October
Plastics

This packet provides information about how and why to use plastics in various road construction applications.

Research Summary #1	Applications of Recycled Materials in Traffic Control Devices (TCDs)
Research Summary #2	Innovative Materials and Design of Soundwalls
TxDOT Experience	Summary of TxDOT's experience using recycled plastic in delineator posts
Material Availability	Map and table listing companies that generate plastic
Appendix #1	This appendix provides a list of TxDOT-approved TCDs that include recycled content.
Appendix #2	It also includes definitions and EPA-suggested minimum recycled contents for barricades (Type I and II), TCDs (channelizers, delineators and flexible delineators), parking stops, safety fencing and traffic cones.

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Material Brief

Plastics are polymers. A polymer is most easily described as a chain made of many monomer units. Plastics offer numerous benefits. They are lightweight, resistant to chemicals, and effective as thermal and electrical insulators. Some plastics are very strong.

There are two broad categories of plastics: thermoplastics and thermosets. Thermoplastic can be heated and reformed over and over again, which facilitates recycling. Thermosets cannot be remelted. Within the thermoplastic category there are several different types of plastic. These plastics have different properties and different melting points. To be successfully recycled, plastics must be separated prior to reuse.

In 1988, the Society of the Plastics Industry, Inc., developed a coding system to easily distinguish types of plastic to help increase recycling. For example, you may have seen the number "1" inside the three-chasing-arrows recycling logo on the bottom of a plastic soda bottle. The "1" indicates that the bottle is made from

polyethylene terephthalate (PET). Milk jugs are usually made from high-density polyethylene (HDPE) and marked with a "2" inside the chasing arrows. PET and HDPE are among the most frequently recycled plastics today.

Recycling plastics is important because plastics make up 11 percent of our trash by volume and do not decompose in landfills. A 1997 American Plastics Council survey estimates that approximately half of U.S. communities collect plastics for recycling. In 1997, more than 600 million pounds each of PET and HDPE were recycled.

Recycled plastics can be blended with virgin plastic (plastic that has not been processed before) to reduce cost without sacrificing properties.

Recycled plastic can be used in many transportation-related applications, including

- traffic cones, barricades, channelizers, delineators, flexible delineators, parking stops and safety fencing;
- guardrail blockout posts;
- manhole adjusting rings;
- plastic lumber; and
- sound barriers.

Overview

Barricades, Traffic Control Devices (TCDs), Parking Stops, Safety Fencing and Traffic Cones

TCDs are frequently made using recycled materials, including plastics. The use of recycled plastics in these applications offers many benefits and, in fact, is required in certain circumstances.

The U.S. Environmental Protection Agency (EPA), through its Comprehensive Procurement Guidelines (CPG), designates items that must contain recycled content when purchased by federal, state and local agencies or government contractors using appropriated federal funds.

If TxDOT or contractors on TxDOT's behalf spend more than $10,000 a year on a CPG-designated product, they are required to purchase the product with the highest recycled-content level practicable.

TxDOT (or its contractors) may purchase designated items that do not contain recycled materials if

- the price of a designated item made with recovered materials is unreasonably high,
- there are inadequate sources of supply,
- unusual and unreasonable delays would result from obtaining the item, or
- the item does not meet TxDOT's performance specifications.

Several TCDs are included on the CPG list of designated products with required levels of recycled content:

- traffic barricades, type I and II;
- channelizers, delineators and flexible delineators;
- parking stops;
- safety fencing; and
- traffic cones.

For more information about recycled content TCDs, see Research Summary #1. The appendix also includes a list of TxDOT-approved TCDs that include recycled content.

Guardrail Blockout Posts

The use of guardrail blockouts is expected to increase significantly because federal safety guideline NCHRP-350 requires that blockouts be used with every guardrail post. The Federal Highway Adminstration

(FHWA) has approved two blockouts made of recycled plastic materials, which meet the NCHRP 350 requirements. The blockouts approved by FHWA are made by Mondo Polymer Technologies and Bryson Products.

The Mondo polymer offset blocks for use with steel w-beam and the standard G4 (2W) wood guardrail post systems are made of 70 percent low-density polyethylene (LDPE) and 30 percent HDPE. The materials used to make this block include bubble wrap, shrinkwrap and stretch films.

These blocks offer increased depth over the steel blockout, which FHWA says "should enhance small car performance by minimizing wheel-to-post contact." Other FHWA comments include, "Vehicular redirection was smooth, and there was less damage to the truck than has been seen in comparable tests with equivalent barriers. Occupant impact velocities and subsequent ridedown decelerations were. . . significantly below the preferred limits."

According to tests conducted by the Ohio Department of Transportation, the plastic guardrail block-out was "very capable of withstanding the extreme and cyclic temperatures which may be found in different climatic zones without material breakdown or any detrimental effect." The plastic experienced "minimal expansion and contraction of the recycled polymer material due to temperature change," which was "not sufficient to cause any problems in the guardrail system."

In an installation test conducted by the West Virginia Division of Highways, Materials Control, Soil & Testing Division, they found that the Mondo recycled blocks were slightly heavier than wood blocks and slippery when wet. On the other hand, the bolt hole on the plastic block was drilled clean through and did not require the redrilling that wooden blocks frequently do. On the whole, installation crews were "quite willing to use this material exclusively," noting that "installing the recycled plastic blocks is somewhat easier than regular wood blocks."

FHWA has also approved a recycled plastic blockout made by Bryson Products, Inc. The Bryson blockout is made from a blend of HDPE and polypropylene (PP). These blockouts are lightweight with void spaces that make them easy to handle. They are resistant to the weathering effects of sun and wind. They are environmentally friendly, not only because they are recycled but also because they do not pose the disposal challenges associated with treated wood.

Manhole Adjusting Rings

TxDOT's Product Evaluation Committee approved manhole adjustment rings made of HDPE by Ladtech, Inc. These manhole adjustment rings are lightweight (approximately 6 pounds each), watertight, non-corrosive, easy to handle, durable, interlocking and reusable. According to the manufacturer, the rings can withstand loading in excess of HS 25. They are made from 100 percent recycled HDPE plastic and come with a two-year material warranty.

Plastic Lumber

Plastic lumber is just what it sounds like, lumber made out of plastic. Recycled plastics can also be combined with fiberglass or wood fibers to enhance strength.

Plastic lumber offers many benefits:

- It requires virtually no maintenance.
- It will not splinter, split or crack.
- It does not rot or decay.
- It does not have problems from termites and other insects.
- It resists damage from the sun's ultra-violet rays.
- It is not damaged by moisture.
- It is available in standard dimensional lumber sizes.
- It does not need to be sealed or painted, although it can be. (Some plastic lumbers are available in colors.)
- It can be cut with standard wood-working tools.
- It helps the environment by using recycled plastic.
- It does not leach wood-preserving chemicals into the ground.

Plastic lumber can be used in barricades, picnic benches, hand railings, sign and fence posts, and numerous other applications. It cannot, however, be used as a structural element in construction.

Sound Barriers

Sound barriers are built along roadsides to reduce the amount of traffic noise that reaches neighborhoods, and they can be built using recycled materials. Several such walls have been constructed in the U.S., including one built for a research project at Texas A&M University.

For more details about the recycled plastic sound barrier at Texas A&M University, see Research Summary #2 in this packet.

Sources

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Research Summary #1

Applications of Recycled Materials in TCDs

Problem Statement

To address the growing volume of waste generated by society, the hurdles in the approval process for siting landfills, and the resulting escalation of waste handling and disposal costs, many manufacturers are attempting to recycle plastics and other materials in various roadside and work-zone TCDs.

The number and cost of these devices installed and replaced annually within Texas and the rest of the nation are significant, so there is potential for a measurable, positive and cost-effective impact on environmental problems.

This summary reviews the first phase of a three-phase research project. In Phase I, researchers compiled information on existing products manufactured in part or in whole from recycled materials, which have been evaluated and recommended for experimental implementation. TCDs evaluated in this study included but were not limited to

- guardrail support posts and offset blocks;
- sign blanks and their supports;
- energy-absorbing elements in crash cushions, end terminals and truck-mounted attenuators;
- delineator posts;
- mailbox supports; and
- work-zone TCDs such as drums, cones and barricades.

For some products, there is insufficient data to make a conclusive decision about suitability for use. Phase II of this study will focus on further assessment and evaluation of products through laboratory and dynamic testing. Phase III will then perform full-scale crash testing of selected products (from Phase II) to validate laboratory results and verify their crash-worthiness.

Objectives

The Texas Transportation Institute (TTI) conducted Project 0-1458, "Applications of Recycled Materials in Roadside Safety Devices," for TxDOT and FHWA to evaluate the use of recycled materials in TCDs. The goal of the project was the implementation of recycled-content TCDs that meet established safety criteria.

Findings

The materials that appear most suitable for roadside safety applications include recycled plastics, fiberglass, rubber and wood fibers, either alone or in various combinations. For strength, it appears practical to design TCDs to match the properties of wood. Consequently, recycled material can conceivably be applied where wood is currently used, such as guardrail posts, offset blocks, sign supports, sign blanks and barricades. Other potential applications include flexible delineator posts, channelizing drums and traffic cones.

To meet the requirements of various end uses, most plastics generally contain some amount of an additive. The main classes of additive in plastic are lubricants, stabilizers, plasticizers, fillers, impact modifiers, reinforcing agents, fire retardants and colorants. Occasionally, virgin material is required as a binder for the recycled material. Plastics are often blended or reinforced with other materials to obtain desired physical or mechanical properties.

Wood, glass fibers and rubber/polyolefin blends are employed to enhance the

strength of plastic products. The addition of rubber generally degrades the mechanical properties of recycled plastic. However, if rubber is used as an impact modifier, the properties of the product may be improved.

The relative density of commercially available plastic lumber products varies from about 0.7 to 0.96, making them one and a half to two times heavier than wood. Susceptibility to moisture for 100 percent recycled plastics and plastic-rubber blends tends to be slight.

Blends containing wood and paper products tend to have higher rates of water absorption. Studies have shown that the strength of wood and paper products decreases with increasing moisture content. In addition, since wood fibers expand with moisture content, the entire product will tend to expand. Various additives can be used to reduce moisture uptake.

Because the coefficient of thermal expansion of plastic products can be up to 12 times greater than wood or steel, they will expand and contract to a much greater extent for a given change in temperature. This fact should be considered in the connection design and in construction details.

Where plastics are bonded to steel or wood in a composite fashion, the difference in expansion between the two could lead to cracking of the plastic or delamination at the interface. Generally, a temperature decrease will result in gained strength of recycled plastics. Conversely, a temperature increase typically decreases mechanical properties such as compressive strength, bending strength and modulus of elasticity in plastics.

Implementation

Information collected and evaluated by the research team was summarized and categorized into two groups: (1) commercially available roadside safety products and TCDs with potential for immediate implementation and (2) other materials not specifically designed for TCDs but with potential for use in such applications.

Researchers developed a prioritization scheme for evaluating roadside safety products currently on the market. The fulfillment of specified safety requirements was of primary importance. Relevant field experience reported by state agencies and the availability of physical and mechanical properties from laboratory testing were also weighed heavily in evaluation.

Based on this evaluation scheme, products suitable for immediate implementation were identified and categorized by application type. Researchers performed no independent testing or field evaluation of the identified products.

Recommendations in this study are based solely on information found in the literature provided to the researchers by manufacturers and state agencies.

The following table contains a list of existing, commercially available TCDs manufactured in part or in whole from recycled materials and recommended for experimental implementation.

Recommended TCDs Made from Recycled Materials

Type of Device	Product Name		Type of Device	Product Name
Barricades	Bear-A-Cade Channelizer Recycled Plastics Products		Bollards	Plastic Pilings, Inc.
Delineators - Flexible Posts	Carsonite-Survivor Post Flexstake Greenline Davidson Plastics Co.-Flexi-Guide Kennco, Inc. Plastic Safety Systems-The Gripper		Delineators-Traffic Cones	Work Area Protection
Delineators - Channelizing Drums	Plastic Safety Systems, Inc.-Lifeguard		Guardrail Offset Blocks	Mobil Oil Corporation-Trex Collins & Aikman Recycled Technology, Inc.
Guardrail Posts	Mobil Oil Corp.-Trex Recycled Technology, Inc.		Sign Blanks	Composite Technologies International Plastics Signs and Blanks, Inc.

Research Summary #2

Innovative Materials and Design of Soundwalls

Problem Statement

Environmental specialists, transportation officials and engineers have focused a great deal of attention on the environmental impact of sound pollution caused by highway-generated noise. In an attempt to contain this type of sound pollution, national and state agencies have implemented the systematic construction of noise barriers.

Sound barriers, or soundwalls, exist primarily to reduce noise detected by people living and working near roadways that have high-volume or high-speed traffic.

The use of recycled plastic in place of more traditional materials such as concrete and steel is a possible solution to the growing waste problem that society faces today.

Objectives

TTI conducted Project 7-2968, "Innovative Materials and Design of Soundwalls," for TxDOT and FHWA to evaluate the use of recycled materials in sound barriers.

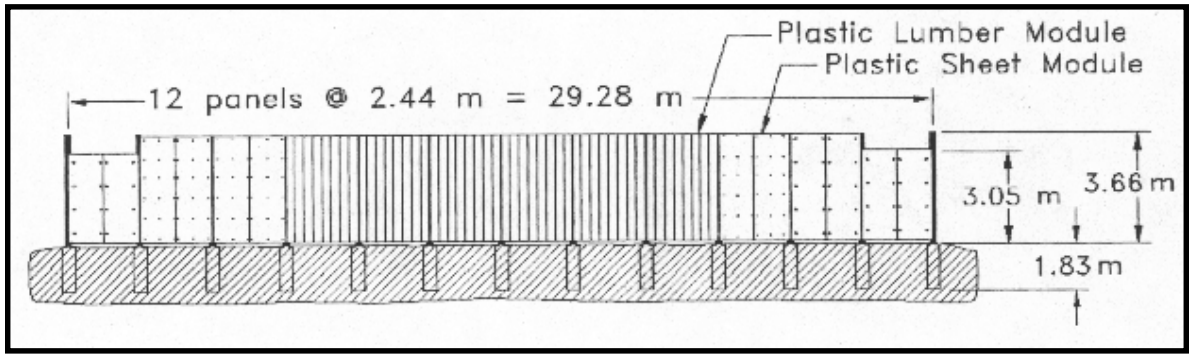
The objective of this project was to develop and construct an effective sound barrier of recycled materials while addressing the issues of constructability, structural integrity, durability, dynamic performance, acoustic effectiveness, aesthetic appeal and cost.

The scope of this project included a review of archival literature and a survey of current governmental agency approaches related to the use of recycled materials in sound barrier design. It also included the procurement of sample materials from manufacturers for laboratory and field studies. A full-scale field model was constructed and monitored for almost one year while regular acoustic and dynamic tests were performed to determine weatherability, wind sensitivity and acoustical effectiveness.

Findings–Constructability and Structural Integrity

The soundwall was built using both plastic sheets and plastic lumber boards to compare the performance of the two materials. Four people constructed the entire 96-foot-long by 12-foot-tall prototype soundwall in approximately three months working part time. Work progressed smoothly once a method of constructing the sheet and lumber modules was developed.

Structurally, all modules maintained their integrity over the course of approximately a year. An exception, mostly aesthetic, was the warping of some plastic sheet panels. The plastic lumber modules proved to have higher rigidity in both the long– and short–span directions compared to the plastic sheet modules. This is a result of the incorporation of fiberglass–reinforced plastic lumber. Future installations should incorporate an inner frame of plastic lumber modules. Minor difficulties were encountered with screws, nails or bolts coming loose. Screws seemed to work best in connecting structural members together.



Elevation View of Prototype Soundwall and Foundation

Findings–Durability

In this project several plastic sheets suffered minor warping over nearly one year. Other sections of the soundwall utilizing plastic lumber boards instead of plastic sheets showed few detrimental effects from weathering and exposure to ultraviolet radiation. Also, there was no noticeable deformation of the soundwall, indicating that the fiberglass-reinforced plastic lumber internal framework is probably capable of withstanding long-term thermal and wind loadings.

Researchers suggest that future applications for soundwall structures employ materials with fiberglass reinforcement, since fiberglass adds substantially to the stiffness and facilitates construction of good connections between members. The recycled plastics used in the prototype soundwall performed acceptably well for approximately one year.

Findings–Dynamic Behavior

The prototype barrier was mildly susceptible to resonant response due to wind loading. No abnormal behavior or vibration was detected, but it was exposed only to moderate winds.

Findings–Acoustic Performance

With a measured insertion loss of 17.1 dBA, future installations of this type of soundwall should easily meet or exceed the required minimum insertion loss of 5.0 dBA. However, because of very low traffic volume in the study area, a power generator was used to produce noise and many assumptions were made to model the noise source in the simulation. This subject is open to further debate by experienced acoustic engineers.

Findings–Aesthetics

The majority of the people who visited the site agreed that the plastic lumber modules were the most aesthetically pleasing sections of the soundwall. The plastic lumber boards resemble natural wood boards and have different color variations.

Findings–Costs

Material and life-cycle costs associated with the use of recycled plastic materials are economically favorable and environmentally beneficial. According to information on noise barrier costs, average unit costs for concrete barriers and brick barriers average $202 and $206 per square meter respectively. The estimated cost of building a fiberglass-reinforced plastic wall is approximately $165 per square meter.

The contents of this summary are reported in detail in TTI Report 2968-S, *Innovative Materials and Design of Soundwalls*, by Paul N. Roschke, H.Y. Yeh and Steven Esche, report dated October 1997. This summary does not necessarily reflect the official views of FHWA or TxDOT.

To obtain a copy of this report, please contact TxDOT's Construction Division Research Librarian at (512) 465-7644.

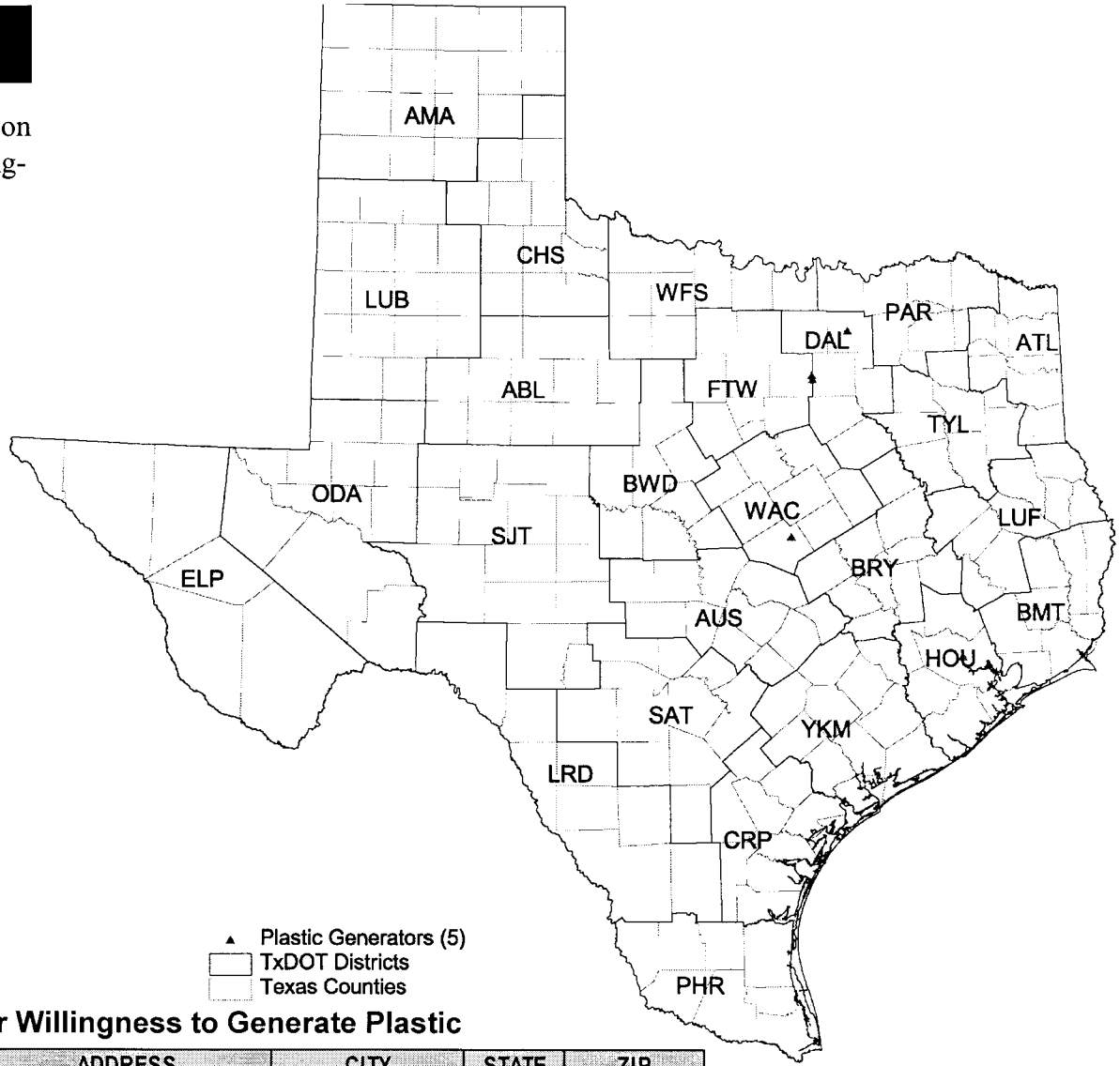
TxDOT Experience

This table provides information about TxDOT's experience using recycled plastic in delineator posts.

District Name	Construction Application	Material	Results	Years of Experience	Location
Beaumont	Roadside Safety Devices	Plastic Delineator Posts	Excellent	1992	Jasper

Material Availability

The map and table provide information on companies with the ability and/or willingness to generate plastic.



Companies with the Ability and/or Willingness to Generate Plastic

COMPANY	ADDRESS	CITY	STATE	ZIP
EGC Corporation	11718 McGallion Rd.	Houston	TX	77076
Fisher Controls International Incorporated	310 East University	McKinney	TX	75069-
Poly-America Incorporated	2000 West Marshall Drive	Grand Prairie	TX	75051-2709
Solvay Polymers	1201 Avenue H East	Grand Prairie	TX	75050-8004
Tenneco Packaging Company	3000 Pegasus Drive	Temple	TX	76503-6119

Appendix #1

The following table shows the recycled content of TxDOT-approved workzone TCDs.

TYPE-I BARRICADE SYSTEMS		
Folding Type-I Barricade Systems		
Plank-A-Cade folding plastic barricade	**Flasher Flare South East, Inc.**	**Contains 20-40% recycled plastic**
Folding barricade with steel legs and plastic waffle panel rails	BENT Manufacturing Co.	Can use any amount of recycled materials based on customer specifications
Folding barricade with stell legs and plywood rails	BENT Manufacturing Co.	Can use any amount of recycled materials based on customer specifications
Universal Plastic Barricade	BENT Manufacturing Co.	Can use any amount of recycled materials based on customer specifications
TrafFix plastic folding barricade	TrafFix Devices, Inc.	All virgin plastic, unless requested by customer
2x4 HPPL uprights & 1x8 HPPL	**Recycled Plastic Products, Inc.**	**100% post consumer and post industrial HDPE plastic**
2x4 HPPL uprights & 1x8 HPPL	**Aeolian Enterprises**	**Percentage varies according to production run and color. (white-up to 25%, gray-between 25-75%, black-up to 100%)**
2x4 HPPL uprights & 1x8 HPPL	**Fender Enterprises, Inc.**	**No more than 25-30% recycled content**
2x4 HPPL uprights & 1x8 HPPL	Centerline Supply, Inc.	Information not available at this time
Plastic Barricade Model PRB-124	Service & Materials Co. (Flex-O-Lite)	Information not available at this time
A-Frame Type-I Barricade Systems		
A-frame plastic barricade	**Flasher Flare South East, Inc.**	**Contains 20-40% recycled plastic**
TrafFix -"A"-CADE rigid A-frame barricade system and TrafFix-RAIL or 1x8 No. 2 SYP (or equivalent)	TrafFix Devices, Inc.	All virgin plastic, unless requested by customer

Skid Mount Type-I Barricade		
Pre-assembled Type-I barricade (skid type)	Melba, USA - system '98 Models M1B-1-24 and M2B-1-48 (Eastern Metal/USA Sign)	Information not available at this time
Pre-assembled Type-I barricade (skid type)	Fendercade type-I modular barricade system (Fender Enterprises, Inc.)	Information not available at this time
Pre-assembled Type-I barricade (skid type)	HPPL barricade with rubber skids (Rad-Tec Fabricators, Inc.)	Information not available at this time
Pre-assembled Type-I barricade (skid type)	TrafFix-CADE modular barricade system (TrafFix Devices, Inc.)	No recycled content
TYPE-III BARRICADE SYSTEMS		
Type-III Barricades		
Complete Type-III Barricade	**Hwy Com, Inc.**	**100% recycled plastic "H" braces**
Complete Type-III Barricade	**Fender Enterprises, Inc. (Models 047HI)**	**All hollow core plastic model: no more than 25-30% recycled content; steel & hollow core plastic model: no more than 25-30% recycled plastic.**
Complete Type-III Barricade	**TrafFix Devices, Inc. (Models 5004-HI-2 & 5008-HI-2)**	**Steel substrates (all steel contains recycled content). Recycled plastic content on request.**
Complete Type-III Barricade	**Western Highway Products, Inc. (Ulti-Mate Barricade)**	**Steel legs, panels made of wood. No plastics. (all steel contains recycled content).**
Complete Type-III Barricade	BENT Manufacturing Co.	Can use any amount of recycled materials based on customer specifications.
Complete Type-III Barricade	PBS, Inc.	All wood
Complete Type-III Barricade	Eastern Metal/USA Sign (Melba, USA-System '98 Model M2B-3)	Information not available at this time
Complete Type-III Barricade	Davidson Plastics Corp. (Model T3B)	Information not available at this time
Complete Type-III Barricade	Plastic Safety Systems, Inc. (Model PST-III)	Information not available at this time
Complete Type-III Barricade	Rad-Tec Fabricators, Inc	Information not available at this time

Type-III Barricade Components		
HPPL, 1x8 rectangular	**Recycled Plastic Products, Inc.**	**100% post consumer and post industrial HDPE plastic**
HPPL, 1x8 rectangular	**Aeolian Enterprises**	**Percentage varies according to production run and color. (white-up to 25%, gray-between 25-75%, black-up to 100%)**
HPPL, 1x8 rectangular	**Fender Enterprises, Inc.**	**No more than 25-30% recycled content**
HPPL, 1x8 rectangular	**Flasher Flare South East, Inc.**	**Contains 20-40% recycled plastic**
HPPL, 1x8 rectangular	Centerline Supply, Inc.	Information not available at this time
HPPL, 1x8 rectangular	Eastern Metal/USA Sign	Information not available at this time
HPPL, 4x4 square	**Recycled Plastic Products, Inc.**	**100% post consumer and post industrial HDPE plastic**
HPPL, 4x4 square	**Aeolian Enterprises**	**Percentage varies according to production run and color. (white-up to 25%, gray-between 25-75%, black-up to 100%)**
HPPL, 4x4 square	**Fender Enterprises, Inc.**	**No more than 25-30% recycled content**
HPPL, 4x4 square	Bufftech	All virgin plastics
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Allied Tube and Conduit Corp.**	**All steel contains recycled content**
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Fender Enterprises, Inc.**	**All steel contains recycled content**
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Ultimate Highway Sales, Inc.**	**All steel contains recycled content**
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Unistrut Corp.**	**All steel contains recycled content**
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Western Highway Products, Inc.**	**All steel contains recycled content**
Steel Tubing, circular metal, 2 3/8" diameter	**P&H Tube Corp.**	**All steel contains recycled content**

Type-III Barricade Components, cont.		
X-Tube, 1 3/4" sqare plastic with X-stiffener	Centerline Supply, Inc.	Information not available at this time
X-Tube, 1 3/4" sqare plastic with X-stiffener	Davidson Palstics Corp. (Model T3B)	Information not available at this time
InteCell Integral Skin Expanded Foam PVC Sheet	Inteplast Group, LTD	Information not available at this time
FRP Pipe, 3" diameter	Hwy Com, Inc.	No recycled content
HDPE Pipe, 3 3/4" diameter	Eastern Metal/USA Sign	Information not available at this time
Stiffeners for a Type-III Barricade		
HPPL, 2x4 rectangular or 4x4 square	**Recycled Plastic Products, Inc.**	**100% post consumer and post industrial HDPE plastic**
HPPL, 2x4 rectangular or 4x4 square	**Aeolian Enterprises**	**Percentage varies according to production run and color. (white-up to 25%, gray-between 25-75%, black-up to 100%)**
HPPL, 2x4 rectangular or 4x4 square	**Fender Enterprises, Inc.**	**No more than 25-30% recycled content**
HPPL, 2x4 rectangular or 4x4 square	Bufftech	All virgin plastics
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Allied Tube and Conduit Corp.**	**All steel contains recycled content**
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Fender Enterprises, Inc.**	**All steel contains recycled content**
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Ulitmate Highway Sales, Inc.**	**All steel contains recycled content**
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Unistrut Corp.**	**All steel contains recycled content**
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Western Highway Products, Inc.**	**All steel contains recycled content**
Steel Tubing, circular metal, 2 3/8" diameter	**P & H Tube Corp.**	**All steel contains recycled content**
Steel Tubing, circular metal, 2 3/8" diameter	Any other manufacturer	All steel contains recycled content

Stiffeners for a Type-III Barricade, cont.		
Solid plastic lumber (SPL), 2x4 rectangular	**Recycled Plastic Products, Inc.**	**100% post consumer and post industrial HDPE plastic**
Solid plastic lumber (SPL), 2x4 rectangular	Metro Plastic Barricades	Information not available at this time
X-Tube, 1 3/4" square plastic with X-stiffener	Centerline Supply, Inc.	Information not available at this time
X-Tube, 1 3/4" square plastic with X-stiffener	Davidson Palstics Corp. (Model T3B)	Information not available at this time
Mid-rail Stiffeners (Type-III Barricade)		
HPPL, 2x4 rectangular or 4x4 square	**Recycled Plastic Products, Inc.**	**100% post consumer and post industrial HDPE plastic**
HPPL, 2x4 rectangular or 4x4 square	**Aeolian Enterprises**	**Percentage varies according to production run and color. (white-up to 25%, gray-between 25-75%, black-up to 100%)**
HPPL, 2x4 rectangular or 4x4 square	**Fender Enterprises, Inc.**	**No more than 25-30% recycled content**
HPPL, 2x4 rectangular or 4x4 square	Bufftech	All virgin plastics
X-Tube, 1 3/4" sqare plastic with X-stiffener	Centerline Supply, Inc.	Information not available at this time
X-Tube, 1 3/4" sqare plastic with X-stiffener	Davidson Palstics Corp. (Model T3B)	Information not available at this time
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Allied Tube and Conduit Corp.**	**All steel contains recycled content**
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Fender Enterprises, Inc.**	**All steel contains recycled content**
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Ulitmate Highway Sales, Inc.**	**All steel contains recycled content**
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Unistrut Corp.**	**All steel contains recycled content**
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Western Highway Products, Inc.**	**All steel contains recycled content**

Mid-rail Stiffeners (Type-III Barricade), cont.		
Solid plastic lumber (SPL), 2x4 rectangular	Metro Plastic Barricades	Information not available at this time
Solid plastic lumber (SPL), 2x4 rectangular	**Recycled Plastic Products, Inc.**	**100% post consumer and post industrial HDPE plastic**
SPL, 2x6 rectangular	**Recycled Plastic Products, Inc.**	**100% post consumer and post industrial HDPE plastic**
SPL, 2x6 rectangular	Metro Plastic Barricades	Information not available at this time
Crumb Rubber	Rad-Tec Fabricators, Inc	Information not available at this time
Posts (Fixed-Type Type-III Barricade)		
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Allied Tube and Conduit Corp.**	**All steel contains recycled content**
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Fender Enterprises, Inc.**	**All steel contains recycled content**
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Ulitmate Highway Sales, Inc.**	**All steel contains recycled content**
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Unistrut Corp.**	**All steel contains recycled content**
Steel Tubing, perforated square metal, 1 1/2" square, 12 gauge	**Western Highway Products, Inc.**	**All steel contains recycled content**
Steel Tubing, circular metal, 2 3/8" diameter	**P & H Tube Corp.**	**All steel contains recycled content**
V-Loc Socket System	TAPCO - Traffic & Parking Control Co., Inc.	Information not available at this time
FRP	Hwy Com, Inc.	All virgin material
FRP	Universal Anchor Systems, L.L.C.	No recycled content
DIRECTIONAL INDICATOR BARRICADES		
Directional Indicator Barricades	IRS Directional Indicator Barricade (IRS - Impact Recovery Systems)	Information not available at this time
Directional Indicator Barricades	SafetyCade S.H.R.P. (WLI Industries, Inc.)	Information not available at this time

VERTICAL PANELS		
Substrates for Rigid Vertical Panels		
Polyethylene panel, 1/8" thick	Fender Enterprises, Inc.	Information not available at this time
Polyethylene panel, 1/4" thick	Fender Enterprises, Inc.	Information not available at this time
ABS acrylic	International Plastics Corp.	Information not available at this time
Fiberglass reinforced polycarbonate	International Plastics Corp.	Information not available at this time
Polyplate Fiberglass reinforced plastic sign panel	Sequentia Inc.	Information not available at this time
Fiber-Brite	US Highway Products	Information not available at this time
Survivor	US Highway Products	Information not available at this time
Plastic Waffle Board, 1/4" thick	Fender Enterprises, Inc.	Information not available at this time
Self-Righting Vertical Panel		
IRS self-righting VP	IRS - Impact Recovery Systems	No post consumer plastic in products. All virgin plastic.
H.I.T.M.E. self-righting VP	Traffic Control Systems	Information not available at this time
Portable Rigid Vertical Panel Systems		
T-top stackable vertical panel with 30lb. Base	BENT Manufacturing Co.	Can use any amount of recycled materials based on customer specifications
Melba, US-System '98 Model M1B-V-36EG/EG	Eastern Metal/USA Sign	Information not available at this time
Fendercade VP	Fender Enterprises, Inc.	Information not available at this time
8x24 or 12x36" VP	**Flasher Flare South East, Inc.**	**Contains 20-40% recycled plastic**
Msi DuraSTem recycled VP	MSI - Mateial Sales International	Information not available at this time
Vertical Panel with crumb rubber base	Rad-Tec Fabricators, Inc	Information not available at this time
Models VPB-36 and 44VPs	Service & Materials Co. (Flex-O-Lite)	Information not available at this time
DDK VP	Service Signing, L.C.	Information not available at this time
Grabber VP with 30 lb. base	**TrafFix Devices, Inc.**	**75-90% recycled rubber**
42" Navigator VP	Plastic Safety Systems, Inc.	Information not available at this time
SafetyCade VP	WLI Industries, Inc.	Information not available at this time
EDGELINE CHANNELIZERS		
Edgeline Channelizers		
T-top stackable channelizer with rubber base	BENT Manufacturing Co.	Can use any amount of recycled materials based on customer specifications

CONES		
42" Navigator	Plastic Safety Systems, Inc.	Information not available at this time
42" Grabber Cone	**TrafFix Devices, Inc.**	**75-90% recycled rubber**
Two-Piece Cones		
T-Top Stackable Channelizer with rubber base	BENT Manufacturing Co.	Can use any amount of recycled materials based on customer specifications
28" Navigator	Plastic Safety Systems, Inc.	Information not available at this time
42" Navigator	Plastic Safety Systems, Inc.	Information not available at this time
28" Grabber Cone	**TrafFix Devices, Inc.**	**75-90% recycled rubber**
42" Grabber Cone	**TrafFix Devices, Inc.**	**75-90% recycled rubber**
DRUMS		
Plastic Drums		
Superdome (LDPE or HDPE) with plastic snap-on base	BENT Manufacturing Co.	Can use any amount of recycled materials based on customer specifications
Superdome (LDPE or HDPE) with 40 lb. solid base	BENT Manufacturing Co.	Can use any amount of recycled materials based on customer specifications
TRI-TIX with plain base	Lakeside Plastics	Information not available at this time
Lifegard Channelizer with recycled truck tire sidewall base	Plastic Safety Systems, Inc.	Information not available at this time
LD10 with plain base	Radiator Specialty Company	Information not available at this time
18000-HDPE or 18000-LDPEw sand bag snap-on base	**TrafFix Devices, Inc.**	**"Road Base" is 100% recycled rubber**
18000-HDPE or 18000-LDPE with San-Fil snap-on base	**TrafFix Devices, Inc.**	**"Road Base" is 100% recycled rubber**
18000-HDPE or 18000-LDPE with 40lb. rubber snap-on base	**TrafFix Devices, Inc.**	**"Road Base" is 100% recycled rubber**
18000-HDPE or 18000-LDPE with recycled truck tire side-wall base	**TrafFix Devices, Inc.**	**"Road Base" is 100% recycled rubber**
Plastic Safety Barrel	Work Area Protection Corp.	Information not available at this time

Substrates for Signs Used on Plastic Drums		
Fiberglass reinforced polycarbonate sign substrate	International Plastics Corp.	Information not available at this time
Polyethylene panel	Fender Enterprises, Inc.	Information not available at this time
ABS acrylic	International Plastics Corp.	Information not available at this time
Polyplate Fiberglass reinforced plastic sign panel	Sequentia Inc.	Information not available at this time
Fiber-Brite sign panel	US Highway Products	Information not available at this time
Survivor	US Highway Products	Information not available at this time
SIGNS AND SIGN SUPPORTS		
Portable Sign Supports		
X-601 Aluminum Interstate Series stand for roll-up signs	Eastern Metals/USA Sign	Information not available at this time
FRP pipe with dual-purpose base	Hwy Com, Inc.	No recycled content
Little Buster sign stand	**TrafFix Devices, Inc.**	**All steel. All steel contains recycled content.**
Big Buster sign stand	**TrafFix Devices, Inc.**	**All steel. All steel contains recycled content.**
Post-type Sign Supports		
Quick-Punch 14-gauge 2" square tubing	**Unistrut Corp.**	**Steel components. All steel contains recycled content.**
Square metal tubing	**Allied Tube and Conduit Corp.**	**Steel components. All steel contains recycled content.**
Square metal tubing	**Centerline Supply, Inc.**	**Steel components. All steel contains recycled content.**
Square metal tubing	**Fender Enterprises, Inc.**	**Steel components. All steel contains recycled content.**
Square metal tubing	Ultimate Highway Sales, Inc.	Information not available at this time
Square metal tubing	Unistrut Corp.	Steel components. All steel contains recycled content.

Post-type Sign Supports, cont.		
Base-bolted sign post system using Franklin Flanged Channel	Franklin Industries	Information not available at this time
FRP pipe	Hwy Com, Inc.	No recycled content
FRP pipe	Universal Anchor Systems, L.L.C.	No recycled content
CP40 composite post	Lancaster Composite	Information not available at this time
Lap Splice U-Channel Breakaway System	**Marion Steel**	**Steel components. All steel contains recycled content**
NEX 12 or 14-gauge octagonal tubing	**Centerline Supply, Inc.**	**Steel components. All steel contains recycled content.**
Slip Safe U-Channel Slip Base System	**Marion Steel**	**Steel components. All steel contains recycled content.**
Tubing, circular metal	**P&H Tube Corp.**	**Steel components. All steel contains recycled content.**
Type "L"& Type "M" Microlam Laminated Veneer Lumber post	Trus Joist MacMillan	Information not available at this time
V-Loc Socket System	TAPCO - Traffic & Parking Control Co., Inc.	Information not available at this time
Substrates for Use on Long-Term/Intermediate-Term Sign Supports		
Polyplate Fiberglass Reinforced Plastic Sign Panel	Sequentia Inc.	Information not available at this time
InteCell integral skin expanded foam PVC sheet	Interplast Group, Ltd.	Information not available at this time
Short-Term/Short-Duration Sign Supports		
SZ-130 Stand for roll-up signs	**Bone Safety Signs**	**Metal components contain recycled content.**
C-102 High Perforamnce Stand for roll-up signs	Eastern Metals/USA Sign	Information not available at this time
C-202 Steel Super-Flex Compact Stand for roll-up signs	**Eastern Metals/USA Sign**	**Steel components. All steel contains recycled content.**
X-501 Aluminum Interstate Series Stand for roll-up signs	Eastern Metals/USA Sign	Information not available at this time
X-551 Steel Interstate Series Stand for roll-up signs	**Eastern Metals/USA Sign**	**Steel components. All steel contains recycled content.**
MBC-12 and MBC-15 Interstate X-Stand Median Barrier Clamp for use with X-501 and X-551 supports above.	Eastern Metals/USA Sign	Information not available at this time

Short-Term/Short-Duration Sign Supports, cont.		
DL-1003W Stand for roll-up signs	Fender Enterprises, Inc./Dicke Tool	Information not available at this time
DL-3000W Stand for roll-up signs	Fender Enterprises, Inc./Dicke Tool	Information not available at this time
FRP pipe with dual-purpose base	Hwy Com, Inc.	No recycled content
50SM SteelMaster Stand for roll-up signs	MDI - Material Displays International	No recycled content
40SMU SteelMaster Stand for roll-up signs	MDI - Material Displays International	No recycled content
50SMU SteelMaster Stand for roll-up signs	MDI - Material Displays International	No recycled content
4818 windMaster Stand for roll-up signs	MDI - Material Displays International	No recycled content
4814DLK WindMaster Stand for roll-up signs	MDI - Material Displays International	No recycled content
4814HDK WindMaster Stand for roll-up signs	MDI - Material Displays International	No recycled content
Quadra Flex V Models QFV and QFV-W	Service & Materials Co. (Flex-O-Lite)	Information not available at this time
Quadra Lite V Models QLV and QLV-W	Service & Materials Co. (Flex-O-Lite)	Information not available at this time
Zepher Stand for roll-up signs	**TrafFix Devices, Inc.**	**100% recycled rubber (total of 30 lbs of rubber)**
Little Buster Stand for roll-up signs	**TrafFix Devices, Inc.**	**All steel (all steel contains recycled content)**
TrafFix Step'N Drop Stand for roll-up signs	**TrafFix Devices, Inc.**	**Metal parts contain recycled material.**
PORTABLE TRAFFIC SIGNALS		
Portable Traffic Signals		
All-Star Traffic Control System - QPVRF 1000	International Traffic Systems - Texas, Inc.	Information not available at this time
GLARE SCREEN		
Glare Screen		
Carsonite Glare Screen	Carsonite International	Information not available at this time
SAFE-HIT Glare Screen System	Safe-Hit Corp.	Information not available at this time

Appendix #2

This appendix provides definitions and EPA-suggested minimum recycled contents for

- barricades (Type I and II);
- TCDs (channelizers, delineators and flexible delineators);
- parking stops;
- safety fencing; and
- traffic cones.

Barricades (Type I and II only)

Traffic barricades can be used to redirect or restrict traffic in areas of highway construction or repair. They are typically made from wood, steel, plastic or a combination of these materials. Many manufacturers have switched to the use of recycled materials in both the supporting frame and rails of the barricades.

Material	Suggested Minimum Recycled Content
Plastic (HDPE, LDPE, PET)	100% recycled content (80-100% post-consumer)
Steel	25% recycled content
Fiberglass	100% recycled content

Channelizers

Channelizers are barrels or drums that direct traffic around areas of road repair and construction. Street maintenance agencies and construction contractors use channelizers on construction sites, medians, on- and off-ramps, mountainous terrain, and areas where fog and haze are common. Channelizers are designed and colored to be highly visible and can be constructed from recovered HDPE and rubber. The bases of the drums are weighted to provide stability and are often made from used tires.

Material	Suggested Minimum Recycled Content
Plastic	25-95% (post-consumer)
Rubber (base only)	100% (post-consumer)

Delineators

Delineators are temporary pavement markers that come in many shapes, sizes and compositions. They are manufactured primarily from recovered and post-consumer HDPE. Delineator bases are either steel stakes that can be driven into the ground or rubber to support the delineator on the road surface.

Material	Suggested Minimum Recycled Content
Plastic	25-90% (post-consumer)
Rubber (base only)	100% (post-consumer)
Steel (base only)	25-85% (post-consumer)

Flexible Delineators

These products are in the form of stakes and are driven into the ground. They are flexible enough for vehicles to strike them without damaging either the vehicle or the delineator. They are used at golf courses, airports, military bases, shopping centers and recreational areas.

Material	Suggested Minimum Recycled Content
Plastic	25-80% (post-consumer)

Parking Stops

Commonly found in parking lots, parking stops are used to mark parking spaces and keep vehicles from rolling beyond a designated parking area.

Material	Suggested Minimum Recycled Content
Plastic and/or Rubber	100%
Concrete Containing Coal Fly Ash	Generally 20-30% but could be up to 40%; 15% when used as partial cement replacement or as admixture in concrete.
Concrete Containing Ground Granulated Blast Furnace Slag	25-70%

Parking stops made from recycled plastic blends offer many advantages. They are virtually indestructible. They won't crack during freezing weather or when hit by cars. They are also generally much lighter weight and therefore easier to install than traditional parking stops. There are even plastic parking stops available that are made from recycled carpet fibers.

Safety Fencing

Plastic safety fencing containing recovered materials can be used to control drifting snow and sand, and as a warning or safety barrier at construction sites. Plastic fencing used in these applications goes by many names—snow fencing, temporary fencing, beach or dune fencing, warning barrier and safety barrier. Such fencing is frequently constructed from recovered and post-consumer HDPE in an open-weave.

Material	Suggested Minimum Recycled Content
Plastic	90-100% recycled content (60-100% post-consumer)

Traffic Cones

Traffic cones may be used to mark a road hazard or to direct traffic. In general, both recovered- and post-consumer content plastics are used in the upper component of the cones, and crumb rubber and/or plastics are used in the base.

Material	Suggested Minimum Recycled Content
Plastic (PVC and LDPE)	50-100% recycled content
Crumb Rubber	50-100% recycled content

Definitions from the EPA Solid Waste and Emergency Response (5306W) EPA530-F-97-036, November 1997.

- http://www.epa.gov/cpg
- http://www.epa.gov/epaoswer/non-hw/procure/products/fencing.htm

Transportation products containing recovered materials must conform to the *Manual on Uniform Highway Traffic Control Devices* used by FHWA, as well as other applicable federal requirements and specifications.

Content levels are based on the dry weight of the raw materials, exclusive of any additives such as adhesives, binders or coloring agents.