

## SECTION 1.

### INTRODUCTION AND BACKGROUND

Nearly 30 years ago, the Federal Highway Administration (FHWA) published the first comprehensive review of the literature on the safety impacts of electronic billboards. FHWA, through the Highway Beautification Act, had, and still has, the authority to regulate off-premise advertising signs (billboards) adjacent to Federal Aid Highways, and these regulations prohibited, in part, any signs that utilized “flashing, intermittent, or moving lights” (Wachtel and Netherton, 1980, p. 16-17). In the late 1970s, the sign display technology in common use permitted little more than digitally displayed time and temperature information, although some signs could display several lines of text and crude, cartoon-like graphic images. Even then it was possible to change the displayed sign messages simply and quickly in real time, and it was possible for these signs to display a number of different visual effects, such as fade, dissolve, flash, and others. The billboard industry took the position that signs using this technology did not present any of the visual characteristics prohibited in the FHWA regulations, and, therefore, should be permitted under the existing regulations. Because the manufacturers of such signs and their potential users saw a bright future for this technology, and because of FHWA’s concern about their potential to distract drivers, the industry presented its case to the U.S. Congress. As a result, the FHWA Office of Research was asked by the agency’s Office of Right-of-Way to investigate what was known about such signage when used for roadside advertising, in anticipation of a possible update to the agency’s regulations. The product of this effort was a comprehensive and critical review of all available literature in the field, some dating back 30 years or more. Wachtel and Netherton termed these new signs “commercial electronic variable message signs,” or “CEVMS.” Because this technology was so new, the authors found little research that had been done with such signs, and therefore had to rely on research that had been conducted with traditional, fixed, billboards. As a result, although they were able to identify specific safety issues and concerns raised by CEVMS, especially when combined with their review of accepted psychological principles of attention, the authors suggested that additional research was needed, and recommended a specific program to accomplish this. Unfortunately, the proposed research was not pursued.

In 2001, with outdoor advertising signs using newer, more powerful technologies, and capable of much higher fidelity displays with higher luminance levels and immediate wireless display and message updates transmitted remotely, FHWA undertook a follow-on project to bring its understanding of the state-of-the-art and –practice up to date, and to again propose a direction for research. Although this study did not undertake a critical review of the literature, it brought to bear recent research and psychological constructs on inattention and distraction. The product of that work (Farbry, et al., 2001), in conjunction with the earlier document, became the basis for a preliminary, scoping, research study by FHWA (Molino, et al., 2009), and a follow-on research study that was recently initiated.

The 1980 project reported that several of the identified research studies had identified a relationship (correlation) between the presence of billboards and crashes, whereas several other cited studies found no such relationship. Wachtel and Netherton, with the assistance of an FHWA statistician who reanalyzed the data reported in a number of these early research studies (Weiner, 1979) concluded that those research studies that had been more rigorously designed, controlled, conducted, and analyzed, seemed to suggest that a relationship between roadside billboards and traffic safety was present, and that safety was adversely affected by such billboards. The findings pointed to an adverse effect when billboards were bright, close to the roadway, and visible to approaching drivers for considerable distances; and when they were located near intersections, interchanges, or horizontal curves. Further, when the driver's task demands were elevated, as might be the case in heavy traffic, adverse weather, or with challenging traffic movements (lane drops, merges, etc.), the more robust research seemed to show the potential for adverse safety impacts from roadside billboards.

During the 20 year gap between the publication of the first two FHWA studies, as well as more recently, a number of other researchers have reviewed the same early studies (along with more recent studies that have since become available), and reached essentially the same conclusions. (See, for example, Bergeron [1996a], Wallace [2003]). In fact, only one researcher (Andreassen, 1984) is known to have reviewed this literature and reached the conclusion that there is no linkage between roadside billboards and traffic safety, and his colleagues at the Australian Road Research Board (now ARRB Transport Research) (Cairney and Gunatillake, 2000) have expressed strong disagreements with his conclusions.

The latest LED technology enables roadside billboards (and on-premise signs using the same technology), to (a) present images, symbols and characters that are extremely bright (such that they can be easily viewed in full sunlight), (b) with visual fidelity on a par with broadcast video, (c) on displays that can be changed instantly and kept on the screen for as long (or short) as desired, and (d) on signs that can be much larger than traditional 14 ft. by 48 ft. billboards.<sup>1</sup> As a result, the question has again arisen as to whether and how these signs should be regulated in the US. Presently, the States are asking FHWA for guidance. While it proceeds with its current research project FHWA has issued interim guidance that addresses characteristics of CEVMS including: message duration, transition time, brightness, spacing, and allowable locations (Shepherd, 2007). Unfortunately, these guidelines are based on little sound empirical data, and, in several cases, are so subjective as to be open to multiple interpretations.

As suggested above, the potential impact from these latest technologies goes far beyond a simple replacement of traditional, static billboards. On-premise advertising signs, traditionally given much more freedom by FHWA and local authorities, are increasingly using the same LED technology now appearing on billboards. Shopping centers, auto malls, and many other local businesses are finding that such signs are affordable, and that the display capabilities they offer are unprecedented in their attention-getting power. In

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<sup>1</sup> One on-premise sign in New York City measures 90 ft. by 65 ft. and is mounted 165 feet above grade where it is visible for two miles from the adjacent Interstate highway (Business Wire, 2002).

addition, these technologies are now beginning to appear on moving vehicles, and some LED billboards can tailor a “personalized” message to approaching traffic by “reading” the digital signal produced by in-vehicle entertainment systems, RFID keys, and other devices. Our research suggests that such alternative, increasingly powerful and compelling uses of the newest technologies for outdoor advertising to the traveling public will continue to evolve at a rapid pace, and that regulators must be prepared to deal with these developments. This paper, however, is limited to a discussion of traditional billboards along the roadside, albeit those with the latest technological capabilities. Although some such signs use scrolling characters across a screen, and others use rotating panels (called Tri-Vision or Roller-Bar signs), it is the LED technology that has the greatest potential for capturing attention, and therefore, distracting the driver. Whether such signs are called digital billboards (DBBs), electronic billboards (EBBs) or CEVMS, they refer to the same types of signs.

Because of the pressures being put on State and local Governments to issue permits for DBBs, and because of the threat of litigation should such permits be denied or revoked, the States have asked for an update about the state of knowledge that results from the latest research. In addition, the States would like to know what guidelines and/or regulations exist in other jurisdictions with regard to DBBs, and have asked for recommendations for appropriate, realistic, data driven guidelines that they might consider adopting for their own streets and highways, and pending updated guidance from FHWA.

The present report, therefore, represents a comprehensive, critical review of the most recent research literature in this field. To a large extent, the research discussed herein has been conducted since the most recent (2001) FHWA report was published. Several earlier studies are discussed, however, either because they were not captured in the two FHWA reports, or because their methods and findings are directly relevant to the questions now being asked. A number of these studies have not been widely reported or are controlled, internal documents. We are grateful to their authors for making them available to us.

After the critical literature review in Section 2, subsequent sections of this report address: research performed on behalf of the outdoor advertising industry, human factors considerations relevant to driver response to these technologies, guidelines and regulations in place or under consideration in other jurisdictions, recommendations for guidance that States and local governments might adopt in the near term, and new technologies and applications for outdoor advertising. After a brief summary, the final report section identifies the references cited in this study.