Traffic noise monitoring using FHWA's Demonstration Projects Division Mobile Noise Laboratory at free field, single wall and parallel barrier site on I-380 in Evansdale, Iowa is described. Access to I-380 prior to its being open to traffic afforded a controlled pass-by monitoring phase involving different vehicle types. A subsequent second phase entailed identical measurement methodology to monitor "real world" I-380 traffic noise. Phase I data indicated increases in noise were significant under the parallel barrier conditions for light duty vehicles operating in the far lane. Phase II results showed that the actual I-380 traffic mix largely offset the earlier observed effect, but minor increases in traffic noise under the parallel system were noted. These differences in noise barrier system effectiveness are judged to be insignificant at this particular study location.
INTRODUCTION

The Iowa Department of Transportation (Iowa DOT) is one of a number of state highway agencies (SHA) which have constructed parallel noise barriers. In the fall of 1982, 2600 feet of parallel steel noise barriers were constructed adjacent to Interstate 380 in the City of Evansdale, Iowa. It was determined during the initial noise impact analysis for this project that some type of parallel noise barriers would have to be constructed. The preliminary barrier design concept called for the construction of an earthen barrier on one side of the highway and a solid wall on the opposite side. It was felt that the berm would not only reduce barrier costs, but virtually eliminate any problems due to reflected noise. However, because of restricted available right of way and other highway design considerations the berm and wall concept had to be eliminated in the final design. Using the best prediction models available at the time (2,3), it was concluded that although the insertion loss may not be as high if the parallel walls were built, instead of the original berm and wall concept, the effective insertion loss would still be significant enough to be of benefit to the impacted receivers.

It was during the development of the I-380 noise barrier project that the Iowa DOT noise analysis staff first became aware of the difficulties in analyzing the effectiveness of parallel barriers. Unlike for the single barrier analysis, there were no computerized prediction models available for parallel barrier analysis. The Federal Highway Administration (FHWA) had provided the SHA's with a simple "parallel barrier nomograph" (3) for the analysis of parallel barriers. Because the staff was not totally confident in the results of a simple nomograph prediction, a literature
search was made for data related to parallel barrier analysis. It was
discovered that although most noise abatement specialists concede that some
reduction in the insertion loss does occur when parallel barriers are
built, there is no consensus over just how significant the reduction could
be. Most of the data relating to the degradation problem is based on
theoretical acoustical analysis or scale model studies. Many of the
"laboratory" studies show that the effective insertion loss of one barrier
can be significantly reduced or even eliminated by the presence of an
opposite parallel barrier (4,5,6). At the same time the limited number of
full scale field measurements which have been made (5,6,8) have provided no
clear cut data which can be used to predict the potential reduction in the
insertion loss when parallel barriers are built.

In early 1983 the Iowa DOT received copies of two papers (1,7) which
not only provided much needed information on the subject of parallel noise
barriers, but also rekindled the noise analysis staff's concern over just
how effective the recently completed I-380 parallel barriers would be. The
Bowlby and Cohn paper (1) described the development of an algorithm and a
computer program called IMAGE-3 for the analysis and design of parallel
barriers. This paper emphasized however, that although models which are
developed for analyzing the effectiveness of parallel barriers may be
mathematically and acoustically sound, few if any, well documented field
validation studies have been performed.

Because the Iowa DOT is always interested in the performance of any
noise barriers constructed along Iowa highways "before" and "after" noise
level data is often obtained for analysis. This data is used to not only
determine overall barrier performance, but to also test the accuracy of the
model used to predict barrier effectiveness. Although no formal study was
originally being proposed, the noise analysis staff was preparing to undertake a more extensive than normal noise monitoring effort after I-380 was opened to traffic.

In August, 1983, noise analysis staff members attended the annual summer meeting of the Transportation Research Board's (TRB) Transportation Noise Committee in Boston, Massachusetts. Although no formal discussions were held concerning the problem of parallel noise barriers during the course of the meeting, it was learned that there has still been very little field data collected in the vicinity of parallel barriers. The FHWA personnel present at the meeting made it known that the FHWA was concerned about the parallel barrier reflection problem and were in the process of funding some experimental field work in this area. Upon hearing of the increased involvement of the FHWA, Iowa DOT staff inquired as to the possibility of having the FHWA provide support in obtaining noise data along the I-380 parallel barrier segment. The FHWA indicated that assistance for this type of work was available.

Shortly after returning from Boston, the noise analysis staff submitted a Research Work Plan (Appendix A) to the FHWA for the proposed I-380 barrier study. Acting expeditiously, the FHWA approved the work plan in September 1983.

The following interim report describes the procedures used in the initial controlled passby phase of the project and discusses the noise data collected.
II. COORDINATION WITH THE FEDERAL HIGHWAY ADMINISTRATION

The work plan submitted to the FHWA Iowa Division office described a two-phase study at the I-380 site in Evansdale. The first phase would entail noise measurements from controlled vehicle passbys at each of three barrier conditions - free field (no barrier), single wall and parallel walls. A second phase to be undertaken after the highway is open to traffic would collect noise data from the normal traffic mix at the same three locations.

Federal Highway Administration participation was to consist of providing the Demonstration Projects Division's noise analysis trailer along with a technician and a project manager to oversee the use of the FHWA equipment. A $10,000 grant was requested to be administered through The Demonstration Projects Division to cover costs incurred by the State.

A preliminary report was to be prepared by the State upon completion of the first phase of the study and a final report was to be prepared upon completion of the phase two monitoring.

Provisions were also agreed upon to provide the study site details and noise measurement data to Vanderbilt University for application of the IMAGE-3 parallel barrier model.