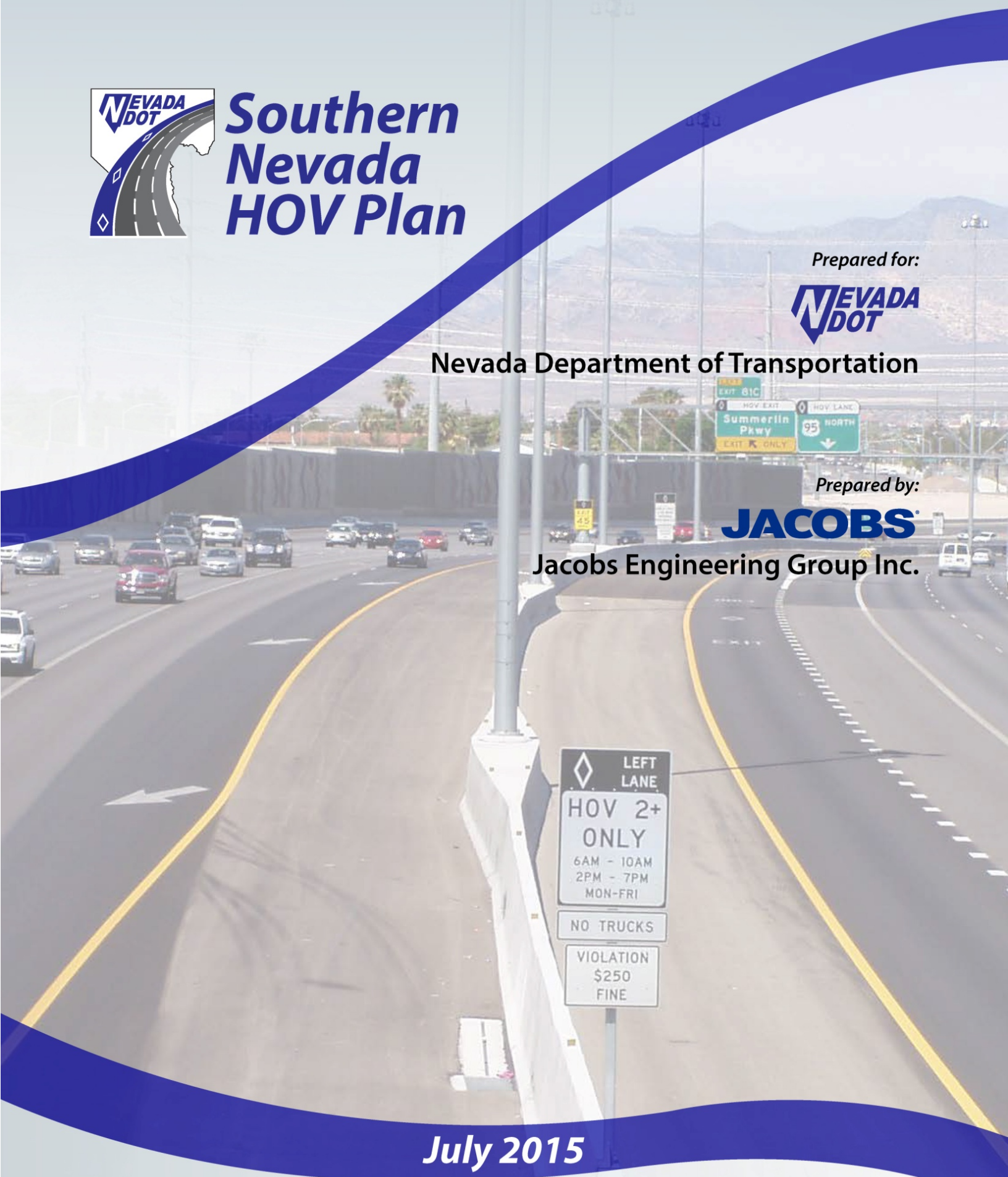
Southern Nevada HOV Plan



Prepared for:

Nevada Department of Transportation

Prepared by:

Jacobs Engineering Group Inc.

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Southern Nevada HOV Plan Update

Prepared for:

Nevada Department of Transportation

Prepared by:

JACOBS

July 2015

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Acronyms

AASHTO:	American Association of State Highway and Transportation Officials
BRT:	Bus Rapid Transit
C-D Road:	Collector-Distributor Road
CC-215:	Clark County Road 215
CMAQ:	Congestion Mitigation & Air Quality Improvement Program
DOT:	Department of Transportation
FAA	Federal Aviation Administration
FAST:	Freeway and Arterial System of Transportation
GP:	General-Purpose
HOT:	High-Occupancy Toll
HOV:	High-Occupancy Vehicle
I-15:	Interstate Highway 15
I-215:	Interstate Highway 215
I-515:	Interstate Highway 515
ISTEA:	Intermodal Surface Transportation Efficiency Act
ITS:	Intelligent Transportation System
LOS:	Level of Service
LVVWD:	Las Vegas Valley Water District
MAP-21:	Moving Ahead for Progress in the 21st Century Act
mph:	miles per hour
MTF:	Model Task Force
NDOT:	Nevada Department of Transportation
NEPA:	National Environmental Policy Act
NRS:	Nevada Revised Statutes
RTC:	Regional Transportation Commission

RTP:	Regional Transportation Plan
SAFETEA-LU:	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SOV:	Single-Occupant Vehicle
STIP:	State Transportation Improvement Program
TEA-21:	Transportation Equity Act for the 21st Century
TIP:	Transportation Improvement Program
TTS:	Travel Time Savings
US 95:	United States Highway 95
USC:	United States Code
v/c:	Volume-to-Capacity Ratio
VMT:	Vehicle Miles Traveled
vph:	vehicles per hour
vphpl	vehicles per hour per lane

EXECUTIVE SUMMARY

The purpose of the Southern Nevada HOV Plan Update (Plan Update) is to update the plan for high-occupancy vehicle (HOV) freeway facilities in Southern Nevada (Las Vegas Valley or Valley). The original Southern Nevada HOV Plan (Original Plan) determined the usefulness of implementing HOV facilities in the Las Vegas metropolitan area in alleviating expected future congestion in the region's roadways. The Original Plan was completed in June 2007. This Plan Update accounts for several changes that have occurred since the Original Plan. Changes include:

- Implementation and programming of the highest priority elements of the HOV system recommended in the Original Plan
- Updates to the Regional Transportation Commission's (RTC) Regional Travel Demand Model (incorporating the mode-choice element)
- Update of the Nevada Department of Transportation's (NDOT's) *Managed Lanes and Ramp Metering Manual*

ES.1. HOV System Evaluation

The regional HOV system planning process involved an evaluation of candidate HOV lane corridors and HOV direct-access ramps from around the Valley. The evaluation criteria follow the guidance provided in *NDOT's Managed Lanes and Ramp Metering Manual.* The evaluation criteria include:

- Congestion and bottlenecks
- HOV demand
- Travel time savings
- Transit service
- Available space
- Connectivity and continuity

The evaluation included both quantitative and qualitative assessment of the candidate facilities. Multiple scenarios of the RTC Model were developed and operated to assist in the quantitative assessment. In addition to this, other readily available information, including existing traffic counts; transit route information; existing and planned park-and-ride lots; availability of right-of-way; geometric feasibility of improvements; and public, private, and agency stakeholders' inputs were used in the system evaluation. The evaluation focused on developing recommendations for the near-term (year 2018 – year 2025 time frame) and the long-term (year 2025 – year 2035).

ES.1.1. Evaluation of HOV Lane Corridors

Following the recommendations of the Original Plan, HOV lanes have already been implemented along US 95 from S. Rancho Drive to Ann Road and Summerlin Parkway from US 95 to Buffalo Drive. The US 95 Northwest Corridor Improvements Project (planned to be completed by year 2020) will extend the HOV lanes from Ann Drive to north of Elkhorn Road. Project Neon (planned to be completed by year 2018) includes implementation of HOV lanes along I-15 from the Sahara Avenue Interchange on the south to the I-15/US 95/I-515 Interchange (the Spaghetti Bowl) on the north. The HOV System Evaluation reexamined these HOV lane corridors to validate the completed/planned improvements and the need for additional long-term additional improvements.

The results of the evaluation indicate that the following freeways have high potential for successful HOV facility implementation:

- I-15 from St. Rose Parkway to Lake Mead Boulevard
- I-515 from I-215 to I-15
- US 95 from I-15 to Elkhorn Road
- I-215 from I-15 to I-515
- CC-215 (Southern and Western Beltway) from I-15 to Summerlin Parkway
- Summerlin Parkway from US 95 to Rampart Boulevard

The segments of I-15 from I-215 to US 95/I-515, US 95 from I-15 to Summerlin Parkway, and I-215 from I-15 to the Airport Connector warrant multiple-lane HOV treatment by year 2035.

ES.1.2. Evaluation of Direct-Access Ramps

Per the recommendations of the Original Plan, the Summerlin HOV Flyover, now constructed, connects the US 95 HOV lanes (from/to south) to Summerlin Parkway. Project Neon includes the construction of direct-access flyover ramps (Project Neon HOV Flyover) connecting the existing HOV lanes on US 95 and the planned HOV lanes on I-15. Project Neon also includes the construction of direct-access local drop ramps (Project Neon HOV Gateway) to a new local street between Oakey Boulevard and Charleston Boulevard. In addition to these, the City of Las Vegas intends to lead the effort to provide the Elkhorn Road direct-access local drop ramps on US 95.

Expanding upon the Original Plan's evaluation of direct-access ramps along the I-15 Resort Corridor, this Plan Update evaluated potential direct-access ramp locations along the other freeways in the Valley. The results of the evaluation indicate that the following direct-access ramp locations have high potential for successful HOV facility implementation:

- Along I-15
  - Blue Diamond Road (ramps to/from the north - from/to the west)
  - Hacienda Avenue (ramps to/from the south)
  - Harmon Avenue (ramps to/from the north)
  - Meade Avenue (ramps to/from both directions)
  - I-15/I-215 interchange direct-access flyover ramps (ramps to/from the north - from/to the east and ramps to/from the north - from/to the west)
- Along other freeways
  - Maryland Parkway on I-515 (ramps to/from both directions)
  - Smoke Ranch Road on US 95 (ramps to/from both directions)
  - Elkhorn Road on US 95 (ramps to/from the south)
  - Airport Connector on I-215 (ramps to/from the north - from/to the west)
  - Sunset Road on CC-215 (ramps to/from both directions)

ES.2. HOV System Recommendations

Based on the results and findings of the evaluation, the following HOV treatments (including facilities that have already been constructed and facilities that are programmed for construction) are recommended for the Near-Term System (shown in Figure ES-1):

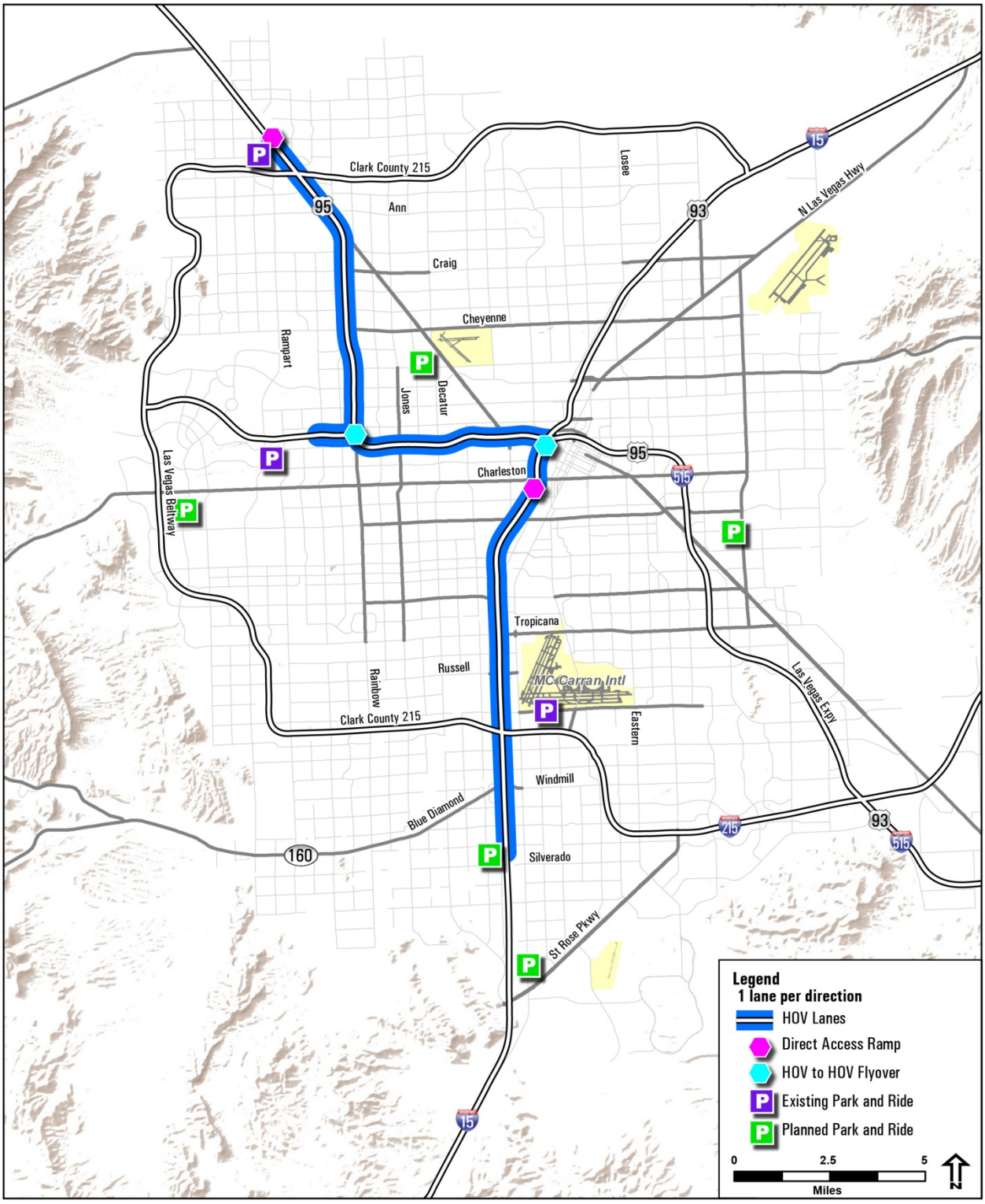
HOV lanes (one lane in each direction) in the Near-Term System:

- I-15 from Silverado Ranch Boulevard to US 95/I-515
- US 95 from I-15 to north of Elkhorn Road
- Summerlin Parkway from US 95 to Buffalo Drive

Direct-access ramps in the Near-Term System:

- Project Neon HOV Gateway
- Project Neon HOV Flyover
- US 95/Summerlin Parkway HOV Flyover (opened in year 2012)
- Elkhorn Road direct-access local drop ramps (ramps to/from the south) on US 95

Figure ES-1: Proposed Near-Term HOV System



The following are recommended for the Long-Term System (shown in Figure ES-2):

HOV lanes in the Long-Term System:

- I-15 from St. Rose Parkway to I-215 with one HOV lane in each direction
- I-15 from I-215 to US 95 with two HOV lanes in each direction
- I-15 from US 95 to Lake Mead Boulevard with one HOV lane in each direction
- I-515 from I-215 to I-15 with one HOV lane in each direction
- US 95 from I-15 to Summerlin Parkway with two HOV lanes in each direction
- US 95 from Summerlin Parkway to north of Elkhorn Road with one HOV lane in each direction
- I-215 from I-15 to I-515 with one HOV lane in each direction except for the segment between I-15 and the Airport Connector which has two HOV lanes in each direction
- CC-215 (Southern and Western Beltway) from I-15 to Summerlin Parkway with one HOV lane in each direction
- Summerlin Parkway from US 95 to Rampart Boulevard with one HOV lane in each direction

Direct-access ramps in the Long-Term System (in addition to the locations recommended for the Near-Term System):

Direct-Access Local Drop Ramps:

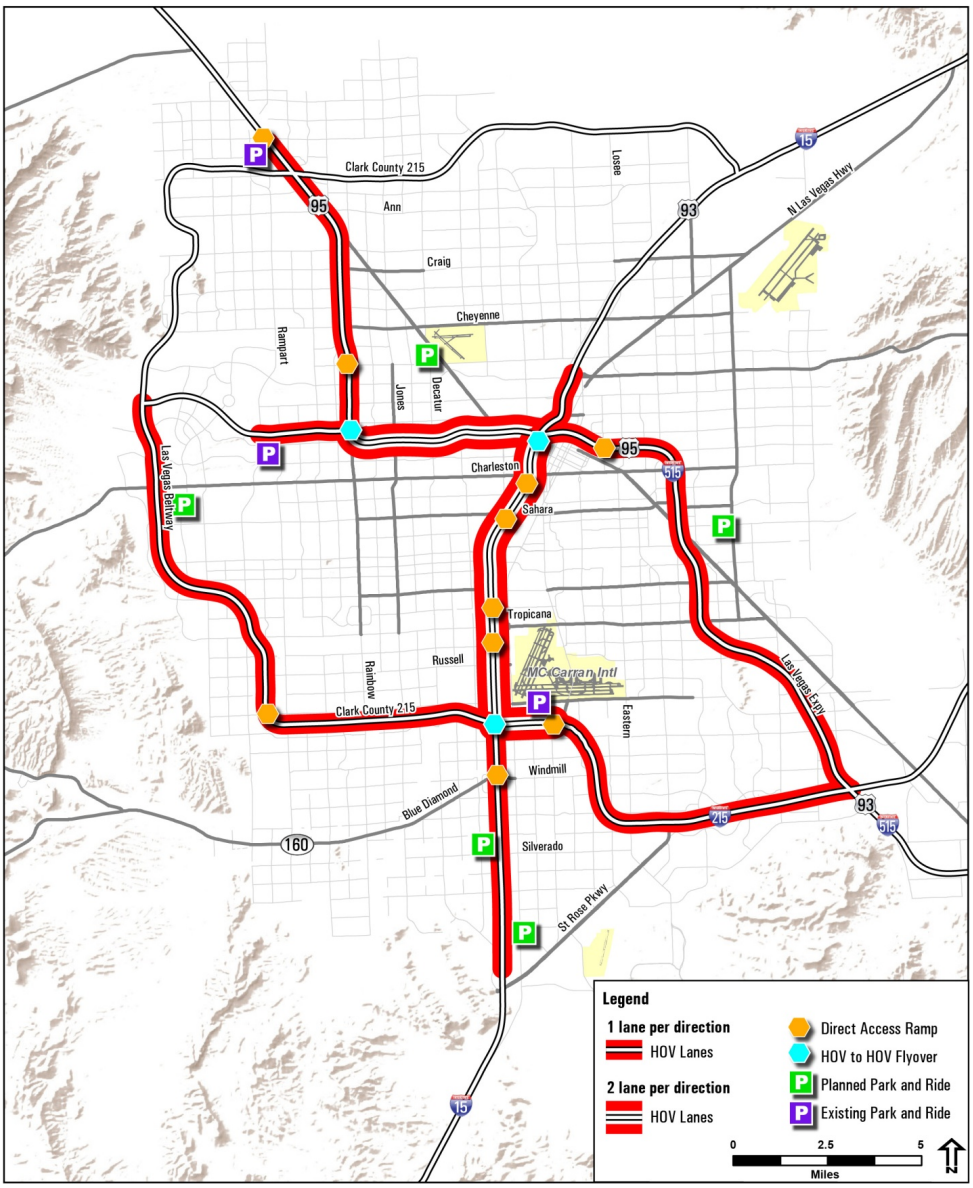
- Blue Diamond Road on I-15 (ramps to/from the north - from/to the west)
- Hacienda Avenue on I-15 (ramps to/from the south)
- Harmon Avenue on I-15 (ramps to/from the north)
- Meade Avenue on I-15 (ramps to/from both directions)
- Maryland Parkway on I-515 (ramps to/from both directions)
- Smoke Ranch Road on US 95 (ramps to/from both directions)
- Airport Connector on I-215 (ramps to/from the north - from/to the west)
- Sunset Road on CC-215 (ramps to/from both directions)

Direct-Access Flyover Ramps:

- I-15/I-215 interchange direct-access flyover ramps (ramps to/from the north - from/to the east and ramps to/from the north - from/to the west)

The proposed Long-Term System is not the ultimate HOV system for the Las Vegas Valley. Future studies and updates to the HOV plan focused on a planning horizon year beyond year 2035 would reevaluate the freeway corridors for additional/alternate HOV lane implementation and direct-access ramp locations. The direct-access ramp locations and corridors where HOV lanes are not proposed in this Plan Update might warrant HOV treatments by this longer-term horizon year (beyond year 2035). All future freeway improvement projects in the Valley (even along corridors where HOV facilities are not proposed in this Plan Update) must provide forward compatibility such that at least one HOV lane in each direction is not precluded beyond year 2035.

Figure ES-2: Proposed Long-Term HOV System



ES.3. HOV System Implementation Phasing Plan

For this Plan Update, the *Priority Area* was defined to include I-15 from St. Rose Parkway to US 95/I-515 and US 95/I-515 from the Project Neon HOV Flyover to Charleston Boulevard. HOV system implementation phasing recommendations are made separately for the *Priority Area* and the rest of the Valley. Table ES-1-1 shows a summary and timeline of the proposed HOV improvements for the *Priority Area*.

Table ES-1-1: Phasing Plan and Timeline of HOV Recommendations for the Priority Area

Implementation Year	HOV Improvement
Neon Opening (2018)	❖ Project Neon HOV Flyover - one lane in each direction ❖ Project Neon HOV Gateway - one-lane ramps ❖ Convert one of the I-15 express lanes in each direction to HOV lanes from Silverado Ranch Boulevard to Sahara Avenue; the second express lane on I-15 between I-215 and Sahara Avenue becomes a general-purpose lane ❖ Provide one HOV lane in each direction within Project Neon
Implementation Year	HOV Improvement
2025	❖ Add a second HOV lane in each direction on I-15 between I-215 and Sahara Avenue (4GP+2HOV) ❖ Add an HOV lane in each direction on I-15 from Silverado Ranch Boulevard to St. Rose Parkway ❖ Extend the second HOV lane on I-15 to the Project Neon HOV Flyover
2030[1]	❖ Improve the HOV flyover to accommodate two lanes in each direction. Alternately, this could be done with the improvements listed for year 2025
2035[2]	❖ Extend I-515/US 95 HOV lanes from the Project Neon HOV Flyover to Charleston Boulevard – one lane in each direction

[1] By year 2035, the HOV flyover requires two lanes in each direction; while one lane in each direction is adequate in year 2025. The year 2025 and year 2035 demand forecasts were interpolated to estimate the year in which the demand would exceed the one-lane threshold, i.e., the year in which the facility would need to be improved to two lanes in each direction. The result was year 2030.

[2] Alternatively, this could be implemented concurrently with any improvements on this section of I-515 (currently programmed for year 2031).

Table ES-1-2 shows the proposed phasing plan of the recommended HOV lanes outside the *Priority Area.* In general, HOV lanes are recommended to be added prior to the addition of any general-purpose lanes. Therefore, implementation of HOV lanes can be opportunistic and need not necessarily follow the order of implementation shown in Table ES-1-2.

Table ES-1-2: Phasing Plan of HOV Lanes (Outside the Priority Area for the Long Term)

Order of Implementation[1]	HOV Improvement
1	Add a second HOV lane in each direction on US 95 from the Project Neon HOV Flyover to Summerlin Parkway
2	Implement HOV lanes on I-215 from I-15 to the Airport Connector (two lanes in each direction)
3	Implement HOV lanes on CC-215 (Southern and Western Beltway) from I-15 to Summerlin Parkway
4	Extend the HOV lanes on I-515 from Charleston Boulevard to I-215
5	Extend the HOV lanes on I-15 from the Project Neon HOV Flyover to Lake Mead Boulevard
6	Implement HOV lanes on I-215 from the Airport Connector to I-515
7	Extend the HOV lanes on Summerlin Parkway to Rampart Boulevard
[1] Lower number to be implemented first.	

Table ES-1-3 shows the proposed phasing plan of the recommended direct-access ramps (excluding existing and programmed locations). Similar to the other long-term elements of the HOV Plan, these direct-access ramps may be designed and constructed opportunistically (need not necessarily follow the order of implementation shown in Table ES-1-2) when other projects at/near these locations are programmed and developed.

Table ES-1-3: Phasing Plan of Direct-Access Ramp Recommendations

Order of Implementation[1]	Improvement	
	Along Freeway	Direct-Access Ramp Location
1	I-15	Hacienda Avenue and Harmon Avenue
2	I-15	I-15/I-215 interchange direct-access flyover ramps to the east
3	I-215	Airport Connector
4	I-15	I-15/I-215 interchange direct-access flyover ramps to the west
5	I-15	Meade Avenue
6	I-515	Maryland Parkway
7	I-15	Blue Diamond Road
8	US 95	Smoke Ranch Road
9	CC-215	Sunset Road
[1] Lower number to be implemented first.		

ES.4. HOV Direct-Access Ramp Implementation Cost Estimates

Planning level cost estimates were prepared for the direct-access ramp locations on I-15 and are summarized in Table ES-1-4. Estimated costs are in year 2014 dollars and include contingencies for items that were not designed or determined at the time of the preliminary layout.

Table ES-1-4: Planning Level Cost Estimates

HOV Direct-Access Ramp Location	Estimated Improvement Cost (Year 2014 Dollars)
Hacienda Avenue and I-15 (ramps to/from the south)	$ 13,690,000
Harmon Avenue and I-15 (ramps to/from the north)	$ 11,505,000

HOV Direct-Access Ramp Location	Estimated Improvement Cost (Year 2014 Dollars)
I-15 and I-215 Interchange (ramps to/from the north - from/to the east and ramps to/from the north - from/to the west)	$ 100,530,000
Meade Avenue (ramps to/from both directions)	$ 26,420,000
Blue Diamond Road and I-15 (ramps to/from the north - from/to the west)	$ 25,110,000

ES.5. HOV System Operational Plan

ES.5.1. Near-Term Operational Recommendations

Operational recommendations are made for the Near-Term System. Operational components such as minimum vehicle occupancy, hours of HOV operation, vehicle eligibility, and access type were studied. The proposed recommendations are summarized in Table ES-1-5.

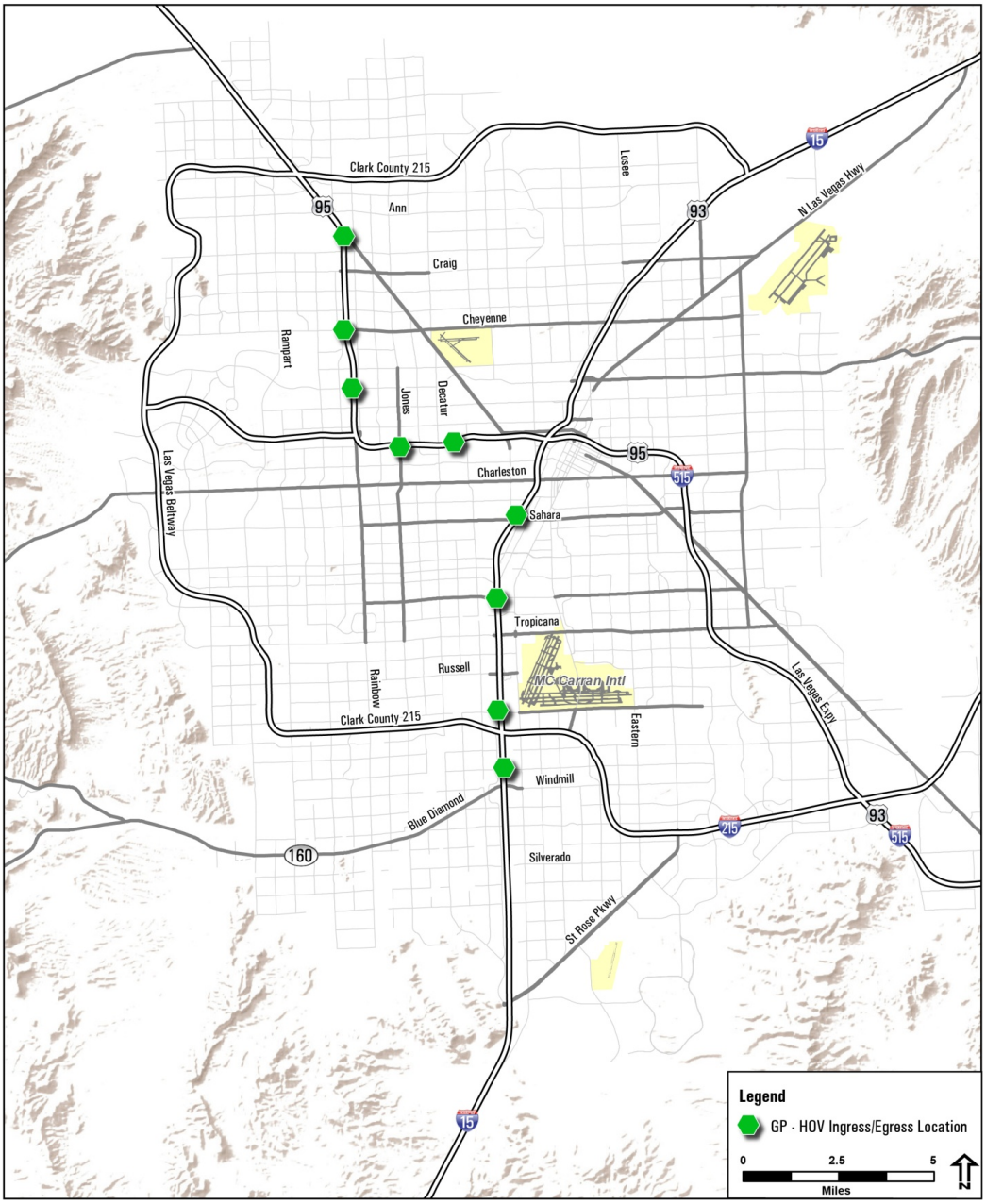
Table ES-1-5: Near-Term Operational Recommendations

Component	Operational Plan
Minimum occupancy	HOV 2+
Hours of operation	24-hours, 7 days of the week
Trucks	Vehicles with more than two axles (or vehicle-trailer combinations) are not eligible
Motorcycles	Eligible
Emergency vehicles	Those responding to an emergency are eligible
Public transit buses	Eligible (including dead-heading buses)
Single-occupant low-emission and energy-efficient vehicles	To be studied
Access Type	Limited access

ES.5.2. Proposed Ingress/Egress Locations for the Near-Term System

Proposed preliminary ingress/egress locations for the Near-Term System are shown in Figure ES-3. The proposed locations allow the required weaving distance to/from the ramps per *NDOT Managed Lanes and Ramp Metering Manual, which* is, a minimum of 800 feet per lane change. During the design stage, however, weaving analysis using operational analysis tools is required to confirm and more clearly define the ingress/egress locations.

Figure ES-3: Proposed Ingress/Egress Locations (Preliminary)



ES.6. Next Steps

A successful HOV program in the Valley will require that ongoing freeway design projects incorporate HOV facilities. Upcoming major investment and corridor studies where the Plan Update recommends HOV facilities should actively include HOV facilities among corridor alternatives prior to the addition of general-purpose capacity improvements. Various projects encompassing major improvements along the freeways are ongoing and planned within the proposed HOV system. Each of these projects is at a different stage of design and at a different point in the environmental process. Each project has to be reviewed to determine if any changes based on the HOV plan are required. NDOT has the responsibility of coordinating the integration of HOV facilities into all freeway and corridor projects on the national highway system.

The current RTP (adopted December 13, 2012) incorporates HOV improvements based on the recommendations from the Original Plan. The projects recommended by this Plan Update should be included in the next round of RTP projects. Once included in the RTP, NDOT will lead the identification and inclusion of HOV projects in the RTC's Transportation Improvement Program (TIP) and NDOT's State Transportation Improvement Program (STIP).

An effective public outreach framework to gain public acceptance and understanding of HOV lanes is key to the successful implementation of the recommendations made in this Plan Update. As part of this Plan Update, a public information and education strategy was developed for the conversion of the I-15 express lanes to HOV lanes. The outreach for this conversion will be an extended effort, requiring proactive education and coordination with corridor stakeholders, users, and adjacent projects. The outreach and education component of this conversion should be initiated early to build understanding with the stakeholders, and should continue through implementation.

1. INTRODUCTION

The purpose of the Southern Nevada HOV Plan Update (Plan Update) is to update the plan for high-occupancy vehicle (HOV) freeway facilities in Southern Nevada (Las Vegas Valley or Valley). The original Southern Nevada HOV Plan (Original Plan) was completed in June 2007. Several changes have occurred since the Original Plan. First, elements of the HOV system recommended in the Original Plan have been constructed or have become part of the programming for freeways and ancillary facilities. Second, the Regional Transportation Commission's (RTC) Regional Travel Demand Model has been updated with the mode-choice element and was released in 2012; the new RTC Model has improved HOV forecasting capabilities. Third, Nevada Department of Transportation's (NDOT's) *Managed Lanes and Ramp Metering Manual* was updated in year 2013; the new Manual includes updated planning, operations, design, and implementation criteria for HOV lanes. With these changes, an update to the Original Plan was necessary to reset priorities and account for current realities.

This report documents the Plan Update. Section 1 (this section) provides background information. Section 2 documents the framework for the evaluation process to identify corridors for HOV lanes and locations for direct-access ramps. Section 3 documents the traffic modeling and forecasting process. Section 4 presents the findings and recommendations from the evaluation process and the proposed HOV system for the near-term and the long-term. Section 5 summarizes the feasibility evaluation, conceptual design, and preliminary cost estimates completed for select recommended direct-access ramps. Section 6 presents the recommended operational plan for the Near-Term System. Section 7 lists the next steps to advance the HOV Plan, including recommended public outreach activities.

1.1. Need for HOV Lanes

An HOV lane is dedicated to the exclusive use of HOVs including buses, carpools, vanpools, or a combination thereof, for at least a portion of the day. HOV lanes, the most common type of managed lanes, emphasize person movement rather than traditional vehicle movement, which in turn improves the highway's ability to move more people in fewer vehicles. When operated and managed at a high level of service, HOV lanes reduce peak-period travel time compared to the adjacent general-purpose lanes and can move substantially more commuters than general-purpose lanes during peak demand periods when priority must be assigned to the highest and best use.[1]

[1] NDOT's Managed Lanes and Ramp Metering Manual (2013) is the resource for information on definitions, types, features, and benefits of managed lanes, including HOV lanes.

Many communities within the Las Vegas Valley have experienced traffic growth far outstripping the growth in roadway capacity. The population of Clark County is projected to grow by 42 percent between year 2013 and year 2035[2], with a consequential increase in traffic on the area's roadways. Nevada residents consistently identify traffic congestion as a serious issue facing the region, much of which is caused by single-occupant vehicle (SOV) trips. According to the 2010 American Community Survey, SOV trips account for 76.5 percent of all work trips in the Las Vegas Valley. By comparison, carpools currently constitute approximately 11.6 percent of all work trips. Limited right-of-way, limited funding, the federal Clean Air Act requirement limitations on traditional roadway expansion, and federal funding provisions often restrict the ability to expand infrastructure to accommodate roadway demand volumes. To better position NDOT to receive federal approval and funding of its projects, congestion management and operational approaches must be considered as means to ensure that new, large-scale transportation projects maximize mobility benefits while minimizing negative impacts.

HOV lanes are a congestion management strategy that enhances mobility for travelers willing to carpool and use transit. The objective of HOV lanes is to provide facilities with higher speeds and less delay by limiting the volume of traffic (and congestion) that occurs within them. Unless time savings is associated with traveling in the HOV lanes, the public has little incentive to use them. Therefore, HOV lanes work best when they are uncongested and the adjacent general-purpose lanes are congested.

Two major potential benefits are associated with HOV lanes. First, they increase the person throughput (i.e., the number of persons passing a fixed point along the freeway) on a congested freeway by increasing the number of persons in each vehicle in the HOV lane. Carpools form in response to the presence of an HOV lane and its faster and more reliable travel times. The carpool members' vehicles travel faster and more efficiently while removing some vehicles that would otherwise be in the general-purpose lanes, thereby freeing up some capacity in those lanes for other vehicles. Second, and perhaps more importantly, HOV lanes have a higher vehicle throughput than congested general-purpose lanes. When properly managed, more vehicles can travel in an HOV lane than in a congested general-purpose lane. A freeway lane operating at capacity will handle approximately 2,000 vehicles per hour; however, when demand exceeds that capacity and heavy congestion and jammed conditions ensue, a freeway lane processes as few as 900 vehicles per hour. Managed lanes, such as HOV lanes, manage or limit the number of vehicles in the lane so that demand is kept below capacity, thereby avoiding saturation and jammed conditions. In that way, the vehicular throughput of an HOV lane is

[2] The Center for Business and Economic Research at the University of Nevada, Las Vegas.

managed so that it is higher than the throughput of an adjacent congested general-purpose lane.

The choice of HOV lanes over other forms of managed lanes for the Las Vegas area is based on a number of factors. HOV lanes are already implemented in the US 95 corridor. The traffic forecasts of HOV utilization on the freeway HOV lanes included in the Plan Update are substantial enough to provide both good utilization of the lanes and a sufficiently extensive system to noticeably improve travel times for the longer distance travel needed to encourage carpool formation. Implementation of HOV lanes is generally simpler than the implementation of other types of managed lanes. Except for continued enforcement and periodic monitoring to confirm the absence of congestion, little is needed in addition to the initial capital investment in the facilities. In contrast, toll lanes require extensive electronic systems for toll collection and dissemination of electronic toll tags for motorists to place in their vehicles. High-occupancy toll (HOT) lanes that provide access to HOV lanes by SOVs for a fee require more extensive monitoring to assure that traffic volumes are not permitted to reach congested levels. Exclusive truck lanes and express lanes require substantial through volumes of these vehicles, which would not address the largest component of traffic focused on the Resort Corridor in the Las Vegas Valley.

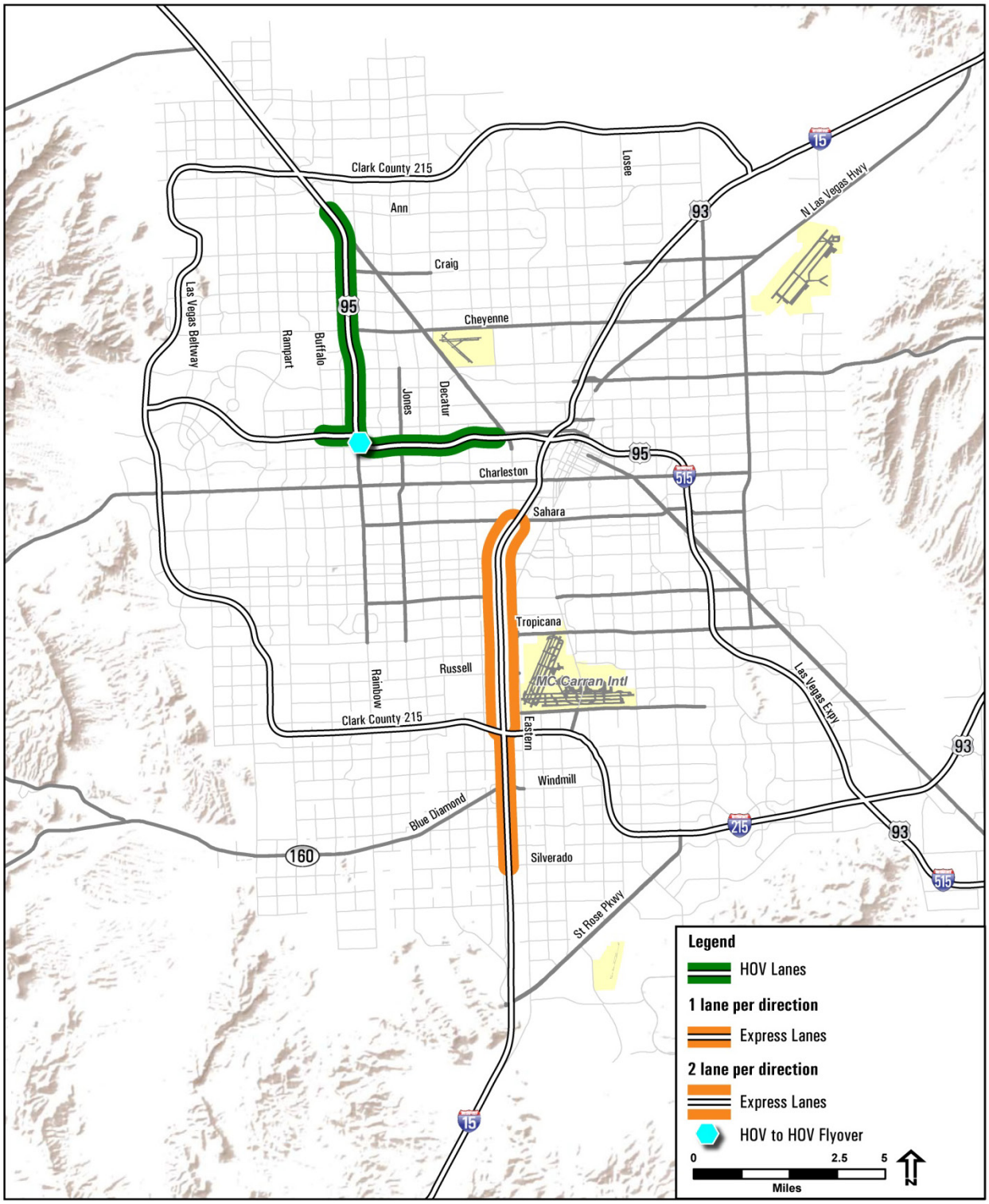
1.2. Existing Managed Lanes in Southern Nevada

The first HOV lanes were opened in Nevada as part of the 2006 reconstruction and widening of US 95 north of I-15 in Las Vegas. Today, US 95 HOV lanes stretch approximately 10 miles in each direction from S. Rancho Drive to Ann Road. The lanes are restricted to HOV vehicles of two or more passengers (HOV 2+) during the periods of 6 to 10 AM and 2 to 7 PM. The HOV lanes are separated by a solid white line from the general-purpose lanes (i.e., contiguous), and they can be accessed at any point (i.e., continuous access). An HOV flyover that connects the US 95 HOV lanes (from/to south) to Summerlin Parkway was opened in 2012. This flyover connects to the HOV lanes on Summerlin Parkway, which extend only to the next interchange - Buffalo Drive.

In 2010, express lanes along I-15 between Sahara Avenue and Silverado Ranch Boulevard opened, consisting of two express lanes in each direction between Sahara Avenue and I-215 and one express lane in each direction between I-215 and Silverado Ranch Boulevard. They were placed in operation as an interim improvement until more extensive improvements, including the HOV system, can be implemented. Therefore, the existing express lanes are intended for conversion to HOV lanes. This Plan Update addresses the timing of this conversion.

Figure 1-1 illustrates the existing managed lanes in southern Nevada.

Figure 1-1: Existing Managed Lanes in Southern Nevada



1.3. Planned HOV Lanes

RTC's Regional Transportation Plan (RTP) includes a number of projects that incorporate HOV elements. For example, the I-15 South Project (I-15 from Sloan Road to Tropicana Avenue) includes HOV lanes. Similarly, future improvements listed for the I-515 corridor include HOV lanes. These and other projects with HOV elements in the RTP are based on the recommendations from the Original Plan and are being reevaluated in this Plan Update. Two projects, however, Project Neon and the US 95 Northwest Corridor Improvements Project, are already in the design stage and programmed to be built within the next five years. This Plan Update, therefore, assumes the HOV elements from these two projects are in place and does not reevaluate their need. These two projects are discussed below.

Project Neon:

Project Neon extends along I-15 from the Sahara Avenue Interchange on the south to the I-15/US 95/I-515 Interchange (the Spaghetti Bowl) on the north. Project Neon will be built in phases. The first phase is planned to open in year 2018. HOV lanes on I-15 are planned within Project Neon. As part of the first phase, direct-access flyover ramps (Project Neon HOV Flyover) are proposed that would connect the existing HOV lanes on US 95 and the planned HOV lanes on I-15. Additionally, direct-access local drop ramps are proposed to a new local street between Oakey Boulevard and Charleston Boulevard, approximately where Wall Street crosses under I-15 (Project Neon HOV Gateway). This Plan Update does not reevaluate the need or location for the Project Neon HOV Flyover and the Project Neon HOV Gateway; however, the required number of HOV lanes on the Project Neon HOV Flyover, the Project Neon HOV Gateway ramps, and the I-15 mainline are evaluated in the Plan Update. Project Neon will be the first project to implement HOV lanes on I-15 and will include converting the existing I-15 express lanes to HOV lanes to provide a continuous HOV system through the Resort Corridor. The Plan Update also evaluates this conversion including the number of lanes to be converted.

US 95 Northwest Corridor Improvements Project:

This project is ongoing with several elements completed. It includes improvements to US 95 corridor from Washington Avenue to Kyle Canyon Road. The recent (year 2013) extension of HOV lanes to Ann Road was part of Phase 1 of this project. Phase 2A, which is planned to be completed by year 2020, will widen US 95 and extend the HOV lanes from Ann Road to north of Elkhorn Road. The City of Las Vegas is a partner in this project. City of Las Vegas in partnership with NDOT proposes to construct direct-access local drop ramps to connect Elkhorn Road and the extended US 95 HOV lanes to serve the Centennial Hills Transit Center (includes 900 park-and-ride spaces) and surrounding land-uses.

2. REGIONAL HOV SYSTEM PLANNING PROCESS

A regional HOV planning process involves an evaluation of the potential for HOV lanes based on a review of existing and forecast travel conditions when compared to a set of baseline and planned transportation improvements in the regional plan. The purpose of the evaluation is to determine if specific conditions, including the presence of congestion, travel time benefits, and demand, are present to make HOV lanes appropriate. Evaluation is typically qualitative, involving input from a wide range of stakeholders. *NDOT's Managed Lanes and Ramp Metering Manual* provides regional-level evaluation criteria for managed lanes. The criteria from the Manual are included in Table 2-1 for reference purposes; more detailed information on each criterion can be found in the *Managed Lanes and Ramp Metering Manual.*

Table 2-1: Regional Evaluation Criteria

Criteria	Thresholds to be Met	Input or Tool
Congestion	❖ Corridors that experience average speeds below 35 mph for several hours during each commute period for the opening year and/or planning horizon year	❖ Speeds and the volume-to-capacity ratios (v/c) from available traffic data and the regional model
Bottlenecks	❖ Locations where speeds fall below 35 mph for several hours during each commute period for the opening year and/or planning horizon year	❖ Speeds and v/c from available traffic data and the regional model
Travel Time Savings and Trip Reliability	❖ Accrued travel time savings on a given freeway route of 3 minutes minimum per trip. An accrued travel time savings of 5 minutes per trip is desirable between major origins and destinations ❖ Trip reliability improvement potential	❖ Output from the regional model
Transit Service	❖ Minimum number of buses or established ridership for existing and future transit services and plans (based on local policy). Generally, at least six buses/hour are needed to justify a bottleneck bypass or direct-access ramp	❖ Transit agency route system and service plan

Criteria	Thresholds to be Met	Input or Tool
	❖ Potential for bus operating time savings	
Travel Patterns	❖ Average trip distances on freeways are at least 5 miles or more ❖ Trip affinities exist for specifically-defined employment generators (e.g., a minimum of a 20 percent corridor demand exiting to a specific employment generator exists during the AM peak hour)	❖ Select link analysis from the regional model or from an origin/destination survey
HOV Lane Demand	❖ Meets minimum demand thresholds shown in Table 2-2	❖ Demand from the regional model ❖ Sketch planning output based on available occupancy
Available Space	❖ Opportunity to widen a roadway based on cursory investigations ❖ Opportunity to modify a roadway through minor changes in geometrics or design exceptions	❖ As-built roadway plans or programmed plans and studies
Connectivity / Continuity	❖ Segments critical to an overall network ❖ Key links through interchanges or with major activity centers ❖ The candidate HOV lane is part of a longer facility	❖ Demand output from the regional model and select link analysis for identified high volume movements between corridors

Source: Managed Lanes and Ramp Metering Manual, NDOT, 2013

Table 2-2 presents the minimum and maximum volume thresholds for the managed lane demand criteria. The number of required HOV lanes depends on these thresholds. Since the primary goal of HOV lanes is to provide travel time savings and travel time reliability to HOVs, a maximum “per lane” volume threshold is required so that the lane(s) do not become congested. Conversely, a minimum “per lane” volume threshold should be met in the opening year to justify the restricted use of the facility and ensure public acceptance of the HOV lanes.

Table 2-2: Vehicle Volume Operating Thresholds

Facility Type	Vehicle Volume Threshold (vehicles/lane/hour)	
	Minimum	Maximum
Concurrent or reversible	700	1,650
Contraflow (borrowed lane in off-peak direction separated by barrier)	700	1,500
Freeway-to-Freeway direct-access flyover ramps	500	1,650
Direct-access local drop ramps* and queue bypass lanes	250	1,400
* Does not apply to ramps used only by buses, such as ramps from a transit center.		

Source: Managed Lanes and Ramp Metering Manual, NDOT, 2013

The Original Plan applied these criteria to each freeway corridor in the Valley, using available data at the time, for potential HOV implementation[3]. In addition to the recommended segments for corridor HOV lane treatments, the Original Plan identified specific high-volume movements for direct-access consideration. HOV direct-access reduces weaving across the general-purpose lanes and provides time savings for HOVs. The two types of direct-access ramps are: direct-access local drop ramps and direct-access flyover ramps. Those that link freeway HOV lanes directly to the arterial system are referred to as direct-access local drop ramps, and the ones that link HOV lanes at two different freeways at a freeway-to-freeway system interchange are referred to as direct-access flyover ramps.

This Plan Update reevaluated the HOV corridors and direct-access ramps recommended in the Original Plan to determine if the recommendations are still valid with the RTC's Regional Travel Demand Model with the mode-choice element. This Plan Update also evaluated other direct-access ramp locations in addition to the ones recommended in the Original Plan. The projects that have been constructed (such as the Summerlin Parkway Flyover); the projects that are

[3] The *Managed Lanes and Ramp Metering Manual* has been updated since the Original Plan. Thresholds for certain criteria have changed with the new update.

programmed to be constructed (such as Project Neon); and the year 2013 update to NDOT's *Managed Lanes and Ramp Metering Manual (*which has updated planning, operations, design, and implementation criteria) are taken into account in the reevaluation.

The evaluation process was based on both the regional-level evaluation criteria shown in Table 2-1 and the vehicle volume operating thresholds shown in Table 2-2. The application of the RTC's travel demand models to develop the year 2025 and year 2035 traffic forecasts that were used in the evaluation process are discussed in Section 3. The HOV System Evaluation process is explained in detail in Section 4.1. For direct-access ramps, preliminary level geometric evaluation was also performed to ensure that it would be geometrically feasible to implement the ramps within the available right-of-way. This evaluation is discussed in Section 5.

3. TRAFFIC FORECASTING

Traffic forecasts for the Plan Update are based on the RTC's Regional Travel Demand Model with the mode-choice element (RTC Model)[4] released in 2012. The Original Plan used the Travel Demand Model RTC 2004 Update Package 1. The calibration of this prior model version was based on the 1996 household survey. Since then, RTC's adopted travel demand model has been updated with mode-choice modeling capabilities. The model has also been recalibrated with 2005 household survey data, 2005 transit on-board and visitor survey data, and 2005 counts. Several features, such as area type model elements, truck model elements, planning variables, highway networks, and transit coding, have also been updated. The improved RTC Model is a planning tool for producing multimodal travel demand forecasts, and this Plan Update is its first use with a focus on HOV lane demand.

3.1. Modeling Overview

The technical memorandum that documents the review, refinement, and application of the RTC Model is included in Appendix A (Traffic Forecasting Memorandum). RTC provided the RTC Model. The model was operated for the years 2013 (base year), 2025 (interim year), and 2035 (horizon year). An overview is provided below.

The RTC Model for year 2013 (base year model) was reviewed for its capabilities regarding HOV forecasts. The intention of the review was to understand the HOV features of the RTC Model and to identify if any refinements could further improve its HOV forecasting abilities. Several refinements were considered, discussed, and documented. A Model Task Force (MTF) was convened to oversee the modeling review, refinement, and application process. The MTF membership included representatives from NDOT Traffic Information Division and representatives from RTC modeling staff. The MTF met as needed throughout the modeling phase of the Plan Update. Minutes of the MTF meetings are included in the Traffic Forecasting Memorandum in Appendix A.

The RTC Model has the structural elements for forecasting HOV traffic. It responds to changes in inputs affecting HOV forecasts, yielding generally intuitive results at the regional scale; however, at the level of detail of individual road segments, the year 2013 model over-projects traffic volume on the US 95 HOV lanes. It should be noted that at the time of calibration of the model, HOV lanes were not yet in existence on US 95. The current field conditions of the general-purpose lanes on US 95 are not heavily congested; and, therefore, the observed HOV lane usage is relatively low. The model, however, places a somewhat equal loading of traffic per

[4] TRUCKS_FINAL_RTC2009_v48_Build575_07_25_2011.RSC

lane between the general-purpose lanes and the HOV lane. Similar results are seen in the year 2035 model; the model places a generally equal amount of per lane traffic on the HOV lanes as it does on the adjacent general-purpose lanes.

To address the general over-projection of HOV lane traffic, several potential strategies were considered for use in the model refinement. The purpose of the refinement was to adjust the model to produce a better representation of the travel patterns observed from the traffic count data. Refinement options that would require a major reworking of the main components of the model were not performed. To retain the integrity of the adopted RTC Model, the identified refinement strategies were related to network characteristics and time-of-day distribution. The following list summarizes the final set of refinements implemented in the RTC Model for its application to improve its forecasts of HOV traffic for the Plan Update.

- Reduced lanes on the HOV ingress/egress links from two-lane directional to one-lane directional
- Reduced HOV link capacity from 1,950 vehicles per hour per lane (vphpl) to 1,500 vphpl
- Reduced HOV ingress/egress capacity from 2,000 vphpl to 1,500 vphpl
- Adjusted time-of-day distribution
- Made the HOV link speed equal to the freeway speed

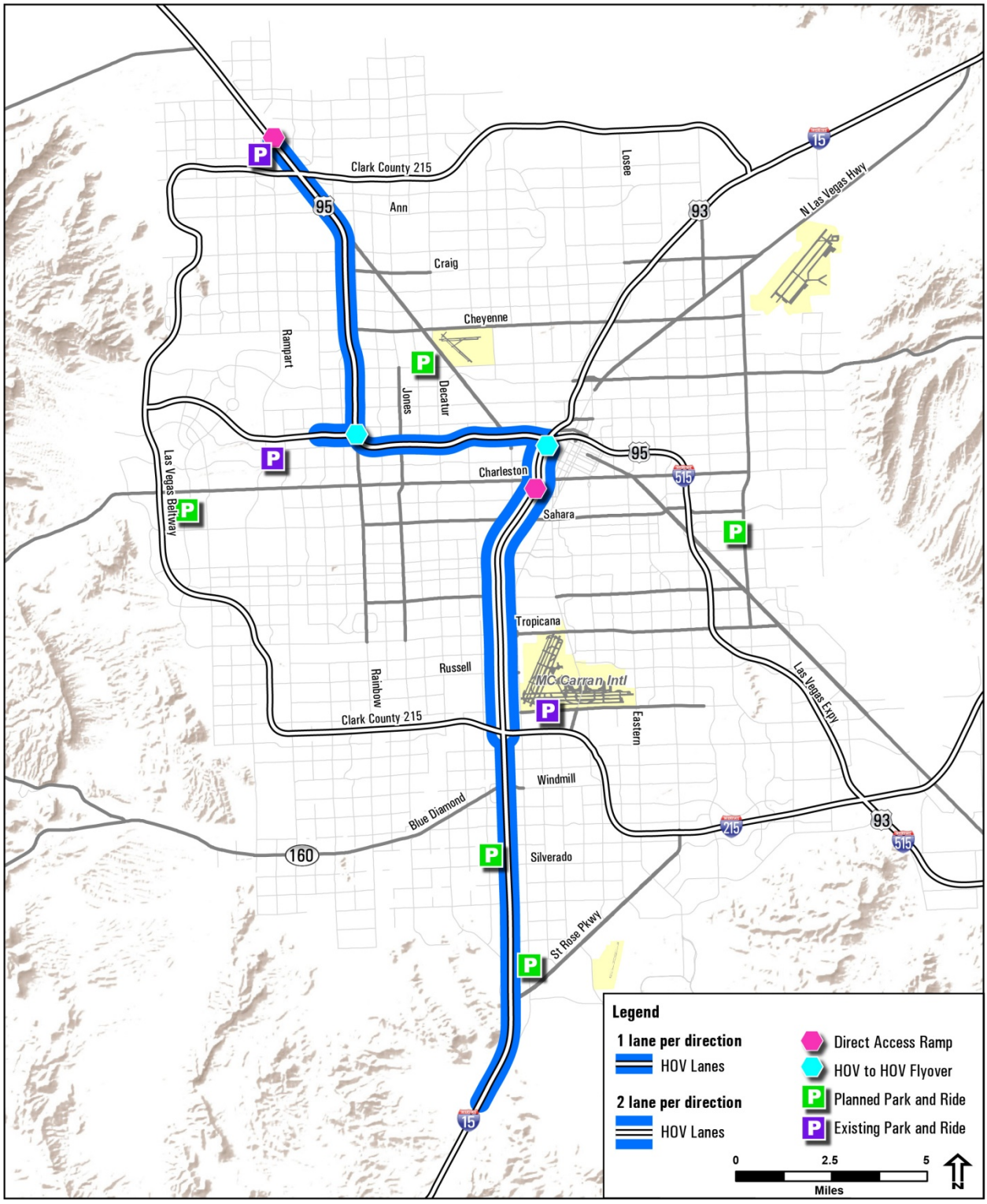
3.1.1. Year 2025 Modeled Network

The year 2025 Model was coded to reflect the following:

- Project Neon improvements were coded based on the available design plans. This includes the Project Neon HOV Flyover and the Project Neon HOV Gateway described in Section 1.3.
- The HOV system was assumed to extend from US 95 at Elkhorn Road through I-15 to south of St. Rose Parkway, as single lanes in each direction except for two HOV lanes in each direction on I-15 between US 95 and I-215.
- Direct-access local drop ramps were assumed at Elkhorn Road on US 95.
- HOV lane restrictions were assumed to be during the AM and PM peak periods only.

The modeled year 2025 HOV network is depicted in Figure 3-1.

Figure 3-1: Year 2025 Modeled HOV System



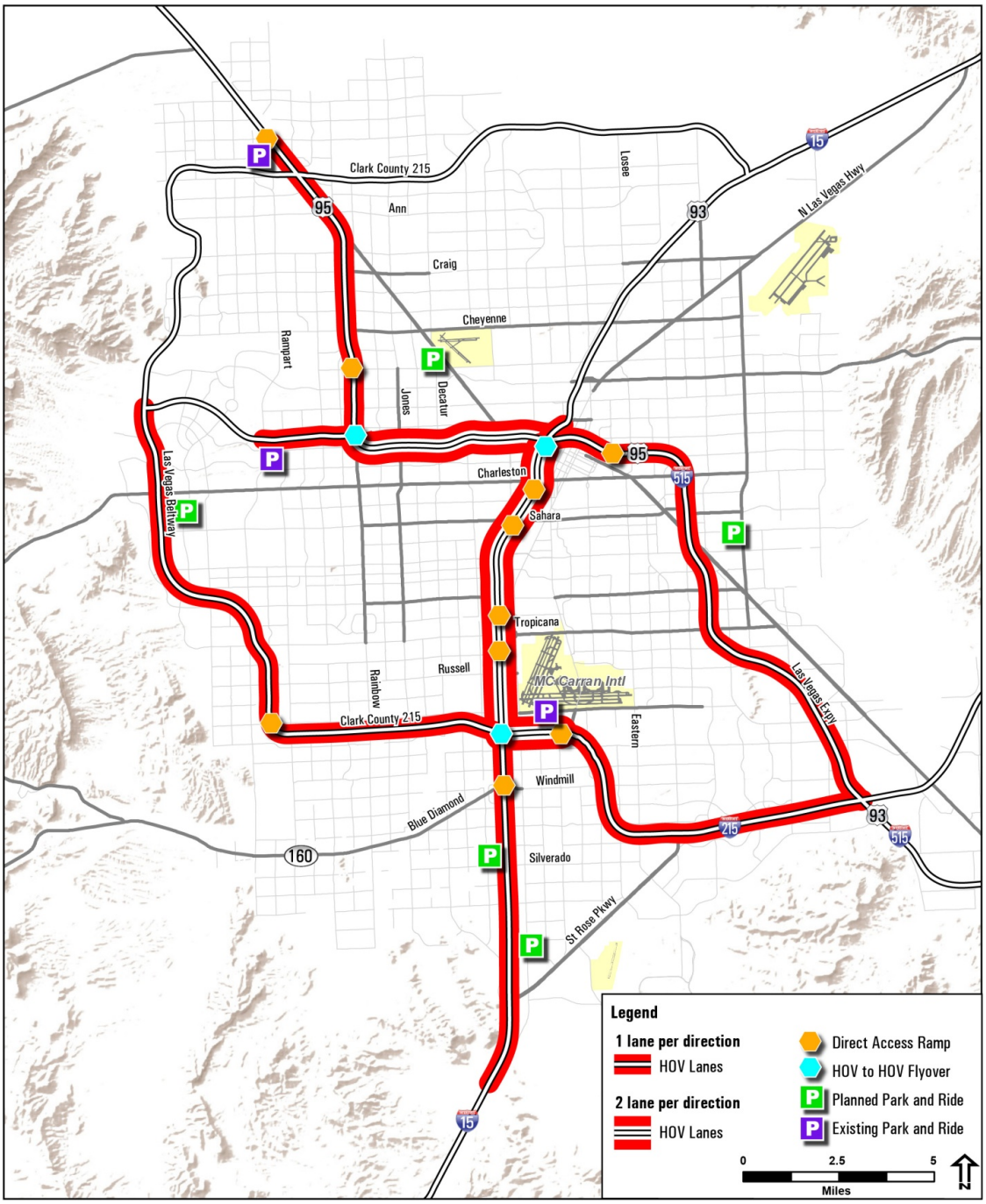
3.1.2. Year 2035 Modeled Network

The year 2035 Model was first coded to reflect three different HOV system scenarios; the Traffic Forecasting Memorandum (Appendix A) describes each. The Traffic Forecasting Memorandum presents the year 2035 forecasts developed for one of the three scenarios (HOV Scenario 2). Based on the regional HOV System Evaluation process and based on project team meetings and stakeholder comments, a recommended year 2035 HOV system, a fourth scenario (HOV Scenario 4) was established. The recommended system includes select elements from the original three scenarios. These changes resulted in a mismatch between the HOV Scenario 2 and the recommended system (HOV Scenario 4). Therefore, the recommended system (HOV Scenario 4) was modeled to develop the corresponding year 2035 forecasts. In other words, modeling of year 2035 conditions was an iterative process that involved four different model runs to identify the most desirable HOV system for year 2035. The year 2035 forecasts for the recommended system (HOV Scenario 4) are presented in the Traffic Forecasting Memorandum – Addendum (Appendix B). The year 2035 HOV network (modeled as Scenario 4) is described below and depicted in Figure 3-2.

- All year 2025 improvements
- HOV lanes on the following facilities:
  - I-15 – From south of St. Rose Parkway to north of the I-15/US 95/I-515 Interchange (Spaghetti Bowl) – two HOV lanes in each direction between I-215 and US 95/I-515
  - I-515 – From I-215 to I-15
  - US 95 – From I-15 to Elkhorn Road – two HOV lanes in each direction between I-15 and Summerlin Parkway
  - I-215/CC-215 (Southern and Western Beltway) – From I-515 to Summerlin Parkway – two HOV lanes in each direction between Airport Connector and I-15
  - Summerlin Parkway – From US 95 to Rampart Boulevard
- Direct-access local drop ramps at:
  - Blue Diamond Road (ramps to/from the north - from/to the west)
  - Harmon Avenue (ramps to/from the north)
  - Hacienda Avenue (ramps to/from the south)
  - Meade Avenue (ramps to/from both directions)
  - Maryland Parkway and I-515 (ramps to/from both directions)
  - Smoke Ranch Road (ramps to/from both directions)
  - I-215 and Airport Connector (ramps to/from the north - from/to the west)
  - Sunset Road and CC-215 (Southern and Western Beltway) (ramps to/from both directions)

- Direct-access flyover ramps at:
  - I-215/I-15 Interchange (ramps to/from the north - from/to the east and ramps to/from the north - from/to the west)
  - Project Neon HOV Flyover (two lanes in each direction)

Figure 3-2: Year 2035 Modeled HOV System (HOV Scenario 4)



3.2. Traffic Forecasts

Raw model volumes were used to develop AM and PM peak hour volume forecasts following NDOT's *Traffic Forecasting Guidelines* (2012). Details of the forecasting methodology are included in the Traffic Forecasting Memorandum (Appendix A). The year 2025 forecasts were used to identify recommendations for the year 2018 to year 2025[5] timeframe (Near-Term System), and year 2035 forecasts were used to develop recommendations beyond year 2025 (Long-Term System). The Near-Term System is expected to have restricted access to HOV lanes through limited ingress/egress locations, (see Section 6.1 for more information); thus, the year 2025 forecasts are based on limited access. Year 2035 forecasts were generally based on continuous access to capture more HOV eligible vehicles in HOV lanes, to better reflect HOV demand, and to plan accordingly for the Long-Term System. Limited access causes some of the HOV eligible vehicles to stay in general-purpose lanes due to limited ingress/egress locations.

Traffic forecasts were first developed for the *Priority Area* for both year 2025 and year 2035. The *Priority Area* includes I-15 from St. Rose Parkway to the I-15/US 95/I-515 interchange and US 95/I-515 from Rancho Drive to Charleston Boulevard (Figure 3-3). These limits were identified as "priority" because NDOT has upcoming projects (such as Project Neon) and studies within these limits and desires to ensure each project/study uses the same set of traffic forecasts[6]. Year 2025 and year 2035 traffic forecasts for the *Priority Area* are included in the Traffic Forecasting Memorandum (Appendix A) and the Traffic Forecasting Memorandum – Addendum (Appendix B), respectively. In addition to the forecasts developed for the *Priority Area*, year 2035 forecasts were also developed at select locations along all the freeways in the Valley to aid in the HOV System Evaluation process. Year 2035 forecasts along freeways outside the *Priority Area* are shown in Appendix C. Figure 3-4 shows the year 2025 forecasts (a more detailed version is available in Appendix B). Year 2025 forecasts are developed to provide an estimate of HOV use associated with upcoming near-term projects and for phasing of the improvements within I-15. Year 2035 forecasts for select locations are presented in Figure 3-5 and Figure 3-6. Figure 3-5 shows the year 2035 forecasts for the *Priority Area* and Figure 3-6 shows the year 2035 forecasts along freeways outside the *Priority Area.*

[5] Year 2018 is the assumed opening of Project Neon for this Pan Update, which is the first upcoming project to implement HOV elements on I-15. Therefore, year 2018 is the beginning of the near-term timeframe.

[6] Both the year 2025 and year 2035 forecasts for the *Priority Area* are approved by NDOT and can be used on other projects and studies within these limits.

Figure 3-3: Priority Area

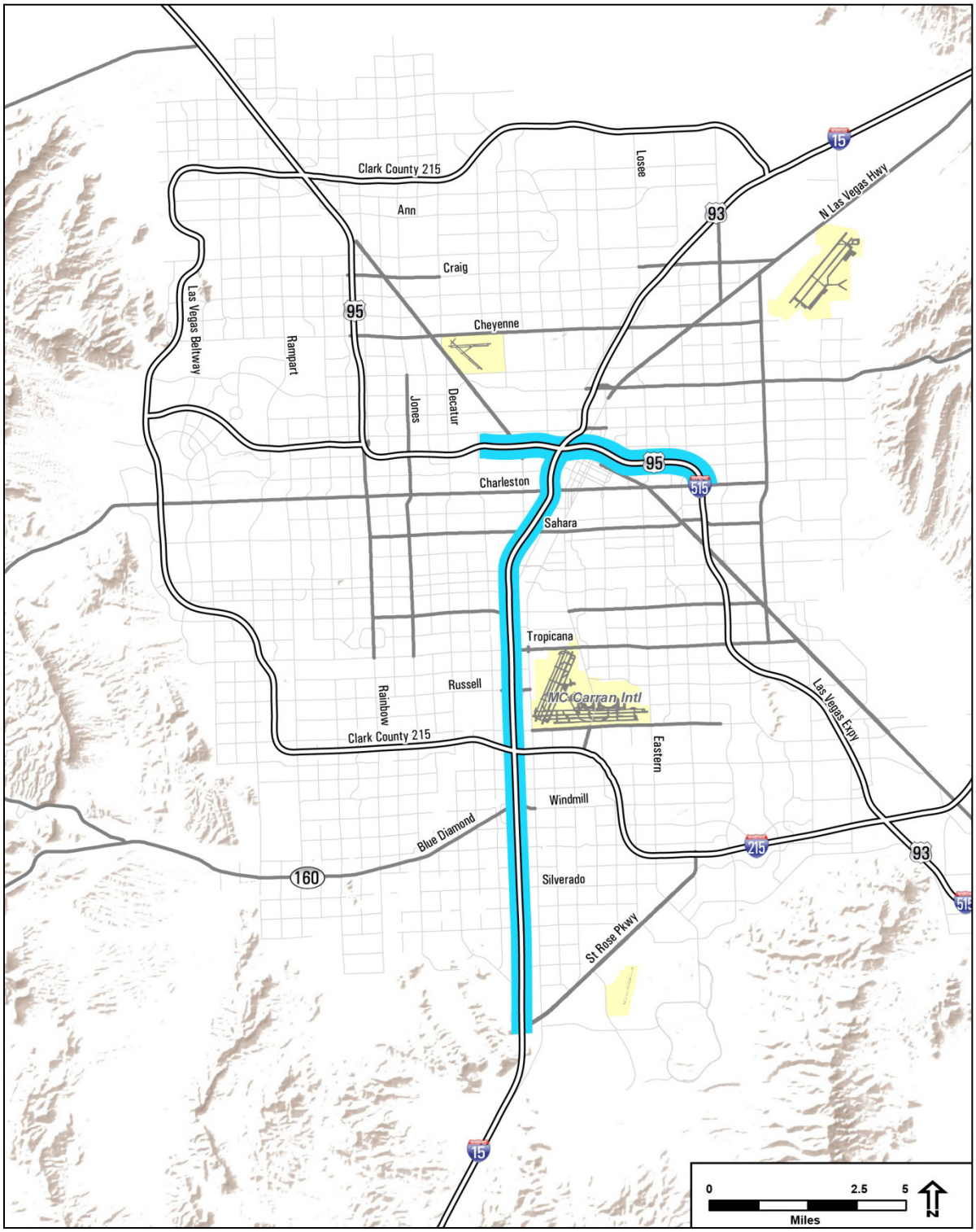


Figure 3-4: Year 2025 Forecasts for the Priority Area

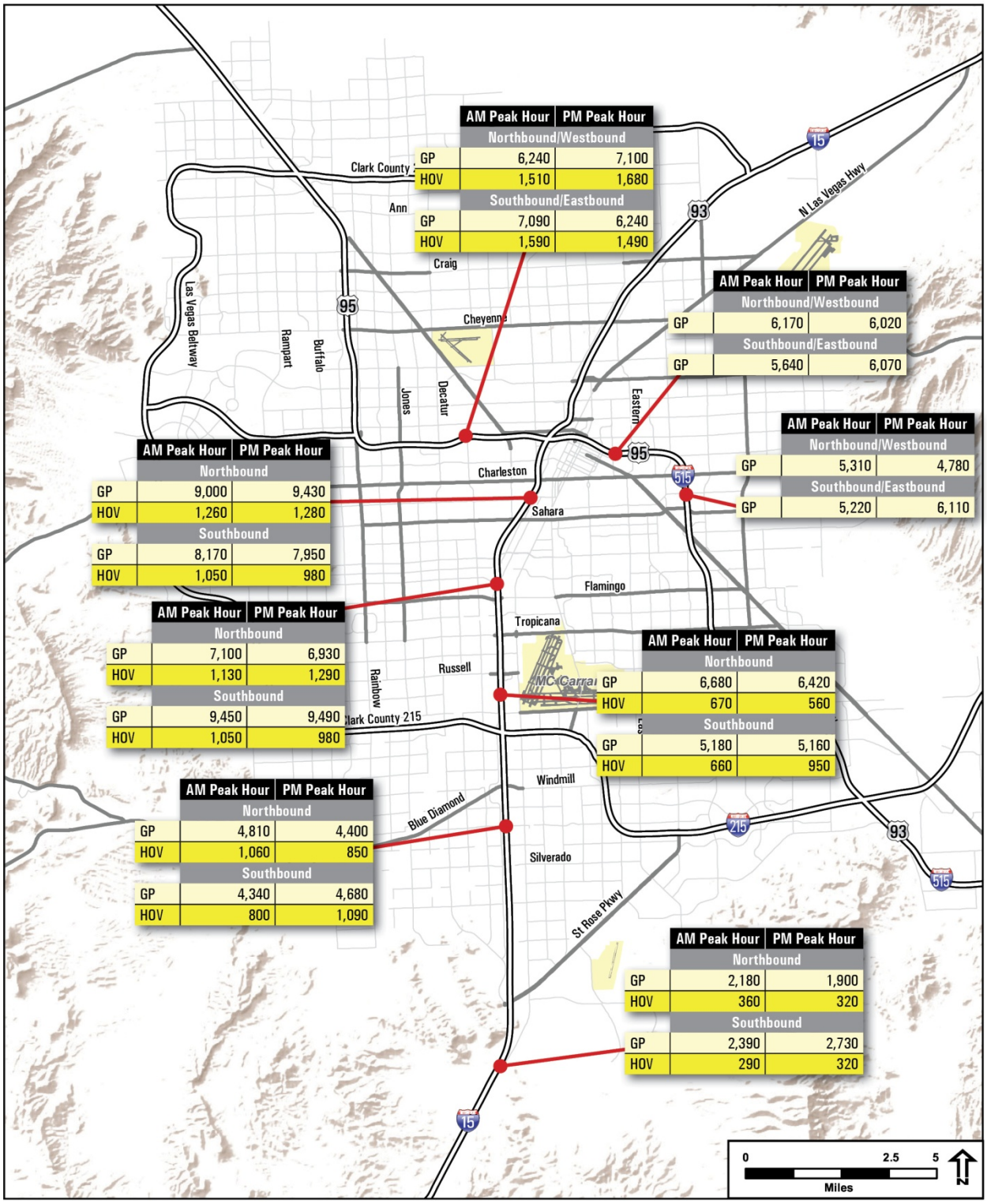
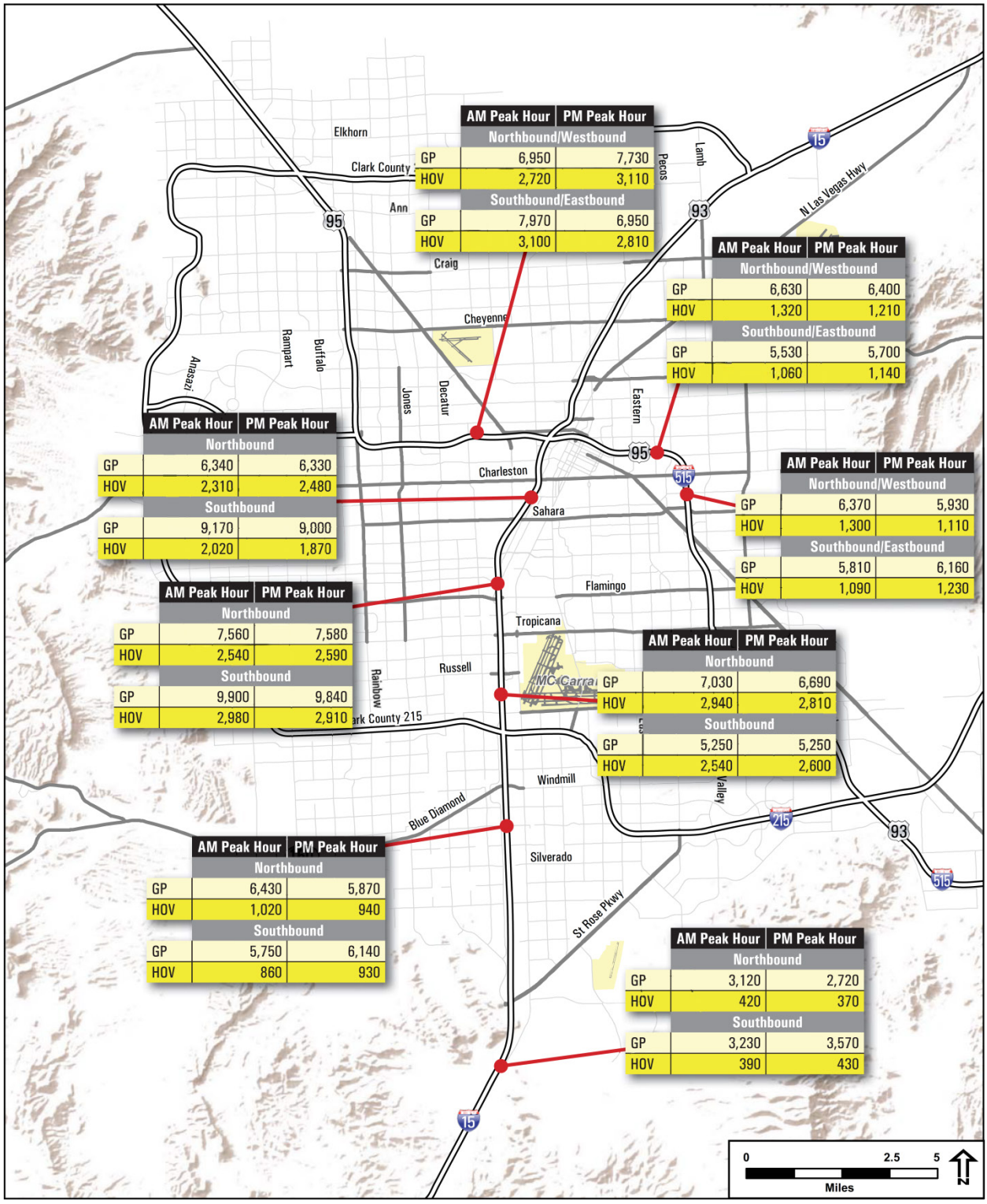


Figure 3-5: Year 2035 Forecasts for the Priority Area



AM Peak Hour	PM Peak Hour
Northbound/Westbound	
GP 6,950	7,730
HOV 2,720	3,110
Southbound/Eastbound	
GP 7,970	6,950
HOV 3,100	2,810

AM Peak Hour	PM Peak Hour
Northbound/Westbound	
GP 6,630	6,400
HOV 1,320	1,210
Southbound/Eastbound	
GP 5,530	5,700
HOV 1,060	1,140

AM Peak Hour	PM Peak Hour
Northbound	
GP 6,340	6,330
HOV 2,310	2,480
Southbound	
GP 9,170	9,000
HOV 2,020	1,870

AM Peak Hour	PM Peak Hour
Northbound/Westbound	
GP 6,370	5,930
HOV 1,300	1,110
Southbound/Eastbound	
GP 5,810	6,160
HOV 1,090	1,230

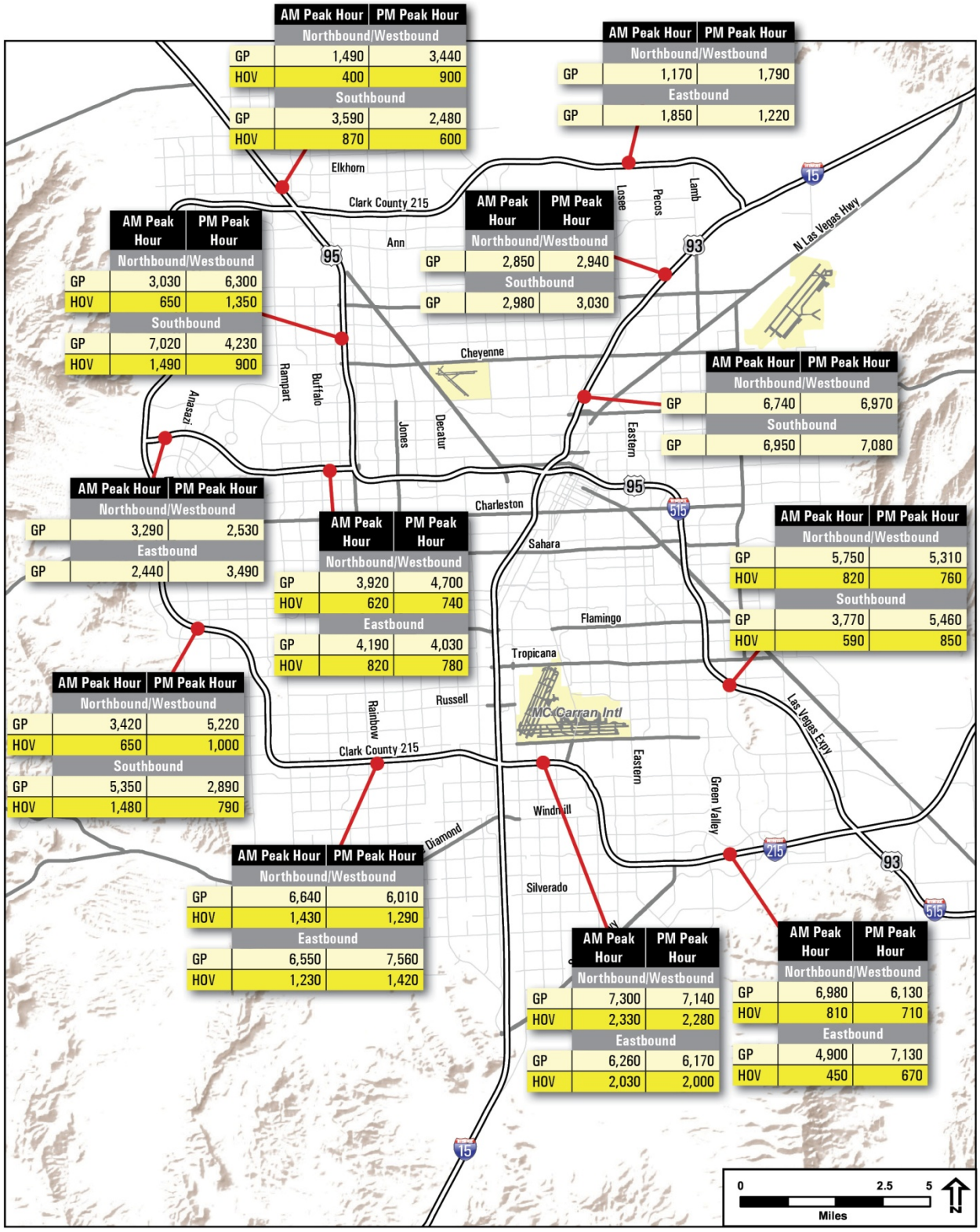
AM Peak Hour	PM Peak Hour
Northbound	
GP 7,560	7,580
HOV 2,540	2,590
Southbound	
GP 9,900	9,840
HOV 2,980	2,910

AM Peak Hour	PM Peak Hour
Northbound	
GP 7,030	6,690
HOV 2,940	2,810
Southbound	
GP 5,250	5,250
HOV 2,540	2,600

AM Peak Hour	PM Peak Hour
Northbound	
GP 6,430	5,870
HOV 1,020	940
Southbound	
GP 5,750	6,140
HOV 860	930

AM Peak Hour	PM Peak Hour
Northbound	
GP 3,120	2,720
HOV 420	370
Southbound	
GP 3,230	3,570
HOV 390	430

Figure 3-6: Year 2035 Forecasts outside the Priority Area



4. HOV SYSTEM PLAN

The recommended HOV Plan for Southern Nevada (HOV System Plan) is divided into two major time frames.

- **Near-Term System:** Represents the HOV system for the year 2018 – year 2025 time frame. Project Neon's Design-Build phase is planned to open in year 2018 and will be the first project to implement elements of the proposed HOV system on I-15.

- **Long-Term System:** Represents the HOV system between year 2025 and the horizon year 2035.

The regional HOV system evaluation criteria are explained in Section 4.1. The Long-Term System was determined based on this evaluation. Recommendations for the Near-Term System were developed depending on the immediacy of the need for HOV treatments. For the *Priority Area* (Figure 3-3), recommendations are proposed for both the near term and long term. For the rest of the Valley, recommendations are proposed for the long term.

4.1. HOV System Evaluation Criteria

The HOV system evaluation was based on the regional-level evaluation criteria shown in Table 2-1 and the vehicle volume operating thresholds shown in Table 2-2. The evaluation process reexamined the HOV corridors and direct-access ramps identified in the Original Plan and other direct-access ramp locations in addition to the ones recommended in the Original Plan. The following criteria were used in the evaluation.

- **Congestion and bottlenecks:** The presence of severe and recurring congestion indicates that HOV facilities may be appropriate for a corridor. The existence of bottlenecks likely points to the need for managed lane treatments, such as direct-access ramps to provide a bypass for eligible vehicles. Overall, I-15 (between I-215 and US 95/I-515) is forecast to continue to be the most congested corridor in the region through year 2035. US 95/I-515 and I-215/CC-215 are also forecast to experience varying levels of congestion. Speeds and the volume-to-capacity ratios (v/c) from travel demand models were used as a measure of the expected congestion and bottlenecks along the various corridors. All these corridors have segments that meet or exceed the threshold for the presence of congestion by 2035, with peak period travel speeds falling below 35 mph. Traffic bottlenecks or congestion points cause significant delays and unreliable travel times.

- **HOV demand:** Existing and estimated levels of HOV demand in a corridor provide information on the potential use of an HOV lane. HOV demand represents one of the

most important criteria because demand ultimately drives lane justification and utilization. Minimum demand is critical to determine a facility's success in its opening year because the public's perception of how successful an HOV lane is operating depends on the number of vehicles using the lane. On the other hand, high levels of demand for the HOV lane might result in the lane becoming congested and ineffective; and therefore, additional HOV lanes were considered in these cases. The year 2025 and year 2035 forecasts (explained in Section 3) were used in the evaluation.

- **Travel time savings:** Research suggests that commuters increasingly shift their travel patterns (to use HOV lanes) when HOV facilities along a freeway or sequence of routes generate increasing levels of travel time savings. In other words, HOV facilities that offer higher travel time savings are more desirable than facilities that offer lower travel time savings. Travel time savings due to the introduction of HOV facilities predicted by travel demand models were used in this evaluation. Since the length of the various study freeway corridors are different, the absolute travel time savings along a corridor were normalized to travel time savings per mile of the corridor.

- **Transit service:** The existing and future potential for transit service on a candidate corridor was used as an indicator of the need for an HOV lane. Bus volumes could justify some type of HOV lane treatment, particularly at bottlenecks. Some RTC transit routes use freeways in a limited fashion. The most recent service expansion improvements are related to bus rapid transit operations along selected major arterial corridors. HOV lanes best serve express bus services in which large portions of the route takes place on the freeway network. The best markets for express bus service lie far enough away from major employment centers that travel time savings can be gained to support mode shifts to transit. Express bus services rely on park-and-ride lots to aggregate enough demand to justify the service, typically of a sufficient size and critical demand service area to support fully loaded buses on a regular headway of about 15 to 20 minutes during the peak commute hours. This service level is not warranted for many corridors today, but could exist in the future along some radial corridors. RTC's existing express bus service routes, the Centennial Express and the Westcliff Airport Express, travel along freeways and rely on park-and-ride lots to aggregate demand. Existing and planned transit service, transit service potential, and park-and-ride lots along the corridors were all considered in this evaluation.

- **Available space:** HOV lanes are to be provided either by widening the existing roadway or by modifying the lanes and shoulders to provide for added capacity. The availability of right-of-way in a corridor for the introduction of HOV lanes was considered in the evaluation. Availability is assumed to be easiest in planned roadway corridors and those

undergoing planning studies that will result in right-of-way acquisition. Available space assumes the possibility to restripe inside shoulders and narrow some lanes to add HOV lanes in isolated pinch points as design deviations or exceptions. Available space is much more difficult in corridor segments where recent construction has been completed and the pavement fills up most of the current right-of-way.

- **Connectivity and continuity:** The success of an HOV lane system may be enhanced if it is part of a larger system. A specific link in a regional system may affect, or be affected by, other links. Key movements in the system will likely require connectivity between corridors to serve high levels of HOV demand and to maximize the mobility benefits to HOV users transitioning between corridors. Through traffic movements at major interchanges are often subject to delays and offer the opportunity for substantial time savings to HOV users who can avoid merging and diverging in the adjacent freeway lanes. Consideration was given to those HOV lane segments that are critical to an overall network plan. Key links needed through interchanges or with major activity centers were identified and considered during the evaluation.

As explained above, travel demand model outputs were used, when available, for the evaluation of these criteria. As explained in Section 3.1.2, four different year 2035 HOV system scenarios were modeled initially with different combinations of HOV lane corridors and direct-access ramp locations. To aid in the HOV System Evaluation process, a year 2035 No-Action model was also developed. This No-Action model network included only the HOV facilities included in the year 2025 RTC model; and none of the HOV facilities planned (in the RTP) to be implemented between year 2025 and year 2035 were included. The desirability of the implementation of HOV facilities was determined based on the outputs from this No-Action model and from a comparison of the outputs between the No-Action and the HOV system scenarios (Build Alternative) models.

4.2. Evaluation of HOV Lane Corridors

Table 4-1 shows the evaluation thresholds for the implementation of HOV lanes. The desirability of HOV lanes along each of the freeway corridors in the Valley was identified by evaluating each corridor against these thresholds. Table 4-2 summarizes the findings of this evaluation. These findings and the proposed recommendations for each corridor are described in the following sections.

Table 4-1: Criteria Thresholds for the Evaluation of HOV Lane Corridors

High ← Moderate → Low

Criteria	Desirability				
					
Congestion/ Bottlenecks	Speeds < 25 mph	25 mph < Speeds < 35 mph	35 mph < Speeds < 45 mph	45 mph < Speeds < 55 mph	55 mph < Speeds
	1.0 < v/c	0.9 < v/c < 1.0	0.8 < v/c < 0.9	0.7 < v/c < 0.8	v/c < 0.7
HOV Lane Demand	1,650 vph < Demand	1,200 vph < Demand < 1,650 vph	700 vph < Demand < 1,200 vph	350 vph < Demand < 700 vph	Demand < 350 vph
Travel Time Savings (per mile in seconds)	20 secs < TTS	15 secs < TTS < 20 secs	10 secs < TTS < 15 secs	5 secs < TTS < 10 secs	TTS < 5 secs
Transit Service	Qualitative assessment				
Available Space	ROW acquisition has already cleared the National Environmental Policy Act (NEPA) procedures	Sufficient ROW generally available without substantial impacts	ROW proposed to be acquired for other freeway improvements (not including HOV)	Sufficient ROW generally not available without substantial impacts	
Connectivity/ Continuity	Qualitative assessment				

Table 4-2: Evaluation of HOV Lane Corridors – Findings

Corridor	Segment	Congestion/Bottlenecks		HOV Lane Demand	Travel Time Savings	Transit Service	Available Space	Connectivity/ Continuity	Corridor Summary (Average)	Corridor Rank
		Speeds	Volume / Capacity (v/c) Ratio							
I-15	South of I-215	◑	◕	◑	◔	◑	●	◕	◑	◕
I-15	Between I-215 and US 95/I-515	◕	●	●	◕	●	◑	●	◕	●
I-15	Between US 95/I-515 and CC-215	◔	◔	◔	○	◑	◕	◕	◑	◑
I-15	North of CC-215	○	○	○	○	○	◕	○	○	○
US 95	Between I-15 and Summerlin Parkway	◕	●	●	●	◕	◔	●	◕	●
US 95	Between Summerlin Parkway and CC-215	◑	◕	◕	◔	◑	●	◑	◑	◕
US 95	North of CC-215	◔	○	◔	○	◑	●	◔	◔	◔
I-515	Between I-15 and Charleston Boulevard	◑	◑	◕	◔	◑	◑	●	◑	◕
I-515	Between Charleston Boulevard and I-215	◑	◕	◑	◕	◔	◑	◑	◑	◑
I-515	South of I-215	◔	◔	◔	○	○	◕	◔	◔	◔

● High
◕
◑ Moderate
◔
○ Low

Desirability

Table 4-2 (Continued): Evaluation of HOV Lane Corridors – Findings

Corridor	Segment	Congestion/Bottlenecks		HOV Lane Demand	Travel Time Savings	Transit Service	Available Space	Connectivity/ Continuity	Corridor Summary (Average)	Corridor Rank
		Speeds	Volume / Capacity (v/c) Ratio							
I-215	Between I-15 and Airport Connector									
I-215	Between Airport Connector and I-515									
CC-215	Between I-15 and Summerlin Parkway									
CC-215	Between Summerlin Parkway and US 95									
CC-215	Between US 95 and I-15									
Summerlin Parkway	Between US 95 and Rampart Boulevard									
Summerlin Parkway	Between Rampart Boulevard and CC-215									

4.2.1. I-15

I-15 is key to the regional freeway system, particularly between I-215 and US 95/I-515 along the Resort Corridor. I-15 represents the core of the regional HOV system.

Along I-15 south of I-215, moderate to high levels of congestion are expected, with bottlenecks near the I-15/I-215 interchange. South of St. Rose Parkway, the year 2035 HOV demand on I-15 is expected to be low and does not meet the vehicle volume operating thresholds shown in Table 2-2 for HOV lanes. Currently within this corridor, the I-15 express lanes (one lane in each direction) extend between Silverado Ranch Boulevard and I-215. They could be converted to HOV lanes without the need for additional right-of-way. In summary, this segment of I-15 has moderate to high desirability for the implementation of HOV lanes.

Between I-215 and US 95/I-515, I-15 achieves the highest desirability ratings in the region for most criteria, as shown in Table 4-2. In this corridor, HOV demand, congestion, bottlenecks, transit service potential, and connectivity/continuity considerations are the highest in the region. The directional year 2035 HOV demand is forecast to exceed 3,000 vehicles per hour (vph) during the peak hours, which is almost twice the optimal capacity for an HOV lane. At this level of demand, a multi-lane HOV treatment will be necessary for this corridor.

In general, the HOV demand and the presence of congestion are moderately low on I-15 north of US 95/I-515. Any congestion present is localized to segments near the I-15/US 95/I-515 interchange. On I-15 north of Lake Mead Boulevard, the year 2035 HOV demand does not meet the vehicle volume operating thresholds shown in Table 2-2 for HOV lanes. In the year 2035, North 5th Street will be continuous across I-15 and will be a continuous north-south multimodal super arterial, accommodating automobiles and transit service. The I-15/Lake Mead interchange offers easy access between I-15 and North 5th Street; hence, Lake Mead Boulevard is a logical terminus for the HOV lanes on I-15.

Direct-access ramps are appropriate along I-15 to accommodate the high levels of HOV demand. Direct-access treatments include the direct-access flyover ramps at the I-15/US 95/I-515 interchange (Project Neon HOV Flyover), the I-15/I-215 interchange, and direct-access local drop ramps to arterial streets. The evaluation of these are described in Section 4.5.

4.2.2. US 95

HOV lanes (one lane in each direction) exist today along US 95 from S. Rancho Drive to Ann Road. HOV lanes are also planned to be extended along US 95 to north of Elkhorn Road.

The results of the evaluation indicate that the highest desirability for HOV lanes exists in the corridor between I-15 and Summerlin Parkway. The 2035 HOV demand exceeds 3,000 vph during the peak hours in this corridor also; and the presence of congestion and capacity bottlenecks highlight the desirability of HOV facilities. At this level of demand, a multi-lane HOV treatment will be necessary. The primary movement for HOV to/from US 95 at the I-15/US 95/I-515 interchange is from/to I-15 south, necessitating the provision of HOV direct-access flyover ramps to serve this demand; however, sufficient demand is also forecast for the through movements between US 95 and I-515 to justify the provision of continuous HOV treatments between these freeways.

HOV demand along US 95 between Summerlin Parkway and CC-215 Northern Beltway remains high enough to warrant one HOV lane in each direction. Bottlenecks and congestion are expected mainly in the vicinity of the US 95/Summerlin Parkway interchange. This corridor achieves moderate HOV desirability, as shown in Table 4-2; however, high demand and bottlenecks in the southern end of the segment validate the need for the Summerlin Parkway HOV Flyover, which is already in operation.

North of CC-215, HOV demand along US 95 is substantially reduced, and congestion is not forecast. Consistent with this forecast, the US 95 Northwest Corridor Improvements Project for the extension of HOV lanes along US 95 terminates the HOV lanes north of Elkhorn Road. The planned direct-access local drop ramps at Elkhorn Road also make this a logical terminus for the HOV lanes.

4.2.3. I-515

The I-515 corridor between I-15 and Charleston Boulevard is characterized by high forecast HOV demand and moderate presence of congestion. High levels of congestion are concentrated along I-515 between I-15 and the downtown Las Vegas interchanges. The results of the evaluation indicate a moderate to high ranking overall for the desirability of HOV lanes in this segment. This corridor is a key link between I-15, US 95, and downtown Las Vegas. The provision of HOV lanes in this segment would provide a logical connection between the higher-ranked facilities described previously and the employment and transit service center of downtown Las Vegas. However, physical limitations exist to providing HOV lanes along this corridor. Implementation of HOV lanes is to be prioritized over the addition of general-purpose lanes. The reconstruction of I-515 would raise the desirability of HOV lanes.

Between I-215 and Charleston Boulevard, forecast HOV demand along I-515 is moderate to high, with the presence of congestion, bottlenecks, and travel time savings potential also being moderate to high. Overall, this segment achieves a moderate rank. Continuity with the segment

in the north (to I-15), and connectivity to I-215 in the south make this segment of I-515 suitable for HOV lanes.

South of I-215, presence of congestion, bottlenecks, and HOV demand are low on I-515 and HOV lanes are not warranted by year 2035.

4.2.4. I-215/CC-215

The I-215 corridor between I-15 and the Airport Connector represents the next most critical link (after I-15 and US 95), with a high presence of congestion, bottlenecks, HOV demand, and travel time savings potential. The highest HOV demand and congestion along I-215 is expected in the vicinity of the McCarran International Airport, with year 2035 HOV demand sufficient to warrant two HOV lanes (in each direction) at this location. The high HOV demand in the vicinity of McCarran International Airport also suggests that direct-access local drop ramps between the HOV lanes on I-215 and the Airport Connector would be beneficial. Combined with the direct-access flyover ramps between I-215 and I-15 and the direct-access local drop ramps along I-15 to the arterial streets near the Las Vegas Strip, HOV users could realize significant time savings. Typical HOV users for these facilities include transit service providers and private taxi and shuttle service providers traveling between the airport and the employment and entertainment destinations along the Las Vegas Strip.

Along I-215 between the Airport Connector and I-515, the forecast HOV demand, presence of congestion, and bottlenecks are moderate to high. Overall, this segment achieves a moderate desirability. Continuity with the previously described segment to the west and connectivity to I-515 make this segment of I-215 suitable for HOV lanes.

The segment of CC-215 (Southern and Western Beltway) from I-15 to Summerlin Parkway is characterized by moderate to high levels of congestion and HOV demand. The Southern Beltway segments of CC-215 (particularly near the I-15/I-215/CC-215 interchange) are forecast to have high levels of congestion, bottlenecks, and HOV demand. This corridor ranks moderately for HOV desirability.

The remaining segments of CC-215 (north from Summerlin Parkway to US 95 and from US 95 to I-15) rank low compared to the other corridors analyzed. The low presence of congestion and few bottlenecks minimize the potential for time savings to attract HOV use of a dedicated lane, thereby minimizing the need for HOV lanes along these corridors.

4.2.5. Summerlin Parkway

Comparatively low levels of congestion and few bottlenecks along Summerlin Parkway minimize the potential effectiveness of HOV lanes. The HOV demand is particularly low west of Rampart

Boulevard and does not meet the vehicle volume operating thresholds shown in Table 2-2 for HOV lanes. The resulting travel time savings due to the implementation of HOV lanes are also expected to be minimal. Summerlin Parkway between US 95 and Rampart Boulevard achieves a moderate rank for HOV desirability because of the ability to provide connectivity to the HOV lanes on US 95 and the ability to bypass bottlenecks near the US 95/Summerlin Parkway interchange; however, this segment should represent a lower priority for implementation compared to other recommended HOV segments. Summerlin Parkway between Rampart Boulevard and CC-215 achieves low HOV desirability.

4.3. Priority Area Recommendations for HOV Lanes

The *Priority Area* includes I-15 from St. Rose Parkway to US 95/I-515 and US 95/I-515 from Rancho Drive to Charleston Boulevard (Figure 3-3). *Priority Area* includes Project Neon and the I-15 "Gap" (here defined as the stretch of I-15 from I-215 to Sahara Avenue). Appendix D is the technical memorandum that documents the recommendations and implementation plan for HOV improvements within Project Neon limits and how these improvements would tie into the US 95 HOV lanes and to the I-15 express lanes. Details of the analysis and recommendations, including evaluation of general-purpose lanes, are included in the technical memorandum. Below is a summary of recommendations for the *Priority Area*.

For the Near-Term System, one HOV lane in each direction is recommended through Project Neon limits. It is proposed that one of the I-15 express lanes in each direction from Sahara Avenue to Silverado Ranch Boulevard be converted to an HOV lane at the time of Project Neon Opening. This would result in a four general-purpose plus one HOV (4GP+1HOV) configuration along the "Gap." The Project Neon HOV Flyover at the Spaghetti Bowl is proposed as one lane in each direction for the near term to connect to the one HOV lane (in each direction) along US 95. HOV lanes are not recommended on I-515 for the Near-Term System.

For the Long-Term System within the *Priority Area*, two HOV lanes in each direction are recommended through the Project Neon limits. The Spaghetti Bowl HOV flyover is proposed as two lanes in each direction as well. Along I-15, two HOV lanes are recommended from I-215 to the Project Neon HOV Flyover. This would require addition of a second HOV lane within the "Gap" (4GP+2HOV). One HOV lane in each direction is recommended to be added south of Silverado Ranch Boulevard to St. Rose Parkway. Additionally, within the *Priority Area*, one HOV lane in each direction is recommended along I-515 from I-15 to Charleston Boulevard.

Table 4-3 presents a summary and timeline of the proposed HOV improvements for the *Priority Area*. Direct-access ramps are addressed in Section 4.5.

Table 4-3: Phasing Plan and Timeline of HOV Recommendations for the Priority Area

Implementation Year	HOV Improvement
Neon Opening (2018)	❖ Project Neon HOV Flyover - one lane in each direction ❖ Project Neon HOV Gateway - one-lane ramps ❖ Convert one of the I-15 express lanes in each direction to HOV lanes from Silverado Ranch Boulevard to Sahara Avenue; the second express lane within the "Gap" becomes a general-purpose lane ❖ Provide one HOV lane in each direction within Project Neon
Implementation Year	HOV Improvement
2025	❖ Add a second HOV lane in each direction on I-15 between I-215 and Sahara Avenue (4GP+2HOV) ❖ Add an HOV lane in each direction on I-15 from Silverado Ranch Boulevard to St. Rose Parkway ❖ Extend the second HOV lane on I-15 to the Project Neon HOV Flyover
2030[1]	❖ Improve the HOV flyover to accommodate two lanes in each direction. Alternately, this could be done with the improvements listed for year 2025
2035[2]	❖ Extend I-515/US 95 HOV lanes from the Project Neon HOV Flyover to Charleston Boulevard – one lane in each direction

[1] By year 2035, the HOV flyover requires two lanes in each direction; while one lane in each direction is adequate in year 2025. The year 2025 and year 2035 demand forecasts were interpolated to estimate the year in which the demand would exceed the one-lane threshold, i.e., the year in which the facility would need to be improved to two lanes in each direction. The result was year 2030.

[2] Alternatively, this could be implemented concurrently with any improvements on this section of US 95/I-515 (currently programmed for year 2031).

4.4. Valley-Wide Recommendations for HOV Lanes (Outside the Priority Area)

Outside the *Priority Area*, the following are the recommended HOV improvements for the Near-Term System.

- Along US 95, extend the HOV lanes (one lane in each direction) from Ann Road to north of Elkhorn Road.[7]
- Implement the Elkhorn Road direct-access local drop ramps (ramps to/from the south) along US 95.[8]

Other freeways that are outside the Priority Area are not warranted for new HOV implementation in the near-term. Additionally, NDOT does not have resources to implement HOV lanes outside the Priority Area in the near-term. HOV lanes on other freeways in the region that are outside the *Priority Area* are recommended for long-term implementation. Based on the HOV System Evaluation, the following HOV lane improvements are recommended:

- Extend the HOV lanes (one lane in each direction) on I-15 from the Project Neon HOV Flyover to Lake Mead Boulevard.
- Extend the HOV lanes (one lane in each direction) on I-515 from Charleston Boulevard to I-215.
- Add a second HOV lane in each direction on US 95 from the Project Neon HOV Flyover to Summerlin Parkway.
- Implement HOV lanes on I-215 from I-15 to I-515 (one lane in each direction except for the segment between I-15 and the Airport Connector, which warrants two lanes in each direction).
- Implement HOV lanes (one lane in each direction) on CC-215 (Southern and Western Beltway) from I-15 to Summerlin Parkway.
- Extend the HOV lanes (one lane in each direction) on Summerlin Parkway to Rampart Boulevard.

The proposed phasing plan of HOV lanes, showing the order of implementation of HOV lanes outside the *Priority Area,* is shown in Table 4-4. After the near-term implementation of the HOV

[7] This improvement is programmed for completion by year 2020 as part of the US 95 Northwest Corridor Improvements Project.

[8] The City of Las Vegas intends to lead the effort to provide the Elkhorn Road direct-access local drop ramps on US 95 within the year 2025 time frame.

lanes, the valley-wide improvements are recommended to be completed per the following phasing plan.

Table 4-4: Phasing Plan of HOV Lanes (Outside the Priority Area for the Long Term)

Order of Implementation[1]	HOV Improvement
1	Add a second HOV lane in each direction on US 95 from the Project Neon HOV Flyover to Summerlin Parkway
2	Implement HOV lanes on I-215 from I-15 to the Airport Connector (two lanes in each direction)
3	Implement HOV lanes on CC-215 (Southern and Western Beltway) from I-15 to Summerlin Parkway
4	Extend the HOV lanes on I-515 from Charleston Boulevard to I-215
5	Extend the HOV lanes on I-15 from the Project Neon HOV Flyover to Lake Mead Boulevard
6	Implement HOV lanes on I-215 from the Airport Connector to I-515
7	Extend the HOV lanes on Summerlin Parkway to Rampart Boulevard
[1] Lower number to be implemented first.	

In general, HOV lanes are recommended to be added to the freeways in the Valley prior to the addition of any general-purpose lanes. Therefore, implementation of HOV lanes can be opportunistic and need not necessarily follow the order of implementation shown in Table 4-4.

4.5. Evaluation and Recommendations for Direct-Access Ramps

Along the HOV system, locations of high HOV volume ingress/egress were evaluated for direct-access consideration. Direct-access ramps reduce weaving by HOVs across the general-purpose lanes from/to the median HOV lane to/from the right side exit and entrance ramps. Additionally, HOV direct-access ramps linking freeway HOV lanes and arterial roadways can provide time savings to HOV users. The Original Plan studied the desirability of direct-access ramps along I-15 within the Resort Corridor. This Plan Update builds upon the findings of the Original Plan and evaluates additional direct-access ramps along I-15 and the other freeways in the region.

Table 4-5 shows the evaluation criteria thresholds for the implementation of direct-access ramps. The desirability of each direct-access ramp was identified by evaluating against these thresholds. Table 4-6 summarizes the findings of this evaluation. These findings and the proposed recommendations are described in the following sections.

As discussed earlier, the Project Neon HOV Flyover and HOV Gateway were assumed to be in place in the evaluation of other direct-access ramps. Additionally, the proposed direct-access local drop ramps at Elkhorn Road on US 95 were assumed to be in place by year 2025. All other proposed direct-access ramps are to be implemented beyond year 2025 (i.e., Long-Term System). Their need in the year 2018 – year 2025 timeframe (Near-Term System) was not justified.

Table 4-5: Criteria Thresholds for the Evaluation of Direct-Access Ramps

High ← Moderate → Low

Criteria	Desirability				
Bottlenecks	Qualitative assessment				
Direct-access ramp Demand	1,000 vph < Demand	750 vph < Demand < 1,000 vph	500 vph < Demand < 750 vph	250 vph < Demand < 500 vph	Demand < 250 vph
Transit Service	Qualitative assessment				
Available Space	ROW acquisition has already cleared the National Environmental Policy Act (NEPA) procedures	Sufficient ROW generally available without substantial impacts	ROW proposed to be acquired for other freeway improvements (not including HOV)	Sufficient ROW generally not available without substantial impacts	
Connectivity/ Continuity	Qualitative assessment				

Table 4-6: Evaluation of Direct-Access Ramps – Findings

Corridor	Direct-Access Ramp Location	Bottlenecks	Direct-Access Ramp Demand	Transit Service	Available Space	Connectivity / Continuity	Corridor Summary (Average)	Corridor Rank
I-15	St. Rose Parkway							
I-15	Blue Diamond Road							
I-15	Warm Springs Road							
I-15	Sunset Road and Hacienda Avenue							
I-15	Hacienda Avenue and Harmon Avenue							
I-15	Meade Avenue							
I-515	Maryland Parkway							
US 95	Smoke Ranch Road							

Table 4-6 (Continued): Evaluation of Direct-Access Ramps – Findings

Corridor	Direct-Access Ramp Location	Bottlenecks	Direct-Access Ramp Demand	Transit Service	Available Space	Connectivity / Continuity	Corridor Summary (Average)	Corridor Rank
US 95	Peak Drive	◑	◕	◕	○	◕	◑	◔
I-215	Airport Connector	◕	●	●	◑	●	◕	◕
CC-215	Sunset Road	◑	◑	◑	●	◑	◑	◑
Summerlin Parkway	Rampart Boulevard	◑	◕	◕	◔	◑	◑	◔
I-15/I-215	Direct-access flyover ramps to the west	●	●	◔	◑	●	◕	◕
I-15/I-215	Direct-access flyover ramps to the east	●	●	◔	◑	●	◕	◕
I-15/CC-215 (Northern Beltway)	Direct-access flyover ramps	○	○	◔	●	○	◔	○

Feedback, and recommendations offered by the stakeholder agencies, including the resort community, local government agencies, and boards and councils were incorporated in the evaluation process. Comments related to the proposed locations of the HOV direct-access ramps, their configurations, and potential new locations prompted further review and reevaluation. The findings from the evaluation of direct-access ramp locations and the recommendations are summarized in the following sections.

4.5.1. Direct-Access Ramps along I-15

The HOV demand is high along I-15, particularly in the Resort Corridor. Direct-access ramps along I-15 would benefit the Valley's residents by offering travel time savings in their daily commutes to the major employment centers along the Resort Corridor. These direct-access ramps would also benefit the visitors by offering easy and convenient access to the major tourist destinations along the Resort Corridor, including the Global Business District. The following is a discussion of the evaluation of direct-access ramps considered along I-15.

Near St. Rose Parkway (ramps to/from the north):

Direct-access local drop ramps were evaluated to provide direct access from the proposed Bruner park-and-ride lot (planned to be located at the north-east quadrant of the I-15/St. Rose Parkway interchange). Located near the southern end of the I-15 HOV system, ramps were considered only to/from the north. HOV demand on the ramps is comparatively low, and minimal congestion and bottlenecks are expected on I-15 in the vicinity. Therefore, direct-access local drop ramps are not recommended at this location. In the absence of these direct-access local drop ramps, access from the park-and-ride lot to the HOV system is available for the vehicles through the I-15/St. Rose Parkway interchange.

Blue Diamond Road (ramps to/from the north - from/to the west):

At Blue Diamond Road, the direct-access local drop ramps were evaluated between Blue Diamond Road to/from the west and I-15 to/from the north. These ramps would serve the anticipated future residential developments in the southwest portion of the Valley. HOV demand is moderate on the ramps, but bottlenecks are expected on I-15 between Blue Diamond Road and I-215.The I-15 South Design-Build Project was designed to be forward-compatible to allow for this proposed direct access. Beginning/ending the HOV lane west of the Valley View Boulevard intersection along Blue Diamond Road is recommended to allow the HOVs to bypass this congested intersection.

Warm Springs Road (ramps to/from the north):

At Warm Springs Road, the direct-access local drop ramps were evaluated to/from the north. This location could be an alternative to the direct-access local drop ramps at Blue Diamond

Road, and therefore not recommended. HOV demand on these ramps is comparatively low if HOV direct access is also available at Blue Diamond Road. The vicinity to the I-15/I-215 interchange could pose some geometric challenges for HOV direct access at this location.

Sunset Road (ramps to/from the north) and Hacienda Avenue (ramps to/from the south):

Sunset Road, with ramps to/from the north, and Hacienda Avenue, with ramps to/from the south, form a couplet that was evaluated as an alternative to the Hacienda Avenue/Harmon Avenue couplet. HOV demand is high but lower than the Hacienda Avenue/Harmon Avenue alternative. The vicinity to the I-15/I-215 interchange could pose some geometric challenges for HOV direct access at Sunset Road.

Hacienda Avenue (ramps to/from the south) and Harmon Avenue (ramps to/from the north):

The HOV demand along I-15 is particularly high in the vicinity of Tropicana Avenue where significant Resort Corridor activity occurs. Consequently, these direct-access local drop ramps have the highest demand of all the locations evaluated. In this area, providing two different locations for HOV direct-access to I-15, one for traffic using I-15 to/from the south and one for traffic using I-15 to/from the north, would better serve the traffic by dispersing demand more evenly over the arterial system. Furthermore, the I-15 right-of-way at Tropicana Avenue is restricted such that median direct-access local drop ramps towards the Tropicana Avenue bridge might not be feasible. Due to these reasons, separate direct-access local drop ramps were evaluated at Harmon and Hacienda Avenue (at Harmon to/from the north and at Hacienda to/from the south). High HOV demand, presence of congestion/bottlenecks, and transit service potential, make this a highly desirable location for direct-access local drop ramps along I-15.

Meade Avenue (ramps to/from both directions):

The Meade Avenue direct-access local drop ramps were first developed and recommended as part of NDOT's I-15 Resort Corridor Study. This location provides enhanced access to the north end of the Resort Corridor where demand for ramps in both directions of I-15 is moderately high. Severe congestion and bottlenecks are expected on I-15 near these Meade Avenue ramps. Furthermore, this location provides the potential to connect to the Global Business District, which is a future high HOV trip attractor/generator. Overall, this location ranks moderate to high for HOV direct-access desirability.

North 5th Street (ramps to/from the south):

The North 5th Street direct-access local drop ramps to/from the south were evaluated to be the northern terminus of the HOV lanes along I-15. Located at the northern end of the I-15 HOV system, ramps were considered only to/from the south. The proximity of the Carey Avenue

bridge over I-15 to the North 5th Street bridge over I-15 makes the implementation of the direct-access local drop ramps at North 5th Street geometrically challenging. Direct-access local drop ramps at Carey Avenue and I-15 would be a potential alternative to the direct-access local drop ramps at North 5th Street. But, this would introduce a new intersection (intersection of the drop ramps and Carey Avenue) very close to the North 5th Street and Carey Avenue intersection. On the other hand, the I-15/Lake Mead interchange offers easy access between I-15 and North 5th Street. In light of these considerations, the evaluation of this location was not taken further; but this location is recommended to be reevaluated in future updates of the HOV Plan.

I-15/I-215 Interchange Direct-Access Flyover Ramps (ramps to/from the north - from/to the east and ramps to/from the north - from/to the west):

Between Sahara Avenue and St. Rose Parkway, one freeway-to-freeway system interchange is located at I-215. This system interchange was evaluated for direct-access flyover ramps. The Original Plan proposed direct-access flyover ramps for movements between I-15 to/from the north and I-215 to/from the east. Together with the direct-access local drop ramps at I-215 and the Airport Connector, these flyover ramps form a critical link for facilitating travel between the airport and the tourist destinations along the Las Vegas Strip. In addition to the ramps to the east, this Plan Update evaluated flyover ramps to the west. Sufficient HOV demand is expected for the ramps to the east as well as the west, and high levels of congestion and bottlenecks on both I-15 and I-215/CC-215 near the I-15/I-215 interchange make both of these ramps highly desirable.

I-15/CC-215 (Northern Beltway) Interchange Direct-Access Flyover Ramps (ramps to/from the south - from/to the west):

Direct-access flyover ramps were evaluated at this freeway-to-freeway system interchange along I-15. HOV demand is expected to be low; and for the year 2035 planning horizon year, these direct-access flyover ramps do not meet the vehicle volume operating thresholds shown in Table 2-2. Minimal congestion and bottlenecks are expected in the vicinity by the year 2035 time frame. Overall, these direct-access flyover ramps rank low for implementation desirability; however, future (beyond year 2035) compatibility with direct-access flyover ramps should be maintained at this interchange.

In summary, the following direct-access ramps along I-15 are recommended for the Long-Term System:

- Blue Diamond Road (ramps to/from the north - from/to the west)
- Hacienda Avenue (ramps to/from the south)
- Harmon Avenue (ramps to/from the north)

- Meade Avenue (ramps to/from both directions)
- I-15/I-215 interchange direct-access flyover ramps (ramps to/from the north - from/to the east and ramps to/from the north - from/to the west)

Figure 4-1 illustrates the proposed direct-access ramp locations along I-15. Preliminary level design plans showing the footprint for proposed locations are provided in Appendix E.

Figure 4-1: Proposed Direct-Access Ramps along I-15

4.5.2. Direct-Access Ramps along Other Freeways

The following is a discussion on the evaluation of direct-access ramps along the freeways other than I-15.

Maryland Parkway on I-515 (ramps to/from both directions):

Maryland Parkway is an integral north-south corridor, which connects the McCarran International Airport in the south to downtown Las Vegas in the north. It also connects the University of Nevada, Las Vegas and a number of commercial and retail areas. Maryland Parkway is also a designated bus rapid transit (BRT) corridor due to its high potential for transit service. Congestion and bottlenecks are expected in this location's vicinity, and moderate HOV demand is expected on ramps in both directions. Additionally, the increased access to downtown offered by these ramps makes this location desirable for HOV direct-access along I-515/US 95.

Galleria Drive/Stephanie Street on I-515 (ramps to/from both directions):

Another potential location for direct-access local drop ramps along I-515 is in the vicinity of Galleria Drive/Stephanie Street. Existing residential land uses, commercial establishments, and proposed developments in this area are expected to result in low to moderate demand for the ramps in both directions. With the existing Galleria Drive interchange with I-515, implementation of direct-access local drop ramps at Galleria Drive might be geometrically infeasible. As an alternative, Stephanie Street was examined for the direct-access local drop ramps. The Russell Road and Galleria Drive interchanges with I-515 are closely spaced, with less than 2,000 feet of spacing available between the ramps of these interchanges. The Stephanie Street bridge over I-515 is located between the Russell Road and Galleria Drive interchanges. Three interchanges are located along I-515 within a 2-mile stretch of the freeway: at Russell Road, Galleria Drive, and Sunset Road. Furthermore, the Stephanie Street bridge is located within the influence area of the Russell Road interchange; and the introduction of the direct-access local drop ramps might result in operational issues. In light of these considerations, the evaluation of this location was not taken further; but this location is recommended to be reevaluated in future updates of the HOV Plan.

Peak Drive on US 95 (ramps to/from both directions):

Peak Drive is an east-west street in the northwest region of the Valley and currently does not cross over US 95. Direct-access local drop ramps were evaluated at this location because of the HOV demand potential. The presence of the Las Vegas Technology Center (a major traffic generator) and medical facilities in the vicinity is expected to generate a significant number of HOV trips. Congestion expected at the adjacent interchanges also makes this location desirable for the implementation of direct-access local drop ramps. Reflecting this, the travel demand

models show moderately high HOV demand on these ramps; but the presence of Las Vegas Valley Water District's (LVVWD) appurtenances along Peak Drive (to the east of US 95) makes the acquisition of right-of-way difficult and precludes the implementation of direct-access ramps at this location. The geometric constraints are further discussed in Section 5.2.

Smoke Ranch Road on US 95 (ramps to/from both directions):

Smoke Ranch Road is also an east-west street, located just south of Peak Drive; and it currently crosses over US 95. Direct-access local drop ramps at this location were evaluated as an alternative to Peak Drive. Consequently, this location serves all the developments proposed to be served by the direct-access local drop ramps at Peak Drive. Moderately high HOV demand and congestion/bottlenecks at the adjacent interchanges make this location desirable for the implementation of direct-access local drop ramps.

Airport Connector on I-215 (ramps to/from the north - from/to the west):

The direct-access local drop ramps at the Airport Connector onto I-215 (with ramps to/from the north - from/to the west) were evaluated in the Original Plan, and their desirability is reinforced by this Plan Update. Together with the direct-access flyover ramps at the I-15/I-215 interchange, these ramps offer critical connectivity and facilitate travel between the airport and the tourist destinations along the Las Vegas Strip. High HOV demand, and the presence of congestion/bottlenecks is expected in the vicinity, and high transit service potential make this location the most desirable for direct access on freeways other than I-15.

Sunset Road on CC-215 (ramps to/from both directions):

Moderate HOV demand is expected on the direct-access local drop ramps at Sunset Road onto CC-215. Congestion and bottlenecks are also expected to be moderate in the vicinity, and the potential for transit service using these ramps is moderate. Overall, these ramps achieve moderate desirability. HOV demand on the ramps at this location is lower than at other locations, and the implementation of these ramps is comparatively a low priority.

Rampart Boulevard on Summerlin Parkway (ramps to/from the east):

HOV demand along Summerlin Parkway reduces significantly west of Rampart Boulevard. Consequently, in the Long-Term System, HOV lanes along Summerlin Parkway are proposed to end immediately west of Rampart Boulevard. Direct-access local drop ramps at Rampart Boulevard were evaluated to match this terminus of the HOV system. Moderately high demand is expected on these ramps, with moderate congestion/bottlenecks expected in the vicinity. Without completely reconfiguring the existing interchange, however, it is not geometrically feasible to implement the direct-access local drop ramps at Rampart Boulevard. (See Section 5.2 for further details on the geometric constraints). Furthermore, the Summerlin

Parkway/Rampart Boulevard interchange is heavily congested; and potential operational issues could arise from adding local drop ramps in the median within this interchange.

I-515/I-215 Interchange Direct-Access Flyover Ramps (ramps to/from the north - from/to the west):

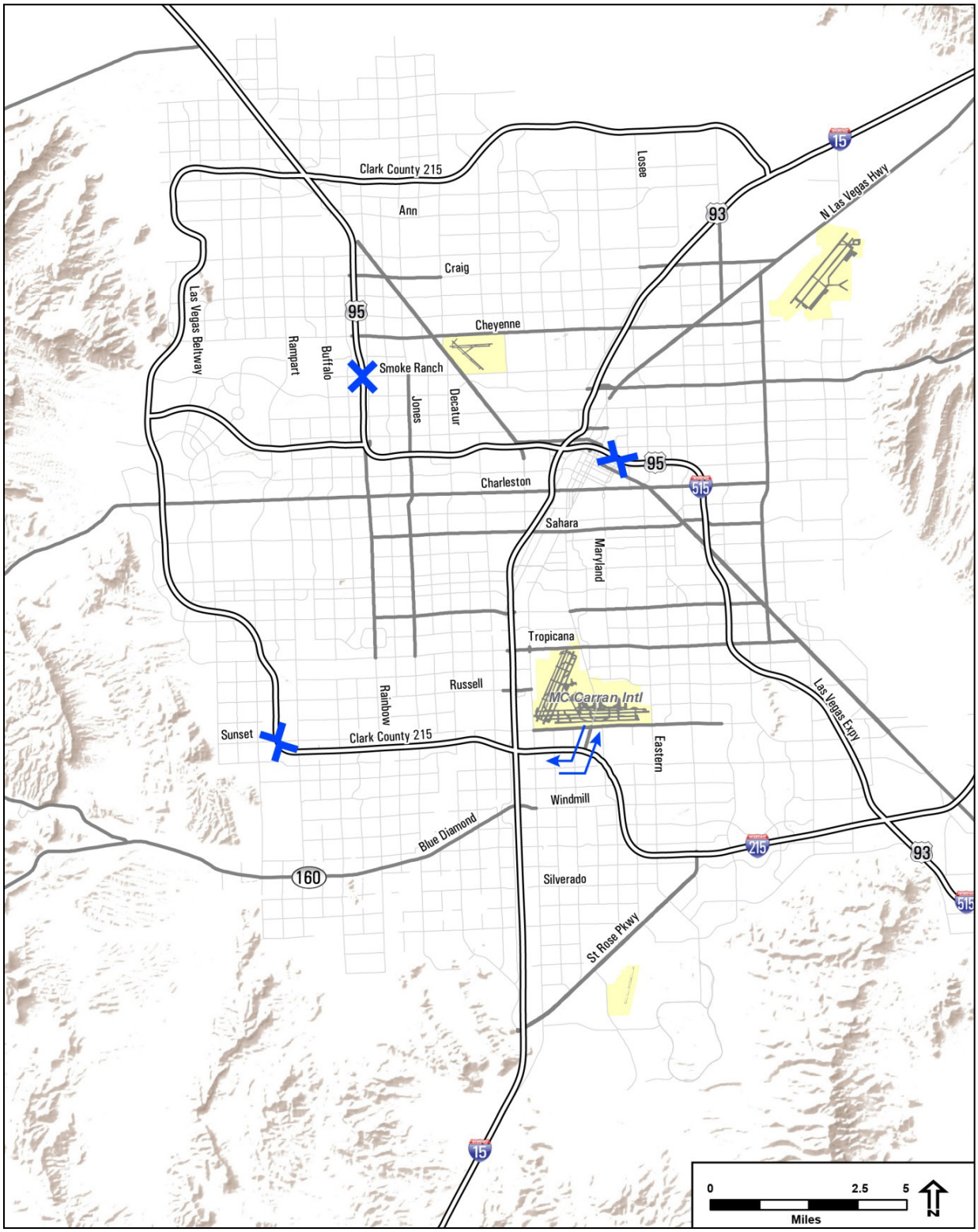
Direct-access flyover ramps (ramps to/from the north - from/to the west) at the I-515/I-215 interchange were evaluated, and moderately low HOV demand is expected on the ramps. The existing Gibson Road interchange with I-215 and the Auto Show Drive interchange with I-515 are located in close proximity to the I-515/I-215 interchange, and challenges exist in accommodating the direct-access flyover ramps within the interchange without any reconfiguration. Given this issue, the evaluation of these direct-access ramps was not taken further; however, this location is recommended to be reevaluated in future updates of the HOV Plan.

In summary, the following direct-access ramps along the freeways other than I-15 are recommended for the Long-Term System:

- Maryland Parkway on I-515 (ramps to/from both directions)
- Smoke Ranch Road on US 95 (ramps to/from both directions)
- Airport Connector on I-215 (ramps to/from the north - from/to the west)
- Sunset Road on CC-215 (ramps to/from both directions)

Figure 4-2 illustrates these proposed direct-access ramp locations. Conceptual plans for the direct-access local drop ramps at Maryland Parkway, Smoke Ranch Road, and Sunset Road are included in Appendix E.

Figure 4-2: Proposed Direct-Access Ramps along Other Freeways



For the Long-Term System, the direct-access ramps are recommended to be implemented per the phasing plan shown in Table 4-7.

Table 4-7: Phasing Plan of Direct-Access Ramp Recommendations

Order of Implementation[1]	Improvement	
	Along Freeway	Direct-Access Ramp Location
1	I-15	Hacienda Avenue and Harmon Avenue
2	I-15	I-15/I-215 interchange direct-access flyover ramps to the east
3	I-215	Airport Connector
4	I-15	I-15/I-215 interchange direct-access flyover ramps to the west
5	I-15	Meade Avenue
6	I-515	Maryland Parkway
7	I-15	Blue Diamond Road
8	US 95	Smoke Ranch Road
9	CC-215	Sunset Road

[1] Lower number to be implemented first.

Similar to the other long-term elements of the HOV Plan, these direct-access ramps may be designed and constructed opportunistically (need not necessarily follow the order of implementation shown in Table 4-7) when other projects at/near these locations are programmed and developed.

4.6. Summary of Proposed Near-Term HOV System Recommendations

Based on the information provided in the previous sections, Figure 4-3 illustrates the proposed Near-Term System (HOV lanes and direct-access ramps).

The Near-Term System consists of the following HOV lanes, all of which are one lane in each direction:

- I-15 from Silverado Ranch Boulevard to US 95/I-515
- US 95 from I-15 to north of Elkhorn Road
- Summerlin Parkway from Buffalo Drive to US 95

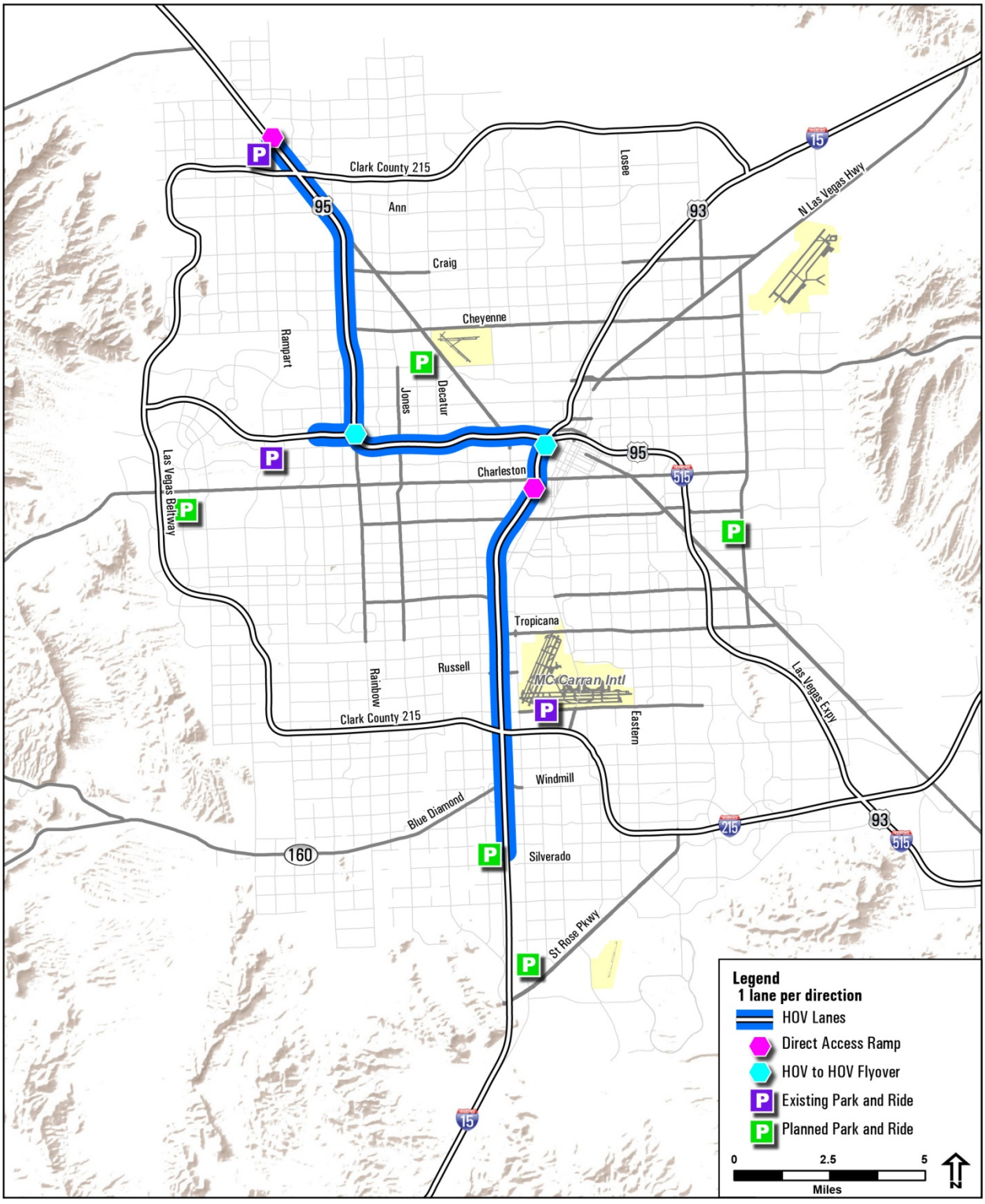
It should be noted that the HOV lanes on Summerlin Parkway from US 95 to Buffalo Drive and on US 95 from Rancho Drive to Ann Road exist today. The extension of US 95 HOV lanes to north of Elkhorn Road is programmed as part of the US 95 Northwest Corridor Improvements Project.

The Near-Term System consists of the following direct-access ramps:

- Project Neon HOV Gateway
- Project Neon HOV Flyover
- US 95/Summerlin Parkway HOV Flyover
- Elkhorn Road direct-access local drop ramps (ramps to/from the south) on US 95

The US 95/Summerlin Parkway HOV Flyover exists today. Project Neon HOV Flyover and HOV Gateway are programmed as part of Project Neon's first phase. The City of Las Vegas intends to lead the effort to provide the Elkhorn Road direct-access local drop ramps on US 95.

Figure 4-3: Proposed Near-Term HOV System



4.7. Summary of Proposed Long-Term HOV System Recommendations

Based on the information provided in the previous sections, Figure 4-4 illustrates the proposed Long-Term System (HOV lanes and direct-access ramps).

As shown in Figure 4-4, the Long-Term System consists of the following HOV lanes:

- I-15 from St. Rose Parkway to I-215 with one HOV lane in each direction
- I-15 from I-215 to US 95 with two HOV lanes in each direction
- I-15 from US 95 to Lake Mead Boulevard with one HOV lane in each direction
- I-515 from I-215 to I-15 with one HOV lane in each direction
- US 95 from I-15 to Summerlin Parkway with two HOV lanes in each direction
- US 95 from Summerlin Parkway to north of Elkhorn Road with one HOV lane in each direction
- I-215 from I-15 to I-515 with one HOV lane in each direction except for the segment between I-15 and the Airport Connector, which has two HOV lanes in each direction
- CC-215 (Southern and Western Beltway) from I-15 to Summerlin Parkway with one HOV lane in each direction
- Summerlin Parkway from Rampart Boulevard to US 95 with one HOV lane in each direction

The actual terminus of the HOV lanes along each freeway is to be determined based on a weaving analysis using operational analysis tools and adhering to the guidance presented in the *NDOT Managed Lanes and Ramp Metering Manual*.

The Long-Term System consists of the following direct-access ramps in addition to the ones proposed for the Near-Term System.

Direct-Access Local Drop Ramps:

- Blue Diamond Road on I-15 (ramps to/from the north - from/to the west)
- Hacienda Avenue on I-15 (ramps to/from the south)
- Harmon Avenue on I-15 (ramps to/from the north)
- Meade Avenue on I-15 (ramps to/from both directions)
- Maryland Parkway on I-515 (ramps to/from both directions)
- Smoke Ranch Road on US 95 (ramps to/from both directions)
- Airport Connector on I-215 (ramps to/from the north - from/to the west)

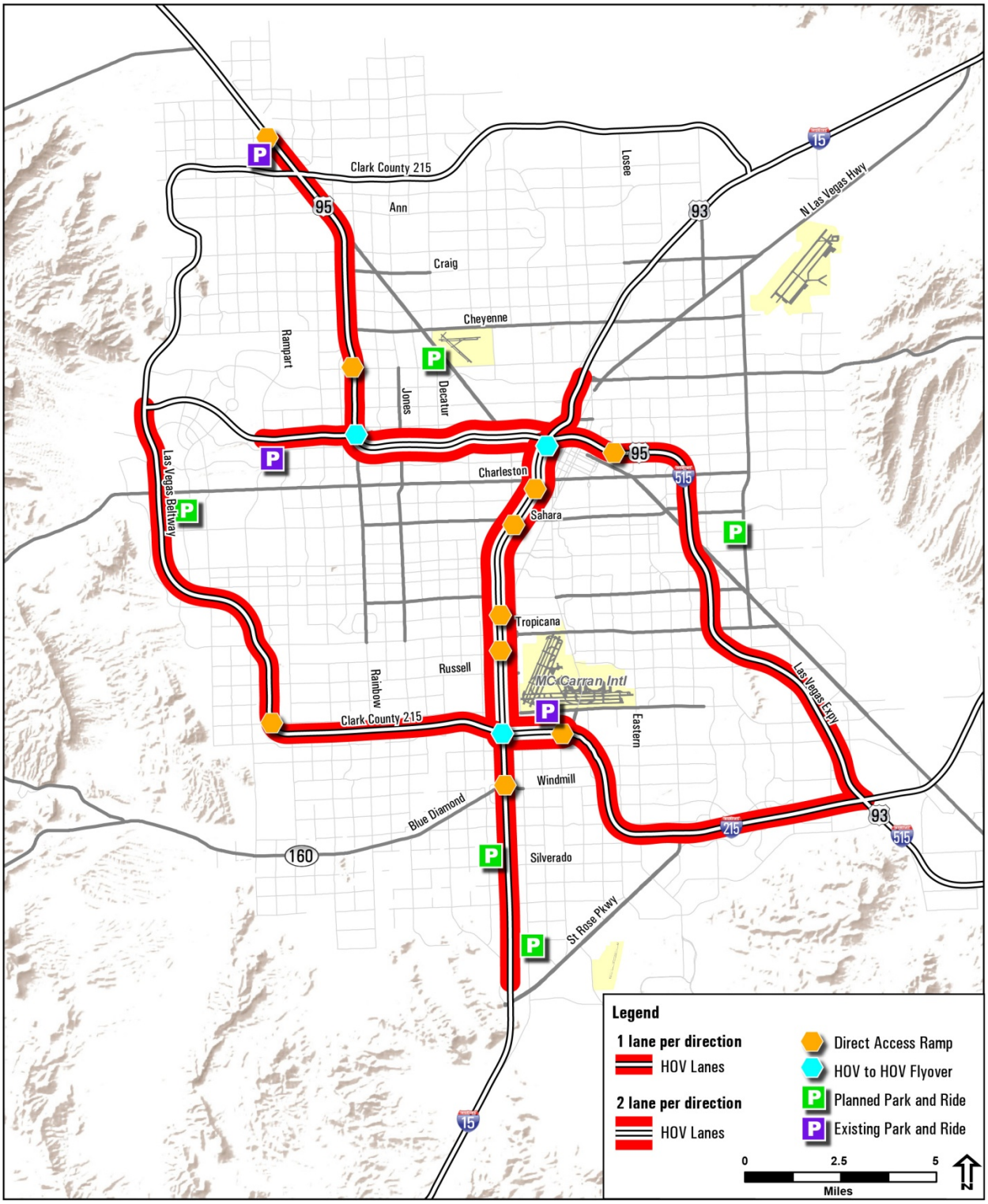
- Sunset Road on CC-215 (ramps to/from both directions)

Direct-Access Flyover Ramps:

- I-15/I-215 interchange direct-access flyover ramps (ramps to/from the north - from/to the east and ramps to/from the north - from/to the west)

Note that the Long-Term System is not the ultimate HOV system for the Las Vegas Valley; future studies and updates to the HOV plan focused on a planning horizon year beyond year 2035 would reevaluate the freeway corridors for additional/alternate HOV lane implementation and direct-access ramp locations. The direct-access ramp locations and corridors where HOV lanes are not proposed in this Plan Update, might warrant HOV treatments by this longer-term horizon year (beyond year 2035). All future freeway improvement projects in the Valley (even along corridors where HOV facilities are not proposed in this Plan Update) must provide forward compatibility such that HOV lanes are not precluded beyond year 2035.

Figure 4-4: Proposed Long-Term HOV System



5. CONCEPTUAL DESIGN OF DIRECT-ACCESS RAMPS

The physical geometric feasibility of the direct-access ramps was evaluated through conceptual (15-percent to 30-percent level) design evaluation. The potential direct-access ramp locations identified in the system evaluation in Section 4.5 were analyzed for geometric feasibility, and the findings from these feasibility checks were, in turn, used in the evaluation process to develop the recommended list of direct-access ramps.

The existing topography, aerial photography, and the as-built design files from the I-15 South Design-Build project were used to determine the existing roadway and other physical configurations for I-15. Along US 95, Summerlin Parkway, and CC-215, existing topography was approximated using aerial photography. Existing I-15 and US 95 rights-of-way were established using information provided by NDOT Project Management and were verified against information provided by NDOT Location Control Division, previous project files, and the aerial topography.

5.1. Geometric Design Criteria

The preliminary horizontal and vertical geometric design was performed to conform with the 2011 American Association of State Highway and Transportation Officials' (AASHTO) Green Book and the 2010 NDOT Roadway Design Guide. The 2011 AASHTO Roadside Design Guide was used to determine clear zone widths and barrier needs. Exceptions to these criteria that were necessary to accommodate the proposed improvements are listed in Section 5.3.

The geometric design was approached with the assumption that the improvements required for the HOV direct-access ramps would not attempt to reconstruct areas of I-15 or US 95 that were identified as substandard or over capacity. Modifications to I-15, US 95, and other adjacent or connecting roadways were limited to those improvements necessary to enable the placement of the direct-access ramps only, assuming other projects would be required to improve surrounding substandard conditions. The preliminary geometry was designed with the intent that the proposed improvements would not cause I-15, US 95, and adjacent or connecting roadways to become substandard due to their implementation.

Generally, it was assumed that ramp design speeds could be reduced from freeway speeds to a minimum of 35 mph for the direct-access ramps (both the direct-access local drop ramps and the direct-access flyover ramps), similar to the speeds of interchange loop ramps. Horizontal geometry was established using the AASHTO and NDOT criteria for 35 mph. It was also assumed that vertical grades for the direct-access ramps could exceed the NDOT maximum of 6 percent for interchange ramps due to the absence of heavy trucks in the HOV lanes. A maximum vertical grade of 8 percent was set as the limiting criteria for these ramp grades.

5.2. Feasibility Evaluation

Initial geometrics were developed and iterated multiple times to ensure that the desired improvements could be implemented within existing right-of-way. Evaluation of the proposed geometrics considered the existing roadway and existing structures, including bridges, retaining walls, signs, lights, and drainage structures. Considerations were made for physical impacts of the direct-access ramps on adjacent property, proximity and functional operations of adjacent intersections and signals, logical termini of HOV system, and future planning work such as the replacement of the Tropicana Avenue, Harmon Avenue, and Hacienda Avenue bridges. Future planning concepts were not assumed to be complete during the evaluation, and pinch points were noted as constraints. The resulting layouts of the evaluated locations are presented in Appendix E. The following is a discussion of the feasibility checks completed and the resulting findings for the direct-access ramp locations.

Blue Diamond Road and I-15:

The I-15 South Design-Build project was designed to be forward compatible with the HOV system, with room in the median of Blue Diamond Road to allow for direct-access local drop ramps. The most significant challenge in accommodating the direct-access local drop ramps from the I-15 HOV lanes onto Blue Diamond Road is the proximity of the Dean Martin Drive intersection to the location where the direct-access local drop ramps would terminate east of the intersection and the potential traffic weaving issues within this section.

To eliminate the weave between the terminus of the direct-access local drop ramps on Blue Diamond Road and Dean Martin Drive, the direct-access local drop ramps should extend west beyond Dean Martin Drive. If the HOV ramps are extended west of the intersection, they would also need to clear Valley View Boulevard 700 feet west of Dean Martin Drive; and clearances to the existing signals at Dean Martin Drive and Valley View Boulevard and other overhead utilities need to be evaluated. NV Energy has a large overhead distribution line crossing Blue Diamond Road west of Valley View Boulevard that may require relocation if the ramps extend west. This extension to the west will also allow HOVs to bypass the congested bottleneck intersections of Blue Diamond Road at both Dean Martin Drive and Valley View Boulevard, significantly improving travel time and travel time reliability.

The preliminary layout shown in Appendix E shows the direct-access local drop ramps and their landing point east of the Blue Diamond Road/Dean Martin Drive intersection, and also shows the space available for weaving. When these direct-access local drop ramps are designed, however, it is recommended that their terminus be west of Valley View Boulevard.

I-15/I-215 Interchange Direct-Access Flyover Ramps:

Direct-access flyover ramps (ramps to/from the north - from/to the east and ramps to/from the north - from/to the west) at the I-15/I-215 interchange were evaluated. The connection to the east was supported in the Original Plan, was not precluded by the I-15 South Design-Build project, and was confirmed to be geometrically feasible. The connection to the west is challenging geometrically, and the preliminary configuration proposed (Appendix E), while geometrically feasible, may not be the best option. A more desirable connection will likely require the reconfiguration of the interchange. Reconfiguration of the interchange to better accommodate this connection was not evaluated. It is also noted that the wall constructed to accommodate lowering of the I-15 Collector-Distributor (C-D) ramp profile adjacent to the Town Square development causes a constraint. This location (where the wall exists) is the logical terminus of the HOV direct-access flyover ramps. As it exists today, this wall creates a horizontal “pinch point” that may require shifting I-15 to the west during final design to accommodate minimum shoulder widths.

A review of Federal Aviation Administration (FAA) regulations was performed using the preliminary vertical geometry to determine whether the profiles constituted an obstruction to McCarran Airport’s flight path envelopes. The direct-access flyover ramps, both to the east and west, will require permit from FAA and should be evaluated further during final design of the ramps and/or reconfiguration of the I-15/I-215 interchange. The preliminary vertical geometry review indicated that the proposed direct-access flyover ramps can be accommodated with the required FAA permit.

Hacienda Avenue/Harmon Avenue and I-15:

Geometrically, the addition of direct-access local drop ramps in the center of the existing I-15 alignment causes the entirety of the northbound and southbound lanes to shift at both proposed direct-access local drop ramp locations. Several layouts were prepared to determine whether the ramps could feasibly fit within the existing right-of-way along with the rest of I-15’s lanes and C-D roads. The first checks were performed assuming no shift of the I-15 centerline alignment. In this configuration, one HOV lane (in each direction) between Hacienda Avenue and Harmon Avenue can be constructed without impacting the right-of-way. If the centerline of I-15 is shifted to equally space the proposed direct-access local drop ramps and mainline lanes, two HOV lanes (in each direction) fit at Harmon Avenue; however, at Hacienda Avenue, the proximity of Frank Sinatra Drive to NDOT’s right-of-way does not allow two HOV lanes around the drop ramp structure. Modifications to Frank Sinatra Drive and the Hacienda Avenue bridge structure were not evaluated. The preliminary design should be further developed to determine whether Frank Sinatra Drive can be modified and continue to operate acceptably in the future. A reconstruction of the Hacienda Avenue bridge structure may also be required to allow two HOV

lanes around the drop ramp structure and is to be considered as part of the design development to accommodate two HOV lanes.

Meade Avenue and I-15:

It is anticipated that a future I-15 widening will add lanes to I-15. This widening, coupled with the width of the direct-access local drop ramps at Meade Avenue, will require additional right-of-way through the lane tapers to accommodate a median access location. If constructed with the existing number of lanes on I-15, the drop ramp structure and all I-15 lanes fit within the existing right-of-way. Connecting the direct-access local drop ramps to Meade Avenue on the west was laid out as part of the geometric design; however, the east side connection was not laid out. The connections to the east, including connections to Industrial Road, Echelon Resort Drive, and potentially to Desert Inn Road (alternatives developed in NDOT's Resort Corridor Study) are to be considered by the City, County, and partners. The connections are desirable and are of value, but the actual alignment has not been studied yet. Therefore, the connection to the east is shown as "future by others" for purposes of this Plan Update.

Maryland Parkway and US 95/I-515:

The direct-access local drop ramps require the widening of US 95/I-515. The widening of this stretch of US 95 to accommodate HOV lanes will also require replacing the US 95 viaduct. This replacement is currently programmed in the RTP. Geometric design was performed assuming that a future project will widen US 95.

Peak Drive and US 95:

Geometrically, HOV direct-access connection at the Peak Drive location is possible. During coordination with the City of Las Vegas and utility companies, it was determined that neither property to the east and the west of the proposed location is public right-of-way. The east and west parcels are currently owned by the LVVWD and a private owner, respectively. The LVVWD property is a well site that is LVVWD's most productive well in the Valley, and relinquishing this location may not be possible and would be contingent on the provision of an alternate well site with the same or greater productivity as this existing one. With the proximity of Smoke Ranch Road as another potential location, the Peak Drive connection was determined to be infeasible.

Smoke Ranch Road and US 95:

Horizontal and vertical geometries for Smoke Ranch lend well to it being a HOV direct-access local drop ramp location. Shifting of the US 95 lanes could be accommodated within the existing US 95 right-of-way.

Sunset Road and CC-215:

Sunset Road has existing intersections with the CC-215 Western Beltway frontage roads at the location of Sunset Road itself, precluding a median direct-access local drop ramp configuration. A new bridge between the CC-215/Durango Interchange and the CC-215/Sunset Interchange to connect the direct-access local drop ramps to the CC-215 frontage roads was considered. This layout was evaluated for spacing and geometrics and is geometrically possible, as shown in Appendix E.

Rampart Boulevard and Summerlin Parkway:

Directly connecting the HOV lanes on Summerlin Parkway to the Rampart Boulevard interchange poses challenging spacing issues when considering the existing service interchange intersections and the proposed HOV direct-access local drop ramp intersections. Without completely reconfiguring the existing interchange to separate the HOV traffic from the general-purpose traffic or braiding those at the ramps, it is not geometrically feasible to implement direct-access local drop ramps at Rampart Boulevard. The preliminary layout shown in Appendix E depicts a median direct-access local drop ramp configuration and the challenges associated with it.

5.3. Design Exceptions

Generally, existing design exceptions have been perpetuated during the conceptual design of the direct-access ramps. The I-15 corridor has inadequate width and contains physical pinch points at many locations, which prevent full compliance to freeway standards. Each recommended direct-access ramp location along I-15 was reviewed to provide a preliminary determination of the expected design exceptions. Design alternatives on I-15 were developed far enough to better determine possible design exceptions. A full list of design exceptions should be prepared during final design to ensure that all design exceptions are identified, mitigated, accepted, and approved. The following is the list of identified design exceptions for the proposed direct-access ramp locations. In general, similar design exceptions currently exist as part of the freeway system, and these would not be a unique feature of the HOV system.

Blue Diamond Road and I-15:

- It is assumed that the curve speeds are 35 mph. Inside and outside shoulders of 4 feet and 8 feet, respectively, have been used. The sight distance around the curve, given the vertical profile and 3-foot 6-inch Type FA median barrier, is not adequate for the northbound direct-access local drop ramp onto I-15. An exception for sight distance will be required.

- The sag curves at both ends of the ramps do not provide adequate headlight sight distance. It is assumed that high mast lighting will be provided. If lighting is not adequate, an exception for the headlight sight distance will be required.
- At the northbound I-15 outside shoulder along the drop ramp structure at Blue Diamond Road northbound entrance ramp, the existing barrier rail will cause the proposed shoulder prior the ramp gore to be a minimum of 5 feet wide at the north end of the existing rail. It widens to the south to over 8 feet but only reaches the standard 10 feet at the south end of the proximity of the barrier. Exception limits: “Le” STA 371+92 to 376+06.
- The I-15 southbound lanes shift to the west, requiring reconfiguration of the ramp gores at the I-15 Blue Diamond Road exit and entrance ramps. Shoulder exceptions may be required to get the earthwork to fit without retaining walls, or other more substantial modifications to the ramps may be required.
- The direct-access local drop ramp shoulders do not provide adequate sight distance around the curve due to the crest curve and barrier obstruction.
- The inside shoulders on I-15 mainline in the vicinity of the HOV drop ramp structure have been assumed to be 4 feet wide.

I-15/I-215 Interchange:

- It is assumed that the curve speeds are 35 mph. Inside and outside shoulders of 4 feet and 8 feet, respectively, have been used. The sight distance around the curve, given the vertical profile and 3-foot 6-inch Type A barrier is not adequate for the ramps. An exception for sight distance will be required on the curved flyover ramps.
- The sag curves at the ends of the ramps do not provide adequate headlight sight distance. It is assumed that high mast lighting will be provided. If lighting is not adequate, an exception for the headlight sight distance will be required.
- Shoulder exceptions will be required at the following locations:
    - I-15 northbound from “Le” 445+00 to 455+00: The I-215 westbound to I-15 northbound ramp retaining wall constrains the space available between it and the HOV flyover ramp structure. Final design may shift the flyover ramp structure to the west, but the west side does not have adequate space to allow full standard shoulders. Both inside and outside shoulders in this section are 2 feet wide in the proposed layout.
    - I-15 southbound in the same area will require shifting the existing barrier rail between the I-215 off-ramp and the southbound C-D road on-ramp. Future placement of this barrier may result in a shoulder exception in order not to impact the profiles of each ramp.

- On CC-215, widening will be required to support the HOV lanes and the flyover ramps. Shoulder exceptions adjacent to the ramp structures will help limit impacts to abutments and piers of structures carrying I-15, system connector ramps, the C-D ramps, Dean Martin Drive, Valley View Boulevard, and Las Vegas Boulevard.
- The HOV flyover ramp shoulders do not provide adequate sight distance around the curves due to the barrier obstruction. Provision of extra width should be considered during final design.
- Inside shoulders on I-15 mainline in the vicinity of the HOV flyover ramp structures have been assumed to be 4 feet wide.

Hacienda Avenue/Harmon Avenue and I-15:

- Shoulder exceptions will be required at the following locations:
  - I-15 northbound from "Le" 527+40 to "Le" 615+50: Adding the direct-access local drop ramps will result in the I-15 northbound and I-15 southbound inside shoulders to be 5 feet wide. Outside shoulders vary from 12 feet to as narrow as 2 feet at some locations.
  - I-15 northbound from "Le" 529+50 to 538+50: In order to stay within the existing right-of-way and to keep the configuration as close to the existing geometry as possible in the vicinity of Frank Sinatra Drive, adding the direct-access local drop ramp will result in the I-15 northbound outside shoulder to vary from 12 feet at "Le" 529+50 to 2 feet at "Le" 538+50 and to remain at 2 feet until "Le" 545+38.
  - Space is not adequate to allow full standard shoulders and avoid impacting the easterly pier at Hacienda Avenue. Therefore, in order to avoid rebuilding the bridge at Hacienda Avenue, northbound C-D road inside and outside shoulders have been narrowed down to 2 feet wide. Also, the northbound C-D road lanes from "Le" 530+62 to 545+38 adjacent to Frank Sinatra Drive have been narrowed down to 11 feet instead of 12 feet.
  - The I-15 southbound C-D road outside shoulder from "Le" 543+85 to 545+95 has been reduced to 5 feet at the Hacienda Avenue westerly bridge pier.
  - In order to match the reinforced concrete box pavement spanning from "Le" 546+80 to "Le" 553+50, southbound I-15 outside shoulder and southbound C-D road inside shoulder from "Le" 531+65 to 545+38 need to be reduced to 4 feet and 2 feet, respectively, keeping the geometry of the road as close to existing condition as possible.
  - Direct-access local drop ramps have 4-foot wide inside shoulders and 8-foot wide outside shoulders at Harmon Avenue and Hacienda Avenue.

- Sign foundation at “Le” 540+57 encroaches between the southbound C-D road and I-15 southbound general-purpose lanes, resulting in a zero shoulder at that location. Therefore, the existing sign needs to be rebuilt as a cantilever sign.
- Sign foundation at “Le” 535+89 northbound falls inside the northbound I-15 general-purpose lanes and therefore needs to be relocated.

Meade Avenue and I-15:

- Inside shoulder exceptions will be necessary on I-15 along the drop ramp walls.
- Depending upon final drainage improvements, outside shoulder exceptions may be desired to limit project impacts on right-of-way.
- The roadway cross section on Meade Avenue will not meet Clark County Standards and will require coordination and approval from the City of Las Vegas.

Maryland Parkway and US 95/I-515:

- No design exceptions were noted, as US 95/I-515 reconstruction improvements are not known. It is expected that a reconstruction of US 95 would allow all improvements to be constructed to current standards.

Smoke Ranch Road and US 95:

- Inside shoulder width exceptions will be necessary on US 95 along the drop ramp walls, as the proposed layout assumed 4-foot wide inside shoulders.
- Outside shoulder width exceptions will be necessary along US 95 through the direct-access local drop ramp locations and lane tapers, especially under the existing Smoke Ranch Road bridge where the existing abutments have been previously underpinned.

5.4. Cost Estimates

Planning level cost estimates were prepared for the direct-access ramp locations on I-15 and are summarized in Table 5-1. These were calculated based on take-offs from major construction components for the proposed locations. Current costs of these items quantified were used as a reference. Line by line quantities and their associated unit costs are included in Appendix F. Estimated costs are in year 2014 dollars and include contingencies (reflecting the configurations shown in the preliminary layouts) for items that were not designed or determined at the time of the preliminary layout.

Table 5-1: Planning Level Cost Estimates

HOV Direct-Access Ramp Location	Estimated Improvement Cost (Year 2014 Dollars)
Blue Diamond Road and I-15 (ramps to/from the north - from/to the west)	$ 25,110,000
I-15 and I-215 Interchange (ramps to/from the north - from/to the east and ramps to/from the north - from/to the west)	$ 100,530,000
Hacienda Avenue and I-15 (ramps to/from the south)	$ 13,690,000
Harmon Avenue and I-15 (ramps to/from the north)	$ 11,505,000
Meade Avenue (ramps to/from both directions)	$ 26,420,000

6. OPERATIONAL PLAN

Operational recommendations are made for the Near-Term System. No specific recommendations are made for the Long-Term System. NDOT has the flexibility to, and should implement the best operational policy in response to future conditions.

6.1. Access Type

Access along an HOV lane could be allowed at any point (i.e., continuous access) or be restricted to discrete locations (i.e., limited access). Generally, both scenarios are viable options when planning HOV lanes. Limited access is recommended for the Near-Term System because of following reasons.

- With continuous access, two HOV lanes in each direction would be required in year 2018 for the I-15 "Gap." I-15 currently has three general-purpose lanes and two express lanes in each direction within the "Gap." The requirement for two HOV lanes indicates conversion of both express lanes to HOV lanes in year 2018; and this is not recommended because: 1) Operations of the general-purpose lanes would be impacted by vehicles displaced by the conversion to HOV lanes, resulting in LOS F conditions; and 2) One of the express lanes (in each direction) was originally established by converting a general-purpose lane. Converting that express lane (which was originally a general-purpose lane) to an HOV lane would likely not be acceptable to the public, primarily because the remaining three general-purpose lanes are anticipated to operate over capacity. Therefore, with the two-HOV-lane scenario, one of the lanes (to have four general-purpose lanes) must be a new add lane; and this is not a practical possibility within the year 2018 – year 2025 timeline.
- Limited access discourages short distance/term use of the HOV lanes, thereby reducing weaving. The scenario that results in less weaving is especially critical within the "Gap," where weaving issues already exist due to the comparatively high frequency of ramps. The existing express lanes have been successful partly because of the limited access and associated reduction of weaving activity between the express lanes and the general-purpose lanes. With continuous access, HOV users driving short-distance trips opportunistically get in or get out of the HOV lanes, causing turbulence in the traffic stream. This would be avoided by limited access.
- Limited access offers the opportunity to ensure that the lanes do not become overloaded regardless of the level of demand they generate, because the limited entry/exit points cause some of the HOV-eligible vehicles to stay in the general-purpose lanes. With limited access it is easier to ensure higher travel speeds (time saving) and reliability for the HOV vehicles that travel greater distances.

- Occupancy violation rates are generally lower with limited-access facilities, and enforcement is easier. In early years of HOV operations, it is important to build a culture of compliance to the operational (and occupancy) restrictions of the HOV lane through increased enforcement activity and education. This is easier with limited-access facilities since they are easier to enforce, and educational messages are clearer and more easily understood (e.g., enter/exit only at broken white-line marking locations, and do not cross double solid white-line markings).

Proposed preliminary ingress/egress locations for the Near-Term System are shown in Figure 6-1. The proposed locations allow the required weaving distance to/from the ramps per *NDOT Managed Lanes and Ramp Metering Manual* (minimum of 800 feet per lane change). During the design stage, however, weaving analysis using operational analysis tools is required to confirm and more clearly define the ingress/egress locations.

6.2. Minimum Occupancy

It is recommended that the minimum occupancy requirement on the proposed HOV facilities be two or more people (HOV 2+). The HOV 2+ requirement allows the widest rideshare market to benefit from the HOV lanes. The demand forecasts, analysis results, and number of lane recommendations in this Plan Update are based on the HOV 2+ eligibility requirement. Nevertheless, in the event that HOV 2+ demand grows beyond the facility's maximum operational threshold after the HOV lanes are implemented, a more restrictive access (HOV 3+) could be considered. The travel demand model does not indicate sufficient HOV 3+ demand; therefore, HOV 3+ is not recommended in the near term.

6.3. Hours of Operation

HOV lanes can operate full time (24-hour) or part time (peak period or extended peak period). Full-time operation provides travel time and reliability benefits for users at all times during recurring and nonrecurring congestion. It is easier to sign, mark, and enforce since there are no changes by time of day. Additionally, full-time operation may promote wider acceptance of the facility. On the other hand, HOV lanes may appear empty during off-peak periods when traffic in the general-purpose lanes also flows freely, making it appear that the HOV lanes provide no apparent advantage for any traffic; and this may create a negative public perception of the HOV lanes.

Using the travel demand model data, two representative locations on I-15 were investigated for shared ride potential beyond the peak periods. Shared ride potential is the total of shared ride demand across all lanes. The two locations were: 1) between Flamingo Road and Tropicana Avenue, and 2) between Sahara Avenue and Charleston Boulevard. The results indicate that at

both locations, shared ride demand for each hour between 7 AM and 8 PM are at similar levels (Table 6-1).

Figure 6-1: Proposed Ingress/Egress Locations (Preliminary)

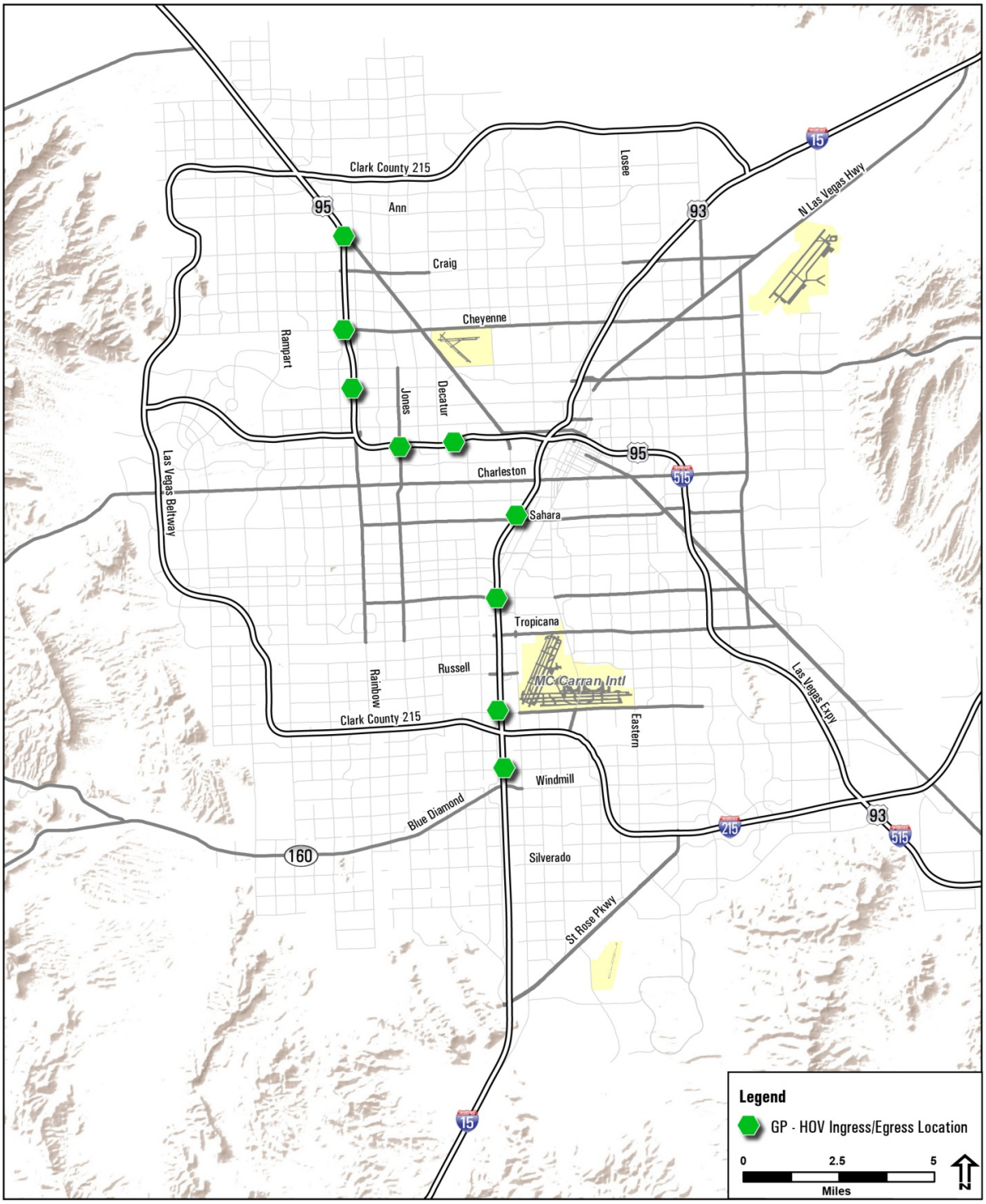


Table 6-1: Shared Ride Demand from the Travel Demand Model

Model Time Period	Between Flamingo Road and Tropicana Avenue		Between Sahara Avenue and Charleston Boulevard	
	Total Shared Ride Demand	Total Shared Ride Demand per Hour	Total Shared Ride Demand	Total Shared Ride Demand per Hour
12 AM to 7 AM	8,780	1,254	8,642	1,235
7 AM to 9 AM[1]	11,115	5,558	10,878	5,439
9 AM to 2 PM[2]	36,451	7,290	37,070	7,414
2 PM to 4 PM[2]	14,781	7,391	15,307	7,654
4 PM to 6 PM[1]	14,462	7,231	14,726	7,363
6 PM to 8 PM[2]	15,042	7,521	15,368	7,684
8 PM to 12 AM	16,980	4,245	16,248	4,062

Notes:

1. Peak commute periods
2. Outside of peak commute periods excluding night hours
3. The shared ride demand volumes are year 2025 raw model volumes for combined northbound and southbound directions. They are used for comparison purposes only.
4. The shared ride demand volumes are not the HOV lane volumes. They are the shared ride model volumes across all lanes.

Total demand (i.e., shared ride plus single occupant) for all time periods were also reviewed for the same two locations on I-15. The goal was to find out if the general-purpose lanes would have adequate demand to justify operating the HOV lanes outside the peak periods (i.e., if the HOV lanes would be beneficial outside the peak periods). The year 2025 model indicates that the hourly demand is similar throughout the day from 7 AM to 8 PM, meaning general-purpose lanes would experience some congestion, thereby justifying the use of HOV lanes. Existing traffic volumes on I-15 also were investigated for the same objective using data from NDOT's permanent count station on I-15 between Sahara Avenue and Charleston Boulevard. The data (Table 6-2) shows the volumes are fairly flat from 6 AM to 7 PM.

Table 6-2: 24-Hour Volume Data on I-15 between Sahara Ave and Charleston Boulevard

Start Time	Volume		Hourly to Daily Ratio	
	Southbound	Northbound	Southbound	Northbound
0:00	2,378	4,172	1.8%	3.3%
1:00	1,712	2,847	1.3%	2.3%
2:00	1,519	2,325	1.1%	1.8%
3:00	2,081	1,988	1.6%	1.6%
4:00	2,828	2,175	2.1%	1.7%
5:00	5,110	2,868	3.8%	2.3%
6:00	6,743	4,425	5.0%	3.5%
7:00	8,012	5,940	**6.0%**	4.7%
8:00	7,799	5,687	5.8%	4.5%
9:00	6,892	5,547	5.1%	4.4%
10:00	6,942	5,885	5.2%	4.7%
11:00	7,368	6,144	5.5%	4.9%
12:00	7,001	6,568	5.2%	5.2%
13:00	7,523	6,922	5.6%	5.5%
14:00	8,037	7,054	6.0%	5.6%
15:00	8,030	7,635	6.0%	6.1%
16:00	7,847	7,758	5.8%	**6.2%**
17:00	7,216	7,585	5.4%	6.0%
18:00	6,312	6,650	4.7%	5.3%
19:00	5,726	5,624	4.3%	4.5%
20:00	4,915	5,188	3.7%	4.1%
21:00	4,718	4,955	3.5%	3.9%
22:00	4,137	4,863	3.1%	3.9%
23:00	3,360	4,860	2.5%	3.9%
Daily Total	134,206	125,663	100.0%	100.0%
Note: Peak hour is shown in bold.				

Source: NDOT Count Station # 0031210 on I-15 0.2 mile north of Sahara Avenue Interchange.

The shared ride and total demand analyses indicate that demand supports an HOV lane operation period that extends well beyond the peak periods. Today, US 95 HOV lanes operate during two extended peak periods (6 to 10 AM and 2 to 7 PM). Based on the analyses, demand supports continuous operation from 6 AM to 7 PM. A 24-hour operation, however, has many advantages, as discussed at the beginning of this section. Since the total traffic is minimal during the night, empty HOV lanes would not create the negative public perception they would during the day. The HOV systems in southern California, Phoenix, and Salt Lake City have a 24-hour operation. A 24-hour operation in the Valley would be consistent with these HOV systems in the neighboring states. Events that occur in the Las Vegas Strip and Downtown Las Vegas attract/generate trips that are usually made in HOVs. Many of these events occur outside the peak periods. Allowing HOVs to access and egress the Strip using HOV facilities would enhance public support for such facilities and support the cultural change required to increase ridesharing and HOV use. Additionally, because many HOV direct-access ramps are planned, a 24-hour operation would be the better option and, therefore, is recommended.

6.4. Vehicle Type Eligibility

6.4.1. Trucks

NDOT policy states that trucks with more than two axles (or vehicle-trailer combinations) are not allowed on HOV lanes[9]. Allowing trucks on the HOV lanes would have adverse impacts on speeds, safety, and reliability and is not consistent with the HOV goal of moving people. Furthermore, allowing trucks on one-lane facilities (such as the HOV flyover) would have significant adverse impacts on speeds due to their slower acceleration during climbing. Additionally, Project Neon and the I-15 South Project Final Environmental Impact Statement documents do not have an objective related to freight vehicles. Therefore, trucks with more than two axles are not recommended on the proposed HOV facilities.

6.4.2. Occupancy-Exempt Vehicles

According to NDOT policy, emergency vehicles responding to an incident and dead-heading[10] public transit buses are allowed on HOV lanes regardless of their occupancy level. Motorcycles are also allowed unless a safety study determines otherwise.

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[9] *NDOT's Managed Lanes and Ramp Metering Manual*. Part 2: Implementation Plan. Page 1-24.

[10] A dead-heading public transit vehicle is a transit vehicle that operates without carrying or accepting passengers. This includes a vehicle's travel to/from the garage and a terminus point where revenue service begins or ends; or a vehicle's travel between the ends of service on one route to the beginning of another.

NDOT does not have a policy for low-emission and energy-efficient vehicles on HOV lanes. State law (NRS 484A) and federal law (23 USC 166) give NDOT the authority to allow low-emission and energy-efficient vehicles that meet specific performance requirements on HOV lanes (defined in USC166 (f) (3)). The HOV demand forecasts used in this memorandum did not include these types of vehicles. It is recommended that NDOT study the possibility of allowing low-emission and energy-efficient vehicles on the HOV system if the federal law is extended beyond its current sunset date of September 30, 2017. It should also be noted that all the conditions required of the enabling federal legislation (if extended beyond September 30, 2017) would have to be met.

6.5. Summary of Near-Term Operational Recommendations

Table 6-3 is a summary of the operational recommendations for the Near-Term System. These recommendations should be revisited as part of the operational plan and revised when appropriate.

Table 6-3: Near-Term Operational Recommendations

Component	Operational Plan
Minimum occupancy	HOV 2+
Hours of operation	24-hours, 7 days of the week
Trucks	Vehicles with more than two axles (or vehicle-trailer combinations) are not eligible
Motorcycles	Eligible
Emergency vehicles	Those responding to an emergency are eligible
Public transit buses	Eligible (including dead-heading buses)
Single-occupant low-emission and energy-efficient vehicles	To be studied
Access type	Limited access

7. NEXT STEPS

This section presents steps needed to advance the recommendations of this Plan Update. These steps include activities that would enhance the status of the Plan Update itself, as well as provide additional infrastructure that would support and enhance the implementation of a successful HOV program.

Several of the "next steps" from the Original Plan have already been implemented. For example, the recommended near-term HOV improvements are now programmed in the RTP; the mode-choice model has been adopted; and the regional park-and-ride plan has been updated. "Next steps" from the Original Plan that are still applicable for recommendation and several additional ones resulting from this Plan Update are discussed below.

7.1. Integration with Freeway Corridor Planning and Design Projects

Various projects are ongoing and planned that encompass major improvements along the freeways within the proposed HOV system. Each of these projects is at a different stage of design and at a different point in the environmental process. Each project has to be reviewed to determine if any changes based on the Plan Update are required. Table 7-1 presents these projects as listed in the current 2035 RTP.

Table 7-1: Construction Projects within the HOV System Area

Freeway	Limits	Project	RTP Project Number
I-15	Sloan Road to Blue Diamond Road	I-15 South Phase 2A: Widen from 6 to 8 lanes, including HOV lanes	4364
I-15	Blue Diamond Road to Tropicana Avenue	I-15 South Phase 2B: Widen from 8 to 10 lanes, restripe C-D, replace concrete section between I-215 and Tropicana, add HOV lanes, replace Tropicana Interchange	247
I-15	Blue Diamond Road to Sahara Avenue	Construct HOV direct-access ramps	270
I-15	I-215	System to system direct connector HOV ramps	4153

Freeway	Limits	Project	RTP Project Number
I-15	Project Neon	Project Neon Phase 1: Construct 4-lane system-to-system direct-connect HOV ramps, including add/drop lanes at Oakey Boulevard/Wyoming Avenue; widen 1-15 to accommodate HOV ramps	4149
I-15	Project Neon	Project Neon Phase 3: Construct southbound C-D roads with new bridges over Alta Drive, Charleston Boulevard, & Oakey Boulevard/Wyoming Avenue	4161
I-15	Project Neon	Project Neon Phase 4: Construct northbound C-D roads with new bridges over Sahara Avenue, Oakey Boulevard/Wyoming Avenue, Charleston Boulevard, & northbound off-ramps to Alta Drive	4162
I-15	Project Neon	Project Neon Phase 5: Construct northbound I-15 ramps	5017
I-215	Eastern Avenue to Windmill Lane	Widen from 6 to 8 lanes	228
I-215	Airport Connector	Upgrade interchange	221
I-515	Charleston Boulevard to I-15/US 95	Widen to 10 lanes to include HOV lanes, and add new interchanges at Pecos Road & 'F' Street	250
US 95	Ann Road to Durango Drive	Widen from 6 to 8 lanes; add auxiliary & HOV lanes	4148
Summerlin Parkway	CC-215 to US 95	Widen to 8 lanes	894

Source: Regional Transportation Plan 2013-2035, RTC, Adopted December 2012

As shown in Table 7-1, several of the projects already include HOV elements based on the recommendations of the Original Plan. This list is to be updated in the next RTP (see Section 7.2) to incorporate the HOV improvements proposed in this Plan Update. NDOT will lead the coordination and integration of HOV facilities into the projects. All capacity improvements to freeways in the Valley should first add HOV lanes consistent with this Plan Update prior to adding general-purpose lanes.

7.2. Regional Transportation Planning

The current RTP (adopted December 13, 2012) incorporates HOV improvements based on the recommendations in the Original Plan. HOV improvements recommended by this Plan Update should be immediately included in the next round of RTP. NDOT will prepare and formally submit to the RTC an application for such inclusions based on RTC's current timetable for project submission. RTC has currently begun the development of a 10-year Transit Development Plan. The recommendations of this Plan Update should be considered in that plan.

In order to facilitate the incorporation of the projects identified in this Plan Update into the next RTP, a financial strategy for their implementation will be required based on the constrained funding requirement for the RTP. RTC and NDOT should agree on which agency will take the lead in developing that strategy because of the multiple jurisdictions and funding sources needed to fund successful HOV implementations. The lead agency should prepare the financial strategy consistent with the timing of preparation of the constrained funding component of the next RTP. Generally, NDOT will lead the implementation on all highways under the state's jurisdiction.

Fully achieving the long-term potential of HOV facilities depends upon the implementation of a variety of support facilities and services. These include express transit and park-and-ride facilities that act as staging grounds for carpool formation and transit services. Regional planning in each of these functional areas and implementation of facilities as a result of those planning efforts will enhance the benefits derived from the HOV facilities proposed in this Plan Update. A comprehensive planning effort covering the range of support facilities envisioned in the Las Vegas area should be undertaken under RTC's regional leadership. RTC's park-and-ride plan should be expanded to incorporate facilities needed to enhance the potential success of the planned HOV system. Both NDOT and RTC should promote HOV use.

7.3. RTC and State Transportation Improvement Programs

With inclusion of HOV facilities in the RTP, federal funding can be made available for HOV projects. Projects receiving federal funds must be included in the RTC's Transportation Improvement Program (TIP) and NDOT's State Transportation Improvement Program (STIP). The process of determining the projects to include in the TIP and STIP includes establishing funding priorities among the host of potential projects competing for limited transportation funding from all levels of government.

Each jurisdiction is responsible for pursuing the inclusion in the TIP of projects on highways owned by the jurisdiction. Since most of the facilities included in this Plan Update are freeway facilities owned by NDOT, NDOT will take the lead in identifying HOV projects for inclusion in

the TIP and STIP. Priority should be given to projects that will support and expand the existing HOV facilities and the implementation of higher priorities shown in Figure 4-3. In order to provide a more extensive and connected system of HOV facilities, NDOT will encourage other jurisdictions to pursue inclusion in the TIP of both HOV roadway facilities and support facilities such as park-and-ride lots.

NDOT will leverage CMAQ funds as they become available, and priority will be given to projects that include implementation of HOV facilities. The Congesting Mitigation and Air Quality Improvement Program (CMAQ) was created under the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 and reauthorized under the Transportation Equity Act for the 21st Century (TEA-21); the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU); and, most recently, the Moving Ahead for Progress in the 21st Century Act (MAP-21). The CMAQ program supports two important goals of the U.S. Department of Transportation: improving air quality and relieving congestion. HOV facilities are cost-effective transportation solutions that help in alleviating congestion and improving air quality; reflecting this, current federal guidance allows CMAQ funds to be used for the implementation of HOV facilities. Appendix G is the technical memorandum that justifies the use of CMAQ funds for the implementation of HOV facilities.

7.4. Performance Measures for Evaluating the Effectiveness of the Implementation of HOV Facilities

Performance measurement of the HOV facilities should be conducted for a variety of reasons. Before and after studies can be conducted to determine whether the anticipated benefits outlined for the region's and corridor's goals and objectives are being met. Ongoing monitoring and periodic evaluations ensure that the HOV facilities are providing the desired results and, more importantly, is helping to validate changes or enhancements in design or operational policies. Table 7-2 lists potential goals and objectives for the HOV system; Table 7-2 also lists performance measures and corresponding thresholds to determine whether the goals and objectives are being satisfied by the implementation of the HOV facilities.

Information on vehicle volumes, travel times, occupancy trends, transit patronage, violation rates, and crash data are critical for the performance measurement of the HOV system. Data for the performance measures are typically available from local or regional modeling, traffic data, and other members of the team involved in implementation and operation of the HOV facilities. Data should be collected in advance of facility opening to allow for a before and after evaluation comparison. Obtaining data for two to three years alongside the general-purpose lanes (preferably prior to any construction activities) helps to form a trend analysis.

Table 7-2: Performance Measures for Evaluating the Effectiveness of the Implementation of HOV Facilities

Goals and Objectives	Performance Measures	Threshold
Goal 1: Optimize the movement of people	Person throughput in the HOV and general-purpose lanes	More person throughput in the HOV lane(s) than adjacent general-purpose lanes
	Average vehicle occupancy rate within the corridor	Higher than "before" condition
	Number of carpools and vanpools within the corridor	Higher than "before" condition
	Number of bus riders on affected routes and services	Higher than "before" condition
Goal 2: Provide travel time savings and a more reliable trip	Peak-period and peak-direction travel time in the HOV lane(s) and in adjacent general-purpose lanes	Faster travel times in the HOV lane(s) than adjacent general-purpose lanes
	Travel time reliability measures for vehicles using HOV lane(s) and adjacent general-purpose lanes	Lower 95th percentile travel time than "before" condition
		Lower 95th percentile travel time than adjacent general-purpose lanes
Goal 3: Increase bus transit efficiency	Vehicle productivity (operating cost per vehicle mile, operating cost per passenger, operating cost per passenger-mile)	Better than "before" condition
	Bus schedule adherence (on-time performance)	Better than "before" condition

Goals and Objectives	Performance Measures	Threshold
Goal 4: Not adversely impact existing traffic operations	Total corridor throughput	Higher than “before” condition
	Speeds in HOV lane(s)	Higher than 45 mph
	Speeds on all lanes	Better or equal to “before” condition
	Crash rate per million Vehicle Miles Traveled (VMT) and per million passenger miles of travel for the HOV lane(s) and adjacent general-purpose lanes	Better or equal to “before” condition based on crash experience (minimum three years)
Goal 5: Secure public support	Observed support for the facility among users, non-users, general public, and policy makers	Net positive response (above 50 percent) based on agency, policy maker, and public feedback
	Lane violation rates (percent of vehicles in the HOV lane(s) not meeting the occupancy requirement)	Rate of 5 percent or less during peak commute periods

Each stakeholder agency plays a role in monitoring the performance of the HOV facilities. NDOT, RTC, law enforcement, and local agencies all have unique needs and ways to access the required data. NDOT is generally responsible for traffic data and relies on transit providers for transit information. Occupancy data generally demands dedicated, periodic field counts that are more reliable than regional occupancy data. Law enforcement would provide lane violation information. Attitudinal surveys could be conducted through NDOT or other local agencies.

A report on usage, time savings, and modifications in transit and rideshare use after the first six months of facility opening and after one year of operation is recommended. After the first year, reporting frequency should be established based on data needs, data availability, performance reporting desired by local partners, and changes in operating conditions that could justify a change in operation policy.

7.5. Public Outreach

An effective framework to gain public acceptance and understanding of HOV lanes is the key to the successful implementation of the recommendations made in this Plan Update.

Appendix H is the public outreach and public education blueprint document for the Plan Update. It summarizes the public outreach objectives and strategies that were adopted concurrent to the development of this Plan Update. Appendix I is the technical memorandum that documents the public information and education strategy for the conversion of the I-15 express lanes to HOV lanes. This document describes the Public Information Plan, including the objectives, target markets, and outreach strategies in support of the planned conversion of the I-15 express lanes to HOV lanes. The conversion of the I-15 express lanes to HOV lanes will be an extended effort, requiring a significant amount of proactive outreach and education, as well as concerted coordination with corridor stakeholders, users, and adjacent projects. The outreach and education component of this conversion should be initiated early to build understanding with the stakeholders, and should continue through implementation.

As part of this Plan Update, several initial elements of the public outreach and public education plan and the public information and education strategy for the conversion of the I-15 express lanes to HOV lanes were completed. This included meetings with public agency stakeholders, informational tables at other projects' public meetings, presentations at local government agencies' boards and council meetings, and public agency and private stakeholder workshops. Summaries of these public outreach efforts are included in Appendix J.

7.6. Congestion Pricing

Congestion pricing has the potential for improving the efficiency of freeway corridor operation in conjunction with HOV lane operation. Available unused HOV lane capacity could be priced and

purchased for use by vehicles whose occupancy does not meet the HOV lane occupancy threshold. This would reduce general-purpose lane demand and potentially improve its operation. Tolls can be set high enough to preclude HOV lane congestion. A consideration of congestion pricing involves a number of topics including tolling techniques and technologies, pricing policies, enforcement mechanisms, physical design requirements, and management strategies that will promote an acceptable level of service in a dynamic mobility environment.

Implementation of congestion pricing through electronic tolling would require a change to the regional Intelligent Transportation System (ITS) architecture. Additionally, state laws with respect to tolling will have to be updated to accommodate potential congestion pricing projects. Congestion pricing and tolling of state roadways is not a current possibility under existing NRS. Therefore, this Plan Update did not examine congestion pricing and tolling in any detail. Congestion pricing and tolling may be considered when Nevada law allows such management measures.

Enforcement of HOV lane restrictions needs consideration in terms of fine levels, grace periods following HOV lane implementation, and enforcement. Area-wide policies that balance enforcement costs and minimization of violations should recognize that enforcement demands upon the introduction of HOV lanes in the Las Vegas Valley may be substantially greater than required after HOV lanes have been in operation for an extended period.

Prepared by:
Jacobs Engineering Group Inc.
319 E. Warm Springs Road, Suite 200, Las Vegas, NV 89119
702.938.5400 | www.jacobs.com