments do nothing, then the future costs of road expansion projects will be much greater on the SDDOT than on the local governments, as noise impacts on abutting homes and other noise sensitive land uses must be addressed as part of Type I capacity improvement projects.

The recommendation consists of Level One technical assistance services shown in Table E-1, to prevent adverse highway noise impacts.
Table E-1
Level One Technical Assistance Services For Local Governments

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<tr>
<th>Technical Assistance Level</th>
<th>Elements of Technical Assistance</th>
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<tr>
<td>Level One</td>
<td>1. Preparation and distribution of educational materials, including a 15-minute DVD, and tri-fold brochure to local units of governments and developers.</td>
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<td>2. Preparation and delivery of annual training programs using the 3-hour PowerPoint slide presentation, and guidebook.</td>
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<td></td>
<td>3. Development and distribution of the guidebook “Tools for Preventing Adverse Effects From Highway Noise” that includes model local planning, zoning, subdivision regulation and building code elements to enable noise compatible land use planning and mitigate highway noise impacts associated with noise sensitive development.</td>
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<td>4. Provision of future condition noise contours defining an area adjacent to highways that is impacted by highway noise.</td>
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<td>5. Ongoing response to technical assistance requests from local governments and developers.</td>
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<td></td>
<td>6. Development of SDDOT technical standards for an approved local highway noise prevention land use planning and development regulation program.</td>
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Recommendation #15: SDDOT should determine which, if any, Level Two and Level Three services will be provided, and develop an implementation plan for the additional services.

This work element involves evaluation of the additional Level Two and Level Three assistance services listed in Table E-2 below. We recommend that SDDOT perform this evaluation over the first three quarters of 2007 while the general technical assistance program is implemented. After a decision is made on which elements of Level Two and Level Three assistance are to be provided, an implementation plan for each should subsequently be developed.

Table E-2
Additional Assistance Services For Local Governments

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<tr>
<th>Technical Assistance Level</th>
<th>Additional Elements of Assistance</th>
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<tbody>
<tr>
<td>Level Two</td>
<td>1. Provision of SDDOT ROW acquisition services for construction of noise barriers by developers or local governments.</td>
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<td></td>
<td>2. Development of SDDOT standards for noise</td>
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barriers.
3. Review and comment on proposed noise barrier specifications in particular locations by communities participating in the program.
4. Inspection of noise barriers during construction to assure conformance with SDDOT standards.
5. Inspection of noise barriers upon completion of construction to assure conformance with SDDOT standards.

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<th>Level Three</th>
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<tbody>
<tr>
<td>1.</td>
<td>Acceptance of responsibility for long term maintenance of noise barriers constructed by others within the SDDOT ROW.</td>
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<tr>
<td>2.</td>
<td>Cost sharing with local governments participating in the program on construction of certain Type II noise barriers.</td>
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Recommendation #16: SDDOT should encourage local units of government to adopt the “quality of life” standards that define the highway noise overlay district for three types of noise sensitive land uses.

Noise standards are needed to define the area adjacent to highways that is impacted by highway noise and the limits of the highway noise overlay zoning district. Such standards should equal or exceed the FHWA standards, which only define a noise impact rather than a desired condition, and should be consistent with the L_{dn} standards used by other federal agencies. Local governments should use:

- The loudest hour L_{eq} of 61dBA as the recommended outdoor noise criterion. This preserves the yard area for conversational speech for NAC B (noise sensitive) land uses. The distance is measured from the centerline, or median, of the roadway to the nearest edge of the active use area.
- The loudest hour L_{eq} of 41dBA (corresponding to an outdoor loudest hour L_{eq} of 61dBA) as the noise criterion for buildings where people regularly sleep, and where there is infrequent or only transient outdoor use. The distance is measured from the centerline, or median, of the roadway to the nearest point of the principal building.
- The loudest hour L_{eq} of 51dBA (corresponding to an outdoor loudest hour L_{eq} of 71dBA) as the recommended indoor noise criterion for buildings where people do not regularly sleep, and where there is infrequent or only transient outdoor use. The distance is measured from the centerline, or median, of the roadway to the nearest point of the principal building.

The traffic volumes used to develop the distances to the 61 and 71 dBA noise contours are based on one of two methods. In locations where the existing highway capacity is significantly greater than the present conditions traffic volumes, the 20-year traffic projection, determined by the SDDOT, is used as the traffic volume. The operating speed used in the calculation is the posted speed limit. In locations where the existing traffic volumes are approaching the highway capacity for interstate and South Dakota state highway segments, the operational capacity of the highway and the operating speed associated with the operational capacity are used in the calculation.
The planning level calculation methodology provided in the TNM Look-up Tables, assumes acoustically soft ground, auto speed, auto volume, heavy truck speed, and heavy truck volume are the only input variables needed. Variation in terrain, obstructions, grades, and natural barriers are ignored in the calculations.

5. **SDDOT Program**

**Recommendation #17: SDDOT should hire a full-time equivalent (FTE) Noise Specialist.**

Implementing the recommendations of the research will require the hiring of 1.0 full-time equivalent (FTE) Noise Specialist. The Noise Specialist would be responsible for SDDOT’s Type I noise policy and program, and would be the important resource person for local governments seeking to implement noise compatible land use planning in their communities. The SDDOT should develop a detailed job description, obtain hiring authorization, advertise for the position, evaluate candidates, and complete the hiring process in time so the noise specialist begins employment at the beginning of FY 2008. Once hired, the Noise Specialist should receive training in the FHWA TNM model, land use planning and zoning, and should participate in the Transportation Research Board’s ADC40 Committee activities regularly.

**Recommendation #18: SDDOT should incorporate GIS Noise Planning Tools into the SDDOT GIS platform, make the interstate highway noise contours available to local governments and use the GIS Distance Calculation Tool and Contour Calculation Tool to develop noise contours for other major South Dakota state highways.**

This work element involves incorporating the GIS Noise Planning Tools, developed as part of the research project, into SDDOT’s GIS platform; making the Interstate highway noise contours, developed as part of the research project, available to local units of government; and utilizing the GIS Distance Calculation Tool and Contour Calculation Tool, with traffic data provided by SDDOT’s Office of Transportation Inventory Management, to develop noise contours for other major South Dakota state highways. Noise contours should be made available only via SDDOT’s web site so that changes to the noise contours that could occur based on changes in traffic projections, speeds or commercial truck volumes can be updated and communicated broadly and quickly. Procedures and protocols for making the Interstate highway noise contours and other SD highway noise contours available to local units of government should be developed. Traffic data used to develop the noise contours should be reviewed annually to verify that no significant changes have occurred to the traffic data. Also, changes to noise contours and roadways as a result of SDDOT Type I projects should be incorporated annually.

**Recommendation #19: SDDOT should send the final report to participants of the April 2006 workshops.**

Those local units of government who sent representatives to the April 2006 workshops should receive copies of the final report and electronic versions of the products of the research that will be made available by SDDOT, since materials distributed at the workshops have since been updated.
Recommendation #20: SDDOT should hire the research team to conduct the 3-hour workshop for interested units of local government every year for the next 3 years.

For interested units of local government who have not participated in a workshop, the SDDOT should hire the research team to conduct the 3-hour workshop annually for the next 3 years. As a part of this, the research team should update the Power Point slide presentation. Materials developed from the research, including the final report, DVD, brochure, and “Tools for Preventing Adverse Impacts from Highway Noise” should be distributed at the workshops. The workshops could be offered as part of another venue, such as the annual Statewide Planning Conference (usually held in October), or as a stand-alone workshops. In subsequent years, the training should be provided by the Noise Specialist.

Recommendation #21: SDDOT should develop procedures and provide assistance to achieve a coordinated review process for development projects along interstate and state highways.

Local units of government who adopt the highway noise overlay district provisions will require assistance and participation from SDDOT under the coordinated review and approval process for Interstate and State highways. SDDOT will need to develop the procedures for the coordination process and the Noise Specialist should participate in the ongoing coordinated site plan reviews.

Recommendation #22: SDDOT should provide ongoing technical assistance for the implementation of proactive noise avoidance and mitigation measures.

Under the Level One technical assistance program, planning department officials from local units of government will require ongoing technical assistance from the SDDOT. This assistance should be provided by the Noise Specialist and may be expanded in the future to include some or all of the portions of Level Two and Three technical assistance.
F. Benefits of the Research

The benefits of proactive noise mitigation and avoidance measures will stem from the partnership between SDDOT and local units of government that will guide future development adjacent to South Dakota highways so that it is compatible with highway noise. In this partnership, the Department proposes policies and provides resources to local governments, who in turn use those resources and the powers already granted to them to guide development in two ways: by encouraging noise compatible development adjacent to highways; and by guiding noise sensitive development to achieve development that is noise compatible.

The benefits of noise compatible land use planning will accrue to:

- People who live, work or visit lands adjacent to highways;
- Local communities
- The South Dakota DOT
- The traveling public