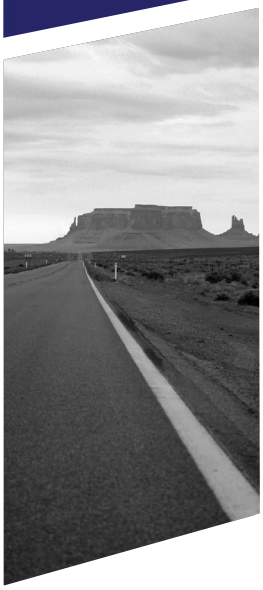
Enhancing ADOT Communications to Reduce Highway Litter in Arizona

SPR-781
November 2025



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16. Abstract

This report summarizes a statewide study commissioned by the Arizona Department of Transportation (ADOT) to inform and enhance anti-litter communications and operational litter remediation practices as they pertain to the Arizona state highway system. The project team conducted communications research, developed a highway visible litter characterization plan and tool, completed two seasonal field surveys (May and November 2023) at 60 randomized sites, analyzed litter composition and sources, identified litter hotspots, evaluated ADOT's Adopt a Highway program impacts on litter and litter abatement costs, and estimated ADOT's litter-related costs for FY2021–FY2024. Key findings include: an estimated 364.4 million pieces of litter on the SHS (38,452 pieces/mile on average), with small litter comprising 82.8% of items; tire tread dominated the inventory (173.5 million pieces; 47.6%), vehicle debris was the largest source (54%), motorists accounted for 33% of litter, and five interstate hotspots were identified. AAH volunteers contributed approximately 334,000 hours with an estimated four-year labor value of $2.5M and SHS sites that had approximately 50% less large litter than non-AAH sites. ADOT's litter abatement costs averaged $8.8–$9.5M in FY2021–FY2024. The report provides targeted recommendations for litter communications, district-level litter collection operations, financial management, and procurement. Recommendations include data tracking, contract evaluation, staff engagement, targeted operational practices, and general and targeted anti-litter communication strategies all in an effort to reduce litter, improve cost tracking, and guide future litter program and communication development and evaluation.

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Acronyms and Abbreviations

AAH	Adopt a Highway
AASHTO	American Association of State Highway and Transportation Officials
ADOT	Arizona Department of Transportation
AZ	U.S. State of Arizona
CDL	commercial driver's license
CLM	centerline miles
Communications	ADOT Communications and Public Involvement
DOT	department of transportation
DVMT	daily vehicle miles traveled
Ecology	State of Washington Department of Ecology
FHWA	Federal Highway Administration
GA	U.S. State of Georgia
GAB	Georgia Association of Broadcasters
GDOT	Georgia Department of Transportation
KAB	Keep America Beautiful
KLB	Keep Louisiana Beautiful
KPI	key performance indicator
LA	U.S. State of Louisiana
LaDOTD	Louisiana Department of Transportation & Development
MAG	Maricopa Association of Governments
MOE	margin of error
NTIS	National Technical Information Service
PECOS	Performance Evaluation Cost System
PPE	personal protective equipment
SHS	State Highway System
SR	State Route
TDOT	Tennessee Department of Transportation
TN	U.S. State of Tennessee
TOC	table of contents
TRDP	technical report documentation page; the first page in an ADOT technical report; provides information about the report to NTIS; required by ADOT for technical reports; also called Form DOT F 1700.7

UDOT	State of Utah Department of Transportation
UT	U.S. State of Utah
WA	U.S. State of Washington
WSDOT	State of Washington Department of Transportation

Introduction

The State of Arizona is one of the most scenic states in the United States (U.S.), famous for the Grand Canyon, its dramatic desert landscapes, mountains, and rivers. It is home to 7.5 million residents and a destination for 45 million annual visitors. Residents and visitors use Arizona's State Highway System (SHS), which consists of more than 21,000 lane miles, to reach beautiful destinations. Unfortunately, litter has become part of the SHS landscape. The Arizona Department of Transportation (ADOT) is committed to keeping the SHS clean to keep motorists and passengers safe, maintain a healthy, beautiful environment, and to maintain the state's tourism economy.

Study Overview

To identify and document the current litter situation along ADOT's SHS and recommend strategies to inform the anti-litter messaging produced by ADOT's Communications and Public Involvement (Communications), the research team conducted litter research with the following tasks:

- **Research anti-litter communications:** Researched statewide litter prevention campaigns, provided case studies for five statewide campaigns, and reported findings.
- **Develop a highway visible litter characterization study plan and tool:** Defined a method for field study research, study parameters, and developed the data-collection tool with which field research would be conducted.
- **Conduct two seasons of field research:** Visited 60 designated SHS sites in May 2023, and November 2023, to observe, count, and determine the composition and sources of roadway litter.
- **Analyze litter characterization data:** Analyzed the data collected during field research and provided the results of the analysis.
- **Estimate litter costs:** Reviewed ADOT-supplied data to estimate the agency's litter-related costs from fiscal year 2021 through fiscal year 2024.
- **Analyze, interpret, and report study findings:** Reviewed and analyzed the preceding tasks and is reporting final study findings and recommendations in this report.

What is Litter?

Litter is waste that is disposed of improperly. This study differentiated between two sizes of litter. Large litter was defined in this study as items four inches long and larger when measured from any point. Large litter items vary in size, including handheld items like beverage bottles and very large items like lumber that fell from a truck. Conversely, small litter was defined in this study as items smaller than four inches measured from any point, such as a credit card. Items like pieces of broken or deteriorated beverage containers, cigarette butts, and beverage bottle caps are all small litter.

People may intentionally or unintentionally litter. Intentional littering examples include tossing a beverage bottle out of a vehicle window, dropping a cigarette butt or chewing gum on the ground, and leaving food packaging behind at a rest area picnic table. Unintentional littering examples include an automobile accident in which vehicle debris is left on the roadway, motorists not properly securing a vehicle load resulting in debris falling onto a roadway, and vehicle tires blowing out and leaving tire shreds on the roadway.

Why Study Litter?

The objective of this study was to inform ADOT in the enhancement of its anti-litter communication strategies. This research establishes a baseline for the quantity, composition, and sources of litter on the SHS from which strategies can be developed.

At the time of this study, an estimated 364.4 million pieces of litter were on the Arizona SHS, which equates to a rate of 32,382 to 44,522 pieces of litter per mile. Litter impacts roadway safety—litter on roadways can cause automobile accidents and damage to vehicles that may result in serious injuries and fatalities. Studying litter provides opportunities to develop strategies for litter cleanup and prevention that keep people safe and support ADOT's 2025–2029 Strategic Plan focus to "reduce fatalities 20% by June 2029."

Litter also impacts the environment, economic development, and the scenic qualities of the SHS for Arizona residents and visitors alike. Significant annual costs for ADOT, other government agencies, community-based organizations, businesses, and individuals arise from managing and remediating litter. This study found that ADOT's cost to clean up litter in fiscal year 2024 was $9.5 million; however, that figure will likely grow as ADOT begins to implement more comprehensive litter cost-tracking measures.

Litter is not a problem unique to Arizona; it is a national problem. Keep America Beautiful (KAB), a national nonprofit with a mission "to inspire and educate people to take action every day to improve and beautify their community environment," has completed national roadway litter studies and subsequent updates. In its 2020 National Litter Study, KAB estimated that 23.7 billion pieces of litter were present along United States roadways.

What Did This Study Find?

Tire Treads, Cigarette Butts, and Beverage Packaging

This study found that 82.8 percent of all litter, an estimated 301.8 million individual pieces, on the SHS were small and often difficult to identify. Conversely, only 62.6 million pieces of litter were large. Regardless of size, the top five identifiable litter items were the following:

1. Tire treads
2. Cigarette butts
3. Construction and demolition debris
4. Vehicle debris
5. Broken glass or ceramic pieces

One category of litter materials stood out: tire treads, defined as partial scraps of tires and often caused by tire blowouts. Both large and small pieces of littered tire treads were found on the SHS, and they accounted for 47.6 percent of all the litter observed, an estimated 173.5 million pieces. For perspective, cigarette butts accounted for 6.9 percent of all litter observed on the SHS at an estimated 25 million pieces.

One other finding stood out in the study: the prevalence of beverage packaging. When the research team looked beyond material groups and individual material categories like plastic bottles, they found that 32.2 million beverage bottles, cups, lids, straws, and other beverage packaging made from paper, plastic, glass, and metal were on the SHS at the time of the study.

Adopt a Highway Volunteers are Effective and Valuable

ADOT's Adopt a Highway (AAH) program is incredibly valuable. This program not only spreads an anti-littering message, its volunteers also save ADOT expenses and labor hours because they donate their time to clean SHS segments. Between 2021 and 2024, Arizonans who volunteered through the AAH program contributed approximately 334,000 hours and a labor value over $2.5 million to ADOT litter collection efforts. During the field research portion of this study, when AAH sites were observed and compared to non-AAH sites, the research team found that the AAH sites contained approximately half the amount of large litter that other sites contained. All of these statistics indicate a healthy and thriving AAH program that is making a significant impact on litter in Arizona.

Recommendations

The recommendations in this section were developed with the results of the communications research, the visible litter analysis, and the litter cost estimation portions of this study, as well as with feedback from the ADOT technical advisory committee that participated in the study. The recommendations that follow are for specific divisions and, in some cases, call for cross-division and cross-department collaboration. It is paramount to the success of ADOT's litter communications and cleanup operations that staff—from all levels, leadership to maintenance crews—are involved in implementing recommendations. It is especially important that decision makers become involved early in the process and are prepared to understand the challenges litter presents from study documentation and from ADOT employees who frequently engage with litter.

Communications and District Maintenance Staff

The recommendations in this subsection are meant to be considered by Communications and District Maintenance staff in collaboration with the Financial Management Services and Procurement divisions. Should ADOT choose to pursue the recommendations, ADOT will benefit from the participation of personnel who have first-hand experience working with litter-related contractors and service providers. The objective of this set of recommendations is to create mechanisms through which ADOT may collect the data it needs to evaluate and compare in-house, volunteer, and contracted litter cleanups. The data essential to these evaluations are the location of litter collection, the full cost of collection, including labor, equipment, and disposal costs, and litter tonnage collected. With this information, ADOT may be able to compare the costs per ton and per labor hour and make decisions about how litter cleanup operations will proceed.

Evaluate Litter-Related Contracts

This recommendation includes reviewing current contracts or service agreements associated with litter-related contractors and services to understand what data those providers are contractually required to provide and if they are providing it.

It is recommended that ADOT review contracts and service agreements with the following contractors and service providers:

1. Highway litter collection contractors/providers
2. Sponsor a Highway-approved contractors/providers
3. Waste and recycling collection contractors, which may include haulers and disposal/material recovery facilities
4. Street sweeping contractors/providers, which may include equipment operators, waste haulers, and disposal/material recovery facilities

The following evaluative questions may aid ADOT personnel as they review contracts and service agreements:

1. Which of the following elements is the contractor required to report to ADOT?
2. Waste/recycling tonnage
3. Disposal costs
4. Pick up frequency/dates
5. Can the requirements listed in the previous question be added at any of the following times?
6. Now, with a contract addendum
7. At the renewal of the contract, with a contract addendum or similar document
8. During procurement of a future contract/service agreement
9. When/if new contract requirements are established, answer the following:
10. How will the contractor or service provider deliver the contractual data? Examples of delivery are invoices for service and quarterly reports.
11. Which ADOT entity(ies) will receive, review, and track that data?

With the information gathered by following the recommendations above, ADOT may develop a system where the data obtained from contractors and service providers is captured, and responsible ADOT entities report the data to Communications at an established frequency.

Evaluate Existing ADOT Litter Cost Data

ADOT provided litter-related cost data for the litter cost estimation portion of this study, which found that ADOT has the opportunity to develop a more comprehensive understanding of its litter costs through improved data tracking. The objective of this recommendation is to understand which litter data can reasonably be tracked and determine how and by whom the data will be tracked. The following ADOT data sources currently exist:

1. Performance Evaluation Cost System (PECOS) reports, organized by fiscal year, that include the following activities by ADOT district:
    a. 1501 Full-Width Litter Pick-Up
    b. 1502 Spot Litter & Debris Pick-Up
    c. 9313 Contract Litter (on call)
2. AAH volunteer participation reports by calendar, including the number of volunteers, volunteer hours, and litter tons collected
3. ADOT's annual cost for waste collection

Current data may be reviewed to identify the following:

1. What ADOT entity(ies) is responsible for creating, tracking, and recording the data?
2. What is included in the specific data categories?
3. Is the cost calculated by fiscal or calendar year?

An example recommendation is to identify the individual elements included in ADOT's annual cost for waste collection. Some of those elements may include contract or service provider costs for waste and/or recycling at rest areas, ADOT administrative offices, and ADOT district maintenance yards; internal labor costs to service rest area trash and recycling receptacles; and material costs like trash-can liner bags and gloves worn to collect trash. To obtain this information, ADOT personnel may need to review individual line items or invoices.

Evaluate Data Gaps

After ADOT reviews existing cost data, it may begin to fill the gaps in its litter data collection. The objective of this recommendation is to organize the data that ADOT needs to develop procedures to evaluate litter costs through future data tracking efforts. For example, ADOT is currently able to evaluate how much litter per hour AAH volunteers collect because it tracks volunteer hours and litter tons collected from each AAH cleanup event. If ADOT wishes to compare AAH cleanups to in-house or contractor cleanups in the future, then it must begin to track litter tonnage collected and labor hours expended by in-house maintenance crews and contractor cleanup crews. The following steps are recommended:

1. Determine if each litter-specific data item can be isolated and tracked.
2. Determine what ADOT entity(ies) is responsible for creating, tracking, and recording each
3. data item.
4. List what cost(s) is included in each specific data item or the resource in which data are found.
5. Note if the cost is calculated by fiscal or calendar year.

Finalize Litter Cost-Tracking Practices

After ADOT evaluates existing litter cost data and data gaps, it may establish an internal work group, led by Communications with involvement from ADOT district staff and Financial Management Services and Procurement division personnel, to finalize a list of litter data that will be tracked, how and by whom those data will be tracked, and what they will be used to evaluate.

Litter Cleanup Operations

The recommendations in this subsection are meant to be considered by Communications in collaboration with ADOT District Management and involve ADOT staff who have first-hand experience working with litter. The objective of the recommendations in this subsection is to empower ADOT employees who work with litter to share their experience and knowledge so that future litter cleanup operations can become more comprehensive and efficient, and also so that staff can support the future adapted operations.

Hold Listening Sessions

Listening sessions, or internal stakeholder workgroups, may be essential if ADOT wishes to understand the knowledge, needs, and concerns of ADOT employees who engage with litter. The specific objectives of this recommendation are to provide employees who work with litter a forum to discuss their observations, successes, and challenges and to provide Communications and ADOT District Management with the information they need to make strategic litter cleanup operations decisions. It is recommended that ADOT follow these guidelines to create listening sessions:

1. Invites stakeholders that include all levels of ADOT employees who engage with litter.
2. It may be appropriate to hold multiple sessions with very different stakeholder groups. For example, one listening session may include maintenance crews from several ADOT districts, while another session may include ADOT district leadership and the Financial Management Services personnel they work with.
3. Assign a facilitator or moderator to lead the groups or sessions.
4. Assign an entity to record input gathered from groups or sessions.
5. During the work group gatherings or listening sessions, provide an overview of the Enhancing ADOT Communications to Reduce Highway Litter in Arizona study results and highlight the results and challenges specific to the stakeholder group that is gathered. For example, share the tire tread and small litter results with district maintenance staff.
6. Request live feedback and discussion of specific litter challenges.
7. Synthesize the results of these group meetings and report session summaries and next steps to the stakeholders involved.
8. During sessions, it is important to avoid formulating solutions, but clarifying or thought-generating questions should be asked. Examples of clarifying questions are, “What is your experience with small litter?” and “Are there tools you currently use or tools you don’t have access to that may make litter cleanup easier or more effective?”

Initiate New Operational and Administrative Practices

Following the previously recommended sessions with internal stakeholders and informed by those listening sessions, both Communications and ADOT District Management may collaborate to establish new or amended operational and administrative practices. The objective of this recommendation is to develop informed practices that empower ADOT employees because their needs and suggestions have been heard and incorporated. The list of operational recommendations that follows is meant to address some of the most impactful ways ADOT might address litter found on the SHS, but as ADOT participates in stakeholder groups, it will identify additional operational changes:

1. To prevent mowing from breaking litter into small pieces, schedule litter cleanups before mowing, especially the first mowing of a season.
2. To address the large number of tire treads on the SHS, increase the number of scheduled litter cleanups that occur in high-use corridors and litter hotspots during the hottest months when tire blowouts are more likely to occur.
3. To evaluate litter cleanup operations and make future changes, establish district-level data tracking informed by the litter cost evaluation recommendations provided by this study. An example of district-level data tracking would be requiring maintenance crews to weigh the litter they collect before depositing it in a dumpster.
4. An optional practice that ADOT may implement to avoid administrative inefficiency is to obtain district maintenance yard dumpsters for litter disposal only. In this scenario, ADOT may require the hauling contractor to provide litter tonnage and disposal costs.

Communications

Personnel from ADOT Communications champion this study and its overarching objective to enhance future litter communications. The study found that vehicle debris was responsible for 54 percent of the litter on the SHS, equating to 20,844 pieces of litter per mile; motorists were responsible for 33 percent of litter on the SHS, equating to 12,697 pieces per mile. These findings suggest that rather than develop a single anti-litter campaign, ADOT may consider both a general anti-litter campaign and strategic communications to specific audiences like drivers responsible for tire blowouts and the resulting tire tread. The objective of this recommendation is to provide ADOT Communications with suggestions for messaging based on the study findings.

Create Unifying Communication Elements

While this study finds that ADOT may benefit from directing communications toward specific audiences, it also finds that shared elements may unify ADOT's anti-litter messaging. When news organizations, citizens, and other groups seek information about litter, they will search ADOT's website, the internet, and social media for messaging. ADOT may create messaging in a way that helps individuals easily locate information and identify that it comes from ADOT. The following strategies are recommended:

1. Create an internal focus group or stakeholder group to invent and collaboratively improve litter campaign concepts and prototypes.
    a. This group may include employees from across ADOT. It is recommended that the group include some employees who engage with litter and some who do not.
    b. A creative firm may be helpful in developing concepts or performing specific market research. For a successful case study that includes a low-cost approach, reference the Georgia Department of Transportation (GDOT) case study in Technical Memo: Task #2 Review of Highway Anti-Littering Communications.

2. Develop a tagline and hashtag for all communications.
    a. *Keep It Grand!* is the name and hashtag used by another entity that promotes Grand Canyon preservation. Change ADOT's litter tagline to differentiate it. These are some suggestions:
        i. Litter Free AZ
        ii. Zero AZ Litter
        iii. AZ Doesn't Litter
        iv. Love AZ
        v. Don't Trash the Magic
        vi. Respect the Desert
    b. Taglines and hashtags should be easy to remember and type, especially on a mobile device. Easy-to-use hashtags make contributions from the public more likely. For example, an AAH volunteer group may post their litter cleanup photos with ADOT's chosen hashtag.

Create a General Anti-litter Campaign

From the results of the study's highway litter characterization analysis and the findings of the communications research, the project team compiled the following statistics and recommends their use in a general anti-litter education campaign. The objective of this recommendation is to bring attention to items that were littered on the SHS, not by material type, but by material use. For example, though a glass soda bottle and plastic soda bottle are made from different materials, people purchase and drink from those containers and sometimes toss them onto roadways. ADOT may choose to focus on these study findings:

1. 32.2 million beverage bottles, cups, lids, straws, and other beverage packaging were estimated to be on the SHS.
2. 25.1 million total cigarette butts at a rate of 2,647 per mile were estimated to be on the SHS.
3. 12.6 million pieces of food packaging (not including beverage packaging) were estimated to be on the SHS.
4. 120.3 million pieces of litter from motorists at a rate of 12,697 pieces of litter per mile were estimated to be on the SHS.

To develop its litter campaign, ADOT may consider the following recommendations:

1. Evaluate current staff capacity and consider hiring additional staff or contracting with a creative consultant for at least a portion of the campaign development.
2. Explore the low-cost ideas and possible partnerships presented in Technical Memo: Task #2 Review of Highway Anti-Littering Communications.

Create Targeted Communications

Tire Blow Outs

To specifically address tire treads, which accounted for nearly half of the litter found on the SHS, ADOT may create messaging that addresses tire blowouts at the source with the following strategies:

1. Communicate highway litter characterization shredded tires results: 173,518,200 total pieces; 18,311pieces per mile; and 47.6 percent of total litter estimated on the SHS.
2. Provide prevention strategies, such as preventative maintenance, by companies responsible for tractor and trailer maintenance, such as checking tire pressure and presence of wear, cracks, bulges, and foreign objects in tires.
3. Provide information to drivers that will prepare and empower them to preemptively take action to prevent tire blowouts in certain difficult situations. For example, "What to do if…" flyers or informational cards may be provided at rest stops, distribution centers, and other areas frequented by truck drivers. These communications may briefly and clearly describe the appropriate actions a driver should take and/or things they should say if they are asked to haul a trailer with tires that show signs of an imminent blowout.
4. Create a distribution list for messaging that includes the following entities who share responsibility for putting vehicles with quality tires on the SHS:
    a. Trucking companies
    b. Companies that lease out trailers
    c. Distribution centers and retailers
    d. Truck stops and locations with trucker lounges
    e. Commercial driver's license (CDL) training and licensing entities

Consumers and Tourists

Arizona is a destination for consumers and tourists. Residents and out-of-state visitors travel across the state in search of unique food offerings, enjoy music festivals, take advantage of year-round golf, and experience Arizona's famous canyons, rivers, desert, and wildlife. There are many specific target audiences that ADOT may identify from within this broad group of consumers and tourists. ADOT may choose to explore communications with these target audiences:

1. Sportspeople, including outdoor enthusiasts, hikers, fishers, boaters, climbers
2. People who love to experience unique food – "foodies"
3. Festivalgoers, including music lovers, foodies, film lovers, and culture enthusiasts

The audiences listed above are also potential tourists and customers for private businesses and state and local tourism organizations. It is recommended that ADOT explore partnerships and sponsorships with these entities:

1. Arizona Department of Tourism
2. Local chambers of commerce
3. Sports gear manufacturers and retailers
4. Travel companies, including travel agencies, airlines, etc.
5. Food and beverage and restaurant associations
6. Food and beverage manufacturers and retailers

Create Tools for Enforcement Entities

ADOT is not an enforcement agency, but it could empower other entities like police and disposal facility managers with communication tools that aid enforcement and prevent litter. ADOT may engage in the following strategies to develop tools that promote litter enforcement:

1. Create a fact sheet(s) that summarizes and cites litter violation statutes, penalties, and procedures.
2. Create a short and simple flyer that promotes prevention of litter from unsecured loads, especially loads created by small waste haulers and building contractors.
3. Provide communication tools to:
    a. Enforcement agencies
    b. Trucking-related entities like CDL training and licensing entities, trucking companies, and distribution centers
    c. Waste-related entities like haulers and disposal facility operators
    d. Building and construction entities like registered contractors, supply stores, and big-box stores

Findings

Anti-Litter Communication Research

For the purpose of this study, an anti-littering campaign is defined as an organized series of actions developed with the purpose of discouraging littering and promoting litter prevention. The project team conducted anti-litter communication research through online investigations into statewide anti-litter campaigns in all 50 U.S. states. It narrowed down its research by selecting the five most recent, robust, and innovative campaigns, researched them further online, and interviewed the staff who developed and managed them. From that research, best practices and unique campaign development strategies emerged.

Communications Research Findings

The five state campaigns the communications research focused on were Georgia, Louisiana, Tennessee, Utah, and Washington. Each state department of transportation's (DOT's) campaign launch expense varied, as shown in Table 1. Georgia attributes its low $60,000 campaign launch cost to its preexisting media contract with the Georgia Association of Broadcasters and its partnership with the Georgia Department of Economic Development. Tennessee's anti-littering campaign was the most expensive campaign, and it was made possible by the state's beer barrelage and soft drink excise taxes.

Table 1. State DOT Litter Expenditures and Anti-Littering Campaign Expenses.

State	Population	Total State DOT-Owned Centerline Miles(1)	Annual DOT Litter Abatement Expense ($)	Initial Anti-Littering Campaign Expense ($)
Arizona	7,151,502	6,863	3.6 M	N/A
Georgia	10,711,908	17,906	12.0 M	60,000
Louisiana	4,657,757	17,042	13.0 M	1,000,000
Tennessee	6,910,840	14,064	12.5 M	3,500,000
Utah	3,271,616	5,905	2.5 M	500,000
Washington	7,705,281	7,052	12.5 M	1,000,000

(1) Source: Federal Highway Administration (FHWA). Highway Statistics 2022.

The majority of these statewide anti-littering campaigns were informed by statewide studies on roadway litter and marketing or creative consultants. For example, based on litter research, both Utah and Washington specifically targeted drivers who transport loads that should be secured to prevent materials from falling or blowing out. Based on litter and market research, Georgia, Louisiana, and Tennessee targeted the general public with messages that appealed to residents' state pride.

Each of the researched anti-littering campaigns included radio and television advertisements as well as social media content, with YouTube®, Facebook®, Instagram®, and X (formerly known as Twitter®) being the most popular social media platforms. These states, with the exception of Tennessee, used their parent-agency's social media channels to publish campaign content and take advantage of the agencies' existing followers. The research of the statewide anti-littering campaign case studies also revealed a variety of options and considerations for potential anti-littering communications, from engaging in intergovernmental partnerships to targeting specific audiences.

Case Studies

Georgia Campaign: *Keep It Clean Georgia*

In 2020, the Georgia Department of Transportation (GDOT) Office of Strategic Communications launched the *Keep It Clean Georgia* campaign to address litter statewide. GDOT reported that it spent $50,000 to $60,000 with a creative consultant to develop the initial campaign and spends $15,000 to $20,000 annually with that consultant to update the campaign. The campaign focuses on all areas of the state, not just on roadways, and messaging engages audiences with state pride, prior knowledge of popular destinations, humor, and references to popular culture like the reference to Taylor Swift's Eras Tour in Figure 1.

Figure 1. *Keep it Clean Georgia* Social Media Image.

Louisiana Campaign: *Let Louisiana Shine*

In 2022, as a result of the Governor's Task Force on Statewide Litter Abatement and Beautification, the State of Louisiana and Keep Louisiana Beautiful (KLB) launched an anti-littering campaign called *Let Louisiana Shine*. KLB manages the campaign, which is funded by the Office of the Lieutenant Governor and the Louisiana Department of Tourism with $1 million a year. The initial campaign included three

phases that communicated how litter is a problem, what citizens can do about it the current litter situation, and how citizens can prevent litter from accumulating in the future. The campaign strategically highlights prevalent litter items like fast-food packaging, as shown in Figure 2, and specific audiences like sportspeople, as shown in Figure 3.

Figure 2. ***Let Louisiana Shine*** **Motorist-Focused Social Media Story from KLB's Marketing Toolkit.**

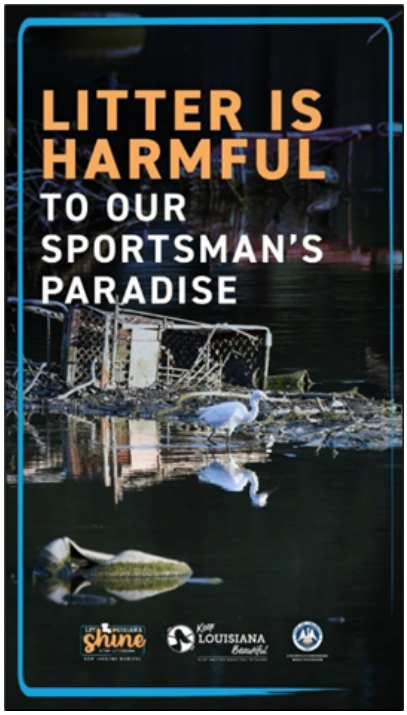

Figure 3. ***Let Louisiana Shine*** **Sportsman-Focused Social Media Story from KLB's Marketing Toolkit.**

To enhance community involvement, KLB made a marketing toolkit available to the public through its website and fostered a rich network of anti-littering advocates across the state, including public libraries, schools, mayoral offices, and chambers of commerce.

Tennessee Campaign: *Nobody Trashes Tennessee*

The Tennessee Department of Transportation (TDOT) developed the *Nobody Trashes Tennessee* campaign. The campaign's current target audience is motorists, based on the results of its 2022 litter study. The campaign includes a YouTube video series with the cast pictured in Figure 4.

Figure 4. The TDOT Public Service Announcement Cast of Characters.

TDOT's campaign is funded by an excise tax on the sale of soft drinks and a beer barrelage tax. The two taxes generate approximately $8.5 million in annual funding. Each year, the campaign spends approximately $2.5 million on paid media and $1 million on marketing to sports fans. A marketing firm researches and produces the campaign. Messaging is also informed by TDOT's periodic roadway litter studies.

Utah Campaign: *Keep It Clean, Utah*

In 2021, the Utah Department of Transportation (UDOT) launched the *Keep It Clean, Utah*, at a cost of $500,000, to address litter from unsecured loads, Utah's most common source of roadside litter. The *Keep It Clean, Utah* campaign used humorous 15-second videos featuring characters that represent litter, as shown in Figure 5.

Figure 5. Keep It Clean, Utah Social Media Image Featuring Unsecured Load Characters.

Washington Campaign: We Keep WA Litter Free

In 2021, Washington Department of Ecology (Ecology) launched *We Keep WA Litter Free*. The campaign has since been updated, informed by the 2022 Washington Statewide Litter Study. The campaign includes television and radio ads, social media posts, brochures, and partnerships with big-box stores where residents can receive litter bags to keep in their vehicles. In 2026, Ecology will again study roadway litter and use the study results to inform its anti-litter campaign strategies.

Findings

This communication research identified the following methods to educate the public about the harmful impacts of littering within a wide range of budgets:

- Use the findings of roadway litter studies to inform campaign strategies.
- Use still images and video.
- Use preexisting social media channels to spread the message.

The research also identified cost-saving practices like these:

- Intergovernmental and cross-agency partnerships may provide photographs, videos, and access to existing media contracts.
- Unused radio and/or television airtime may be purchased from a state media association at a reduced rate.
- There are free assets available that do not require licensing. Examples are songs in the public domain, song titles, and popular culture references.
- Provision of litter education to enforcement entities and disposal facility managers can promote roadway litter prevention.
- Co-branding opportunities may exist with other state agencies, businesses, and nonprofit organizations.

Highway Visible Litter Characterization Study Plan and Tool

The project team developed a study plan and tool to guide its field research, including the sampling plan, litter characterization plan, and surveying protocol that follow.

Sampling Plan

The project team developed a plan detailing how and where it would survey litter on the SHS. The plan included defining that the total area the study represented was the entire SHS, including interstate highways, U.S. routes, and state routes. The objective of the sampling plan was to create a sample of a large-enough number of sites across a large-enough area that the team could create statistically meaningful litter estimates representative of the entire SHS. The plan called for the survey of 60 SHS sites. Each site was surveyed during season one, May 2023, and season two, November 2023, for a total of 120 samples.

Sample sites on the SHS and in ADOT districts, in both urban and rural areas, were randomly selected by a computerized process. In discussions with ADOT, the project team agreed that the number of samples proportionately allocated to the Central District would be reduced to prevent oversampling from this district because the Maricopa Association of Governments (MAG) is in this district and has specific funding for litter removal. The samples reduced from the Central District were reallocated to other ADOT districts.

Litter Characterization Plan

For this project, litter was categorized into six material groups: paper, plastic, glass, metal, organics, and other. Each of those groups included categories that further subdivided litter, creating a total of 88 material categories. The project team used these categories to characterize litter at each survey site. They also characterized litter by assigning a litter source to every litter item observed. Those sources are defined in Table 2.

Table 2. Litter Sources.

Litter Source	Definition
Motorist	Drivers and passengers improperly discarding trash from vehicles.
Pedestrians	Persons improperly discarding trash while walking or cycling.
Improperly Secured Loads	Improperly discarded trash from inadequately secured loads (e.g., trash from garbage trucks or pickup truck beds).
Overflowing Containers	Improperly discarded trash in the immediate vicinity of trash and recycling containers (e.g., overflowing litter receptacles).
Vehicle Debris	Improperly discarded trash resulting from transportation corridors (e.g., tire tread and vehicle accident debris).

Surveying Protocol

During seasons one and two of the litter study fieldwork, the project team followed safety and sampling protocols consistent with national litter studies such as the KAB 2020 National Litter Study and customized for fieldwork on the Arizona SHS.

Highway Visible Litter Characterization

Overview

The *Litter Characterization* portion of this study included visiting all the planned survey sites. At each site, the project team systematically quantified litter and applied defined characteristics to every piece of observed and counted litter. The litter characteristics the project team defined and collected during this study follow:

- **Litter size:** Litter was defined as two sizes: large litter items, which are four inches or larger from any axis point; and small litter items, which are smaller than four inches at the longest dimension.
- **Litter composition:** There were six litter material groups and 88 litter material categories as previously defined in the Highway Visible Litter Characterization Study Plan and Tools portion of the *Findings* section of this report.
- **Litter Sources:** There were five litter sources that could be attributed to each piece of observed litter as previously defined in the Highway Visible Litter Characterization Study Plan and Tools portion of the *Findings* section of this report.
- **Location:** Litter was characterized by where it was observed. Observations occurred at Arizona SHS roadway sites. These sites were characterized by roadway type, urban or rural demography, and ADOT district as shown in Figure 6.

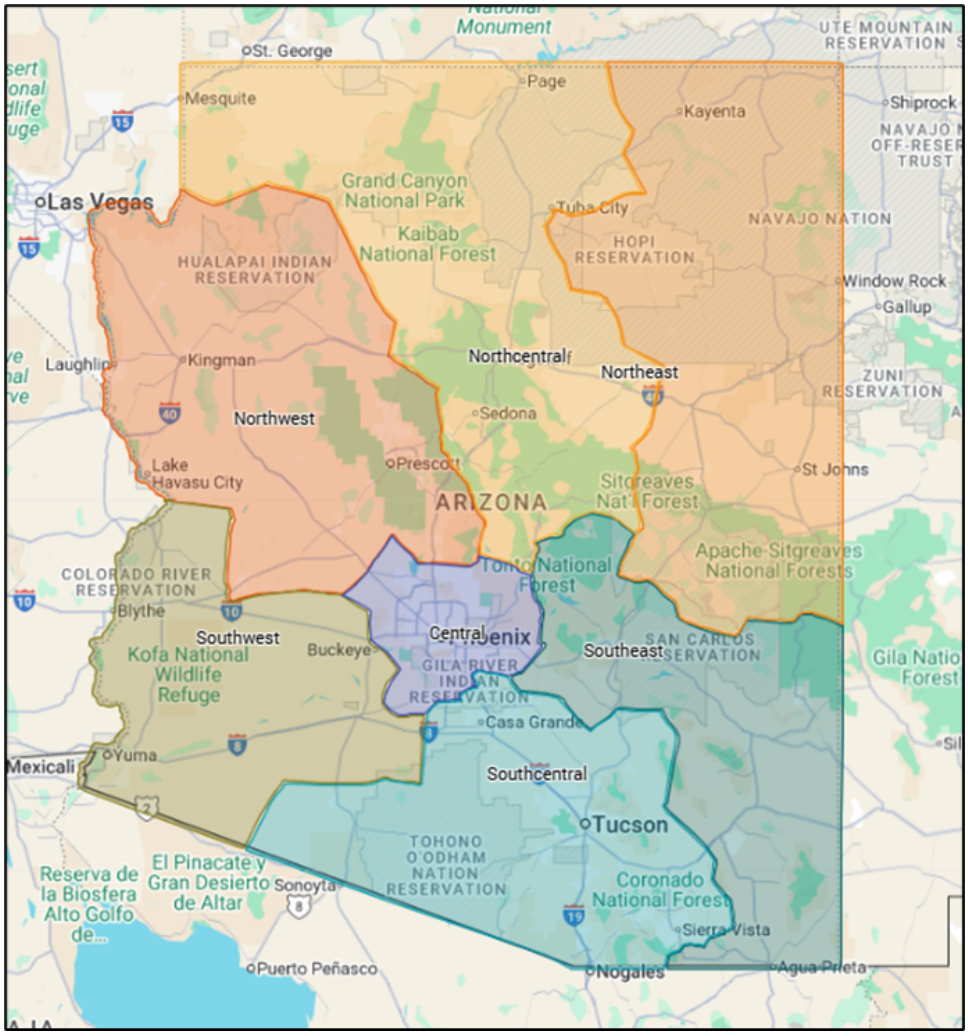

Figure 6. ADOT Maintenance Districts.

ADOT Districts and the MAG Region

In coordination with ADOT staff, the project team recognized the MAG, a region that receives specific funding for litter abatement. As shown in Figure 7, the MAG region, represented by the gray shape overlaid on ADOT maintenance districts, exists in the Northwest, Northcentral, Southeast, Southcentral, Southwest, and Central maintenance districts. It almost completely covers the Central District.

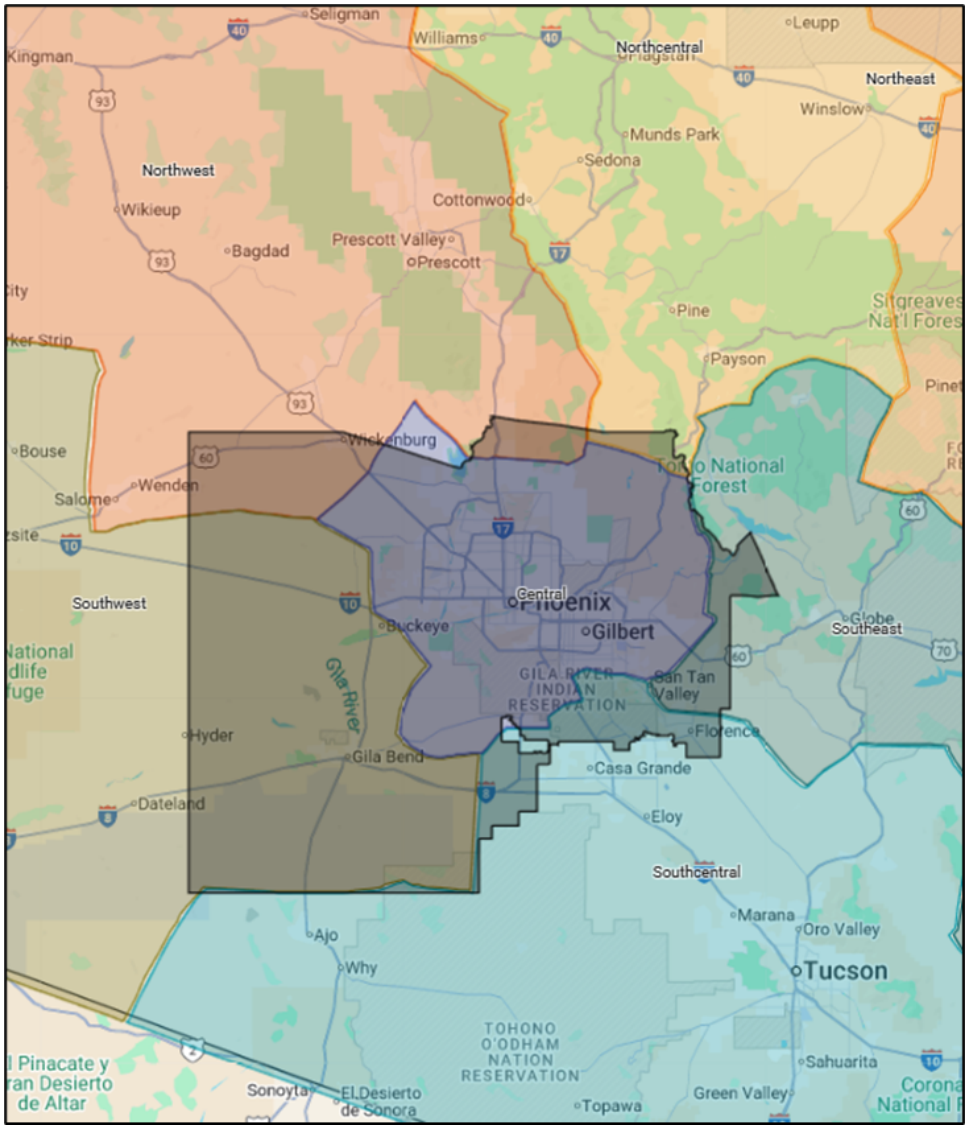

Figure 7. MAG Region Overlayed on ADOT Maintenance Districts.

Results of the study will be presented in two ways: statewide results that include all ADOT maintenance districts and statewide results that exclude the Central maintenance district in place of MAG. These results will be presented as "Excluding MAG" in the results section.

Results

The results reported in this portion of the study include the following key metrics:

- Litter incidence (litter pieces per mile)
- Total litter
- Percentage of total litter
- Litter items per capita (the number of litter items per resident)

The following statistical principles were used during this study and should be reviewed to understand the study results:

- **Point-in-Time Estimates:** This study uses point-in-time estimates to assess the amount of litter present along ADOT roadways at a specific moment. Rather than measuring change over time, point-in-time estimates offer a snapshot of conditions as observed during the survey. These estimates do not represent annual, quarterly, or long-term averages. If this study is repeated at a different time, some of the same roadway segments may show significantly different litter levels due to fluctuations in litter generation, cleanup activities, and environmental factors that influence litter accumulation and dispersal.
- **Margins of Error:** Where appropriate, the results of this study include margins of error (MOEs) so that the metrics presented can be understood as ranges in which the results fall. The MOE for small litter items is significantly higher than for large litter because there is greater variability in small litter counts across sampling locations.

Statewide Results

The study estimated a statewide litter incidence of 32,382 to 44,522 pieces per mile, with an average litter incidence of 38,452 pieces per mile. Litter incidence fluctuated by roadway type, with the highest estimated litter incidence on interstate highways at 86,037 pieces per mile. Litter incidence on state routes was estimated at 15,841 pieces per mile, and litter incidence on U.S. routes was estimated at 14,212 pieces per mile. This study also estimated between 306.9 million and 421.9 million total pieces of litter on the SHS, with an average piece count of 364.4 million.

Statewide litter per capita, or pieces of litter per Arizona resident, was estimated to be between 39.5 and 56.7 pieces with an average rate of approximately 48 pieces of litter per resident on the SHS. It was highest on interstate highways at an average of 35.8 pieces per capita, much lower on U.S. routes at approximately eight pieces per capita, and lower yet on state routes at 4.4 pieces per capita. Litter per capita was calculated by dividing total statewide litter by total Arizona residents, based on 2024 U.S. Census data. Litter per capita for each roadway type was calculated by dividing total litter on each roadway type by the total number of Arizona residents. Table 3 presents statewide results of this study.

Table 3. Statewide SHS Litter Incidence by Roadway Type.

Roadway Types	Samples (#)	Litter Incidence (Pieces/Mile)	MOE: Litter Incidence (Pieces/Mile)	Roadway Miles (CLM)	Total Litter Count (Pieces in Millions)	MOE: Total Litter Count (Pieces in Millions)	Percent of All Litter (%)	MOE: Percent of All Litter (%)	Litter Items per Capita* (Pieces)	MOE: Litter Items per Capita* (Pieces)
Interstate	40	86,037	*+/- 16,507*	3,151	271.1	*+/- 52.0*	74.4	*+/- 14.3*	35.8	*+/- 6.9*
U.S. Route	46	14,212	*+/- 2,742*	2,092	60.2	*+/- 11.6*	16.5	*+/- 3.2*	7.9	*+/- 1.5*
State Route	34	15,841	*+/- 4,487*	4,234	33.1	*+/- 9.4*	9.1	*+/- 2.6*	4.4	*+/- 1.2*
Total (+/- MOE)	**120**	**38,452**	***+/- 6,070***	**9,476**	**364.4**	***+/- 57.5***	**100.0**	**—**	**48.1**	***+/- 8.6***

Source: U.S. Census Bureau; Arizona Statewide Population of 7,582,384 (2024).
* DVMT (ADOT, 2023) Statewide Excluding MAG.

Without MAG, litter incidence dropped to between 31,989 and 42,343 pieces per mile with a median of 37,166 pieces of litter per mile. This brings the estimate of total litter pieces on the entire SHS from 373.7 million down to 295.8 million pieces. Interestingly, when the MAG region is removed from the count, the number of litter items for these roadways increases to between 95 and 126 pieces per capita. Table 4 presents statewide results that exclude the MAG region.

Table 4. Statewide Litter Incidence by Roadway Type, Excluding MAG.

Roadway Type	Samples (#)	Litter Incidence (Pieces/Mile)	MOE: Litter Incidence (Pieces/Mile)	Roadway Miles (CLM)	Total Litter Count (Pieces in Millions)	MOE: Total Litter Count (Pieces in Millions)	Percent of All Litter (%)	MOE: Percent of All Litter (%)	Litter Items per Capita* (Pieces)	MOE: Litter Items per Capita** (Pieces)
Interstate	34	80,130	*+/- 12,819*	2,780	222.7	*+/- 35.6*	75.3	*+/- 12.0*	85.4	*+/- 13.6*
U.S. Route	40	14,559	*+/- 6,429*	1,874	48.1	*+/- 12.0*	16.3	*+/- 3.4*	18.5	*+/- 3.8*
State Route	32	13,311	*+/- 1,996*	3,305	24.9	*+/- 6.6*	8.4	*+/- 1.7*	9.6	*+/- 1.9*
Total (+/- MOE)	**106**	**37,166**	***+/- 4,591***	**7,959**	**295.8**	***+/- 36.5***	**100.0**	**—**	**113.4**	***+/- 14.3***

* Based on state population (minus Maricopa and Pinal Counties) of 2,683,280 (2024).
** DVMT Source: Mary Currie, Adopt a Highway Communications, unpublished data, 2023.

Table 5 shows the breakdown of litter by ADOT district, including litter incidence (pieces per mile), total litter count (pieces), and the percentage of all litter found in each region. These results presented by ADOT district do not include a statistically representative number of samples and therefore include high MOEs. They should be viewed as offering insight and opportunity for further, more detailed study.

Table 5. Litter Incidence by ADOT Maintenance District.

ADOT Maintenance District	Samples (#)	Litter Incidence (Pieces/Mile)	MOE: Litter Incidence (Pieces/Mile)	Roadway Miles (CLM)	Total Litter Count (Pieces in Millions)	MOE: Total Litter Count (Pieces in Millions)	Percent of All Litter (%)	MOE: Percent of All Litter (%)
Central	14	45,196	*+/- 40,129*	1,518	69.0	*+/- 60.9*	18.80	*+/- 16.7*
Northcentral	22	30,337	*+/- 4,371*	1,523	46.0	*+/- 6.7*	12.70	*+/- 1.8*
Northeast	18	16,792	*+/- 5,499*	1,431	24.0	*+/- 7.9*	6.60	*+/- 2.2*
Northwest	12	34,589	*+/- 9,945*	1,380	48.0	*+/- 13.7*	13.10	*+/- 3.8*
Southcentral	20	62,596	*+/- 19,416*	1,520	95.0	*+/- 29.5*	26.10	*+/- 8.1*
Southeast	12	11,714	*+/- 5,051*	1,125	13.0	*+/- 5.7*	3.60	*+/- 1.6*
Southwest	22	70,914	*+/- 10,472*	980	69.5	*+/- 10.3*	19.10	*+/- 2.8*
Total	**120**	**38,452**	***+/- 6,070***	**9,476**	**364.0**	***+/- 57.5***	**100.00%**	**—**

Source: ADOT (2023).

Results by Litter Source

This study estimated that vehicle debris, defined as improperly discarded trash located along transportation corridors (e.g., tire tread and vehicle accident debris), was the litter source for over 54 percent of the litter observed. This was followed by intentional motorist litter sources, defined as drivers and passengers improperly discarding trash from vehicles, as the source of roughly 33 percent. Litter that results from improperly secured loads is the third largest source of litter; it accounted for over 12 percent of the litter observed in this study. Other sources, including pedestrians and overflowing containers, contributed very little to the litter observed along the SHS. This is likely due to the limited pedestrian access and activity on state highways, which are primarily designed for vehicle traffic. Figure 8 summarizes the litter sources identified in the study.

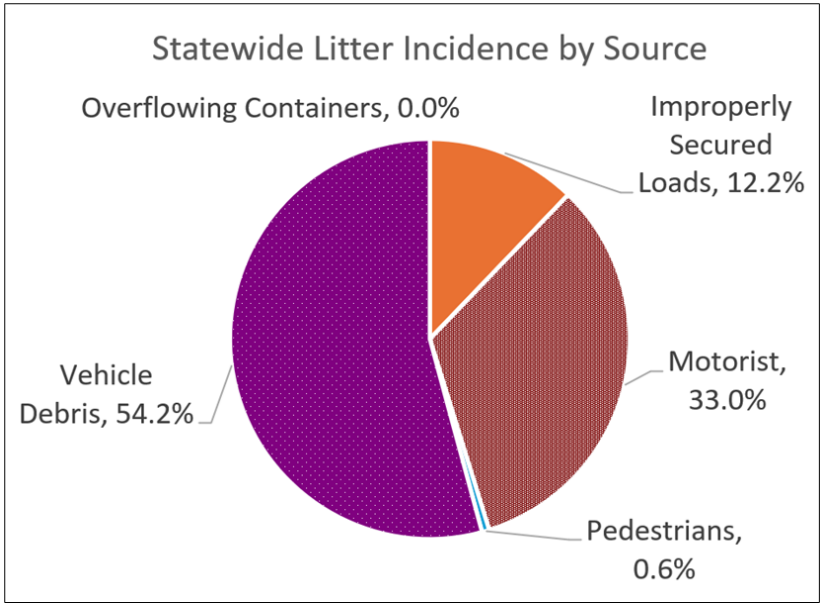

Figure 8. Statewide Litter Incidence by Source.

This study estimated that vehicle debris was the source of 20,844 pieces per mile, motorists were the source of 12,697 pieces per mile, and improperly secured loads were the source of 4,683 pieces per mile. Out of 373.7 million pieces of litter on Arizona's SHS, litter from vehicle debris accounted for 197.5 million total pieces. Litter incidence, total litter, percent of all litter, and litter items per capita by source are tabulated in Table 6.

Table 6. Statewide Litter by Source.

Litter Source	Litter Incidence (Pieces/Mile)	MOE: Litter Incidence (Pieces/Mile)	Roadway Miles (CLM)	Total Litter Count (Pieces in Millions)	MOE: Total Litter Count (Pieces in Millions)	Percent of All Litter (%)	MOE: Percent of All Litter (%)	Litter Items per Capita* (Pieces)	MOE: Litter Items per Capita (Pieces)
Overflowing Containers	0	*N/A*	9,476	0.0	*N/A*	0.00%	*N/A*	0.0	*N/A*
Improperly Secured Loads	4,683	*+/- 3,524*	9,476	44.4	*+/- 33.4*	12.20%	*+/- 9.2%*	5.9	*+/- 4.4*
Motorists	12,697	*+/- 1,489*	9,476	120.3	*+/- 14.1*	33.00%	*+/- 3.9%*	15.9	*+/- 1.9*
Pedestrians	228	*+/- 265*	9,476	2.2	*+/- 2.5*	0.60%	*+/- 0.7%*	0.3	*+/- 0.3*
Vehicle Debris	20,844	*+/- 3,359*	9,476	197.5	*+/- 31.8*	54.20%	*+/- 8.7%*	26.1	*+/- 4.2*
Total	**39,438**	***+/- 6,070***	**47,382**	**364.4**	***+/- 57.5***	**100.00%**	**—**	**48.1**	***+/- 8.6***

* Based on state population of 7,582,384 (2024).

Results by Litter Composition and Size

Understanding the types of materials and their relative sizes will help ADOT develop strategies for litter abatement, public education, and source reduction. The results provide insight into which materials are most prevalent and how their physical characteristics may influence visibility, cleanup efforts, and environmental impacts. The composition of the entire SHS is visually summarized in the Figure 9 pie chart and detailed in the Appendix. The pie chart presents the proportional breakdown of litter pieces per mile by material group, highlighting the dominant presence of the other material group that accounts for over 63 percent of all items and includes the tire tread material category which accounts for 48 percent of the total litter observed in the study. Figure 10 is a photograph captured during May 2023 fieldwork; it shows shredded pieces of tire tread stretching indefinitely along the roadway. Plastic is the next most prevalent category at 16.6 percent, followed by organics, glass, metal, and paper, which all account for less than 10 percent of the total litter observed.

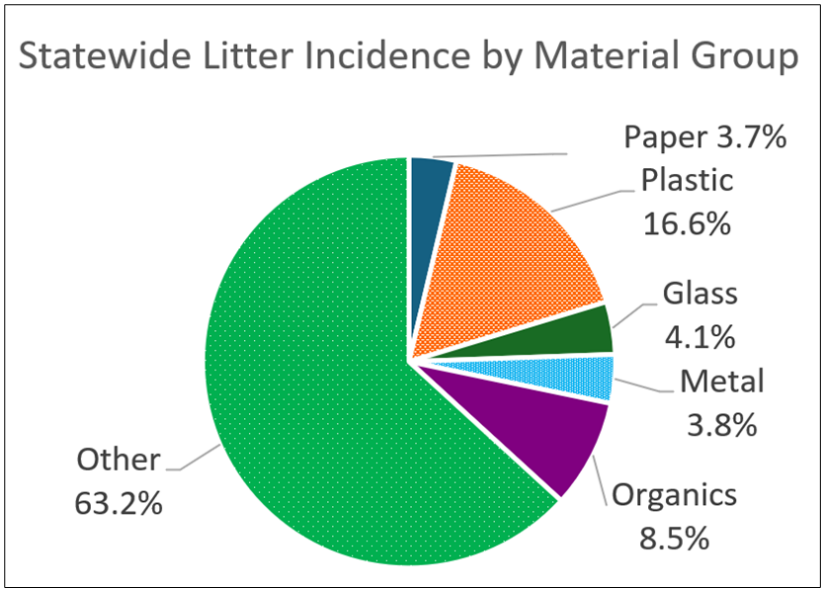

Figure 9. Statewide Litter Incidence by Material Group.

Table 7 (*Appendix*) provides detailed SHS litter results with litter counts rounded to the nearest 100. The table categorizes the six litter material groups into 88 material categories and details the number of large and small litter items per mile and in total. This breakdown into material categories shows that the most prevalent material categories are tire treads, other plastics, and other organics. It also shows that small litter totals nearly 301.8 million pieces and outnumbers large litter, which totals nearly 62.6 million pieces.

Figure 10. Tire Tread at May 2023 Sample Site RI-06, I-10, M29P.

The second most common litter group observed in this study was plastic at 16.6 percent of total litter. The most prevalent plastic material category was other plastic, defined as items made mostly of plastic that do not fit into other plastic categories. This includes items that look like plastic but are unidentifiable by the project team. In this study, most other plastic was observed as small litter. Figure 11 includes a photograph captured during the November 2023 fieldwork at Site UI-10, an urban site in the Southcentral District at milepost 261MP of I-10. Many of the litter pieces in this image are small pieces of plastic that were once part of a larger piece of litter such as a beverage container or a plastic bag. They have degraded over time and become several pieces of small litter.

Figure 11. Litter at Urban Sample Site UI-10 at 261MP of I-10.

Figure 12 highlights the most prevalent littered items that could still be clearly identified as belonging to one of the specific material categories defined in this study. Of the identifiable litter items, tire treads were the most frequently observed. This is likely due to frequent tire blowouts and wear-related failures on high-speed roadways, especially in hot climates like Arizona where pavement temperature and friction accelerate tire degradation. Following tire treads, other common items included cigarette butts, construction and demolition debris, vehicle debris, and broken glass or ceramic fragments. These top five items were predominantly small, measuring less than four inches in size, which may contribute to their persistence on the roadway due to being harder to detect and remove.

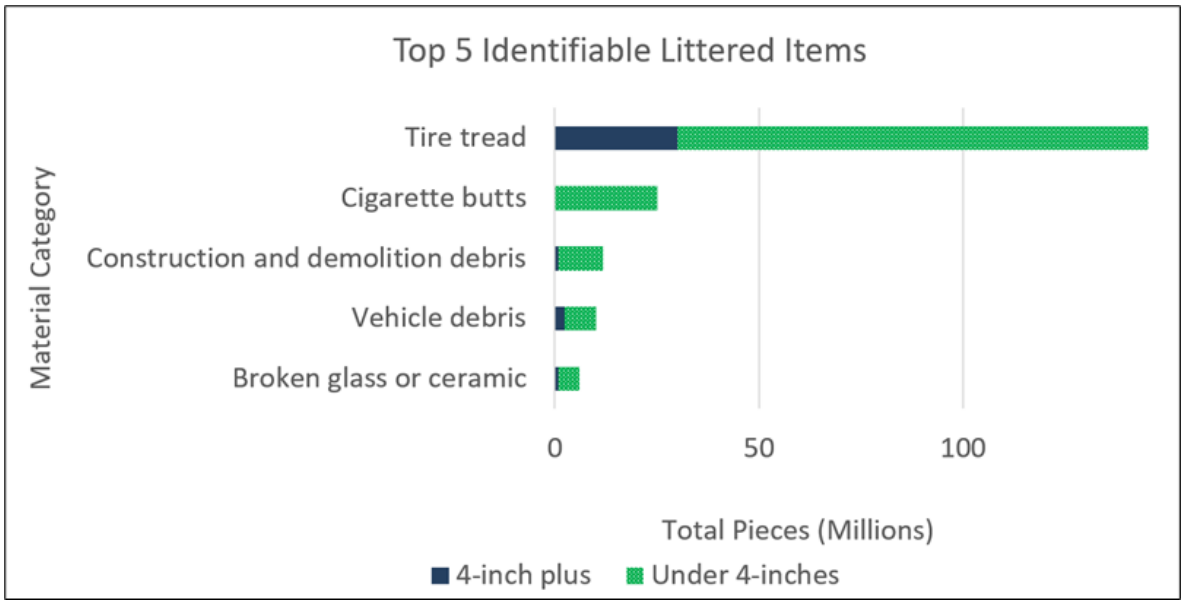

Figure 12. Top Five Identifiable Littered Items.

Litter Hotspots Results

The study identified five litter hotspots from the 60 sample sites observed. Each of the study-designated litter hotspots are along interstate highways, and none were found on any other sampled roadway types. They are shown as letters A through E in Figure 13.

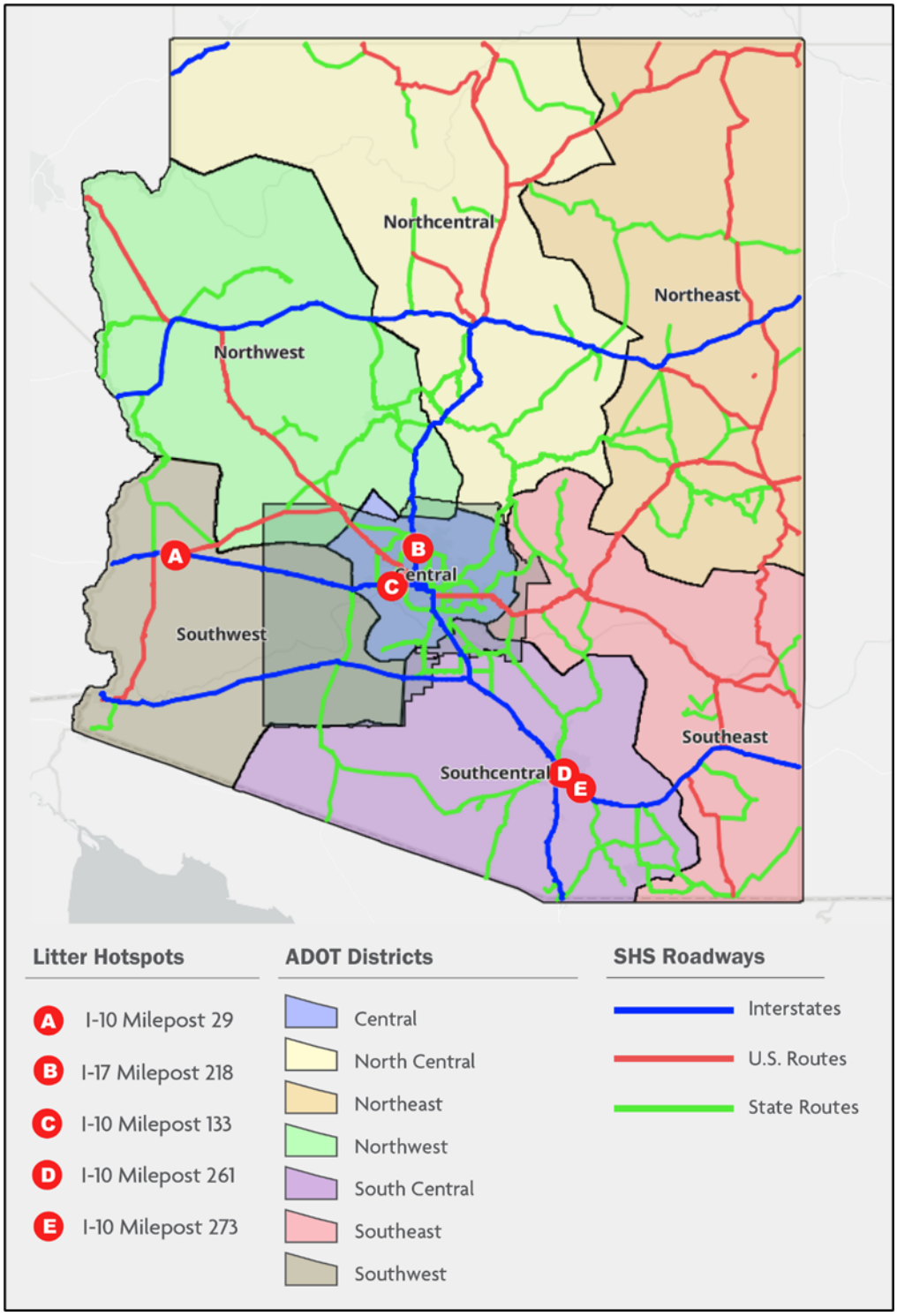

Figure 13. Hotspots Identified by Study.

Figure 14 compares the average litter incidence by material group for the five hotspot locations versus the statewide aggregate litter incidence. The results show that while all material groups increased in absolute quantity, two groups stood out in particular: other materials and organics. Other materials, which consisted primarily of tire treads, vehicle debris, and miscellaneous unidentifiable items, rose from 24,305 pieces per mile statewide to 108,895 pieces per mile when averaged across the five hotspot sites combined. This suggests a strong presence of transportation-related litter and potential locations of frequent vehicle debris. Organics increased from 3,281 pieces per mile to 48,576 pieces per mile when averaged across the five hotspot sites combined.

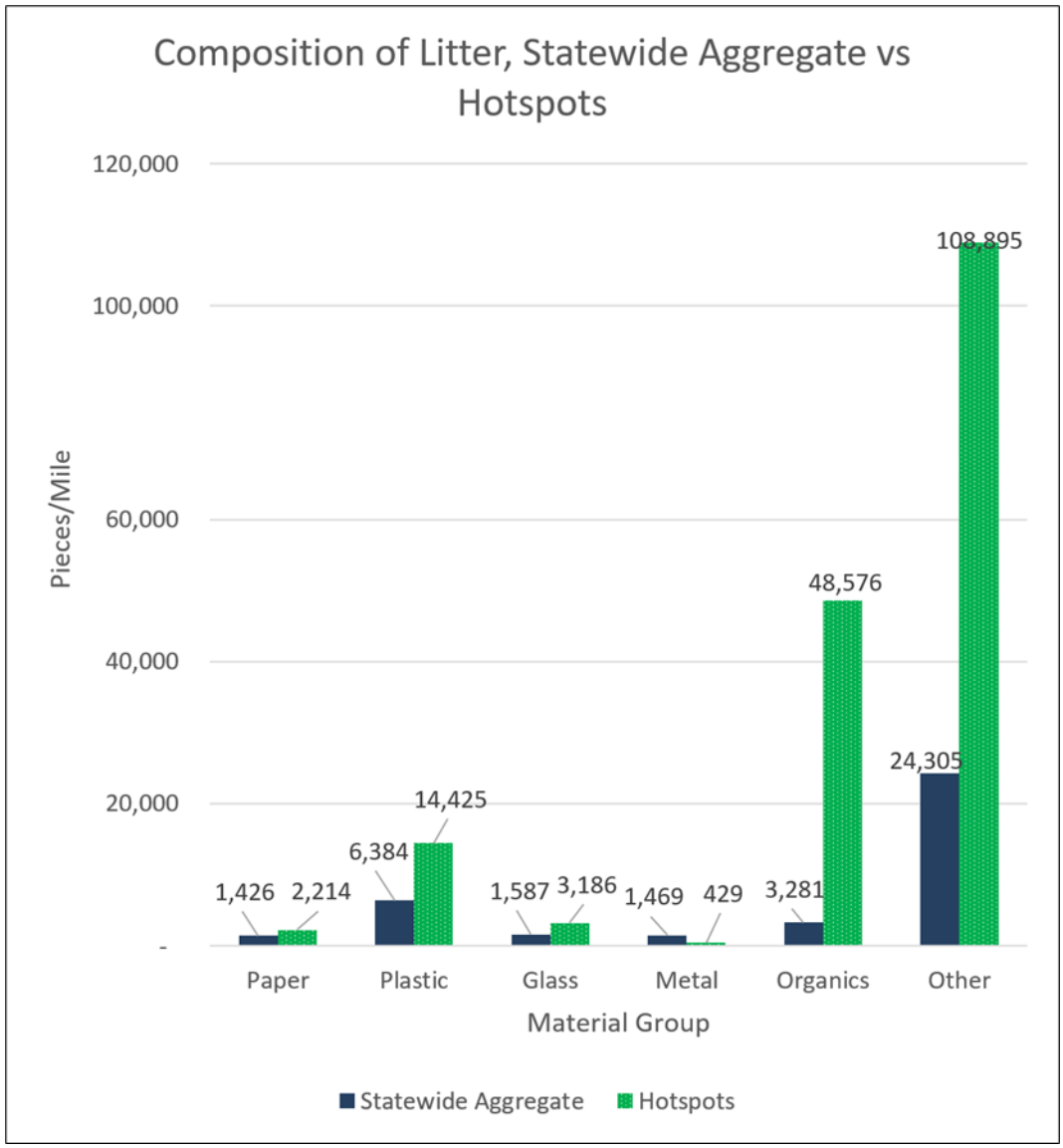

Figure 14. Composition of Litter by Material Group, Statewide Aggregate vs. Hotspots.

AAH Program Results

The AAH sites surveyed in this study had a nearly identical overall litter incidence compared to non-AAH sites, with a litter incidence of 37,706 pieces per mile versus 38,601 pieces per mile. The breakdown by litter size, however, highlights a notable difference. At AAH sites, there was 50 percent less large litter incidence than non-AAH sites. At the same time, AAH sites showed an eight percent higher small litter incidence than non-AAH sites.

Figure 15 compares litter incidence data reported in Figure 12 with large and small litter incidence from AAH sites, represented by the first bar in each pair, and non-AAH sites, represented by the second bar in each pair.

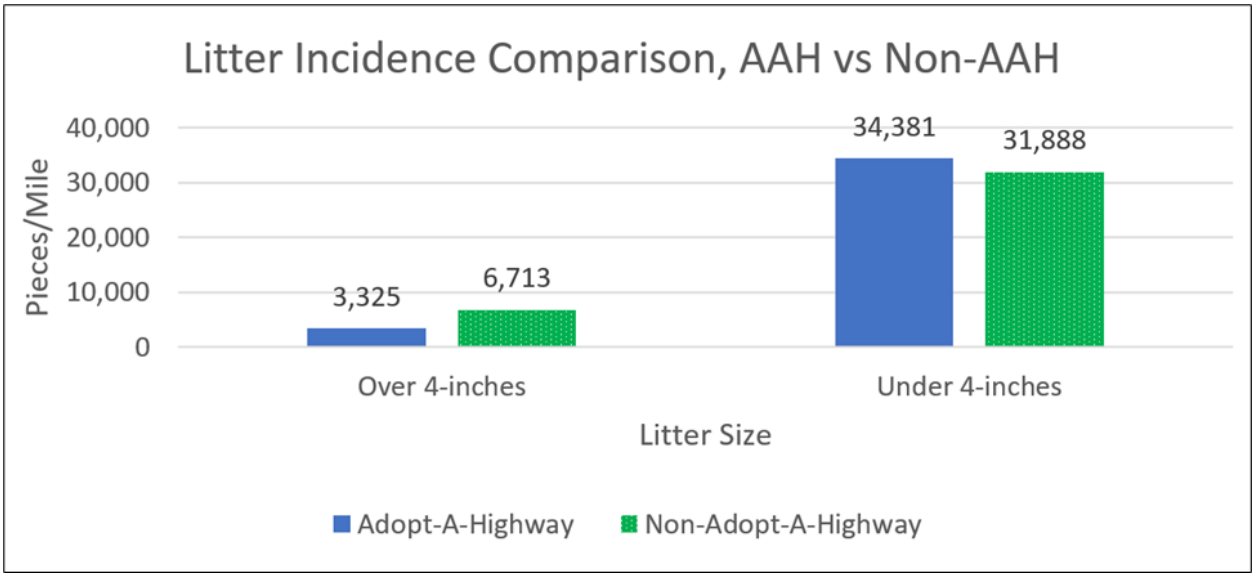

Figure 15. Litter Incidence Comparison of AAH vs. Non-AAH.

The findings indicate that while AAH sites show similar overall litter levels to non-AAH sites, volunteer cleanup efforts appear especially effective at removing larger, more visible debris such as bottles, bags, packaging, and vehicle parts. However, smaller items—including tire fragments, broken glass, plastic shards, shredded paper, and cigarette butts—are less likely to be noticed or collected, which may explain the similar higher incidence of small litter at AAH sites. This could be attributed to several practical constraints of volunteer efforts. Figure 16 is a photograph of small, difficult-to-collect litter embedded in vegetation on the SHS.

Figure 16. Litter Accumulated in Roadside Vegetation at Site UI-11 in the Southcentral District.

Key Litter Characterization Results

This study provided a snapshot of litter on the Arizona SHS and has provided ADOT with a baseline that it may use to drive litter remediation planning and interpret the impact of litter remediation and prevention strategies that it implements in the future. The following are the key results:

- **Key Result 1:** Litter incidence on the Arizona SHS at the time of this study was 38,452 pieces per mile and equates to 32,382 to 44,522 pieces of litter per mile.
- **Key Result 2:** Total litter items on the SHS numbered 306.9 million to 421.9 million pieces.
- **Key Result 3:** Litter composition was dominated by tire treads at173,518,200 total pieces, which equates to 18,311 pieces per mile. The second largest material category encountered during this study was cigarette butts at 25,086,900 total pieces.
- **Key Result 4:** Small litter accounted for 82.8 percent of all litter encountered during the study. Large litter accounted for 17.2 percent of all items. Although not measurable, a takeaway from this result is that large litter particles break apart and become multiple small litter particles over time, likely due to wind, precipitation, and other environmental interactions.
- **Key Result 5:** The most common litter source was vehicle debris at 54 percent of all litter observed in this study. Within this 54 percent, three percent of litter was in the plastic material group, and 51 percent was in the other material group that includes the tire tread and vehicle debris material categories.
- **Key Result 6:** Litter hotspots identified in this study were particularly characterized by large quantities of tire treads, organic waste, and general, unidentifiable debris. This finding suggests that these sites may benefit from targeted strategies, including regular and scheduled litter cleanups.
- **Key Result 7:** AAH sites had less than half the amount of large litter compared to non-AAH sites; however, there was eight percent more small litter at these sites compared to non-AAH sites. These results indicate that AAH efforts improve roadside conditions by removing prominent debris, but there remains an opportunity to improve small litter cleanup.

Litter Cost Estimation

Overview

It is difficult to estimate the cost of litter cleanup and other litter programs because litter activity is often included with other activities like highway maintenance and general education efforts that are dispersed across multiple departments and include volunteer efforts. In recent years, more attention has been paid to estimating the true cost of litter remediation by states around the U.S. that have created best practices in litter cost collection. Those best practices include the following categories: education and outreach, prevention, abatement, and enforcement.

ADOT's Litter Costs by Category

Litter Education and Outreach Costs

The ADOT Office of Communications and Public Involvement is responsible for litter education and outreach. It produces ADOT's current litter communications on the ADOT blog, ADOT's children's activities, social media channels, and the *On the Road with ADOT* podcast. These efforts are often combined with other transportation education efforts, and ADOT does not track staff time and associated material costs.

Litter Prevention Costs

ADOT SHS litter prevention includes supplying trash and recycling collection containers as well as pet stations stocked with pet waste bags at SHS rest areas. ADOT does not track specific hours and materials included in servicing its rest area trash, recycling, and pet stations, and therefore, these costs are not included in the cost estimation.

Litter Abatement Costs

ADOT funds litter abatement through in-house roadway litter cleanups provided by ADOT district maintenance staff, contractor litter cleanups funded by ADOT districts and Sponsor a Highway program sponsors, and AAH cleanups performed by volunteers. ADOT tracks some of the costs involved in these litter abatement activities, but there are opportunities to track more costs for a more comprehensive understanding of ADOT's true cost of litter abatement. The cost estimation included the cost data available to the project team. Many costs were not available at the time of the study, and the *Recommendations* section of this report provides guidance for tracking those costs in the future.

Litter Enforcement Costs

ADOT is not an enforcement agency, nor does it collaborate with enforcement agencies on litter violations. It therefore does not have litter enforcement costs.

Estimated Litter Costs

The following are the key results of the litter cost estimation:

- **Key Result 1:** ADOT's total estimated cost for litter includes only litter abatement costs. The following are ADOT's total litter abatement costs by fiscal year:
  - **2024:** $9.5 million statewide, $4.6 million with MAG excluded
  - **2023:** $8.8 million statewide; $3.1 million with MAG excluded
  - **2022:** $8.0 million statewide; $2.8 million with MAG excluded
  - **2021:** $8.4 million statewide; $2.7 million with MAG excluded
- **Key Result 2:** While not all of the costs included with the AAH program were available during this study —for example, the costs of PPE and collection bags were not available—the cost estimate shows that the AAH program saves money. Between 2021 and 2024, AAH volunteers contributed 334,000 labor hours, saving ADOT at least $2.5 million in litter remediation expenses.
- **Key Result 3:** ADOT has several opportunities to improve its cost tracking and to develop a comprehensive system to track litter costs. This study contains recommendations for future cost tracking.
- **Key Result 4:** ADOT faces challenges in tracking litter costs including differing operational procedures between districts, staff capacity to add additional administrative tasks, and litter-related activities that occur in multiple divisions, departments, and districts.

Methods

Anti-Litter Communication Research

To research statewide anti-litter communications, the research team conducted online research to compile information about statewide anti-litter communication campaigns, including campaign names, whether they were active, if campaigns reported on their effectiveness, and more. From that list, the research team contacted representatives engaged with the active campaigns to gauge their interest in research interviews. Five states participated in research interviews, which followed a standard list of interview questions developed for the project and approved by the ADOT project team. After the interview, the research team developed a case study and presented it to the corresponding state for review and feedback. Final case studies were included in the Technical Memo: Task #2 Review of Highway Anti-Littering Communications.

Highway Visible Litter Characterization Study Plan and Tool

In developing a study plan and tool that would guide field research for the highway visible litter characterization, the project team developed a surveying methodology, including litter material groups and categories, litter sources, sample selection, and surveying protocol consistent with national litter studies such as the KAB 2020 National Litter Study. The complete plan, detailed in Technical Memo: Task #3 Highway Visible Litter Characterization Plan and Tool Development, specified that the project team would collect the following information for each piece of litter observed in the field during this study:

- Litter size and composition
- Litter Source
- Location

The study team employed the litter characterization method adopted by KAB and adapted to this study.

Highway Visible Litter Characterization

The study analysis quantifies litter data collected through fieldwork by litter incidence, defined as the pieces of litter per centerline mile, which captures litter on both sides of the roadway, and litter pieces counts. To accomplish this, the research team organized samples into 42 distinct datasets that represent all combinations of roadway type, demographic classification (urban/rural), and ADOT maintenance districts.

The process used to analyze each of the 42 baseline datasets included the following steps:

1. The large litter counts were scaled up from 300-foot lengths to one-mile lengths, and small litter counts were scaled up from 15-foot lengths to one-mile lengths.
2. Litter counts, scaled to one-mile lengths, were averaged to achieve the average pieces of litter per mile, with equal weighting across samples within each dataset. The MOE was calculated at a 90 percent confidence level using standard statistical methods.
3. The litter counts were doubled to account for litter on both sides of the road.
4. The litter counts, now representing the amount of litter found on both sides of a roadway, were weighted according to the percentage of total centerline miles they represented.
5. Weighted datasets were summed up to produce the statewide litter incidence (pieces per mile).
6. The statewide litter incidence was multiplied by total SHS centerline miles to determine total pieces of litter.

Litter Hotspot Analysis

The project team analyzed the results of the study to identify litter hotspots within the study sample sites. The following steps were followed to determine the litter hotspots:

Calculate litter per mile for each site with the same process used in the main analysis to achieve a standardized estimate of total litter pieces per mile for each site.

1. Compute the average litter incidence (pieces per mile) and standard deviation across the full dataset, without separating sites by season.
2. Compare the litter incidence at each site against the statewide litter incidence mean to assess how far each site deviates from the norm.
3. Designate a site as a litter hotspot if the litter incidence at that site is significantly higher than the statewide litter incidence. A figure of 2.0 standard deviations above the mean is used to make this designation.

AAH Analysis

The analysis of AAH sites was added to this study after survey sites were determined, and therefore, AAH site status was not considered during the highway visible litter characterization plan and tool development. During fieldwork, the project team noted whether a site was marked with a sign that designated it as an AAH site, and after fieldwork, sites were cross-referenced with ADOT's current list of AAH permits. Both methods were used to designate surveyed sites as AAH sites and provide quality control measures. Of the 60 sites surveyed, 21 sites were designated AAH sites, and 39 sites were designated non-AAH sites. Each site was surveyed in season one and again in season two, which provided a sample of 42 AAH samples and 72 non-AAH samples. The study team compared litter based on the roadway type and urban or rural demography the site represented, at AAH sites and non-AAH sites.

Litter Cost Estimation

The research team developed a litter cost estimate based on the litter-related data that was available to ADOT. It included the following:

- Tonnages, including litter, disposed of at ADOT district maintenance yards
- Labor hours and expenses related to in-house litter cleanups
- Expenses for contacted litter cleanups
- Descriptions of litter prevention, outreach and education, abatement, and enforcement programs and activities
- Interviews with Communications staff

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Appendix

Table 7. Statewide Litter Piece Counts by Material Group, Category, and Size.

Statewide Material Category	Litter 4 Inches or More (# of Pieces)	Litter Less than 4 Inches (# of Pieces)	Litter Total (# of Pieces)	Percentage of Total Litter (%)
MATERIAL GROUP: PAPER	—	—	—	—
Fast-food paper bags	126,200	14,900	141,100	0.00%
Fast-food paper cups	398,700	0	398,700	0.10%
Other paper fast-food service items	1,357,700	511,000	1,868,700	0.50%
Cardboard	948,500	649,100	1,597,600	0.40%
Kraft bags	23,200	8,100	31,300	0.00%
Receipts	145,400	684,000	829,400	0.20%
Political signs	500	0	500	0.00%
Other advertising signs	21,400	0	21,400	0.00%
Office paper/ mail	317,500	5,700	323,200	0.10%
Newspaper/ inserts	151,500	131,200	282,700	0.10%
Magazines	18,900	133,500	152,400	0.00%
Books	9,400	66,800	76,200	0.00%
Aseptic/ gable-top containers	13,500	0	13,500	0.00%
Beverage carriers/ cartons	65,400	85,500	150,900	0.00%
Paper home food packaging	232,800	0	232,800	0.10%
Other paper	3,376,300	4,018,500	7,394,800	2.00%
Paper subtotal	**7,206,900**	**6,308,300**	**13,515,200**	**3.70%**
MATERIAL GROUP: PLASTIC	—	—	—	—
Soda	514,700	29,400	544,100	0.10%
Single-serve wine and liquor	1,045,000	58,800	1,103,800	0.30%
Other wine and liquor	50,300	0	50,300	0.00%
Sports and energy drinks	509,000	90,600	599,600	0.20%
Juice	67,000	0	67,000	0.00%
Tea and coffee	62,900	156,400	219,300	0.10%
Still water	1,977,700	23,200	2,000,900	0.50%
Other water	22,800	0	22,800	0.00%
Other plastic beverage bottles	121,400	28,900	150,300	0.00%
Loose bottle and container caps	1,800	3,500,500	3,502,300	1.00%
Fast-food plastic cups	448,300	133,700	582,000	0.20%
Plastic straws	426,900	574,200	1,001,100	0.30%
Other beverage packaging	51,900	129,400	181,300	0.00%
Plastic trash bags	98,100	187,200	285,300	0.10%

Statewide Material Category	Litter 4 Inches or More (# of Pieces)	Litter Less than 4 Inches (# of Pieces)	Litter Total (# of Pieces)	Percentage of Total Litter (%)
Other plastic bags	716,200	18,700	734,900	0.20%
Food packaging film	1,216,000	4,142,500	5,358,500	1.50%
Other film	2,415,300	3,154,600	5,569,900	1.50%
Plastic food service items	704,600	1,455,700	2,160,300	0.60%
Expanded polystyrene food service items	351,600	1,486,800	1,838,400	0.50%
Other expanded polystyrene	466,100	608,500	1,074,600	0.30%
Other plastic food packaging	286,100	689,000	975,100	0.30%
Other plastic	3,530,300	28,949,500	32,479,800	8.90%
Plastic Subtotal	**15,084,000**	**45,417,600**	**60,501,600**	**16.60%**
MATERIAL GROUP: GLASS	—	—	—	—
Beer	1,532,000	462,200	1,994,200	0.50%
Soda	613,000	35,700	648,700	0.20%
Single-serve wine and liquor	487,200	0	487,200	0.10%
Other wine and liquor	17,500	0	17,500	0.00%
Sports and energy drinks	71,700	0	71,700	0.00%
Juice	4,400	0	4,400	0.00%
Tea and coffee	54,600	101,000	155,600	0.00%
Still water	11,600	0	11,600	0.00%
Other water	1,500	823,300	824,800	0.20%
Other glass beverage bottles	365,000	3,724,300	4,089,300	1.10%
Broken glass or ceramic	764,100	5,334,000	6,098,100	1.70%
Other glass food packaging	448,300	0	448,300	0.10%
Other glass	1,500	187,200	188,700	0.10%
Glass Subtotal	**4,372,400**	**10,667,700**	**15,040,100**	**4.10%**
MATERIAL GROUP: METAL	—	—	—	—
Beer	96,400	0	96,400	0.00%
Soda	26,800	0	26,800	0.00%
Sports and energy drinks	0	0	0	0.00%
Juice	0	0	0	0.00%
Tea and coffee	7,900	0	7,900	0.00%
Still water	0	0	0	0.00%
Other water	10,000	0	10,000	0.00%
Other metal beverage bottles	7,800	7,400	15,200	0.00%
Other beverage packaging	62,900	13,076,500	13,139,400	3.60%
Metal food packaging	3,300	11,400	14,700	0.00%
Other metal	21,300	590,500	611,800	0.20%
Metal Subtotal	**236,400**	**13,685,800**	**13,922,200**	**3.80%**

Statewide Material Category	Litter 4 Inches or More (# of Pieces)	Litter Less than 4 Inches (# of Pieces)	Litter Total (# of Pieces)	Percentage of Total Litter (%)
MATERIAL GROUP: ORGANICS	—	—	—	—
Pet waste	33,200	0	33,200	0.00%
Human waste	182,600	0	182,600	0.10%
Confection	5,500	0	5,500	0.00%
Other food waste	86,800	314,700	401,500	0.10%
Other organics	98,900	30,365,700	30,464,600	8.40%
Organics Subtotal	**407,000**	**30,680,400**	**31,087,400**	**8.50%**
MATERIAL GROUP: OTHER	—	—	—	—
Medical waste	1,100	0	1,100	0.00%
PPE^ gloves	244,500	0	244,500	0.10%
PPE masks	33,700	0	33,700	0.00%
Hazardous waste	7,500	1,402,800	1,410,300	0.40%
Vehicle debris	2,267,500	7,707,700	9,975,200	2.70%
Tires	0	0	0	0.00%
Tire tread	29,915,200	143,603,000	173,518,200	47.60%
Construction and demolition debris	950,100	10,759,100	11,709,200	3.20%
Textiles/ small rugs	1,241,000	776,800	2,017,800	0.60%
Bulky items	25,900	0	25,900	0.00%
Cigarette butts	0	25,086,900	25,086,900	6.90%
Electronic cigarettes	25,100	0	25,100	0.00%
Other tobacco-related products and packaging	184,700	346,500	531,200	0.10%
Toiletries/ personal hygiene products	57,200	0	57,200	0.00%
Entertainment items	0	0	0	0.00%
Flat-screen televisions and computer monitors	0	0	0	0.00%
CRT* televisions and computer monitors	0	0	0	0.00%
Portable electronics	11,000	0	11,000	0.00%
Electronic cords	33,100	36,100	69,200	0.00%
Other electronics	9,200	0	9,200	0.00%
Other items	280,900	5,316,600	5,597,500	1.50%
Other Subtotal	**35,287,700**	**195,035,500**	**230,323,200**	**63.20%**
GRAND TOTAL	**62,594,400**	**301,795,300**	**364,389,700**	**100.00%**

^PPE = personal protective equipment

*CRT = cathode ray tube