

PERFORMANCE-BASED MAINTENANCE OF TRAFFIC CONTROL DEVICES STUDY

FINAL REPORT



Prepared for
The Regional Transportation Commission of Southern Nevada

by
Booz Allen Hamilton

Las Vegas, Nevada
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*This report is confidential and intended solely for the use and
information of the party to whom it is addressed.*

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1. EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

STUDY BACKGROUND

In February 2010, the Regional Transportation Commission of Southern Nevada (RTC) engaged Booz Allen Hamilton to develop a regional strategy towards meeting new Federal Highway Administration (FHWA) regulations regarding minimum retroreflectivity standards that will go into effect from 2012 through 2018.

The new FHWA regulations updated the Manual on Uniform Traffic Control Devices (MUTCD) in 2007 after nearly two decades of study and consultation. Retroreflectivity is a measure of nighttime visibility, and the new standards are intended to improve nighttime driving safety, especially for older drivers. Section 2A.08 in the 2009 edition of the MUTCD details the new minimum retroreflectivity, contrast, and sign material requirements by sign and sheeting type. The same section also stipulates that responsible jurisdictions must implement a management method to ensure sign assets are compliant with the MUTCD standards. In the RTC region, these jurisdictions include Clark County, as well as the cities of Las Vegas, North Las Vegas, Mesquite, Boulder City and Henderson. The MUTCD guidance identifies the following six nighttime sign visibility management approaches:

Management Method	Description
a) Timed Replacement	Signs are replaced based on the manufacturer's expected sign useful life
b) Timed Replacement with Control Signs	Signs are replaced based on the observed useful life of control signs
c) Measured Retroreflectivity	Signs are replaced based on the inspection of each sign with a retroreflectometer
d) Nighttime Visual Inspections	Signs are replaced based on the visual inspection of each sign
e) Blanket Replacement	Signs are replaced all at once by sector regardless of age or condition
f) Other Methods*	Based on engineering studies.

**Dropped from further analysis due to lack of empirical cost data.*

The FHWA regulations specify the schedule for compliance, which is based on the effective date of the final rule (January 2008):

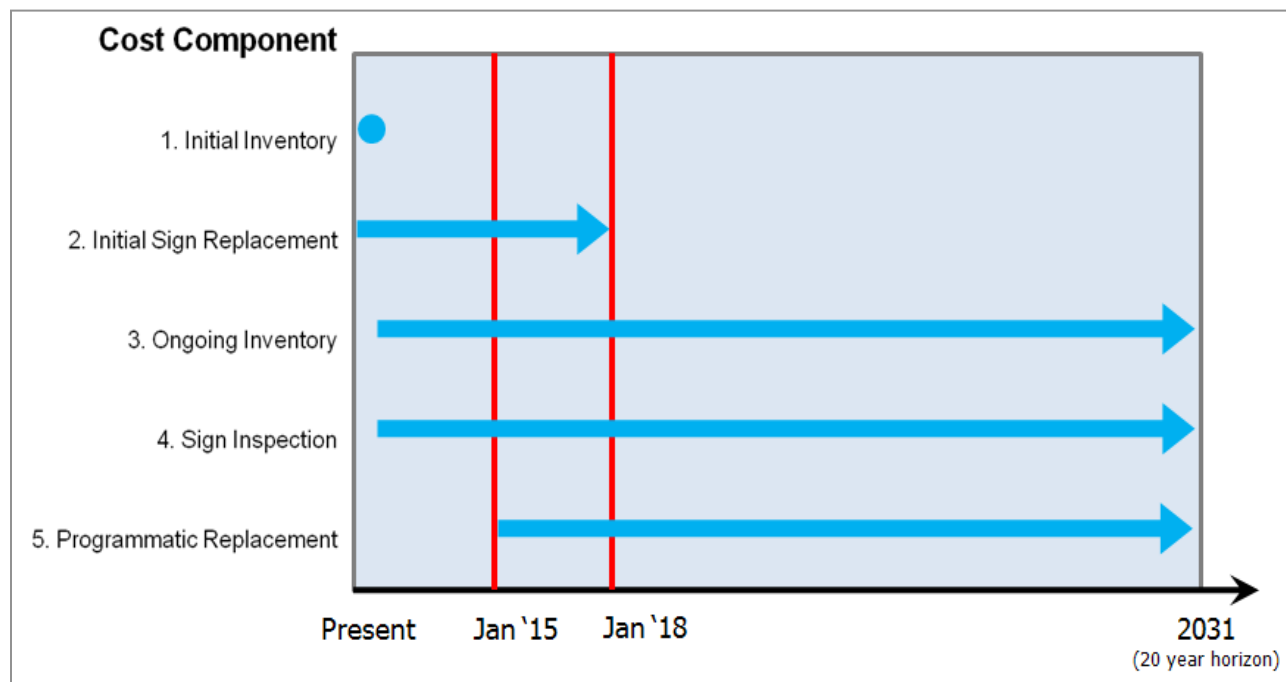
1. Establish and implement a sign retroreflectivity management method in 4 years (January 2012)

2. Replace regulatory, warning, and ground-mounted guide signs (except street name) identified as having substandard retroreflectivity in 7 years (January 2015)
3. Replace identified substandard street name and overhead guide signs in 10 years (January 2018).

DEFINITION OF COST COMPONENTS

After comprehensive on-site interviews for the local agencies and a national peer review, the consultant team developed a detailed cost model to assess, and ultimately recommend, the cost effective path forward to RTC and the individual jurisdictions.

It is critical to point out that the assessment must take into account not only the costs of completing the initial inventory (for all methods but the blanket replacement method) but also maintaining this inventory over time; the various sign replacement requirements to comply to the requirements; sign inspections over time; and also the ongoing costs to replace the sign population over time (“programmatic” replacement). The study examined a 20-Year period for the evaluation as shown below. Drawing conclusions based on fewer than all five of these cost components would be misleading as it would not capture total cost for the program.



Detailed findings and recommendations are contained in the three technical memoranda attached to this report:

1. *Summary of Local Practices* examines the current sign management practices of the six RTC members in light of the new FHWA rules

2. *Summary of Peer Practices* describes the findings from the interviews with six similar peer agencies in the southwest United States
3. *Assessment of Management Method Options* details the development of the cost model and the findings drawn from it.

REGIONAL FINDINGS FOR COST COMPONENTS

Key findings for each cost component for all six jurisdictions are presented in the table below. The estimates are based on partial data provided by the six RTC members, on cost and performance data collected from peer jurisdictions with similar characteristics, and on expected sign life and work performance standard data from a literature review. The RTC and the six jurisdictions were provided with the cost model tool to update the projections as they collected additional data.

Management Method	1. Initial Inventory	2. Initial Sign Replacement	3. Ongoing Inventory	4. Sign Inspection	5. Programmatic Replacement
a) Timed Replacement	\$1,359,381	\$33,971,288	\$56,353	\$0	\$3,842,450
b) Timed Replacement w/ Control Signs	\$1,359,381	\$33,971,288	\$56,353	\$36,261	\$3,293,529
c) Measured Retroreflectivity	\$1,359,381	\$27,127,740	\$56,353	\$1,578,045	\$3,293,529
d) Nighttime Visual Inspections	\$1,359,381	\$27,127,740	\$56,353	\$1,585,540	\$3,293,529
e) Blanket Replacement	\$0	\$40,163,794	\$0	\$0	\$4,610,940

Estimates to complete the initial inventory are \$1.4 million (2010 dollars) and the biggest cost component is the initial sign replacement, at up to \$33 million.

REGIONAL FINDINGS FOR NET PRESENT COST OF MANAGEMENT METHODS

Since the compliance costs are spread over a 20 year horizon, the consultant team conducted a net present value calculation to facilitate comparison among the sign retroreflectivity management methods. The net present value calculation discounts the 20 year stream of program expenditures to a single present equivalent for each sign management method scenario. Timed replacement with control signs is the most cost effective regional solution.

Jurisdiction	a) Timed Replacement	b) Timed Replacement w/ Control Signs	c) Measured Retroreflectivity	d) Nighttime Visual Inspections	e) Blanket Replacement
Boulder City	\$583,858	\$590,791	\$520,330	\$516,261	\$612,885
City of Las Vegas	\$16,628,671	\$15,332,428	\$21,452,283	\$18,659,959	\$21,155,369
Clark County	\$33,118,704	\$30,804,535	\$35,102,003	\$34,860,001	\$36,669,307
Henderson	\$9,903,276	\$9,176,333	\$10,757,367	\$13,993,438	\$11,387,803
Mesquite	\$1,020,112	\$991,433	\$996,026	\$982,069	\$1,016,109
North Las Vegas	\$10,983,906	\$10,231,725	\$11,159,511	\$11,068,807	\$12,693,222
Regional Total	\$72,238,527	\$67,127,244	\$79,987,520	\$80,080,536	\$83,534,695

JURISDICTION INDIVIDUAL LIFECYCLE COSTS

One interesting finding from the analysis was that individual jurisdictions did not all share the same lifecycle cost profiles for compliance. For medium and large size jurisdictions (i.e., City of Las Vegas, Clark County, City of North Las Vegas and Henderson), timed replacement with control signs clearly is the lowest expected cost method. However, the two smallest RTC jurisdictions by population, Mesquite and Boulder City, have night time sign inspections as the lowest option (close to measured retroreflectivity). The table below summarizes these findings, using a normalized scale (1.00 in bold font being the lowest) to contrast lifecycle costs for each method and each jurisdiction. For instance, for the City of North Las Vegas, blanket replacement costs 24 percent more over the 20 year lifecycle than timed replacement with control signs.

Jurisdiction	a) Timed Replacement	b) Timed Replacement w/ Control Signs	c) Measured Retroreflectivity	d) Nighttime Visual Inspections	e) Blanket Replacement
Boulder City	1.13	1.14	1.01	1.00	1.19
City of Las Vegas	1.08	1.00	1.4	1.22	1.38
Clark County	1.08	1.00	1.14	1.13	1.19
Henderson	1.08	1.00	1.17	1.52	1.24
Mesquite	1.04	1.01	1.01	1.00	1.03
North Las Vegas	1.07	1.00	1.09	1.08	1.24
Regional Total	1.08	1.00	1.19	1.19	1.25

FUNDING SOURCES

The Booz Allen team documented eight primary and five secondary sources of funding to develop the inventory and provide for on-going, programmatic sign replacement. The jurisdictions, and RTC, should also remain on the lookout for discretionary funding for key initiatives, such as the recent TIGER grants. The primary opportunities include:

Program	Potentially Eligible Uses
State and Community Highway Safety Grant Program	Roadway safety Replacement of non-compliant signage
Highway Safety Improvement Program	Regulatory and warning signs on busy roadways Development of initial sign inventory
High Risk Rural Roads Program	Nighttime visibility of signs in rural Clark County
Railway-Highway Crossings Program	Highway/railway grade crossings throughout the RTC region
Safe Routes to School Program	Pedestrian and bicycle safety and mobility signage
National Highway System Program	Signs and pavement markings on NHS roadways in unincorporated Clark County, the City of Las Vegas, and Boulder City
Surface Transportation Program	Signs and pavement markings on designated NHS roadways, including major roadways throughout the RTC region
Transportation, Community and System Preservation Program	Public/private strategy for development of sign asset management

CONCLUSIONS

Developing a complete sign asset inventory is a major priority for the region in attaining compliance. RTC has offered, and is well positioned, to play a lead role in this pursuit. The role would include writing the grant application, securing the funding, and overseeing the execution of the grant.

The consultant analysis was primarily based on cost effectiveness of the various methods. Other important considerations for the jurisdictions include local budgets, staffing, and compatibility with other operating practices.

The major recommendation stemming from the study is to pursue the timed replacement with control signs approach. This is true at least for the Clark County and

the cities of Henderson, Las Vegas, and North Las Vegas. The City of Las Vegas has offered to host the control signs for regional benefit.

For the two smallest cities, Mesquite and Boulder City, performing actual nighttime visual inspections is slightly less costly than timed replacement. However, complete regional uniformity then would become the tradeoff to be considered.

Technical Memorandum #1

2. SUMMARY OF LOCAL PRACTICES

April 6, 2010

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STUDY BACKGROUND

NEW FEDERAL HIGHWAY ADMINISTRATION REGULATIONS

The Regional Transportation Commission of Southern Nevada (RTC) engaged Booz Allen Hamilton to evaluate member jurisdictions' progress towards meeting new Federal Highway Administration (FHWA) regulations regarding minimum retroreflectivity standards that will go into effect over the next eight years. Booz Allen was also tasked with evaluating regional strategies to ensure that RTC members reach compliance on schedule.

The new FHWA regulations updated the Manual on Uniform Traffic Control Devices in 2007 after nearly two decades of study and consultation on the new standards. Retroreflectivity is a measure of nighttime visibility, and the new standards are intended to improve nighttime driving safety, especially for older drivers. Section 2A.08 in the 2009 edition of the MUTCD details minimum retroreflectivity, contrast, and sign material requirements by sign type (see Figure 1 in Section 4). The same section also stipulates that responsible jurisdictions must implement a management method for ensuring sign assets are compliant with the MUTCD standards. The MUTCD guidance identifies the following six nighttime sign visibility management approaches:

1. Visual Nighttime Inspection
2. Measured Sign Retroreflectivity
3. Expected Sign Life
4. Blanket Replacement
5. Control Signs
6. Other methods based on engineering studies

The FHWA regulations state a schedule for compliance. The compliance schedule is based on the effective date of the final rule (January 22, 2008):

4. Establish and implement a sign retroreflectivity management method in 4 years (January, 2012: 1 year, 8 months remaining)
5. Replace regulatory, warning, and ground-mounted guide signs (except street name) identified as having substandard retroreflectivity in 7 years (January, 2015: 4 years, 8 months remaining)
6. Replace identified substandard street name and overhead guide signs in 10 years (January, 2018: 7 years, 8 months remaining).

DATA COLLECTION ON LOCAL PROCESSES

The nine month study is divided into three main tasks. First, the Booz Allen Hamilton team evaluated the current sign management and maintenance practices in the region. Next, the Booz Allen Hamilton team is currently reaching out to similar peer cities and

counties of the RTC members in an effort to define the state of practice and evaluate other jurisdictions' approaches to sign management as lessons for the RTC region. Finally, the Booz Allen Hamilton team will present its recommendations for the region's approach to reach compliance going forward.

This technical memorandum focuses on the six RTC member jurisdictions' current sign management practices, along with the practices of NDOT, who maintains some roads in the RTC area. The report is based on information collected during a kick-off meeting and interviews with key sign management staff at each of the six RTC members and NDOT. Between March 16th and March 18th 2010, the Booz Allen Hamilton conducted ninety-minute interviews at each jurisdiction based on a standard questionnaire attached in the Appendix. Subsequently, the Booz Allen Hamilton team conducted a phone interview with NDOT personnel based on the same questions. The findings presented in the remainder of this report reflect the survey responses from the interviews.

BACKGROUND ON JURISDICTIONS

DESCRIPTION OF JURISDICTIONS

The RTC constituent jurisdictions represent a wide range in sizes whether measured in geographic extent or the number of signs being managed. While the cities and county are all facing similar environmental conditions, they represent a mix of large unincorporated areas, small cities, and large, densely populated cities. The jurisdictions are compared in Table 1 below.

Table 1 – Key Jurisdiction Attributes

Jurisdiction	Center Lane Miles	Population (2008 Est.)	Geographic Extent For Signs (Square Miles)	Total Controlled Intersections
Boulder City	78	14,720	4	Unknown
City of Las Vegas	Follow Up	558,383	250-300	Unknown
Clark County (unincorporated)	7,700	806,882	~8,000	Unknown
Henderson	800	252,064	103	Unknown
Mesquite	67	16,444	32	Unknown
North Las Vegas	1,800	217,253	100	Unknown

Source: Source for population, Interviews with Traffic Engineering and Public Works staff, March 2010

Mesquite and Boulder City are the smallest two cities, both geographically and in terms of population. With smaller public works departments, their approach to sign management differs from the other RTC members and reflects their significantly smaller size.

Clark County faces unique geographic challenges among the RTC members. The County is responsible for all unincorporated areas, which is a jurisdiction many times the size of the five incorporated cities combined. Clark County's jurisdiction contains many rural roads and communities, including some over an hour away from the County's maintenance yard.

STATE OF SIGN INVENTORIES

For compliance with the FHWA retroreflectivity rules, the most important information to maintain in the sign inventory is the sign's age, type, material, and location. Other attributes such as orientation, sign post type, intersection identification, and size can also be useful to help administer a more efficient and effective sign replacement program.

As the data presented in Table 2 shows, not all jurisdictions were able to provide precise sign count totals. All but one jurisdiction either do not have a formal sign inventory in place or do not have an up-to-date sign inventory. Most jurisdictions

provided their sign totals based on extrapolating the data from representative samples. In some cases, it is not clear what proportion of the total sign assets is non-exempt with respect to the new FHWA rules.

Table 2 – Scale of Sign Assets

Jurisdiction	Total Signs	Estimated Non-Exempt Share	Signalized Intersections	State of Inventory
Boulder City	2,000 - 3,000 (estimate)	~70%	Unknown	No inventory
City of Las Vegas	67, 472	Unknown	507	Mostly Complete
Clark County	130,000 (estimate)	Unknown	515	Incomplete/In Progress
Henderson	40,000 - 45,000 (estimate)	~80-90%	161	Incomplete/In Progress
Mesquite	4,000 - 5,000 (estimate)	Unknown	Unknown	No inventory
North Las Vegas	90,000 (estimate)	Unknown	136	Incomplete/Unmaintained

Source: Interviews with Traffic Engineering and Public Works staff, March 2010

The six jurisdictions vary significantly in their implementation of a sign inventory system and process. Some of the jurisdictions, including the City of Las Vegas and Clark County have performed complete sign inventories in the past few years. Others, including Mesquite and Boulder City have more limited sign asset information based on work order or other records. The uncertainty or absence of many of the figures in Table 2 illustrates how many RTC members' sign data is incomplete or not up-to-date.

Clark County's figures are only an estimate because the original sign inventory carried out by Stantec in the late 1990s has not been kept up-to-date. With fluctuating budgets and practices, several of the jurisdictions have experienced difficulties maintaining their inventories. Sections 2 and 3 provide further details of the jurisdictions' existing systems and practices and elaborate the sign management challenges they face.

EXISTING SYSTEMS

EXISTING SIGN INVENTORY MANAGEMENT SYSTEMS

The existing sign inventory management systems range widely in their approach, processes, and progress towards meeting the MUTCD standards. In some cases a formal inventory system is lacking entirely. More often, it has not been fully implemented or is not up-to-date. None of the six jurisdictions has a complete up-to-date sign inventory in place; however, some foresee more challenges in completing an inventory than others given budgetary resources available.

For approximately a decade, the Las Vegas region has benefitted from uniform standard specifications that proactively addressed nighttime sign visibility by requiring relatively high quality sheeting. As a result, most signs in recent developments are made with sheeting material that complies with the current Manual on Uniform Traffic Control Devices (MUTCD) standards.

Because of their small size and the predominance of very recent development (i.e., last ten years), both Boulder City and Mesquite have taken a neighborhood-based approach to sign management and inventorying. They keep paper records of blanket replacement efforts but do not track individual signs except through work records. The remaining jurisdictions keep their inventories in a geographic information system (GIS), typically entering data through ArcMap into ArcGIS. The Cities of Las Vegas and North Las Vegas each use an asset management system from Hansen to manage sign maintenance. Table 3 provides an overview of the state of each RTC member's sign inventory.

Table 3 – Sign Inventory Systems and Progress

Jurisdiction	State of Inventory	Inventory System	Other Sign Maintenance Records
Boulder City	No inventory	Records of blanket replacement	Written records since 2007
City of Las Vegas	Mostly Complete	Hansen	Hansen, paper work orders
Clark County	Incomplete/In Progress	ArcGIS	Work orders (paper system)
Henderson	Incomplete/In Progress	ArcGIS (with Maximo under implementation)	Paper work records, Contact Henderson database
Mesquite	No inventory	Records of blanket replacement	Work orders, notebook records
North Las Vegas	Incomplete/Unmaintained	ArcGIS	Excel spreadsheet, paper work orders, Hansen

Source: Interviews with Traffic Engineering and Public Works staff, March 2010

Of the six jurisdictions, Mesquite and Boulder City currently use the most basic approach to track sign maintenance. Mesquite does not track individual signs but does

track sign condition within each area of the city. Street by street, the city is implementing a blanket replacement program beginning in the city's oldest areas. The city's detailed development records have allowed the sign management staff to prioritize the city's oldest areas for sign replacement. By tracking their sign replacement efforts and the age of developments, the city is able to ensure that most signs remain in the warranty period. Mesquite's public works staff also inspects new developments to ensure they comply with county standard specifications. Boulder City has a similar strategy: the city's sign maintenance program also proceeds geographically and prioritizes older neighborhoods for blanket replacement.

Henderson and Clark County each have implemented an inventory process to add sign assets to their GIS. However, neither has a process in place to keep this data up-to-date through its work order processing system. Henderson plans to complete this loop once its Maximo system from IBM comes online in 2011. North Las Vegas only uses Hansen to track work orders. Not all of their sign maintenance activities get entered into Hansen. All three of these jurisdictions have incomplete sign inventories because their existing processes do not tie maintenance activities directly to their asset inventory system.

Only the City of Las Vegas has fully integrated its sign maintenance program with its inventory process. All work orders are processed through Hansen. Newly installed signs include georeferenced information to ensure they enter the GIS properly. As a result of this continuous maintenance, the City of Las Vegas has the most complete and up-to-date sign inventory of all RTC members. The inventory is considered about 85 percent complete; given a gap in the database updating process several years ago.

Several reasons account for the variation. A primary reason is that the RTC members have devoted dramatically different resources levels to sign management as illustrated in Tables 6 and 7 in Section 6. Also, the core areas of metropolitan Las Vegas have a larger proportion of older development and face more retroreflectivity issues from older signs. Clark County, the City of Las Vegas, and North Las Vegas are most affected by this issue. The remaining cities benefit from a newer sign inventory with lower average sign ages and wider use of compliant sheeting. Section 3 examines these issues in more detail.

OTHER EXISTING SYSTEMS AND DATA SOURCES

Although not every jurisdiction uses GIS directly for their sign maintenance program, every RTC member visited maintains a GIS (Geographic Information System) in the public works department. All of the jurisdictions use the ArcGIS family from ESRI to store some geographic public works asset information, but not all of them currently store sign locations and data in the system. In most cases, the GIS includes pavement, streetlights, signals, and utility layers. For RTC members who have a separate traffic operations unit, they often do not have the same level of direct experience with GIS as other sections of the public works department.

Many of the RTC members have utilized additional sources of data on sign maintenance. For instance, the City of Las Vegas completed an eight year field survey, ending in 2004, to help bring their database up-to-date. Data from this survey was entered directly into the department's GIS. Development plans and records are also an important data source. Finally, there has been at least one contracted survey to inventory signs, carried out by Stantec for Clark County in the late 1990s. Henderson was able to inventory a substantial portion of the city's sign assets through a grant from the federal Safe Routes to School program. Table 4 below provides an overview of each jurisdiction's data collection processes.

Table 4 – Sign Inventory Data Collection

Jurisdiction	Data Collection Method	Sign Attributes Tracked	Sign Labeling
Boulder City	Maintenance records	Type, intersection location	No
City of Las Vegas	Development maps, field data collection, work orders	direction, size, sign support type, material type, sign type	Limited
Clark County	Field data collection	Date, direction, size, sign support type, material type, sign type, condition	Installation date if installed by City, sticker if manufactured by Safeway
Henderson	Development maps, field data collection	Inspection date, sign code, size, legend, condition, support type, orientation, sign type	No
Mesquite	Maintenance records	Date of installation	Installation date if installed by City
North Las Vegas	Survey Department data, maintenance records	Location	Installation date if installed by City

Source: Interviews with Traffic Engineering and Public Works staff, March 2010

ASSESSMENT OF CURRENT DATA INVENTORY

None of the jurisdictions feel confident in their current sign inventory. North Las Vegas, Clark County, and the City of Las Vegas all identified inventory accuracy as an issue with at least certain segments of their existing sign GIS data. Table 4 shows that several of the jurisdictions are missing key sign attributes in their existing sign inventory. Finally, most of the RTC members do not have a consistent and reliable process in place to ensure the maintenance of an accurate sign asset inventory.

The most serious problem found in interviewing many of the RTC members is that they lack the ability to complete or maintain their sign inventories. Those jurisdictions that have started systematic inventories, including Clark County and City of Las Vegas, worry that they cannot depend on having sufficient resources to complete or maintain their inventories. For example, the City of Las Vegas, where development contractors install between thirty and sixty percent of new signs each year, recently lost the survey position responsible for verifying the accuracy of development maps submitted to the City.

Bringing sign inventories up-to-date will require several parallel efforts. It is necessary to identify and input signs currently installed but missing in the database. It is also necessary to correct existing inaccurate entries in the sign asset database. Entries may be inaccurate either because the sign no longer exists or has been replaced or because the original information about the sign was inaccurate.

Other challenges are more specific to the jurisdictions. For instance, Clark County's large geographic extent imposes a particular strain on its efforts to bring its sign asset inventory up-to-date. Henderson and Clark County do not have a formal process to incorporate newly accepted developments' sign assets into their inventories, an issue which will continue to be a challenge. Finally, the smaller cities have so far not identified an inventory process that will sufficiently benefit their current sign maintenance practices and do not necessarily see the value of a comprehensive inventory beyond compliance.

SIGN CONDITION MEASUREMENT AND REPLACEMENT

MINIMUM NIGHTTIME VISIBILITY GOALS

Every jurisdiction expressed a desire to meet the federal standards shown in Figure 1 and maintain high nighttime visibility for safety. Every RTC member has implemented high quality sign material standards for at least the past decade, and these standards are a reflection of their commitment to nighttime driving safety. However, in the interviews, all of the jurisdictions acknowledged that issues remain in their sign management practices.

Figure 1: MUTCD Minimum Retroreflectivity Requirements

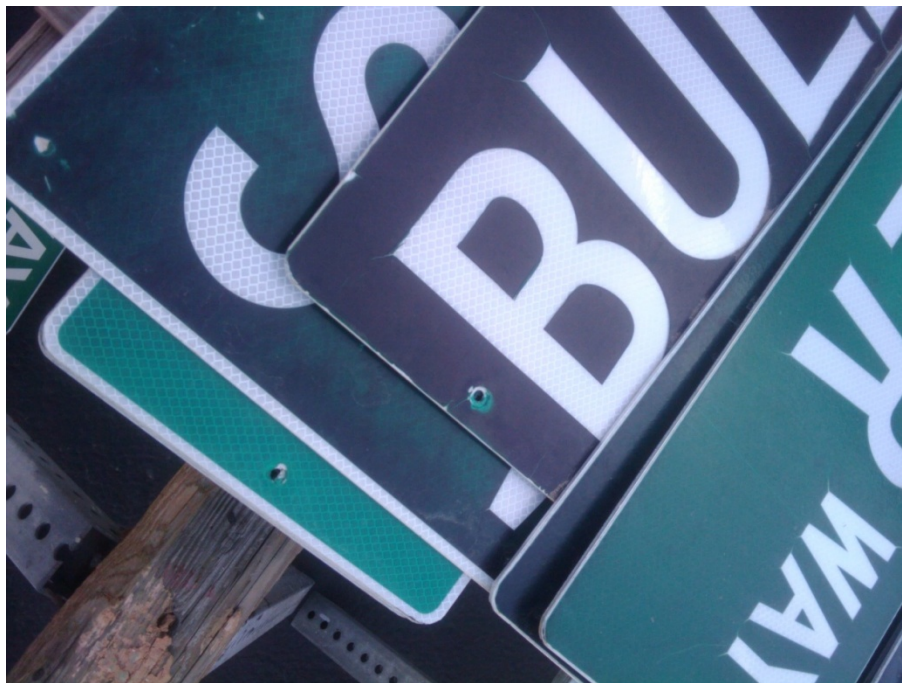
Sign Color	Sheeting Type (ASTM D4956-04)				Additional Criteria
	Beaded Sheeting			Prismatic Sheeting	
	I	II	III	III, IV, VI, VII, VIII, IX, X	
White on Green	W*; G ≥ 7	W*; G ≥ 15	W*; G ≥ 25	W ≥ 250; G ≥ 25	Overhead
	W*; G ≥ 7	W ≥ 120; G ≥ 15			Post-mounted
Black on Yellow or Black on Orange	Y*; O*	Y ≥ 50; O ≥ 50			2
	Y*; O*	Y ≥ 75; O ≥ 75			3
White on Red	W ≥ 35; R ≥ 7				4
Black on White	W ≥ 50				–
¹ The minimum maintained retroreflectivity levels shown in this table are in units of cd/lx/m ² measured at an observation angle of 0.2° and an entrance angle of -4.0°.					
² For text and fine symbol signs measuring at least 48 inches and for all sizes of bold symbol signs					
³ For text and fine symbol signs measuring less than 48 inches					
⁴ Minimum sign contrast ratio ≥ 3:1 (white retroreflectivity ÷ red retroreflectivity)					
* This sheeting type shall not be used for this color for this application.					
Bold Symbol Signs					
<ul style="list-style-type: none"> • W1-1,2 – Turn and Curve • W1-3,4 – Reverse Turn and Curve • W1-5 – Winding Road • W1-6,7 – Large Arrow • W1-8 – Chevron • W1-10 – Intersection in Curve • W1-11 – Hairpin Curve • W1-15 – 270 Degree Loop • W2-1 – Cross Road • W2-2,3 – Side Road • W2-4,5 – T and Y Intersection • W2-6 – Circular Intersection • W2-7,8 – Double Side Roads 		<ul style="list-style-type: none"> • W3-1 – Stop Ahead • W3-2 – Yield Ahead • W3-3 – Signal Ahead • W4-1 – Merge • W4-2 – Lane Ends • W4-3 – Added Lane • W4-5 – Entering Roadway Merge • W4-6 – Entering Roadway Added Lane • W6-1,2 – Divided Highway Begins and Ends • W6-3 – Two-Way Traffic • W10-1,2,3,4,11,12 – Grade Crossing Advance Warning 		<ul style="list-style-type: none"> • W11-2 – Pedestrian Crossing • W11-3,4,16-22 – Large Animals • W11-5 – Farm Equipment • W11-6 – Snowmobile Crossing • W11-7 – Equestrian Crossing • W11-8 – Fire Station • W11-10 – Truck Crossing • W12-1 – Double Arrow • W16-5P,6P,7P – Pointing Arrow Plaques • W20-7 – Flagger • W21-1 – Worker 	
Fine Symbol Signs (symbol signs not listed as bold symbol signs)					
Special Cases					
<ul style="list-style-type: none"> • W3-1 – Stop Ahead: Red retroreflectivity ≥ 7 • W3-2 – Yield Ahead: Red retroreflectivity ≥ 7; White retroreflectivity ≥ 35 • W3-3 – Signal Ahead: Red retroreflectivity ≥ 7; Green retroreflectivity ≥ 7 • W3-5 – Speed Reduction: White retroreflectivity ≥ 50 • For non-diamond shaped signs, such as W14-3 (No Passing Zone), W4-4P (Cross Traffic Does Not Stop), or W13-1P,2,3,6,7 (Speed Advisory Plaques), use the largest sign dimension to determine the proper minimum retroreflectivity level. 					

Source: Manual on Uniform Traffic Control Devices, 2009 edition

Even though none of the RTC members has a nighttime sign visibility maintenance program in place to monitor minimum sign retroreflectivity and contrast, all members interviewed were fully aware of the latest Federal regulations. All of the jurisdictions expressed a goal of complying with the regulations, including better management of sign nighttime visibility. However, the RTC region faces significant challenges in meeting the MUTCD requirements.

One challenge the region faces is that signs in new developments do not always meet county standards. While all jurisdictions have acceptance inspection processes in place for new developments, the sign maintenance staff is not always involved in this function. Both North Las Vegas and Henderson face this situation. Figure 2 provides an example of the potential consequences when contractors employ lower quality sign materials. In this case, the sign coating contains vinyl, which has turned black under prolonged sun exposure.

Figure 2: Substandard Sign Materials Used in New Developments



Source: City of Mesquite

Another barrier to implementing an effective management program, particularly for the larger jurisdictions, is the difficulty of coordinating with other sections of the public works department. Sign maintenance can be a lower priority than many other public works activities and as a result can face lower levels of awareness throughout the rest of public works department. Inventorying and inspection efforts can benefit tremendously from coordination with other public works field activities.

One advantage for the region, already mentioned, is that all jurisdictions are already using high grade sheeting. Most jurisdictions use 3M's Diamond Grade sheeting, either ASTM Type IX or XI. The first already meets the MUTCD retroreflectivity materials standards. However, Type XI sheeting, which effectively means 3M's DG³, is pending a final FHWA decision reviewing its retroreflectivity compliance. Note that Figure 1 does not include Type XI sheeting as part of the current MUTCD standard. FHWA has raised several concerns with the use of DG³ under certain circumstances. There is a small chance that FHWA may find Type XI sheeting's use to be inappropriate for certain sign types.

SIGN NIGHTTIME VISIBILITY MANAGEMENT METHODS

All jurisdictions interviewed reported they had no backlog of "critical" sign maintenance/replacement and that the replacement method was primarily reactive to complaints received from the public or reactive to field crew observations. Each jurisdiction prioritizes its response to sign replacement, assigning the highest priority to stop signs and regulatory signs such as speed signs. For example, jurisdictions will replace a stop sign within a few hours compared to a longer period for a non-critical sign. Most of the time, field crews notice defective signs themselves and replace them on that basis.

It is notable that the majority of sign replacements are due to signs having been knocked down, or covered in graffiti. Among all six RTC members interviewed, in only one instance was there a record of any complaint specifically highlighting a nighttime visibility issue.

Table 5 describes each jurisdiction's current sign management method.

Table 5: Sign Management Methods

Jurisdiction	Maintenance Program	Minimum Retroreflectivity Compliance	Inventory Method
Boulder City	Reactive/Blanket Replacement	On track	No current method
City of Las Vegas	Reactive/Control Signs	On track	Field updates, tracking work orders, development maps
Clark County	Reactive	Behind	Field updates, legacy map
Henderson	Reactive	On track	Field updates
Mesquite	Reactive/Blanket Replacement	On track	No current method
North Las Vegas	Reactive/Blanket Replacement	Behind	Receive data from Survey Department; no updates

Source: Interviews with Traffic Engineering and Public Works staff, March 2010

The City of Las Vegas is the most advanced in exploring potential sign management methods. The city's goal is to use its sign inventory to more proactively manage its sign assets. Boulder City, Henderson, and Mesquite have effective blanket sign replacement

programs in place which prioritize older developments and are making good progress. However, none of the RTC members has undertaken a comprehensive study of the available sign management methods described in the MUTCD, nor is a member too vested in their current approach to potentially adopt a new one.

Below, the technical memorandum outlines the management methods set forth in the MUTCD and briefly examines their appropriateness in the Southern Nevada region. Each section outlines the applicability and challenges of a sign retroreflectivity management method provided in the MUTCD Section 2A.08 guidance.

1. Visual Nighttime Inspection

Many of the jurisdictions feel that visual nighttime inspection could be too costly as it is labor intensive. Also, it requires working non-standard shifts, which could be difficult for some departments to implement. However, were they to have the resources, several of the jurisdictions felt this would be an effective inspection method. Sign maintenance personnel from several of the jurisdictions have recently attended an NDOT-sponsored training session about retroreflectivity, and they report that implementation of nighttime visual inspections requires only modest training of inspectors. Also, MUTCD does offer the guidance that day and night time inspections should be included as part of the sign maintenance program.

2. Measured Sign Retroreflectivity

Measuring retroreflectivity requires specialized equipment and is an even more labor intensive operation than visual inspections. Depending on the speed and sensitivity of the measurements, the inspection time per sign can double. Clark County, the City of Las Vegas and the City of North Las Vegas all currently have retroreflectivity test instruments but they are not currently used in the field. While Boulder City considered using this method, the expense and time compared to night time visual inspection have caused them to rule out this method.

Figure 3: North Las Vegas' Retroreflectometer

Source: City of North Las Vegas

3. Expected Sign Life

The Expected Sign Life method appears to be a good fit for the region for several reasons. Most of the jurisdictions have standardized for at least several years on a sign sheeting material (3M Diamond Grade or 3M DG3) which carries a specific warranty for retroreflectivity. While the warranty may vary by jurisdiction, it could nevertheless be used as an established baseline for expected sign life.

As documented earlier, patterns of development in and around Clark County are such that large clusters of signs have been at the same dates. The expected sign lives for signs in the cluster should theoretically be similar, by direction, and this method would provide a means to adapt replacement cycles depending on the sign orientation (such as, seven years for a South facing sign and ten years for other signs).

The expected sign life approach, however, does require a reasonably up to date inventory and would also benefit by being paired with control signs to validate and perhaps extend the expected sign lives.

4. Blanket Replacement

North Las Vegas, Boulder City, and Mesquite have used blanket replacement methods for parts of their coverage areas already. Most jurisdictions are considering blanket replacement as a possible primary method of compliance.

5. Control Signs

No jurisdiction currently has a control sign test facility. Prior to the interviews no one except the City of Las Vegas was considering using one as a method of compliance. The City of Las Vegas has offered to host a Control Sign test yard to benefit the entire region.

6. Other Methods Based On Engineering Studies

None of the jurisdictions expressed interest in using this method. However, the jurisdictions do appear willing to undertake a hybridized approach based on the five management methods described above.

SUPPORT OF CONTRACTORS

Contractors have supported sign management across the RTC area. Contractors are involved with sign assets in several ways:

1. Contractors who build developments are responsible for installing signage throughout the developments. When the development is accepted by the city or county, the jurisdiction accepts responsibility for maintaining those signs if the right-of-way becomes public. Often the as-built drawings for these developments are not accurate or are not digitally transferrable to the GIS. The city or county typically sends out inspectors in order to get check compliance with regional specifications and in some cases to get an accurate inventory. Most of the jurisdictions have had issues getting this data into their sign inventory system of record, leading to inaccurate and incomplete inventories. While the pace of new developments has slowed significantly with the economic downturn, it remains important to ensure that signs in future developments are accurately reflected in the sign inventories.
 2. Contractors who are responsible for capital projects such as new or widened streets are also responsible for installing the signage. Similar problems exist for public works capital projects as do for private developments, though they tend to be smaller in overall scale.
 3. Several jurisdictions including Clark County and the City of Las Vegas also use private contractors to supplement their crews for sign manufacture and maintenance.
 4. Looking to the future, RTC members are most interested in using contractors to accelerate their sign inventorying efforts.
-

An advantage of the area wide de-facto standardization on newer and long-wearing sign sheeting materials is that all the contractors responsible for sign installation have been consistently required to use the high level standard sheeting, primarily 3M Diamond Grade or 3M DG Cubic.

IMPACT OF FEDERAL RULING

IMPACTS OF NEW FEDERAL RULES

The economic downturn has severely impacted the overall budgets of the cities and county in the Southern Nevada region. Public works departments are no exception to the general budget environment and fiscal challenges. The budget cuts to date have already impacted some jurisdictions' ability to comply with the new mandate.

Specifically:

1. Every jurisdiction will have difficulty completing and maintaining an accurate inventory in place in time to meet the 2012 management plan deadline. Those that have started systematic inventories cannot expect to receive the resources to continue them. Some jurisdictions are simply not making progress fast enough to meet the 2012 deadline.
2. North Las Vegas and Clark County will likely have significant difficulty complying with the replacement requirements under the 2015 deadline. Their annual sign maintenance program cannot meet the sign replacement volumes likely needed to replace all non-compliant signs.

These budgetary issues drive one of the two primary challenges for RTC constituents to meet the mandates:

1. Funding

Identifying funding sources for both the management plan implementation (including funding for inventories) and, at least for some jurisdictions, the sign replacement itself will be critical in allowing RTC constituents to meet the mandate. Some of the jurisdictions may need to identify additional funding sources for both efforts.

2. Schedule

In order to meet the 2012 management plan deadline several elements will need to be in place quickly:

- a. Identification of the inventory system for each jurisdiction
- b. Completion of initial inventory and validation of existing data
- c. Adoption of an approach, possibly regionally based for retroreflectivity management

- d. Establishment of a control sign test facility if a regional approach is chosen.

Getting these and the other necessary components in place before the 2012 deadline will be very challenging for some jurisdictions.

TORT LIABILITY ISSUES

Until now, jurisdictions have been able to manage their liability through purely reactive sign maintenance programs. Poorly maintained signs are not an issue until the jurisdiction is made aware of them. As long as they react in a timely manner, they are well protected. As a result, none of the jurisdictions has had a significant issue with tort liability issues to date.

As the new retroreflectivity standards are phased in, the jurisdictions will have a higher duty of care for sign visibility, condition, and compliance with MUTCD standards. Although most jurisdictions do not expect incidents to increase dramatically, their legal obligations for maintenance will increase substantially regardless. The maintenance standards not only apply to retroreflectivity and contrast but also to sign condition generally. Therefore, it is important that the RTC members take proactive steps to address the new requirements and meet the implementation schedule.

COSTS AND FUNDING

CURRENT ANNUAL OPERATING RESOURCES AND BUDGET

As previously mentioned, the Clark County region has been one of the metropolitan areas most impacted by the economic downturn. For example, the Traffic Operations unit of North Las Vegas' Department of Public Works saw its budget cut approximately 20 percent in fiscal year 2010 after an already difficult FY 2009. The region may face continued fiscal challenges over the next two years.

The RTC member jurisdictions each commit different levels of resources available. Table 6 provides an indication of the varying levels of resources provided for sign maintenance activities based on rough estimates. The table compares the full-time equivalents dedicated to sign management and maintenance.

Table 6: Sign Management Labor Resources

Jurisdiction	Department	FTEs	Sign Assets per FTE
Boulder City	Department of Public Works	0.9	2,200 - 3,300
City of Las Vegas	Traffic Engineering and Field Operations	7.5	9,000
Clark County	Traffic Operations	4.5	29,000
Henderson	Traffic Maintenance Department	2	20,000 - 23,000
Mesquite	Department of Public Works	1.5	2,700 - 3,300
North Las Vegas	Traffic Operations	4.5	20,000

Source: Interviews with Traffic Engineering and Public Works staff, March 2010

The right hand column shows that Clark County and North Las Vegas, with their higher average sign age, will have the most difficulty in the meeting the retroreflectivity requirements based on their labor resources (although the Clark County figure does not include contractors' FTEs). Table 7 provides complementary financial information for the six RTC member jurisdictions.

Table 7: Sign Management Budgets

Jurisdiction	Total Department Budget	Materials Budget	Total Estimated Sign Maintenance Budget	Maintenance Budget per Sign
Boulder City	Unknown	\$20,000	\$120,000	\$40 - \$60
City of Las Vegas	\$1,800,000	\$100,000	\$750,000	\$11
Clark County	\$2,000,000	\$50,000	\$500,000 - \$600,000	\$4
Henderson	\$4,000,000	\$60,000	\$230,000	\$5 - \$6
Mesquite	\$1,600,000	\$35,000	\$71,000	\$14 - \$18
North Las Vegas	\$5,000,000	\$80,000	Unknown	N/A

Source: Interviews with Traffic Engineering and Public Works staff, March 2010

The financial figures also indicate that the smaller jurisdictions benefit from more resources to address the federal retroreflectivity requirements.

CURRENT AND EXPECTED FUNDING SOURCES

All the jurisdictions use general operating funds for their sign maintenance budgets. The City of Las Vegas funds some of the installation of new signs from capital funds, but most fund all installation and maintenance from operating budgets. The one exception has been the use by Henderson of a Safe Routes to Schools to map city signs. As sales and property taxes take time to stabilize and recover, finding new funding sources may be important for many RTC members.

ROLE OF THE NEVADA DEPARTMENT OF TRANSPORTATION

NEVADA DEPARTMENT OF TRANSPORTATION SIGN MANAGEMENT PROGRAM

Because the Nevada Department of Transportation (NDOT) owns and operates a high number of lane miles in the region, NDOT is an important stakeholder in the region. While NDOT is responsible for maintaining most of its own right-of-way, the agency has agreements in place with many of the RTC members dividing maintenance responsibility for the right-of-way. NDOT has also gradually turned over full control and ownership for many its state routes in the region. In order to better understand NDOT's role in the region and identify any prospective concerns or opportunities, the Booz Allen team interviewed the sign supervisor for NDOT District 1.

The District 1 sign shop consists of a supervisor and a five person crew. NDOT tracks its maintenance responsibilities through a milepost index map that gives the milepost markers where NDOT's roadway sections begin and end. However, the District 1 sign maintenance program does not have access to the GIS system that generates the maps. The sign maintenance shop does not use GIS for its internal operations, either. The NDOT sign operation does not have or maintain a formal location-based sign inventory. Work is tracked using paper records and email work orders generated for external requests.

NDOT's District 1 sign shop does manage sign nighttime visibility proactively. The district designates one month per year during which the road maintenance crews conduct nighttime inspections checking for sign visibility and maintenance among other things. The annual inspection efforts generate a list of work items which the road maintenance crews send to the sign shop. The sign maintenance team works its way through this work item list over the course of the year. For questionable signs, the sign maintenance crew uses a retroreflector for verification. Typically signs with low retroreflectivity levels are only a small portion of the signs needing replacement. Downed signs take first priority, so the sign shop has a significant backlog of work.

COORDINATION WITH OTHER JURISDICTIONS

Currently, NDOT's District 1 sign maintenance program does not coordinate directly with other local jurisdictions. In the urban areas, the sign maintenance shop performs work based on the milepost index map and the crew's experience knowing NDOT's areas of responsibility. NDOT takes a liberal approach when maintaining shared areas, replacing signs if there is any doubt about the responsible party.

APPENDIX

LOCAL SIGN MANAGEMENT PRACTICES QUESTIONNAIRE

Interviewee/Title: _____

Agency: _____

Contact Information: _____

1. BACKGROUND

- Can you provide us with some details about your jurisdiction:
 - a. Street/street-lane miles
 - b. Intersections
 - c. Geographic extent/area
- Can you provide us the sign inventory details:
 - a. Locations
 - b. Types
 - c. Quantities
 - d. Age
 - e. Orientation
- What is the typical life span of different types of signs? Are there any available statistics?

2. SYSTEMS

- Do you have a sign inventory management system? How much did it cost (capital expenses, operating expenses)?
- What other systems, software (including interface with GIS), and hardware do you use for performance based maintenance of signs?
- How accurate and complete do you estimate your inventory to be?
- What staffing levels are dedicated to updating and maintaining the database?

3. CONDITION MEASUREMENT AND SIGN REPLACEMENT

- What are your goals for minimum nighttime visibility of the signs?
- What methods or processes are being used to determine whether signs meet your goal of reasonable nighttime visibility?
 - a. Nighttime visual inspection
 - b. Measured Sign Retroreflectivity
 - c. Control Signs
 - For A, B, and C: What is the frequency of inspection?
 - d. Expected Sign Life
 - e. Blanket Replacement
 - f. Some combination of the above
 - g. Driver complaints (is there a process in place for receiving complaints)
- What practices exist for documenting the results of methods and processes being used?
- What processes are in place to initiate actions to replace signs that are at or near the minimum levels?
 - a. Is there a backlog of work orders?

- b. Have you found your jurisdiction varies significantly from standards?
- What staffing levels are available to maintain signs in your jurisdiction?
 - a. Do you use an outside contractor to supplement staff? If so, what percentage of the overall work do they perform?

4. IMPACT OF FEDERAL RULING

- How are the FHWA Minimum Levels of Retroreflectivity Ruling and new federal retroreflectivity standards going to impact you over the next 2, 5 and 8 years?
 - a. By January 21, 2012, implement and continue using an assessment or management method to maintain traffic sign retroreflectivity at or above the established minimum levels.
 - b. By January 21, 2015, replace regulatory, warning and ground-mounted signs (except street name signs) that fail to meet the established minimum levels.
 - c. By January 21, 2018, replace of street name signs and overhead guide signs that fail to meet the established minimum levels.
- Have you had any tort liability issues due to poor sign reflectivity?
- Have you engaged contractors/vendors to help with the signs management? Who are they?

5. COSTS AND FUNDING

- What are your annual operating resources and budget?
- Can you provide an estimate of the annual labor hours involved?
- What is your annual traffic sign replacement budget/expenditure?
- What are the funding sources used for these expenditures (capital, operational)

Technical Memorandum #2

3. SUMMARY OF PEER PRACTICES

June 15, 2010

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INTRODUCTION

PURPOSE OF THE PEER INTERVIEWS

Task 2 of the RTC Sign Asset Management Study consisted of an industry review of sign asset management practices. The MUTCD guidance for sign management leaves local jurisdictions with a high degree of autonomy in determining their management approach. Many local jurisdictions have already implemented compliant sign management approaches, and the RTC members can benefit from an examination of these peers' experiences.

The Booz Allen Hamilton consultant team focused on finding and reaching out to jurisdictions that have fully implemented a sign management approach or have made significant progress in doing so. The peer interviews focused on learning about peers' overall compliance strategies, the technologies and systems used, the resources expended, and their funding strategies. The main purposes were to identify important sign management strategy elements, challenges, and successes.

BACKGROUND ON PEER JURISDICTIONS

The Booz Allen Hamilton consultant team set out to interview up to ten peer jurisdictions. The team's objective was to select peers with geographic, population, and other resemblances to the Las Vegas Region jurisdictions. At its first meeting, the project technical working group refined a list of geographies to target, focusing on the Salt Lake City, Phoenix, Denver, Albuquerque, and Southern California regions.

Exhibit 1: Peer Jurisdictions Interviewed

Jurisdiction	Population (2008 Est.)	Area (Miles ²)
Austin, TX	757,688	272
Bernalillo Cty, NM (unincorporated)	40,873	450
Fontana, CA	184,984	46
Golden, CO	17,321	9
Long Beach, CA	463,789	50
Mesa, AZ	463,552	108

Based on these recommendations, the Booz Allen Hamilton consultant team identified a list of peers to contact that fall within the aforementioned geographies and that have

made significant progress complying with the new FHWA standards or are already compliant. Successful interviews were conducted with the six jurisdictions in Exhibit 1. The jurisdictions include a combination of cities and a county, similar to the Las Vegas region, cover a wide range of geographies, and represent a wide range of scales and approaches. The jurisdictions were found through literature and news searches, examining public works department websites, and speaking directly with public works contacts.

PEER INTERVIEWS APPROACH

As a guideline for the interviews, the Booz Allen Hamilton developed a questionnaire to complement the information gathered in Task 2. Broadly, the questionnaire covers the jurisdiction's background information, its approach to creating and managing its sign inventory, and its strategy for managing the signs' retroreflectivity. The interview template is included in the appendix.

Once a point of contact at the jurisdiction had been established and it was certain that the city or county met the selection criteria discussed above, a Booz Allen Hamilton team member conducted the interview. In all cases, the interview was with the traffic operations manager or with the sign maintenance program manager if this position was distinct. The following six sections present the interview findings for each of the jurisdictions.

CASE STUDY: AUSTIN, TEXAS

BACKGROUND ON SIGN INVENTORY

The Traffic Operations Program in the City of Austin's Transportation Department is responsible for managing signs on approximately 2,200 center-line miles of streets for than 750,000 residents. The city's sign inventory was completed in 2007 by the contractor PBS&J for approximately \$312,000. The City's general budget provided funds for the contract.

Austin's sign inventory is managed through ESRI's ArcGIS. The sign inventory originally contained only the coordinates of the signs, but no other information. Over the past couple of years, the Traffic Operations section has been entering the installation date of new signs into the sign database. Currently, the sign technicians are using handheld Trimble GPS data collection devices to add other attributes to the database in the field. The Traffic Operations program adds the signs in new developments to the sign inventory according to the construction plans. The traffic sign maintenance program uses Austin's ePerformance website to track key data and performance indicators such budget, signs installed, full time equivalents, and cost per sign installed.

COMPLEMENTARY SYSTEMS AND PROCESSES

Traffic Operations is currently in the process of implementing IBM's Maximo asset management software. The application will only serve the sign maintenance program. It will remain compatible with the City's GIS data infrastructure.

RETROREFLECTIVITY MEASUREMENT AND SIGN REPLACEMENT

Austin's Traffic Operations section is in the process of planning a sign inspection program. The program is based on Pierce County's control sign management method to ensure satisfactory sign condition which has been in place since 2007. Traffic Operations will identify approximately 3,000 control signs in the field. Sign technicians will check their reflectivity annually. When a significant portion of the sample signs in a given category fall below the MUTCD mandated thresholds, the whole category will undergo blanket replacement. The Traffic Operations Program manager also hopes to use control signs' attributes such as sign orientation to determine whether signs must be replaced.

CASE STUDY: BERNALILLO COUNTY, NEW MEXICO

BACKGROUND ON SIGN INVENTORY

Bernalillo County is home to New Mexico's largest city and is the state's most populous county. The Traffic Engineering Program in county's Department of Public Works is responsible for street sign maintenance in all unincorporated areas of the county. The County manages over 21,000 street signs on suburban and rural roads.

Bernalillo County's sign inventory program has been in place since 2005. The Traffic Engineering Program uses a Microsoft Excel spreadsheet inventory to track sign locations. Each signpost is listed a linear distance from the nearest intersection. The database not only tracks the sign location but also the sign type, signpost type, and offset distance. The sign technicians are also beginning to add installation dates for new signs.

The Department of Public Works GIS Department is planning a transition from the spreadsheet database to a GIS-based system supported by field Trimble GPS data collection units. The new units are in testing and buzz when in the proximity of a sign recorded in the asset inventory. The new system will allow sign technicians to make faster updates and write work orders in the field on their laptops. The county has not received any federal funding for sign management.

COMPLEMENTARY SYSTEMS AND PROCESSES

Bernalillo County currently uses a work order program that is not integrated with its GIS system. Paper work orders can be filled out in the field and entered into the system at the end of the day. When work orders are created by other departments, the system generates electronic requests. The County is currently developing a plan for integrating this system with its GIS capabilities based on the field GPS devices.

RETROREFLECTIVITY MEASUREMENT AND SIGN REPLACEMENT

The Traffic Engineering Program's sign technicians currently spend most of their time conducting inspections in the field. They carry the most common signs premade and must create work orders for street signs and other custom or uncommon signs. These work orders are consolidated and carried out in dedicated work sessions. The regular patrols ensure that signs are well maintained and that each sign is inspected approximately four times per year. The Traffic Engineering Program is not currently conducting night inspections, but the staff does plan on instituting daytime measured retroreflectivity checks when it is able to procure a new retroreflectometer. The program's goal is to check at least 100 signs per day; the sign technicians will only replace substandard signs.

When conducting their inspection rounds, workers can simply print the database records for the roads they will be driving and check off the signs as they drive along. As the sign technicians conduct their inspections, if any sign attributes are missing, these are filled in. Downed, damaged, faded, or otherwise impaired signs are replaced immediately if possible and the paper work order documented in the field. New signs are simply entered into the database in the appropriate distance order. The Traffic Engineering Program is responsible for inspecting new developments and adding the additional signs to the inventory. However, Bernalillo County is only growing at a moderate pace, and this work takes up only a small share of sign technicians' time.

CASE STUDY: FONTANA, CALIFORNIA

BACKGROUND ON SIGN INVENTORY

Fontana California began its sign inventory process in 2006. The Traffic Engineering Section of the Department of Public Works is responsible for street sign management, with the exception of street name signs which are the responsibility of another department. The Traffic Engineering Section is responsible for approximately 20,000 regulatory signs within 46 square miles of the city of 185,000.

The initial inventory was carried out by the Information Technology Department with some help from Public Works. The department makes extensive use of part-time employee and intern hours to keep the inventory up-to-date. Problems still arise accepting new developments because the IT department usually depends on the project plans to update the sign inventory. Pavement construction and maintenance contractors can also create problems when they pass on information on sign replacement. Fontana tries to avoid using contractors for sign work to ensure the quality of materials and work and to preserve the accuracy of the inventory.

COMPLEMENTARY SYSTEMS AND PROCESSES

Fontana's Public Works Department uses the GBA Master Series software application to manage work processes, but the inventory is hosted in ArcGIS. The city's Information Technology Department supports all city GIS functions, so GBA is the primary interface for the sign technicians to maintain the inventory, record work, and enter data. The same system is used to track sewer and storm drain system components, street lights, and other assets.

Currently, the GBA system is not yet fully implemented for the sign maintenance program. To keep the system updated, the sign technicians fill out daily reports which part time employees enter into the database. To date, the sign technicians still take hand written notes of sign attributes including location, sign type, sign post, and pole orientation. Eventually, the data collected will be input in the field through GBA on laptops in the sign maintenance trucks.

RETROREFLECTIVITY MEASUREMENT AND SIGN REPLACEMENT

Fontana's sign management program relies on measured reflectivity to assess nighttime visibility. This is the approach currently implemented to meet the federal mandate. The city originally used visual inspection but decided to migrate to the measured retroreflectivity approach to achieve greater consistency and accuracy. The Traffic Engineering Section's goal is to complete a comprehensive inspection of all signs under their responsibility every two years. The inspection process is currently being conducted on an ongoing basis, so one inspection period will roll into the next.

For stop signs, the city uses a higher retroreflectivity standard for replacement to ensure the compliance of these key regulatory signs. The signs are replaced when white retroreflectivity levels fall below 45 and red below 14 as opposed the mandated minimum levels of 35 for white and 7 for red. On average sign technicians take five minutes to measure each sign. If a sign needs replacement, it can take up to 1.5 hours in the field. The Traffic Engineering Section is currently shopping for a new retroreflectometer to reduce the average sign inspection time.

CASE STUDY: GOLDEN, COLORADO

BACKGROUND ON SIGN INVENTORY

Golden, Colorado is a suburb of Denver with a population of 17,321 in 2008 and an area of nine square miles. Golden's Public Works Department began its program to create a sign inventory seven years ago and completed the process in 2006. The inventory effort had a long duration in part because the new sign management program was funded entirely through city general funds. The effort received no state or federal funding.

The city's sign technician uses a Trimble handheld data collection unit to record data in the field using Cartegraph. The system records the sign location, sign type, signpost type, signpost height, signpost rating, offset, orientation, backing material, sheeting type, installation date, and inspection records including retroreflectivity readings and visibility. The sign maintenance staff is very satisfied with the system.

COMPLEMENTARY SYSTEMS AND PROCESSES

The sign management staff work with the GIS Department staff to manage the sign inventory. All data gathered on the Trimble device is uploaded at the end of the day by the GIS staff and hosted in Cartegraph. The information maintained in the sign inventory and the Cartegraph inspection and work order records allows Public Works managers to better forecast sign management needs and estimate the budget.

RETROREFLECTIVITY MEASUREMENT AND SIGN REPLACEMENT

Golden's sign technician makes regular inspections to check sign condition and to measure retroreflectivity. The city first began checking the coefficient of retroreflectivity last year and uses a Delta RetroSign GR3 retroreflectometer, which has performed well for the city. The sign technician is able to check 120-130 signs per day on average, and each sign is checked once per year.

The sign maintenance manager anticipates that the inspection program will generate significant savings for the city relative to their old blanket replacement program. In an area that had been slated for blanket replacement, only 40 to 50 percent of the signs actually needed replacing. However, the program is currently leading to higher sign expenditures as the sign technician finds legacy signs that do not meet the MUTCD standards.

The sign management program has already helped the city save money in several other ways. When the sign technicians receives a work request from a resident or another department, he knows the sign information in advance of going into the field and often can bring the correct sign on the first trip out. The sign inventory's record of inspections was also used to help counter a liability claim by a driver alleging the sign was not

visible. Finally, the city's signs are made by a vendor, and the sign manager uses the retroreflectometer to test signs before accepting them.

CASE STUDY: LONG BEACH, CALIFORNIA

BACKGROUND ON SIGN INVENTORY

The City of Long Beach in Southern California has nearly 470,000 residents, 50 square miles of area, and 38,000 signs. The city's inventory effort began in 2007 when Long Beach hired the engineering firm Woolpert to inventory the city's existing signs for \$400,000. Woolpert collected the location of every sign and entered it into Azteca, the city-wide work order system.

The sign inventory tracks assets by signpost primarily, with sign type and other sign characteristics as secondary attributes. The sign technicians continue to enter these additional attributes for the remaining signs. The Long Beach Traffic Operations Program maintains the sign inventory with Trimble GPS units.

COMPLEMENTARY SYSTEMS AND PROCESSES

The Azteca system is linked with the City's ArcGIS mapping platform. Sign maintenance staff can look up individual or groups of signs with the aerial photo and parcel layers. The Azteca system also contains parking meters and traffic signals and coordinates with the city's underground service alert system.

RETROREFLECTIVITY MEASUREMENT AND SIGN REPLACEMENT

One of the primary benefits of the inventory system is that it allows sign technicians to check sign specifications before going into the field for sign replacements. Because the sign technician teams can take the appropriate signs with them, their productivity has increased significantly, creating \$200,000 per year in labor value. The inventory has also allowed easier budget planning and better sign maintenance performance metrics.

Long Beach's 2007 inventory identified below-standard signs with respect to retroreflectivity and other standards, and these signs were replaced. Going forward, Long Beach Traffic Operations is planning to manage sign condition and visibility through timed blanket replacement based on signs' expected lives. The city's sign management program is not fully in place: the maintenance program manager estimates that it is 75% in place. The sign management program continues to populate the additional sign attributes, especially installation dates, to enable proper functioning of the system. Sign crew inspections continue to gather such data. Going forward, the city is now using sign installation dates to determine sign replacement. A simple query of the inventory generates a report of the signs needing replacement.

CASE STUDY: MESA, ARIZONA

BACKGROUND ON SIGN INVENTORY

Mesa, Arizona, a bedroom community in the Phoenix metropolitan area, is similar in size to Long Beach. The city's sign inventory currently stands at approximately 70,000 signs. The city began its sign inventory effort approximately seven years ago. Over the course of establishing a sign inventory system and completing it, Mesa has taken a variety of approaches. While the sign inventory began in-house, Mesa has used several contractors including 3M over the past five years.

Mesa has had issues over the years growing from a rudimentary database to a more stable SQL system with easier query capabilities. After working with multiple contractors, the sign maintenance supervisor expressed frustration with the ability of both 3M and other contractors to supply sign inventory in a useful and compatible format. Integrating the data at the end of a project resulted in additional, often significant costs to the city. Most recently, the sign maintenance manager has found it significantly cheaper to use the city's two sign crews on overtime, saving over half the cost of contracting the inventory effort. Inventory costs range from \$10,000 per square mile for in-house efforts to nearly \$35,000 for some contracted sign inventory projects.

COMPLEMENTARY SYSTEMS AND PROCESSES

While the City of Mesa has deployed a citywide asset management software, the sign management program continues to rely on its own database. Eventually, the sign management program would like to integrate its system or data into the city's overall system. The sign shop has relied on the public works department's information technology staff to support the integration of data from successive survey efforts and multiple contractors and formats into the current database. The same information technology staff is responsible for ongoing management of the database.

RETROREFLECTIVITY MEASUREMENT AND SIGN REPLACEMENT

To bring its sign assets into compliance, Mesa has pursued a blanket replacement strategy over the last two years. Going forward from its blanket replacement program, Mesa will now rely on timed replacement and therefore replace its signs based on the stated sign sheeting warranty. The transition to timed replacement has been expensive for the city. Over three years, including the next fiscal year, the city will have replaced over 30,000 signs made with engineering grade sheeting.

The fast pace of sign replacement meant that Mesa had to rely on contractors to manufacture the majority of the new signs. However, all signs will then have an inventory entry with installation date, location, and other sign details. The department information technology staff can generate annual reports of signs needing replacement by grid sector which in turn become work orders. When the sign is replaced, its

information will be updated in the field. The sign supervisor also notes that the city has had excellent luck with grants to fund projects. Recently the city received a grant of several tens of thousands of dollars from a federal mobility grant targeted at senior citizens' safety.

CONCLUSION

INVENTORY APPROACHES

The peer jurisdiction interviews revealed a variety of strategies for creating and managing street sign inventories. In all cases, the sign inventory program was a major undertaking for the jurisdiction's sign maintenance program in terms of both cost and time investments. However, all of the jurisdictions interviewed did cite significant benefits of having a sign inventory in place including more efficient operation in the field, better inspection records, and easier and more precise budgeting and forecasting.

Exhibit 2: Inventory Approaches

Jurisdiction	Initial Inventory Approach	Inventory Format	Software/Systems	Coordination with Other Departments
Austin, TX	Contracted initial collection	GIS/upgrading to asset management software	ArcGIS; upgrading to Maximo for interface	None currently
Bernalillo Cty, NM (unincorporated)	Created and maintained internally	Spreadsheet database using linear distances	MS Excel; upgrading to ArcGIS with Trimble laptop system	Supported by GIS Department
Fontana, CA	Created and maintained internally	GIS	Trimble handheld units; GBA and ArcGIS	DPW IT/GIS Department led the inventory effort
Golden, CO	Created and maintained internally	Asset management software	Trimble handheld units; Cartegraph and ArcGIS	Supported by GIS Department
Long Beach, CA	Contracted initial collection	Asset management software	Azteca; also supported by ArcGIS	Supported by GIS Department
Mesa, AZ	Both contracted and conducted internally	Asset management software	Custom SQL database	Supported by Publics Works IT staff

It is interesting to note that the largest three jurisdictions solicited the help of contractors. The relatively smaller jurisdictions seem to have been better able to complete their sign inventories independently. In most cases the sign inventory efforts involved significant cooperation between the sign maintenance staff and other departments, most notably the GIS departments. Finally, ESRI's ArcGIS is an important structural basis of the sign asset inventory.

According to several of the sign maintenance managers interviewed, one major pitfall to a successful inventory program is planning. In their opinion, it is important to give careful consideration to sign inventory processes and systems. Details such as the attributes collected, the anticipated inspection methods, and the integration with other work

processes feed into the design of the system and can mitigate the need for additional investment to correct unanticipated issues. One jurisdiction was unhappy that it had not input more sign characteristics into its database initially. Multiple jurisdictions underlined the need to ensure sufficient resources have been dedicated to maintain the sign inventory and to keep it up-to-date. Several jurisdictions have faced significant challenges in implementing their sign management program. As a result, these jurisdictions continue to make adjustments to their programs. Especially for the largest jurisdictions, after the fact changes represent a significant obstacle and a strain on their budgets.

RETROREFLECTIVITY MANAGEMENT APPROACHES

Like the sign inventory programs, the retroreflectivity management programs also require significant resources. However, the benefits of managing retroreflectivity are more predictable than for sign inventory programs. Putting a retroreflectivity management program in place can substantially reduce costs relative to a basic blanket replacement program. Based on the experiences of the jurisdictions interviewed, retroreflectivity management programs work best when they well integrated into existing work procedures and processes.

Exhibit 3: Retroreflectivity Management Approaches

Jurisdiction	Approach	Details	State of Implementation
Austin, TX	Control Signs	Sample of 3,000 signs in the inventory	In planning
Bernalillo Cty, NM (unincorporated)	Measured Sign Retroreflectivity	Dedicate one truck part time to the program; check signs once per year	Implemented, but retroreflectometer is broken
Fontana, CA	Measured Sign Retroreflectivity	Conduct periodic inspections by sector	Implemented; looking for new retroreflectometer to improve the program's efficiency
Golden, CO	Measured Sign Retroreflectivity	Each sign is checked once per year and photographed	Implemented
Long Beach, CA	Expected Sign Life	Replace signs based on the warranty period	Do not yet have installation dates for all signs
Mesa, AZ	Expected Sign Life	Replace signs based on the warranty period	One more year of replacing legacy engineering grade signs

Among the jurisdictions interviewed, three selected measured retroreflectivity as a management approach because of its high level of potential cost savings relative to

timed or blanket replacement. However, of those three jurisdictions, only Golden, Colorado has been satisfied with the performance of its retroreflectometer.

The largest three jurisdictions by population preferred the simpler approach of timed sign replacement. For example, Austin's control signs approach offers advantages to such a large city where the incremental inspections costs of measured retroreflectivity or nighttime visual inspections would be substantial while not producing immediate cost savings. Thus the approach of the largest three jurisdictions is more risk averse and may be more appropriate given the resources invested in their programs. Overall, it is evident from the interviews that a robust sign inventory offers the jurisdiction a higher level of flexibility in implementing a retroreflectivity management program. A rich sign database provides valuable information that can support multiple approaches to maintaining retroreflectivity.

APPENDIX

PEER JURISDICTIONS SIGN MANAGEMENT PRACTICES QUESTIONNAIRE

Interviewee/Title: _____

Agency: _____

Contact Information: _____

1. BACKGROUND

- Can you provide us with some details about your jurisdiction:
 - a. Street/street-lane miles
 - b. Signalized intersections
 - c. Developed geographic extent/area
- Can you provide us the sign inventory details:
 - a. Total sign inventory size
 - b. Number of non-exempt signs (signs subject to MUTCD's minimum retroreflectivity standards)

2. SIGN INVENTORY SYSTEMS

- Do you have a sign inventory program in place?
 - a. What is the current state of implementation?
 - b. When did the inventory process begin?
 - c. How much has it cost (capital expenses, operating expenses)?
Have you received additional funding to cover these costs?
 - d. Is the system shared with any other departments or used for other functions?
 - e. Is your inventory process integrated with or include a work order system?
(*What work order system?*)
- How accurate and complete do you estimate your inventory to be?
 - a. What are the barriers to completing an accurate inventory?
 - b. How do you keep the system up-to-date?
 - c. Do you have a process for accepting signs from new developments?
- What staffing levels are dedicated to updating and maintaining the database?
- Do you use any *other* systems, software (including interface with GIS), and hardware for performance-based maintenance of signs?
- What sign sheeting materials do you typically use?
 - a. How satisfied are you with this sheeting?
 - b. How long do these typically last?

3. CONDITION MEASUREMENT AND SIGN REPLACEMENT

- Under what circumstances do you replace signs?
- Have the new nighttime visibility requirements impacted your future sign replacement or sign management goals?
- What methods or processes are being used to assess signs' nighttime visibility?
 - a. Nighttime visual inspection
 - b. Measured Sign Retroreflectivity
 - c. Control Signs
 - *For A, B, and C: What is the frequency of inspection?*
 - d. Expected Sign Life
 - e. Blanket Replacement
 - f. Some combination of the above
 - g. Driver complaints (is there a process in place for receiving complaints)
- What processes are in place to initiate actions to replace signs that are at or near the minimum levels?
 - a. Is there a backlog of work orders?
- Have you fully implemented the process?
 - a. What is your level of progress towards meeting the FHWA compliance deadlines?
 - b. What have been the main challenges to implementing the sign management program?
 - c. What barriers to full implementation and compliance still remain?
- What staffing levels are available to maintain signs in your jurisdiction?
 - a. Do you use an outside contractor to supplement staff?
 - b. What work do they perform?
 - c. If so, what share (percentage) of the overall work do they perform?
- Have you had any tort liability issues due to poor sign reflectivity?

TECHNICAL MEMORANDUM #3

**4. ASSESSMENT OF RETROREFLECTIVITY
MANAGEMENT OPTIONS**

October 7, 2010

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1. INTRODUCTION

PURPOSE OF TASK 4

Task 4 of the Regional Transportation Commission of Southern Nevada's (RTC) Sign Asset Management Study – "Implementation Plan" – follows on Task 2 – "Industry Review" – and Task 3 – "Summary of Local Practices." Task 4 has two elements. The first is an analysis of the cost effectiveness of each sign retroreflectivity management option. The second is the identification of possible funding sources to help RTC members reach compliance with the new Manual of Uniform Traffic Control Devices (MUTCD) sign retroreflectivity management rules in accordance with the schedule set by the Federal Highway Administration (FHWA).

The cost effectiveness analysis is intended to help RTC members select an appropriate sign management method for their jurisdiction and to help the RTC evaluate the feasibility of a regional sign retroreflectivity management solution. The cost analysis provides order of magnitude estimates for retroreflectivity compliance and for programmatic sign replacement. These estimates are intended to help RTC members in their budget planning in the short and longer terms.

While the FHWA has mandated new sign retroreflectivity standards to improve signs' nighttime visibility, the agency has not provided for any automatic funding to local jurisdictions to meet compliance costs. The Booz Allen Hamilton team identified potential federal funding sources to cover program costs, especially initial compliance costs.

At the end of this report is the appendix which provides additional summary results for individual jurisdictions, sample cost model tabs, and a bibliography of sources used in developing the cost model. The Booz Allen team submitted a compact disk attached to this report containing related documents including the cost model and the reports and studies found as part of the research conducted in Tasks 2, 3, and 4.

SIGN RETROREFLECTIVITY MANAGEMENT COST ANALYSIS

The analysis of the cost effectiveness of the five main sign management options considered each management option separately for all six RTC member jurisdictions as well as for the combined region. The analysis proceeded in three main steps:

- Data collection
- Cost estimation
- Cost effectiveness comparison.

Each step is examined in detail in its own section with the basic assumptions described. The report addresses each of the key model variables which best capture the

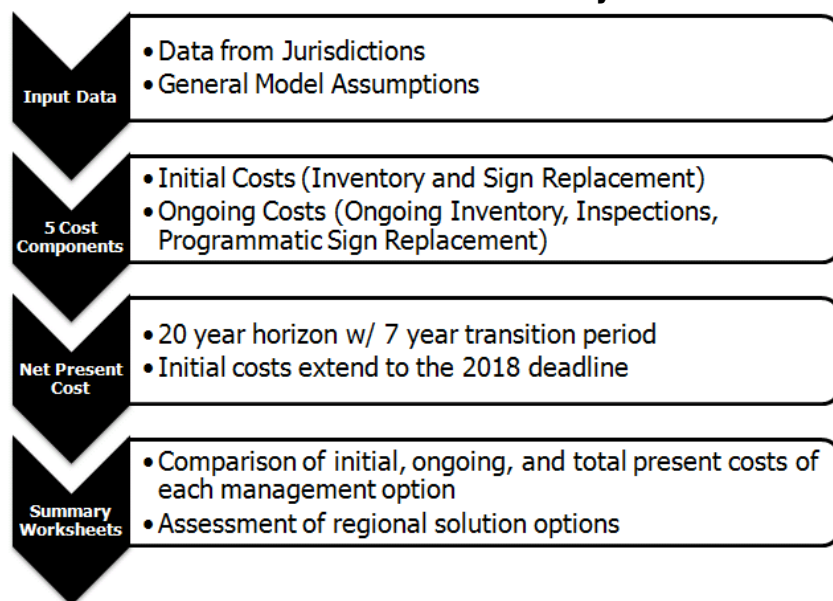
differences among the management methods and which determine the relative cost-effectiveness of the five management methods listed in Exhibit 1-1.

Exhibit 1-1: Sign Retroreflectivity Management Methods

Management Method	Description
Timed Replacement	Signs are replaced based on the manufacturer's expected sign useful life
Timed Replacement w/ Control Signs	Signs are replaced based on the observed useful life of control signs
Measured Retroreflectivity	Signs are replaced based on the inspection of each sign with a retroreflectometer
Nighttime Visual Inspections	Signs are replaced based on the visual inspection of each sign
Blanket Replacement	Signs are replaced all at once by sector regardless of age or condition

The final cost model tool is included as a digital attachment to the report. After the creation of an initial draft of the model, each member of the Booz Allen team reviewed the model in detail to assess its strengths and flaws. The iterative review process resulted in numerous updates to the original model's structure, in the layout of the workbook, and finally in the presentation of results. Before the model was finalized, the Booz Allen team reviewed it with the RTC project manager for final comments. The results in this report are based on the final model version submitted to the RTC with this report. Exhibit 1-2 below provides a schematic of the cost analysis process, which is explored in detail in Section 2 of this report.

Exhibit 1-2: Schematic of Cost Analysis Process



IDENTIFICATION OF POTENTIAL FUNDING SOURCES

The second part of this report examines potential funding sources to assist with initial compliance with the new FHWA sign retroreflectivity management rules. The Booz Allen team's research on potential funding sources included inquiries with peer jurisdictions as part of Task 2 and separate research of peers' experiences and state and federal resources in Task 4.

2. COST EFFECTIVENESS ANALYSIS

DATA COLLECTION

Data collection for the cost analysis began from the beginning of the project. The data for the model came from three categories of sources:

- RTC member jurisdictions
- Peer jurisdictions
- Relevant reports and research studies.

Some of the data from the RTC members were collected in March 2010 in the course of the preliminary interviews as part of Task 3. Following the July 2010 Technical Working Group (TWG) meeting, the Booz Allen team met with the City of Las Vegas TWG members for a work session focusing on program costs. The other TWG members also received a questionnaire on agency costs which several jurisdictions completed and returned. The data obtained directly from the RTC members included a burdened cost per sign, burdened sign technician hourly labor rates, hourly vehicle overhead costs, and average inventory and inspection times per sign. Following the work session with the City of Las Vegas, the consultant team received a copy of the City's sign inventory, another useful resource.

In the course of interviewing peer jurisdictions, the Booz Allen team collected a range of data related to sign retroreflectivity management and maintenance. Most of these data could not be used directly in the model; however, they served as useful reference points to check both input data and output results. Relevant data received from peer jurisdictions included sign inventory costs, average inspection times per sign, and blanket sign replacement costs.

Finally, the Booz Allen team accumulated a variety of literature relevant to the project over the course of Tasks 2 and 4. While researching prospective peer jurisdictions, the Booz Allen team uncovered news articles and local agency documents related to costs and expected work standards. In Task 4, the Booz Allen team collected additional reports and studies to fill key information gaps. These included the expected useful lives of signs under different management programs and work standards such as average sign inspection time, sign installation cost and time, and sign inventory time.

The Booz Allen team chose the variables to incorporate into the model based on several factors. First, data availability was an important consideration. Where possible, the model would rely on data easily available from the RTC members. Second, the variables should allow a straightforward rendering of the lifecycle cost of each management method without double counting or gaps. Finally, the model must include the sufficient variables to characterize the fundamental differences between the five management methods.

Unfortunately, the Booz Allen team did not receive complete data from all Las Vegas region jurisdictions. Exhibit 2-1 shows which key data were made available for the cost modeling effort. In cases where data gaps existed for particular jurisdictions, there were sufficient benchmark values from other RTC members and from other sources to make informed assumptions about the variable's approximate value.

Exhibit 2-1: Data Solicited From RTC Members

Data Requested	Boulder City	City of Las Vegas	Clark County	Henderson	Mesquite	North Las Vegas
Total Cost per Sign Replaced	Collected	Collected	Missing	Collected	Missing	Missing
Average Time per Inspection (measured)	Missing	Collected	Missing	Missing	Missing	Missing
Average Time per Inspection (visual)	Missing	Collected	Missing	Collected	Missing	Missing
Average Time per Sign Inventoried	Missing	Collected	Missing	Missing	Missing	Missing
Loaded Technician Hourly Cost	Collected	Collected	Missing	Collected	Collected	Missing
Hourly Overhead Cost	Collected	Collected	Missing	Collected	Missing	Missing

Fortunately, all data for all key variables were collected from at least one RTC member. The cost model was also distributed to the TWG members for their own use and allows them to update variables' values as they wish.

CREATION OF COST MODEL

In creating the cost model, the Booz Allen team used a bottom-up, lifecycle approach. Each component activity involved in sign retroreflectivity management was broken out and accounted for individually. Then activities were allocated year by year over a projected program lifecycle. Twenty years was selected as a reasonable time horizon given the lifecycles of technologies and regulations. Any management approach is not likely to last longer than that timeframe.

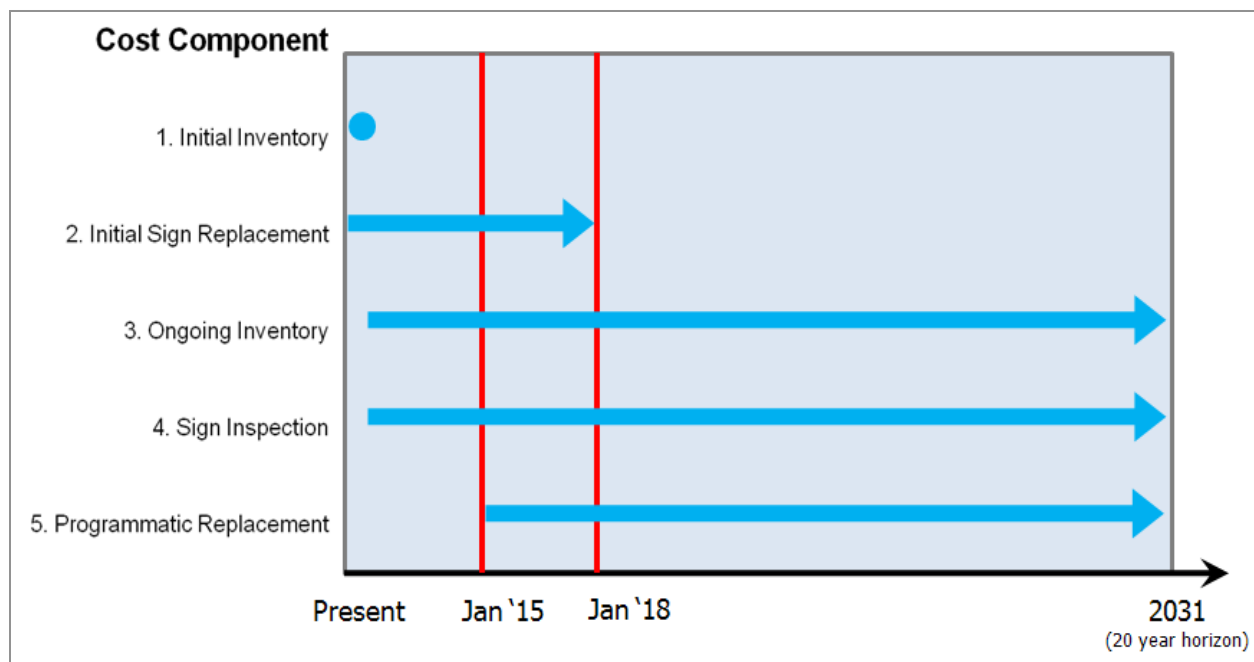
In order to separate out the key cost components, the Booz Allen team first broke the compliance process into two parts. The first part includes the activities to reach initial compliance:

A jurisdiction must (in most cases) complete an initial inventory and conduct an initial sign replacement of all non-compliant signs by the applicable FHWA deadlines.

The first includes cost components 1 and 2 shown in the timeline in Exhibit 2-2 and lasts seven years from the beginning of calendar year 2011 through January 2018.

The second part focuses ongoing compliance. To maintain ongoing compliance, jurisdictions must maintain the sign inventory, complete sign inspections (if applicable), and continue targeted programmatic replacement of signs which fall beneath the minimum retroreflectivity values. Ongoing compliance includes cost components 3, 4, and 5 in Exhibit 2-2. It begins the calendar year after the completion of the initial inventory and ends twenty years later in January 2031.

Exhibit 2-2: Timeline for Compliance with Retroreflectivity Standards



One important takeaway from Exhibit 2-2 is that the two parts do overlap. As soon as the initial inventory is complete, it must be kept up-to-date. In January 2015, all regulatory, warning, and ground-mounted guidance signs except street name signs must comply with the new minimum retroreflectivity standards. The remaining guidance signs including street name signs must comply with the standards by January 2018. Once sign compliance is established for the January 2015 deadline, these signs must be inspected and undergo programmatic replacement as necessary to maintain compliance.

For the next step in developing the sign retroreflectivity management cost model, the Booz Allen team applied the five identified cost components in the two phases to each of the five management methods. Not all methods included all five cost components. As

Exhibit 2-3 below shows, timed replacement does not require ongoing sign inspections, and blanket replacement requires neither sign inspections nor an inventory.

Exhibit 2-3: Sign Retroreflectivity Management Method Cost Model Components

Management Method	1. Initial Inventory	2. Initial Sign Replacement	3. Ongoing Inventory	4. Sign Inspection	5. Programmatic Replacement
Timed Replacement	One-time capital	Capital cost annualized over 1st 7 years (2011 - 2017)	Annual operations cost	N/A	Annual capital cost
Timed Replacement w/ Control Signs	One-time capital	Capital cost annualized over 1st 7 years (2011 - 2017)	Annual operations cost	Annual operations cost	Annual capital cost
Measured Retroreflectivity	One-time capital	Capital cost annualized over 1st 7 years (2011 - 2017)	Annual operations cost	Annual operations cost	Annual capital cost
Nighttime Visual Inspections	One-time capital	Capital cost annualized over 1st 7 years (2011 - 2017)	Annual operations cost	Annual operations cost	Annual capital cost
Blanket Replacement	N/A	Capital cost annualized over 1st 7 years (2011 - 2017)	N/A	N/A	Annual capital cost

Since one purpose of the model is to highlight funding needs, the model was designed to distinguish between capital and operations costs, a fact highlighted in Exhibit 2-3. The table shows that initial compliance includes only capital costs. As detailed Section 3 of this report, these program “start up” costs are eligible for federal assistance from a variety of sources. Ongoing programmatic costs involve both significant operating costs (for most options) and significant capital costs. Section 3 of this report also discusses how the ongoing compliance costs are eligible for fewer funding sources.

While the RTC members could potentially spread an inventory effort over multiple years, the model assumes that the initial inventory costs all fall within a single year. The initial sign replacement costs are spread over the first seven years of the compliance period with an equal amount assumed to be invested each year. The model calculates all component costs in present dollars.

The next stage in creating the cost model was to define the individual cost structure of the five cost model components. In keeping with the bottom-up approach, the Booz Allen team determined the cost components using an appropriate unit cost. For each of the five cost model components, the cost model defines a relevant quantity and a relevant unit cost. To get the cost component totals for each management method, it is only necessary to multiply the applicable quantity and unit cost. The cost components are then rolled up into a lifecycle cost by year and jurisdiction, allowing comparisons

among the five potential sign retroreflectivity management methods. Exhibit 2-4 displays the variables used for the quantity and the cost for each of the five cost components.

Exhibit 2-4: Input Variables by Cost Model Component

Cost Component	Primary Cost Drivers
1. Initial Inventory Costs	Quantity: Sign inventory size Unit Cost: Cost per sign inventoried
2. Initial Sign Replacement Costs	Quantity: Signs requiring replacement by FHWA deadlines Unit Cost: Cost per sign replaced
3. Ongoing Inventory Costs	Quantity: Number of signs inventoried Unit Cost: Cost per sign inventoried
4. Sign Inspection Costs	Quantity: Total labor hours Unit Cost: Loaded sign technician hourly cost
5. Programmatic Sign Replacement Costs	Quantity: Number of signs requiring programmatic replacement Unit Cost: Cost per sign replaced

Several of the variables in Exhibit 2-4 were calculated from multiple input data. Exhibit 2-5 below provides an explanation of the sources of the variables presented in Exhibit 2-4. For example, the number of signs needing replacement by each deadline is product of the share of total signs subject to each deadline and of the estimated number of those signs in compliance. Using the City of Las Vegas' sign inventory, the Booz Allen team concluded that 44 percent of that city's total signs were subject to the 2015 deadline and that 49 percent were subject to the 2018 deadline. The consultant team assumed these proportions applied to the remaining jurisdictions as well, an assumption based on the fact that the entire region is subject to nearly uniform standards for traffic guidance. Then, based on the interviews with the RTC members, the background literature, and the peer experiences, the Booz Allen team developed initial estimates of the share of noncompliant signs subject to each deadline. To find the number signs needing replacement for each deadline, the total sign population is multiplied by the fraction subject to the deadline and the fraction of signs estimated to be noncompliant.

Three sign management methods require sign inspections: timed replacement with control signs, measured sign retroreflectivity, and nighttime visual sign inspections. The annual sign inspection cost is based the quantity of sign technician hours spent inspecting signs and recording data. To get the total annual sign technician hours expended, three basic data inputs are needed:

- The average amount of time to inspect each sign

- The size of the crew needed for inspections (either one or two sign technicians)
- The necessary frequency of sign inspections (annually for visual inspections and biannually for retroreflectometer inspections).

By multiplying the total sign population by these three variables, the model arrives at the total sign technicians required for sign nighttime visibility inspections every year.

The final quantity variable composed of multiple input data is the annual number signs requiring programmatic replacement. This variable comes from the division of the jurisdiction's total sign inventory by the average sign life under the given sign retroreflectivity management method. Exhibit 2-5 details the origin of the remaining key cost variables as well as those of the three just described.

Exhibit 2-5: Input Data for Cost Model Component Variables

Variable	Input Data
Sign inventory size	Collected from RTC members
Cost per sign inventoried	Collected from RTC members and from the literature search
Signs requiring replacement by FHWA deadlines	Based on estimates from City of Las Vegas data of the number of signs subject to each deadline and on estimates of the number of signs is currently in compliance under different management methods
Cost per sign replaced	Collected from RTC members
Number of signs inventoried	Collected from RTC members
Total labor hours	Based on the average sign inspection times found in the literature, the inspection crew size needed, and inspection frequencies based on data in the literature
Loaded sign technician hourly cost	Collected from RTC members
Number of signs requiring programmatic replacement	Based on the expected average sign life under different management methods

Using the variables above, the cost model tabulates all five cost model component for each sign management method for each jurisdiction on a separate tab in a Microsoft Excel workbook. The Appendix contains the five example tabs from the City of North

Las Vegas. Each workbook tab shows the precise calculation used to convert the input data into the necessary quantity and unit cost amounts if applicable and then into the final component cost.¹³ Below, Exhibit 2-6 provides the regional component costs, summed over all six jurisdictions, for each of the five sign retroreflectivity management strategies studied.

Exhibit 2-6: Cost Component Values for Regional Sign Management Strategies

Management Method	1. Initial Inventory	2. Initial Sign Replacement	3. Ongoing Inventory	4. Sign Inspection	5. Programmatic Replacement
Timed Replacement	\$1,359,381	\$33,971,288	\$56,353	\$0	\$3,842,450
Timed Replacement w/ Control Signs	\$1,359,381	\$33,971,288	\$56,353	\$36,261	\$3,293,529
Measured Retroreflectivity	\$1,359,381	\$27,127,740	\$56,353	\$1,578,045	\$3,293,529
Nighttime Visual Inspections	\$1,359,381	\$27,127,740	\$56,353	\$1,585,540	\$3,293,529
Blanket Replacement	\$0	\$40,163,794	\$0	\$0	\$4,610,940

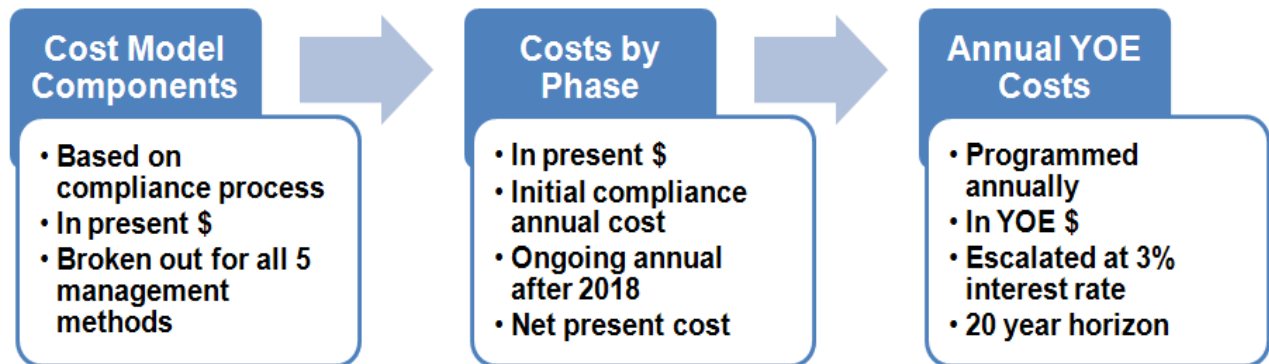
To render the component costs more useful, the Booz Allen team converted the costs to annual expenditures. The model programs the five component costs year by year for each management method for each jurisdiction, based on Exhibits 2-2 and 2-3:

- Cost component #1, Initial Inventory – only occurs in the first year (2011) of the twenty year lifecycle or program time horizon.
- Cost component #2, Initial Sign Replacement – is a uniform cost applied over the first seven years of the time horizon – 2011 through 2018.
- Cost component #3, Ongoing Inventory Costs – is a uniform cost recurring annually after the first year – 2012 through January 2031.
- Cost component #4, Sign Inspection Costs – is a flat annual cost beginning once the 2015 compliance deadline is reached.
- Cost component #5, Programmatic Sign Replacement Costs – begins in 2015 covering the signs subject to the 2015 deadline and expands to cover the remaining regulated signs after the 2018 deadline through January 2031.

The full cost estimation process is summarized in the schematic in Exhibit 2-7 below.

¹³ The full workbook was also submitted to the RTC of Southern Nevada and contains the full set of tabs and summary tables for all six jurisdictions.

Exhibit 2-7: Cost Model Summary



The twenty year lifetime annual programmed costs by management method are available to the operators in the digital copy of the cost model. The twenty year regional summary is included in the report Appendix, as are the cost model component values for each RTC jurisdiction.

COMPARISON OF COST MODEL OUTCOMES

After the development of cost estimates, the focus of this section is on the comparison of the management methods' cost. It compares the expected costs of each management method for all six jurisdictions and for the region as a whole. The regional cost totals are intended to assess the potential of a coordinated solution for each management method. Since no single cost measure provides a comprehensive comparison, the section analyzes the program lifecycle costs, initial compliance costs, and ongoing programmatic costs.

The net present cost is a useful measure of the lifecycle costs of each sign management option since it takes into account not only the magnitude of project costs but also their timing. The net present cost calculation weights future costs less which reflects the lower opportunity cost of these expenditures as well as their greater uncertainty. The aggregation of the stream of expenditures into a single cost value allows easy comparison of the management method and highlights high cost outliers.

The cost model's net present value calculation gives the total present cost to each jurisdiction for each management option. These net present value calculations discount the twenty year stream of program expenditures to a total present equivalent for each sign management method scenario. The discount rate selected – three percent – is net of expected inflation (forecast at an average of three percent) and the sign inventory growth rate (also forecast at an average of three percent). Exhibit 2-8 shows the net present cost of each management method for each of the six jurisdictions as well as for the region as a whole.

Exhibit 2-8: Net Present Cost of Sign Retroreflectivity Management Methods

Jurisdiction	1. Timed Replacement	2. Timed Replacement w/ Control Signs	3. Measured Retroreflectivity	4. Nighttime Visual Inspections	5. Blanket Replacement
Boulder City	\$583,858	\$590,791	\$520,330	\$516,261	\$612,885
City of Las Vegas	\$16,628,671	\$15,332,428	\$21,452,283	\$18,659,959	\$21,155,369
Clark County	\$33,118,704	\$30,804,535	\$35,102,003	\$34,860,001	\$36,669,307
Henderson	\$9,903,276	\$9,176,333	\$10,757,367	\$13,993,438	\$11,387,803
Mesquite	\$1,020,112	\$991,433	\$996,026	\$982,069	\$1,016,109
North Las Vegas	\$10,983,906	\$10,231,725	\$11,159,511	\$11,068,807	\$12,693,222
Regional Total	\$72,238,527	\$67,127,244	\$79,987,520	\$80,080,536	\$83,534,695

Note that if the lowest cost option is selected for each of the six jurisdictions, the total regional cost is \$67,043,351. That is not even one percent less than the regional total for timed replacement with control signs, the lowest cost uniform approach.

To facilitate the comparison of management options, Exhibit 2-9 provides a simple comparison index for all of the RTC jurisdictions. The number is the net present cost of the management option divided by the least expensive option's cost. The result is a table where the number "1.00" marks the best option and the highest number in the row is the most expensive compliance option.

Exhibit 2-9: Comparison of Sign Program Lifecycle Net Present Costs

Jurisdiction	1. Timed Replacement	2. Timed Replacement w/ Control Signs	3. Measured Retroreflectivity	4. Nighttime Visual Inspections	5. Blanket Replacement
Boulder City	1.13	1.14	1.01	1.00	1.19
City of Las Vegas	1.08	1.00	1.4	1.22	1.38
Clark County	1.08	1.00	1.14	1.13	1.19
Henderson	1.08	1.00	1.17	1.52	1.24
Mesquite	1.04	1.01	1.01	1.00	1.03
North Las Vegas	1.07	1.00	1.09	1.08	1.24
Regional Total	1.08	1.00	1.19	1.19	1.25

As Tasks 2 and 3 underscored, many differences in sign management approaches show up along population lines. While one approach seems appropriate for small jurisdictions, often a very different approach works better for large jurisdictions. Exhibit 2-9 shows that timed replacement with control signs clearly has the lowest expected costs of all of the management options for unincorporated Clark County, the City of Las Vegas, Henderson, and North Las Vegas. It is also definitively the lowest cost option at the regional level. However, the two smallest RTC members by population, Mesquite and Boulder City, have sign inspections as the lowest options, with measured retroreflectivity and nighttime visual inspections closely matched in cost. In fact, the cost forecasts for the City of Mesquite show that the lifecycle costs as measured by the net present cost are closely clustered and that Mesquite could plausibly choose any of the management methods.

If a RTC jurisdiction is more concerned with completing initial compliance and the short term budget impacts, the costs before the January 2018 deadline will carry much more importance. This concern is valid since, for the region as a whole, initial annual costs are between 15 and 71 percent higher than ongoing annual costs and could put short term stress on a sign program's budget. Exhibit 2-10 shows the total present dollar costs and the comparison costs for all six jurisdictions.

Exhibit 2-10: Comparison of Sign Program Initial Phase Costs

Jurisdiction	1. Timed Replacement		2. Timed Replacement w/ Control Signs		3. Measured Retroreflectivity		4. Nighttime Visual Inspections		5. Blanket Replacement	
Boulder City	\$48,817	1.33	\$50,267	1.37	\$36,903	1.01	\$36,715	1.00	\$45,919	1.25
City of Las Vegas	\$1,251,740	1.02	\$1,228,188	1.00	\$1,415,317	1.15	\$1,286,745	1.05	\$1,713,054	1.39
Clark County	\$2,830,167	1.08	\$2,786,242	1.07	\$2,624,667	1.00	\$2,613,525	1.00	\$2,969,293	1.14
Henderson	\$760,613	1.02	\$748,164	1.00	\$749,946	1.00	\$898,950	1.20	\$853,200	1.14
Mesquite	\$78,303	1.24	\$79,151	1.25	\$68,564	1.08	\$67,921	1.07	\$63,325	1.00
North Las Vegas	\$905,015	1.15	\$892,061	1.13	\$792,047	1.01	\$787,870	1.00	\$1,027,832	1.3
Regional Total	\$5,874,655	1.03	\$5,784,074	1.02	\$5,687,443	1.00	\$5,691,726	1.00	\$6,672,622	1.17

In most cases, focusing on short term costs favors the implementation of an inspection program. Timed replacement usually resembles the blanket replacement approach initially because signs with unknown ages must be replaced while a sign inspection

approach minimizes the initial rate of sign replacement. For this reason, many jurisdictions would save on initial compliance costs by choosing to do sign inspections and replacing fewer signs before the 2015 and 2018 deadlines. However, since Mesquite has already made significant progress with its blanket replacement effort, that management option presents lower future costs for that city. Because they have higher existing sign compliance rates than the other large jurisdictions, the City of Las Vegas and the City of Henderson displayed less difference between the lifetime program costs and the initial program costs.

Finally, some jurisdictions may wish to examine which of the five sign retroreflectivity management methods has the lowest ongoing costs. For instance, if the agency receives significant grant funding for the initial costs, then the focus may be more on the cost of maintaining compliance. As Exhibit 2-11 shows, the model definitively points to timed replacement with control signs as the lowest cost option. Only Boulder City has another option that comes close.

Exhibit 2-11: Comparison of Sign Program Ongoing Costs

Jurisdiction	1. Timed Replacement		2. Timed Replacement w/ Control Signs		3. Measured Retroreflectivity		4. Nighttime Visual Inspections		5. Blanket Replacement	
Boulder City	\$30,498	1.01	\$30,269	1.00	\$32,019	1.06	\$31,691	1.05	\$36,038	1.19
City of Las Vegas	\$973,058	1.15	\$843,449	1.00	\$1,406,049	1.67	\$1,181,049	1.40	\$1,150,875	1.36
Clark County	\$1,686,633	1.16	\$1,456,551	1.00	\$2,066,651	1.42	\$2,047,151	1.41	\$1,994,850	1.37
Henderson	\$566,397	1.15	\$493,183	1.00	\$672,701	1.36	\$933,458	1.89	\$669,600	1.36
Mesquite	\$58,383	1.07	\$54,563	1.00	\$62,859	1.15	\$61,734	1.13	\$69,053	1.27
North Las Vegas	\$583,835	1.15	\$508,129	1.00	\$687,648	1.35	\$680,339	1.34	\$690,525	1.36
Regional Total	\$3,898,803	1.15	\$3,386,143	1.00	\$4,927,926	1.46	\$4,935,421	1.46	\$4,610,940	1.36

In the long term, the cost of inspections appears to trump their benefit. Timed replacement with control signs offers a relatively simple approach to minimize programmatic sign replacement costs.

CONCLUSION

Overall, there seem to be two approaches split by population. Timed replacement with control signs has the lowest net present cost for the four highest population RTC members, with other options trailing by at least seven percent. The two smallest jurisdictions have multiple low cost options. For Boulder City and Mesquite, visual

nighttime inspections has the lowest net present cost but measured retroreflectivity has a comparably low cost for both. Mesquite could plausibly choose any of the five alternatives since the highest cost option is only four percent more than the lowest cost option.

It is important to keep in mind the uncertainty of the cost model estimates. The cost model defines the likely magnitude of the program costs quite well. The output costs are relatively closely grouped for most jurisdictions. All of the sign management methods' net present costs fall within 25 percent of the lowest cost option except for one scenario for North Las Vegas. However, the cost model did not take into account contractor costs, which could be significantly different, or the costs associated with updating existing sign maintenance processes to accommodate the compliance method. The cost model developed as part of Task 4 is best used to eliminate sign retroreflectivity management options with relative high costs: the outliers. Exhibit 2-12 lists the three lowest cost management options for each jurisdiction according to the three time period measures.

Exhibit 2-12: Lowest Cost Sign Management Methods

Jurisdiction	Net Present Cost (20 year horizon)	Average Annual Initial Cost (1st 7 years)	Average Annual Program Cost (after Jan 2018)
Boulder City	<ol style="list-style-type: none"> 1. Nighttime Visual Inspections 2. Measured Retroreflectivity 3. Timed Replacement 	<ol style="list-style-type: none"> 1. Nighttime Visual Inspections 2. Measured Retroreflectivity 3. Blanket Replacement 	<ol style="list-style-type: none"> 1. Control Signs 2. Timed Replacement 3. Nighttime Visual Inspections
City of Las Vegas	<ol style="list-style-type: none"> 1. Control Signs 2. Timed Replacement 3. Nighttime Visual Inspections 	<ol style="list-style-type: none"> 1. Control Signs 2. Timed Replacement 3. Nighttime Visual Inspections 	<ol style="list-style-type: none"> 1. Control Signs 2. Timed Replacement 3. Blanket Replacement
Clark County	<ol style="list-style-type: none"> 1. Control Signs 2. Timed Replacement 3. Nighttime Visual Inspections 	<ol style="list-style-type: none"> 1. Nighttime Visual Inspections 2. Measured Retroreflectivity 3. Control Signs 	<ol style="list-style-type: none"> 1. Control Signs 2. Timed Replacement 3. Blanket Replacement
Henderson	<ol style="list-style-type: none"> 1. Control Signs 2. Timed Replacement 3. Measured Retroreflectivity 	<ol style="list-style-type: none"> 1. Control Signs 2. Measured Retroreflectivity 3. Timed Replacement 	<ol style="list-style-type: none"> 1. Control Signs 2. Timed Replacement 3. Blanket Replacement
Mesquite	<ol style="list-style-type: none"> 1. Nighttime Visual Inspections 2. Control Signs 3. Measured Retroreflectivity 	<ol style="list-style-type: none"> 1. Blanket Replacement 2. Nighttime Visual Inspections 3. Measured Retroreflectivity 	<ol style="list-style-type: none"> 1. Control Signs 2. Timed Replacement 3. Nighttime Visual Inspections
North Las Vegas	<ol style="list-style-type: none"> 1. Control Signs 2. Timed Replacement 3. Nighttime Visual Inspection 	<ol style="list-style-type: none"> 1. Nighttime Visual Inspection 2. Measured Retroreflectivity 3. Control Signs 	<ol style="list-style-type: none"> 1. Control Signs 2. Timed Replacement 3. Nighttime Visual Inspections

Regional Total	1. Control Signs	1. Measured Retroreflectivity	1. Control Signs
	2. Timed Replacement	2. Nighttime Visual Inspections	2. Timed Replacement
	3. Measured Retroreflectivity	3. Control Signs	3. Blanket Replacement

For all jurisdictions except Mesquite, blanket replacement does not have competitive costs. Therefore, most RTC members will need to create or complete their sign inventories and maintain them. If the RTC members can agree which sign characteristics need collection, a regional solution for creating the initial sign inventory would be a good opportunity to leverage economies of scale and realize significant savings. Most likely, independent jurisdictions will need to remain responsible for the ongoing maintenance of the inventory to avoid the need for expensive recurring sign asset surveys. RTC members should carefully assess and update their work order processes to make sure they can effectively maintain their inventories after the initial inventory. This concern is particularly relevant if the RTC pursues a regional solution for the initial inventory. The jurisdictions must have effective inventory processes in place by the time the inventory begins.

That the six jurisdictions do not all share the same lowest cost option suggests that an ongoing regional sign management initiative may not offer sufficient savings to justify a uniform approach. However, a regional initiative could bring inspection costs down significantly and increase the attractiveness of the measured retroreflectivity and nighttime visual inspection options. Nevertheless, even cutting the predicted measured retroreflectivity costs in half does not make it the lowest cost sign management method.

The different outcomes between the initial annual costs and the ongoing program costs suggest that jurisdictions may benefit from hybrid approaches. For example, a jurisdiction might implement the measured retroreflectivity method to achieve initial compliance and to save on initial costs by reducing the need for initial blanket replacement. Once the sign inventory supports timed replacement within complete installation date information and the control signs are all in place, it would be possible to transition to the new management method.

It is recognized that cost is not the only important characteristic of a management method. As covered by the Task 2 and 3 reports, each jurisdiction varies in its geography, budget, capabilities, and current organization and systems as well as in other characteristics. Likewise, each management method varies in its complexity and in its compatibility existing agency practices. The Task 2 and 3 reports provide useful documentation and analysis of these issues; however, the jurisdictions themselves are best positioned to assess alternate criteria beyond cost. Many of the non-cost characteristics of a sign management approach depend on the specific implementation and are difficult to capture in a general report. However, since the FHWA requirements will raise sign program costs significantly, the cost comparisons can effectively identify high cost outliers.

3. POTENTIAL FUNDING SOURCES

MANDATE

The intent of this section is to identify potential sources of funds that could be used to help RTC members to achieve retroreflectivity compliance in accordance with the provisions of the of Uniform Traffic Control Devices and to provide for on-going, programmatic sign replacement in accordance with the FHWA's compliance schedule. Sources of funds have been reviewed and those that are applicable for these purposes are described below. The funding sources identified here could be used to cover all or part of the cost of the one-time inventory effort and ongoing sign rehabilitation/replacement/maintenance requirements.

In addition to the federal funds listed below, the Department of Transportation provides discretionary funding for key initiatives, such as the recent TIGER grants. These opportunities can be found on <http://grants.gov> and the Federal Highway Administration's website: www.fhwa.dot.gov. Additional information on many of these programs may be found at <http://www.fhwa.dot.gov/safetealu/factsheets>.

FUNDING SOURCES

This section describes several sources of Federal funding, and presents them in two categories. Detailed descriptions are provided for those sources that are the most directly applicable to the needs of RTC and its members. These sources include the following, which are discussed in this section:

- Highway Safety Program / State and Community Highway Safety Grant Program
- Highway Safety Improvement Program
- Safe Routes to School Program
- High Risk Rural Roads Program
- State Highway Preservation Program
- National Highway System Program
- Surface Transportation Program
- Transportation, Community and System Preservation Program.

A second category, programs applicable to specific highway-related programs that might be extended to include signage replacement/maintenance, are summarized at the end of this section, in Exhibit 3-1. These are programs that could provide funding to the extent that on-going rehabilitation/replacement needs could be conducted as part of another program, such as a highway bridge replacement or maintenance on an interstate freeway.

Highway Safety Program

In 1966, Section 402 of the Highway Safety Act (Title 23 United State Code (USC), Chapter 4, Section 402) established the first highway safety program: the **State and Community Highway Safety Grant Program**. Congress has revised the highway safety grant program many times over the years, most recently in 2005 with the adoption of the Safe, Accountable, Efficient, Flexible Transportation Equity Act – A Legacy for Users (SAFETY-LU). Title II (Highway Safety) of SAFETY-LU reauthorizes appropriations of the Highway Trust Fund for a variety of highway safety programs, including the programs that were originally authorized in 1966. Today, Section 402 funds continue to support State and Community Highway Safety Grant Programs (commonly referred to as Section 402 grants) to reduce deaths and injuries on highways.

Section 402 funds are distributed to all 50 states, the District of Columbia, Puerto Rico, the Indian Nations, and the four territories by formula, based 75 percent on road miles and 25 percent on population. States receive no less than 1/2 of 1 percent of the total apportionment, the Indian Nations receive 2 percent of total funding (beginning in FY 2006), and the U.S. territories receive 1/4 of 1 percent. For FY 2010, the State of Nevada's formula share of Section 402 funds was \$1.76 million. Including funding from three highway safety incentive (i.e., discretionary) grant programs (Section 405 – Occupant Protection; Section 408 – State Traffic Safety Information System Improvement; Section 2010 – Motorcycle Safety), the state received \$2.59 million in highway safety funding in FY 2010.

At the federal level, the Section 402 program is jointly administered by the National Highway Traffic Safety Administration (NHTSA) and FHWA and the funds may therefore also be used for some limited safety-related engineering projects. At the state level, the funds are administered by the State Highway Safety Office.

State and Community Highway Safety grants are designed to support states and communities in the development and implementation of highway safety programs to reduce traffic crashes and resulting deaths, injuries, and property damage. States may use 402 funds only for behavioral highway safety purposes. A minimum of 40 percent of a state's 402 funds must be expended by local governments or be used for the benefit of local governments, to address local traffic safety. Funds are available for obligation for the year in which they were allocated plus three years.

States are required to prepare an annual Highway Safety Performance Plan (HSPP) for review by NHTSA. The HSPP must be based on a problem identification process, establish performance goals and objectives based on identified problems, and include countermeasures that will help the state reach its stated goals. At the end of each year, each state must submit an Annual Report that describes progress made toward reaching the identified goals.

The Section 402 grant application process requires states to submit assurances that they will implement activities in support of national goals that also reflect the primary

data-related factors within a state, as identified by the state highway safety planning process. These include national law enforcement mobilizations, sustained enforcement of impaired driving, occupant protection and speeding-related laws, an annual safety belt use survey conducted in accordance with DOT criteria, and development of statewide data systems.

Another 402 grant condition that states must satisfy is to actively encourage all relevant law enforcement officials in the state to follow the IACP (International Association of Chiefs of Police) police pursuit guidelines. Section 402 funds can be spent in nine national priority areas:

- Alcohol countermeasures
- Occupant protection
- Police traffic services (e.g. enforcement)
- Emergency medical services
- Traffic records
- Motorcycle safety
- Pedestrian and bicycle safety (jointly administered by FHWA and NHTSA)
- Non-construction aspects of roadway safety (administered by FHWA)
- Speed control (jointly administered by NHTSA and FHWA).

States may fund additional non-priority countermeasures (such as school bus safety) if they provide additional justification and receive NHTSA's approval.

FHWA has stated that State and Community Highway Safety grants may be used to set up the management systems for nighttime visibility of signs on non-NHS highways. However, the data collected must address some federal and state safety goals, such as speed limit enforcement.

Highway Safety Improvement Program (HSIP)

The Highway Safety Improvement Program (HSIP) was authorized by SAFETY-LU in 2005, with the overall purpose of achieving a significant reduction in traffic fatalities and serious injuries on all public roads through the implementation of infrastructure-related highway safety improvements.

HSIP funds must be used for safety projects or activities that are most likely to reduce the number of, or potential for, fatalities and serious injuries. The HSIP requires a process for collecting and analyzing available safety data to provide a basis for identifying safety improvement projects and developing a data-driven **Strategic Highway Safety Plan (SHSP) that corrects or improves hazardous road locations or features, or addresses a highway safety problem.**

HSIP funds are apportioned to the states by formula, based equally on lane miles of Federal highways, vehicle miles traveled on lanes on Federal-aid highways, and number of fatalities on the Federal-aid system. The Federal share of HSIP-funded projects is 90 percent in most cases; it is 100 percent for certain projects, including installation of traffic signs (23 USC 120(c)).

Each state's annual apportionment of HSIP funds is subject to set-asides for the **Railway-Highway Crossings Program, which provides** for the elimination of hazards and the installation of protective devices at public railway-highway crossings, and the **High Risk Rural Roads Program (HRRRP)** that provides funding for construction and operational improvements on rural major or minor collectors or rural local roads with a fatal and incapacitating injury crash rate above the statewide average for those classes of highways. Both of these programs are included in Exhibit 3-1 as programs that could fund sign replacement as part of a larger, program-specific project.

States with a strategic highway safety plan that can certify they have met infrastructure safety needs for railway-highway grade crossings and high risk rural roads for a given fiscal year, are eligible to use up to 10 percent of the amount apportioned for each fiscal year to carry out other safety projects that are consistent with the SHSP and eligible under the HSIP. However, HRRRP funds could provide funding specifically to improve nighttime visibility of traffic signs in rural areas of unincorporated Clark County. At least two of the state case studies described in the FHWA Office of Safety's *Implementing the High Risk Rural Roads Program* included installation of signage.

As a condition of obligating HSIP funds, states are required to submit an Annual Report describing and assessing locations with the most severe safety needs and describing progress on and effectiveness of safety improvement projects.

Safe Routes to School

Also created by SAFETY-LU, the Safe Routes to School (SR2S) program is targeted specifically at safety and could be directed to sign maintenance, management, and replacement. Any program seeking SR2S funding should focus on improving pedestrian and bicycle safety and mobility in the vicinity of schools. SR2S funding requires the cooperation of local schools and districts and the preparation of a SR2S action plan to be eligible for the funding.

Funds are apportioned to the states annually based on their relative shares of total K-8 enrollment. For FY09, \$1.45 million in SR2S funding was apportioned to Nevada. The federal share of SR2S projects is 100 percent.

National Highway System¹⁴

¹⁴ A letter from FHWA to the National Association of County Engineers, published by ATSSA, states that jurisdictions should also consider using National Highway System Program and Surface Transportation Program funding to achieve compliance with minimum retroreflectivity standards.

The National Highway System (NHS) Program provides funding for improvements to rural and urban roads that are part of the NHS, including the Interstate system and connections to major intermodal terminals.

Apportionments are based 25 percent on lane miles of principal arterials, 35 percent on vehicle miles of travel on principal arterials, 30 percent on diesel fuel used, and 10 percent on total lane miles of principal arterials per capita.

The federal share of NHS-funded projects is generally 80 percent.

A state may transfer up to 50 percent of its NHS apportionment to its Interstate Maintenance, Surface Transportation, Congestion Mitigation and Air Quality Improvement, Highway Bridge Replacement and Rehabilitation, or Recreational Trails apportionment. Up to 100 percent may be transferred to the Surface Transportation Program.

NHS funds could be used to improve signs and pavement markings on designated NHS roadways, including major roadways in unincorporated Clark County, the City of Las Vegas, and Boulder City. However, these routes make up only a small share of the center lane miles of roads in the region. Exhibit 3-1 provides a list of the non-freeway NHS in the RTC region.

Exhibit 3-1: Non-Freeway National Highway System Routes in the RTC Region

Jurisdictions	NHS Routes
Unincorporated Clark County	Rancho Drive, Rainbow Blvd, Tropicana Blvd
City of Las Vegas	Main St., Rainbow Blvd, West Charleston Blvd
Boulder City	Hwy 93

Surface Transportation Program

Of all the programs discussed here, the Surface Transportation Program (STP) provides the most flexible funding – and may be used on projects on all public roads except local and minor rural collectors.

STP funds are apportioned by formula to states based 25 percent on total lane miles of Federal-aid highways, 40 percent on vehicle miles traveled on Federal-aid highways, and 35 percent on estimated contributions to the Highway Account of the Highway Trust Fund. For FY 2009, \$49.5 million in STP funds were apportioned to Nevada. STP funds required at least a 20 percent non-federal match.

STP funds may be programmed for highway safety infrastructure improvements and programs, hazard eliminations, and railway-highway grade crossings; establishment of highway safety management systems; intersection projects.

STP funds could be used to achieve compliance with MUTCD retroreflectivity management rules. However, STP funds are not discretionary and are typically programmed through MPOs, so dedicating all or a portion of these funds to sign maintenance could undercut other programs. As noted in discussing the NHS Program, state DOTs have the discretion to transfer up to 50 percent of their NHS funding to their Surface Transportation Programs, as well as to a variety of other programs.

Transportation, Community, and System Preservation (TCSP) Program

The TCSP program provides funds to carry out projects to integrate transportation, community, and system preservation plans and practices, and identify private sector-based initiatives to improve those relationships. Program goals include:

- Improving the efficiency of the transportation system of the United States.
- Reducing the impacts of transportation on the environment.
- Reducing the need for costly future investments in public infrastructure.
- Providing efficient access to jobs, services, and centers of trade.
- Examining community development patterns and identifying strategies to encourage private sector development.

The TCSP Program is an FHWA Program being jointly developed with the Federal Transit Administration, the Federal Rail Administration, the Office of the Secretary, and the Research and Innovative Technology Administration within the US Department of Transportation, and the US Environmental Protection Agency.

Grant announcements have included a significant focus on road safety. For example, in the FY2007 announcement, FHWA included called for projects that:

“Will result in a measurable reduction in the loss of property, injury, or life; incorporates innovative safety design or operational techniques, including variable pricing for congestion reduction, electronic tolling, barrier systems, and intersection-related enhancements; incorporates innovative construction work zone strategies to improve safety; is located on a rural road that is in need of priority attention based on analysis of safety experience; and/or is located in an urban area of high injury or fatality, and is an initiative to improve the design, operation or other aspect of the existing facility that will result in a measurable safety improvement. “

Sign asset management falls within the overall Program goal of maintaining key infrastructure. It also improves livability by increasing safety levels and augmenting the travel environment for alternative modes. Sign asset management is also a capability building function. A variety of case studies from projects completed to date indicate that projects have demonstrated the role of partnerships and participation in transportation modeling, the benefits of collaboration for neighborhood planning, the benefits of

public/private partnerships in transportation planning, the benefits of partnering with stakeholders to achieve regional goals, and innovative approaches to public involvement.

The Federal share of TCSP projects is 80 percent. Funds are available to States, metropolitan planning organizations, local governments, and tribal governments. Annual reporting is a condition of the grants.

In addition to these sources, there are a number of federal funding programs that might be leveraged to provide funding for on-going compliance with sign retroreflectivity requirements, on an incidental basis and to the extent that those activities could be funded and accomplished as part of another program. These programs are shown in Exhibit 3-2. While it is not likely that these funding sources could be used specifically to fund overall sign maintenance or replacement programs, RTC members should make sure that sign maintenance and replacement is included in project planning for street maintenance and rehabilitation projects wherever possible.

Exhibit 3-2: Additional Federal Highway Funding Programs

Program	Program Purpose	Potential Applicability
Federal Lands Highways Program (FLHP)	Funding for transportation improvements that provide access to or within public lands, national parks, and Indian reservations	Signage on roads and highways, most likely in rural areas of Clark County
Highway Bridge Program	Funding to enable States to improve the condition of their highway bridges through replacement, rehabilitation, and systematic preventive maintenance	Bridge-related signage, replaced as part of a highway bridge maintenance program
Interstate Maintenance Program	Funding for resurfacing, restoring, rehabilitating and reconstructing (4R) most routes on the Interstate System	Sign maintenance/replacement as part of safety engineering for Interstate highways in the RTC region (I-15, I-215, I-515)
National Scenic Byways Program	Funding to recognize roads having outstanding scenic, historic, cultural, natural, recreational, and archaeological qualities and to provide for designation of these roads as National Scenic Byways, All-American Roads or America's Byways	Signage on roads designated for their scenic, historic, cultural, natural, or archaeological qualities throughout the RTC region
Railway-Highway Crossings Program	Funding to reduce the number of fatalities and injuries at public highway-rail grade crossings through the elimination of hazards and/or the installation/upgrade of protective devices at crossings	Highway/railway grade crossings throughout the RTC region

CONCLUSIONS

The funding sources that have the greatest relevance to RTC's sign retroreflectivity compliance needs, and the applicability of each, are summarized in Exhibit 3-3. In FY 2008, the last year for which data are available on NDOT's website, Nevada received \$316.1 million in federal apportionments: \$58.9 million in NHS funds, \$51.9 million in STP funds, \$47.0 million from Interstate Maintenance, \$19.7 million in CMAQ, and \$138.7 million from a variety of other programs (including Planning, Bridge Replacement, Advance Right of Way, High Priority, and Forest Highway funds).

Exhibit 3-3: Eligible Uses of Funding Sources

Program	Potentially Eligible Uses
State and Community Highway Safety Grant Program	Roadway safety Replacement of non-compliant signage
Highway Safety Improvement Program	Regulatory and warning signs on busy roadways Development of initial sign inventory
High Risk Rural Roads Program	Nighttime visibility of signs in rural Clark County
Railway-Highway Crossings Program	Highway/railway grade crossings throughout the RTC region
Safe Routes to School Program	Pedestrian and bicycle safety and mobility signage
National Highway System Program	Signs and pavement markings on NHS roadways in unincorporated Clark County, the City of Las Vegas, and Boulder City
Surface Transportation Program	Signs and pavement markings on designated NHS roadways, including major roadways throughout the RTC region
Transportation, Community and System Preservation Program	Public/private strategy for development of sign asset management