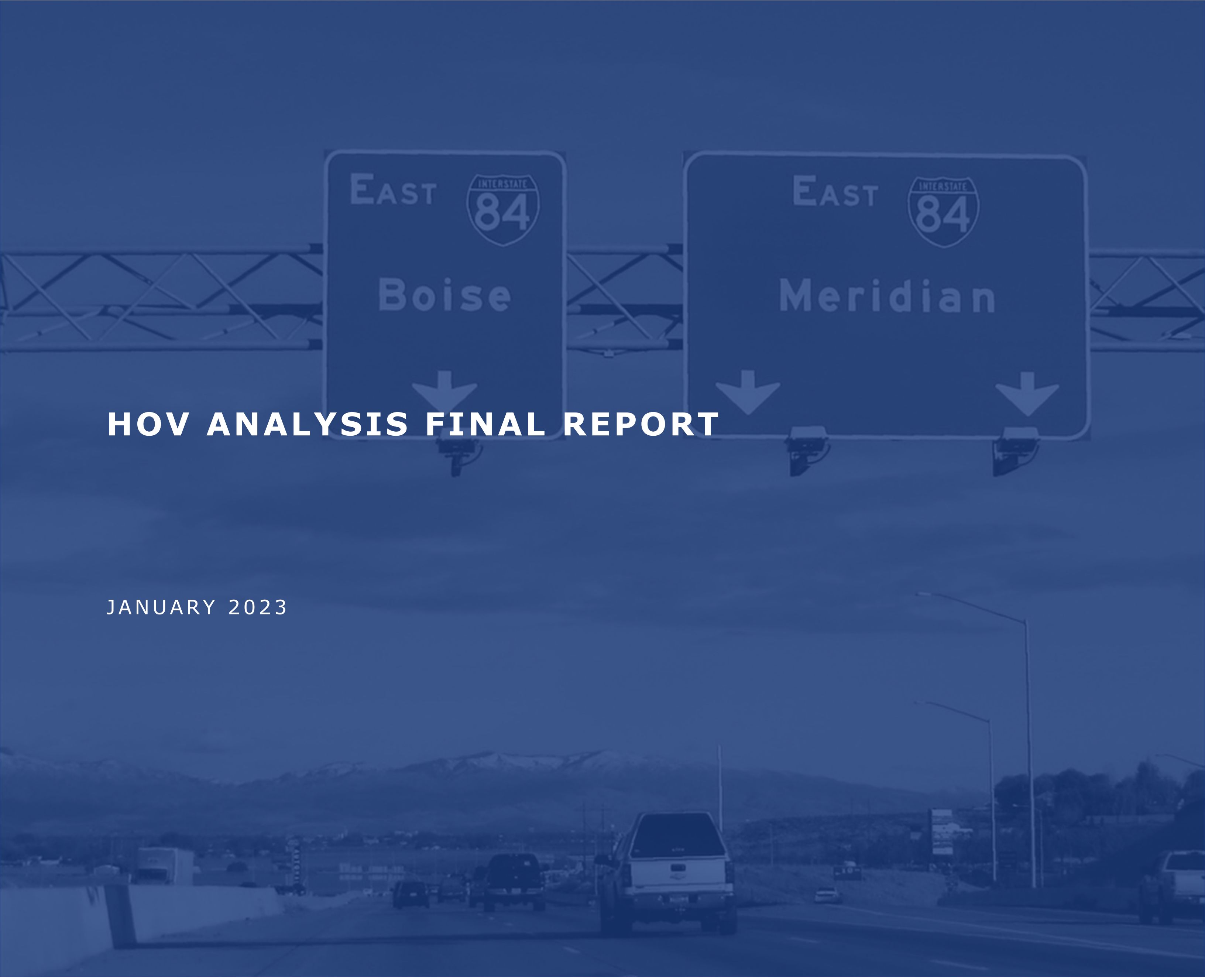

HOV ANALYSIS FINAL REPORT

JANUARY 2023

COMPASS
COMMUNITY PLANNING ASSOCIATION
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IDAHO TRANSPORTATION DEPARTMENT

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This report summarizes the high-occupancy vehicle (HOV) lane evaluation included as a part of the I-84 Corridor Operations Plan. The evaluation and information presented are intended to summarize the potential benefits of HOV or managed lanes as a future travel demand management strategy for the I-84 corridor. This report will be included as an addendum to the larger I-84 Corridor Operations Plan. Included are several case studies of HOV systems across the United States, a quantitative analysis of potential volumes for an HOV lane in 2050, conceptual graphics of the potential system, cost estimates, and a discussion of next steps.

WHY IS COMPASS STUDYING HOV LANES?

Boise is Idaho's largest city with approximately 235,000 residents. The other major cities in the greater Boise area, Caldwell, Meridian, and Nampa, were included in the top 15 fastest growing cities[1] in the United States with a growth of 5.0 percent from 2020 to 2021. This population is served by a single freeway corridor, I-84/I-184, which is approaching capacity on certain segments in the peak hours. As the population of the region continues to grow, users of the transportation system will experience more congestion, environmental impacts, and delays that impact the regional economy and quality of life. I-84 has recently seen significant investments in adding capacity but as the corridor expands right-of-way is becoming more constrained making additional capacity less feasible. The Idaho Transportation Department is currently working with regional stakeholders to develop a vision for the next generation of the corridor to include investments in operational, technological, and demand management strategies to continue to improve safety and reliability on the corridor. The latest vision is included in the I-84 Corridor Operations Plan (June 2022).[2]

Traditionally, adding additional lanes to interstates and highways has temporarily relieved congestion caused by increasing traffic volumes but in most cases, due to induced demand and continued population growth, traffic volume again exceeds the available capacity. HOV lanes, or managed lanes, offer an alternative to repeated capacity projects by enabling policies to manage newly added capacity by defining the permitted vehicles and operational conditions of the new lane. This demand management strategy can incentivize a shift to higher occupancy vehicle trips as road users recognize the travel time reduction and reliability offered by the managed lane. As congestion increases in the managed lanes the criteria to use the lane can be modified to maintain capacity in the managed lane. For example, when HOV lanes in Washington State were opened, the rules required a 2+ vehicle occupancy to use the lane. After approximately a decade, the volumes in the HOV lanes increased to the point where the benefits were significantly reduced. At that time, the rules were changed to require 3+ occupancy, and remain at that requirement today.

[1] https://www.census.gov/newsroom/press-releases/2022/fastest-growing-cities-population-estimates.html

[2] https://www.compassidaho.org/documents/prodserv/tsmo/I84_Ops/COMPASS_I-84_CorridorOperationsPlan_6-13-22.pdf

RELATIONSHIP TO THE CORRIDOR OPERATIONS PLAN

High occupancy vehicle lanes were included as a tactic in the initial first-level screening of 37 tactics in the I-84 Corridor Operations Plan but were not progressed to the second level screening primarily due to a focus on non-capacity related improvements, the high cost, and probable implementation timeline. This additional analysis was conducted to provide more information about potential benefits of HOV lanes. It does not supersede the recommendations from the I-84/I-184 Corridor Operations Plan particularly because the timeline for the widening to support an HOV lane is on a different timeline than the other improvements that were progressed in the plan.

RELATIONSHIP TO COMMUNITIES IN MOTION 2050

A HOV/managed lane improvement along I-84 aligns with the following objectives identified in the regional long range transportation plan, Communities in Motion 2050:

- **Reliability -** Provide a reliable transportation system to ensure all users can count on consistent travel times for all modes.
- **Accessibility and mobility** - Develop a regional transportation system that provides access and mobility for all users via safe, efficient, and convenient transportation options.
- **Connectivity** - Develop a transportation system with high connectivity that preserves capacity of the regional system and encourages walk and bike trips.
- **Efficiency and congestion management** - Manage and reduce congestion with cost-effective solutions to improve efficiency of the transportation system.
- **Environment -** Develop and implement a regional vision and transportation system that protects and preserves the natural environment.

BENEFITS OF HOV

HOV or managed lanes may provide the following benefits to commuters and the overall transportation system by:

- Reserving managed lane capacity by prescribing the permissible usage of the new facility
- Improving person throughput of the corridor by encouraging higher occupancy carpooling, vanpooling, or transit trips
- Benefiting human and environmental health by encouraging reductions in single occupancy vehicle (SOV) use
- Offering eligible drivers a shorter and more reliable travel time

SUPPORTIVE STRATEGY, POLICY, AND LAWS

There are several strategic, political, and legal considerations that need to be addressed to implement a HOV or managed lane program. These considerations include:

- Changing current Idaho legislation (Idaho Statues 49-1421a) to enable implementation of managed/HOV lanes in areas where they are currently restricted
- Establishing guidance that defines the conditions under which an HOV lane will be implemented (such as congestion, speed, right-of-way, or environmental requirements)
- Defining the vehicles eligible to use the managed/HOV lane such as HOV only, HOV plus electric vehicle (EV), HOV plus freight, HOV plus motorcycles, and HOV plus toll for non-HOV
- Defining the conditions for changing eligibility for managed/HOV lane usage (2+ eligibility to 3+ eligibility)
- Determining periods and direction of operation, such as peak period, peak direction only, or continuous
- Designing an approach for addressing violations.

CASE STUDIES

The project team reviewed three metropolitan (MPO) areas that have HOV lanes as one method to compare the potential HOV performance on I-84 and to guide the development of the scenarios used in the analysis:

- Salt Lake City, Utah
- Minneapolis, Minnesota
- Phoenix, Arizona

These locations were selected by geographic similarity (Salt Lake City) and/or similar daily traffic volumes on the managed freeway segments. Due to a lack of available, consistent information the case studies primarily focus on the perspective of the user e.g., travel time savings, rather than the perspective owner-operator characteristics such as cost and revenue.

The average proportion of high occupancy vehicles in the fleet, measured from a selection of metropolitan areas across the United States, is 16 to 23 percent during peak periods.[3] In all three case studies, HOV enforcement is handled by respective State Patrol troopers. Violation estimates range from 9 to 37 percent. A more detailed case study memo of HOV/managed lanes was completed in conjunction with this analysis. See the memo titled "HOV and Managed Lanes Case Studies" for more information.

[3] https://ops.fhwa.dot.gov/publications/fhwahop09030/index.htm

TABLE 1: CASE STUDIES SUMMARY[4]

COMBINED STATISTICAL AREA	BOISE CITY-MOUNTAIN HOME-ONTARIO	SALT LAKE CITY-PROVO-OREM	PHOENIX-MESA	MINNEAPOLIS-ST. PAUL
POPULATION (2020 CENSUS)	850,500	2,700,000	4,900,000	4,100,00
MEDIAN HOUSEHOLD INCOME	$65,000	$78,000	$67,000	$81,000
AVERAGE TRAVEL TIME TO WORK	22 minutes	23 minutes	27 minutes	25 minutes
EMPLOYMENT RATE	62%	68%	60%	69%
CARPOOL PERCENTAGE OF AUTOMOTIVE TRIPS	9.72%	12.23%	12.74%	9.32%
LENGTH OF HOV SYSTEM	15 miles[A]	38 miles	73 Miles	46 miles
AVERAGE HOV LANE UTILIZATION	-	-	12.9% AM 14.0% PM	19.5% AM 20.7% PM

A. Length of the proposed system in the analysis

HIGH-OCCUPANCY TOLL VARIATION

Many states use high-occupancy toll (HOT) lanes to leverage pricing with HOV lanes to create a greater overall impact. Tolling non-HOVs increases compliance, reduces congestion and emissions, and optimizes capacity, while the revenue generated from the tolls can be used to supplement the operations, enforcement, and maintenance cost for the facilities.[5]

[4] Population, employment and commuting characteristics data from US Census 2020 profiles of Combined Statistical Areas.

[5] 21st Century Operations Using 21st Century Technologies, *HOV Lanes, Cool Facts. https://ops.fhwa.dot.gov/publications/fhwahop12031/fhwahop12027/index.htm#:~:text=Traditional%20high%2Doccupancy%20vehicle%20(HOV,toll%20to%20use%20the%20lane.*

SALT LAKE CITY, UT

TABLE 2: SALT LAKE CITY SELECTED[6] HOV STATISTICS – I-15 FROM 600 NORTH TO 14600 SOUTH

DIRECTIONAL LANES (GENERAL / HOV)	LANE MILES	HOV ROUTE LENGTH	FACILITY HOURS	HOV/HOT (% OF TOTAL VEHICLES)	PEAK HOURS VIOLATION ESTIMATE (% OF LANE VOLUME)
4 / 1	21.0	21.0	24 / 7	13%	13%

- I-15 serves an average of 220,000 (2019 traffic volume[7]) daily vehicles through the selected segment.
- The high occupancy toll (HOT) express lanes operate 24/7.
- Tolling is based on congestion across multiple segments, ranging from $0.25 cents to $2.00 per zone.
- The Utah Department of Transportation (UDOT) received $1.9 million dollars in revenue from the system in 2017[8]. After expenses, UDOT netted $164,000 which went back into the budget to maintain the program. The system began as an HOV system with a pay-per-month flat fee for SOV use, but UDOT converted the HOV lanes to HOT at a capital outlay of $25 million in 2010 during an expansion project[9].

[6] The HOV characteristics in Table 2, Table 3, and Table 4 are selected from the Compendium of Existing HOV Lane Facilities in the United States (FHWA, 2008) but does not represent the entire HOV system as described in Table 1.

[7] https://data-uplan.opendata.arcgis.com/

[8] https://www.ksl.com/article/46149951/hov-lane-violations-on-the-rise-says-udot-official

[9] https://ops.fhwa.dot.gov/freewaymgmt/publications/documents/nrpc0610/workshop_materials/case_studies/salt_lake_city.pdf

PHOENIX, ARIZONA

TABLE 3: PHOENIX SELECTED HOV STATISTICS – I-10 FROM LOOP 101 TO LOOP 202

DIRECTIONAL LANES (GENERAL / HOV)	LANE MILES	HOV ROUTE LENGTH	FACILITY HOURS	AM USAGE (% OF TOTAL VEHICLES)	PM USAGE (% OF TOTAL VEHICLES)	PEAK HOURS VIOLATION ESTIMATE (% OF LANE VOLUME)
4 / 1	28.5	28.5	6 to 9 AM 3 to 7 PM	12%	12%	9%

- HOV facilities operate Monday through Friday during peak hours except for Arizona Route 51 that operates 24/7.
- There is a planned 26-mile expansion of I-10 that will include 6 miles of HOV lanes[10].

MINNEAPOLIS, MINNESOTA

TABLE 4: MINNEAPOLIS SUMMARY HOV STATISTICS – I-35 FROM BURNSVILLE PKWY TO 86TH ST

DIRECTIONAL LANES (GENERAL / HOV)	LANE MILES	HOV ROUTE LENGTH	FACILITY HOURS	AM USAGE (% OF TOTAL VEHICLES)	PM USAGE (% OF TOTAL VEHICLES)	PEAK HOURS VIOLATION ESTIMATE (% OF LANE VOLUME)
2 / 1	5.7	5.7	6 to 9 AM 3 to 6 PM	14%	22%	37%

- 80% of the people using the HOT lanes (E-ZPass) are carpooling or riding on buses.
- Single occupant vehicles represent 22% of *vehicles* in the lane but only 12% of the *people.*
- Currently, vehicles in the E-ZPass lanes are traveling at speeds above 45 mph approximately 96% of the time.
- Capital cost in 2010 dollars for ATM and E-ZPass equipment for six-to eight-lane freeway: $1.2 million to $1.6 million per mile (both directions). These costs include tolling equipment, signs, sign structures, and communications infrastructure.

[10] https://www.fox10phoenix.com/news/i-10-expansion-project-chandler-casa-grande-reduce-congestion

HOV ANALYSIS

Currently, the COMPASS regional travel demand model does not include high occupancy vehicle (HOV) trips or lanes in the model framework. This is for obvious reasons that, under the current state law, they are precluded in the area. Therefore, HOV fleet percentages were estimated at each on ramp. These estimates were based on data at the Census Tract level from the American Community Survey[11] about travel mode to work and the 2021 COMPASS Treasure Valley Transportation Study (household travel survey). By using factors, rather than attempting to estimate travel behavior based on traveler characteristics, various levels of HOV adoption were evaluated. The analysis assessed HOV system volumes, speeds, and travel times with various levels of participation and potential mode shift from single occupant to high occupant vehicle trips.

SCENARIOS

Four scenarios were evaluated for this analysis. The scenarios assume the HOV lanes are an additional lane added in both directions between the Karcher Road interchange (Exit 33) and the Wye not a conversion of an existing lane. The percentages used in each scenario are shown in Figure 1 below. The four scenarios are:

- 2050 baseline – This scenario reflects the forecasted 2050 volumes in the current model network. This network does not include any additional lanes along I-84.
- Current 2050 Rate – This scenario reflects the estimated eligible HOV volume with current carpool rates (by ramp location) estimated from the 2019 American Community Survey and the 2021 COMPASS Treasure Valley Transportation Study.
- Moderate 2050 Rate – This scenario reflects at least the rate reflected in the current carpool rate but at selected locations the rate was increased by three to five percent. Adjustments were generally determined based on the scale of the current HOV rate with lower existing rates adjusted more aggressively (five percent) than higher existing rates (three percent).
- High 2050 Rate – This scenario reflects a conservative high-end scenario with a HOV rate of 18 percent at all ramp locations (except for the Franklin Road (Exit 29) - in the PM peak that is already at 20 percent). With appropriate incentives, rates above 20 percent could be achieved at multiple ramp locations along I-84. This is based on observed rates above 30 percent at certain locations in the case studies.

[11] Table S0802 "Means of Transportation to Work by Selected Characteristics" https://data.census.gov/cedsci/table?q=S0802&g=0500000US16001%241400000&tid=ACSST5Y2019.S0802

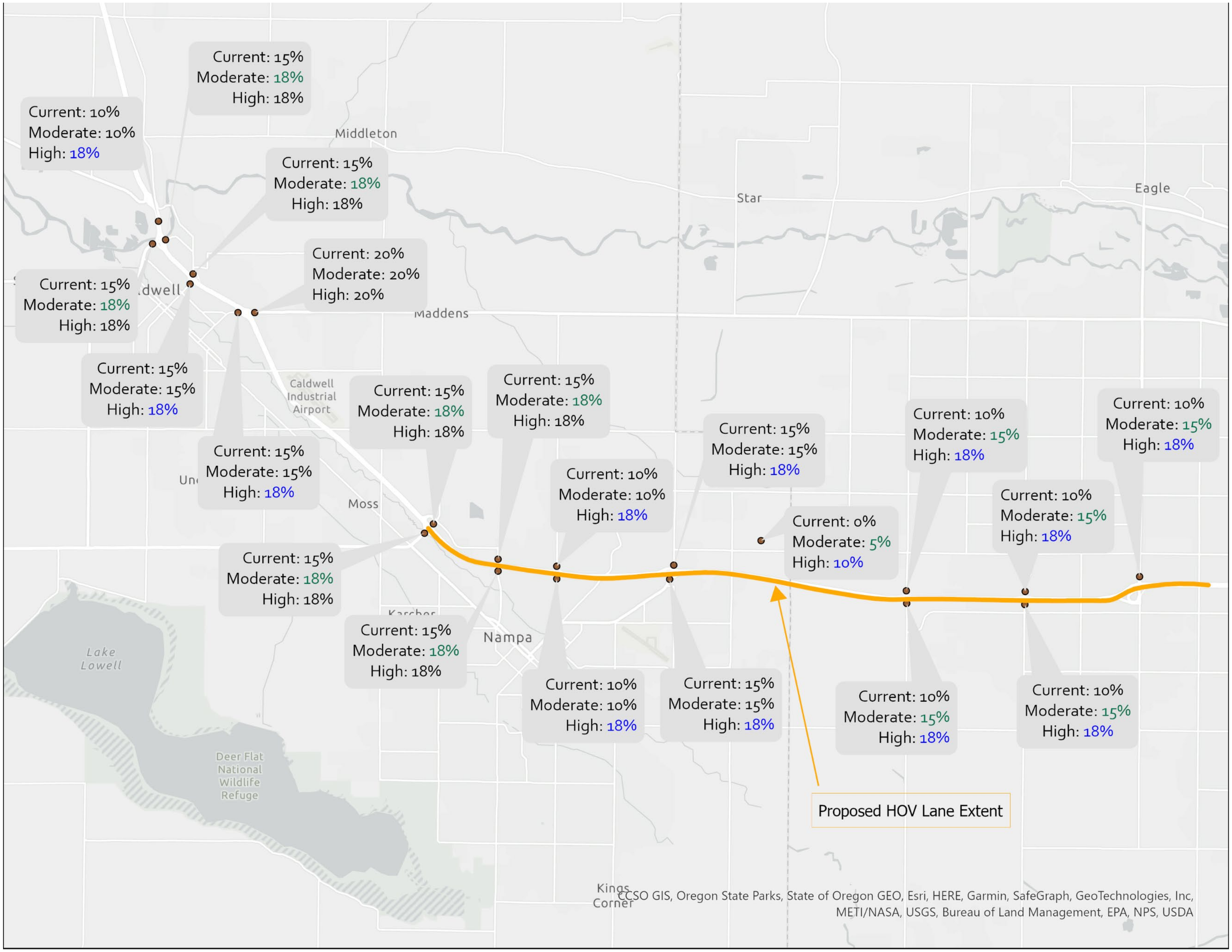

FIGURE 1: CURRENT, MODERATE, AND HIGH HOV FLEET PERCENTAGES

MEASURES OF EFFECTIVENESS

The following measures of effectiveness (MOE) are useful to evaluate the potential of a future HOV system. These MOE are evaluated for the peak direction of each peak period only (the AM peak period is the hour from 7 to 8 AM, the PM peak period is the hour from 5 to 6 PM):

- Average segment HOV lane and general-purpose volumes.
- Average HOV lane and general-purpose speed.
- Average HOV lane and general-purpose travel time – based on regional model delay.

The metrics above are used to compare the results of various HOV adoption levels, as shown in Table 6 and Table 7 below. Access to the HOV lane is managed, therefore these metrics can provide insight into the sensitivity of the lane to attract eligible drivers based on their proportion in the fleet and trip distance in the network without the need to explicitly model a HOV vehicle class in the regional model. However, it would not be appropriate to compare these sensitivity test results to other capacity improvement scenarios that are not managed because access to this capacity would be unrestricted and likely attract higher traffic volumes. Another measure of effectiveness is overall person-throughput. This measure is not included in the table because the average vehicle occupancy for the proposed HOV lane is unknown and depends on the operational characteristics of the lane e.g., "3+" vehicle occupancy requirements versus "2+" vehicle occupancy requirements. However, the average vehicle occupancy is expected to be greater in the HOV lane than the general-purpose lanes by a factor of about 2 and therefore the person-throughput is also expected to be greater in the HOV lane.

Key findings include:

- Moderate travel time savings in the HOV lane compared to the general-purpose lanes over the same length for all three scenarios. This analysis did not assume any violation of the HOV lane by ineligible vehicles. Violation of the lane would likely increase congestion and reduce travel time benefit however the degree of this impact is not well understood due to the wide range of violation percentages recorded in the case studies above.
- An average HOV percent used in the scenarios are generally lower than corridors included in the case studies. This suggests that there is opportunity to promote carpooling through public outreach to increase the overall HOV fleet percentage or implement other operational strategies such as peak period only operation for the HOV lane.

TABLE 6: AM PEAK RESULTS

SCENARIO	I-84, EXIT 33 (KARCHER ROAD) TO THE WYE						
	GENERAL PURPOSE LANES TRAVEL TIME	AVG GENERAL PURPOSE SEGMENT VOLUME	GENERAL PURPOSE LANES AVG SPEED	HOV SYSTEM TRAVEL TIME	AVG HOV SYSTEM SEGMENT VOLUME	HOV SYSTEM AVG SPEED	AVERAGE HOV PERCENT
AM 2050 BASELINE	21 minutes	6,100	44 mph	-	-	-	-
AM HIGH SHIFT HOV	17 minutes	5,300	54 mph	15 minutes[A]	800	61 mph	12%
AM MODERATE SHIFT HOV	18 minutes	5,450	51 mph	14 minutes	650	65 mph	9%
AM CURRENT RATE HOV	18 minutes	5,500	51 mph	14 minutes[B]	550	65 mph	8%

A. Including a violation rate of 30 percent (240 additional vehicles) or 10 percent does not change the travel time.

B. Including a violation rate of 30 percent or 10 percent does not change the travel time.

TABLE 7: PM PEAK RESULTS

SCENARIO	I-84, THE WYE TO EXIT 33 (KARCHER ROAD)						
	GENERAL PURPOSE LANES TRAVEL TIME	AVG GENERAL PURPOSE SEGMENT VOLUME	GENERAL PURPOSE LANES AVG SPEED	HOV SYSTEM TRAVEL TIME	AVG HOV SYSTEM SEGMENT VOLUME	HOV SYSTEM AVG SPEED	AVERAGE HOV PERCENT
PM 2050 BASELINE	23 minutes	6,250	40 mph	-	-	-	-
PM HIGH SHIFT HOV	17 minutes	5,250	54 mph	15 minutes[A]	1000	61 mph	14%
PM MODERATE SHIFT HOV	18 minutes	5,450	51 mph	15 minutes	850	61 mph	11%
PM CURRENT RATE HOV	19 minutes	5,550	48 mph	15 minutes[B]	700	61 mph	9%

A. Including a violation rate of 30 percent (300 additional vehicles) the travel time increases to 17 minutes. A violation rate of 10 percent increases the travel time to 16 minutes.

B. A violation rate of 30 percent or 10 percent does not change the travel time.

RESULTS SUMMARY

The results above summarize the 2050 forecasted HOV-lane volume based on a range of potential HOV utilization rates (current, moderate and high). While there is uncertainty about the level of HOV lane eligible vehicles in the transportation system in 2050, these results show that the estimated travel time in the HOV lane ("HOV System Travel Time") has a moderate savings over the travel time along the same sections of the corridor in the general-purpose lanes ("General Purpose Lanes Travel Time"). The "Average HOV Percent" column reflects the system wide average proportion of HOVs compared to total vehicles. This provides a backcheck against the rates assumed at the individual ramps and is conservative when compared to the range from the case studies of 12 to 22 percent.

Given that many other adjustments can be made to maximize the vehicle and person throughput, such as hours of operation and/or implementation of HOT lanes (charging ineligible single-occupant vehicles to use of the HOV lane), and that this analysis shows potential for moderate HOV lane utilization and travel time savings even with conservative volume assumptions, a managed lane facility could provide an opportunity to extend the useful life of future capacity improvements along I-84/I-184 between Caldwell and Boise.

HOV LANE GEOMETRY

FHWA[12] provides guidance on standard geometric characteristics of high occupancy vehicle lanes. There are two types of HOV facilities, buffered and continuous. Buffered lanes provide separation between the HOV lane and the adjacent general-purpose lane and restrict access to specific segments. Continuous HOV lanes do not have access restrictions and, for eligible vehicles, effectively operate as general-purpose lane that can be accessed and exited at any point. Generally, buffered lanes provide operations and management benefits that exceed a continuous lane but are more expensive and have a larger footprint. Buffered lanes also require the design of ingress and egress zones, where there is a break in the buffer. Even though continuous lanes do not provide these added benefits they have still been shown to operate effectively. Specific geometric design options should be evaluated as a part of any future traffic analysis as they will impact the operations of the HOV facility. Conceptual graphics of a buffered HOV facility are included in Figure 2 and Figure 3 below. The key dimensions shown are:

- The minimum distance to merge from the outermost lane to the start of the ingress/egress zone. The minimum required distance is 1,000 feet per lane for a typical distance of 4,000 feet (for most segments though the corridor).
- The minimum length of the ingress zone, 1,000 feet.
- The minimum length of the egress zone, 2,500 feet.

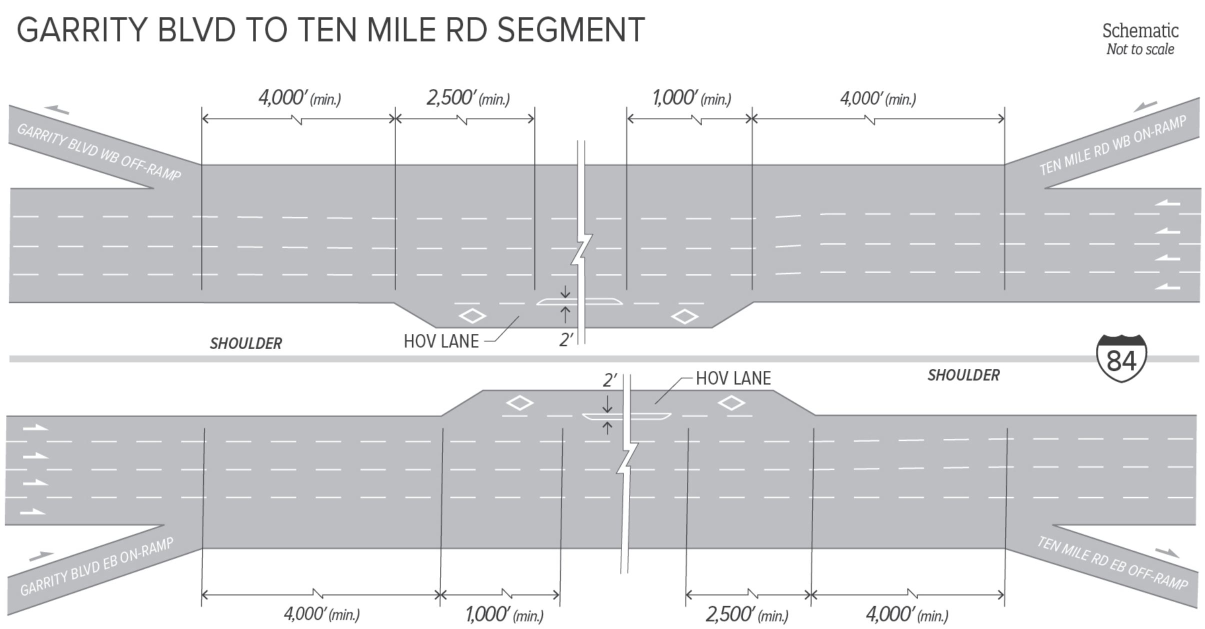

FIGURE 2: MID-SEGMENT, BIDIRECTION, INGRESS/EGRESS ZONE

[12] https://ops.fhwa.dot.gov/publications/fhwahop13007/pmlg6_0.htm

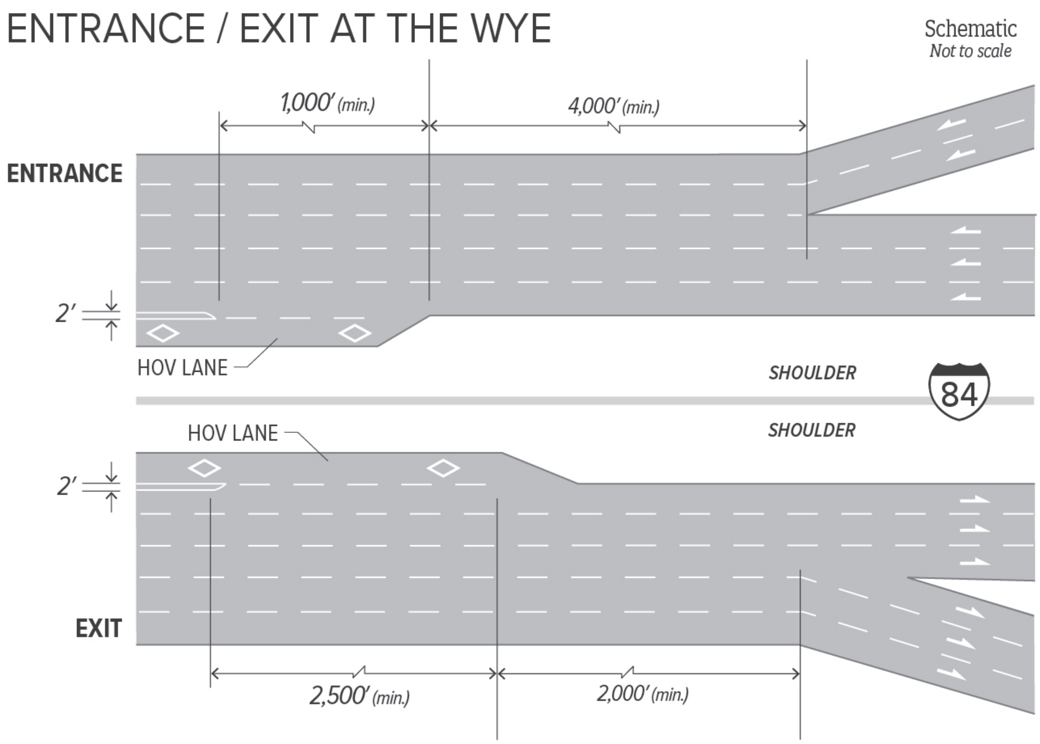

FIGURE 3: START/END OF HOV FACILITY AT THE WYE

PLANNING LEVEL COST ESTIMATE

A high-level cost estimate was developed based on the cost of recent freeway projects in the region. The following assumptions were used to estimate the cost of the HOV facility:

- Total unidirectional length – 15 miles
- Cost per mile per lane for at-grade freeway widening - $13.2 million
- Cost per mile for structural widening - $210 million
- 50 percent contingency on top of estimated cost
- 2050 cost estimate, with 2.5 percent average annual inflation

The resulting 2050 cost estimate for a bidirectional HOV lane from west of the Wye interchange to the W Karcher Road interchange is **$1.29 billion**. This cost is expected to be similar to the cost of adding an additional general purpose lane along the corridor. The cost of a HOV/managed lane would be slightly higher due to additional signage and other necessary design elements but on the same scale.

CONCLUSION

The results of the analysis show that an HOV/managed lanes on I-84 could provide moderate travel time benefits relative to the existing general-purpose lanes in 2050 (Table 6 & Table 7) for a majority of the HOV participation alternatives tested. In the PM peak period, with high utilization, violation rates from 10 to 30 percent would reduce or eliminate the travel time benefit in the managed lane. Methods to reduce violation rates include improved enforcement and/or designation of the managed lane as “HOT” (high occupancy toll) which charges the ineligible vehicles a toll to use the lane.

Additional analyses are needed to evaluate and compare the relative performance of a HOV/managed lane alternative with other capital improvement options, including general purpose lanes. This additional analysis should identify improvement(s) that best support the goals and objectives identified in the I-84 Corridor Operations Plan and the long-range transportation plan, Communities in Motion 2050.

COMPASS currently has two programmed studies, the Treasure Valley High-Capacity Transit Planning and Environmental Linkages (PEL) Study and the Transportation Demand Management Plan, that will influence and inform future decision making. These plans may impact the role of a future HOV lane in the transportation system but that impact is currently unknown. HOV/managed lanes should continue to be considered as a strategy to reserve capacity in a future lane along I-84/I-184. With the right operational configuration, such as peak period only operation, a HOV/managed lane could be a beneficial demand management tool for the regional transportation system.

NEXT STEPS

The following will assist in any future planning of an additional freeway lane along I-84/I-184.

ANALYTICAL TOOLS

1. **Travel demand forecast model update with High Occupancy Vehicle mode** – By incorporating a HOV mode into the travel demand model a more refined forecast is possible. The model can estimate ramp by ramp changes in fleet composition and network wide trip distribution. The feedback between the supply (the transportation network) and demand (land use trip generators) inherent to a travel demand model will improve understanding of the impact of HOV on the transportation system and facilitate additional analysis.

2. **Microsimulation model of I-84** – Microsimulation can further analyze the systemwide impacts of various improvements in the freeway system. By modeling individual vehicle movements, metrics such as queuing, and travel time are a better reflection of expected traffic conditions. Weaving and merging conditions can also be visualized to evaluate the impact of particularly high volume on/off ramps. Using the updated travel demand model

described in #1 above additional analysis of HOV lanes is also possible using microsimulation. Good data is essential to building a good micro simulation model. The data needs are described below.

PUBLIC OUTREACH

Public engagement is particularly important for a HOV/managed lane as the behavior of drivers is a factor in determining its success or failure. Public outreach can collect feedback on a future HOV/manage lane proposal to better understand how members of the public view the improvement and if it would incentivize them to modify their behavior.

Additional data needs

To support the development of a microsimulation model the following data is needed.

- **Detailed traffic count data –** A microsimulation model typically simulates the variation of vehicle demand over 15-minute periods. Count data over the peak period (generally two hours) with a granularity of at least 15 minutes is needed to create a peaking profile for the demand along the corridor. Higher volume inputs use a specific peaking profile while lower volume inputs can use an average profile. Ideally, this peak period traffic count data would be collected on one day or over the course of few days in the same week. If data is collected over multiple days there should be some locations that are collected on all days to provide a point of comparison across the network.
- **Fleet composition –** Fleet composition is generally collected with count data and should provide the relative composition of automotive/light truck vehicles and heavy truck vehicles. For future alternative analysis the HOV percentage can be estimated using the updated Travel Demand Model.
- **Travel time –** Floating car travel times should be collected on the same day or days as the traffic count data to provide a consistent reference point. This data collection effort should mirror count data collection so that there is travel time data available on everyday traffic counts are collected. For microsimulation calibration purposes it is helpful to have multiple shorter segments rather than one long segment. This helps identify congested locations in the network.

APPENDIX

This appendix describes the methodology for developing focus model used for High-Occupancy Vehicle (HOV) lane analysis along the I-84/I-184 corridor in between Caldwell and Boise. This analysis used a modified subarea of the COMPASS regional travel demand model to estimate potential utilization and most logical geographic extent of a new HOV facility. A methodology flowchart is shown in Figure 1 below.

BACKGROUND AND DATA NEEDS

The framework for HOV analysis is based on the following data sources.

- Existing (2022) estimates and future (2050) forecasts from the COMPASS regional travel demand model along the I-84/I-184. The estimate and forecasted demand from the model provided a basis for the volume forecasting to generate future (2050) baseline volumes for the corridor – without HOV.
- Traffic counts (various years) to use as a basis for the forecasting based on the regional model growth.[13]

FUTURE VOLUME FORECASTING

COUNT BALANCING

The available traffic count data did not provide a continuous volume set along the entire length of the I-84/I-184 corridor. To evaluate the HOV lane performance and forecast a future volume set, the available count data was balanced along the corridor. The balancing process was iterative and required several passes up and down the I-84/I-184 corridor to calibrate the adjustments so that the overall corridor volumes remained as close to the original count as possible. Reliable mainline count values were available from ITD’s Automatic Traffic Recorders and interchange ramp volumes were inferred based on upstream and downstream mainline count locations and data.

FORECASTING

With a balanced existing volume set available, the existing and future year model volumes were used to forecast a future year analysis volume. Forecasting was done in accordance with the procedures outlined in NCHRP 765.[14] This NCHRP report estimates the growth of existing traffic volumes using four growth methods and selects the most appropriate growth by comparing the relative relationship between the counted value, the base year model volume, and the future year model volume. The result is an estimate of future year (2050) traffic volumes that are based on existing counts but reflect the expected land use and network changes incorporated in the regional

[13] https://compassidaho.maps.arcgis.com/apps/webappviewer/index.html?id=289a97755b184ddd87b5b20f38f2e63d

[14] https://www.trb.org/Publications/Blurbs/170900.aspx

model. These forecasted volumes were reviewed and adjusted as appropriate to better reflect the expected growth along the study corridor.

MATRIX ESTIMATION

The forecasted, 2050 volumes provided a basis to generate an origin-destination matrix to use in the traffic assignment for the HOV analysis model. To generate the matrix a process called origin-destination matrix estimation (ODME) was used. This process produced a matrix that "fits" the corridor traffic volumes. ODME requires two inputs, a traffic volume to fit to and a seed matrix to use as a starting point. The resulting matrix can vary depending on the initial values that are assumed in the seed matrix, therefore this process was iterative and required various modifications to the initial seed matrix to produce a valid result. The fit of the matrix to the counts was evaluated using the GEH[15] statistic. The GEH statistic is similar to the root mean square error (RMSE) statistic but is sensitive to the scale of the quantities evaluated. For example, a large value with a large error will result in a larger GEH value than a small value with a large error. This behavior is perfect for traffic analysis where the larger volumes are often the primary focus.

APPLICATION

The traffic assignment from the focus model was used to evaluate the expected use of the HOV lane based on eligible vehicles and a minimum freeway trip length. The minimum freeway trip length for trips that would benefit from the HOV lane was assumed to be at least four miles. Ramp-to-ramp flow bundles, meeting the minimum trip distance, were saved from the focus model traffic assignment. These unique flow bundle volumes were factored based on the estimated HOV fleet percentage for the specific analysis scenario, as discussed in the "Scenarios" section above, and aggregated to estimate the total HOV lane traffic volume.

[15] GEH represents the initials of the transportation planner who developed the statistic, Geoffrey E. Havers